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Electricity demand and loadshedding: Impact on Zambian business: A case study of selected solwezi based businesses

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Abstract
The ability of a country to meet its wider development objectives is largely affected by access to reliable energy. In Zambia, demand for energy, in particular electricity, has been rising due to economic activity in the country, particularly in the Mining, Agriculture, Manufacturing sectors and in all other businesses in general. As a result, load shedding and unannounced power-cuts have characterized Zambia's economy. Zambia`s business sector, both formal and informal, has not been spared and has been crippled and hit hard by electricity load shedding which is seen as a solution to the inability of the power utility to supply electricity to meet demand. Businesses and entrepreneurs are relied upon as the future engines of growth for the economy. It was therefore critical to understand the extent to which load shedding had affected this sector and how this could have affected the country`s economic development. The general objective of the study was to investigate the impact of electricity demand and load shedding on Zambian businesses and entrepreneurship. The specific objectives of the study were: (a) To establish the effects of load shedding on the Zambian business in terms of productivity and profitability. (b) To assess the measures employed and available energy alternatives the businesses depend on as the replacement to ZESCO electricity. (c) To find out how these measures have affected profitability and productivity. (d) To increase knowledge on the relationship between affordable and reliable energy sources and business growth. (e) Find out the options to mitigating the effects/ ending load shedding. The research was done in Solwezi district of North Western province of Zambia. A non probability purposive sampling approach was used, in particular the judgment sampling technique. One hundred (100) firms/ businesses falling in any of the five (5) sub-sectors categorized below were sampled. The firms or businesses that were included had to satisfy the following sampling objectives: (1) had to be a firm that use electricity and relied on ZESCO supplied electricity for its business operations or processes (2) experienced power rationing/load shedding/power cuts (3) selected out of the sub-sectors categorized in: (1) service provision (water supply, Banks and internet services/ IT Enabled Services), (2) manufacturing/welding shops/Iron & Steel, (3) food and Beverage/restaurant/tourism sector/Hotels business, (4) salons/barber shop, (5) Poultry/grain milling. The study was conducted by using self-administered questionnaires containing both closed and open questions, along with personal observation to take responses from targeted business houses. The approach relied on the individual respondent's self-assessment method of valuing for example, the cost of electricity outage. The study demonstrated that the power rationing and load shedding embarked by ZESCO to manage the power deficit had impacted negatively on both firm`s productivity and profitability. The study also revealed that very few business firms resorted to using alternative energy sources, and employed measures in order to mitigate the effects of load shedding. The study however, established that the measures put in place to mitigate load shedding resulted in mixed effects on productivity and profitability. It was also established that lack of affordable and reliable energy sources resulting from load shedding impacted on business growth and entrepreneurship negatively. The study recommended the implementation of energy efficiency policies and measures, improved notification and strict adherence to schedules by ZESCO, ZESCO also to consider excluding business/town centre from load shedding especially during day time and instead load shed business centres at night, investment in generation capacity, need for diversification in energy, and needs concerted efforts from all stakeholders.

Keywords: electricity demand, load shedding, impact on Zambian business

1. Introduction
The demand for electricity in the country has been growing at an average of about 3%, or between 150 and 200 MW, each year. The shortage of electricity has been building for some time but has become more pronounced with reduced water levels at Kariba North Bank Power Station, Kafue Gorge Power Station and Victoria Falls Power Station. ZESCO has embarked on a countrywide power rationing scheme in its efforts to maximise the power generated from limited water leading to load shedding and prolonged power cuts. Evidence shows that the power deficit in the country will increase if new capacity is not generated. The inability to meet this projected demand growth that is expected to greatly outstrip supply would surely have an effect on the businesses and the Zambian economy in general as the country will fall into the unbearable load shedding and power cuts. The study brings out main features, challenges and costs that go along with electricity demand, load shedding and power cuts to businesses in Solwezi district. Also provides mitigation measures that could be taken in the same respect. The research collected information from business firms and entrepreneurs. This provided primary information from the actual business people that brought out issues as faced on the ground.

1.1 Statement of the Problem
The businesses worldwide are recognized as a key contributor

to economic growth. The case for fostering business growth in the world and in Zambia in particular is of high significance since it offers diversified areas of contribution. There are few factors found to be critical for accelerating businesses in the country. Electricity is one of those key factors. Electricity is used not only for lighting and household purposes, but it also allows for the driving of business equipment and processes, mechanization of many farming operations, and many others. It also allows for greater productivity at reduced cost.

However, load shedding, unannounced power-cuts and fuel shortages have characterized Zambia's economy. Zambia`s business sector, both formal and informal, has been crippled and hit hard by electricity load shedding which is seen as a solution to the inability of the power utility to supply electricity to meet demand. This surely has significant changes on the production costs, profit margin, development and modernization of businesses.

The power sector of Zambia has been scrutinized immensely in the recent past but not many studies have captured the impact the power cuts/ load shedding have on the country`s industry and business sectors. This study therefore aimed to establish to what extent the selected categories of business firms in Solwezi had been affected by electricity demand and ZESCO`s load shedding.

1.2 Purpose of the Study

The purpose of this study was to investigate the impact of electricity demand and load shedding on Zambian businesses. The business sector worldwide is recognized as a key contributor to economic growth. It is particularly important to Zambia at its current stage of economic development. Businesses and entrepreneurs are relied on as the future engines of growth for the economy. Therefore, the case for fostering the growth of the sector in Zambia is of high significance since it offers and would offer diversity contributions to national development.

It was therefore critical to understand the extent to which load shedding had affected this sector and how this might affect the country`s economic development, and thereby come up with effective measures to go round severe effects.

This study was important because it would expose the real experiences that the Zambian business sector is exposed to in the event of load shedding and power cuts. It was hoped that policy makers and ZESCO including other stakeholders would understand the effects of load shedding and power cuts on the business sector and how it might impact on the general economy of the country. Its findings would help stakeholders in a number of areas including developing and putting up measures to mitigate the impact of load shedding, supporting investment programs in the electricity company, to call upon Government to accelerate policy formulation and investments in renewable energy and infrastructure and developing the updated framework for business/enterprise development and also overall employment creation in Zambia. In other words, care would be taken to avoid the situation where load shedding and power cuts result in increased costs for entrepreneurship and the business sector and consequently employment cuts.

1.3 General Objective

The general objective was to investigate the impact of electricity demand and load shedding on Zambian businesses.

1.4 Specific Objectives

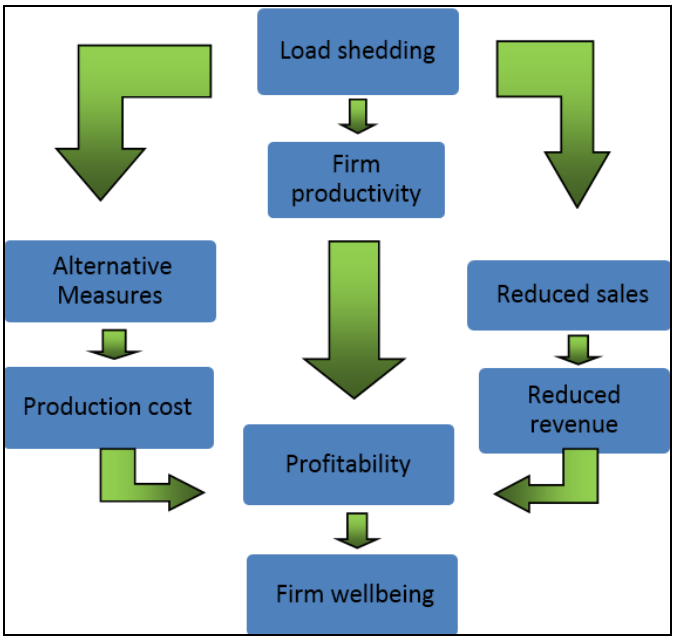
1. To establish the effects of load shedding on the Zambian business in terms of productivity and profitability.
2. To assess the measures employed and available energy alternatives the businesses depend on as the replacement to ZESCO electricity.
3. Find out how these measures have affected profitability and productivity.
4. To increase knowledge on the relationship between affordable and reliable energy sources and business growth.
5. Find out the options to mitigating the effects/ ending load shedding.

1.5 Research Questions

1. What are the effects of load shedding on firm's production and profits?
2. What are the measures put in place by business firms if any, to mitigate the impact of load Shedding?
3. How have such measures affected productivity and profitability?
4. What is the relationship between affordable and reliable energy sources and business growth?
5. What are the options to mitigating the effects/ ending load shedding?

1.6 Conceptual Framework of the study

A model of the Conceptual Framework for this study is as shown below:



1.7 Limitation

Time was one of the limiting factors to this study. In additional, the study was restricted to the five (5) sub-sectors and the 100 selected firms based in Solwezi district. Findings of this research may not be used to make conclusions on the impact of load shedding on the Zambian businesses or firms outside the five (5) sub-sectors.

2. Literature Review

2.1 Global Perspective

Generally, power sector plays a key role in economic development. Many scholars have stated and others have found the electricity sector to be a key driver of economic growth of any given country, Zambia in particular. Each segment of modern society is dependent heavily on power, from domestic, agriculture and industrial to service and governmental operations, all require electricity and energy to function, without which the world, regardless of a specific sector, would come to a standstill (Federation of Indian Chambers of Commerce & Industry 2012) [1].

Literature further adds that access to reliable, affordable energy is an essential input to economic growth. Agriculture, manufacturing, shops, transportation, and construction including SMEs are all engines of economic growth and all require energy such as electricity to function efficiently. Electricity is also an essential building block for fighting poverty and promoting sustainable development. In Zambia, electricity has been accorded prominence in the country's poverty reduction strategy (Wang, 2007) [2].

2.1 Zambian Perspective and Previous Studies

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. *All which are not yet fully exploited, if at all even exploited at any level*. For example, literature has it that Zambia has the potential to generate 6,000 MW of hydro-electricity and holds up to 28% of the water supply of the SADC region. Yet up to 70% of its hydro-generation capacity has not yet been exploited.

The Zambian electricity power system is operated as part of an interconnected power system linking South Africa, Zimbabwe, and the DRC. The Zambia Electricity Supply Industry was predominantly a market run by a single state owned company, the Zambia Electricity Supply Corporation (ZESCO) prior to the liberalization of the sector through an Act of Parliament in 1995 so as to attract private sector companies to participate in the generation, transmission and distribution of electricity in the country. In order to promote this policy, the Government set up two new institutions; Energy Regulation Board (ERB) and the Office for the Promotion of Private Power Investors (OPPPI) to regulate operations and pricing, and promote new players to the electricity market respectively (Zesco Limited 2009) [3].

Currently, power supply is still dominated by ZESCO. It has an installed hydro-based generation capacity of 2,178 MW and its main generation stations are Kafue Gorge Power Station with 990 MW capacity; Kariba North Bank Power Station with 1080MW capacity and Victoria Falls Power Station with 108 MW capacity (Zambia Development Agency (ZDA) 2014) [4]. It also has mini-hydro power plants with total capacity of 24MW and nine diesel power plants with a capacity of 6.3MW, which serve isolated mini grids in rural areas (Zesco Limited 2009) [3]. Another important sector participant is Copperbelt Energy Corporation (CEC), a private company based in Kitwe that purchases bulk power from ZESCO and supplies the copper mines and neighbouring population. Another is Lunsemfwa Hydro Power Company based in Kabwe which is an independent power producer generating about 56 MW of power that it sells to ZESCO Limited under a Power Purchase Agreement. There is also the Rural Electrification Authority (REA) which deals with the cause for increasing access to electricity in the rural areas and the Energy Regulation Board which is the regulator of the energy sector in Zambia. Other participants in the industry include small-scale generators and solar based energy services companies supplying power to some rural areas. More than 50 percent of electricity generated in Zambia serves the mining sector and the rest is shared among different sectors.

However, many countries including Zambia and many other parts of the world are being faced with the challenge of generating enough electricity to meet demand. In Zambia, the increase in demand for electricity has been rising due to rise in economic activity in the country particularly in the mining, manufacturing and agriculture sectors (Policy Monitoring and Research Center (PMRC) 2013) [5]. This increase in economic activities has resulted into a corresponding and indeed overwhelming increase in demand for electricity services, which has ultimately put a strain on the existing electricity supply capacity. ZESCO had attributed the increased load shedding being experienced in the country to a power generation deficit and low water levels at the power generation stations. Zambia's current generation capacity is about 2,178 MW of power, which is almost solely generated from hydropower through state-owned ZESCO. However, the available capacity has been brought down due to maintenance and upgrading leading to a shortage of around 200 MW during peak times and this is causing power outages and necessitating load shedding (Anita Kruger 2013) [6].

In the year 2012 during a press brief, the Acting Managing Director then, Mr. Victor Mundende, said that the deficit was being caused by increased mining, industrial and agricultural investments that were not supported by investment in the company's transmission and distribution systems (http://www.lusakatimes.com/2012/06/16/zesco-explains-increased-loadshedding-country/) [7]. As Mr. Victor Mundende added, load shedding management was being carried out to protect the generation equipment, which would automatically shut down should there be an overload, a situation he said would be costly. In the same year 2012, the then Managing Director, Mr. Cyprian Chitundu said that load-shedding was unavoidable as the growing economy puts pressure on the power utility company (http://geraldopearson.typepad.com/blog/2012/08/load-shedding-worries-business-houses-zambia-daily-mail.html) [8]. *It is therefore right to think that load shedding is here to stay and is part of us especially that new capacity is not to be generated soon as things look.*

One other reason for sure to this load shedding is poor planning & lack of maintenance on the part of the power utility and to a larger extent on the part of Government. According to Collin Wood (Business Report, 14 January 2008) cited by Calldo (2008) [9], he also suspected that a lack of planning was the real reason for the crisis in South Africa with the Eskom in the later months of 2007. During this period, South Africa started experiencing widespread rolling blackouts as supply fell behind demand, threatening to destabilize the national grid.

As cited by Kaseke & Hosking (2012) [10], Load shedding is an organized form of electricity outages. *However, the load*

shedding of Zambia, in particular Solwezi, does not seem to be organized as power is switch on and off by the power company without any time table developed and communicated to stakeholders.

Consequently, Zambia`s business sector has been hit hard by electricity load shedding which is seen as a solution to the inability of the power utility to supply electricity to meet demand. This is because the current power deficit has resulted in prolonged load shedding and power cuts, and has occasionally affected trade and production, and business in general. A manifestation of this problem can be seen in the large number of reports in the popular press of high incidence of outages/load shedding and protests, by not only the domestic and commercial, but also industrial consumers. We have also seen such protests and complaints by the various chambers of commerce and industry and other industrial associations in the country that the level of production in a number of industries and sectors had been reduced and adversely impacted due to the persistence of outages which apparently have fundamentally disturbed the normal rhythm of the production cycle in a large number of industrial units and other business sectors, especially in electricity-intensive sectors like leather products, Mining, rubber and plastic products, paper and paper products, water supply, Banks and internet services/ IT Enabled Services), Manufacturing/Iron & Steel, food and Beverage/restaurant/tourism sector/Hotels business, and salons/barber shops.

As Attigah & Mayer-Tasch (2013) [11] identified, quality and reliability of electricity supply is an important factor both for the decision to connect and for the impact on business performance. They argue that in some countries, the reliability is so low that electricity-reliant businesses have no choice but to invest in diesel generators if they want to maintain business operations at a minimum level of steadiness. *A move I personally feel, results in a huge cost for the business to sustain, especially for small businesses and upcoming businesses. In today`s market, businesses are striving to remain competitive by lowering the cost of production and general operational cost and in turn maximizing profits that hold the heart of the business.*

However, one would still argue that why businesses not invest in cheaper energy sources as opposed to diesel generators in this era of load shedding? The most likely reason is that most energy sources such as wind and solar remains untapped in Zambia, and also because most business houses generally lack the resources necessary to invest in alternative sources of energy.

According to the World Bank's Doing Business report (Attigah & Mayer-Tasch 2013) [11], firms in low-income countries are affected by electricity supply interruptions on average 18 times in a typical month. Business managers interviewed for the Doing Business project in Malawi which was done in various countries by World Bank estimated that losses due to electricity outages amount to an average of 3.2 % of annual sales and as much as 22.6 %. These resulting workflow interruptions and the combined damage of sensitive electrical equipment such as computers caused by voltage fluctuations can surely curtail profits significantly.

In an analysis of investment climate surveys from 26 African countries by Escribano *et al*. (2009) as reviewed by Attigah & Mayer-Tasch (2013) [11], found that in low-income countries, a low infrastructure quality has a significant negative impact on total factor productivity, which is at least as important as other factors such as crime, red tape and access to finance. More importantly the analysis indicated that poor-quality electricity supply is the infrastructure element that has the strongest negative effect on enterprise productivity, especially in poor African countries such as Eritrea, Ethiopia, Mali, Senegal, Uganda and Zambia.

Numerous studies state that access to electric light by small businesses leads to longer operating hours which in turn leads to increased income by these businesses (Attigah & Mayer-Tasch 2013) [11].

What is critical with the Attigah & Mayer-Tasch (2013) [11] study is the fact that the study exploits the role electricity plays in business and in particular in increasing business incomes and more importantly contributing to economic growth and development.

During what Ketelhodt &Wöcke (2008) [12] called "The Cape Town electricity crisis", due to an electricity crisis in 2005-2006 periods, which was compounded by the economic growth in the region and resulted in demand outstripping supply, it was estimated by the Cape Town Chamber of Commerce and Industry, following a survey of members, that the blackouts costed the Cape Town economy about $900 million directly. Other consequences of the blackouts were a loss of 12 days of production at the Chevron refinery. It caused Multinationals that were considering investing in South Africa to openly question South Africa as a destination for their investments (Ketelhodt &Wöcke 2008) [12]. *Multinationals usually put their investments in a particular country in order to either gain access to that country`s domestic market or to maximize profits by way of reducing production cost and on the other hand increase productivity by taking advantage for example, of cheap raw material, energy and cheap labour and just the general business environment (Government policies).*

Daily Mail Newspaper published a story in titled "Load-shedding worries business houses". It read in part that *"*various stakeholders have expressed concern over the ripple effects of load-shedding citing loss of business amounting to millions of Kwacha daily, among others." (http://geraldopearson.typepad.com/blog/2012/08/load-shedding-worries-business-houses-zambia-daily-mail.html) [8].

The Poultry Association of Zambia (PAZ), Dairy Association of Zambia (DAZ), small medium enterprises such as restaurants and salon owners all complained of losing business due to what they term the indiscriminate and inconsistent load-shedding by ZESCO.

Coming back to what Ketelhodt &Wöcke (2008) [12] called "The Cape Town electricity crisis", Ketelhodt &Wöcke (2008) [12] reported that there were various reports covering the extent of the damage to businesses and households. Examples of this include damaged computers, traffic congestion, perishables damaged in refrigerators, non-delivery to clients, and an oil refinery unable to operate. *This investigation was important as it brought a variety of business firms into the picture. This is because load shedding can impact different businesses or sectors differently. It is however important to note also that businesses can be impacted differently depending on the business size and level.* This was similar to what was contained in the Daily Mail News paper published story, in titled "Load-shedding worries business houses". The Daily Mail story reported that DAZ said farmers are losing about

K12.5 million per day because of power outages, especially that they deal in fresh products, PAZ said that the poultry industry has also been adversely affected as it is one sector that is centred on power and water with regards hatching, breeding, processing and storage, while the Zambia Environmental Management Agency (ZEMA) expressed concern at the impact that load shedding has on the environment (http://geraldopearson.typepad.com/blog/2012/08/load-shedding-worries-business-houses-zambia-daily-mail.html) [8]. ZEMA spokesperson Irene Chipili said apart from industries, households and restaurants are using charcoal as a source of energy because generators are not affordable for most. She added that the dependency on charcoal as a source of energy would in the long term have adverse implications on the overall state of the environment.

In a study carried out in Zimbabwe, Chinhoyi Residential Urban areas to be specific, to establish the effects of load shedding through a questionnaire survey, the survey established that 60% of residence experienced losses in perishable food stuffs due to refrigeration failure, 15% reported production downtime in their home industries with 10% having their electrical appliances such as television sets being damaged as a result of the power surges fashioned by the power outage. Critically, a number of enterprising urban dwellers that generate revenue from their backyard home industries which require the service of electricity are being starved of the prospect due to load shedding (Musademba *et al*. 2012) [13].

This investigation despite concentrating on households, we can still draw some lessons from this study that if load shedding can affect households in such a way, what more of business houses that dream, eat, speak, walk, and think how to make profits, how to grow the business, how to be productive, competitive and so on. It can be very interesting indeed to find out the extent of the impact of load shedding on the business houses.

The Zimbabwe survey also established that income for the residents was disproportionately eroded as a result of load shedding. The fraction of energy cost to income was found to increase from 16% without load shedding up to 64% for those in the low density and up to 49% for those in the high density areas. This has consequently impoverished the residents. The survey concluded that women are unduly burdened by the power outage exercise and people in general have been reduced to poverty levels as they are left with dwindled income (Musademba *et al*. 2012) [13]. *It can therefore be interesting to establish how incomes are being affected in the event that the business houses have to adjust their way of doing business by adopting new energy sources if at all other sources are adopted.*

In another investigation by Kaseke & Hosking (2012) [10], carried out in Zimbabwe on the Mines to estimate the cost of load shedding, it was concluded that electricity load shedding resulted in high cost to mining sector in Zimbabwe. It was observed that Mines flooded as a result poor pumping of water outside the tunnels and mine shafts, and also lost productive hours of production. The results also revealed that low capacity mines incurred higher load shedding cost compared to high capacity mines. It was also seen that high valued mineral mines (gold, diamond and platinum mines) incurred high outage cost as compared to low valued mineral mines (vermiculite, graphite and phosphate).

The Bangladesh study by Bose *et al*. (2013) [14] that was intended towards evaluating the impact of electricity availability on the operation and performance of SMEs in the rural areas of Bangladesh, detected favorable changes on the production costs, profit margin, development and modernization of business, women empowerment, quality of life, and human development due to the electrification. It was observed that organizations produce more products, opened more hours, sold more products and in turn earned higher profit. It was concluded that as the earnings increased then it ultimately impacts quality of life such as improving health and literacy levels, raising household income, providing employment, preserving the environment, curbing rural-urban migration and stemming population growth, empowering women and many more.

The electricity outages (load shedding) have attracted interest from various stakeholders including government.

The Zambian government in its quest to improve the well being of its citizens as outlined in the Vision 2030 and the Poverty Reduction Strategy Paper (2002) documents outline various objectives and targets that should be realized. Among them are: reducing head count poverty, develop economic structures that are resilient to external shocks, improve national productivity, have reliable transport and communication that connects the entire country.

The government of Zambia has re-affirmed its commitment to promoting small and medium enterprises in the country due to their significant contribution to the national GDP and employment. This is evidenced by the major strides that the government has taken to invest in electricity, water and roads in various parts of the country. *However, more needs to be done in terms of investment in energy.*

Development of any country requires a favorable macroeconomic environment that supports various economic activities (Prest 1985) [15]. Key sectors that are involved in production and manufacturing should be supported. Prest (1985) and the Zambian Economist (2012) [16] emphasize the need for government to foster development plans that holistically provides general guidance and policies for economic development to be a reality. *In my view, such policies include deliberate policies to encourage more investments in the electricity and energy sector in general.*

In the same line, given the cardinal role electricity plays in socio-economic development, the ERB is working closely with all industry stakeholders to promote investment in power infrastructure (Anita Kruger 2013) [6].

Zesco claims that the country needs an investment of over $5 billion to fund the supply shortage, yet Zambia offers some of the region's lowest electricity tariffs and is the main reason why funding for generation capacity upgrades and new projects have been hard to come by (Anita Kruger 2013) [6]. This is made worse as any hike in tariff excludes mining tariffs that have been negotiated through contracts, some of which date back as far as the 1990s with the onset of privatization.

Tariff re-negotiations between the Zambian government and the mining companies are dependent on the willingness of the mining companies to engage in such efforts, however in the face of declining copper prices, there is increased pressure on mining companies to minimize costs. This means that tariff hikes in the mining sector, the country's economic backbone,

may lead to widespread job losses: a trade-off that will be hard for authorities to justify by.

Obviously, the cost of doing business in Zambia has increased as a result of load shedding. This is resulting in locally produced products being more expensive compared to products produced in other countries and hence Zambian products being less competitive on market.

3. Methodology

The research or study was done in Solwezi District. This district is in North Western Province of Zambia. Solwezi District is a district that is developing fast because of the growing mining sector in the province.

3.1 Research Design

The research design refers to the overall strategy that one is to choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring that the research problem is effectively addressed; it constitutes the blueprint for the collection, measurement, and analysis of data (William 2006) [17]. In this research therefore, the design used was non experimental because the research was done or carried out in uncontrolled environment and natural setting. A survey of 100 business houses was conducted. The study was conducted by using self-administered questionnaires, along with personal observation to take responses from targeted business houses. The design looked at the frequency of answers and focused on answers given by all respondents. The approach relied on the individual respondent's self-assessment method of valuing for example, the cost of electricity outage. The self-assessment method is an economic appraisal tool that estimates the cost of power outages by allowing electricity consumers to express their losses in monetary terms (Bose *et al*. 2006) as cited by Kaseke & Hosking (2012) [10].

3.2 Sampling Frame

The sampling frame consisted of a representative of each business house or firm that was sampled in Solwezi district of North Western province of Zambia. In this sampling frame, a particular business or firm was sampled and mainly, the research targeted the firm representative who was believed to have had some knowledge on the operations and background of the business or firm.

3.3 Sample Selection

The sample in this research consisted of businesses or firms in Solwezi. A non probability purposive sampling approach was used, in particular the judgment sampling technique. One hundred (100) firms/ businesses falling in any of the five (5) sub-sectors categorized below were sampled. The firms or businesses that were included had to satisfy the following sampling objectives: (1) had to be a firm that use electricity and relied on ZESCO supplied electricity for its business operations or processes (2) experienced power rationing/load shedding/power cuts (3) selected out of the sub-sectors categorized in: 1) service provision (water supply, Banks and internet services/ IT Enabled Services), 2)manufacturing/welding shops/Iron & Steel, 3) food and Beverage/restaurant/tourism sector/Hotels business, 4) salons/barber shop, 5) Poultry/grain milling.

3.4 Target Units

The target group for this study was the business houses/ firms, small, medium or large which were utilizing ZESCO electricity as power and energy resource to run their businesses, and were experiencing load shedding/power rationing.

3.5 Data Collection

Both secondary and primary data was collected in this research. The secondary data was used in developing and coming up with the literature review and acted as the basis for confirming the research findings from primary sources. The secondary data for this research was collected from published books, published materials and mainly from the internet. Primary data was collected from the field by the researcher from key informants who were identified and selected from selected business houses.

3.6 Research Instruments

One instrument of data collection was used in this research or study. The questionnaire was administered by the researcher and it included both open (unstructured) and closed (structured) type items. Closed ended aimed at facts about the impact of electricity demand and load shedding while the open ended questions aimed at obtaining the respondents' opinions as this allowed them to express themselves as they were not restricted.

3.7 Data Analysis

The data collected was analyzed using quantitative and qualitative approaches. Responses to closed questions and open ended questions were analyzed normally to bring out frequencies of responses on the variables that guided the study. The responses that came from open ended questions were grouped according to similarities as judged by the researcher. The responses then were captured and analyzed.

4. Findings and Discussion of results

4.1 Effects of load shedding on firm`s production and profit

The analysis on the effects of load shedding on firm`s productivity and profitability revealed that whenever load shedding is effected, business houses experience reduction in productivity as illustrated in table 2. The analysis also established that this led to reduction in profits for firms as illustrated in table 2.

Table 1: Distribution of respondents according to the effects of the use of substitute energy on business.

Sample Size	Type of response	Frequency	Percentage
100 (21 used substitute energy)	Increased operation cost	12	57%
	Constant supply & production/ service provision	5	24%
	Drop in supply and production/ service provision	3	14%
	Not indicating	1	5%
Total		21	100%

Source: Author (2016)

Table 2: Distribution of respondents according to whether load shedding led to reduction in profits/ production

Question	Responses		
	Yes	No	Not indicated
whether load shedding led to reduction in profit	96	4	0
whether load shedding led to reduction in production/service	96	4	0

***Source*:** Author (2016)

This was further supported as observed in table 3 that revealed that business houses incurred a loss as a result of experiencing load shedding. The analysis established that the reduction in both production and profits in percentage was 30% as it can be observed in table 4.

Table 3: Distribution of respondents according to whether they incurred a loss as a result of load shedding.

Sample Size	Type of response	Frequency	Percentage
100	No	1	1%
	Yes	98	98%
	Not indicating	1	1%
Total		100	100%

***Source*:** Author (2016)

Table 4: Distribution of respondents according to how much percentage in reduction in production and profits

100 Respondents	Reduction in percentage (%)									
	5%	10%	20%	25%	30%	35%	40%	50%	60%	Not Indicated
Production	1	4	8	5	15	4	11	5	4	43
Profit	1	4	7	5	18	3	10	6	4	42

***Source*:** Author (2016)

This reduction can be attributed to the following

1. Reduced operation hours. It was established that load shedding enabled businesses to operate for fewer hours as it can be observed in table 5. It was found that load shedding was experienced 4 times in a week and lasted for 6 hours as illustrated in table 6 and 7 respectively. It was established that, on average, most businesses operated for only 2 hours during the days they experienced load shedding as most of the businesses on a normal day (day when there was no load shedding) operated for between 9 hours and 8 hours as can be observed in table 8. This thus meant that production and service provision was reduced and this in turn resulted in reduced sales which in turn affected revenues and profits negatively. It was observed that both large and small scale businesses slowed down on production as they had to work only when there was electricity.
2. Increase in operation cost. It was established that the use of substitute energy sources resulted in increased operation cost as can be confirmed in table 1 that showed that "increased operation cost" was the highest ranked effects of using substitute energy sources. This is further supported by table 9 that revealed that load shedding led to increased operation cost. Increase in operation cost affected the businesses` profits. It was also observed that increase in operation cost forced some businesses to reduce on their operation hours as a way of cushioning the cost for using substitute energy sources, which led to reduction in production despite using alternative sources.

Table 5: Distribution of respondents according to whether load shedding enabled the enterprise to operate for fewer hours.

Sample size	Type of response	Frequency	Percentage
100	No	4	4
	Yes	96	96
Total		100	100%

***Source:** Author (2016)*

Table 6: Distribution of respondents according to number of times they experience load shedding in a week.

Sample size	Type of response	Frequency	Percentage
100	3 times	37	37%
	4 times	51	51%
	5 times	7	7%
	6 times	3	3%
	7 times	1	1%
	8 times	1	1%
Total		100	100%

***Source*:** Author (2016)

Table 7: Distribution of respondents according to length in hours load shedding takes.

Sample size	Type of response	Frequency	Percentage
100	5 hours	6	6%
	6 hours	63	63%
	7 hours	16	16%
	8 hours	15	15%
Total		100	100%

***Source*:** Author (2016)

Table 8: Distribution of respondents according to length in hours they operate when there is no load shedding.

Sample size	Type of response	Frequency	Percentage
100	7 hours	4	4.08
	8 hours	36	36.73
	9 hours	35	35.71
	10 hours	8	8.16
	11 hours	1	1.02
	12 hours	2	2.04
	13 hours	1	1.02
	14 hours	2	2.04
	17 hours	1	1.02
	18 hours	1	1.02
	22 hours	1	1,02
	24 hours	6	6.12
Total		100	100%

***Source*:** Author (2016)

Table 9: Distribution of respondents according to whether load shedding led to increased operation cost

Sample size	Type of response	Frequency	Percentage
100	Disagree	9	9%
	Agree	91	91%
Total		100	100%

***Source*:** Author (2016)

It was however observed that the decline in production/ service provision depended on the length of load shedding experienced and the type of business involved. It was also observed that the effects were even much severe to businesses that did not put any measures or use any substitute energy sources to mitigate the effects of load shedding.

4.2 The measures put in place by business firms to mitigate the impact of load shedding

The analysis established that very few businesses used alternative or substitute energy sources during load shedding. As can be observed in table 10, 79% of the business firms sampled, did not use any source of energy, and only resumed operation when electricity power was restored. It was however found that the majority of the business houses that used alternative energy sources relied on standby gen-sets as a measure to mitigate the impact of load shedding. A few others used sola power during load shedding.

Table 10: Distribution of respondents according to the kind of energy they use during load shedding.

Sample size	Type of response	Frequency	Percentage
100	Solar	2	2%
	Standby gen set	14	14%
	Other	5	5%
	None	79	79%
Total		100	100%

***Source*:** Author (2016)

It was also revealed that apart from not using alternative or substitute energy sources, many business firms still had not put in place other measures to mitigate the effects of load shedding as it can be observed in table 11. It was however established that some other business firms prepared their products, example food, in advance as a way of mitigating load shedding. It was also revealed that others prepared products such as perishables, only enough to be exposed or sold within the shortest possible period of time to avoiding wastage while others switched all appliances that were not in use at a given time to reduce demand on electricity that would have resulted in load shedding even on the days that were not to be load shaded. However, it was observed that such measures had their challenges, for example products going to waste on days when they had limited customers.

On the other hand, it was observed that the measures put in place to mitigate load shedding by business firms were frequently frustrated by failure by the electricity company to make advance warning arrangements, as it can be observed in table 12, and failure by it to follow communicated load shedding schedules.

Table 11: Distribution of respondents according to measures (other) put in place to mitigate the effects of load shedding.

Sample size	Type of response	frequency	Percentage
100	Preparing products e.g food in advance	8	8%
	No measure put in place	84	84%
	Preparing products only enough to be exposed in shortest period of time	1	1%
	Switching all appliances not in use to reduce demand at a given time	1	1%
	Use of substitute energy	1	1%
	Not indicating	5	5%
Total		100	100%

***Source*:** Author (2016)

Table 12: Distribution of respondents according to whether advance warning arrangements were made between power utility and affected business houses.

Sample size	Type of response	Frequency	Percentage
100	No	59	59%
	Yes	40	40%
	Not indicated	1	1%
Total		100	100%

***Source*:** Author (2016)

4.3 How the measures put in place have affected productivity and profitability

It was revealed that the measures put in place to mitigate load shedding resulted in mixed effects on productivity and profitability. It was established that the following resulted from the measures put in place: in increased operation cost for the firms or business, constant supply and production/ constant service provision and drop in supply and production/ service provision. This is illustrated in table 1.

Operation cost increase, affected the businesses` profits and production as some businesses reduced on their operation hours as a way of cushioning the cost for using substitute energy sources, which led to reduction in production and in turn reduced sales and subsequently reduced revenues. The same reasoning can also be attributed to the drop in supply and production/ service provision which was one of the effects of measures put in place to mitigate load shedding.

However, constant supply and production/ constant service provision was attributed to the fact that instead of operating for few hours and supply only for few hours for example, during load shaded days, firms at least after putting up measures, operated for a bit longer hours and continued supply for longer hours compared to the hours they could have been supplying had it not been for the measures put in place.

4.4 The relationship between affordable and reliable energy sources and business growth

It was revealed that lack of affordable and reliable energy sources resulting from load shedding impacted on business growth negatively. It was established that load shedding hindered diversification of services as it can be observed in table 13. Businesses filed to diversify into other services especially services that are electricity dependant.

It was further discovered that load shedding led to the reduction and disappearance of business firms. This is also shown in table 13. It was observed that a good number of entrepreneurs, especially newer entrepreneurs, closed down there businesses following reduced production, service provision and profits due to load shedding, a situation which is not good for the country`s employment creation agenda.

Also, it was established that load shedding resulted in inefficiency in processes, both of doing business and within particular businesses. Table 13 confirms this. This was as a result of damage to machinery and stress on some equipment. It was observed that processes were taking longer than expected especially that we are in a computer and electronic world that is more reliant on energy, and businesses have modernized to suit the demands of modern business where energy drives their wheels of operations.

It was also found that load shedding resulted in reduced quality of products and services, table 13 confirms this. This is mainly due to inefficiencies in processes resulting from load shedding. It can also be attributed to the reduction and disappearance of business firms that in turn diminishes the idea of firms competing on the basis of quality as customers have limited variety goods and services.

Further, it was found that load shedding made communication with service providers, inefficient, table 13. Being in a computer and digital era where almost everything including communication is driven by some form of energy, it meant that when there was load shedding, businesses could not communicate through for example internet, with service providers and clients and waited when power was restored to communicate the message which they could have communicated immediately. Therefore, communication being critical in any relationship including business, delayed communication and inefficiency in communication hamper business growth. Furthermore, it was also found that load shedding resulted in firms operating for fewer hours and also that it led to increase in operation cost. This can be observed in tables 5 and 1 respectively. These in themselves impact negatively as we saw earlier, on the business and thus therefore, are impediments to the growth of businesses and entrepreneurship generally.

Table 13: Relationship between affordable and reliable energy sources and business growth (respondents disagree/agree)

Question	Disagree	Agree	Total
whether load shedding hindered diversification	15	85	100
whether load shedding had resulted in reduction/disappearance of firms	14	86	100
whether load shedding led to inefficiency in processes	11	89	100
whether load shedding led to reduced quality of products/services	7	93	100
whether load shedding led to reduced hours of operation	4	96	100
whether load shedding led to increased operation cost	9	91	100
whether load shedding made communication with service providers inefficient	24	76	100

***Source*:** Author (2016

4.5 The options to mitigating the effects/ ending load shedding

As it can be observed in tables 11, 14, and 15, it was established that the options to mitigate the effects of load shedding included the promotion of the use of alternative energy sources, switching off all electric appliances not in use to reduce on demand, business firms to consider using substitute energy sources and the government to consider

empowering business firms with loans to acquire alternative energy. Other options included to exclude the load shedding of business/town centre especially during day time and instead load shed business centers at night, utility company to be making advance warning arrangements/ informing business houses of load shedding schedules and to strictly follow load shedding schedules that they communicate to business houses as this will enable business firms plan their operations and avoid costs associated with unexpected load shedding such as wasted raw materials already in the production process. Further, it was established that options to end load shedding included attending to faults/ errors at Kariba station and other power generation stations, building more reliable electricity generation stations around the country to ensure constant power supply to businesses that depend on electricity, maintenance/recapitalize/modernize existing electricity infrastructure, cut and wipe out all illegal consumers- illegal consumers create unnecessary demand, decentralization of power generation per region, importation of power from other countries, stop/ reduce power exportation to other countries and switching off electrical appliances not in use so as to avoid unnecessary demand.

Table 14: Distribution of responses according to what respondents thought needed to be done to reduce on the effects of load shedding on business firms.

Sample Size	Type of response	Frequency
100	Promotion of the use of alternative energy	13
	Switching off all items not in use to reduce on demand	1
	Business firms to consider substitute energy sources	19
	Utility company ensure that illegal consumers are disconnected	1
	Empower business firms with loans to g*et al*ternative energy	6
	Exclude the load shedding of business/town centre	2
	Utility company to strictly follow load shedding schedule	2
	Utility company to be making advance arrangements/ informing business firms on load shedding times	2
	Load shedding of business/ town centre to be done at night	1
Total		47

***Source*:** Author (2016)

Table 15: Distribution of responses according to what respondents thought were the immediate term solutions to mitigate load shedding.

Sample size	Type of response	Frequency
100	Attend to faults/errors at Kariba station	27
	Build more reliable electricity generation station around the country	2
	Maintenance/recapitalize/modernize existing electricity infrastructure	20
	Constant power supply to businesses that depend on electricity	1
	Cut all illegal consumers- illegal consumer creates unnecessary demand	6
	Decentralization of power generation	1
	Importation of power from other countries	1
	Stop/ reduce power exportation to other countries	1
	Switching off electrical appliances not in use.	2
Total		61

***Source*:** Author (2016)

5. Research Conclusions and Recommendations

5.1 Introduction

The research sought to investigate the impact of electricity demand and load shedding on Zambian businesses, a study carried out in Solwezi district. The research was guided by the following research objectives:

1. To establish the effects of load shedding on the Zambian business in terms of productivity and profitability.
2. To assess the measures employed and available energy alternatives the businesses depend on as the replacement to ZESCO electricity.
3. Find out how these measures have affected profitability and productivity.
4. To increase knowledge on the relationship between affordable and reliable energy sources and business growth.
5. Find out the options to mitigating the effects/ ending load shedding.

The objectives guided the research to remain focused. From the results and findings of the research, the following conclusions have been formulated:

5.2 Conclusions

- There is a huge power demand as a result of increase in economic activities particularly in the mining, manufacturing, agriculture sectors and in all other businesses and entrepreneurship activities in general, which has resulted into electricity deficit of about 500MW and putting a strain on the electricity company. The power rationing and load shedding embarked by ZESCO to manage the deficit had impacted negatively on both firm`s productivity and profitability. It had led to significant reduction in production and profits.
- Although very few business firms used alternative energy sources during load shedding, in order to mitigate the effects of load shedding, firms were forced to resort to using alternative energy sources such as gen-sets and sola power. Others were forced to be preparing their products, example food, in advance, others prepared products such as perishables, only enough to be exposed or sold within the shortest possible period of time to avoiding wastage while others switched all appliances that were not in use at a given time to reduce demand on electricity that would

have resulted in load shedding even on the days that were not to be load shaded.

- The measures put in place to mitigate load shedding resulted in mixed effects on productivity and profitability. The use of alternative sources of energy resulted in increased production or operation cost for the firms or businesses which in turn impacted negatively on firm`s profitability. For many, procurement of gen sets was expensive and maintaining them was another challenge. On the other hand, the use of other measures such as preparing of products in advance, somehow boosted sales and revenue as it meant that firms were in constant supply and production/ constant service provision, as instead of operating for few hours and supply only for few hours for example, during load shaded days, they worked for a longer period. This however had its challenges, for example products going to waste on days that they had limited customers and thus resulted in lost revenue.
- Lack of affordable and reliable energy sources resulting from load shedding impacted on business growth negatively. It was found that lack of affordable and reliable energy sources acted as a hindrance to business and service diversification, resulted in businesses closing down, resulted in inefficiencies in processes, resulted in compromised quality of products and services, resulted in businesses operating for few hours, resulted in increased operation and production cost, and made communication with service providers and other partners inefficient. In this regard, lack of affordable and reliable energy sources acts as a barrier and disincentive to businesses growth and entrepreneurship.
- Load-shedding was unavoidable as the economy continues to grow and putting pressure on the power utility company ZESCO, to satisfy the ever increasing demand. However, the electricity deficit challenge could be better managed to mitigate the effects of load shedding and ending load shedding. Options to mitigate the effects of load shedding include the promotion of the use of alternative energy sources, switching off all electric appliances not in use to reduce on demand, business firms to consider using substitute energy sources and the government to consider empowering business firms with loans to acquire alternative energy. Other options include to exclude the load shedding of business/town centre especially during day time and instead load shed business centers at night, utility company to be making advance warning arrangements/ informing business houses of load shedding schedules and to strictly follow load shedding schedules that they communicate to business houses so as to enable firms to plan for their production and operation and avoid cost associated with unexpected interruptions. The options to end load shedding include attending to faults/ errors at Kariba station and other power generation stations in the country, building more reliable electricity generation stations around the country to ensure constant power supply to businesses that depend on electricity, maintenance/recapitalize/modernize existing electricity infrastructure. This will demand massive increase in investments into electricity by both the Government and ZESCO. The other option is to cut and wipe out all illegal consumers as the illegal consumers create unnecessary demand. Other options include decentralization of power generation per region, importation of power from other countries although costly and not sustainable, stop or reduce power exportation to other countries and switching off electrical appliances not in use so as to avoid unnecessary demand and pressure on the electricity system.

5.3 Recommendations

Following the conclusions above, the following are the recommendations:

Short term Solutions

- First and foremost, the implementation of energy efficiency policies or measures is recommended. Energy efficiency measures such as the use of energy-saving appliances, simple demand-side management measures, or energy conservation in buildings, would significantly reduce electricity demand on the immediate term. Encouraging energy efficiency, even through campaigns and sensitizations, can provide substantial cost savings to governments, businesses and households, while freeing up power for other more productive uses. The government should also consider empowering business firms with soft loans to enable them acquire alternative energy as one of the challenges businesses face is procurement of substitute energy sources such as gen-set.
- The other challenge with current load shedding is that schedules for the power-cuts are not consistent and not strictly followed. This has made it difficult for consumers to plan their activities. Improved notification and strict adherence to schedules is required from ZESCO. Improved communication with the public is essential as it would make power outages be more predictable and commerce and industry could plan to work round them.
- ZESCO should also consider excluding of business/town centre from load shedding especially during day time and instead load shed business centers at night as many businesses are expected to be closed during night time. However, this would mean increase of load shedding for other consumers who would not take it kindly as well, and hence would require some balance to be strike.

Long term Solutions

- The current electricity deficit challenge in the country is partly due to unexploited hydro power potential. Therefore, investment in generation capacity would unlock this potential and assure self sufficiency. Thus, we should not only concentrate on maintaining the existing power generation infrastructure but also building new ones to increase generation capacity. Decentralization of power generation per region can also be helpful.
- There is need for diversification in energy especially that the country has substantial unexploited reserves of different forms of energy sources. As a country, we should seek to diversify the country's energy source away from ZESCO as the sole provider of energy. This would require more investments into unexploited energy potentials and sources. This would also need incentives such as waiver of tax on energy sources and appetizing tariff structure to encourage more private investments into the energy sector. This would require the government to develop legislations that can support the open market in the energy sector.

- All in all, the energy deficit that Zambia faces needs concerted efforts to address because it has caused major challenges on the local economy. It needs the government, the private sector, the general public and the international community to play its contributing part.

6. Further Research

The replication of the study in different areas of Zambia and with different sectors of the economy and different business sizes would enable better regulation of the findings of the study.

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