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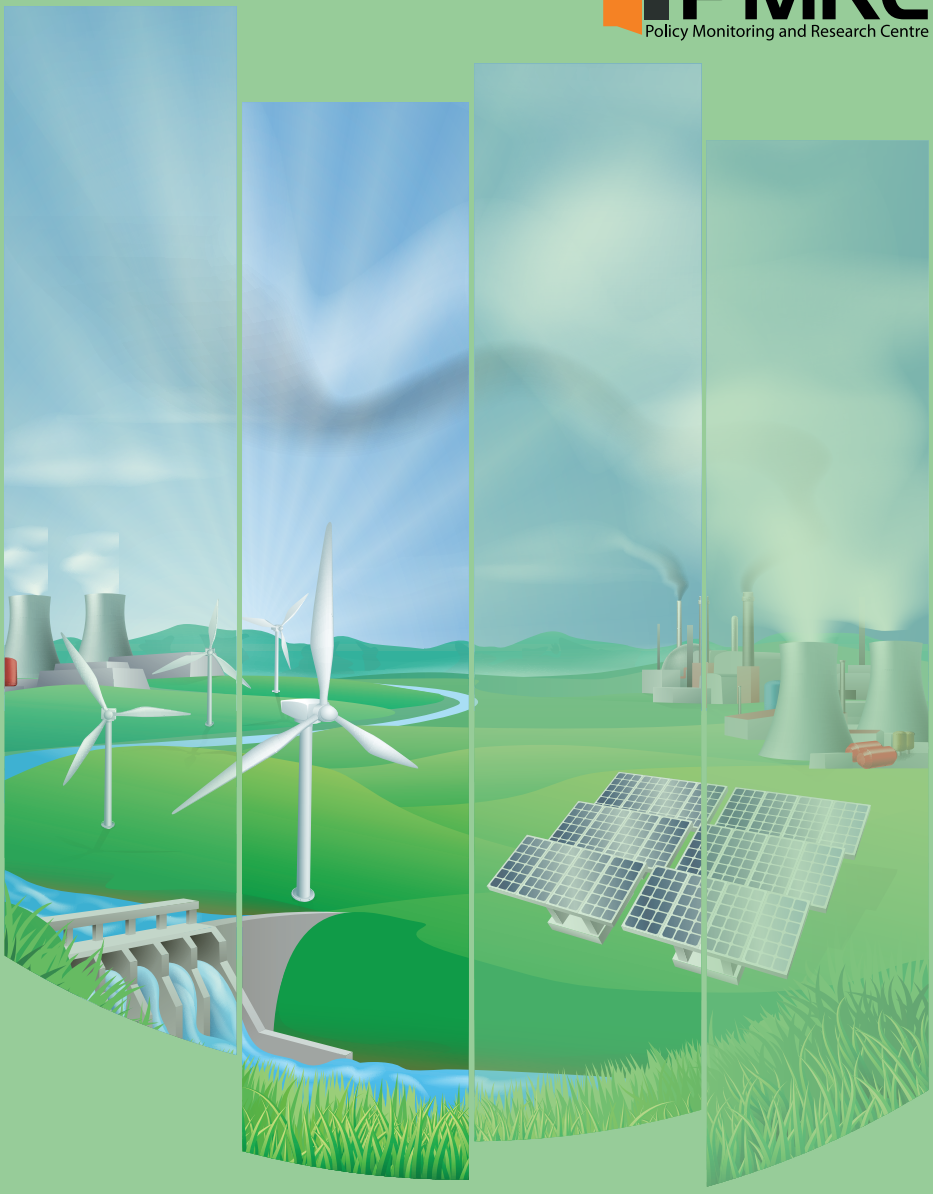

The State of the Energy Sector in Zambia

Implications for Industrial Development, Jobs and Poverty Reduction

Background Note

October 2013

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ABBREVIATIONS

EIA	Energy Information Administration
ERB	Energy Regulation Board
ESCOM	Electricity Supply Commission
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
KWH	Kilo Watt Hours
MW	Mega Watts
REEEP	Renewable Energy and Energy Efficiency Policy Database
SADC	Southern African Development Community
W	Watts
WHO	World Health Organisation
ZDA	Zambia Development Agency
ZESCO	Zambia Electricity Supply Corporation

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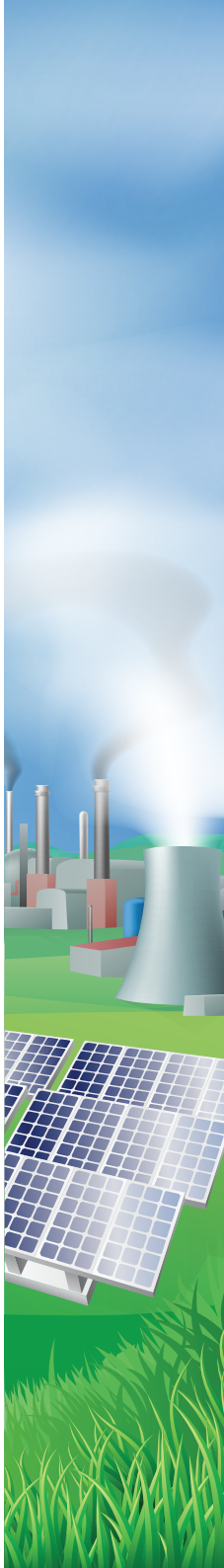


INTRODUCTION

Energy and its accessibility is at the core of social, economic and, environmental concerns facing all nations. It is particularly critical in developing countries as the implications to reduced poverty are significant. Numerous studies on the correlation of access to reliable energy and The Human Development Index (HDI), demonstrate that access to reliable energy has positive effects on human development. This is predominantly applicable in rural clinics and schools, especially as energy affects access to clean water and sanitation.
Furthermore, the ability of a country to meet its wider development objectives is largely affected by access to reliable energy. Economic growth is synonymous with energy access.

Zambia has abundant renewable and non-renewable energy resources, these include:

- Vast water reserves for hydro power generation
- Industrial minerals such as coal
- Agricultural land to support bio-fuels
- Ample forest for biomass
- Abundant wind for wind energy
- Zambia also has long and intense hours of annual sunlight to support solar energy generation.

Demand for energy has been rising due to economic activity in the country particularly in the mining, manufacturing and agriculture sectors. According to the Ministry of Finance, Zambia's economy has been growing at an average of 5% per annum over the past 10 years. Strategic utilization and development of Zambia's energy sources can increase industry competitiveness, improve rural service delivery and reduce rural poverty.
This PMRC Energy Series Background Note (BN) critically reviews the state of the energy sector in Zambia and what it means for future economic expansion, industrial development and job creation. The objective is to contribute to the current policy discussions on the energy sector and to call upon Government to accelerate policy formulation and investments in renewable energy and infrastructure.

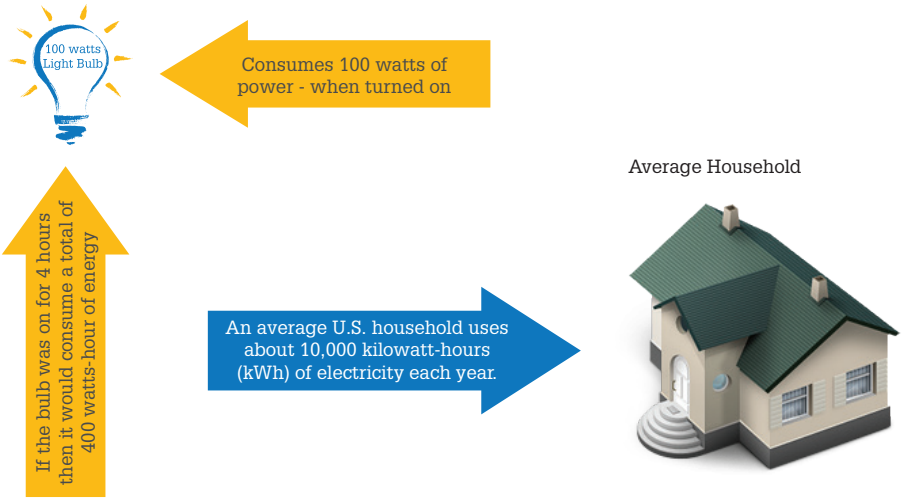
UNDERSTANDING ENERGY

Energy is defined as the capacity or effort to create heat, light, or motion (capacity to do work). Energy is also used to generate power. Power is a measure of the rate at which energy flows, and in electrical systems it is measured in watts (W). A watt is a measure of energy flow. For example, an average U.S. household uses about 10,000 kilowatt-hours (kWh) of electricity each year. This means that each household, on average, uses energy at a rate of about 1 kilowatt (1,000 watts, which equal to ten 100-watt light bulbs).

Illustration 1: Energy usage of a bulb and a household

1,000 Watts = 1 kilo watts
100 kilo watts = 1 Mega watt
1 Mega watt = 100 million watts

Source: - United Nation Statistical Database



Source: Adapted by PMRC for the American Energy Information Administration Report

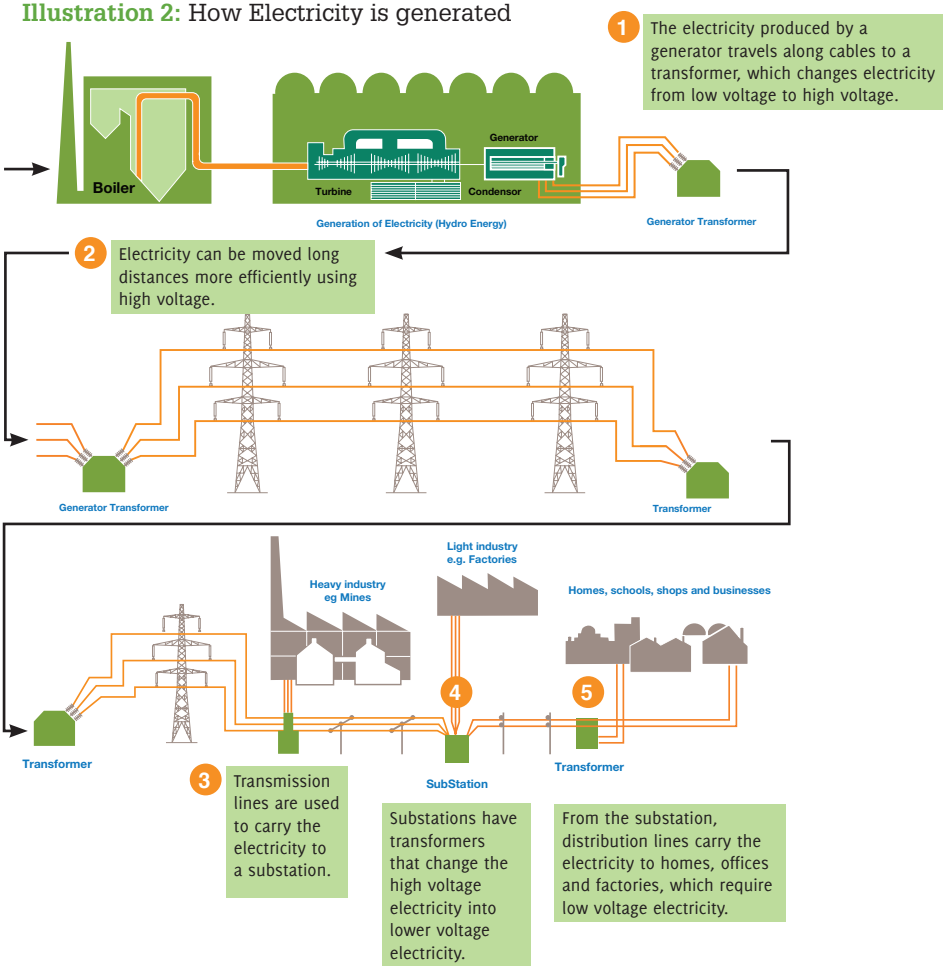
Energy used per day is measured in watt-hours, or kilowatt-hours. A 100-watt light bulb, for example, is rated to consume 100 watts of power when turned on. If such a light bulb were on for 4 hours it would consume a total of 400 watt-hours (Wh) of energy. The number of houses that 1 mega watt (MW) can power, varies from country and region as well as the types and number of appliances used. According to 2001 Energy Information Administration (EIA) data, the commonly used "1 MW of generation equates to 1,000 homes" varies in different regions of the world.

EXPLAINING ELECTRICITY GENERATION

Electricity is a form of energy used in the applications of heat, light and power. Electricity is the flow of electrical energy through conductive material. An electricity utility power station uses a turbine, engine, and water wheel, to drive an electric generator for production of electricity.

Electricity generation, Transmission to Substations and Distribution to end-users

Illustration 2: How Electricity is generated



Source: Adapted by PMRC from Energy Exploration Resource

OVERVIEW OF ZAMBIA'S ENERGY SECTOR

According to The Zambia Development Agency (ZDA) Energy Sector Profile (June 2013), Zambia has about 6,000 (MW) megawatts unutilized hydropower potential, while only about 1,985 MW has been developed. This comes from the scenario that Zambia possesses vast water resources in the Southern Africa (SADC) region.

Despite Zambia's vast renewable and non-renewable energy sources, little of these have been utilized to improve the attractiveness of the energy sector and transfer the benefits for industrial expansion, employment creation and poverty reduction. The energy market structure and consumption shows that traditional wood fuels (biomass), such as firewood and charcoal sourced from natural woodlands and agricultural lands dominant the energy market.

Figure 1: Energy use in Zambia

Firewood

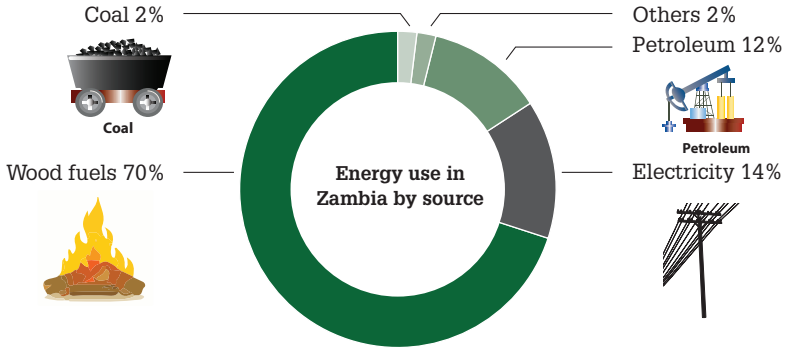
Charcoal

Vs.

- Nearly 70% of energy consumed by households in Zambia comes from biomass.
- Only 14% supplied by the national electricity grid.

Figure 2: Energy use in Zambia by source

Currently, more than 70% of Zambians use biomass sources such as charcoal (firewood). This has increased the levels of deforestation in the country because it is a cheaper energy source.

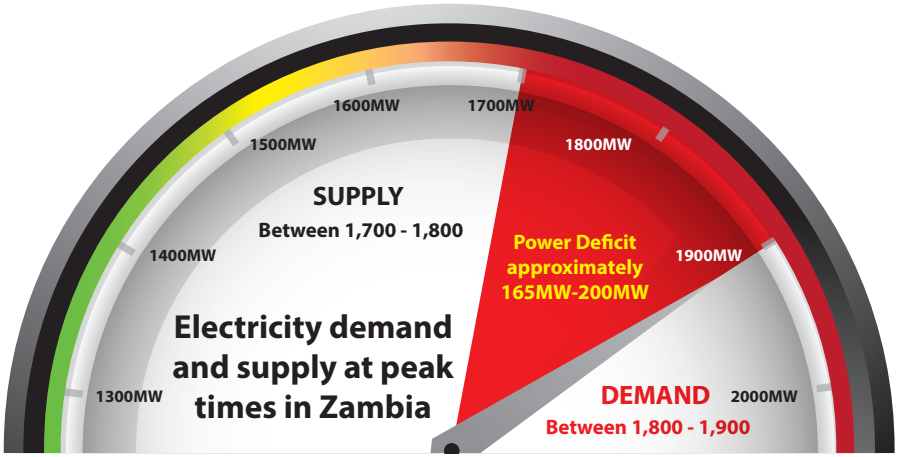


Source: Adapted by Policy Monitoring and Research Centre (PMRC) 2013 from (Ministry of Mines, Energy and Water development)

THE ENERGY MARKET (DEMAND VS. SUPPLY)

As of December 2012, total energy demand exceeded internal generation capacity. This was as a result of the expansions in the mining sector, manufacturing sector and overall expansions in the economy and population. The current power deficit has resulted in prolonged load shedding and power cuts, which have occasionally affected trade and production.

Figure 3: Approximation of Electricity demand and supply at peak times in Zambia



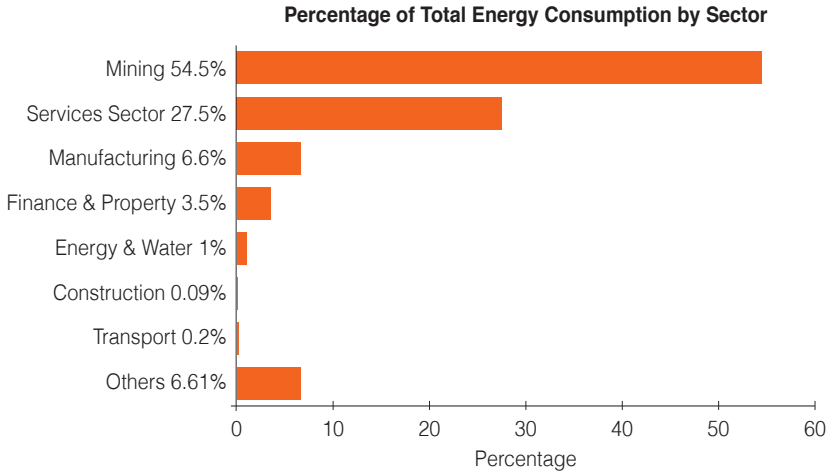
Source: Adapted by Policy Monitoring and Research Centre (PMRC) 2013 from the ZESCO Newsletter (January – April 2013)

The Zambia Electricity Supply Corporation (ZESCO) reports in its latest publication (ZESCO Newsletter January-April 2013) that "The power deficit is not a myth, it is real. Currently, the national demand of power is far above 1,780 MW at peak; however, ZESCO Limited has the capacity to generate around 1,700MW giving a power deficit of about 165 mw at peak time which leads to load management."

ENERGY CONSUMPTION PER SECTOR

Mining sector and domestic consumers, account for a combined 82% of total electricity consumption. Zambia is also faced with the challenge of satisfying the demand of more than 80% of its population with renewable forms of energy. Inadequate investments in the generation and transmission infrastructure have led to the current drop in the energy generation capacity and infrastructure.

Figure 4: Depiction of the total energy consumption by sector

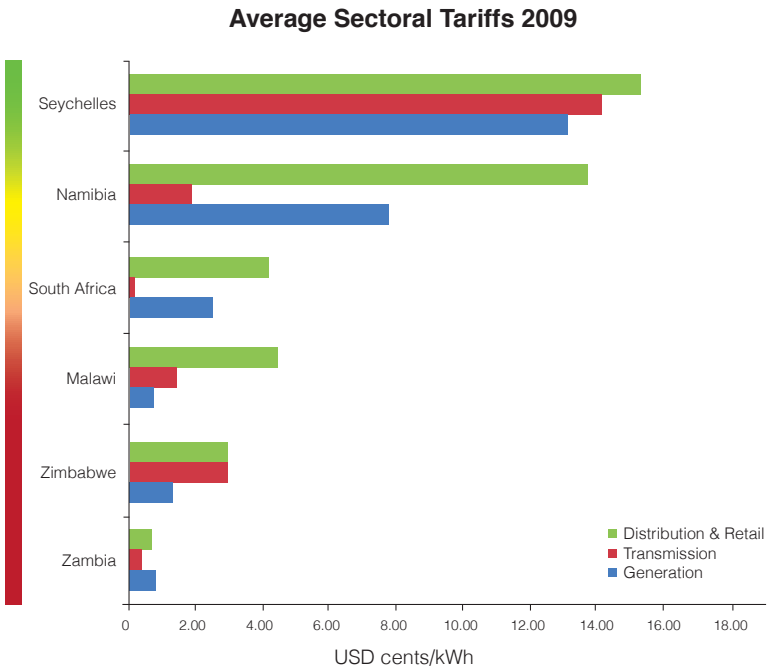


Source: Adapted by Policy Monitoring and Research Centre (2013) from Ministry of Mines, Energy and Water Development Statistics, (2010)

ELECTRICITY TARIFFS

It is said that power tariffs in Zambia are amongst the lowest in the sub-region, but this without taking into account deforestation, which results from the general lack of access to electricity and other green sources of energy. The lower tariff structures in Zambia should actually serve as an attraction for foreign Direct Investment (FDI) and assist in economic diversification through power exports to the sub-regional markets. The policy challenge for Zambia is managing the inefficiencies of the public energy generation and transmission infrastructure to ensure a viable business environment that supports sustained economic growth and industrial expansion.

Figure 5: Comparative Electricity Tariffs in SADC



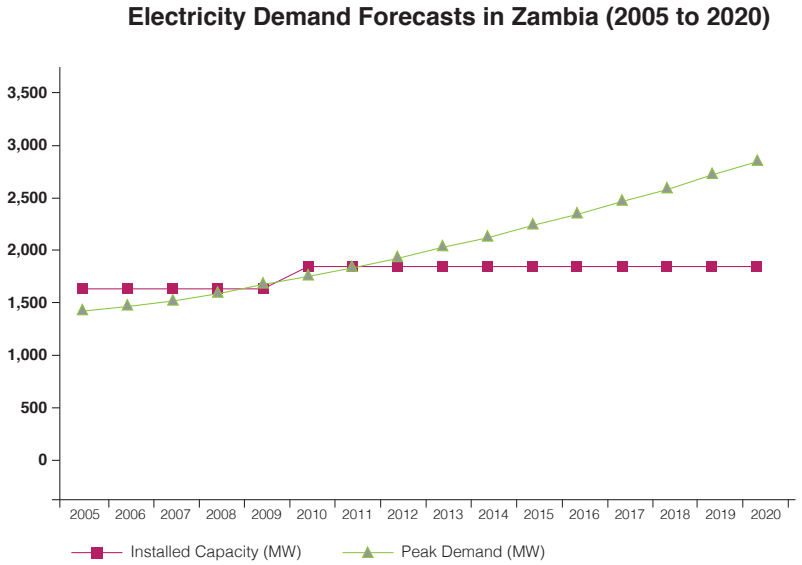
Source: Adapted by PMRC 2013 from (USAID, RERA, Electricity Tariffs in SADC Region and UPDEA, Comparative study report of Electricity Tariffs uses in Africa, 2010)

LOAD SHEDDING

According to The ZESCO Load Profile in 2008, 450 MW (megawatts) were unavailable from the country's generating infrastructure, leading to a peak-period deficit of 280 MW. Load-management has been practiced since, in order to maintain the balance of supply and demand. The expected demand growth in the next few years is estimated between 150 to 200MW per annum. Evidence shows that the power deficit in the country will increase if new capacity is not generated.

Zambia's power demand forecast by ZESCO, shows a severe and immediate shortfall in supply, if the new mining and industrial loads begin to occur at the pace ZESCO currently expects. The inability to meet this projected demand growth, would cause significant risk to the Zambian economy and delay the pace of further development.

Figure 6: Electricity Demand Forecasts in Zambia (2005 to 2020)



Source: Ministry of Energy and Water Development (2010).

RENEWABLE ENERGY SOURCES

Renewable energy is energy that comes from resources, which are continually replaced such as sunlight, wind, rain, water and geothermal heat. Bio-fuels continue to be a potential viable alternative source of fuel. In recognition, Government in 2008 issued a Statutory Instrument (SI) #42 that declared bio-fuels as an energy source under the Energy Regulation Act. Bio Fuels are commended for providing green energy for a cleaner environment. REEEP (Policy Database)

Zambia has the potential for the following renewable energies

- **Solar Energy;** Average solar insolation is roughly 5.5 kWh/m^2/day, with approximately 3,000 sunshine hours annually. Solar usage has remained relatively low due to high initial cost (Zambia Energy Sector Profile, 2013). EIA reports that every square meter (m^2) of the earth's surface, when exposed to direct sunlight, receives about 1,000 watts (1 kilowatt) of energy from the suns light. This means for example, if the sun's light provides 6 productive hours of solar energy per day, then a square meter (m^2) of land in direct sunlight will receive about 6 kw/h of solar energy during the course of the day.

Solar power is a cost-effective method for rural electrification and a compliment to existing auto-generation in the country.
Development of the country's solar resource is still relatively slow; despite numerous past projects that have proven the effectiveness of solar technology e.g. European Union-funded installations in healthcare centres.

- **Wind energy;** Wind speeds average 2.5m/s at 10m above the ground, a speed that is mainly suitable for mechanical applications. Seven (7) areas have been identified as viable for off-grid wind power generation. The Department of Energy has plans to develop a wind atlas to identify areas where electricity can be generated from wind. Evidence shows that a wind turbine with capacity of 2.5-3 MW can produce more than 6 million kWh in a year, enough to supply 1,500 average households with electricity. There is need for investment in identified opportunities.

According the www.greenbang.com, the top 5 countries producing wind energy are: -

1. China - 62.4 Giga Watts
2. United States - 46.9 Giga Watts
3. Germany - 29 Giga Watts
4. Spain - 21.7 Giga Watts
5. India - 16.1 Giga Watts

- **Biomass energy;** Woodlands and forests are estimated to cover about 50 million hectares or 66 % of Zambia's total land area. According to the ministry of Energy, 341,000 units of biogas digesters are currently operational in the country. *"A biogas digester is a piece of equipment, which can turn organic waste into usable fuel. The biogas digester relies on bacterial decomposition of waste material (biomass) that attracts bacterial organisms, which emit a number of distinctive gases, most notably methane (a gas that can be collected and burned as a fuel)".*
  With ample forest coverage, and dedicated support from the government, an integrated household-level biogas program is a viable solution.
  Sugar cane is being grown in three provinces, and processed by three different companies with a projected capacity of 483,000 tonnes of sugar per year. At present no ethanol[1] is being produced by the main sugar growing companies, but Lee Yeast Ltd in Kafue (Lusaka Province) produces ethanol from molasses purchased from Zambia Sugar Plc." This presents a significant opportunity to harness the biomass energy as a supplement to the demands in Zambia. (Ibid, 2013)

- **Geothermal energy;** According to The Zambia Development Agency (ZDA) 2013 Energy Profile, Zambia has more than 80 hot springs with heated

1. Ethanol is a grain alcohol that can be blended with gasoline and used as a fuel.

water of meteoric origin. The springs[2] have not been tapped for industrial or energy provision purposes due to high operational cost.
Kapisya Hot springs is an example of installations that have been constructed. Zambia Development Agency (ZDA) 2013 further reports that efforts are being made by the National Electricity Utility- ZESCO to revive the plant and also the government is working to make the road accessible so that works progress to revamp Kapisya Hot Springs and commence power generation.

- **Hydropower;** Zambia has an estimated large-hydro power potential of 6,000MW, of which less than 2,000MW has been harnessed. This is due to the infrastructure that has not been developed fully. Available capacity is 1,811MW and projected capacity by 2017 is 3,116 mw. Hydropower generation has the potential to satisfy the entire national demand for energy.

Figure 7: Hydro generation Projects and capacity

Power Station	Generation capacity (MW)	Available Capacity (MW)	Capacity after updating (MW)	Projected Capacity by 2017 (MW)
Kafue Gorge	990	990	990	990
Kariba North Bank	720	690	720	720
Victoria Falls	108	108	108	108
Kariba North Bank Extension	-	-	-	360
Kafue Gorge Lower	-	-	-	750
Itezhi Tezhi	-	-	-	120
SMALL HYDROS		**Available Capacity (MW)**	**Capacity after updating (MW)**	
Lunzua	0.75	0.75	15	15
Lusiwasi	12	12	-	86
Chishimba	6	6	15	15
Musonda	5	5	10	10
Shiwang'andu	-	-	-	1
	1,841.75	1,811.75	1,858	3,116

Source: GRZ- Rural Electrification master plan for Zambia (2008-2030)

2. Springs are water flowing or seeping out of an opening in the ground or hillside.

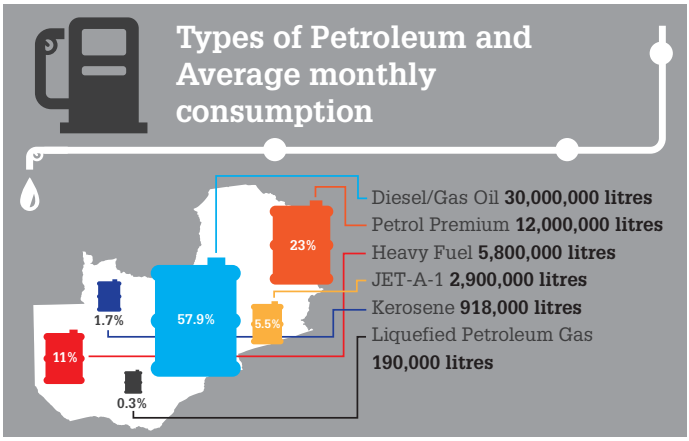
NON-RENEWABLE SOURCES OF ENERGY

According to the Renewable Energy and Energy Efficiency Policy (REEEP) database, over 85% of the energy used in the world is from non-renewable sources. Most developed nations are dependent on non-renewable energy sources such as fossil fuels (coal and oil) and nuclear power. These sources are called non-renewable because they cannot be renewed. Zambia is endowed with coal reserves, which also has great potential for augmenting energy generation to meet the growing demands resulting from economic expansion.

- **Petroleum;** Zambia imports all its petroleum requirements, which contribute approximately 9% of the national energy demand. Petroleum is oil that is extracted from underground. The import of petroleum dominates all other expenditures and forms a major part of Zambia's import bill. This is in spite of its large untapped potential for bio-diesel[3] and ethanol from both sugar and maize, which can transform the economy towards a total green economy driven by clean energy.

Expanded investments in energy infrastructure to support the commercial utilization of bio-fuels could serve as a critical pull factor to improving the investment climate through higher energy-efficient economy, competitive energy prices and low overall cost of doing business. According to the Energy Regulation Board (ERB), the demand of petroleum products in the country is about 52 million liters per month.

Figure 8: Types of Petroleum and Average monthly consumption



Source: - Adapted by PMRC from Energy Regulation Board, (2009)

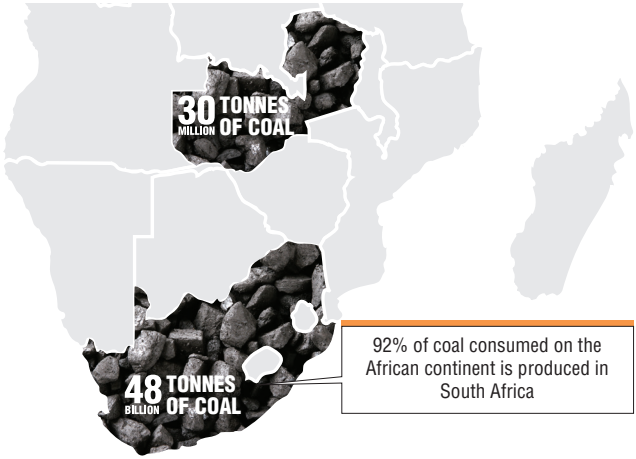
3. Biodiesel is a clean burning renewable fuel made using natural vegetable oils and fats

- **Wood fuel;** It is the largest source of household energy in Zambia followed by petroleum, electricity and coal. It is a cheap alternative and mostly used by the majority of citizens in the rural areas. However there is also need to put up reforestation programmes to enable the effectiveness of this green energy.

- **Coal;** Coal is an important industrial energy source. It is the raw material in the manufacture process of Ammonium, Ammonium Nitrate fertilizer and explosives. When adequately integrated to the manufacturing sector, coal mining can expand rural employment opportunities and supply chains as more contractors and suppliers provide services to the expanding coal mines. Similarly, expanded coal mining can boost the manufacturing of carbon dioxide, which is used in the manufacture of carbonate beverages, and production of sulphuric and nitric acid used in agricultural and mining sectors.

Currently, coal mining is undertaken by Maamba Collieries Limited (MCL) and Collum Coal Mining Industries Ltd in Sinazongwe District.
The Ministry of Mines Energy and Water Development reports that Zambia possesses proven coal reserves estimated at over 30 million tonnes. By comparison South Africa has proven coal reserves of 48 billion tonnes and around 77% of South Africa's energy needs are directly derived from coal. Significantly, 92% of coal consumed on the African continent is produced in South Africa. In Zambia however, very little of this has been commercialized to complement industrial energy supply or stabilize the energy demand and supply.

Figure 9: Coal Reserves in Zambia and South Africa

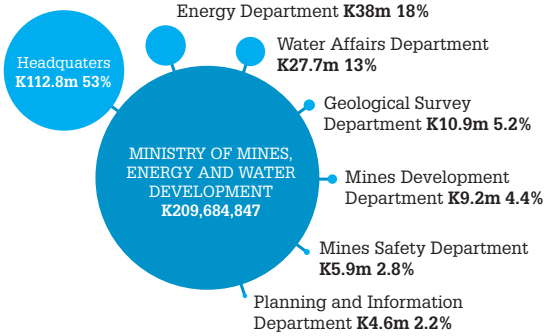


Source: Policy Monitoring and Research Centre (PMRC), 2013

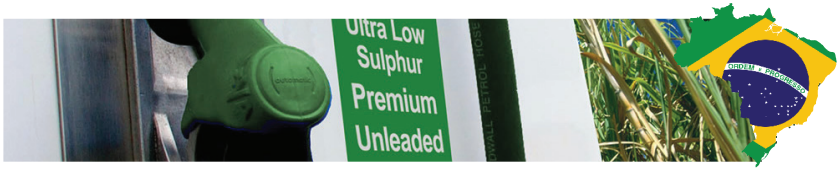
BUDGET ALLOCATION AND ENERGY EFFICIENCY

Over the years, Government has strived to increase the generation capacity of energy to meet the expanded demand. It has also engaged foreign companies to supply oil and to invest in the energy sector. In the 2013 budget, K209, 684, 847 has been allocated to the Ministry of Mines, Energy and Water development. It is expected that this allocation will enhance the energy infrastructure, improve its reliability and prevent the frequent power rationing through load shedding. The Government however, must formulate additional incentives to attract more investments in the energy sector so that it can reduce on the number of challenges it faces. Given the important role electricity plays in socio-economic development, the Energy Regulation Board (ERB) is working closely with all industry stakeholders to promote investment in power infrastructure.

Figure 9: 2013 Budget Allocation to the Ministry of Mines, Energy and Water Development



Energy lessons from the BRICS countries (case of Brazil and South Africa)



BRAZIL

Renewable energy in Brazil accounted for more than 85.4% of the domestically produced electricity used in Brazil, according to preliminary data from the 2009 National Energy Balance, conducted by the Energy Research Corporation (EPE). After the oil shocks of the 1970s, Brazil began focusing on developing alternative sources of energy, mainly sugarcane ethanol, (assisted by sugarcane

commercial farms). In 1985, 91% of cars produced that year ran on sugarcane ethanol. The success of flexible-fuel vehicles, introduced in 2003, throughout the country, allowed ethanol fuel consumption in the country to achieve a 50% market share of the gas-powered fleet by February 2008.

SOUTH AFRICA

The state-owned power company Eskom, which in 2010 produced 96.7% of power used in the country dominates electricity generation. Eskom's total installed electricity capacity in 2010 was 44,175 MW. Energy contributes about 15% of South Africa's gross domestic product (GDP). Eskom is one of the world's 10 biggest electricity generators, and is in the top 11 in terms of sales. It generates around 96% of the electricity used in South Africa, as well as exporting power to other African countries. Fuel for the country's only nuclear power plant comes from indigenous mining operations, mainly as a by-product of coal mining.

In 2008, South Africa's supply and demand gap rose to 4,000MW and this accelerated the need to diversify the county's energy sources. They focused on planning and upgrading infrastructure such as the construction of a 3,800 MW of coal-fired generation capacity and construction of two 4,800 MW coal plants in 2008, to be completed by 2013. They proposed an increase of 22% of capacity development of the power by 2030 to be from nuclear power. Zambia Electricity Supply Corporation (ZESCO) can learn from Eskom's experiences especially on planning for increased demand as well as managing generation infrastructure.

FUTURE PROSPECTS OF ENERGY IN ZAMBIA

With electricity access rates at 22% - 25% at national level, (49.3% in urban areas and only 3.2% in rural areas for a population of 13 million people), low electrification rates continue to be one of the significant challenges. It is therefore vital that access rates are accelerated for the Vision 2030 objective to be realized. To address this, Government through the Rural Electrification Master Plan (REM) has targeted to increase electrification rates to 66% of households by 2030 of which, 90% would be for urban areas while 51% would be for rural areas. In view of the foregoing, the REM has identified 1,217 rural growth centres as priority for electrification throughout the country. In order to accelerate the development of the electricity subsector, Government adopted an Electricity Strategy Paper that identified the key issues affecting the sector ranging, among other things;

- Power deficit,
- Increased demand,
- Lack of new investment in the sector,
- The low tariffs,
- The poor state of transmission and distribution infrastructure,
- Financial viability of the Utility and the urgency of implementing the planned power projects.

THE STATE OF ELECTRICITY IN ZAMBIA

- Access to electricity is still at 25%
- The challenge for citizens is affordability of capital contribution or connection fees
- ZESCO and the Rural Electrification Authority (REA) have embarked on facilitating a connection fee subsidy scheme aimed at extending electricity to many more households
- The current connection fee for planned settlements is K769 and K1,700 depending on the area.
- 75% of Zambia does not have access to electricity
- The current domestic peak demand for electricity exceeds generated capacity by about 165mw during peak
- More funds required for revamping the capacity in generation, transmission and distribution.

Source: The ZESCO Newsletter (January- April 2013)

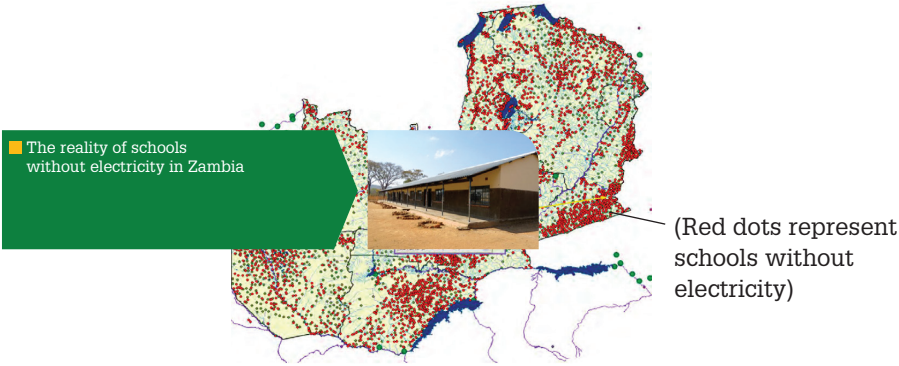
POTENTIAL LINKAGES OF GREEN ENERGY AND POVERTY REDUCTION

The energy sector is the critical driver of sustained economic growth, industrial efficiency and job creation all of which have positive implications on income generation and poverty reduction.

- **Poverty alleviation;** Renewable energy projects in many Least Developing Countries (LDCs) such as Zambia have demonstrated that renewable energy can directly contribute to poverty alleviation by providing the energy needed for creating small and medium businesses and employment. Renewable energy technologies can also make indirect contributions to alleviating poverty by providing energy for cooking, space heating, and lighting.
- **Education;** Renewable energy can also contribute to education, by providing electricity to schools. Renewable energy for cooking and heating can reduce the time that children spend out of school collecting fire wood. In addition, the displacement of traditional fuels reduces the health problems from indoor air pollution produced by burning those fuels.

For young pupils in rural areas, this results in shorter learning hours and cannot invest in studying after dark. This lack of access to the energy grid translates into higher illiteracy rates in rural areas and erodes their opportunities to find decent rewarding jobs.

Figure 10: Geographical Information System (GIS) Map of Zambia Schools without Electricity supply



Source: GRZ, Rural Electrification Master Plan for Zambia (2008- 2030)

- **Health;** According to World Health Organization (WHO) 2005, evidence has shown that about 2.4 billion people use only traditional biomass, such as wood, residues and dung, for cooking and heating. The constant use of these types of energy sources exposes them to indoor harmful particles and carbon monoxide[4] concentrations many times higher than the WHO standards. Traditional stoves using dung and charcoal emit large amounts of carbon monoxide and other toxic gases. Acute respiratory illnesses affect as much as 6% of the world population. Renewable energy can contribute to improve this situation by avoiding exposure to indoor pollutants. Furthermore, renewables can also provide energy to refrigerate medicine and sterilize medical equipment in rural areas where the access to electricity is difficult. It can also provide power to supply the fresh water and sewerage services needed to reduce the spread of infectious diseases.

- **Industrialization;** Economies striving for industrial development cannot achieve industralisation without a reliable energy sector. For the factors of production to be efficiently used, a viable energy sector needs to exist in an economy. This also attracts huge investments in the manufacturing, production and construction sectors. An effective energy sector is the drive

4. Carbon monoxide (CO) is a deadly, colorless, odorless, poisonous gas. It is produced by the incomplete burning of various fuels, including coal, wood, charcoal, oil, kerosene, propane, and natural gas

for any country seeking industrial development as it supplies all the power, electricity and any other resources needed for production.

- **Economic growth;** The energy sector constitutes a relatively uncertain share of GDP in most countries, except for those in which oil and gas income emerge large. Importantly, energy is an input to nearly every good and service in the economy. For this reason, stable and reasonable energy prices are beneficial to reigniting, sustaining and expanding economic growth. Its broad supplier networks and resultant multiplier effect also drive the energy sector's influence on economic growth.

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

- **Agriculture;** Energy has a key role in economic and social development but there is a general lack of rural energy development policies that focus on agriculture. Agriculture has a dual role as an energy user and as an energy supplier in the form of bio-energy. This energy function of agriculture offers important rural development opportunities as well as one means of climate change mitigation by substituting bio-energy for fossil fuels.
- **Mining;** Mining is a vast industry involving a diverse range of energy intensive processes such as excavation, mine operation, material transfer, mineral preparation and separation. The rising demand for mineral resources, driven by emerging markets, highlights the fact that maintaining the levels of needed supply will be a significant challenge in the future and energy will become increasingly more important for the bottom line, shareholder value, and license to operate. Many of the key industry players in the mining sector have developed energy saving strategies and are investing directly into renewable energy infrastructure. This is primarily derived by the industry-wide realization that emerging technologies and strategies exist to better manage energy consumption, costs, supply, and risks from international and national regulations. The high-energy consumption of the mining industry signifies that the potential for generating electricity as a by-product of the process of mining is an attractive proposition.

ENERGY AND ENVIRONMENT

Renewable energy has the potential to reduce pollution, slow global warming, create new industries and jobs, and move the economy toward a cleaner, healthier energy future. But renewable energy is not without its challenges and impacts. Using fossil fuels-coal, oil and natural gas to make electricity pollutes the natural elements of the environment (air, water, plants), creates toxic wastes, and causes global warming. Using nuclear fuels equally poses serious safety risks. Renewable energy resources can provide many immediate environmental benefits by avoiding these impacts and risks and can help conserve fossil resources for future generations. Renewable energy also has environmental impacts, for instance; biomass plants produce some emissions, and fuel can be harvested at unsustainable rates. Wind farms change the landscape, and some have harmed natural habitat and wildlife. Depending on only a few energy resources makes the country vulnerable to unpredictable prices and interruptions to the fuel supply. Energy is a prerequisite for the proper functioning of all sectors in the economy. With rising demand in Zambia and the SADC region having outpaced generation by significantly expanding installed capacity. Distribution networks also need to be extended and upgraded to improve the standard of living in Zambia.

CONCLUSION

Renewable energy technologies have an important role to play in Zambia's energy sector. With the right approach, the renewable energy industry in Zambia can become a major player in the energy sector, and meet the energy needs of a significant proportion of the population. Assertive lobbying for renewables at national, regional and sub-regional levels is required. It also should be noted that in as much as bio-fuels are stimulants to development, developing countries, like Zambia, should make a careful analysis of the consequences involved in bio-fuels production. Bio-fuels have their fair share of challenges with the most prominent being competition with food crops for land use. As the nation prepares to address the global energy crisis to stimulate industrial development and sustain mining activities, it should avoid investing the limited resources into one solution.

Other accessible, clean energy sources such as wind, solar, hydropower and biogas from waste should be considered. This will provide affordable energy and hopefully increase access to energy in the rural areas. Overall, the efficient world scenario shows how tackling the barriers to energy efficiency investment can unleash clean energy potential and realize huge gains for the environment, energy security and economic growth.

Energy Terms and Definitions

Compiled from [Environmental Protection Agency (EPA) and Renewable Energy and Energy Efficiency Policy (REEEP) Database]

Biodiesel is a clean burning renewable fuel made using natural vegetable oils and fats

Bioenergy refers to the bio-currents that reside in all living beings.

Biofuels are a type of renewable fuel, usually found in liquid form that have been distilled and produced from a variety of grains and animal fats.

Biomass is organic material, which has stored sunlight in the form of chemical energy. Biomass fuels include wood, wood waste, straw, manure, sugar cane, and many other byproducts from a variety of agricultural processes

Carbon monoxide (CO) is a deadly, colorless, odorless, poisonous gas. It is produced by the incomplete burning of various fuels, including coal, wood, charcoal, oil, kerosene, propane, and natural gas

Electricity is the flow of electrical energy through some conductive material

Electricity tariff is a schedule of fees or prices that relate to the receipt of electricity from a specific provider

Energy is defined as the capacity or effort to create heat, light, or motion (capacity to do work)

Ethanol is a grain alcohol that can be blended with gasoline and used as a fuel.

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter.

Hydropower utilizes different forces that are created by moving water in order to generate power.

Nuclear energy originates from the splitting of uranium atoms in a process called fission. At the power plant, the fission process is used to generate heat for producing steam, which is used by a turbine to generate electricity.

Non-renewable energy resources cannot be renewed or regenerated quickly enough to keep pace with their use

Petroleum is oil that is extracted from underground

Power is a measure of the rate at which energy flows

Reforestation is the natural or intentional restocking of existing forests and woodlands that have been depleted, usually through cutting down of trees (deforestation)

Renewable energy is energy that comes from resources, which are continually replaced such as sunlight, wind, rain, waves and geothermal heat.

Solar energy is the radiant energy of the sun, which can be converted into other forms of energy, such as heat or electricity

Springs are water flowing or seeping out of an opening in the ground or hillside.

Turbine is a type of engine that can extract energy from a fluid, such as water, steam, air, or combustion gases. It has a series of blades, typically made of steel but sometimes ceramic, that can withstand higher temperatures.

Watt is a measure of energy flow

Wind energy is a collection of windmills or turbines, which are used to generate electrical power through their mechanical motions as they are pushed by the wind

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Unlocking Zambia's Potential

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