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Evaluation of Pre and Post-privatization of Nigeria's electric power system

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Abstract

The study was aimed at evaluating the performance of Nigeria's Electric Power System before and during Privatization using Akure 33kV distribution Network as a case study. This is done to ascertain the effectiveness of the Privatization programme that occurred in the Electric Power Sector in Nigeria. The amount of energy served, the peak load supplied and load flow data of the Network for periods of 2010 to 2015 were collated from the daily log entry recording sheets of the 132/33kV transmission substation office in Akure. The percentage transformer loading and power transferred across the line were determined through load flow studies. The cost of energy not served due to faults was evaluated at a rate of NGN 24.30k per Kilo-Watt Hour (KWHr). The analysis was for a period of pre-privatization (2010-2012) and post-privatization (2013-2015). The results from the study indicate that the energy served decreased by 9% from 2010 to 2015 while the cost of energy not supplied increased largely after the Privatization. A decreasing rate in peak load supplied and transformer loadings were also observed during the Privatization. These results show that less customers might have been served or customers being served by this utility system experienced power outages more frequently in the post-privatization period than in the pre-privatization era.

Keywords: Privatization; Electric; Power-Sector; 33kV-Feeder

1 Introduction

The availability of a consistent, reasonably priced, and efficient energy supply is related to the growth and development of any community or country [1]. The availability of electricity has grown to be a highly important and priceless resource as a result of its seemingly vital involvement in every aspect of our daily life. An extended time of no electricity not only makes people feel uncomfortable, but it also reduces productivity. The amount of energy available for consumption can also be used to gauge a country's standard of life and degree of industrialization [2].

With a GDP of USD569 billion in 2014, Nigeria has the largest economy in Africa [3]. But compared to peer nations, its power industry is underperforming. Around 55% of the population does not have access to energy from the grid, and those who are linked to the grid frequently experience power outages [3].

The first generating facility was set up by the British Colonialist Government in 1898, which is when electricity first became available in Nigeria [4]. The Public Works Department (PWD) was in charge of running the power plants. The Federal Government of Nigeria approved an ordinance in 1950 creating the Electricity Corporation of Nigeria (ECN), which was given the duty of producing, transmitting, distributing, and selling energy in Nigeria. In 1962 the Federal Government of Nigeria formed the Niger Dam Authority (NDA)in 1962, which was in charge of building and maintaining dams and other works in the River Niger, producing electricity using water power, enhancing navigation, and encouraging fisheries and agriculture. NDA sells its electricity to ECN for distribution and sale at utility voltages. The ECN and NDA were combined to form National Electric Power Authority (NEPA) in 1972 with the goal of consolidating

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production and distribution under one corporation to help the country's electrical supply business make efficient use of its human, financial, and other resource bases [5]. To improve the power sector, the National Electric Power Policy was created in 2001, and the Electric Power Sector Reform Act (EPSRA) was passed in 2005, continuing the power sector reform in Nigeria [4]. This has hampered the building of infrastructure that would have aided in the rehabilitation of the power sector and resulting in an insufficient flow of funding to the industry as a whole [5]. With the help of the World Bank, the Federal Government of Nigeria and NERC developed and executed the PSRP in 2017 to clear up and stabilize the power sector's mounting debt [6]. The Nigerian electricity sector was divided into three functions under the Electric Power Sector Reform Acts (EPSRA), generation, transmission, and distribution. Power generation and distribution were then privatized. Nigeria's power sector reform aimed to decrease financial burden on the government and increase efficiency through privatization [7]. The EPSRA and related regulations in Nigeria do not provide a framework to reduce the capital investment risk and credit risk of power producers, the electricity tariff optimization framework is not proceeding as intended despite being enacted into law, and independent power producers are not guaranteed a stable fuel supply [8]. The Power sector recovery program (PSRP) is a program that consists of a number of action plans for governance, policy, and regulation. The entire Nigerian power sector was intended to be reset over a five-year period from 2017 to 2021 by reviving the electricity sector's solvency, enhancing sector transparency and power supply services, addressing issues like consumer complaints, loss, and electricity theft, as well as revising electricity tariffs to a level that can be recovered as a cost. However, there are several factors affecting the electricity sector in Nigeria since the privatization of generation companies and distribution companies. The problem facing electricity sector in Nigeria can be sub categorized into four as show in Table 1, since the major subsectors are consumers, distribution companies, transmission companies and generation companies.

Table 1 Problem facing each sub sector of power sector in Nigeria [9]

Subsectors	Problem Faced
Consumers	Many consumers are faced with unreliable supply of electricity, bad quality of supply that caused damages to equipment this led to dissatisfaction of consumer which they are unwilling to pay their electricity tariff.
DISCOS	DISCO struggles to raise money because of large distribution losses, which are primarily caused by customer non-payment. Due to low power meter installation rates brought on by inadequate investment, which in turn results in declining customer management capabilities, commercial losses are considerable. DISCO'S was unable to perform necessary maintenance due to a lack of investment financing, which caused its distribution assets to deteriorate and cause significant technical losses. High technical, commercial, and collection losses make it difficult to meet demand for power.
TRANSCO	TCN was unable to perform necessary maintenance due to a lack of investment money, which caused the transmission assets to deteriorate and cause significant technical losses. High technical losses make it difficult to produce enough electricity to satisfy demand.
GENCOS	Due to its inability to completely recoup its gas tariff, the Nigerian Gas Company (NGC) restricts the delivery of gas to GENCO's. As a result, GENCO's struggle to generate electricity using all of their installed capacity since they cannot obtain enough gas for that purpose.

The problem stated in table shows that there is no synergy between all the sub sectors of electricity in Nigeria. The Nigeria electricity regulating commission (NERC) that coordinate the activities of all the subsectors are finding difficult to implements its law. Despite the reform in the Electric Power Sector, incessant power outages lasting for days or even weeks is still being witnessed in urban city of Nigeria. The problem encountered by any of the sub sector as overall effect on all the other sub-sector of electricity. This research critically examine and compare the rate of energy consumption and load supplied during the pre and post privatization in the power sector in Nigeria using 33 kv distribution network of Akure as a case study.

2 Material and methods

A study on Akure 33kV distribution network was carried out to ascertain the networks topology and route length of each feeder. Several visitations were made to the 132/33kV transmission injection sub-station located at Oyemekun-Ilesha Road in Akure town, where the data used was obtained. The amount of energy served, the peak load supplied and load flow data of the Network for periods of 2010 to 2015 were collated from the daily log entry recording sheets of the substation. The percentage transformer loading and power transferred across the line were determined through load flow studies. The cost of energy not served due to faults was evaluated at a rate of NGN 24.30k per KWHr. The graphical

analysis of the results, which was for a period of pre-privatization (2010-2012) and post-privatization (2013-2015), was done using Microsoft Excel tool.

2.1 The Structure of Akure Region 33kV Distribution Network

Akure Region 33kV Distribution network consist of seven 33kV distribution feeders fed by a single 132kV sub-transmission line from Oshogbo through three 132/33kV Power transformers (T1A= 30MVA, T2A= 30MVA and T3A=60MVA). Transformer T1A conveys power to Igbaraoke and Owena 33KV distribution feeders, T2A feeds T2B and T2C 33kV feeders and T3A delivers power to OWO, IJU and OBA-ILE 33kV feeders. The line diagram shown in Figure 1 was developed on the information obtained at the 132/33kV sub-transmission injection substation in Akure using standard symbols. The diagram shows the incoming 132kV line from Oshogbo, the three 132/33kV power transformer, the 33kV feeder, the protecting breakers and isolators. The distances of the sub-transmission buses consisting of Owo, Iju, Oba-Ile, T2B, T2C, Igbara-Oke, and Owena buses, from their main buses are 78 km, 34.2 km, 24 km, 0.4 km, 0.4 km, 124.3 km and 47 km respectively.

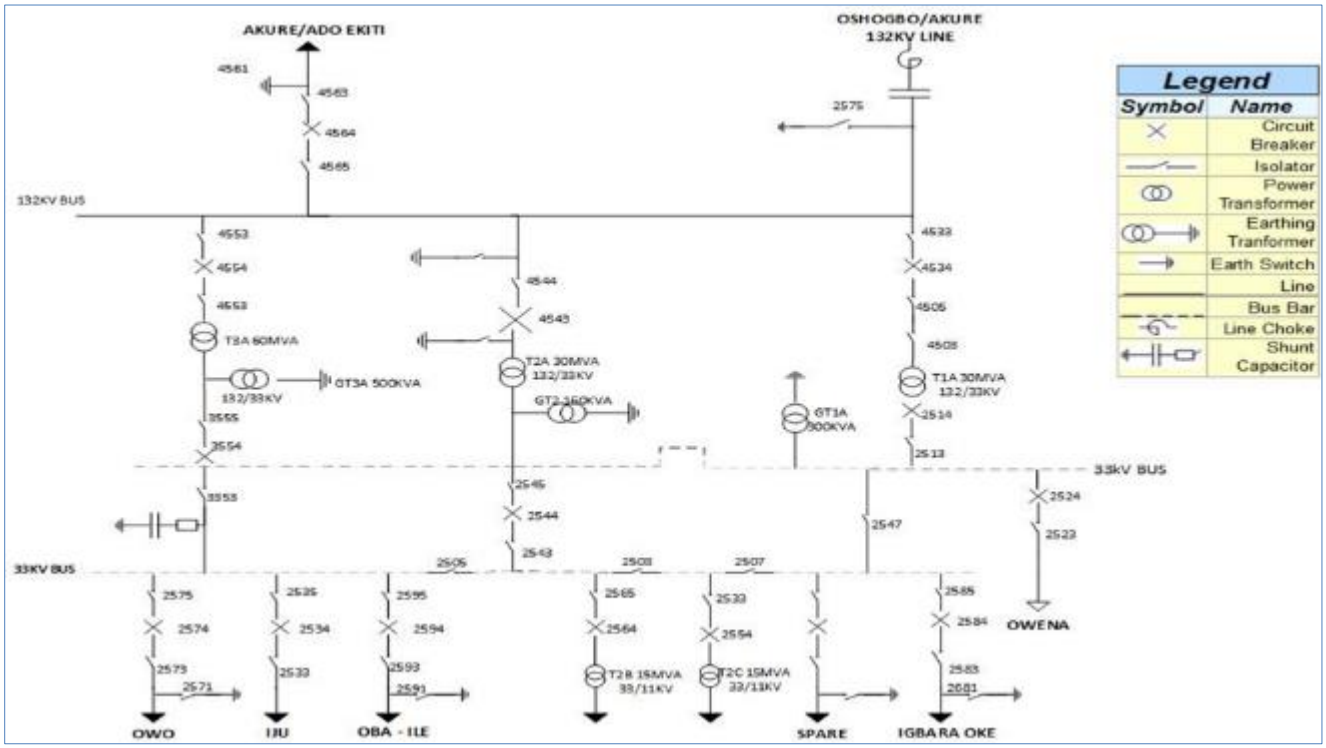


Figure 1 Single Line Diagram of Akure 33 kV Feeder

3 Results and discussion

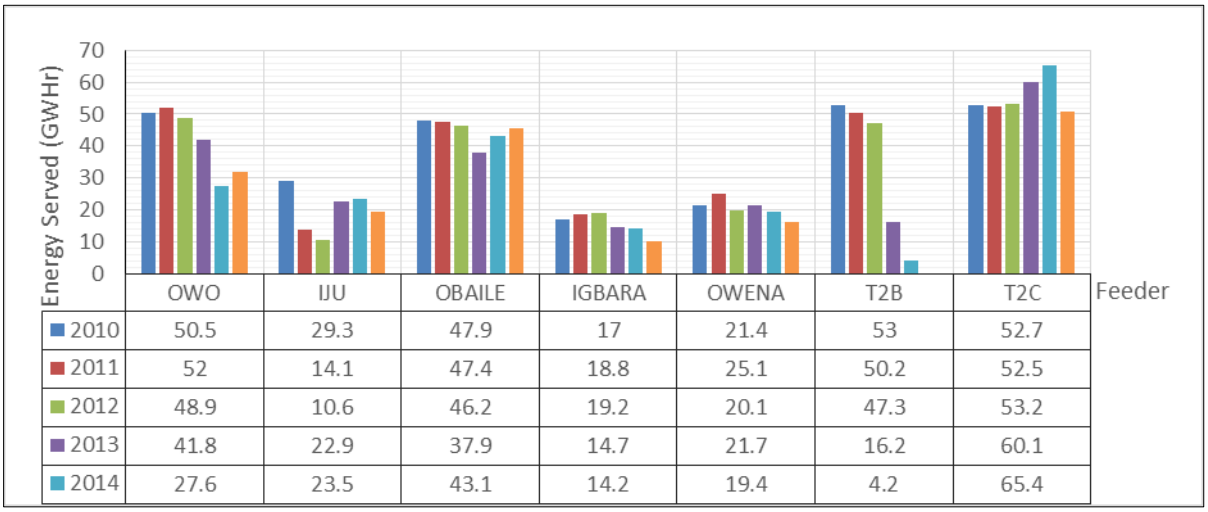
The graph showing the feeder-to-feeder energy served on the network in the periods under study is illustrated by Figure 2.

The results in Figure 2 indicated that Owo 33kV feeder shows that more energy was served on the feeder before the privatization (2010-2012) compared with the value during privatization (2013-2015). The energy served decreased at a rate of 12.5% from 50.5GWH in 2010 to 32GWH in 2015. Also considering the IJU 33kV Feeder, recorded higher energy served before the privatization. The peak energy supply on the feeder during privatization is 23.5GWH, which is energy served decreased at a rate of 50.1% from 29.3GWH in 2010 to 10.6GWH in 2012. Though the energy served decreased from 2013 and 2015, the data shows that more energy was served on the feeder during privatization. Likewise, in Oba-Ile feeder the energy served by the feeder from the year 2010 to 2012 during the privatization is higher than the energy served from 2013 and 2015 during privatization. Though the energy served increased from 37.9GWH in 2013 to 45.7GWH in 2015.

Also, Igbaraoke feeder the energy served on this feeder shows an increasing trend before the privatization from 16.97GWH in 2010 to 19.2GWH in 2012. The energy served, however, decreased at a rate of 18.5% from 2013 to 2015.

Consequently, more energy was served on the feeder before than during privatization. Furthermore the indicates the energy served on Owena 33kV Feeder which shows that more energy was supplied to Owena Feeder before the privatization. A constantly decreasing yearly value of energy served was observed during the privatization. Over the period under study, the energy served decreased at a rate of 5.7% from a value of 21.4GWH in 2010 to 16.5 GWH in 2015, the T2B and T2C 33kV Feeders

These two feeders jointly supplies power to customers within Akure town, a study of the pattern of energy served by the two feeders shows that as one increases the other decreases. In the post privatization period, higher energy was served on feeder T2C as feeder T2B is gradually removed from operation for repair works. A close study on the summation of the energy served by the two feeders indicates that more energy was served between 2010 and 2012 than the period of 2013 to 2015. Hence, the result shows a higher amount of energy served before privatization.



	OWO	IJU	OBAILE	IGBARA	OWENA	T2B	T2C
2010	50.5	29.3	47.9	17	21.4	53	52.7
2011	52	14.1	47.4	18.8	25.1	50.2	52.5
2012	48.9	10.6	46.2	19.2	20.1	47.3	53.2
2013	41.8	22.9	37.9	14.7	21.7	16.2	60.1
2014	27.6	23.5	43.1	14.2	19.4	4.2	65.4

Figure 2 Energy Served Feeder-by-Feeder on Akure 33kV Distribution Network

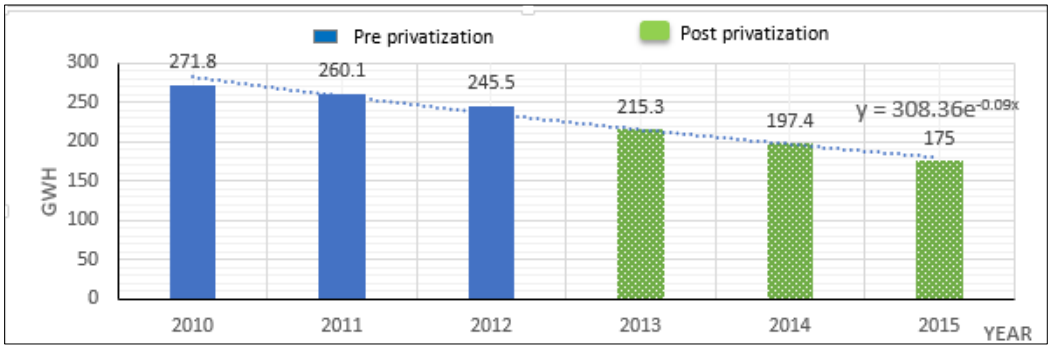


Figure 3 Total Energy served on Akure 33kV distribution network before and during Privatization

The total energy served by the network between the two periods under study, which is the summation of energy served in all the feeders, is shown in figure 3. The results show that more energy was served through the network before privatization (2010-2012). The amount of energy served through the network decreased constantly at a rate of 9% from 271.7GWH in 2010 to 174.9GWH in the year 2015. From the results in Figure 2 and 3, it can be observed that all the feeders but Iju and T2C shows a decreasing trend in the amount of energy served during the privatization. It can therefore be inferred that more energy was served on the network before than during privatization. This implies that privatization of distribution companies is not favourable to consumers as compared to pre privatization because the energy supplied in all the feeders under consideration during pre-privatization is lesser to energy supplied during privatization. This may be associated to the problem of customers that is the consumer not willing to pay for the energy consumed.

3.1 The Cost of Energy Not Served in the Network

An evaluation of the cost of energy not served resulting from load lost for the periods before and during privatization is presented as follows:

The result presented in Figure 4 shows the Calculated Cost of energy not supplied in the network before and during privatization. The calculation is based on #24.30/kWH

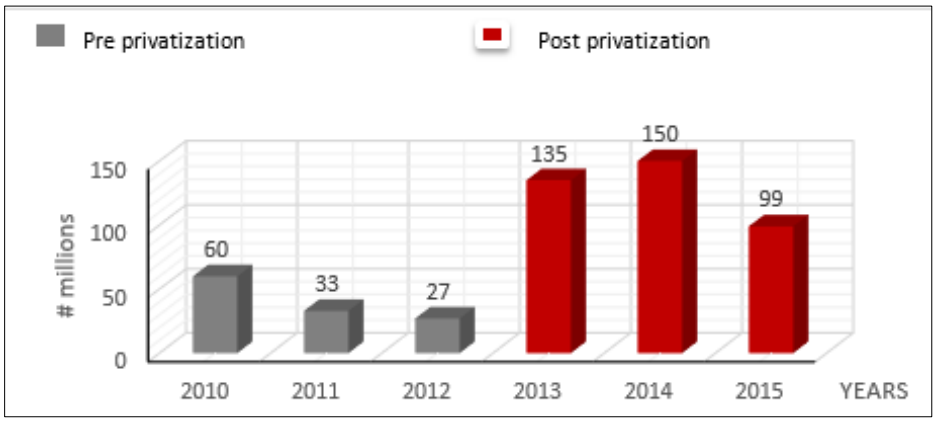


Figure 4 Cost of Energy Not Served on Akure 33kV Network before and during privatization

Figure 4 shows that before the privatization, the highest cost of energy not served was #60 million, which occurred in 2010. This value decreased to #27 million in the year 2012. During privatization, the cost of energy not served increased to #135 million in the year 2013. In the study period, the highest cost of energy not served occurred during privatization in 2014. However, there was drastic change in the cost of energy not served in 2015. The value decreased by 15.5% from #135 million in 2013 to #99 million in 2015. Comparing the result for the quantity of energy served in Figure 3 and cost of energy not served in Figure 4, it is observed that the utility lost more money when it was not delivering power to the customers. More also, less customers had been served in the privatization era compared to pre-privatization period.

3.2 Peak loads Supplied and Available Power

Figure 5, shows the trend of peak loads supplied and the available (generated) power obtained for the pre and post privatization period in Akure Township and the connecting areas.

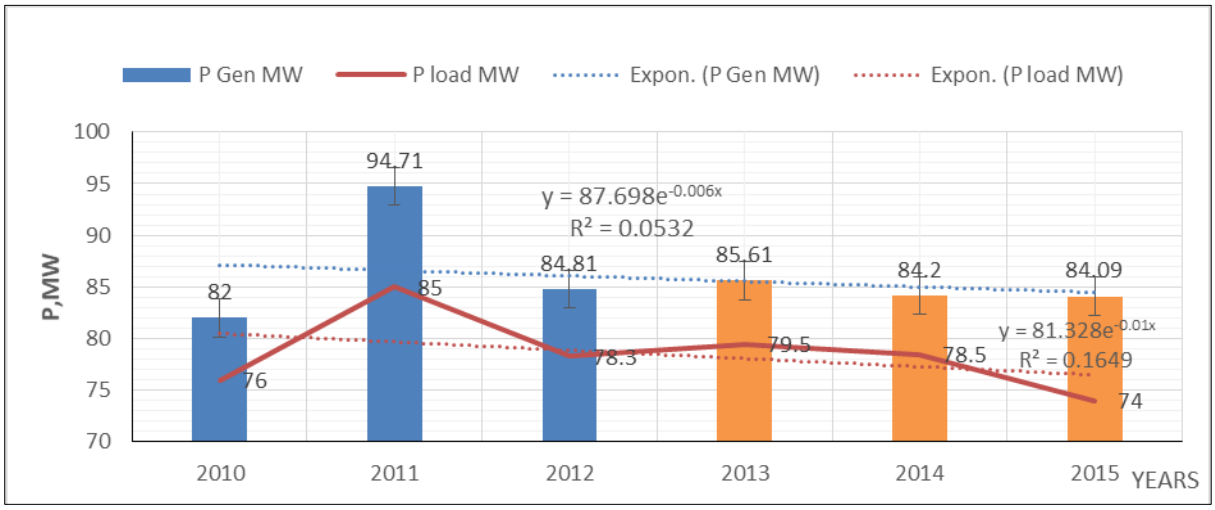


Figure 5 Available Power and Peak Loads in the Pre and Post-Privatization period

Figure 5 shows that maximum power of 94.7 MW was available for supply in 2011 due to sudden increase in the peak load obtained for that year. The available power for distribution increased at a rate of 1.68% from a value of 82 MW in the year 2010 to 84.81MW in year 2012.On the other hand, the available power decreases at a rate of 0.9% from 85.61MW in the year 2013 to 84.09 MW in year 2015.Also, the peak loads supplied decreased at an obtained rate of 1% from76 MW in 2010 to 74 MW in 2015

These results show that less customers might have been served and /or customers being served by this utility system experienced power outages more frequently in the post-privatization period than in the pre-privatization era.

3.3 Power Transferred Across the Feeders

The power transferred pattern across the feeders is shown in figure 6

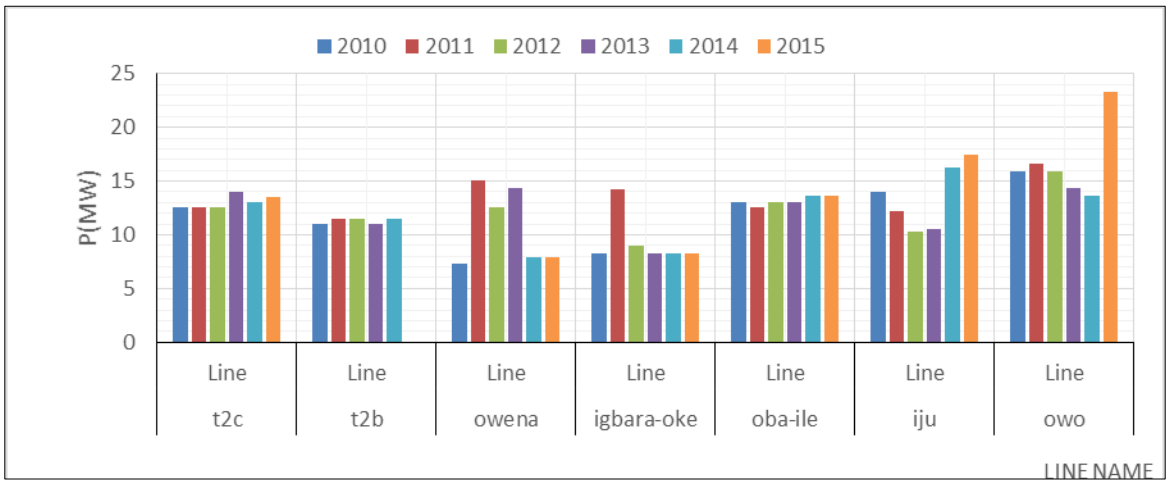


Figure 6 Power-Transferred pattern across the Distribution Lines before and during Privatization

Figure 6 shows a decreasing trend in the power transferred across Igbara-Oke, T2B and Owena lines and an increasing trend at T2C, Oba-Ile, and Iju lines from pre- privatization to post-privatization period. Meanwhile, power transferred at Owo bus maintained a decreasing trend until 2015 when the power transferred increased sharply to 23.3MW from a previous value of 13.6MW in 2014. The overall yearly network power transferred in shown in Figure 7

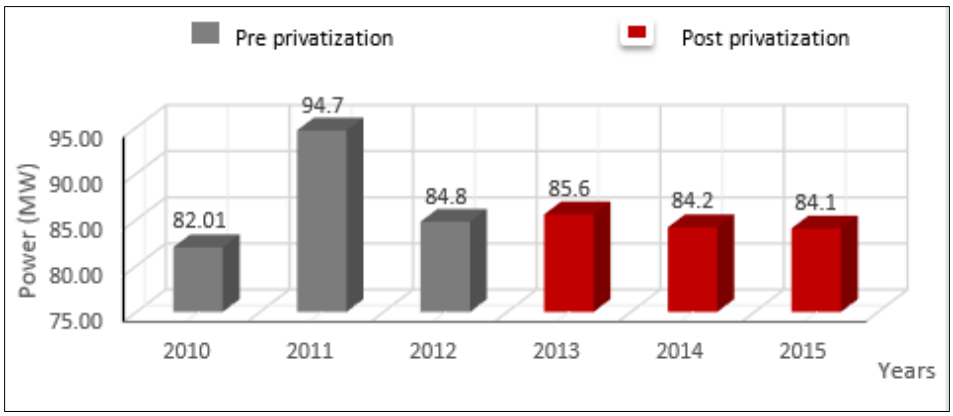


Figure 7 Total network power Transfered

From Figure 7, the network experienced the highest amount of power transferred in 2011. On the average, the result shows an increase in the amount of power transferred in the pre-privatization era. The power transferred decreased slightly from 2013 to 2015.

3.4 Percentage Transformer Loading

The percentage loading on the substation supplying transformers is shown in Figure 8

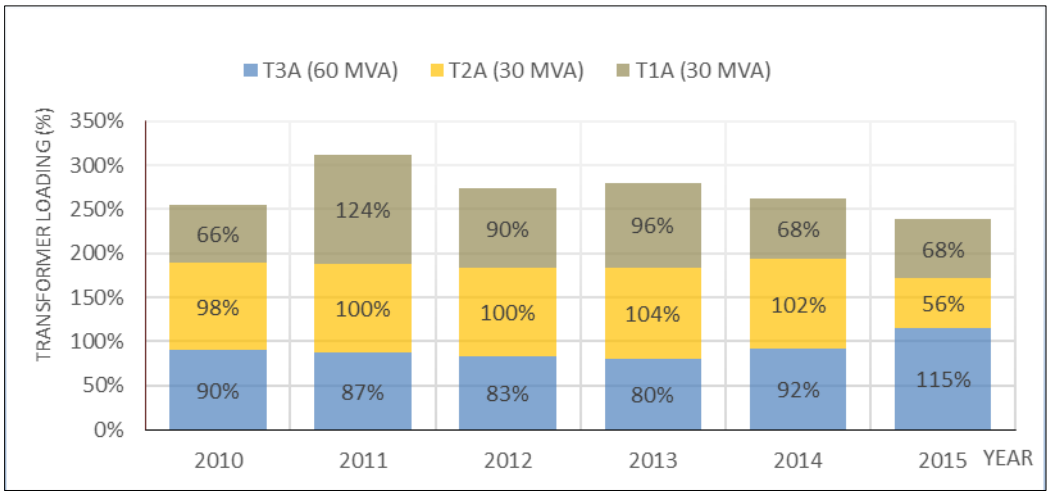


Figure 8 Transformer loading percentages before and during privatization

Figure 8 shows that the normal loading of transformer T1A was exceeded by 24% in 2011, T2A (30 MVA) transformer was fully loaded in 2011 and 2012, and overloaded in the years 2013 and 2014. Transformer T3A (60 MVA) was overloaded in 2015 by 15%. At least, one supplying transformer was overloaded each year except for the years 2010 and 2012. On average, the loading of the connected transformers decreased from 2010 to 2015 at the rate of 2.3%.The result shows that the supplied loads in the post-privatization period is in a decreasing order and that the existing facilities do not have the capacity for delivering power under an intense or increasing loads.

4 Conclusion

Addressing the problems of epileptic supply, improper billing of Electric power, and other challenges faced by the state owned PHCN formed the basis for the Power Sector Privatization. This study provided a basis for assessing the impact and effectiveness of the reform program on the country's Electric power system. From the results analysis, it can be inferred that three years after the reform programme no substantial improvement has been recorded in the utility system as the results indicate a reduction in the amount of energy served, higher revenue lost due to increased load lost, decreasing trend in peak load supplied and a reduction in the percentage loading on supplying transformers. This research recommends that the privatization of power sector should done based on region and a single company should be responsible for generation, transmission and distribution of power to consumer.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

There is no interest of conflict among the Author's, all the author accepted that the manuscript should be published in the Journal.

References

[1] Joseph IO. Issues and Challenges in the Privatized Power Sector in Nigeria. Journals of Sustainable Development Studies. 2014, 6(1): 161-174.

[2] Ale TO, and Odesola AO. Unreliable Electric Power Supply in Nigeria Akure 11kV feeders a case study. International Journal of Emerging Engineering Research and Technology 2015 March (3):68-75.

[3] Okesola A. Green Banks as an Institutional Model for Bridging the Electricity Access Gap in Nigeria (January 18, 2021). Available at SSRN: https://ssrn.com/abstract=3768106 or http://dx.doi.org/10.2139/ssrn.3768106

[4] Osaretin A, Ebiton O. Electric Power Sector Reform Act 2005 and the Development of Renewable Energy in Nigeria. Renewable Energy Law and Policy Review. 2016. 7(1): 20-29.

[5] Adoghe A, Odigwe I, Igbinovia S. Power Sector Reforms-Effects on Electric Power Supply Reliability and Stability in Nigeria. International Journal of Electrical and Power Engineering. 2009 3(1): 36-42.

[6] PWO. Solving the Liquidity crunch in the Nigerian Power Sector. White Paper presented at Power Sector Roundtable Conference hosted by Mainstream Energy Solutions Limited on September 24, 2019 at Kanji Dam Hydropower Plant, Niger State 1-20.

[7] Federal Republic of Nigeria. Partial Risk Guarantee in Support of the Power Sector Privatization, Published by Nigeria Bulk Electricity Trading PLC PP 1-35.

[8] Christopher H., The Legal Framework on Privatisation of the Power Sector in Nigeria: Issues and Prospects. International Journal of Business & Law Research. 2021 9(3):76-84.

[9] Federal Ministry of Power. Data Collection Survey on Performance Improvement of Distribution Companies In The Federal Republic Of Nigeria published by Japan International Cooperation Agency (JICA) 2021.