Electrical Energy Insecurity and the Performance of the Small and Medium Enterprise Sub-Sector in Nigeria

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Abstract: This study empirically investigates electrical energy insecurity and the performance of the SME sub-sector in Nigeria using data from the World Bank Enterprise Survey for Nigeria. The survey covered a total of 2676 SMEs which were categorized as "small", "medium" and "large" based on the number of their employees. Differences among the categories of SMEs based on the effect of energy insecurity are identified from the study. The study reveals that electricity insecurity is a reality among SMEs in Nigeria as they experience outages on daily basis on the average, with duration of 11.6 hours. Large Enterprises experience more outages of 44.2 times in a month. On the average, SMEs record loss of 15.6% of their annual sales to electricity outages and generate 56% of electricity from generator. Large and small firms generate as much as 64.8% and 59.2% electricity from generator, respectively. Also, the findings show that SMEs spend an average of N766, 801.5 naira (USD 2,126.93 at USD360.52 exchanges) on electricity annually, and indicate electricity insecurity as major obstacle to their operations. Thus, government should address electricity issues in the country as a state of emergency with priority given to not only the households but also the SME sector.

Keywords: Energy insecurity; Electricity; SMEs; Enterprise survey

JEL Classification: L32

1. Introduction

Global demand for energy is rapidly increasing with population and economic growth. Many countries are making impressive progress in meeting the increasing energy demand by increasing energy supply. Amidst this impressive development in energy supply, there exist disparities among the regions and countries of the world. A study by IEA in 2014 showed that energy supply in sub-Saharan Africa continues to fall short of demand. Energy demand rose by 45 percent from 2000 to 2012, and more than 620 million people do not have access to electricity, while 730 million rely on unclean energy (solid biomass) for cooking.

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In Nigeria (the largest economy in the sub-Saharan region), the condition seems more critical. Poor electricity generation has remained a burden in Nigeria, and has inhibited the drive towards industrialization, technological advancement and development of micro and macro businesses (Ohiare, 2015). Less than 40 percent of Nigerians have access to electricity, with only 30 percent of their demands being met (Mushelia, 2004). The gap between demand and supply of power is as a result of poor and obsolete infrastructure, and poor managerial capabilities, among others. Gas flaring and disruptions in gas supply coupled with recurrent attacks on gas pipelines by militants in the Niger-Delta region, have further worsened power generation in the country. Power generation capacity fluctuates between 3500MW and 4400MW with per capita electricity usage about 144 kWh; among the least in the sub-Saharan Africa[1].

Significantly, Nigeria is a large market for business penetration given its population size – the largest in the sub-Saharan region. It is home to many multinationals, micro and macro enterprises that leverage on its natural resources and market size for growth in business. However, many businesses have experienced retarded growth and complete shutdown of business with the major factor attributed to inadequate electricity supply and high operation costs. Recurrent power outages have forced about 90 percent of the industrial and commercial sectors to indulge in self-generation of electricity, contributing to high operation costs (Adenikinju, 2005).

Self-power generation by industries and commercial entities exert costs of about four times more than what they would have to pay the national grid, as revealed in the literature. A survey study released by the Manufacturing Association of Nigeria revealed that expenditure on self-generated energy in the manufacturing sector increased by about 122% from $162.2 million (N58.82 billion) in 2015 to $359.5 million (N129.95 billion) in 2016 (MAN, 2014). Many small scale businesses with potentials for employment generation and wealth creation in the country have failed as a result of deficiency in electricity supply and high costs. Many have experienced ineffectiveness in terms of competitiveness, and many operate below capacity.

Hence, there is a need to empirically determine the impact of electricity energy insecurity on the performance of the SME sub-sector in the country. This study therefore empirically examines energy insecurity and the performance of SME sector in Nigeria. Specifically, it evaluates the level of electricity outages and electricity generation by the SMEs; the level of losses and costs incurred by the SMEs as a result of electricity outages. The study is divided into five sections namely:

[1] Kenya (167kWh), Cameroon (281kWh), Angola (312kWh), Ghana (355kWh), Mozambique (463 kWh), Morocco (901 kWh), Gabon (1175 kWh), Botswana (1749 kWh), Libya (1857 kWh); all these have per capita electricity consumption higher than Nigeria (IEA Statistics, 2014)

introduction, literature review, methodology, results and discussion, and conclusion and recommendation.

2. Literature Review

2.1. Energy Security

The concept of energy security has been viewed by different authors and scholars in different ways. Some have viewed it from the dimension of supply security and availability, while some have included vulnerability, threat and risk in their definition of the concept of energy security. Three categories of authors have been identified with a common focus in their definitions of energy security (Azzuni and Breyer, 2018). The first category of authors defines energy security as the continuity of energy commodity supplies (Scheepers et al. 2007; Lieb-Dóczy, Börner, and MacKerron 2003; Ölz, Sims, and Kirchner 2007; Wright 2005; Hoogeveen and Perlot 2007).

The second category of authors introduced subjective impact measure to their definitions of energy security to differentiate between secure and insecure levels of continuity (DECC, 2009; McCarthy et al., 2007; Taiwan, 2000). The most famous of these definitions was given by the International Energy Agency (2001) "…in terms of the physical availability of supplies to satisfy demand at a given price". The concept behind this definition seems to imply that apart from supply interruptions, security is only impaired if the scarcity of energy leads to prices above a certain threshold, while the price volatility below that threshold is not relevant (Mabro, 2008). The use of subjective severity filters makes the concept of security very imprecise and difficult to measure. Continuity and price levels that are considered as insecure by one country could be completely sufficient for another country (Paul et al., 2018; Spanjer 2007; Rutherford *et al*., 2007).

A third group of authors extend the scope of the impact measure. Instead of measuring the continuity of prices and quantities on the commodity market, they extend the impact measure to the price and continuity of services; the impacts on the economy and in some cases, the environment (Winzer, 2011; Kruyt et al., 2009; Verrastro and Ladislaw, 2007). An extension of the concept to the continuity of services can be found in the definition of Noel and Findlater (2010): "security of gas supply (or gas supply security) refers to the ability of a country's energy supply system to meet final contracted energy demand in the event of a gas supply disruption" (Noel and Findlater 2010). The standard definition for the extension of the impact measure to the economy is the one given by Bohi, Toman, and Walls (1996). They defined energy insecurity as "the loss of welfare that may occur as a result of a change in the price or availability of energy" (Bohi *et al*. 1996).

This study defines energy security as the ability of an economy to guarantee the availability of energy resource supply in a sustainable and timely manner with the energy price being at a level that will not adversely affect the economic performance of the economy. This implies that energy insecurity occurs when an economy cannot guarantee the availability of energy resource supply in sustainable and timely manner, and cannot regulate the price to an affordable level to end users (firms and households).

2.2. The nature of SMEs in Nigeria

Nigeria is a developing country in sub-Saharan Africa where SMEs account for 60 to 70 percent in terms of employment according to Allen (2001). Chima (2014) stated that these SMEs currently represent about 90 percent of the industrial sector in terms of number of enterprises. A study conducted by the International Finance Corporation (IFC) in 2006, estimated that 96 per cent of all businesses in Nigeria are SMEs compared to 53 percent in USA, 65 percent in the EU (European Union) with SMEs in both places accounting for over 50 percent of their respective country's Gross Domestic Product (GDP) (IFC, 2006). SMEs can be considered as the driving force for the Nigerian economy as they assist in promoting the growth of the country's economy (Iddris, 2012); hence, all the levels of government at different times have policies that promote the growth and sustenance of SMEs.

In Nigeria, SMEs are instrumental in job and wealth creation. The future of the economy relies heavily on ensuring that SMEs improve their competitiveness by their performances. SMEs also play a vital role in enhancing the economic development of Nigeria, having contributed greatly by the provision of employment opportunities, marketing of goods and services, supplying the needs of larger industries and in terms of growth and development of the rural areas. They have also brought about the growth of indigenous entrepreneurship in Nigeria and increased local participation (Chima, 2014).

2.3. Energy Insecurity and the Performance of SMEs Nexus

A study conducted by Scott *et al*. (2014) reveals a relationship between electricity outages and the performance of SMEs in low and medium income countries. The study establishes a positive correlation between electricity outages and costs of SMEs business operations. Electricity outages exert more cost on the SMEs in the form of high cost of alternative power generation, loss of output, damage of equipments. Also, electricity outages lead to high product cost and reduce labor productivity of the SMEs (Doe and Asamoah, 2014; Tarun *et al*., 2013; Cecelsi, 2004). Auru and Okoro (2011) found that about 820 manufacturing SMEs shut down operation between 2000 and 2008 as a result of energy insecurity and high cost of alternative energy generation.

Electricity insecurity seems to have more effect on the growth of medium and large-scale business enterprises than small ones, and influences choice of location for investments by SMEs (Adenikinju, 2005). A study on firms operating under electricity constraint in developing countries by Alby *et al*., (2011) found that countries with high frequency of power outages have less concentration of small firms in sectors with high energy requirement. This is because only large firms have the capacity to absorb the high cost self-generation of electricity to reduce the effects of outages (Alby *et al.*, 2011). Evidence from India implies that in countries with high levels of electricity insecurity, firms find it unattractive and unprofitable to expand or move industries with enhanced productivity, as this will mean more reliance on electricity with its associated high cost (Abeberese, 2012).

Frederick and Asamoah (2014) did a study on how the performances of 70 SMEs within Accra Ghana have been affected by unreliable power supply using historical data over a period of time. They found that SME business performances were directly linked to power instability situation in Accra. Another study by Paul et al. (2018) on factors affecting the investment climate, SMEs productivity and entrepreneurship in Nigeria, revealed that SMEs contributed significantly to economic growth in Nigeria. However, among the factors affecting investment climate and SMEs productivity include poor power availability, as access to electricity ranked second in position (27.2%) behind finance as obstacles to business development in Nigeria.

Ado and Josiah (2015) examined the impact of deficient electric power supply on the operations of small scale businesses operating in North-East Nigeria. They discovered the severity of electricity supply outages and the costs associated with it, including self-generation costs, on the operation of this class of businesses in the region. Hence, the need for policy attention towards revamping electricity in Nigeria becomes critical in enhancing the performance of the SMEs sector to realize its potential in contributing to economic development of the country.

3. Methodology

3.1. Research Design

The research design adopted by this study is a descriptive survey approach (Muhammad et al., 2017; Ohiare, 2015; Adenikinju, 2005). Descriptive study involves accurate portrayal of events, persons, or situations. It is aimed at collecting data and describing them in a systematic manner, the characteristics, features and facts about a given population. In this method, the problem is structured based on the previous research problem and may involve multiple variables (Borg and Gall 1989).

3.2. Population and Sample Size

The SMEs sector in Nigeria serves as the population size for the study. However, for availability of data and simplicity, this study focuses on 2676 SMEs in manufacturing industry and service sector which constitute the sample size for the study. The manufacturing industry covers SMEs in the following businesses: food & beverage, garments, fabricated metal products, non-metallic mineral products, furniture, publishing, and other manufacturing. The service sector covers SMEs in retail, wholesale, transport, hotels & restaurants, repair of motor vehicles, and other services (World Bank, 2015). The criteria for classification of business unit as SMEs was based on the definition of SMEs by the Central Bank of Nigeria as firms with capital (aside land) between N5 million to N500 million and with a labour force of 1 to 300 workers (CBN, 2010).

3.3. Sources of Data

The study made use of secondary data from the Nigeria Enterprise Survey, 2014, conducted by the World Bank. The survey covers a total of 2676 SMEs in the country. The survey sample was selected using stratified random sampling (World Bank, 2015). Three levels of stratification were used in the survey: industry, region and size.

i. Industry stratification: For panel firms, the universe was stratified into manufacturing industries and two service sectors (retail and other services). For fresh firms, the universe was stratified into seven manufacturing industries and six service sectors.

ii. Regional stratification: SMEs in 19 states were captured: Abia, Abuja, Anambra, Cross River, Enugu, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kwara, Lagos, Nasarawa, Niger, Ogun, Oyo, Sokoto, Zamfara.

iii. Size stratification: Small (1 to 19 employees), medium (20 to 99 employees), and large (more than 99 employees).

Wide ranges of relevant questions which revealed the condition of the business establishment for the study were covered in the survey. The questions covered area such as: ownership of establishment, years in operation, number of employees, energy (electricity) access, usage, and generation, frequency of electricity outages, and losses and costs from electricity outages, among others.

3.4. Method of Data Analysis

Descriptive statistics, simple percentages, tabulation, charts, and graphs were majorly employed as analytical tools for the study (Forkuoh and Li, 2015). Data were analyzed using STATA 14.0 statistical software.

4. Result and Discussion

A total of 2676 SMEs were surveyed through the World Bank Enterprise Survey in Nigeria, 2014. The SMEs were further categorized into three groups as small, medium and large. The categorization was based on number of employees (see Table I). A total number of 1711 (64%) small, 740 (28%) medium, and 225 (8%) large SMEs were surveyed. This outcome revealed the dominance of small SMEs in the Nigerian SME sector. This may be as a result of the high cost involved in establishing and running medium or large SMEs, the risk level associated, and the managerial and technical requirements which serve as hindrance to the business community.

Table 1. Categorization of SMEs in Nigeria Based on Size

Category of SMEs	Number of Participation	Percentage (%)
Small (1-19)	1711	64
Medium (20-99)	740	28
Large (100 and above)	225	8
Total	2676	100

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

4.1. Level of Electricity Energy Insecurity Experienced by SMEs in Nigeria

The results in Tables II, III and IV explain of the level of electricity energy insecurity experienced by the SMEs sector in Nigeria. Table II shows the number of SMEs in aggregate that have experienced electrical outage during the previous fiscal year. A total of 2027 (76.4%) of the SMEs experience electrical outage in the previous fiscal year while 597 (22.5%) have not, the remaining 28 (1.06%) indicated no ideas to the question. The result reveals that most SMEs in the country experience electrical outage which shows the level of non-reliability of power supply in the country.

Table II. SMEs (aggregated) that Experienced Electrical Outages

Did your firm experience electrical outage during the previous fiscal year?		
Total SMEs	Frequency	Percentage (%)
Yes	2027	76.4
No	597	22.5
No Idea	28	1.06
TOTAL	2652	100

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

Table III shows that 76.5 percent of the small enterprises experience electrical outage, while 77.7 and 71.3 percents of the medium and large enterprises experience electrical outages respectively. This implies that small enterprises experience more power outage than medium and large enterprises in Nigeria. This could be attributed

to their relative sizes and capacity for self-generation of more reliable power as backup. The result is in line with the findings of Henry et al., (2016) that small enterprises are most prone to frequent power outages in Nigeria.

Table III. SMEs that Experienced Electrical Outages

Did your firm experience electrical outage during the previous fiscal year?						
	Yes		**No**		**No Idea**	
SMEs	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Small (1-19)	1307	76.5	382	22.3	19	1.1
Medium (20-99)	566	77.7	155	21.3	7	1.0
Large (100+)	154	71.3	60	27.7	2	1.0
Total	**2027**		**597**		**28**	**2652**

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

Table IV shows that 75.7 percent of the total SMEs surveyed in Nigeria experience electrical outages 32.8 times in a month, with about 11.6 hours duration on the average. This implies that on the average, SMEs in the country experience electrical outages which last for a period of 11 hours on daily basis. This reality is a miserable situation considering that most of these SMEs depend on electrical energy for operation. The aggregate result does not reveal the disparities among the various categories of SMEs in the country. The situation appears worse among large and medium enterprises. Large enterprises experience electrical outages up to 44.2 times in a month with duration of 11.4 hours, while medium enterprises experience electrical outages of 39.5 times in a month with 14.7 hours duration. Small enterprises have the least number of electrical outages and duration in a month.

Table IV. Electrical Outages Experienced by SMEs in a typical month

SMEs	**Frequency**	**Percentage**	**No. of Outages**	**Duration of Outage**
SMEs in Aggregate	***2027***	***75.7***	***32.8***	***11.6***
Small (1-19)	1307	64	31.1	10.9
Medium (20-99)	566	28	39.5	14.7
Large (100+)	154	8	44.2	11.4
Total	**2027**			

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

From the results so far, it can inferred that the SMEs in Nigeria experience high rate of energy insecurity. This is evident in the high percentage of SMEs that witness electrical outages within the previous fiscal year, number of outages experienced in a month and the duration of the electrical outages on the average. The result is disturbing at all instance compared to that of the sub-Saharan Africa (SSA). SMEs

in the SSA recorded power outages of about 9 times in a month with average of about 6 hours. Small, medium and large SMEs in SSA experience monthly power outages of about 8, 9 and 9 times respectively with durations of 6, 6 and 5 hours respectively (World Bank, 2015).

4.3. Cost of Electricity Energy Insecurity to the SMEs

Average losses (% of annual sales) of typical electrical outage of SMEs in Nigeria are shown in Table V. The result shows that only 1930 (73%) SMEs responded to the question related to losses as a result of electrical outage in the survey. Despite this shortfall, the percentage of SMEs that responded to this particular survey question is high enough to be used as basis for drawing conclusion on the outcome of the result. On the aggregate, average loss recorded by SMEs in the country is 15.6 percent of their annual sales. This result is in sharp contrast with that of the Sub-Saharan Africa (8.3%) (World Bank, 2014). The losses incurred by the SMEs in Nigeria range from destruction of raw materials, loss of output, restart cost, to damage of equipment (Adenikinju, 2003).

Large enterprises in the country experience the highest percentage loss (23.8%) as a result of electrical outage with small and medium enterprises recording 16.3 and 11.9 percent respectively. From the survey, it is observed that the monetary value of the losses by the SMEs in Nigeria amount to over five hundred thousand naira (N500, 000.00) on the average as percentage of their annual sales. Large firms report the highest monetary value of losses of over one million naira (N1, 000,000.00) as a percentage of their annual sales. The survey further reveals that SMEs spend a total of N766, 801.5 naira (USD 2,126.93 at USD360.52 exchange rate) on the average as annual cost of electricity in their business operation (World Bank, 2014). The result is an indication that unavailable, unreliable and inconsistent supply of electrical power in Nigeria constitutes avoidable costs to the SMEs sector in the country. These costs could have been avoided if the development of the energy sector has been a priority of the government. These costs, coupled with the unfavourable business condition in Nigeria signify that sustainability and continuation of SME businesses face serious threat as highlighted by Igwe et al., (2018).

Table V. Average Losses of Typical Electrical Outage to SMEs in Nigeria (% of annual sales)

SMEs	Frequency	Percentage	% of Losses	Mean ($\bar{X}$)
SMEs in Aggregate	***1930***	***73***	***15.6***	
Small (1-19)	1241	73	16.3	16.0 (21.9)
Medium (20-99)	543	73	11.9	
Large (100+)	146	57	23.8	
Total	**1930**			

Source: Author's Analysis using data from World Bank Enterprise Survey 2014
Note: Value in bracket = Standard Deviation (SD)

4.4. Level of Electricity Generation by SMEs in Nigeria

Ownership/share of a generator by SMEs in Nigeria for electricity generation is shown in Tables VI and VII. The results reveal the rate of self-generation of electricity power by the SMEs in Nigeria. Table VI shows that 78.2 percent of total SMEs in the country own or share a generator in their business outlets over the last fiscal year, while 21.3 percent do not, and the remaining 0.5 percent indicated no idea. This figure is an indication of the level of uncertainty and unreliability of electrical power supply in the country. Hence, SMEs resolved to self-generation of electricity through the use of a generator as a backup.

Table VI. Ownership/Share of Generator over the last Fiscal Year by SMEs in Nigeria

Did this firm own or share a generator over the last fiscal year?		
Total SMEs	Frequency	Percentage (%)
Yes	2074	78.2
No	565	21.3
No Idea	13	0.5
TOTAL	**2652**	**100**

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

The result in Table VII reveals that medium and large enterprises in the country record the largest percentage of SMEs that own or share a power generator for the supply of electricity. From the result we can infer that most SMEs in Nigeria depend on self-generation of electricity as backup, and power generator is widely used other than any alternative energy supply. This indeed poses additional costs to the SMEs in Nigeria, as revealed above, which affect their performances. Many SMEs have either close shops or relocated to another country in Nigeria as a result of these accumulated operation costs caused by energy insecurity in the country (Adenikinju, 2003). This result is in agreement with the findings of George and Oseni (2012) that SMEs are faced with electrical power self-generation in the country which constitute to more costs to them.

Table VII. Ownership/Share of Generator over the last Fiscal Year by SMEs in Nigeria

Did your firm own or share generator over the course of fiscal year?						
	Yes		**No**		**No Idea**	
SMEs	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Small (1-19)	1274	74.5	424	24.8	10	0.7
Medium (20-99)	618	84.8	107	14.6	3	0.6
Large (100+)	182	84.3	34	15.7	0	0.0
Total	**2074**		**565**		**13**	

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

On the aggregate, average electricity generated by the SMEs in the country through a power generator stands at 56 percent, as shown in Table VIII. This gives a picture of the level at which electrical energy is unstable and unreliable; hence, the SMEs rely on alternative source of electricity – majorly electrical power generator – for their business operation. This finding is in agreement with the findings of Yekeen and Gideon (2016) in their study on energy poverty and its spatial differences in Nigeria, that there is energy instability which leads to high energy poverty in the country. The result is more disturbing when the SMEs are disaggregated on categorical basis. Large enterprises have the highest percentage (64.8%) of average electricity generation through a generator for their business operations followed by small firms (59.2%). Medium firms have the least percentage (56.1%). This shows that self-generation of electrical power is critical in the operation of SMEs in Nigeria. Since most of the SMEs depend on electrical power to carry out most of their activities, they are left with no option than self-generation. It has been argued by many authors that it costs much to generate electricity by self than the public energy supply. Just as much as this argument many be valid, SMEs in Nigeria consider it as the only option which in turn exerts more costs on them (Nigerian Economic Summit Group, 2017). The survey further shows that most SMEs indicated electricity as a major obstacle to business operation in Nigeria.

Table VIII. Average Electricity from a Generator used by SMEs in Nigeria (%)

SMEs	Frequency	Percentage	Average Electricity from Generator (%)	Mean ($\bar{X}$)
SMEs in Aggregate	***2074***	***77.5***	***56***	***56.3 (28.7)***
Small (1-19)	1274	74.4	59.2	
Medium (20-99)	543	73.4	56.1	
Large (100+)	182	80.1	64.8	
Total	**1930**			

Source: Author's Analysis using data from World Bank Enterprise Survey 2014

5. Conclusion and Recommendation

This study is an empirical investigation on how energy (electricity) insecurity affects the performance of SMEs in Nigeria. No doubt, huge investment has been made to improve electrical energy generation and supply by the government; to meet the demand in the country; however, the outcome seems disappointing. It is quite clear that whatever investments and policies the government of Nigeria has made towards resolving the electricity challenges are far from appropriate by reason of the findings from the study.

The following conclusion can be drawn from the result of the study:

i. Electricity insecurity is a reality among SMEs in Nigeria.

ii. Electricity outage is a daily occurrence among the SMEs in their daily operations, and such daily outage lasts for long hour durations.

iii. Electricity insecurity exerts much cost on SMEs in Nigeria as they rely on generator for electrical power source for their business operations.

iv. Electricity insecurity is a major constraint to the performance of SMEs in Nigeria.

Based on the conclusion made from the findings of the study, we recommend that:

i. Government should design regulatory policies for generation and distribution of electricity targeting not only the households (final consumers), but also the SMEs sector and investors as priority. This is essential considering that the devastating effect of energy insecurity on the business sector has a negative trickle down effects on the household.

ii. There should be deliberate, detailed and pragmatic commitment on the part of government in addressing the electricity issue as a state of emergency in the country.

iii. The private owners of power generation and distribution companies should be encouraged to invest in new technologies to improve generation efficiencies. Institutions should also be put in place to see to power transmission expansion and improved efficiency in power distribution to SMEs sector.

iv. Government should find a way to ensure peace in the Niger Delta (the hub of crude exploration and gas production) to minimize or eradicate pipeline vandalism that usually disrupts supplies to gas power plants.

v. Government should build institutions around the power sector that are robust enough to self-check corruption across its agencies and the private investors to reduce the level of wastes which culminate to low reliable supply, that leads to disruption of business operations and high operation costs.

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