A COMPARATIVE COST ASSESSMENT OF ELECTRICITY OUTAGES AND GENERATION EXPANSION IN ZIMBABWE

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Abstract: *The study assesses the sectorial cost of electricity outages and cost of expanding own generation to avert outages in Zimbabwe. The main sectors used were agriculture, mining, industry and households. These sectors lost significantly due to electricity outages. The cost has been assessed on the basis of direct and indirect cost. Sector surveys were carried out. Questionnaires were used as the main research instruments. Results revealed that households were exposed to more outages and other sectors were priorities. Mining reported the highest both direct and indirect outage cost per mine and in total industrial sector reported the highest. For the overall sector cost, industry reported the highest cost and households the least. Total outage cost for one year represents a quarter of total expansion cost required to avert the problem. The study concluded that expansion is a must to avoid electricity outages. The study recommends large scale expansion in generation.*

Key Words: *Cost of Electricity outages, Direct cost, Indirect Cost, Generation Expansion Capacity, load Shedding, Price Differentials.*

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1 INTRODUCTION

There are large differences between the distribution of electricity usage and that of value added over the various economic sectors and households (de Nooij *et al.* 2006). Electricity interruption in manufacturing plants, commercial service firms, mines, farms or households has different consequences for each sector (Mbohwa 2002). The losses incurred due to the disruptions can be regarded as an invisible tariff that the farms, mines, firms and households have to pay. This study compares costs incurred by four sectors (mining, agriculture, industry and households) of the Zimbabwean economy due to power outages in order to derive a national outage cost figure, thereby showing the scale of economic cost wastage in Zimbabwe due to under-investment in power generation. The study also estimates the cost of averting power outages through expansion in the current national generation and calculates the percentage national outage cost of the total averting cost. It is estimated that an investment of US$260 million has been invested by individuals and companies, generating an average of 300MW per annum. The averting public utility investment cost not only generates the benefit of saving the outage cost, but also the total willingness to pay benefit. The percentage outage cost make-up of this benefit includes the waste cost being incurred in Zimbabwe by insufficient investment in power generation and management.

1.1 Background

There is only one producer and seller of electricity, namely the Zimbabwe Electricity Supply Authority (ZESA). For about 50 years the industry operated as a regulated monopoly (Mangwengwende 2005:5; World Bank 2008). The public monopoly operates under difficult circumstances (Mangwengwende 2005:2): power generation limitation, declining investment and aging hydro and thermal plants. Of the installed capacity (ZESA 2009):

- 25% is over 45 years old (Kariba Hydro-power Station).
- 50% is over 20 years old (Hwange and Bulawayo Thermal Power Stations)
- 25% is over 25 years old. (Harare and Munyati Thermal Power Stations)

Most of the generators are in need of rehabilitation.

Zimbabwe's electricity generation, transmission and distribution are handled by ZESA, a government parastatal under the Ministry of Energy and Power Development (MEPD).

The generation capacity available from the potential (installed) capacity for the years 2000 and 2009 is shown in Table 1. In 2009, the sources accounted for 52% thermal and 48% hydro as some of the coal fired plants were not generating as they were decommissioned.

Table 1: Power Generation Capacity in Zimbabwe: 2000 and 2009

Station Name	Plant type	Nameplate capacity(MW)	Available Capacity (MW) by 2000	Available Capacity (MW) by 2009
Hwange	Coal-fired	920	800	560
Kariba	Hydro-electric	720	470	420
Harare	Coal –fired	135	60	0
Bulawayo	Coal-fired	120	90	0
Munyati	Coal-fired	150	60	0
Total		**1975**	**1480**	**1080**

Sources: ZESA(2000); ZESA(2009) and UNDP (2009)

Zimbabwe also imports electricity from other countries. Zimbabwe was importing 40% of its electricity requirements in 2005 (ZESA 2009), but imports dropped dramatically after that.

The generation of electricity in 2009 was at 55% of the potential capacity (ZPC 2009). To meet local demand the rest had to be imported (ZESA 2009). Total electricity supply fell well below demand. To manage the load, the power utility provider (ZESA) resorted to planned and unplanned load shedding. The supply of electricity in Zimbabwe depends on weather conditions because the latter affects water levels for electricity generation at the Kariba Hydro Power Station (HPS) and reliability of coal supply to Hwange thermal power station (TPS). The latter consumes about 6 000 to 9 000 tonnes of coal per day (ZESA 2009).

The causes of outages are mainly load shedding due to limited supply. The power utility, ZESA, switches-off some load in order to balance supply and demand in the event of loss of internal generation or power imports. Outages are experienced during peak hours. ZESA has to balance power during peak, standard and off-peak hours of a day and these are shown in Table 1.9.

Table 2: The Time of Use Periods

	Hour																							
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
S/H[a]	O	O	O	O	O	O	O	S	S	S	S	S	S	S	S	s	S	P	P	p	S	S	O	O
WD[b]	O	O	O	O	O	O	O	P	P	P	P	P	S	S	S	s	S	P	P	p	P	S	O	O
Sa[c]	O	O	O	O	O	O	O	P	P	P	P	S	S	S	S	s	S	P	P	P	S	S	O	O

[a]S/H –Sunday or Holiday; [b]WD- Week Day; [c]Sa- Saturdayp-Peak time; s-Standard time; o-Off-peak

Source: ZESA (2009)

The different times and patterns of use translates to the daily load curve. Load shedding times are required when supply falls below demand, namely when there is peak demand.

All the productive sectors and households are negatively affected by unreliable electricity supply (Mayo 2004; Zimmerman, Lave, Restrepo, Dooskin, Hartwell, Miller, Remington, Simonoff, & Schussler 2005) and Zimbabwe's producers and consumers experience very high levels of electricity unreliability (Mangwengwende 2005:1). In 2008 and 2009, most industries were operating below capacity as a result of power outages and other problems (Confederation of Zimbabwe Industries (CZI) 2009). Firms were forced to invest in generators as a back-up source of power, although they too have proved to be unreliable because of shortages of fuel (*ibid*). The result was a substantial contraction in work time and multiple contractions in the demand for other factors used in the production of electricity and production in the productive sectors. Electricity consumers responded to unreliable electricity supply through choice of location, factor substitution, private provision, choice of business and output reduction.

2. LITERATURE REVIEW

For many developing countries unreliable supply of electricity is the norm rather than the exception (Jyoti, Ozbafli & Jenkins 2006:1). Electricity power problems are not unique to Zimbabwe alone. Most countries in SADC region and Africa as a continent were experiencing power outages during the period 2008 to 2010. Unreliable electricity supply is a serious problem because electricity is irreplaceable for the sustainable development of a country, as it laterally drives the economy (Eto, Divan & Brumsickle 2004:1). It is a powerful tool for uplifting people's livelihoods (Rose, Oladosou & Salvino 2004).

Power outage costs can be classified as direct or indirect costs (Munasinghe 1979). Direct costs are those which occur during or following an outage, while indirect costs are those which result because an outage is expected and people take mitigating actions (*ibid*). This identification of costs by Munasinghe (1979) forms the basis of the approach taken in this research. There are two cost estimates – direct or welfare cost and indirect cost (mitigating or captive generation cost).

The direct or welfare cost is mainly estimated using the direct assessment method. Survey questionnaires were administered to ascertain the cost of power outages or a reduction in its quality as perceived by consumers (Munasinghe & Gellerson 1979). The method uses the value of production loss or utility loss for each unit of power outage. The lost production or time in each sector during an outage can be estimated directly from this feedback and aggregated to a total. The approach provides a first estimate of the cost of power outages.

The indirect cost (backup cost or mitigating/generation cost) is estimated from the actions taken by consumers to mitigate outages by acquiring generators or captive power units and diesel pumps (Klytchnikova & Lockshin 2007:1). This method of estimation is based on observed market behaviour, e.g. of consumer expenditures on generators and use of interruptible contracts (Caves, Harriges & Windle 1992). The backup cost was estimated using the captive generation method; a method that estimates the cost that customers incur to ensure a reliable power supply. The captive generation method is widely acknowledged to be a reliable second way of estimating the cost of power outages (Adenikinju, 2005).

Power outage cost can also be incurred beyond outage time, as operations cannot be restarted instantaneously (Rose *et al.* 2004:2). Household outage costs are often intangible (Carlsson & Martinsson 2004:1). Households described their costs in terms of the hassle or inconvenience of outage, rather than in terms of specific labour or material costs (Rose *et al*. 2004:2). In addition, costs are incurred in trying to reduce potential losses, through the purchase of backup generators, permanent changes in production schedule and capacity utilisation (Munasinghe & Gellerson 1979).

To evaluate an outage cost requires a good understanding of the customer's damages when an outage has occurred. The losses incurred due to disruptions can be regarded as an invisible tariff that the customers of the utility have to pay (Carlsson & Martinsson 2004:2). Even in the best of systems, it is difficult to estimate the cost of unserved (COU) electricity to different categories of consumers, due to the challenge of dealing with common cost allocations (Lawton *et al.* 2003:4).

3. METHODOLOGY

The researcher carry out a survey off all sectors regarding the outages they are experiencing and the cost they are incurring as a result of outages. Simple random sampling was carried out in each sector with sample sizes of 168 for mines, 272 for industrial sector, 305 agriculture and 400 households. Questionnaires were the main research instruments used in the study.

4. FINDINGS

4.1 Outage Severity

The sectors were asked about the severity of outages during 2009 and the information shown in Figures 1, 2, and 3 reveals the crisis of electricity supply.

Figure 1: Frequency of weekly outages incidences experienced by sectors

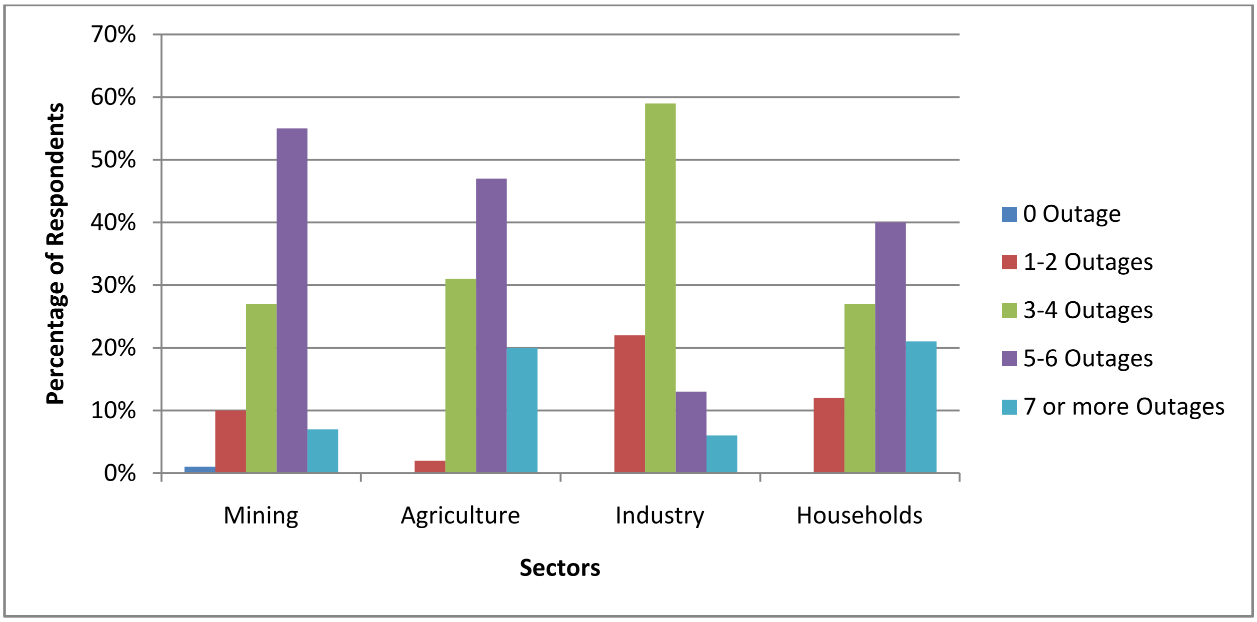
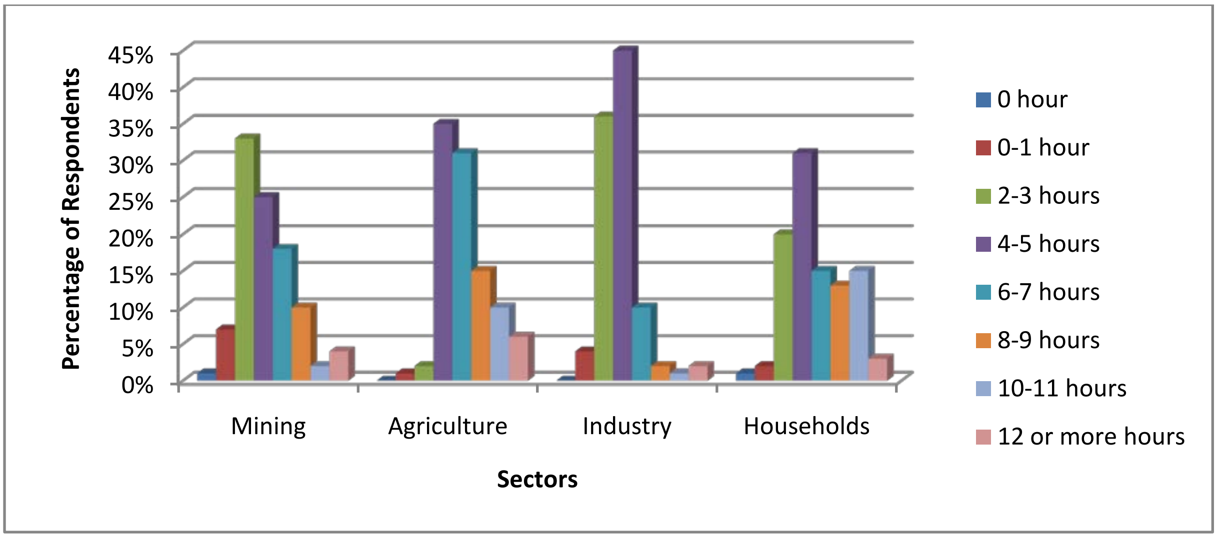


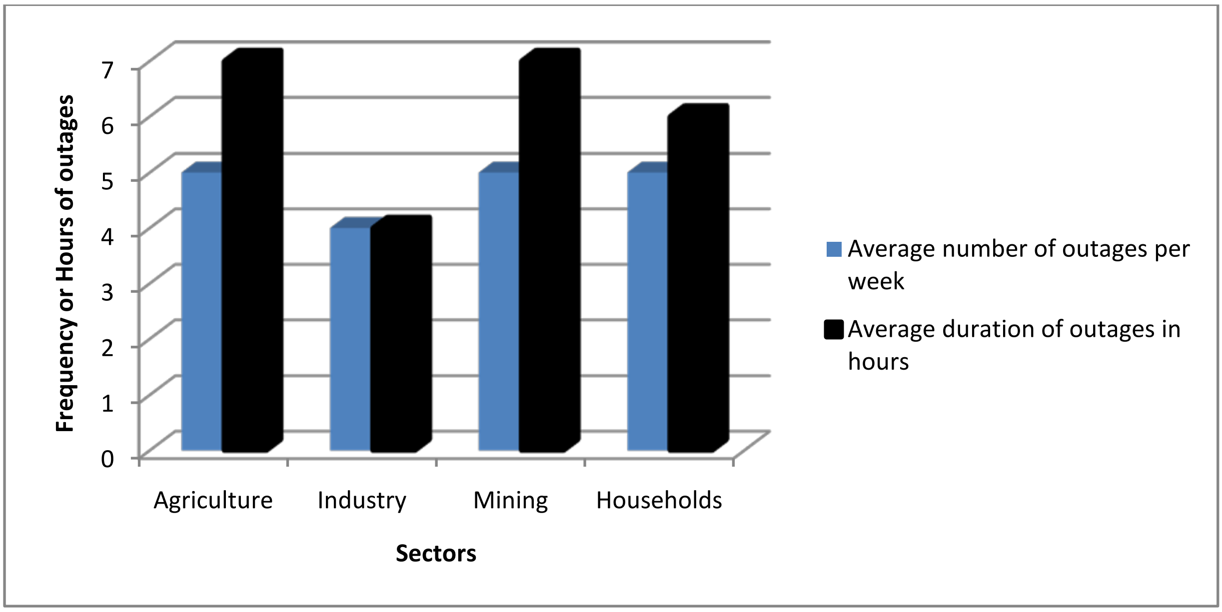
Figure 1 shows that households reported the highest proportion on 7 or more outages incidences per week, followed by mining, agriculture and industry. This reflects ZESA priorities – households are the lowest priority and are the first to be load shedded.

Figure 2: Average duration of outage incidences experienced by sectors (in hours)



The agricultural sector reported the highest inrespect of the longest duration of outages (12 or more hours per outage incident), closely followed by mining and industry which reported the least hours (Figure 2).

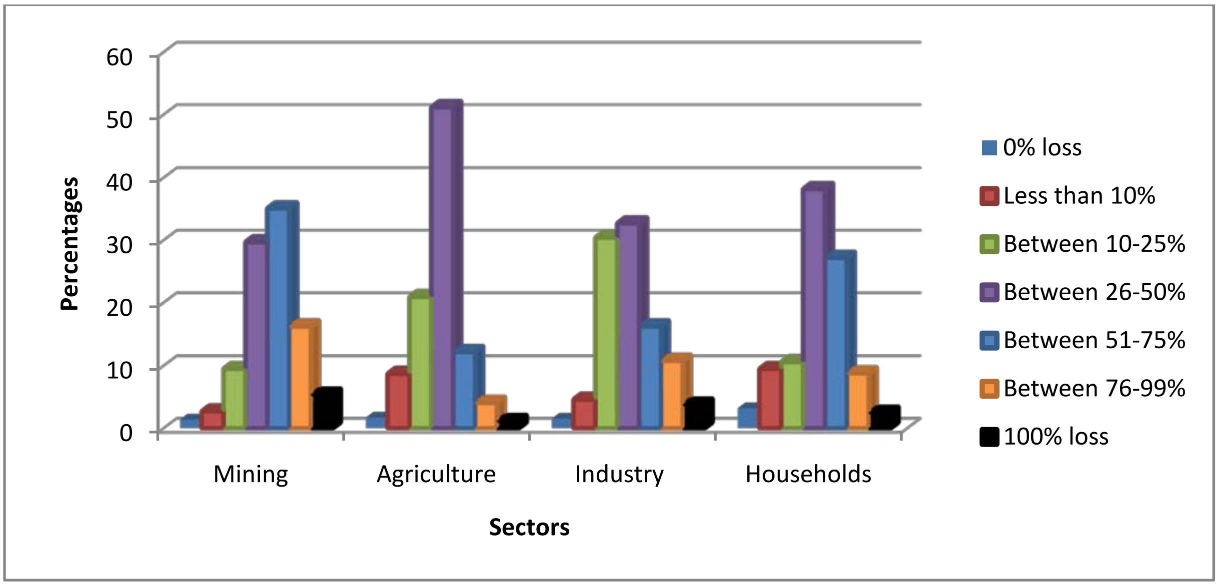
Figure 3: Average frequency and duration of outages experienced by sectors per week



Agriculture, mining and households reported an average of 5 outage incidences and the industrial sector reported the least, namely 4 outage incidences per week (Figure, 3).The agriculture and mining sectors were exposed to the highest durations per outage incident and the industrial sector the least.

The proportionate loss caused by electricity outages are shown in Figure 4.

Figure 4: Average proportion of total output/service loss due to power outages



All the sectors reported high proportions of total output loss but mining reported the highest.

4.1.1 Ranking of electricity service problem by sectors

A comparative ranking of the electricity infrastructure limitation on economic activity by sector is shown in Table 3.

Table 3: Ranking of electricity services by sectors (percentage)

Sector	Major Obstacle	Moderate Obstacle	No Obstacle
Agriculture	74.9	23.4	1.7
Industry	67.3	29.2	3.5
Mining	87.8	8.1	4.1
Households	72.1	23.4	4.6

All were negatively impacted on but the mining sector was found to be worst affected.

Table 4: Summary of descriptive statistics

Item	Agriculture	Industry	Mining	Households
Average Total Number of outages (Year)	265	180	232	240
Average Total Outage hours (Year)	2152	1608	1080	2186
Average Electricity expenditure (US$)	27655	415331	104558	139
Average kWh consumed from the grid (Year)	19753	296669	174682	1401
Average Hours electricity available from the grid	3849	4407	6599	7173
Average Total kWh lost (Year)	4858	694747	69761	1550

The highest numbers of average total outages were reported in the agricultural sector and least in the industrial sector. The sectors incurring the highest costs due to outages were industry and mining.

4.2. Summing Direct Cost

The direct cost estimations were done by estimating the value of lost output, labour cost, material cost, other additional cost (restart cost, damage to equipment and repair and maintenance cost) for mining, agriculture and industry sectors and using lost food and cost of damage and replacement of household appliances for households.

4.2.1 Outage cost by type of cost for sectors

Table 5 reports the direct cost by type using the mean values from the surveyed respondents in all sectors.

Table 5: Direct outage cost for sectors by type (US$)

Cost Type	Agriculture	Industry	Mining	Households
Lost output/food stuffs	5258	20521	219059	34.93
Labour cost	431	1304	22745	-
Destruction of material (stocks)	637	4343	1816	9.10
Restart costs/emergency cost	110	616	5313	18.19
Damage to equipment	240	213	6156	23.29
Total	**6677**	**26997**	**255089**	**86.21**

Lost output or food stuffs made up the greatest proportion of the direct cost component. The highest average total direct cost was incurred in the mining sector and lowest cost in the household sector.

The total outage cost for all sectors is calculated in Table 6.

Table 6: Total direct cost for the sectors (US$)

Sector	Total Direct Cost (US$)
Agriculture	52116305
Industry	747281135
Mining	249736248
Households	32448700
Total	**1081582388**

It is concluded that outages directly cost the Zimbabwean economy about US$1.08 billion in 2009. This estimate does not include indirect impact even though aspects such as political instability induced the outage problem.

4.3 Indirect Cost Sector Comparison

The backup equipment used for the cost estimation was generators owned and used by respondents during outages.

4.3.1 Investment in backup equipment by sectors

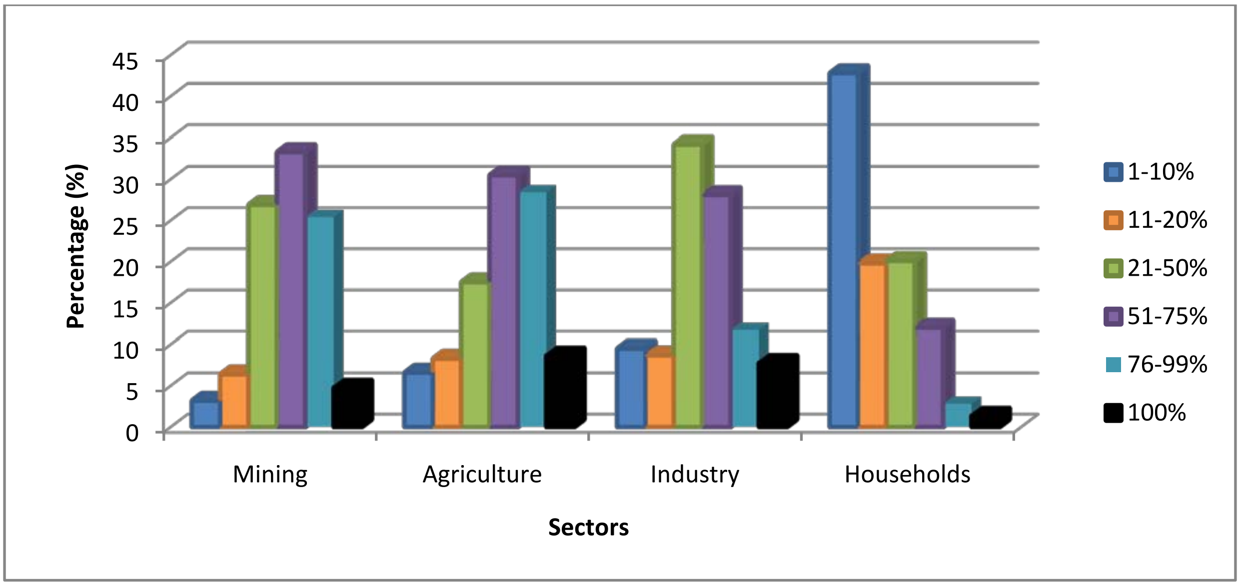
Respondents from all sectors reported additional investment in backup equipment to mitigate against the unreliability of ZESA supplies. It is a significantly high additional cost to mines, farms, firms and households in acquiring and running the backup equipment (generators) because this power can be produced much cheaper by the public utility company (ZESA). The average cost, capacity and period in use of generators for each sector is shown in Table 7.

Table 7: Descriptive information for the generators owned by sectors

Consideration	Agriculture	Industry	Mining	Households
Cost (US$)	25387	64382	120727	420
Capacity (kVa)	75	120	135	8
Period in Use (Years)	4	4	5	3

Of all the sectors, mining incurred the highest average value of cost of investing in generators and households, the lowest. As would be expected, mines also reported the highest average generator capacity (kVa) and households, the least. Mines require high power voltage for their operations and the costs of them being without power are very serious (trapped miners underground).

Figure 5: Proportion of sector operations/activities powered by backup equipment



Of all the sectors, the highest proportional operations were covered by investment in backup equipment in agriculture.

4.3.2 Cost structure of own generations by sectors

The mean cost structure of running own backup equipment by the sectors in terms of capital cost and operating cost items is summarised in Table 8.

Table 8: Mean cost structure of own generation by sectors in terms of cost items (US$)

Consideration	Mining	Agriculture	Industry	Households
Capital Item	**US$**	**US$**	**US$**	**US$**
Generator cost (US$)	120727	25387	64382	420
Installation cost (transport, house, oil & fuel tank)	1170	942	840	22
Total Capital cost	**121897**	**26329**	**65222**	**442**
Running Cost Item				
Fuel, oil and grease cost	28807	17590	15642	290
Labour cost (wages and salaries)	1165	1159	1745	-
Maintenance cost	1424	1551	1217	90
Total Running Cost	**31396**	**20300**	**18604**	**380**

Of all the sectors, mining reported the highest total capital investment cost, followed by industry; households were the lowest. The mining sector also incurred the highest running cost, followed by agriculture. Households incurred the lowest.

Table 9: Average per kWh and total indirect cost by sectors

Sector	Cost per kWh lost (US$)	Total indirect cost (US$)
Agriculture	1.64	32224459
Industry	5.15	432237491
Mining	6.20	162107136
Households	0.30	20693766
TOTAL		**647262852**

As would be expected, the mining sector reported the highest total indirect cost per kWh (US$6.20) and the households sector reported the lowest cost per kWh (US$0.30) lost. The industrial sector reported the highest total indirect cost (US$432 237 491) and households the least (US$20 693 766). Summing the backup costs shows that the country incurred almost US$0.65 billion in 2009 due to this category of outage cost.

4.4 Total Outage Cost Sectoral Comparison

The total outage cost was obtained by summing direct cost and indirect cost (Table 10).

Table 10: Total outage cost by sectors

Sector	Direct Cost (US$)	Total indirect cost (US$)	Total outage cost (US$)
Agriculture	52116305	32224459	84340764
Industry	747281135	432237491	1179518626
Mining	249736248	162107136	411843384
Households	32448700	20693766	53142466
TOTAL	**1083656982**	**628638452**	**1712295434**

The industrial sector reported the highest total outage cost and households the lowest. The country incurred about US$1.8 billion in 2009 due to outages; almost 33% as a proportion of GDP (US$1.8 billion/US$5.4 billion); where the GDP for Zimbabwe was US$5.4 billion in 2009.

Outage cost impact for the sectors was assessed using the GDP of about US$5.4 billion for 2009 (RBZ 2010). The results are shown in Table 11.

Table 11: Total outage cost impact on GDP for the sectors (percentage)

Sector	Total Outage Cost Impact on GDP Assessment (%)
Agriculture	1.6
Industry	22.1
Mining	7.7
Households	1.24
All Sectors	**32.64**

The industrial sector reported the highest total outage cost impact as a percentage of GDP and households the lowest.

5. COST OF EXPANDING OWN GENERATION

5.1 Cost of Expanding Own Generation Capacity

The reason why the cost of expanding own generation capacity is incurred is because of the failure to increase generating capacity and management thereof in order to meet demand. Large scale investment in electricity generation requires a lot of capital. The power utility engineers estimated the cost of improving the current generators and output in order to more than meet demand would be as shown in Tables 12 and 13 (see also The Electrical Energy Development Plan, 2000). With this capacity Zimbabwe could even become a net exporter of electricity.

Table 12: Cost of improving existing national generating plants

Power Generators	Number of Units	Size (MW)	Total Generation Expected (MW)	Total Improving cost (US$)
Hwange phase 1	4	120	480	45000000
Hwange phase 2	2	220	440	30000000
Kariba	3	240	720	36000000
Bulawayo phase1	2	15	30	2200000
Bulawayo phase2	3	30	90	8000000
Munyati phase1	2	10	20	2000000
Munyati phase2	5	20	100	10000000
Harare phase1	2	7.5	15	1200000
Harare phase2 a	2	10	20	1500000
Harare phase2 b	2	20	40	3000000
Harare phase3	2	30	60	5000000
TOTAL	**30**		**2015**	**143900000**

Table 13: Capital cost of constructing new generating units/plants

Power Generators	Number of Units	Size (MW)	Total Generation Expected (MW)	Total Improving cost (US$)
Hwange unit7	1	150	150	225000000
Hwange Unit8	1	150	150	225000000
Batoka	4	200	800	1200000000
Kariba South Extension	2	150	300	450000000
Gokwe North	3	320	960	2500000000
Lupane Gas Turbine	2	150	300	500000000
TOTAL			**2660**	**5100000000**

In addition, about US$450 million is required to restructure the transmission (transmission and distribution lines and transformers). The total capital cost required is about US$5.7 billion (143.9 million + 5100 million + 450 million). The average life span of each new plant is about 40 to 50 years.

Zimbabwe does not need all the suggested generating units to be in place at the moment to solve its current power outage problems. The country currently only needs an additional generation capacity of 950MW; a shortfall that can be met through extension of existing generating units (Hwange Thermal Power Station units 7 and 8 are capable of generating 300MW and Kariba Hydro Power Station extension is capable of generating 300MW) and two units of the four possible Hydro Power Plant units at Batoka generating 400MW (200MW each). Such an expansion would only require ZESA to finance about US$1.5billion additional investment, less than that lost in outage cost in the year 2009.

5.1.1 The Cost of financing capital investment in own generation

The financing of own power generation projects will require funding from either the domestic market or international development banking institutions. Such projects cannot be funded by short term sources. There is a finance gap for power utilities' long term capital project in Zimbabwe. Table 14 shows the parastatal loan terms from a few selected potential lending institutions and from the domestic market.

Table 14: Selected parastatal loan terms from banks/institutions/countries

Creditor Bank or Institution	Average Maturity (Years)	Average Interest rate (%)	Grace period in Years
African Development Bank (AfDB)	15	3.75	2
World Bank (WB)	20	1.26	7
Namibia – Nampower	5	5.25	1
South Africa	12	5.50	2
Japan	22	4.10	2
China	11	4.92	1
Domestic (long term bonds)	15	5.11	2

The World Bank offers relatively cheap finance with quite a reasonable maturity period. Japan and China have reasonable interest rate charges, but the average maturity period from China is too short for major projects. South Africa and the domestic market charge the highest rates of interest. The Namibia power utility Nampower is currently funding rehabilitation of the existing Hwange thermal power units, but the maturity period is too short for the type of projects proposed in Table 13.

A key factor influencing the lender is the capacity of ZESA to service and repay the loan taken. The interest and maturity values at the above interest rates for a 20-year loan of US$5.1 billion are shown in Table 15 and for a 20 year loan of US$1.5 billion are shown in Table 16.

Table 15: Potential ZESA loan and interest from selected banks/institutions/ countries

Creditor Bank or Institution	Principal loan amount (US$)	Interest to be paid for (US$)	Total maturity amount (US$)
African Development Bank (AfDB)	5100000000	2868750000	7968750000
World Bank (WB)	5100000000	1285200000	6385200000
Namibia – Nampower	5100000000	1338750000	6438750000
South Africa	5100000000	3366000000	8466000000
Japan	5100000000	4600200000	9700200000
China	5100000000	2760120000	7860120000
Domestic (long term bonds)	5100000000	3909150000	9009150000

Table 16: ZESA loan requirement from banks/institutions/countries (US$)

Creditor Bank or Institution	Principal loan amount (US$)	Interest to be paid for (US$)	Total maturity amount (US$)
African Development Bank (AfDB)	1500000000	843750000	2343750000
World Bank (WB)	1500000000	378000000	1878000000
Namibia – Nampower	1500000000	393750000	1893750000
South Africa	1500000000	1035000000	2535000000
Japan	1500000000	1353000000	2853000000
China	1500000000	811800000	2311800000
Domestic (long term bonds)	1500000000	1149750000	2649750000

The World Bank, Namibia- NamPower and China offer the cheapest potential sources of funding.

6. OVERALL CONCLUSION

The challenges presented by electricity as a scarce resource are closely linked to the lack of investment expansion in power generation, poor electricity demand side management policies, and poor planning and administration of electricity infrastructure. The consequences of not adjusting electricity supply to meet demand are power supply interruptions and the cost of production loss, damage to equipment, material destruction, restart cost, idle productive time, firm relocation cost, consumer welfare loss and higher cost of providing alternative backup sources from required backup equipment.

Interventions are needed. The main intervention is the improvement in electricity supply through investment in generation capacity expansion at national level or at regional power pool level.

The cost of electricity supply outages in Zimbabwe in 2009, was estimated to be US$1.8 billion – massive for a country the size of Zimbabwe. The continuation of the existing state of power under-supply is undermining the development of mining, farming and industrial sectors of the economy and the government's desire to diversify production, the export base of the economy and to improve people's well being. Not only do frequent power outages adversely affect output in productive sectors, they prompt firms to disinvest in Zimbabwe and to discourage new firms from locating or investing in the country. The power outage problem reduces the rate of job creation, accelerates loss of jobs, reduces households' income and lowers tax receipts for central and local government.

Each outage has an impact on different sectors increasing with the duration of outage. The decision to acquire a backup is a rational decision on the part of the firm (industry, mine or farm) or household electricity consumer in order to protect it from larger losses arising from frequent and long power fluctuations, but not a socially efficient one. The public utility can generate this power cheaper by harnessing economies of scale.

7. RECOMMENDATIONS

Based on the estimates made of the cost of power outages in Zimbabwe, this study recommends to the government and the power utility (ZESA), the following.

Large scale expansion in generation capacity – First and foremost, the country cannot afford to immediately begin investing in large scale electricity generation expansion schemes. The relevant engineering expertise must be contracted to advise at the soonest. Expansion is possible at the source for both thermal plants (coal mines) and hydro power plant and at other suggested generation sites for both thermal and hydro generation to solve supply deficiency problems. The capital expenditure required is currently estimated at about US$5.8 billion, enough to make Zimbabwe a net exporter of electricity or US$1.88 billion to solve the current outage problems. Large scale national generation projects have several attractive features, mainly the exploitation of economies of scale.

Raising finance – Raising the capital requirement will require government guarantees for the repayment of such loans on maturity. The cheapest source would be the World Bank. Meeting the requirements for borrowing from this source will be advantageous to Zimbabwe.

Tariff setting - There should be a clear division of authority among policy makers and tariff setters when pricing electricity. One of the major causes of the problem as identified in the thesis is incorrect pricing. The unit price per kWh is below the cost of generating the unit. This practice is unsustainable and should cease. Under-cost recovery will:

- most likely deter potential lenders from advancing loans to Zimbabwe to generate additional power; and
- distort economic choices in the economy, resulting in inefficiency.

Higher (cost recovery) tariffs will induce more energy efficient building design, greater private sector participation in power generation, appropriate adjustments in demand for power and the adoption of efficient technologies.

Laws governing the industry – Concurrent with setting cost-recovery tariffs, the laws and regulations governing the electricity supply industry should be changed so that Independent Power Producers (IPPs) can be allowed to invest in the power sector. The failure by the power utility to expand generation capacity over the past 24 years further justifies the need to speedily implement this policy option because public utility failures in the sector are very costly.

Effective strategic policy and planning – The lack of strategic policy and planning for the electricity sector at central government level is a critical weakness and has contributed to the current outage problems. The Government should focus on integrated interventions rather than peace-meal solutions. An articulate plan for the sector will allow government to move beyond the "firefighting" that has reduced its ability to plan for exogenous shocks, such as drought.

Be innovative in planning to meet the demand for power in Zimbabwe – Zimbabwe has many natural advantages in power generation; including green options. Hydro power is not the only non-fossil fuel dependent power generating option in which Zimbabwe has an advantage. Solar photovoltaic systems can provide electricity to communities, industries and national grid. Zimbabwe experiences an insolation of 2 000 kW/m^2 per year, uniformly across the country and across the season. This level is five times more than it is in Spain, the leading country in solar energy generation.

Price differential (on and off-peak hours) – The power shortage problem is most acute during peak times. Higher tariffs should be charged during on-peak hours to encourage consumers to schedule their activities during off-peak times.

Advance warning – One of the main problems consumers face is being caught unaware by outages. Advance warnings about outages save costs and are an important management function. Information on outages need to be communicated to consumers in terms of time and duration on a regular basis before the incidences take place in order that proper planning (rescheduling of work, postponing operations, calling employees during time of supply, prepared backup supplies, etc.) can be effected by consumers to minimise the damage and cost.

Prioritisation of sectors and times – ZESA should load shed customers based on value addition through use of electricity and on the basis of cost incurred due to loss of power.

7. REFERENCES

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