Zimbabwe: An Assessment of the Electricity Industry and What Needs to Be Done

Zimbabwe highlights the weaknesses in power pooling that typically occur in third world countries, particularly when foreign currency is in short supply. The electricity industry's monopoly should be abolished, independent power producers should be attracted into the industry, and an independent regulator should be created for the power sector.

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I. Introduction

Zimbabwe currently has an electricity generation capacity of just about 2,000 MW, valued at about $2.5 billion (U.S.). The system maximum demand is 2,034 MVA (megavoltampere). Energy imports have at times risen to 50 percent of total energy needs. The scarcity of foreign currency has made it imperative that load shedding be introduced at times. The scale of energy disruptions, whether planned or unplanned, has resulted in huge losses to industries. The losses incurred due to the disruptions can be regarded as an invisible tariff that the customers of the utility have to pay. Large-scale investment in electricity generation requires a lot of capital. An extra capacity of 300 MW would require around $450 million in investment capital (assume an average of $1,500 per kW capacity developed). This investment level is beyond the capacity of the currently heavily indebted Zimbabwe Electricity Supply Authority (ZESA) and the Government of Zimbabwe, given the current economic problems.

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While micro-scale and localized energy production systems can be considered, it is clear that economic growth through industrialization would be limited if such initiatives are pursued. One way would be to encourage independent power producers (IPPs) to come to the rescue. This article assesses the current state of the electricity industry in Zimbabwe, examines potential sources of electricity in the future, and suggests ways of attending to the problems faced by the industry at the moment.

The Ministry of Mines and Energy is the responsible authority for energy policy and for public administration of the energy sector in Zimbabwe, through the Department of Energy (DOE) in this Ministry. The DOE does not have exclusive control over all matters in the energy sector. A number of other institutions including other government ministries, international oil companies, private mining companies, and the National Railways of Zimbabwe influence activities in this sector, particularly with respect to pricing of energy products. Zimbabwe relies mainly on coal for thermal power generation, producing about 70 percent of total national electrical energy production. Electricity is also produced from hydro resources of the Zambezi River. Transmission voltage is 330, 400, and 420 kV. Sub-transmission voltage is 132, 88, and 66 kV. The distribution voltages are 33 or 11 kV. Supply voltages are 220 and 380 V.[1] Some intermediate non-standard voltages are also found in rare instances.

II. Hydroelectric Power Stations Are Affected by Droughts

The major source of hydropower for Zimbabwe is the Zambezi River, which has a total capacity (developed and estimated potential capacity) of 7,200 MW. About 4,200 MW of this capacity can be owned jointly by Zimbabwe and Zambia. The two countries share water for hydroelectric power generation from the Kariba Dam, which was built on the Zambezi in 1955–1960. The present total capacity is 1,266 MW, comprised of four 150 MW generator sets installed on the northern bank (the Zambian side) of the river in 1962 and known as Kariba North Bank Power Station, and six 111 MW generator sets installed on the Zimbabwean side and commissioned in 1965. The latter sets, known as the Kariba South Bank Power Station, have been upgraded to 125 MW each. This later installation brought the Kariba Dam's hydroelectric power capacity to 1,350 MW.[2] The Kariba Power Station has at times been affected by drought and the flows into the lake had been progressively low since the early 1980s, resulting in a critical fall in levels which almost rendered the station inoperable in 1992–1993. In August 1993, the lake level was about 1 meter above the power station intake level, yielding projections that the water would last only until November 1993. Early rains in that year avoided the shutdown of the power station. The drought cycles have resulted in a change of preference towards thermal plants.

The scale of energy disruptions, whether planned or unplanned, has resulted in huge losses to industries.

There is a power purchase agreement between ZESA and an independent producer at Rusitu in the Chimanimani area, which runs an 800 kW mini-hydro plant, producing entirely for the grid. This agreement has served to indicate the willingness of the utility to purchase private power, an option which has been missing in the energy sector in Zimbabwe. The tariff agreement provides for a guaranteed price set as a percentage of the ZESA tariff. This assists in project planning for new producers. Mini-hydroelectric plants have been installed at Kwenda (80 kW), Sithole-Chikate (30 kW), Svinurai (20 kW), Mutsikira (10 kW), Rusitu (700 kW), Nyafaru (40 kW), Aberfoyle (30 kW), and Claremont (250 kW) in Zimbabwe. There have been plans to install a 140 kW micro-hydroelectric power plant at Manyuchi dam, about 350 km south of Harare. This project could provide 700,000 kWh of renewable energy a year, avoiding carbon dioxide emissions of 900,000 kg per year. Additional benefits would be in technology transfer and the local social and economic benefits associated with electrification. However, it is clear that small-scale hydroelectric plants, besides bringing about positive social and economic benefits, have a more limited capability to address the future energy requirements in Zimbabwe or reduce the current energy import bill effectively. While large-scale hydroelectricity schemes are very economic, mini-hydro schemes do not offer the same levels of scale economies. In Zimbabwe, these schemes would also be adversely affected by drought. This underlines the need to look at complementary electric energy sources in future.

III. Thermal Power Has Taken over as the Main Electricity Source

Coal-based thermal power generation assumed an important role in the energy supply scenario of Zimbabwe in 1984, when the Hwange Power Station was built at the Wankie coal mine. At present, Zimbabwe has an installed coal-based thermal capacity of 1,295 MW, with a total annual coal intake of about 3 million tonnes per year. The role of coal in power generation is highlighted in Table 1, which shows power generation by source for the years 1996 to 1999.[3] The import level in 1999 represents over 40 percent of national needs. This figure has tended to be around 50 percent recently. The growing trend in electricity demand and the rising level of imports can be easily noticed.

Table 1: Power Generation by Source, 1996–1999

Fuel/Source	Power Generation (GWh by Year)			
	1996	1997	1998	1999
Coal	5,160	5,175	7,129	4,141
Hydro	2,163	2,122	2,927	2,949
Imports	3,172	4,013	7,461	5,275
Totals	10,495	11,310	17,510	12,365

Electricity consumption peaked in 1998, when the economy was doing well. The decline in electricity consumption in 1999 marks the beginning of a slowdown of the national economy, which has continued to date. The poor business and political climate have therefore recently distorted demand forecasts for electricity. The technical data of the existing thermal power stations is shown in Table 2.[4] It can be observed that the oldest power plants at Harare, Munyati, and Bulawayo range from 44 to 55 years old and contribute about 345 MW of thermal capacity.

IV. Zimbabwe Is One of the Most Interconnected and Electricity-Import-Dependent Countries in Africa

Central to the Southern African Development Community (SADC)'s energy management program is the Southern African Power Pool (SAPP), under which member states are linked to one electricity grid. This enables the regional reserve to provide options for power supply to the member countries. The cost of this imported energy has to be weighed against the factors that support domestic production of electricity. The SAPP enables easier export and import of electricity throughout the region. The pool is made up 12 national utilities: Empresa National de Electricidade (ENE) of Angola, Botswana Power Corporation (BPC) of Botswana, Lesotho Electricity Corporation (LEC) of Lesotho, Electricity Supply Commission (ESCOM) of Malawi, Electricidade de Mozambique (EDM) of Mozambique, Namibia Power (NamPower) of Namibia, ESKOM of South Africa, Swaziland Electricity Board (SEB) of Swaziland, Tanzania Electricity Supply Corporation (TANESCO) of Tanzania, Societe National d'Electricite (SNEL) of Democratic Republic of Congo, Zambia Electricity Supply Corporation (ZESCO) of Zambia, and Zimbabwe Electricity Supply Authority (ZESA) of Zimbabwe.

Table 2: Specifications of ZESA Thermal Power Stations

Name of Station	Construction Year	No. of Units	Size of Unit (MW)	Installed Capacity	Generating Voltage (kV)
Hwange 1	1983	4	120	480	10.5
Hwange 2	1985	2	220	440	17.0
Munyati	1947	2	10	20	11.0
		5	20	100	11.0
Harare 2	1946	2	7.5	15	11.0
		2	10	20	11.0
		2	20	40	11.0
Harare 3	1957	2	30	60	11.0
Bulawayo	1948	2	15	30	11.0
		3	30	60	11.0
Total installed capacity				1,295	

Source: ZESA Annual Report, 1993.

Zimbabwe's greatest electricity imports derive from South Africa (450 MW), Mozambique (500 MW), Democratic Republic of Congo (250 MW), and Zambia (100 MW). Imports from Zambia were expected to stop in the year 2000, but this was not the case, as planned investment in the power sector was not implemented. The electricity system is interconnected with Zambia through two 330 kV transmission lines, South Africa through a 132 kV transmission line from Beitbridge and a 400 kV transmission line from Insukamini in Bulawayo, Mozambique through a 420 kV transmission line, and Botswana through a 220 kV line from Bulawayo to Francistown. System interconnection serves to improve reliability.[5] This network has made Zimbabwe's transmission grid the most strongly interconnected within the whole of Africa. However, Zimbabwe is now permanently dependent on imports, worsening further the foreign currency shortages. More than 200 companies closed down in the year ending July 2001, and one of the major causes of closure was foreign currency shortage and the related artificially low currency exchange rate coupled with a very high exchange rate in the parallel, or black, market.[6]

V. The Demand for Electricity Far Outstrips Supply

The electrical energy demand forecast for Zimbabwe is based on knowledge of historical demand regressed to project future demand. Demand is limited by access or lack of it to the existing infrastructure. There are a number of developments in the country that are set to affect the domestic load significantly. These include the following:

- The economy has a large number of (mainly domestic) consumers whose demand is not being met due to limited investment on the part of the utility. There has been a very large countrywide housing development initiative by both the private sector and government, and urban accommodation is now virtually built for the connection of electricity. An additional capacity demand of about 2,000 MW is expected, if all the 2.2 million households in Zimbabwe are to be electrified. Currently, about 30 percent of the households are electrified, with a heavy bias towards the urban areas.[7] The households have on the average accounted for about 20 percent (2,500 GWh) of all electrical consumption. Providing all Zimbabwean households with electricity would require about 12,500 GWh, or roughly double the current output.

• There are a few industrial projects that are in the pipeline involving the construction of several industrial entities in the major cities and growth points.

It is forecast that demand will increase steadily in the foreseeable future. However, these demand growth factors have been perturbed by the current economic and political situation. This has temporarily affected the demand pattern as politically induced economic difficulties have set in. Load shedding and blackouts by ZESA also helped to temporarily reduce demand. In the year 2000, ZESA experienced a 1.9 percent drop in energy use. It was anticipated that there would be a 3 percent drop in the year 2001 as the disorder related to the presidential elections in 2002 reached a peak. It is expected that demand will start increasing from the year 2003 onwards, when the country starts to recover from the current political problems. The shortage of foreign currency will continue to force the utility to shed load, resulting in lower electricity consumption levels. However, despite this setback, about 50 percent of electricity demand is met by imports, showing that domestic supply has been lagging behind demand for a long time.

VI. The ZESA System Development Plans Have Been Very Poorly Implemented

The system development plans for ZESA are based on the criteria that internal generation should be equal to or excess to demand and the system should be planned for a minimum reserve of 25 percent, with imports exceeding or meeting the reserve margin. The development plans over the last few years have included refurbishment of existing plants, augmentation of cooling capacity and control equipment, upgrading of the Hwange Power Station, construction of interconnectors, and construction of new plants at Batoka, Gokwe North, and Hwange. They reflect the most realistic route to adding electricity generation. The ZESA system development plan, which was a part of the 1993 annual report, is shown in **Table 3**. **Table 4** reflects the additional capacity that would become available when the plan is implemented.[8]

The electricity sector is the sole supply domain of ZESA, which generates, imports, and distributes all electrical energy in the country except for a few small private generators run either as stand-alone systems in remote communities or as backup systems by large urban companies and in some schools and hospitals. The lack of investment capital and the effects of the implementation of the Zimbabwe Electricity Act have inhibited power sector development. Approval is needed from the minister in order to charge cost-reflective tariffs. This has not been forthcoming at times. Implementation of the investment plans has been very poor, partly due to these bureaucratic delays. **Table 5** outlines the delays encountered.

The current system development plan is shown in **Table 6**.

It clearly shows that many further changes have been made. The main highlights are summarized in **Table 7**.

One of the main reasons for ZESA's failure to stick to these excellent plans, besides political and government noise factors (complete disruptions), is the failure to raise the necessary capital, particularly in foreign

Table 3: Zimbabwe Electrical Energy Supply System Development Plan, for 1994 and Onwards

Project	Capacity Addition (MW)	Planned Date	Actual Date
Kariba refurbishment	84	1994–1997	Completed
Small thermal refurbishment	120	1994–1996	1996
Interconnector to South Africa	400	1994–1995	1996
Cahora Bassa Interconnector	500	1994–1996	1997
Hwange upgrading	Improved reliability	1994–1996	1996
Hwange 7	220	1996–2000	Not yet started
Hwange 8	220	1996–2000	Not yet started
Batoka	800	1997–2004	Not yet started
Sengwa 1	220	1998–2004	Not yet started
Sengwa 2	220	1999–2004	Not yet started
Sengwa 3	220	2001–2006	Not yet started

Table 4: Electrical Energy Development Plan, Reflecting Additional Capacity to be Available

Project	Year	Capacity (MW)		
		Hydro	Thermal	Total
RSA inter-country	1995		400	400
Cahora Bassa	1996	500		900
Hwange upgrading	1996			900
Old thermal refurbishment	1996		220	1,120
Kariba refurbishment	1997	84		1,204
Hwange 8	2000		220	1,424
Hwange 7	2000		220	1,644
Sengwa 2	2004		220	1,864
Sengwa 1	2004		220	2,084
Batoka	2004	800		2,884
Sengwa 3	2006		220	3,104

Source: ZESA, 1993.

currency. Infrastructure development is very expensive and there is a need to open parts of it to the private sector. This is where the IPPs can come in. The above projects, including generation, transmission, distribution, and supply networks required an estimated $4 billion at 1998 prices. This is too much capital for ZESA and for the Government of Zimbabwe. This also opens up a role for investment in small-scale plants to bridge the current gap in the supply of electricity.

VII. There Is Great Electricity Generation Potential in Zimbabwe

There is a potential to exploit hydroelectric resources that exist in the country in the future. The Zambezi River provides most of the potential power sources. The micro- and mini-hydroelectric schemes also provide interesting opportunities. These need to be more comprehensively quantified. Some studies have been conducted to determine the potential of some of the large dams. The use of biomass in electricity generation has been limited so far, but its potential is very high and it needs to be fully exploited. The sugar industry produces electricity for its own consumption. There is room to modernize technology in this area to enable the industry to export power to the grid. The wood industry can also generate electricity. Wind energy has limited applications due to low wind speeds in most parts of Zimbabwe. The use of photovoltaic (PV) technology offers practical energy solutions for remote regions. The Zambezi offers potential hydroelectric resources at Batoka Gorge, Devil's Gorge, and Mupata Gorge, and at Cahora Bassa in

Table 5: Project Delays in the 1993 Plan Compared to the 1991 Plan

1. The Sango-Bindura 330 kV (500 MW) interconnector, which was supposed to be installed between 1994 and 1996, was rescheduled and completed in 1997, after a delay of one year.
2. The Kariba South upgrading and refurbishment (84 MW), which had been planned for the period 1994–1997 was rescheduled to begin in 1998, four years later. This was completed in 2001.
3. The Hwange 7 and 8 (220 MW) each were both planned to be carried out in the period 1994–2000. They were re-planned to start in the years 2000 (six years later) and 2003 (nine years later), respectively, and are now deeply entangled in a deal with a Malaysian company. They have not been started up to now.
4. The Batoka Gorge Hydropower Plant (800 MW) was planned to start in 1997 and to be completed in 2004. It was pushed forward to start in the 2004, a seven-year delay. There were no indications that it was on the cards, since it was not a priority for Zambia and there are other higher priority projects still outstanding.
5. The Sengwa Coal-fired Power Stations Units 1, 2 and 3 of 220 MW capacity each were supposed to be constructed in the periods 1998–2004, 1999–2004, and 2001–2006, respectively. The updated plans of 1997 showed that the first unit was planned to start in 2009 (11 years later), the second unit in 2011 (12 years later) and the third unit had been left out of the plan.

Table 6: Zimbabwe Electrical Energy Supply System Development Plan 1999 Onwards[9]

Project	Capacity	Commissioning Date
Hwange Units 7 and 8	2 × 300 MW	2005
Gas Turbine	2 × 150 MW	2008
Batoka Unit 1	1 × 200 MW	2010
Batoka Unit 2	1 × 200 MW	2011
Batoka Unit 3	1 × 200 MW	2012
Batoka Unit 4	1 × 200 MW	2013
Kariba South Extension Unit 1	1 × 150 MW	2014
Kariba South Extension Unit 2	1 × 150 MW	2015
Gokwe North Unit 1	1 × 320 MW	2016
Gokwe North Unit 2	1 × 320 MW	2018
Gokwe North Unit 3	1 × 320 MW	2019

Source: ZESA, 1999.

Table 8: Potential Hydroelectric Resources on the Zambezi River

Site	Capacity (MW)
Batoka Gorge	1,600
Devil's Gorge	1,240
Mupata Gorge	1,000
Cahora Bassa North Bank	1,200
Total	5,040

Source: ZESA Annual Report, 1993.

Mozambique. The potential hydroelectric resources are shown in Table 8.

Sites for mini- and micro-hydro power plants in Zimbabwe have been assessed but the total potential has not yet been fully stated. Table 9 shows some of the potential sites and their capacity based on historical performance of their hydrology.[10]

Biomass and biogas can be used for electricity generation. However, there has been no contribution to the national grid from this sector recently. The Department of Energy in Zimbabwe through two projects promoted biomass gasifiers. An Indian Ankur engine with a dual fuel gasifier and with 40 kW capacity was installed at Nijo in 1989 as an experimental project. An Italian Soft Energy System with a similar capacity was also installed at Rushinga as an experimental project in the same year. Both systems ceased to operate by the end of 1991. The technology transfer method used was inappropriate, with the gasifiers dumped into the communities with no instruction on the technology and needed maintenance procedures, so that the systems were run until they failed. Research institutions were not involved at all in the two projects.

A technical, financial, and economic feasibility of a biomass-fueled plant has been done in Chimanimani, a remote area in the Eastern Highlands of Zimbabwe. Such a combined heat and power (CHP) plant can provide commercial gains to the private sawmill operators and provide socioeconomic gains to the local community, while providing a new source of power and heat. It is noted that the deficit in energy supply in Zimbabwe is taken care of by also importing energy from South Africa and other SAPP countries' coal-fired power stations. Since most of the electrical energy in Zimbabwe is from

Table 7: Main Changes in the 1999 Plan

1. Hwange 7 and 8 have been moved by another five years and two years respectively. The planned capacity has been increased for both plants to 300 MW.
2. A new feature is the gas turbine plant taking a cue from the experiences in England, where liberalization of the electricity sector has shown that they can at times offer the most viable and economic method of electricity production.
3. The Batoka project has been split into four units installed at different times. Commissioning of the first unit has been pushed forward to the year 2010, another six-year delay.
4. Another additional feature is the extension in Kariba South of two units that are to be commissioned in the years 2014 and 2015.
5. The Sengwa project is now called the Gokwe North Project. The three units will now have a capacity of 320 MW each and the first one is planned for commissioning in 2016, another seven-year delay from the last planned date. All three units are part of the current plan.

Table 9: Potential of Some of the Mini- and Micro-Hydro Sites in Zimbabwe

Site	Capacity (kW)
Bangala	800
Kyle	1,500
Siya	450
Odzani	60
Small bridge	70
Manyuchi II	170
Ruti	200
Palawan	170
Mwenge II	100
Jumbo	30
Gairezi	20,000
Tsanga	3,300
Duru	2,300
Total	29,150

Source: DOE study on hydroelectric potential of irrigation dams, and ZESA.

thermal power stations, the contribution to greenhouse gas emissions is increased further. On the other hand, residues from forestry industries and sawmills in the Chimanimani area have little or no productive use. Recovery from logs under bark is 40 percent to 50 percent. The rest is residue in the form of sawdust, chips, and slabs. The bark is about 7 percent of the log input. All this waste can be used to produce electrical power.

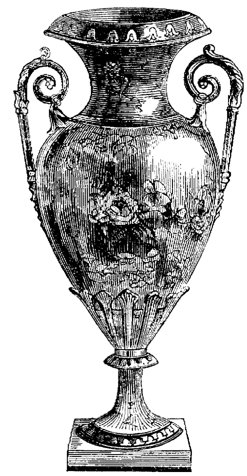
Residue from 200,000 cubic meters of solid logs from the largest sawmill in the Chimanimani region has an energetic value of 185 GWh, which can run a 6 MW plant, generating about 50 GWh of electricity. This is based on a feasibility study conducted by the Swedish International Development Agency (SIDA). There is room to improve efficiency and the amount of electricity generated. Some of the energy would be in the form of steam that can be used for process heating. The five sawmills in Chimanimani have the potential to produce a total of 20 MW. Similar plants exist in Scandinavia and other countries, and the technology could be adapted to Zimbabwe. The steam from the plants can be used to generate all the steam requirements of the sawmill, help to start drying kilns, and can stimulate the starting of other steam-using industrial projects in the area. The efforts to substitute coal with biomass in electricity generation would have a beneficial impact on the environment. It is noted that strong reforestation initiatives would need to be put in place in order to protect the envisaged environmental gains. There is also room to replant indigenous trees in order to recreate natural forests. Forests close to the rivers and streams would not be used in order to avoid siltation.

Another possible source of biomass is crop waste. It is estimated that Zimbabwe produces about 2.5 million tonnes of crop waste a year; this could potentially produce about 295 MW of electricity.[11] The cotton stalks, which are burnt in huge amounts in the cotton-growing areas of Zimbabwe every year, to kill pests and the eggs, can be used for energy production. Logistical problems might provide some limitations to possible large-scale usage. Also, the use of chemicals in fumigation in cotton production would have negative environmental impacts. However, these would not be additional, since the stalks are being burnt currently. Other types of crop waste, like maize stock, are used as stock feed and as compost manure. Competing uses like this would need to be taken into account. However, the most promising biomass source of electrical power in Zimbabwe occurs in the sugar industry from the use of bagasse, the moist fibre that remains after juice extraction from sugarcane.

The two sugar companies in Zimbabwe, Triangle Ltd. and Hippo Valley Estates, have the potential to provide about 8 percent of the country's electrical energy requirements. The two plants have a combined capacity of 81.5 MW. Each of the sugar plants has a high sugar cane crushing capacity, which can be able to support a power plant with a large capacity, if coal is used to supplement the bagasse produced. Future investment in the firms' power plants would improve electricity production from about 32.2 kWh to more than 120 kWh per tonne of sugar cane crushed. This would enable the two sugar companies to export more than 500 GWh of bagasse-generated electricity to the grid, from two plants of 105 MW each.[12] The use of gasification technology, if it is fully developed in future, could raise the total output from the two sugar plants. It is estimated that at least 2,000 GWh of bagasse-generated electricity would be available to the grid if bagasse gasification technology is fully developed in the sugar industry.[13]

Solar photovoltaic systems can provide electrical energy in areas very far away from the grid. Zimbabwe experiences an insolation of 2,000 kW/m^2 per year. Insolation is uniform across the country and across the seasons. There are more than 20,000, 45 W-equivalent PV systems in the country. A majority of them (12,000 systems) were provided through the Global Environmental Facility (GEF), a United Nations Development Programme (UNDP) project. These improve life in the rural areas by supplying lighting, powering radios, televisions, sewing machines, refrigerators, telecommunication radios, electric fencing, and water purification. There are more than 50 companies employing more than 500 people in the solar industry in Zimbabwe. The Japan International Cooperation Agency (JICA) in 1999 proposed a master plan for the electrification of 150,000 households at a total investment cost of $108 million and managed by the national utility.[14] This is a viable and economic investment option given that it will be decades before rural communities are connected to the grid.

The use of wind energy in electricity generation has been limited. Wind speeds in Zimbabwe are relatively low at only 3.2 m/s. Information recorded by the meteorological office shows that the highest wind speeds are experienced at Bulawayo (4.25 m/s), Chipinge (3.8 m/s), and Gweru (3.8 m/s). These speeds are irregular both by season and by area and vary widely diurnally. This wind regime rules out utilization of wind energy only for power generation. This resource is, however, sufficient to enable utilization of windmills for water pumping. At present there are a few companies supplying windmills for power generation. The initiatives are in most cases in the area of hybrid wind and battery combinations. This has applications in the rural areas that are very far away from the grid.



VIII. The Way Forward for the Electricity Industry in Zimbabwe

A number of issues have been raised in this article. There has been inability to expand electricity generation capacity since 1985. Load shedding has been introduced as the utility failed to import electricity due to foreign currency shortages. This is against a growing long-term trend energy demand pattern. The oldest thermal plants, which contribute 345 MW, are more than 44 years old and there are limited benefits of upgrading them since they are located very far away from the coal mines. Micro-scale and standalone systems like PV units are a viable option for providing electricity to remote locations in the country. The following recommendations are therefore made:

- The laws and regulations governing the electricity industry should be changed so that IPPs can be allowed to invest in the power sector. The failure to expand capacity over the past 16 years further justifies the need to speedily implement this policy option in order to meet growing electricity demand. Investment in thermal power plant can be opened up to large-scale investors, while ZESA concentrates on investment in hydroelectric power plants and PV installation and maintenance. There is room for small- to medium-scale investors in generating power in the sugar industry, wood industry, wind systems, and photovoltaic electrification areas.
- It is clear that creating a power pool and being connected to the pool like Zimbabwe is does not ensure reliability of power supply on its own. An argument has been presented that when faced with foreign currency shortages, it is a better strategy for a country to have adequate internal capacity and to use the pool for short-term peaking. The government of Zimbabwe should stabilize the economy and promote local generation of electricity in order to avoid crowding out the private

sector from access to foreign currency as its utility struggles to pay for electricity imports.

- There should be a clear division of authority among policymakers, policy implementers, and tariff setters when pricing electricity. An independent regulatory authority is necessary. ZESA plans have been affected by failure to set tariffs at levels above the long-range marginal cost. Political decisions have dominated the management of the utility in a negative way.

A full picture of the electricity industry in Zimbabwe, its potential, and the way forward in order to revive it has been offered. The current political and economic environment poses more challenges, albeit transient ones. The issues and views raised have put forward topical aspects about the stagnant electricity industry. The policy options suggested can offer a way out for the struggling sector.■

Endnotes:

1. AFREPREN, Data Sets for Mauritius Workshop, Presented to AFREPREN Energy Workshop on Power Sector Reforms: Implications for the Cogeneration Industry, Quatre Bornes, Mauritius, Aug. 24–25, 2001.

2. Zimbabwe Electricity Supply Authority, Annual Report, 1993.

3. Source: ZESA Annual Reports, 1999. The utility's annual reports are always published late. However, recent information has shown that electricity imports are still high, around 50 percent, and coal thermal power stations still have a dominant role in electricity generation in Zimbabwe. Hydroelectric power generated is shared equally with Zambia.

4. Thermal electricity generation capacity has remained almost stagnant since installation. Subsequent refurbishment has been mostly maintenance-related, without expanding capacity. The refurbishment, which increased capacity by 120 MW, was completed in 1996, hence increasing thermal capacity to 1,415 MW. However, the stabling of the old inefficient plants and the increased transport costs of coal to these faraway installations has reduced total thermal plant output.

5. The information on the power pool connections and levels was supplied by the Zimbabwean utility ZESA following an official request from the author.

6. Financial Gazette, July 15, 1999, reported this situation. Since then, more companies have closed down as foreign currency shortages have reached chronic levels. The Confederation Industries of Zimbabwe and the Zimbabwe National Chamber of Commerce have recently reported that 400 companies closed in the year 2001, with one of the main reasons being the excessive cost of foreign currency on the parallel markets. More than 20,000 people have lost their jobs in the process.

7. Japan International Cooperation Agency, *Study on the Promotion of Photovoltaic Rural Electrification in the Republic of Zimbabwe*, Draft Final Report, Dec. 1998. Since then the electrification of rural areas has been slow. The Rural Electrification Programme reported that about 10,000 more rural households had been electrified in the years 1999, 2000, and 2001. Electrification rates remain around 25 to 30 percent of all households.

8. This plan was in the ZESA 1993 annual report. The "Actual Date" column, which has been added to the table, helps to assess the historical implementation of the plan based on current information. It is very clear that the utility failed to implement the plan completely.

9. This is based on the Zimbabwe Electricity Supply Authority Annual Report, 1999. The fact that the exchange rate has been fixed by the government since then, resulting in a parallel market rate which is about 500 percent of this rate, has disrupted everything. Since the economic disruption in 1999, the company has been depending on crisis management. Capital investment has been put on hold and the plan remains on paper without any implementation. Most attention is focused on sourcing for foreign currency to pay South Africa and other power pool countries for electricity.

10. The Department of Energy in the Ministry of Mines and Energy has carried out a study of some of the dams in the country, to assess their generation potential. ZESA has also carried out feasibility studies at sites in the Eastern Highlands of the country together with potential independent power producers.

11. UNEP Collaborating Centre on Energy and Environment, Denmark, and Southern Centre for Energy and Environment, Zimbabwe, Implementation Strategy to Reduce Environmental Impact of Energy and Related Activities in Zimbabwe, Jan. 1997.

12. K. Deepchand, *Overview of Commercial Scale Cogeneration of Bagasse Energy in Mauritius*, paper presented to AFREPREN Energy Workshop on Power Sector Reforms: Implications for the Cogeneration Industry, Quatre Bornes, Mauritius, Aug. 24–25, 2001. In this paper, the author shows that similar plants in Reunion and Mauritius have been able to export 110 kWh per tonne of sugarcane to the grid, after meeting sugar plant energy requirements. This is based on the latest French technology using high-pressure (82 bar) boilers co-fired by bagasse and coal. Each boiler can drive a 35 MW alternator.

13. C.T. Mbohwa, *Adaptation, Deployment and Use of the Modern Bio Fuel/Bio Power Technologies: A Case Study of Zimbabwe*, Oct. 2001. A power yield of 500 kWh per tonne of sugarcane crushed is expected if bagasse/biomass integrated gasifier steam turbines are fully developed.

14. Japan International Cooperation Agency: Study on the Promotion of Photovoltaic Rural Electrification in the Republic of Zimbabwe, Final Report, March 1999. The report, conducted by the Institute of Energy Economics unit of Japan Fuji Technosurvey Co., Ltd., provides an economic and financial appraisal of photovoltaic systems in Zimbabwe.