

## Original Research Article



# Implications of the Electricity Billing System in Aluu, Rivers State

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## ABSTRACT

Electricity billing based on estimated bills is a big problem for the consumers of electricity in Nigeria and Rivers state in particular, because of the unrealistically high monthly bills. Electricity billing has evolved from analogue meter based billing to estimated billing and digital prepaid meter billing. Four and a Half years bills obtained from a location in Aluu, were collated and analysed using the principles of band system of electricity billing as stipulated by Nigeria Electricity Regulation Commission (NERC). Band system billing makes use of the ratio of cumulative duration of electricity availability (hours) to maximum approved hours, bill cap (kwh), band based tariff rate, and the value added tax (%) to generate the amount in naira. The lack of actual duration (hours) of electricity availability, data prompted the researchers to make two assumptions to do a phenomenological model of poor and good electricity availability options to compare with those used in the PHED monthly bills. The result of the PHED monthly bill analysis shows the following daily average availability of 39.33%, 77.17%, 115.75%, 110.50%, and 122.33% from 2019 to 2023 while the researchers' monthly bill provides the following daily average availability of 23.00%, 47.67%, 46.67%, 52.83%, and 55.00% for the same years. The PHED availability data appears to be highly exaggerated as the power supply in Aluu and its environs over the years do not reflect such. This might be corroborated by NERC's accusation of all the eleven distribution companies in Nigeria of overbilling customers in 2023.

## Introduction

Electricity is a basic necessity of modern day living standards for enhanced productivity. Any developed society is expected to have good and

affordable supply of electricity. It is said that the continent of Africa appears dark when viewed from space due to the relative poor illumination. Nigeria has an on grid electricity generation capacity of 12,522MW [1,2] and up to 16,384MW [2] with off grid generation

included. As in January 2024, it has peak generations of about 4700MW and off peak generation of about 2600MW [3] because of its abundant gas reserves but is like the case of those leaving around rivers and water sources yet lacking good drinking water. The electricity company has metamorphosed from Nigerian Electricity Power Authority (NEPA) to Power Holding Company of Nigeria (PHCN) and finally, broken down to Generation Companies (GENCOS) and Distribution Companies (DISCOS) [4,5], with different DISCOS responsible for distributing electric power to various states in the country. The problem hoped to be solved by emergence of GENCOS and DISCOS seem to have eluded the leadership of the country or become insurmountable because of the inherent revenue management issues with the DISCOS such as consumers' reluctance to pay for electricity consumed, payment apathy [6,7], lack of proper database of electricity consumers in growing settlements, lack of proper metering of consumers facilities, lack of proper accountability for revenues from non-metered consumers, and outright electricity theft [8-10] by unscrupulous consumers who are sometimes aided by some staff and agents of the distribution companies. Analogue meters have been used for a very long time before the introduction of various digital meters. However, it seems the distribution companies are reluctant to fully embrace the digital meters despite the amount of pressure mounted by concerned consumers, the National Assembly of Nigeria, and the Nigerian Electricity regulatory Commission (NERC) [11-14].

The preferred mode of electricity billing by the DISCOS is the estimated billing which is supposed to be a stop gap whenever there is a problem with metering. Why has the alternative billing system come to stay despite the cry against its continued use, despite the intervention of NERC and legislative arm of government? Is it probably due to lack of transparency of the billing system? Or is it the preferred choice of the consumers? Or is it benefiting the DISCOS more than using hardware metering? This is the focus of this article as we go through the NERC billing guidelines and the some electricity bills issued

by one of the DISCOS known as the Port Harcourt Electricity Distribution Company (PHEDC) in order to determine the accuracy of these estimated bills.

### Method

Electricity bills from 2019 to 2023, issued by PHEDC to a customer, in a two-bedroom accommodation, in Umuokiri-New Layout community in Aluu, Ikwerre Local Government Area, of Rivers State were obtained. The details of the billing such as the feeder, bill charge mode/band type, tariff code, units billed and tariff rate, arrears from previous months, and percentage VAT, were tabulated and used to regenerate the current bill, monthly bill and cumulative bill for each month as issued by PHEDC. The relevant documents related to estimated billing and estimated bill capping, for the band-type allotted to the feeder, were downloaded from NERC website; i.e. Multi Year Tariff Order (MYTO) and Order on Estimated Bill Capping for the years under consideration. The relevant estimated bill caps together with the tabulated PHEDC bill data were used to determine the electricity availability to the consumer. An independent electricity bill for the consumer, tagged researchers monthly bill, was generated based on NERC regulations on estimated bill caps and two phenomenological power availability assumptions. The assumptions are as follows.

(1) Since it may not be possible to get 100% availability of eight (8) hours power supply per day for thirty (30) days as stipulated by NERC guideline for the maximum billed units, let us assume a good supply or availability of eight hours a day for between 15 to 20 days out of a month as the best PHEDC can provide.

(2) Let us also assume a poor supply or poor power availability to be the supply of eight (8) hours a day for between 5 to 10 days out of 30 days in a month as the poorest supply PHEDC provides. The assumptions thus reflect a definition for a good and a poor power supply regime for each month of the year.

### Researchers estimation

According to NERC guidelines for electricity billing based on the band system, which is

presented in Table 1, the consumers' bill fall under band D, Non MD. The customers on this band are expected to get electricity for an average of eight (8) hours a day for thirty (30) days with a maximum of four interruptions daily. The maximum monthly bill for the electricity consumed is as shown in Table 2, according the NERC, Orders and Amended Orders, on the Capping of Estimated bills for Port Harcourt Electricity Distribution Company (PHEDC), document for the respective years under consideration.

The maximum hours of electricity supply per month, as shown in Equation (1), can be equated with the estimated bill cap for the respective years which are 125 units, 162 units, and 231 units (Capping Order dependent) [16], as listed in Table 2. This is used to determine power supply availability as follows.

$$8 \text{ hrs} \times 30 = 240 \text{ hrs} \quad (1)$$

$$240 \text{ hrs} = X \text{ units} \quad (2)$$

Where, X is the energy capping for the respective years.

Availability was determined using Equation (1). The maximum approved hours are dependent on the tariff band, where the researchers used 8 hours for 30 days or 240 hours as the benchmark for 100% availability as stipulated by NERC guideline.

$$\text{Availability} = \frac{\text{Hours available}}{\text{Maximum approved hours}} \times \frac{100}{1} \quad (3)$$

$$\text{Units billed} = \frac{\text{Availability} \times \text{bill CAP}}{\text{Approved Total hours}} \quad (4)$$

$$\text{Estimated Bill} = T_R \cdot x \text{ Units billed} + \text{VAT}(5 \text{ or } 7.5)\% \times T_R \times \text{Units billed} \quad (5)$$

$$\text{Availability} = \frac{\text{Units billed}}{\text{Bill CAP}} \times \frac{100}{1} \quad (6)$$

Where,  $T_R$  = Tariff Rate.

*Researchers' estimations based on assumption I: (Good availability)*

Max. Billed units are based on (15 to 20) days which are equivalent to (15 to 20 x 8 hours = 120 to 160 hours).

$$8 \text{ hrs} \times (15 \text{ to } 20) \text{ days} = 120 \text{ to } 160 \text{ hrs} \quad (7)$$

(a) If 240 hrs is equivalent to 125 units [17], 120 to 160 hrs (50% to 66.67%) will be equivalent to:

$$\frac{125 \times (120, 160)}{240} = 62.5 \text{ to } 83.33 \text{ units} \quad (8)$$

(b) If 240 hrs is equivalent to 162 units [16], 120 to 160 hrs (50% to 66.67%) will be equivalent to:

$$\frac{162 \times (120, 160)}{240} = 81 \text{ to } 108.00 \text{ units} \quad (9)$$

(c) If 240 hrs is equivalent to 231 units [18], 120 to 160 hrs (50% to 66.67%) will be equivalent to:

$$\frac{231 \times (120, 160)}{240} = 115.5 \text{ to } 154.00 \text{ units} \quad (10)$$

**Table 1:** Electricity consumption classification into Band system by NERC [15]

Consumption Classification	Minimum duration of supply (Hours/Day)	Duration	Number of Interruptions Per Day
Band A:	20 Hours	30 days	2
Band B:	16 Hours	30 days	3
Band C:	12 Hours	30 days	4
Band D:	8 Hours	30 days	4
Band E:	4 Hours	30 days	5

**Table 2:** Energy capping for the band D under UPTH sub feeder for the years: 2019-2023

Consumption Classification	2019	Nov. 2020	2021	2022	April 2023
Band D:	125kWh	162 kWh	162 kWh	162 kWh	231 kWh

Source: NERC [13].

### Researchers' estimations based on assumption II: (Poor availability)

Max. Billed units are based on (5 to 10) days or (5 to 10 x 8 hours = 40 to 80 hours).

- (a) If 240 hrs is equivalent to 125 units (NERC APPROVED: 2015), 40 to 80 hrs (16.67% to 33.33%) is as follow:

$$\frac{125 \times 80}{240} = \mathbf{20.83 \text{ to } 41.67 \text{ units}}(11)$$

- (b) If 240 hrs is equivalent to 162 units (NERC APPROVED: NOV. 2020), 40 to 80 hrs (16.67% to 33.33%) will be equivalent to:

$$\frac{162 \times 80}{240} = \mathbf{27.00 \text{ to } 54.00 \text{ units}}(12)$$

- (c) If 240 hrs is equivalent to 231 units [18] (NERC APPROVED: APR. 2023), 40 to 80 hrs (16.67% to 33.33%) will be equivalent to;

$$\frac{231 \times 80}{240} = \mathbf{38.50 \text{ to } 77.00 \text{ units}}(13)$$

### Calculation of average daily availability in 2019-2023

This was done by taking the average of the monthly availabilities for each of the years under consideration.

### Calculation of average monthly bill inflation estimations in 2019-2023

The average inflation in monthly bills (Av. Mbill<sub>Inf</sub>) in 2019 to 2023 were calculated by finding the difference between total PHED monthly bills and total researchers monthly bills and dividing by total researchers monthly bills, as shown in Equation (14):

$$Av. Mbill_{Inf} = \frac{(\text{Sum of PHED monthly bills} - \text{Sum of Researchers monthly bills})}{\text{Sum of Researchers monthly bills}}$$

(14)

The summary of the computations is provided in [Table 4](#).

## Results and Discussion

Tables 3 to 4 in supplementary material shows PHED monthly bills in 2019 to 2023 for an undisclosed residential accommodation in Umuokiri-Aluu of Ikwerre local government area, Rivers state, Nigeria. Likewise, the calculated average daily power availability (%) is indicated based on the monthly bills acquired and the regulatory guidelines for doing estimated billing as contained in NERC, MYTO documents, as well as NERC Orders and Amended Orders, on the capping of estimated bills for PHED. Other items contained in the table are the researcher's computed bill based on researchers' power availability (%) assumptions following NERC guidelines.

Figures 1, 4, 7, 10, and 13 show the monthly bills for the years under consideration as issued by PHED and the researchers' monthly bills based on power availability assumptions following NERC guidelines. Figures 2, 5, 8, 11, and 14 demonstrate the average daily availability (%) for the months of the years under consideration while Figures 3, 6, 9, 12, and 15,16,17 show the average daily availability (hours) for the months under consideration.

### The 2019 PHED monthly bills

Now, examining the monthly bills for the year 2019, it is observed that the sum of N1,539.47 was charged for January to July and December while the sum of N1,587.08 was charged for August to November. This represents the average power consumption of the customer with a slight increase in the last months. Now, it is necessary to examine what this translates to in terms of the average power availability in order to understand these monthly bills. Converting these monthly bills to availability (%), we have for January to July and December, 39% power availability while the remaining of months had 40% power availability. Certainly, this implies a poor power supply for 2019. The units billed by PHED for these months were

48.50 for January to July, December inclusive and 50.00 for August to November which are reasonable compared to NERC CAP of 125 for band D, Non MD in the year 2019.

However, to better appreciate the monthly bill, this 39% and 40% availability translates to an average of 3.12 hours and 3.20 hours of power cumulatively every day for January to December 2019. Though 39% to 40% availability may sound poor, three (3) hours of power in a day is enough to power water pumping machines or “SUMO”, do clothes ironing and power fans especially in those hot months of the year, even with some

interruptions. It is difficult to say if that could have been the case. Hence, we proposed a mild adjustment of 8 hours of power a day for just seven (7) days out of the 30 days, in the monthly bill. This translates to 23% availability or 1.84 hours of power in day for every month in 2019. The hours of power availability in a day is just less than 2 hours but can be sufficient to do a few chores in a home and corresponds to researchers’ monthly bill of N925.79 as against the N1,539.47 and N1,587.08 issued by PHED which saves the customer N600.00 every month or N7,200.00 in 2019. These are summarized in Figures 1-3.

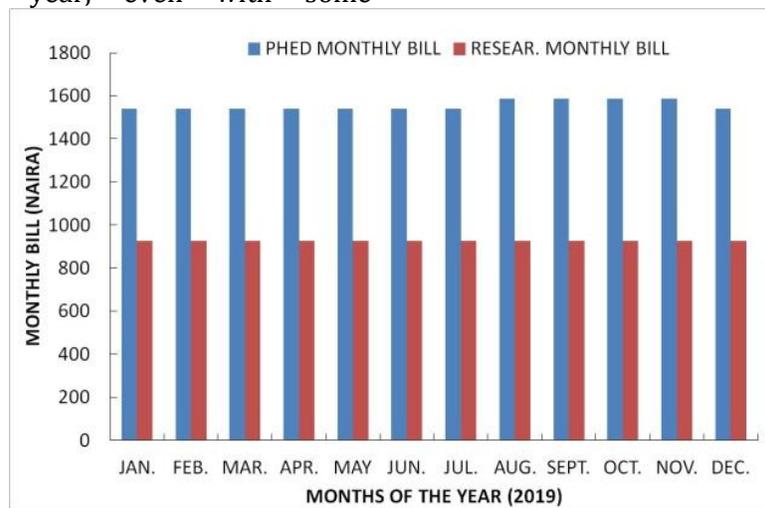


Figure 1: The monthly bills by PHED and researcher in 2019.

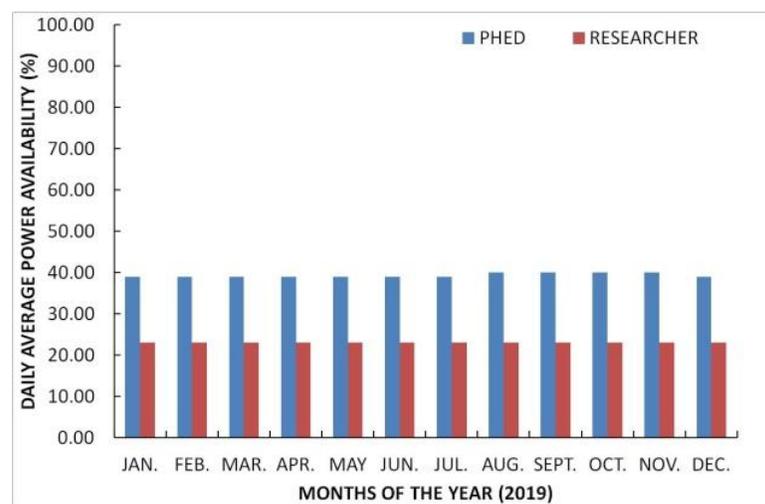
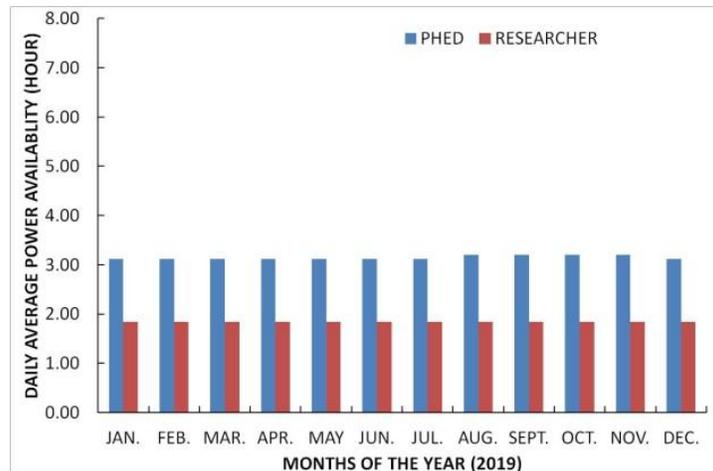


Figure 2: The daily average power availability (%) in 2019 as deduced from PHED monthly bills and researchers’ version based on “realistic” assumptions.



**Figure 3:** The daily average power availability (hours) in 2019 as deduced from PHED monthly bills and researchers' version based on "realistic" assumptions.

### *The 2020 PHED monthly bills*

Examining the monthly bills in 2020, it is observed that the sum of N1,539.40 was charged for January, N1576.12, for February, N3,737.18 for July to August with a spike of N5,565.16, for September, N3,802.18 for October, N2,334.93 for November, and N4,330.70 for December. This monthly bill trend shows a carryover of the trend for 2019 up to March 2020 except for the drop in March. April to December witnessed a new monthly bill regime in 2020, except for the spike in September and the dip in November. This represents a general increase of the average power consumption of the customer in 2020. It is also necessary to examine what this translates to in terms of the average power availability in order to understand these monthly bills. Converting these monthly bills to power availability (%) tells us that for January to March, there was 38%, 39%, and 24% power availability, respectively, while for April to October, it was 92% to 94% with a spike of 134% in September, a dip of 44% in November and 82% in December. Obviously, this implies a good power supply for most of 2020. The units (Kwh) billed by PHED for these months were 43.37, 48.50, and 29.57 for January, February, and March, 115 to 117 for April to October except for the spike of 171.25 for September, a dip of 71.85 for November, and lastly 132.33 for December. The NERC estimated bill CAP in

2020 was 125 for January to October and increased to 162 by November and December for customers on the particular feeder for band D, Non MD. To better appreciate these monthly bills, the 38%, 39%, 24%, 92%, 94%, 134%, 44%, and 82% availabilities, translate to an average of 3.04, 3.12, 1.92, 7.36, 7.52, 10.96, 3.52, and 6.56 hours of power availability cumulatively, every day, for January to December 2020. These power availabilities (%), are too good for every day of the month for a band D, Non-MD; but if this happens, PHED would be celebrated as the customers on those power schemes are not used to such magnanimity especially for the latter parts of the months. Likewise, to make it worse, the 10.96 hours, overshoot the 8 hours a day cap NERC regulation and this is claimed to happen for all the days of the month of September, which might be outrageous. We do not believe that could have been the case and hence, we proposed a mild adjustment of 8 hours of power a day for eighteen (18) days out of the 30 days, in the monthly bill. This translates to 60% availability or 4.80 hours of power in day for those months of the year 2020 with good power availability. The 4.8 hours of power availability in a day corresponds to researchers' monthly bill of N2,437.29 as against the N3,802.18 issued by PHED which saves the customer N1,364.89 for each of those 6 months or N8,189.32 for half the year 2020. These are summarized in [Figures 4-6](#).

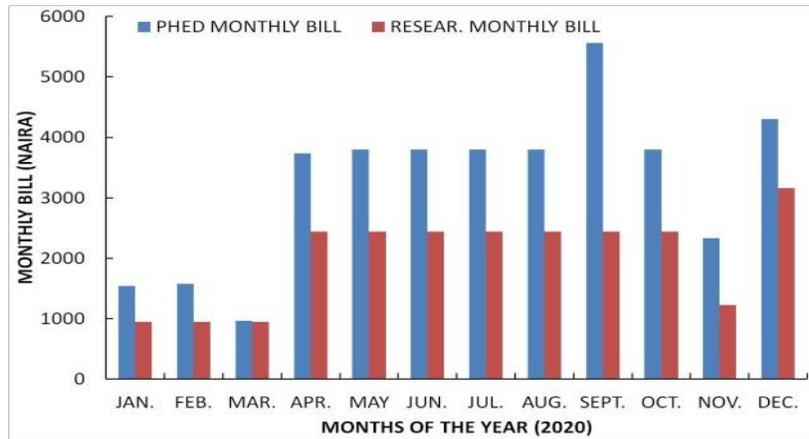


Figure 4: The monthly bill by PHED and researcher in 2020.

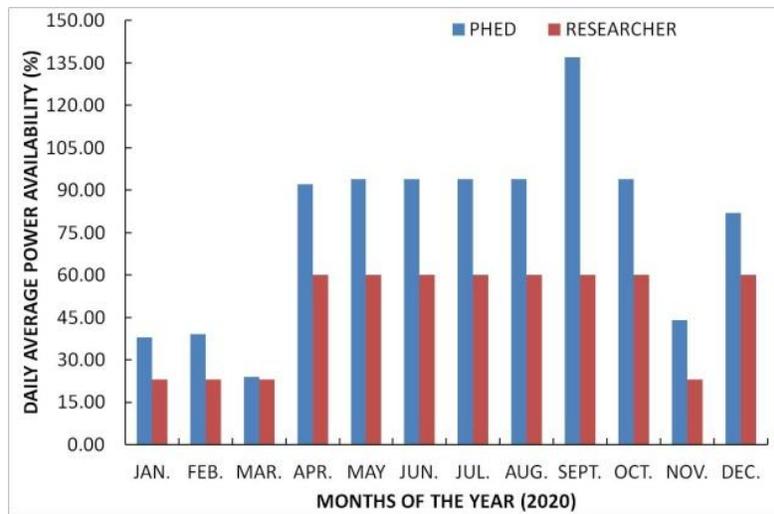


Figure 5: The daily average power availability (%) in 2020 as deduced from PHED monthly bills and researchers' version based on realistic assumptions.

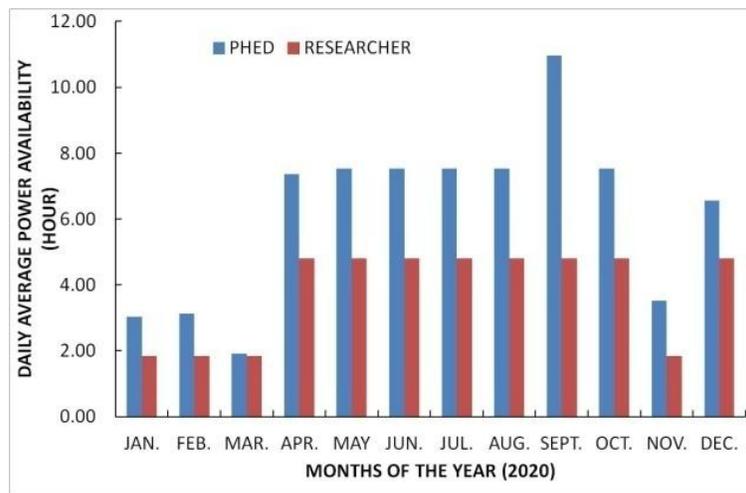
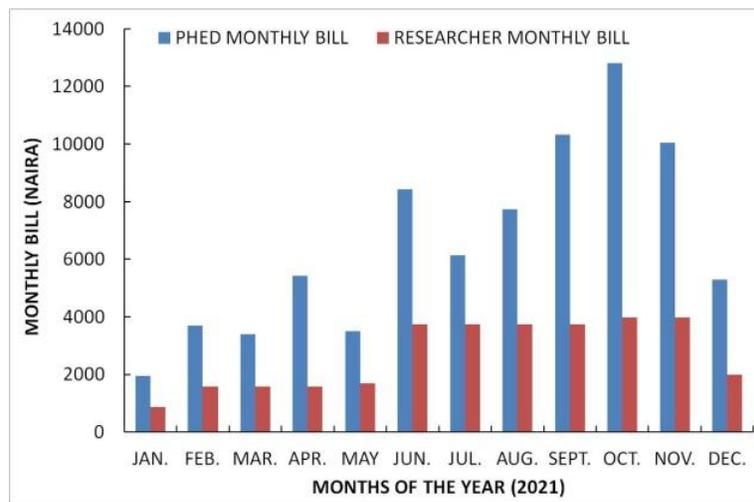


Figure 6: The daily average power availability (hours) in 2020 as deduced from PHED monthly bills and Researchers' version based on realistic assumptions.

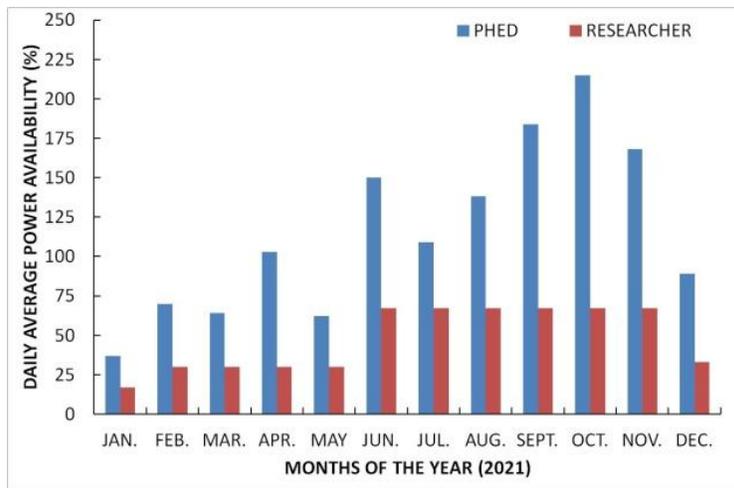
*The 2021 PHED monthly bills*

Now, examining the monthly bills in 2021, it is observed that the sum of N1,946.58 was charged for January, N3,704.69, for February, N3,384.58 for March, N5,427.04 for April, N3,503.53 for May, N8,431.06 for June, N6,132.56 for July, N7,725.99 for August, N10,324.88 for September, N1,2817.48 for October, N10,038.29 for November, and N5298.80 for December. This monthly bill trend shows a gradual increase of consumption by the customer with a peak in October. This also represents a general increase of the average power consumption of the customer in 2021. Now, it is also necessary to examine what this translates to in terms of the average power availability to understand these monthly bills. Converting these monthly bills to power availability (%) gives January 37%, February 70%, March 64%, April 103% May, 62%, June 150%, July 109%, August 138%, September 184%, October 215%, November, 168%, and December, 89%. This also implies a good power supply for most of 2021 even though the customer is on band D, Non MD. The units (Kwh) billed by PHED for these months are, for January 59.9, February 114, March 104.15, April 167, May 101.12, June 243.34, July 177, August 222.99, September 298, October 348.33, November 272.8, and December 144. The NERC estimated bill CAP for 2021 was 162 for January to December on the particular feeder for band

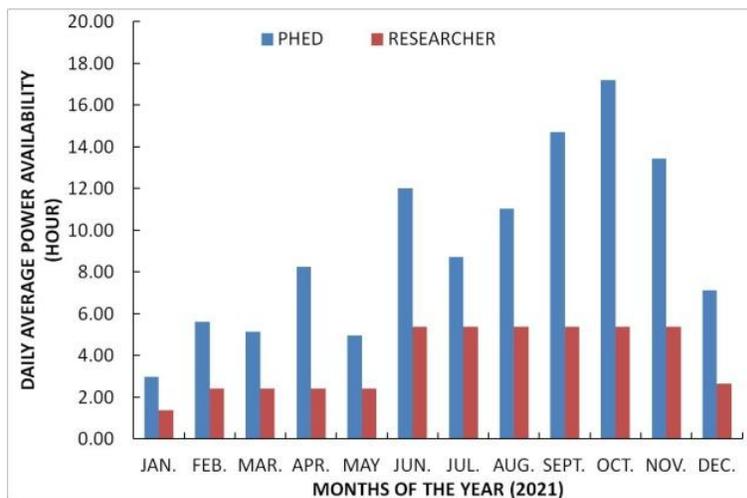
D, Non MD. To better appreciate these monthly bills, the respective power availability (%) translates to an average of 2.96, 5.60, 5.12, 8.24, 4.96, 12.00, 8.72, 11.04, 14.72, 17.20, 13.44, and 7.12 hours of power cumulatively every day for January to December 2021. These power availabilities (%), appear too good for every day of the month for a band D, Non-MD; but if this happens, PHED would be celebrated as the customers on those power schemes might not use to such performance. Likewise, to make it worse, the 12.00 hours, 11.04 hours, 14.72 hours, 17.20 hours and 13.44 hours for June to November with exception of July, overshoot the 8 hours a day cap NERC regulation and these are being claimed to happen for all the days of the month of June to November not counting July, these appear exaggerated, if not outrageous. It may not be possible if that could have been the case and hence, we proposed a mild adjustment of 8 hours of power a day for twenty (20) days out of the 30 days, in the monthly bill. This translates to 67% availability or 5.36 hours of power in day for those months of 2021 with good power availability. The 5.36 hours of power availability in a day for five (5) months corresponds to researchers' total monthly bill for June, and August to November of N19,173.92 as against the N49,337.70 issued by PHED for same combined months, which saves the customer N30,163.79 for those 5 months in 2021. These are summarized in Figures 7-9.



**Figure 7:** The monthly bill by PHED and researcher in 2021.



**Figure 8:** The daily average power availability (%) in 2021 as deduced from PHED monthly bills and researchers’ version based on realistic assumptions.



**Figure 9:** The daily average power availability (hours) in 2021 as deduced from PHED monthly bills and researchers’ version based on realistic assumptions.

*The 2022 PHED monthly bills*

Now, examining the monthly bills in 2022, it is observed that the sum of N11,387.48 was charged for January, N6,832.49, for February, N5,215.09 for March, N6,955.68 for April, N4,844.62 for May, N5,298.54 for June, N6,289.83 for July, N13,672.07 for August, N6,439.43 for September, N6,688.48 for October, N8,699.63 for November, and N6,396.79 for December. This monthly bill trend shows average power consumption by the customer with two peaks in January and August. This represents an average power consumption of the customer in 2022. Now, it is

also necessary to examine what this translates to in terms of the average power availability to better interpret these monthly bills. Converting these monthly bills to power availability (%) gives January 185%, February 111%, March 77%, April 103% May, 72%, June, 78%, July, 93%, August, 198%, September, 93%, October, 97%, November, 126%, and December, 93%. Certainly this implies a good power supply in 2022 for a customer on band D, Non MD. The units (Kwh) billed by PHED for these months are for January 300.00, February 180.00, March 125.00, April 166.72, May 116.12, June 127.00, July 150.76, August 320.60, September 151.00, October 156.84, November 204.00, and

December 150. The NERC estimated bill CAP for the year 2022 was 162 for January to December on the particular feeder for band D, Non MD. To better appreciate these monthly bills, the respective power availability (%) translates to an average of 14.80, 8.88, 6.16, 8.24, 5.76, 6.24, 7.44, 15.84, 7.44, 7.76, 10.08, and 7.44 hours of power cumulatively every day for January to December 2022. These power availability (%), are also too good for every day of the month for a band D, Non-MD; but if this happens, PHED would be celebrated as the customers on those power schemes might not be used to such supply regime. Likewise, to make it worse, the 14.80 hours, 8.88 hours, 8.24 hours, 15.84 hours, and 10.08 hours for January, February, April, August, and November, overshoot the 8 hours a day cap NERC regulation and these are

being claimed to happen for all the days of the respective month in question, this is outrageous. It may not be possible if that could have been the case; hence, we proposed a mild adjustment of 8 hours of power a day for fifteen (15-20) days out of the 30 days, in the monthly bill. This translates to (50-67)% availability or (4.00-5.36) hours of power in day for those months with of the year 2022 with good power availability. The (4.00 - 5.36) hours of power availability in a day for five(5) months corresponds to researchers' total monthly bill for June, and August to November of N18,347.86 as against the N40,798.15 issued by PHED for same combined months, which saves the customer N22,450.29 for those 5 months of 2022. These are summarized in [Figures 10-12](#).

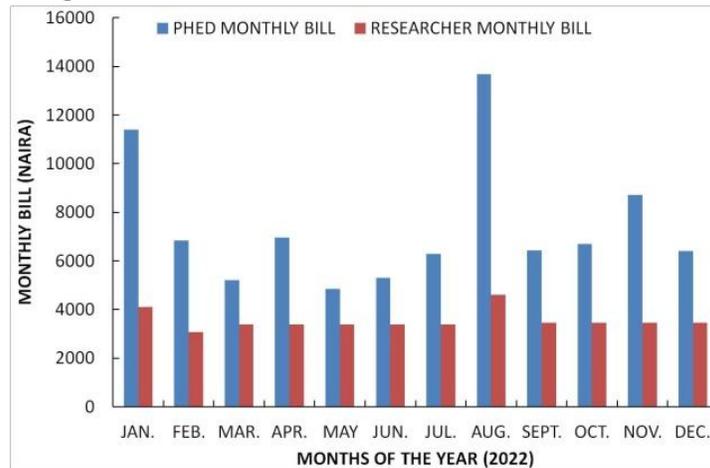


Figure 10: The monthly bill by PHED and researcher in 2022.

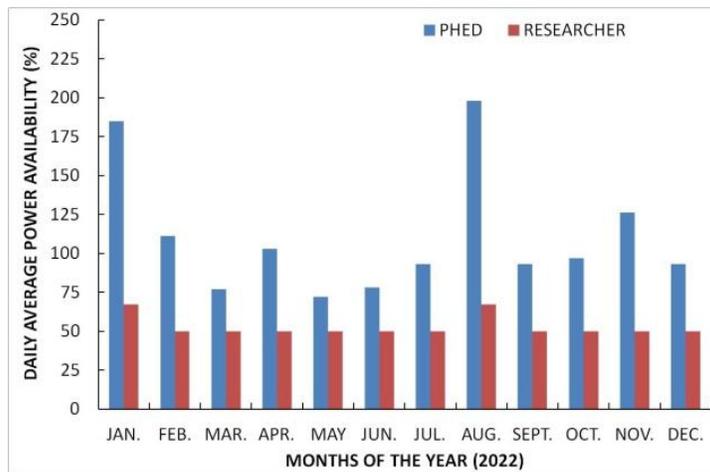
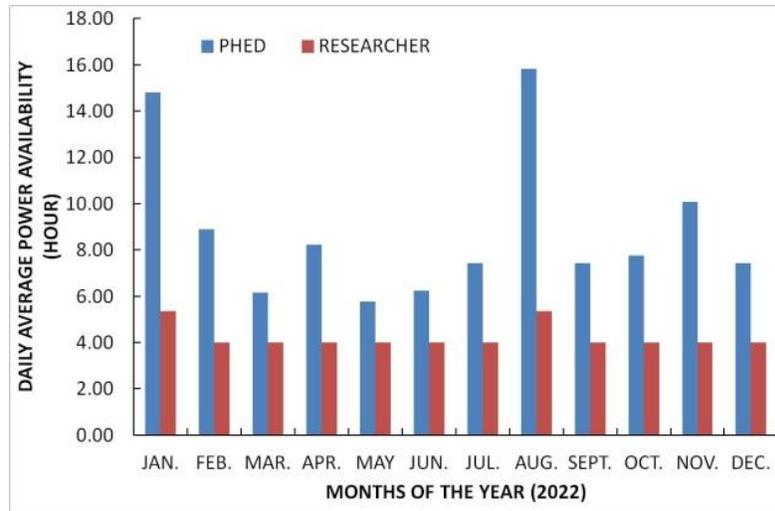


Figure 11: The daily average power availability (%) in 2022 as deduced from PHED monthly bills and researchers' version based on realistic assumptions.



**Figure 12:** The daily average power availability (hours) in 2022 as deduced from PHED monthly bills and researchers' version based on realistic assumptions.

### *The 2023 PHED monthly bills*

Going through the monthly bills in 2023, it is observed that the sum of N8,614.34 was charged for January, N6,044.54, for February, N6,768.23 for March, N12,344.52 for April, N12,522.35 for May, and N16,990.29 for June. The bill for the other months could not be obtained. This monthly bill trend shows increasing power consumption by the customer within the 6 months under consideration. Now, it is also necessary to examine what these translate to in terms of the average power availability to better interpret these monthly bills. Converting these monthly bills to power availability (%), we have for January 125%, February 87%, March 98%, April 125%, May 127%, and June 172%. Certainly this implies a good power supply for half of the year 2023 for a customer on band D, Non MD. The units (Kwh) billed by PHED for these months are for January 202.00, February 141.74, March 158.71, April 289.47, May 293.64, and June 398.41. The NERC estimated bill CAP in 2023 increased from 162 to 231 units by April 2023 on the particular feeder for band D, Non MD. To better appreciate these monthly bills, the respective power availability (%) translates to an average of 10.00, 6.96, 7.84, 10.00, 10.16,

and 13.76 hours of power cumulatively every day for January to June 2023. These power availabilities (%), might be exaggerated for every day of the month for a band D, Non-MD; and if this happens, PHED would be celebrated as the customers on those power schemes might not be used to such supply trend. Likewise, to make it worse, the 10.00 hours, 10.16 hours, 13.76 hours, for January, April, May, and June overshoot the 8 hours a day cap NERC regulation and these are being claimed to happen for all the days of the respective month in question, this obviously appears to be extreme exaggeration. It may not be possible if that could have been the case hence, we proposed a mild adjustment of 8 hours of power a day for fifteen (15-18) days out of the 30 days, in the monthly bill. This translates to (50-60) % availability or (4.00-4.80) hours of power in day for those months with of the year 2023 with good power availability. The (4.00-4.80) hours of power availability in a day for four (4) months corresponds to researchers' total monthly bill for January, April, May, and June of N21,186.16 as against the N50,471.50 issued by PHED for same combined months, which saves the customer N29,285.34 for those 4 months of the year 2023. These are summarized in [Figures 13-15](#).

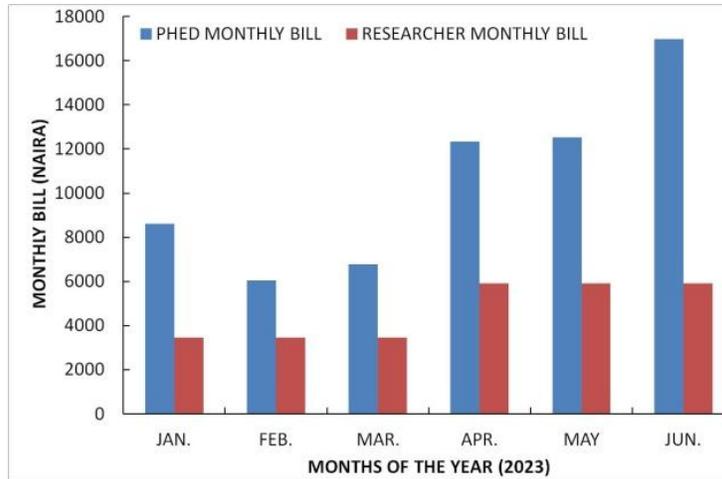


Figure 13: The monthly bill by PHED and researcher in 2023.

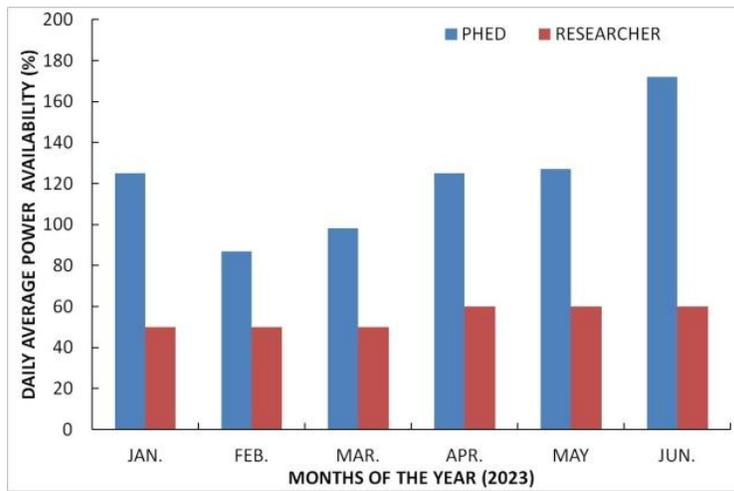


Figure 14: The daily average power availability (%) in 2023 as deduced from PHED monthly bills and researchers' version based on realistic assumptions.

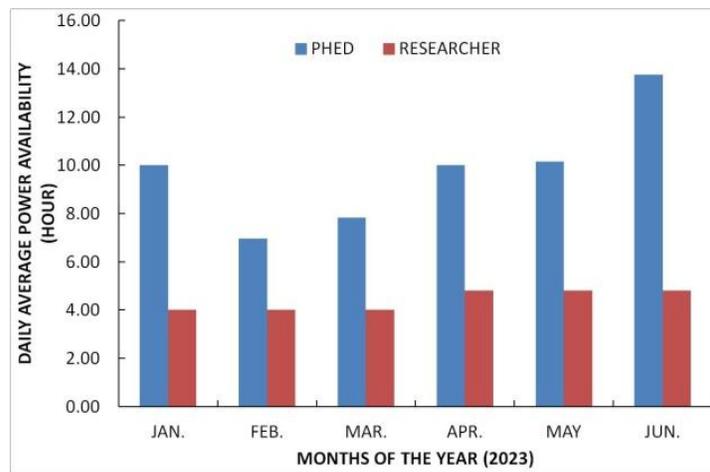


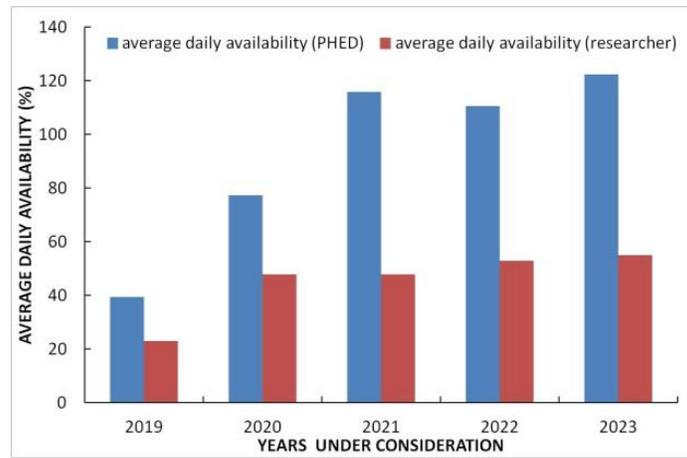
Figure 15: The daily average power availability (%) in 2023 as deduced from PHED monthly bills and researchers' version based on realistic assumptions.

**Table 3:** Average daily power availability as a percentage of 8 hours band D cap in 2019-2023

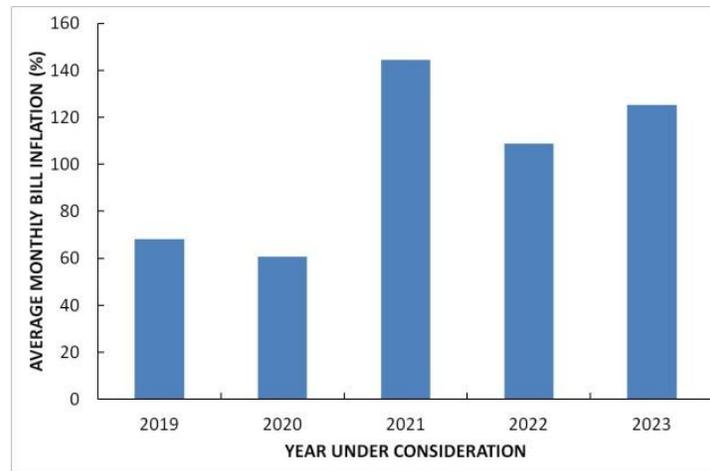
Years	Average daily availability (%) (PHED)	Average daily availability (hour) (PHED)	Average daily availability (%) (researcher)	Average daily availability (hour) (researcher)
2019	39.33	3.15	23.00	1.84
2020	77.17	6.17	47.67	3.81
2021	115.75	9.26	47.67	3.81
2022	110.50	8.84	52.83	4.23
2023	122.33	9.79	55.00	4.40

**Table 4:** Average inflation (%) in monthly bills in 2019-2023

Years	Sum of PHED monthly bills (N)	Sum of researcher monthly bills (N)	Difference in Monthly Bills (N)	Average Monthly Bill Inflation (%)
2019	18664.05	11109.53	7554.52	68.00
2020	39025.00	24291.69	14733.31	60.65
2021	78735.48	32216.3	46519.18	144.40
2022	88720.13	42493.76	46226.37	108.78
2023	63284.27	28094.69	35189.58	125.25



**Figure 16:** The average power availability (%) for the years under consideration.



**Figure 17:** The average monthly bill inflation (%) for the years under consideration.

### *Average daily power availability for the years under consideration*

The calculated average daily power availabilities for the years under consideration are provided in [Table 3](#).

### *Average inflation (%) in monthly bills for the years under consideration*

The calculated average inflations (%) in monthly bills for the years under consideration are indicated in [Table 4](#).

## **Conclusion**

Based on [Figures 1, 4, 7, 10, 13, 16, 17](#), and [Tables 3 and 4](#) in the supplementary material, it can be seen that there was very poor power supply in 2019 with daily average power availability (%) of 39.33% according to PHED but the researchers believes it might be as low as 23%. In 2020, there was an improvement in the power supply even though there was initial hang over of the 2019 poor availability, it improved with an average high availability of 77.17% according to PHED, but the researchers believes 47.67% availability might have been the case. The year 2021, also has a better supply even though it is believed to be over exaggerated with a high availability of 115.75% but the researcher might rather go with an average of 47.67%. The year 2022 had a drop in supply availability averaging at 110.50%, but the researcher also believes an average of 52.83% might be more realistic. The last of the years under consideration is 2023 even though we only had data for half of that year it recorded an averaged 122.33% availability according to PHED, but the researchers also believes 55.00% average availability might be more appropriate. The PHED data for this year might have justified the case of exaggeration of power availability which is the basis of the recorded high monthly bills. The regulatory body NERC as at 2024 had to sanction all the eleven DISCOs in the country for overbilling in the monthly bills for the year 2023 by imposing a N10.5 billion naira fines on them [19]. What was the basis of that fine, one may ask? The year 2023 witnessed the removal of fuel

subsidy on petroleum products thereby raising public outcry by the labour unions, meanwhile, one of the DISCOs planned and actually applied to NERC [20] for an increment of tariff rates which the government through NERC did not approve. In the months that followed, the DISCOs using their knowledge of the billing factors inflated the power availability while maintaining the old tariff rates, thereby achieving their aim of monthly bill increment, through the backyard route.

In conclusion, using the two assumptions proposed by the researchers, the PHED monthly bills for years under consideration appears to have the following average inflations of the monthly bills; 2019, 68.00%; 2020, 60.65%; 2021, 144.40%; 2022, 108.78%, and 2023, 125.25%. These corresponds to an over billing of the PHED customer of the sum of N7,554.52 for 2019 and N35,189.58 for 2023 and a cumulative over billing to the tune of N150,223.00 for the roughly five years under consideration, since we only had data for half of the year 2023. The two assumptions were applied either, as power being available within the range of 5 to 10 days out of the 30 days in a month, for poor availability in the days of the months and within the range of 15 to 20 days out of the 30 days in a month, for good availability. The researchers' assumptions appear to imply that for the monthly bills where power supply was poor, there was power for only 1.84 hours a day (23%) in a month in 2019 cumulatively and when power supply was at its best it amounted to an average of 4.40 hours a day (55%) in a month in 2023 cumulatively. The researchers believe the assumptions might have been justified to be a true reflection of the exaggerations in the monthly bills after the fine of N10.5 billion imposed on the eleven DISCOs in Nigeria in 2024 [20] for the overbilling observed by NERC in 2023 when power supply in Nigeria was at its low. It is notable that such exaggerated billing could not have been invented overnight but had simply gone out of hand. Therefore, further research should be done using data loggers to monitor and record power availability and when this is done both the customer and PHED or any other DISCO would

be on the same page with regards to accuracy of the monthly bills.

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