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Viability Assessment of Power Distribution Business in Edo State, Nigeria

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ABSTRACT

This work sought to determine the viability of the power distribution business in Edo State, Nigeria. The data utilized were distribution and commercial records of Ehor, Ubiaja and Uzebba 33 kV feeders from 2015 to 2018. The potential revenue from the energy not served (ENS) was determined according to IEEE STD 1366 Energy Index. Findings showed that it will require a total investment of 6.3 billion Naira to distribute and collect 4.7 billion Naira worth of energy in the study area. This was due to the high level of aggregate technical, commercial and collection (ATC&C) losses (up to 66%) in the system and the poor tariff. Adequate customer metering and continuous monitoring of customer network facilities is highly recommended for proper energy accounting and reduction of commercial losses respectively. The findings from this work will assist in policy formulation and strategic business decision in the power sector by the investors, management and government.

1. INTRODUCTION

A business venture can be seen as viable if the financial return can adequately cater for all the expenses and there is more for the investor to share as profit. In the power distribution sector of Nigeria, power is purchased by the distribution companies from The Nigerian Bulk Electricity Trading (NBET) Plc and sold to the customers who pay for the energy they consumed (Ejoh, 2021). Therefore, a viable Distribution Company (DisCo) must be able to make profit after paying for the cost of power purchased from NBET, the running cost and any other loss incurred during the distribution power.

The survivability of any business depends largely on the availability of the product to sell and the customer base ready to pay for the product. Therefore, it is expected that every customer should pay for the energy consumed by them for the utility providers to able to remain in business. The product marketed by the

distribution companies is electricity which is in high demand by various customers because it is very essential to the wellbeing of individuals, business operations, environmental security and national prosperity (Iweama et al., 2020). Therefore, the customers for the power industry include residential, commercial (small scale business owners) and industrial users. These customers deserve quality and safe power to remain as loyal customers. However, many have complained of poor services as a result of long duration and high frequency of outages (Okoro and Chikuni, 2007). These have led to increase in the cost of living and production prompting many customers to seek alternative solutions.

The cost paid for power outages may come in form of increased production cost, insecurity, health hazard, unemployment, underemployment, material wastages, impeded social and night life amongst others (Omoroghomwan, et al., 2020). Consequently, the effect of power blackout is usually felt by everyone. This means that, apart from the power users which could be for personal (residential) or for commercial purposes, the power utility companies also feel the heat of outages.

The financial impacts of outages on the viability of businesses in society have been researched by different scholars. Adenikinju (2005) highlighted the financial consequences of power outages to the production industry. Consequently, the restructuring and commercialization of the utility company was suggested. The work of Forkuoh and Li (2015) on cold-store in Asafo markets in Kumasi also revealed significant increase in production cost in the advent of power outages. In the absence of backup generators, the preserved stocks could go bad if the outages persist for too long. Nnanna and Uzorh (2011) focused on the industrial axis of Nigeria. These include Kano and Kaduna in the north, Lagos/Ibadan axis in the western part and Anambra/Aba in the east. This work also reported significant financial losses to commercial users of electricity due to power outages. These findings are very similar to report of Bental and Ravid (1982). Their work showed that commercial businesses depended on backup generators to meet production goal during power outage event. Adenikinju (2003) posited that the cost of production was three times higher when alternative power such as a backup generator was used for production compared to that of the utility provider. The worst hit by this production cost increase due to power outages are the small-scale industries (Ahmed and Mallo, 2015). This is as a result of the lack of funds to acquire and maintain backup generators to keep production activities during outages. This prompted Forkuoh and Li (2015) to suggest that small and medium scale enterprises (SMEs) operating in clusters should combine resources to own a common generator as back up for power supply.

The reviewed literature has shown that there are a lot of financial impact on the electricity dependent businesses as a result of black out. To this effect, Uchendu (1993), suggested a legislation that will compel utility providers to bear the financial consequences of commercial losses due to power outages.

It is obvious that extensive studies have been conducted to study the financial impact of power outages. However, the reviewed works showed that these studies mainly focus on the customer and user end of the divide thereby neglecting the possible losses incurred by the utility providers during such outages. To this end, Omoroghomwan et al. (2020) conducted research to investigate the commercial losses to the distribution companies as a result of power outages. In that work, the cost of the energy not served (ENS) was determined to assess the potential additional revenue that could have been collected by the utility company assuming there was no outage. However, the work did not consider the cost of purchasing that energy and the cost of collecting that revenue such as staff cost, mobility, operation cost, technical and revenue losses. In this article the commercial viability of the utility companies in Edo State, Nigeria under the prevailing conditions will be determined by comparing the financial requirement for power distribution with the equivalent revenue from the distributed energy. This study has become inevitable due to the need to give a balanced view of the financial flow in the power industry. This will assist policy makers in taking decisions and serve as a guide for access to financial aid and intervention. It will also be of assistance to interested investors and management in the sector.

2. METHODOLOGY

The data used for this study were obtained from the interruption records of the 33 kV feeders in Irrua Transmission Station in the central part of Edo State, Nigeria as documented in the Central Load Dispatch database. These include four years of outage records of Ehor, Ubiaja and Uzebba 33 kV feeders from 2015 to 2018 as presented in Table 1. A sample of the detailed report of each event (which include time of outages, interrupted load (Amps) and the duration (hours) of the outage) is presented in Table 2. The unit cost of energy with which Benin Electricity Distribution Company (BEDC) Plc purchased the energy from The Nigerian Bulk Electricity Trading Plc is presented in Table 3. Table 4 represents the average sale price for unit energy for the power distributed by Ehor, Ubiaja and Uzebba feeders. Also, the aggregate technical, commercial and collection (ATC&C) records were obtained as presented in Table 5.

Table 1: Outage records of Ehor, Ubiaja and Uzebba 33 kV feeders (Source: BEDC)

Feeders	Outage records				
	2015	2016	2017	2018	Total
Ehor	378	426	416	573	1793
Ubiaja	351	415	348	429	1543
Uzebba	201	339	280	364	1184
Total	930	1180	1044	1366	4520

Table 2: Sample of Ehor, Ubiaja and Uzebba 33 kV feeder outage event records (Source: BEDC)

Feeder	Day out	Time out (hh:mm)	Duration (hr)	Load (A)
Ehor 33 kV feeder	09-03-15	10:00	0.42	114
	10-03-15	18:17	0.45	170
	10-03-15	0:14	6.97	240
	11-03-15	9:15	1.08	190
	13-03-15	11:20	1.47	120
	14-03-15	23:56	6.77	272
	14-03-15	0:10	7.77	144
Ubiaja 33 kV feeder	28-03-15	10:39	4.87	140
	29-03-15	17:55	19.15	166
	30-03-15	23:52	12.55	56
	04-04-15	17:04	25.57	140
	05-04-15	13:35	4.32	80
	09-04-15	19:12	16.63	116
	09-04-15	13:15	0.85	116
Uzebba 33 kV feeder	09-07-15	16:10	0.3	204
	09-07-15	20:26	0.15	1
	10-07-15	8:59	6.35	356
	10-07-15	7:50	0.67	356
	13-07-15	15:15	5.68	262
	14-07-15	11:55	8.45	248
	15-07-15	9:05	0.6	240

Table 3: Average cost (₦) of electricity unit to BEDC (Source, BEDC)

Year	2015	2016	2017	2018
Average cost (₦) of electricity unit	12.98	19.77	23.06	24.93

Table 4: Average sales price of energy (₦ /kWh) based on the billed amount of the power supplied from Ehor, Ubiaja and Uzebba 33 kV feeders by Benin Electricity Distribution Company (Source: BEDC)

Months	Average sales price of energy (₦ /kWh)			
	2015	2016	2017	2018
Jan	20.31	20.83	27.17	33.76
Feb	22.56	21.23	33.69	33.63
Mar	24.55	27.06	33.89	34.05
Apr	25.35	27.1	33.72	33.94
May	23.21	27.17	33.95	33.93
Jun	23.73	27.61	33.62	33.87
Jul	23.43	27.14	33.76	33.95
Aug	21.86	26.96	33.54	34.02
Sep	21.64	27.21	33.52	33.77
Oct	21.48	27.2	33.79	33.94
Nov	21.23	27.06	33.54	34.01
Dec	21.54	27.24	34.02	33.99
Average	22.57	26.15	33.18	33.91

Table 5: The average aggregate technical, commercial and collection losses on Ehor, Ubiaja and Uzebba 33 kV feeders (Source: BEDC)

Year	2015	2016	2017	2018
ATC&C losses (%)	66.75347	58.7319823	66.1753664	59.7468829

The energy not served according IEEE STD 1366 – 2012 and the consequent revenue loss to BEDC as a result of outages were determined using Equations 1 to 3 (Billinton and Allan, 1996; IEEE, 2012) and the outage information presented in Table 2.

$$P = \sqrt{3} IV \cos \emptyset \quad (1)$$

$$ENS = \sum_{i=1}^{N} P_i \times O_{di} \quad (2)$$

$$RL = ENS \times T_A \quad (3)$$

Where P is load lost (kW) due to outage, I is system load current (Amps) before the outage, V is system voltage (33,000 V), RL is revenue lost, T_A is tariff, O_{di} is outage duration in hours and $\cos \emptyset$ is power factor taken as 0.85.

The amount it would have cost to purchase the energy not served (assuming it was distributed) was calculated using Equation 4.

$$C = ENS \times T_C \quad (4)$$

C is cost of purchasing the energy not served (₦) and Tc is cost of purchasing unit of power by Disco (₦) from NBET.

The ATC&C losses were calculated using Equation 5.

$$K = h \times RL \quad (5)$$

K is the aggregate technical, collecting and collection losses (₦) and h is the aggregate technical, collection and collection losses (%).

The other expenses such as salaries, operation and maintenance were fixed at 2% of the total gross revenue (Xiong, 2020). The estimated costs in this category were therefore calculated using Equation 6.

$$E_o = RL \times \frac{2}{100} \quad (6)$$

Where Eo represents the other expenses.

The total cost of distributing power were calculated by summing all the constituent financial costs and loss components together as presented in Equation 7.

$$E_s = C + K + E_o \quad (7)$$

Where Es is the summation of all the expenses and incurred losses.

The net profit that would have been lost due to outage was then determined using Equation 8.

$$P_n = RL - E_s \quad (8)$$

3. RESULTS AND DISCUSSION

The commercial performance of the electric power supply industry depends on the total revenue collected and the total investment in the business. The revenue is the total amount paid by the customers based on their bills for the energy they consumed. While the investment includes the cost of purchasing the distributed energy from NBET and the cost of collecting the revenue from the customers such as staff cost, mobility, operational cost, technical and other commercial losses such as meter bypass. Hence, a fair viability appraisal of the power supply business will involve the comparison of all the components of revenue and expenses with the help of Equations 1 - 8. Therefore, to determine the power/load lost during the outage event that occurred on Ehor feeder on 09/03/15 (the first record in Table 2), the following data were utilized.

I = 114 A, V = 33,000 V, $\cos\emptyset$ is the power factor taken as 0.85

Therefore, from Equation 1:

$P = \sqrt{3} \times 114 \times 33{,}000 \times 0.85$

= 5,538,578 W

$ENS = P_i \times O_{di}$

$O_{di} = 0.42\ h$

Using Equation 2, the energy loss is:

$ENS = 5{,}538{,}578 \times 0.42$

= 2,326,202 Wh

= 2,326.202 kWh

From Table 4, the tariff per unit (kWh) was ₦ 24.55

Therefore, the revenue loss can be obtained by substituting these values into equation 3.

$RL = 2{,}326.202 \times 24.55$

= ₦ 57,108,277.76

The above calculations are presented in Table 6.

Table 6: Sample results from the calculation of energy not served and revenue loss for the outage event that occurred on Ehor 33 kV feeder on 09/03/15

Parameters	Current (A)	Duration (h)	Tariff (₦)	Power (W)	Energy (Wh)	Revenue lost (₦)
Symbols and equations	I	O_{di}	T_A	$P = \sqrt{3}\, IV \cos\emptyset$	$ENS = P^* O_{di}$	$RL = ENS \times T_A$
Values	114	0.42	24.55	5,538,578	2,326,202.00	57,108,277.76

All the monetary equivalent of the energy not served due to outages are not necessarily potential profit to the distribution company because there are financial costs and aggregate technical, commercial and collection losses incurred during the process of power distribution.

The financial costs of power distribution include

1. Cost of purchasing power from NBET.
2. Running cost (salary, operation, maintenance)

To determine the cost of the energy not served (ENS), the appropriate values of ENS (2,326,202.00 kWh from Table 6) and the unit cost of energy (₦12.98 from Table 3) were substituted into equation 4.

Therefore:

C =2,326,202.00 × 12.98

= ₦ 30,194,101.96

The ATC&C losses were calculated using Equation 5.

For instance, the monetary equivalent of the ATC&C loss in our case, when the percentage (h) was 66.75% (as presented in Table 5) and the revenue loss (RL) was N57,108,277.76 (from Table 6) is done by substituting these values into Equation 5.

Therefore:

K = (66.75/100) × 57,108,277.76

= ₦38,119,775.41

The other expenses such as salaries, operational and maintenance costs were calculated using Equation 6.

Hence, for the case under consideration, when the gross revenue loss (RL) was ₦ 57,108,277.76,

Eo = 57,108,277.76 × (2/100)

= ₦ 114,216.56

The total cost of distributing power was determined by substituting the appropriate values into Equation 7.

Therefore, the total expenses and losses that would have been incurred by the distribution company to distribute energy not served due to outages and subsequently collect the money from customers in our study event would have been

Es = 30,194,101.96 + 38,119,775.41 + 114,206.56

= ₦68,428,083.93

Then, equation 8 was used to determine the net financial status (whether profit or loss) of the utility company after distributing the energy purchased from NBET.

For the case under review, the net profit would have been

=57,108,277.76 - 68,428,083.93

= - ₦11,319,806.17

This case shows a financial loss because the total expenses incurred in the process of power distribution was more than the equivalent sale amount of the energy.

These steps were repeated for each event presented in Table 1 using the information from Table 2 to determine the financial cost of each component of power distribution business and the results are presented in Table 7.

Table 7: Financial implications of outages

Items	Energy not served (kWh)				
	2015	2016	2017	2018	Grand Total
Ubiaja	13,384,750	10,279,441	7,866,213	10,863,552	42,393,956
Ehor	11,574,253	17,169,640	10,295,703	17,586,194	56,625,790
Uzebba	15,559,542	17,427,684	14,388,124	18,003,306	65,378,656
Total energy	40,518,545	44,876,765	32,550,040	46,453,052	164,398,402
Revenue loss (₦)	914,503,561	1,173,527,405	1,080,010,327	1,575,222,982	4,743,264,275
Cost of power (₦)	526,015,685	887,373,302	750,455,943	1,157,970,636	3,321,815,566
ATC&C losses (₦)	610,462,860	689,235,908	714,700,791	941,146,631	2,955,546,190
Other running costs (₦)	18,290,071	23,470,548	21,600,207	31,504,460	94,865,285
Total expenses (₦)	1,154,768,616	1,600,079,758	1,486,756,940	2,130,621,727	6,372,227,042
Net profit (₦)	-240,265,056	-426,552,354	-406,746,613	-555,398,745	-1,628,962,767

The result showed a total of 164,398,401 kWh were not served to customers due to outages. Of these, it was observed that Uzebba was the worst affected (65,378,655 kWh) as a result of outages followed by Ehor (56,625,790 kWh) and Ubiaja (42,393,955 kWh). This total energy amounted to ₦4,743,264,274 within the period under review. However, the total estimated financial expenses (financial costs and system losses) within the same period were found to be ₦6,372,227,041 comprising cost of power (₦3,321,815,566), ATC&C losses (₦2,955,546,190) and other costs (N94,865,285). Therefore, the result revealed that it will require the sum of ₦6,372,227,041 to purchase and distribute ₦4,743,264,274 worth of energy under the prevailing circumstances. This scenario will lead to a financial loss of ₦1,628,962,767.

The result shows that bulk of the financial losses were as a result of high ATC&C (up to 66%) losses in the system and poor tariff. This was probably the reason for the gradual increase in the quantity of energy not served from 40.5 billion units in 2015 to 46.5 billion units in 2018 in the study area. Consequently, the current commercial status is very bad for power distribution business and cannot sustain the electric power supply industry in Edo State, Nigeria. This is also responsible for the inability of the DisCos to meet up with their financial obligations to the Nigerian Bulk Electricity Trading Plc. Consequently, the indebtedness of the DisCos to NBET has increased to N510.53 billion by 2020 (Ejoh, 2021). This has prompted the Nigerian Electricity Regulatory Commission (NERC) which is the regulatory agency of the power sector to introduce the Meter Asset Provider (MAP) policy in 2018 (Amaza and Okwurionu, 2018). This was to ensure that the customers were metered so that there will be billing transparency (energy accounting) and full payment for power consumed. Another commercial boosting policy that was introduced was the Service Based Tariff (SBT) policy in 2020 (IE, 2020). This was to amend the Multi Year Tariff Order (MYTO) so that customers with higher availability pay higher tariff compared to others. This is referred to as Service Reflective Tariff (SRT). This was to motivate the DisCos to increase availability and sell their product at a higher price for business profitability without compromising customer satisfaction.

Despite these interventions, many DisCos were still found to be financially bankrupt. This prompted the Federal Government of Nigeria to take over 5 out of the 11 DisCos on the 5th of July, 2022 (Udegbunam, 2022). The affected DisCos include Benin, Port Harcourt, Kaduna, Ibadan and Kano.

The undistributed 164 million units of energy (as presented in Table 7) will in no small way impact the customers in the study area. These customers include Watch Tower of Jehovah Witness in Igieduma, Ambrose Alli University in Ekpoma, Irrua Specialist Teaching Hospital in Irrua and AgroTech rice mill in Ugboha. Others are banks, hotels, and recreational centers. They will have no choice than to make up for this energy not served through alternative means (Izuegbunam, et al., 2014). This will result to high operational cost and pollution to the environment (Omoroghomwan, et al., 2020).

4. CONCLUSION

The survivability of any business depends on the market viability of the goods and services being marketed by the company. This work investigated the viability of the power system in Edo State, Nigeria using the outage data of distribution feeders from Irrua Transmission Station located in the central part of Edo State, Nigeria. The current commercial status showed that power distribution business is not viable and cannot sustain itself in Edo State, Nigeria. The high level of ATC&C contributed greatly to the poor commercial performance of the sector in the study area. Also, the tariff was not good enough to cater for the financial costs of power distribution. Hence the introduced Service-Based Tariff (SBT) policy will go a long way in helping the industry if properly harnessed by the DisCos. The Meter Asset provider (MAP) policy should be fully implemented to ensure every customer is metered (preferably with smart prepaid meters). The utility companies should ensure continuous monitoring of customers installations (especially meters) to promptly attend to any issue that could result to ATC&C losses. More research is required to analyze the components of ATC&C losses to determine the best way to tackle the menace.

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6. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

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