

Challenges in the Energy Sector of Zambia: A Case Study of Effects on Manufacturing Industry in Lusaka

Larry Malambo & Mr. Marvin Kabubi

MBA Generic, School Of Business, Department of Business Studies,
Information and Communication University.

ABSTRACT

This research sought to assess the impact of Zambia energy challenges and its effects on the manufacturing industry. The research further sought to ascertain whether the selected firms had resorted to the use of alternative sources of energy and their impact on productivity and profitability.

In order to achieve the objectives of the research, a case study of ten Zambia Association of Manufacturers affiliated Lusaka based firms was undertaken. The primary data was obtained by the use of self-administered questionnaires. Secondary data was sourced from ZAM, Zambia electricity supply corporation (ZESCO) and the Internet. Literature from published and unpublished work was also used to support the research. From the conceptual framework, the following proposition was developed:

From the analysis of the primary data, the research established that the current power rationing had negatively impacted on firm productivity and profitability. Productivity had reduced by a monthly average margin of 11.8% for the six firms in the food, beverage and tobacco sub-sector, 5% in the non-metallic mineral products sub-sector, 15% in the chemical, rubber and plastic products sub-sector and 30% in the paper and paper products sub-sector. Profitability had fallen by 15% in the paper and paper products sub-sector, 20% in the chemical, rubber and plastic products sub-sector, 12.6% in the food, beverage and tobacco sub-sector and 5% in the non-metallic mineral products sub-sector.

The research also established that there was a very strong positive relationship between length of load shedding and magnitude of production decline. The longer the firms were off supply, the more production decline they experienced. In order to mitigate the impact of power rationing, five firms reported that they had resorted to the use of alternative sources of energy and measures such as

standby generators and overtime. Research findings showed that the five firms experienced less decline in production. However, the use of mitigating measures resulted in the increase of production costs by an average of 8% per month in the firms in question impacting negatively on their profitability.

1 Background to the Study

1.1 Introduction

ZESCO Limited was formed in 1970 after the Zambia Electricity Supply Act was passed in Parliament. This Act brought together the electricity undertakings that were previously managed by the local authorities. The Corporation traces its origins to 1906 when a small thermal station was established in Livingstone to serve a small section of the town.

In 1994, the name of Zambia Electricity Supply Corporation Limited was changed to ZESCO Limited. This was to reflect the recommitment to providing a high quality of customer service. Shareholding The Government of the Republic of Zambia is the sole shareholder of ZESCO Limited.

The Permanent Secretaries of the Ministry of Finance and National Planning, and the Ministry of Mines, Energy and Water Development represent the Government on the Board.

ZESCO is committed to providing safe and reliable electricity to improve the quality of life for all. (www.zesco.co.zm).

ZESCO produces most of its electric power from hydro-power stations which constitutes about 99.9% of its total production and the remaining 0.1% comes from diesel power stations. Its total installed capacity is 1,669 Megawatts (MW) as indicated in table 1.1 (www.zesco.co.zm).

Lunsemfwa Hydroelectric power generation is privately owned but is in contract with ZESCO to sell the total electricity it generates to ZESCO. Although the total installed capacity is 1,669 MW, ZESCO is currently only able to produce 1,300 MW of electricity against the peak demand of 1,450 MW, thus resulting in a shortfall of 300 MW. The power utility company is only able to produce 1,300 MW of electricity due to shortage of capacity to enable it utilise the total installed capacity. ZESCO's current customer base stands at over 300,000 and rising (www.zesco.co.zm). It employs 3,900 members of staff and its annual turnover is US\$200 million with an asset base value in excess of US\$3 billion (www.zesco.co.zm).

In Lusaka, like most other places in the country, most of the electricity supplied is hydro generated and this is the major type of energy that most manufacturing firms in the country have access to. Manufacturing firms rely on electricity to drive their machinery and equipment to facilitate production and processing of their products. All the Lusaka based manufacturing firms selected for this study rely on hydro-generated electricity supplied by ZESCO. In this regard, if ZESCO fails to produce and supply adequate electricity, and institutes power rationing, some manufacturing and other firms are off supply during certain periods. When this happens, the affected firms may fail to produce. If the non-supply persists, productivity as well as profitability is likely to be affected in a given period of time.

1.2 Capacity Shortage

ZESCO's current installed capacity is 1,669 MW. However, the utility company is only able to generate 1,300 MW of electricity. The failure to utilise the full installed capacity has been attributed to lack of investment in the power generation equipment. Most equipment is old and use old technology making it more susceptible to frequent breakdowns. Further, the equipment cannot operate at full capacity because of wear and tear suffered over the years. Lack of investments in new electricity generation plants to generate additional electricity to cushion rising demand has made the situation more desperate. Ultimately, lack of capacity by ZESCO to generate enough electricity coupled with non-availability of viable alternative sources of energy, is what is responsible for the energy shortages being experienced in Zambia.

1.3 The Research Problem

As early as 2006, ZESCO's installed capacity was about 1631 MW against the total demand of 1200 MW. This gave the company a surplus capacity of 431 MW some of which was exported within the

region (www.zesco.co.za). However, by early 2007, ZESCO's generation capacity dropped to 1000 MW while demand increased to 1300 MW resulting in a shortfall of 300 MW. The generation capacity currently stands at 1,300 MW while peak demand has further increased to 1,450 MW resulting in a shortfall of 150 MW. ZESCO has further predicted that Zambia's power demand will drastically increase from the current 1,450 MW to 2,500 MW in the next five years resulting in a shortfall of 1,200 MW or 92% if the current generation capacity remains at the current levels (Chirwa and Sinyangwe, 2015).

This situation has resulted into electricity demand outstripping supply (shortage) by as much as 150 MW during peak periods. In order to cope with the shortage during peak periods, ZESCO, the major electricity power generation company in the country, has resorted to power rationing or load shedding. The other option of addressing the shortage through importation of electricity from other utilities in the region is currently not available because of electricity shortages that have hit the entire Southern African region (www.zesco.co.zm).

Zambia recorded a trade deficit valued at K1.29 Billion Kwacha in June 2015 from a trade deficit of K1.21 Billion recorded in May 2015. This study therefore, sought to establish to what extent productivity and profitability in the selected Lusaka based manufacturing firms had been affected as a result of ZESCO's power rationing.

1.4 Research Questions

The research questions to be answered were:

- Has power rationing affected (reduced) productivity in the selected firms?
- Has the reduction in productivity affected profitability in the selected firms?
- Have the selected firms put in place any measures to mitigate the impact of power rationing?
- Have the alternative sources of energy increased production costs?
- What were the long term solutions to power rationing?

1.5 Research Objectives

1.5.1 General Objectives

- To establish whether power rationing had led to a reduction in productivity and profitability in the selected firms.

1.5.2 Specific Objectives

- To assess whether power rationing had led to a reduction in productivity in the selected firms.
- To establish if the reduction in productivity had affected profitability in the selected firms.
- To verify whether the selected firms had put in place measures to mitigate the impact of power rationing.
- To ascertain whether the measures put in place to mitigate the impact of power rationing had led to increase in production costs.
- To identify the long term solutions to power rationing

1.6 Scope and Limitation of the Study

This study is restricted to electricity supply and assesses Load-shading and the impact it has had on Zambian Businesses. The study will concentrate on establishing the impact of ZESCO's power rationing on Firm productivity and profitability. The study was restricted to the following ten (10) Lusaka based ZAM affiliated manufacturing Firms:

- Kazuma Plastics Limited
- Lafarge Cement Plc
- Manzi Valley Limited
- National Milling Corporation
- Parmalat Zambia Limited
- Printech Limited
- Fresh Pikt Limited
- Zamanita Limited
- Zambian Breweries Plc and
- Batul Investments Limited

The Researcher would have desired to expand the sample size but was constrained by financial and logistical reasons. The tens firms were purposively selected from a total of thirty eighty (38) ZAM affiliated manufacturers based in Lusaka.

The research focused on manufacturing firms. Due to this limitation, findings of the study may not be used to draw conclusions on the impact of power rationing on productivity and profitability of firms in other sectors.

1.7 Significance of the Study

Four main reasons stated below justified undertaking of this study:

- The findings of the study would assist ZESCO, the Zambian Government and other stakeholders to understand the extent to which power rationing has affected firm productivity and

profitability and how this might impact on economic development.

- The study could be used to persuade the Donor Community, private investors and other financiers to fund power generation rehabilitation, maintenance and expansion programme.
- ZESCO, Government and other stakeholders will gain access to the firms' proposed long term solutions to power rationing which could be used to address the power deficit.
- The study would contribute to the body of knowledge for use by other researchers and interested parties.

Literature Review

2.1 Introduction

The increase in activity in various sectors has been largely responsible for improved economic development in a number of countries. In Zambia, the manufacturing sector contributed a total of 10.1% towards the country's total Gross Domestic Product (GDP) in 2010 (Central Statistical Office, 2010). However, the upswing in economic activity has also led to increased demand for electricity to drive production and other related processes. On the other hand, investments in new power generation plants and reinvestments in old power generation plants have not matched the increase in demand for electricity (Chirwa and Sinyangwe, 2015). As a result, most parts of the world including the entire Southern African region have been experiencing power deficits (Chirwa and Sinyangwe, 2015). The deficit in turn poses a big threat to economic activity and consequently economic development. It also poses a risk of reversing all the economic gains made thus far by negatively impacting on firm productivity and profitability. Although a practical and relatively affordable source of energy is available in the form of fossil fuels (oil), the cost of its use as an alternative may prove uneconomical and prohibitive.

2.2 Power Rationing in Zambia

2.2.1 Impact on the Manufacturing Sector

The Millers Association of Zambia (MAZ) attributed the increase in mealie meal prices around the country to the constant power outages. MAZ stated that mealie meal prices had increased across the country mainly due to the shortage of the product on the market. MAZ Vice Chairman stated that the constant power outages had negatively impacted on most Millers' capacity to produce mealie meal to meet local demand. MAZ further complained that most of the equipment for Millers

had been destroyed, reducing production further (Post Newspaper, 2015).

Zaminata Limited a subsidiary of Zambeef Products and a producer of edible oils, reported that it was losing a lot of money due to electricity power deficit. The company's Technical Director reported that three hours of power outage to the company was equivalent to losing ten hours of production due to the time it took the machinery to start working at a normal rate. This loss in production was despite the company having a back-up generator (Zambia Daily Mail Newspaper, 2015). In order to mitigate the effect of the power outage, the company was planning to invest in more generators. The loss in production had derailed the company's plans to export its products to the SADC region and the Common Market for Eastern and Southern Africa (COMESA) countries. The Chairman of Zaminata stated that the company had, through ZAM, complained to ERB the effect manufacturers were experiencing due to power failure. The Chairman noted that the effect could lead to manufacturing companies closing up because they were losing huge amounts of money (Zambia Daily Mail Newspaper, 2015).

Zaminata Limited also reported that it had lost over K1 billion in a period of two months since the beginning of January 2008 due to frequent power outages. Management of the company noted that a number of companies could fold if no solution was found to mitigate the negative impact of power shortages on the manufacturing sector. The company Technical Director reiterated the company's plans to invest in diesel powered generators to supplement electricity provided by ZESCO (Zambia Daily Mail Newspaper, 2015).

In their complaint to ZAM on losses due to load shedding, Kachema Meat Supplies reported that due to its reliance on generators due to erratic power supply, the company was using as much as K300, 000 worth of diesel on a daily basis pushing its production costs to high proportions. The company further reported that it had suffered losses on products that were in the production process but could not be completed due to power interruptions. The company's maintenance costs had risen by K2 million in one given month due to damages caused by power interruptions.

The company reported that load shedding had put extra pressure on production management as it could not run its large cookers on generators. It stated that in order, to maintain meet its targeted production, it had resorted to the use of over time which was in turn increasing production costs and

stressing its employees (Complaint to ZAM by Kachema Meat Supplies, 2008).

Research Methodology

4.1 Research Design

A survey of ten ZAM affiliated manufacturing firms was conducted. The survey was conducted by the use of a self-administered questionnaire which contained closed and open ended questions.

4.2 Research Population

The study focused on ten ZAM affiliated manufacturing firms based in Lusaka.

4.3 Sampling Design

In order to choose a sample from a population of 38 Lusaka based firms, a non-probability purposive sampling approach was used, in particular, the Judgement sampling technique.

4.4 Sample Size

From a population of 38 Lusaka based ZAM affiliated firms, 10 firms from 4 different manufacturing sub-sectors were purposively selected for this study as follows:

The Researcher would have desired to expand the sample size and depth but was constrained by financial and logistical reasons. However, the sample size was representative enough to make inferences about the impact of power rationing on firm productivity and profitability in the manufacturing sector.

4.5 Types and Sources of Data

In order to achieve the objectives of the research, two types of data, i.e., primary and secondary were collected and used in this research.

4.5.1 Primary Data

Primary data was collected using a self-administered questionnaire .

4.5.2 Secondary Data

Secondary data was sourced from ZAM, ZESCO and the internet. Literature from published and unpublished work were used to support the research.

4.6 Data Analysis

The data collected was both qualitative and quantitative. Due to the relatively small sample size, the data collected was be non-voluminous. Therefore, the analysis was undertaken manually.

CHAPTER 5 Data Analysis

5.1 Impact of Load Shedding on Production

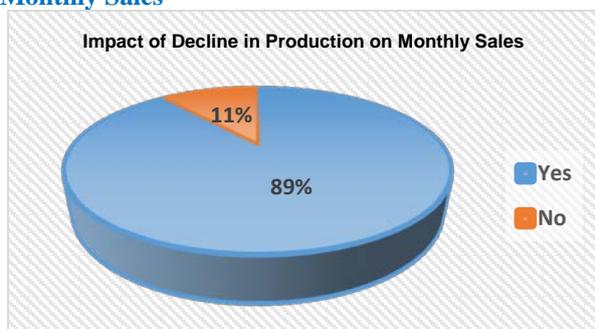
All the nine firms that responded to the questionnaire stated that load shedding had led to a reduction in their production.

The selected firms relied on electricity to operate their production machinery. When they were off supply, their equipment did not run and therefore they could not produce. Sustained lack of electricity eventually resulted into reduced production

5.2 Impact of Decline in Production on Monthly Sales Volume

Eight of the nine firms indicated that the decline in monthly production had subsequently resulted into reduced monthly sales volume as shown in figure 5.2.

Figure 5.2: Impact of Decline in Production on Monthly Sales



Source: Author (2015)

5.3 Impact on Monthly Profits

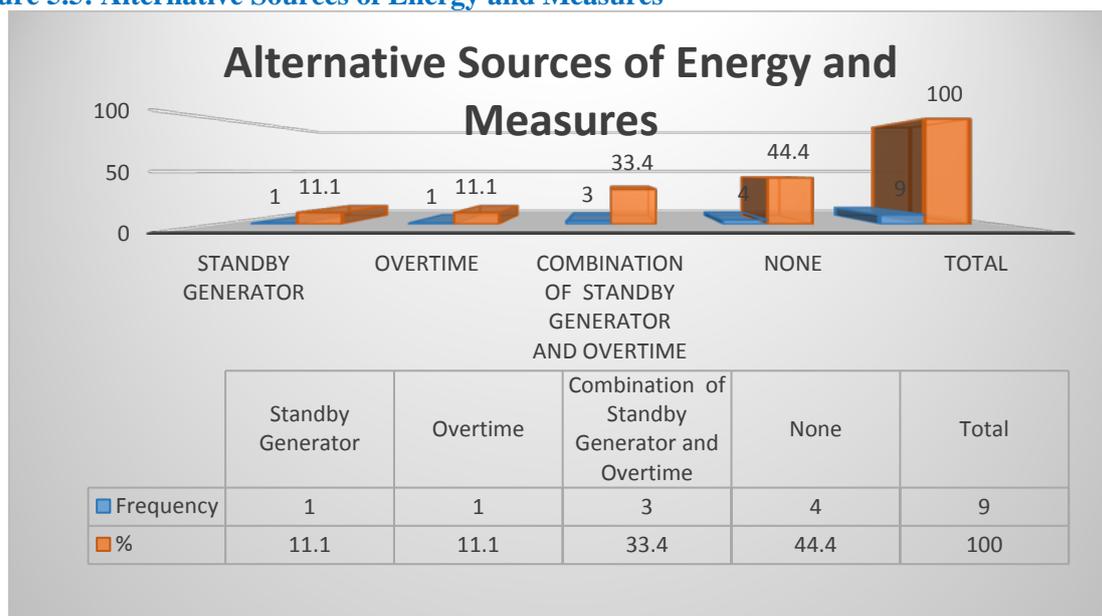
All the nine firms reported that they had suffered a decline in monthly profits. This number included the firm that did not suffer a drop in monthly sales. Therefore, the decline in profits for the firm in question was attributed to an increase in production costs by 15% per month.

5.4 Magnitude by which Profits had declined in the Sub-sectors per Month

The firm in the paper and paper products sub-sector experienced a decline of 15% in monthly profits. A decline in monthly profits of 20% was recorded in the chemical, rubber and plastic sub-sector, while the non-metallic products recorded a decline of 5%. The six firms in the food, beverage and tobacco sub-sector recorded an average of 12.6% reduction in monthly profits.

5.5 Alternative Sources of Energy and Measures to Mitigate Load Shedding

Figure 5.5: Alternative Sources of Energy and Measures



Source: Author (2015)

Research Findings and Discussion of Results

6.1 Firm Productivity

The analysis on the impact of load shedding on productivity established that whenever load shedding is effected, firm productivity declines. The analysis also established that the longer firms were off supply, the higher was the decline in production irrespective of the sub-sector the firm belonged to.

6.2 Firm Profitability

It was established that reduced productivity resulted in the failure of firms to achieve their monthly sales volume targets resulting in a reduction of monthly profits in all the firms. Therefore, the analysis confirmed that load shedding had led to a decline in profits in the selected firms.

Firms that used alternative sources of energy such as standby generators, and measures such as the use of overtime, to mitigate the impact of load shedding on their productivity reported that production costs increased thus impacting negatively on their profitability. This was expected considering the high fuel costs which at the time of the study was US\$150 per barrel on the world market and about K7, 000 per litre on the local market.

6.3 Overall Equipment Effectiveness (OEE)

Load shedding resulted in reduced overall Equipment Effectiveness (OEE) by almost 150% when compared to world class standard OEE. This implies that when firms were off supply during load shedding, their OEE was tremendously reduced. The low availability rate accounted for most of the resultant low OEE.

6.4 Firm Welfare

Load shedding had a negative impact on firm welfare. This was evidenced by the failure by some firms to pay suppliers and freezing of employment of new staff. Other negative impacts of load shedding included damage to some machinery and reduction of taxes remitted to ZRA due to reduced profits.

6.5 Research Problem

The research problem formulated was as follows; in the last decade the demand for electricity has sharply increased while electricity generation capacity has remained fairly steady. This situation has resulted into electricity demand outstripping supply (shortage) by as much as 150 MW during peak periods. In order to cope with the shortage

during peak periods, ZESCO, the largest electricity power generation company in the country, has resorted to power rationing or load shedding. The option of addressing the shortage through importation of electricity from other utilities in the region is currently not feasible because of electricity shortages that have hit the entire Southern Africa region.

Being the only viable available (currently) source of energy, hydro-electric energy remains the most preferred energy source for most firms. However, power rationing implies non availability of power at certain times. This in turn, means that manufacturing firms whose machinery depend on electricity to run, cannot produce anything during the times they are off supply. This study therefore, sought to establish to what extent productivity and profitability in the selected firms had been affected as a result of ZESCO's power rationing.

6.6 Possible Solutions to the Research Problem

The research established that possible short term solutions to the research problem included:

- (i) Strict adherence to load shedding schedules by ZESCO. Although ZESCO publicizes load shedding schedules, it has also stated that, it is not possible to adhere to them because electricity consumption was not constant but varied from time to time.
- (ii) Exclusion of manufacturing firms from load shedding at the expense of other consumers. This option entails increasing load shedding to other consumers such as domestic houses.

The research also established that long term solutions to load shedding included:

- (i) Increased investments in electricity generation by ZESCO. ZESCO should not only concentrate on maintaining the current power generation infrastructure but should also explore building of new infrastructure to increase its installed capacity and consequently the amount of power generated.
- (ii) Government should not only open up electricity generation to private companies but put in place legislations and mechanisms such as Government-Private partnerships that support easy implementation of electricity generation programmes.

- (iii) ZESCO should continue with its programmes of maintaining electricity generation equipment to enhance the equipment's optimal operation and avoid making the situation worse.

6.7 Research Questions

The research questions to be answered were as follows:

- Has power rationing affected (reduced) productivity in the selected firms?
- Has the reduction in productivity affected profitability in the selected firms?
- Have the selected firms put in place any measures to mitigate the impact of power rationing?
- Have the alternative sources of energy increased production costs?
- What were the long term solutions to power rationing?

6.8 Answers to the Research Questions

The research findings confirmed that load shedding had led to a reduction in productivity in the selected firms. The findings further revealed that reduced productivity had ultimately led to a reduction in profits. The decline in profits emanated from the failure by firms to meet targeted sales volume as a result of a drop in production and the increase in production costs as a result of using alternative sources of energy and measure to mitigate the impact of load shedding.

The research findings also revealed that five out of nine firms stated that they were forced to resort to the use of alternative sources of energy such as standby generators and other measures such as the use of overtime to minimise a further drop in production. This was evidenced by relatively lower declines in monthly production which ranged from 5% to 15% compared to firms that did use any alternative measures which recorded declines in production ranging from 6% to 30%.

The use of alternative sources of energy and measures led to an increase in production costs by an average of 15% per month impacting negatively on profitability.

Further research findings established that, long term solutions to power rationing included a combination of increased investments in electricity generation by ZESCO and opening up electricity generation to private companies. Firms thought

increased investment in electricity generation was a long term solution to electricity deficit because it implied opening up newer electricity generation plants resulting into more electricity generation and consequently elimination of electricity deficit.

None of the firms thought that privatization of ZESCO and increasing electricity tariffs to generate more revenue for ZESCO were long term solutions to the power deficit. This is because the two options implied increased tariffs which could lead to an increase in the firms' production costs.

6.9 Addressing the Electricity Deficit

Despite the desperate electricity situation currently prevailing in the country not all is lost. A personal interview with the Director of Customer Service at the time of the research revealed that ZESCO was carrying out rehabilitation and up-rating works on all its major generation and transmission plants. Once the rehabilitation works and up-rating of ZESCO's major equipment is completed, the power utility company will increase its generation capacity from the current 1,300 MW to 1,830 by the first quarter of 2009 and from 1,830 MW to 2,013 by the year 2013.

However, ZESCO has predicted that Zambia's power demand will drastically increase from the current 1,450 MW to 2,500 MW in the next five years. By that time ZESCO expects to have increased its generation capacity to 2,013 MW. If the predictions are correct, Zambia will still experience a shortfall of 487 MW. If other countries in the region will not have boosted their electricity generation capacity to levels where they will be able to export some of their electricity to countries like Zambia, the resultant shortage will have unpleasant consequences on firms and the economy.

The impact of electricity shortages should not be taken lightly. The harm that may be caused to firms and the economy could take a very long time to reverse.

CHAPTER 7

Research Conclusions and Recommendations

From the findings of the research the following conclusions have been drawn:

7.1 Conclusions

- The current electricity deficit of about 150 MW is harming the operations of manufacturing firms. Power rationing embarked on by ZESCO to manage the deficit had led to a decline in both

productivity and profitability in all the selected firms. The impact of load shedding was the same across sub-sectors but the decline in productivity depended on the length of load shedding experienced by the firm. The longer the duration of load shedding, the higher was the decline in production.

- Power rationing has also had a very negative impact on firm welfare resulting in their failure to meet some of their financial obligations such as payment of suppliers, freezing of employment of new staff and damage to some equipment.
- In order to mitigate the impact of load shedding, firms were forced to resort to the use of alternative sources of energy such as diesel run generators and measures such as the use of overtime. However, these alternatives led to an increase in production costs which in turn impacted negatively on firm profitability.
- ZESCO is faced with a daunting task to generate enough electricity to satisfy the ever increasing demand. However, the electricity deficit can still be managed to mitigate the impact of the shortage. It has been established that ZESCO's failure to adhere to load shedding schedules has worsened the situation because firms are not able to plan for power outages. Therefore, as a short term solution to the deficit, ZESCO should endeavour to adhere to its load shedding schedules. This will enable firms to plan their production and avoid costs associated with unanticipated disruptions in production such as wasted raw materials already in the production process which cannot be salvaged. Adhering to load shedding schedules is a short term solution to the deficit. For a long term solution, Government and ZESCO should increase investments in electricity generation by not only concentrating on maintaining the current power generation infrastructure but should also explore building of new infrastructure to increase its installed capacity and consequently the amount of power generated.

7.2 Recommendations

Short term solutions to load shedding include:

- ZESCO should strictly adhere to load shedding schedules. This will enable firms to plan their production.

- ZESCO should exclude manufacturing firms from load shedding at the expense of other consumers. This option entails increasing load shedding to other consumers such as domestic houses.
- ZESCO should intensify its power saving campaigns. The research established that none of the nine firms had put in place any electricity saving measures.

Long term solutions to load shedding include:

- ZESCO should increase investments in electricity generation. ZESCO should not only concentrate on maintaining the current power generation infrastructure but should also explore building of new infrastructure to increase its installed capacity and consequently the amount of power generated.
- Government should not only open up electricity generation to private companies but put in place legislations and mechanisms such as Government-Private partnerships that support easy implementation of electricity generation programmes.
- ZESCO should exploit Zambia's vast hydro-electric potential to generate more electricity. The extra electricity generated can be exported to southern African countries that are also facing electricity shortages. This initiative will not only address Zambia's electricity deficit but will also earn ZESCO the much needed revenue for its operational needs.

Bibliography

1. www.zesco.co.zm, 2015
2. Sisala, R. (2015): ZESCO Corporate Newsletter, 1st Edition. Lusaka.
3. Chirwa, J. and Sinyangwe, C. (2015): *Geostrategy: A Window of the World*. Lusaka.
4. Central Statistical Office. (2009): *The Monthly*. Lusaka. Volume 70.
5. Jayalath, M.S. and Wijayatunga, B.P. (2004): *Energy Conversion and Management*. Sri Lanka. Volume 45.
6. United Nations. (2008): *2007 United Nations Office of the Coordination of Humanitarian Affairs Report*. New York.
7. Cecilia, P. (2015): *The Potential Impact of Productivity Losses as a result of Electricity shortages in South Africa*. Cape Town. Volume 5.
8. www.miningweekly.com, 2015
9. Daily Mail Newspaper, 17th June 2015.

10. IMF Country Report No. 08/29. (2008): Zambia: Selected Issues. Washington DC.
11. Chisela, M. (2008): Paper presented to the KPLC Delegation Workshop. Kafue Gorge Regional Training Centre, Lusaka.
12. www.mineweb.com, 2015
13. African Economic Outlook. (2008): 2007/2008 ADB Country Study Report. Addis Ababa.
14. Post Newspaper Limited. (2015): The Post Newspaper, 15th June 2015. Lusaka.
15. Maliti, B. (2008): Research Methods (unpublished). Copperbelt University: Kitwe.
16. www.oeo.com, 2015
17. www.eia.doe.gov, 2015.
18. www.instalblog.com, 2015