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Closing Electricity Metering Gap in the NESI: A Prelude to Power Supply Stability, Industrialization and Economic Boom

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***Abstract*— The Nigerian electricity power supply situation has been plagued with lots of debates and protest over the inability of the Distribution licensees to provided metering facilities for fair billing of customers connected to the national grid network. The effect have been the refusal of customers to pay estimated billing thus disrupting the liquidity of the sector, militating against the improvement of the network infrastructures, refusal of the Distribution companies to accept load due to the requirement for 100% remittance to the market operators (the Nigerian Bulk Electricity Trading Company, NBET). The cost of energy consumed by the customers are used to finance the value chain of the Nigeria Electricity Supply Industry (NESI), thus there appears to be a greater need for the proper metering of all customers connected to the national grid to incentivize the customers and improve the Aggregate technical, commercial and collection (ATC&C) losses.**

Key words: Metering component; formatting; style; styling;

1. INTRODUCTION

Meter is an instrument for measuring the energy (kWh) consumption of an electricity consumer connected to an electricity supply system. The supply system could be a distribution network (national grid) or isolated or captive electricity supply (private). The act of measurement is an international best practice with the ultimate goal of ensuring fair billing as against estimated billing [1] in the case of the connection to the national grid and for recording energy requirements for private network owners. Metering becomes the arbiter for resolving the argument of how much energy is required and used by a particular consumer [2] and how much should be paid for the energy consumed especially when financial obligation is attached with all stakeholder benefitting [3] from the metering program, energy conservation is optimized, stable power is achieved and industrial revolution could be evoked leading to Nigerian economic boom.

2. POWER SUPPLY PROBLEM IN NIGERIA

The population of Nigeria currently is estimated be over 218 million [4] but the total average generation capacity stands at about 4,000 MW with an installed capacity of 12,000 MW of electricity [5], This suggest the reason Nigerians are experiencing energy poverty as each Nigerian connected to the National grid can only enjoy a limited 20W per person of electricity when equally distributed in comparison with those in other clime, like South Africa, USA, United Kingdom, etc., whose power generation stood in Gigawatt of electricity [5,6,7,8,9,10]. The yawning gap between the expected or forecasted load demand and the available energy from the national grid has caused the adoption of different forms of renewable energy generation approaches across Nigeria; more especially, the solar photovoltaic option [11,12,13, 14, 15,16, 17,18, 19,20, 21,22, 23,24, 25,26, 27,28, 29,30, 31,32] , the wind option and some forms of hybrid energy generation options [33,34,35,36] are commonly used.

According to [37], the Nigerian grid system referred to as the Nigerian national grid is plagued by constant system collapse. The key factor responsible for the series of system collapse is the refusal of the Distribution licensees (DisCos) to pick load largely due to low cash collections, energy theft etc. Load shedding is usually done when there is low generation capacity and supply is rotated to a cluster of consumers or load center in turn, however, the mammoth of the Nigerian power system collapse is caused by load difference to generated power. The electric power is dynamic and any attempt not to consume electric power generated will lead to frequency variation.

Power system operation can well be kept balance if the power generated meets the load demand and system losses.

$$\text{Total Generation} = \text{Total load} + \text{Total loss} \quad (1)$$

The above equation provides a balance condition that power system will operate at the synchronous frequency of 50Hz. But when the electric power balance state in Equation 1 above is disturbed, the system frequency changes [38].

Table1. Different Condition of Generation and Demand

System Condition	System frequency
1.Generation = demand + losses	No change
2.Generation > demand + losses	Increase
3.Generation < demand + losses	Decrease

Therefore, under condition 2 and 3 there could be system collapse, the only condition that promotes stability is condition under 1. The abysmal generation capacity in Nigeria do not match the ever-growing population, most of the power plants are moribund and requires replacement. Hence the power generation is low when compared to the Nigerian population.

1. METERING REVIEW, INTERNATIONAL BEST PRACTICE

The analogy of metering could be compared to a merchant who sells his products by measuring his goods to have the financial equivalent. Other utility industries like water, gas, etc., are measured to have an equivalent pricing, electricity is also no less a commodity and should be measured to have accurate and fair billing. Estimated billing kills customer's trust [2,39] and at the same time leads to poor collection of revenue by the DisCo as the customer becomes apprehensive and refuses to pay for even the energy already consumed. In Hungary, electricity bill stood at $0.095 per kWh for residential and $0.118 for kWh for business and it includes all components of the electricity bill such as the cost of power distribution and also taxes. Suppliers are required to provide smart meters to customers and connect them to the grid, while customers are given the opportunity to choose from the pool of Suppliers. Suppliers have connection agreement with the DisCo, so power supply is guaranteed, good example to copy, isn't it?

In Austria and Germany [40] regulations using smart metering allowed power users to choose their preferred Metering Point Operator (MPO) or measuring Services provider (MSP) as they are called, and according to the authors, customer's feedback indicated a saving of 3.7% of total average electricity consumption per household as compared to estimated billing.

The application of estimated billing system [341] in the Nigerian Electricity Supply Industry (NESI) by the DisCo has generated a lot of concerns [42] and has lead to low revenue collections as customers refuses to pay. This has adversely affected the DisCo's ability in meeting the 100% remittance to NBET. The DisCo in turn tries to limit the load acceptance and this caused system unreliability and system collapses [37] and this has even occurred repeatedly in the last few months of year 2022.

Global electric power supply system have recently embraced metering as a way of consciously encouraging energy saving, example, in several countries like Pakistan [43] with high electricity demand has adopted the use of prepaid meters as a way of measuring electricity consumption and inciting energy conservation and it has helped the country focused on sustainable power sector development.

2. REASON FOR THE METERING GAB IN NIGERIA

According to the Guardian editorial Board, July 23, 2021, failure of the metering programs in the NESI from the outset is a metaphor of the endemic corruption bedeviling the society and its consequent frustration of many otherwise worthwhile people – oriented program. According to the author, it is a sad irony of fate, which those concerned with these programs should endeavour to unraveled, Nigerians are suffering a lot due to chronically deficient electricity management. The DisCos lack the enthusiasm to address the issue though it is their responsibility as enshrined in the performance agreement and the extant laws and codes [44,45]. Hence government's direct and indirect measure to address the issue of metering has had very little impact due to the DisCos un-complementing effort.

3. GOVERNMENT EFFORT

The Nigerian power sector is regulated by agent of the federal government, the Nigerian Electricity Regulatory Commission [NERC], as empowered by the Electricity Power Sector Reform Act (EPSRA) 2005 [46] and they are saddled with the responsibility of providing policy direction and guidance that will aid the growth and sustainability of the NESI while exercising their regulatory functions as enshrined in the Act including and not limiting to monitoring for compliances and enforcement as required. One of the policies is the provision of relevant regulations, codes and orders. The Distribution code 2012 and Metering Codes, [46] stipulates that the DisCo was responsible for the installation, maintenance and replacement of end-use meters within their franchise network coverage area, which is also governed by the Distribution connection agreement (DCA).

Prior to privatization of the distribution assets [37] the EPSRA 2005, was formulated and the power sector then under the umbrella of National Electric Power authority (NEPA) was transferred into a holding company called Power Holding Company of Nigeria (PHCN) and it included the 11 distribution companies, 6 generation assets and 1 transmission company. Ab initio, it was mandatory for NEPA to install meters, mostly analogue electricity meters to all their customers which were eventually inherited by the successor companies and many or all of these meters has been declared obsolete by the DisCos as they have passed their lifespan of 10 to 15 years, not minding the Order released by NERC [48]. Order on structural replacement of faulty and obsolete end-use customers meters in the NESI) and newspaper publication [47] refuting allowing the declaration of obsolete postpaid meters. Following this backdrop the prepaid meters and smart meter were introduced [44] thus giving the electricity customers the impetus to measure accurately their energy consumptions. However, due to insufficient prepaid meters DisCos were still permitted to estimate the bills for

unmetered customers using the estimated billing methodology [45]. Another order was issued in 2016 by Dr. Anthony Akah, the Ag. CEO of NERC forbidding the billing of Maximum Demand (MD) customers on estimated billing, implying that all MD customers must be metered. The estimated billing methodology was grossly abused by the DisCos creating so much disputes regarding billing which led to low collection, the DisCo now adopt a new approach at reducing energy taken from the grid as allocated to them by the market operator, through the National control Centre (NCC) by rejecting load, creating blackout on their feeders, shutting down most transformer substations especially in rural areas, thus evoking energy poverty as experienced nowadays all over the country.

According to [49], a statement from the Special Adviser to the President on infrastructure shows that about N120 billion in capital expenditure (CAPEX) funds was being provided by CBN for DisCos to improve the metering challenges. It is therefore evident that though the distribution asset have been privatized, government was still making concerted effort to ensure fair pricing through metering and hoping that the DisCos will rise to the occasion by doing their own bit.

4. DISCOS OBLIGATION

According to the Act EPSRA, 2005 [46] section 67 subsection 1(a & b) states that subject to such terms and condition as the Commission may fix in the license, a distribution license shall authorize the licensee to construct, operate, and maintain a distribution system and facilities, including but not limited to the following activities as may be specified in the license: the connection of customers for the purpose of receiving a supply of electricity; the installation, maintenance and reading of meters, billing and collection. The EPSRA 2005 has thus clearly identified the DisCo as one responsible for metering and this obligation has been rejected by the Disco, so what happened to their license? This is an infraction to the term and condition of their license.

3. REGULATORY RESPONSIBILITY AND MONITORING

Emmanuel Adde, in his paper [49] commented that after decades long effort to provide meters for electricity customers in Nigeria, there are 8.1 million Nigerians out of the 12.8 millions connected to the national grid not provided with metering facilities. The regulators having sensed the difficulties from the DisCo in providing prepaid or smart meter, came up with the following regulations:

(i). ***CAPMI*** (Credit advanced payment for metering implementation) was introduced in 2015 [2] to allow electricity customers finance their prepaid meter installation but the DisCo refused to install those meters after payments by customers [44].

(ii). ***MAP/NMMP*** (Meter asset provider / National mass metering program) is the latest regulation to replace the CAPMI program. NERC had lunched the MAP metering program in 2018 to allow the DisCos once again to exercise their responsibility with a third party company called MAP along with agents called meter installers to be procured by the DisCo, again the program was in two ways (1) the window for self finance by customers, and (2) Meter service charge (MSC) provision to encourage the DisCo fund the metering as already included in MYTO 2, but again there was no iota of zeal from the DisCo to comply with this policy again. The phase zero of the national metering program has come and gone and it seems the federal government is no-longer able to fund the phase one. Till date customers are the one financing their metering and the so called refund of customers funds has not yet been activated, will it die naturally like the CAPMI program? Time will tell. Again the metering gap has not been bridged, as the MAP seems not to fulfill the need born by the regulator to ensure electricity customers are connected to the grid with metering facilities [2] which motivated the introduction of MAP/NMMP (NERC, Reg.No.NERC-R-113-2021), [3].

(iii). ***Capping Of Estimated Billing:*** The failure of both the CAPMI program and the MAP/NMMP program gave birth to an order from NERC termed the "Order for capping of estimated bills or Energy capping order for unmetered customers. The order states that "since metering is a critical component of the business of electricity, it serves as the only parameter for quantifying energy delivered and energy utilized by the supplier and customer respectively (Order No./NERC/197/2020, 210/2020 and 307/2022). The first order was initiated in 2015 after several efforts by government to encourage the Distribution companies to meter their customers before connecting them to the national grid network failed.

(iv). ***Estimated Billing Methodology:*** According to [2] one of the reason for the woes in the power sector is the customer's apprehension over the unfair overestimated billing given to them by the DisCo every month, irrespective of supply availability, quantity and quality of electricity. This has led to either outright refusal to pay the estimated bill or engaged in energy theft, thus the lack or insufficient metering constitutes serious challenges to the survival of the electric power sector. To checkmate the menace of overestimated billing, NERC introduced the estimated billing methodology in 2012 [45] where unmetered maximum demand (MD) customers are billed based on what is termed "load measurement method" voltage and current measurement are taken at the customer's premises for a specific period within 24 hours operational hours and the following formula applied to compute the customer's consumption for the month:-

$$\text{Consumption in kWh} = \sqrt{3}x\, V_L\, x\, I_L\, x\, P.F\, x\, A_V\, x\, L.F\, x\, 1000 \qquad (2)$$

Where:

$V_L = Line\ voltage\ in\ Volts$

$I_L = Line\ current\ in\ Ampere$

L.F = Load factor

$$A_V = \frac{\text{Number of hours of power supply availability}}{\text{in the month}}$$

Amount payable = (tariff class rate x kWh) x fixed charge x VAT

But in the case of non-maximum demand customers several factors as specified by the regulation were taken into consideration, for example, hours of availability, total energy given to the DisCo, numbers of feeders, numbers of metered customers on the feeders in a cluster, however, this has not had a positive effect on the customers in terms of energy efficiency as compared to the use of prepaid meters [50].

Under the "Notice of approved methodology for the determination of connection charges by the Distribution licensee, it was found out that the DisCo do not comply with the provision of the terms and condition of their license which made it imperative for the DisCos to install a meter before connecting a customer to the grid at the DisCos expense as expressed in the condition 41(6). The regulator has the responsibility to enforce several regulations that has been flouted by the DisCos. [36] stated that one of the contentious issue in the Nigerian power sector has been inappropriate billing system and agreed that with appropriated billing system (prepaid meter), there will be improved cash flow and controlled energy usage among others. The authors in [36] blamed weak electricity regulatory institution for the problems of the power sector, the author assertion includes the inability to enforce compliance to the various policies and programs especially the goal on closing the metering gap by implementing the CAPMI, MAP and NMMP.

In 2015, NERC gave an order exempting the customers who has paid for CAPMI meters and were not installed within 45 days to stop paying estimated bills after 60 days of non-installation of the CAPMI meter. In 2016, a directive from the Acting CEO NERC, Dr. Anthony Akah (Mni), enforced the DisCos to meter all their MD customers with a penalty if defaulted before December 1, 2016 as metering was part of the performance agreement. Such directive was desirable and to also inflict penalty for any infringement on the right of the customers and for any infraction on the regulations in other to create a stable and improved power sector. There should be constant monitoring to check compliance and to enforce compliance to all regulations, orders, code and extant laws.

4. CUSTOMER'S RIGHT AS SOLUTION TO NIGERIA POWER PROBLEM

As expressed in the Distribution code and Metering code Version 02, the customers are entitled to fair billing and the only way this could be achieved is through metering and precisely prepaid meters. Customers also have the right to reject utterly any arbitrary billing of any kind, as it does not in any way measure correctly the consumption of the customer, metering is the ultimate way of exacting the accuracy of energy consumed by the customer.

Odion in [51] recommended that NERC extend the right for customers to procure their own meters by liberalizing customers metering through de-coupling the cost of metering from the energy tariffs under a revised MAP regulation.

5. BENEFIT OF METERING

The DisCo have a mandate to reduce aggregate technical, commercial and collection (ATC&C) losses in their franchise network, all of the above mentioned losses are all centered on finances. In the research carried out in [50] it was seen that as a result of installation of prepaid meters, 91.8% of the respondents switched off all their electrical appliances when not in use, 91.5% avoided using some kind of electrical appliances where possible, while 88.5% considered energy rating before purchase of any electrical appliances. The result of the above research gave way to energy conservation, thus allowing the DisCo to prioritize in providing the supply of electric energy to industries with better collection efficiency. The technical losses could also be mitigated through investment of received revenue in improving the network infrastructures.

The customer also benefitted in paying the fair bills for energy used, [5,52] therefore, concluded that metering programs MAP and NMMP when fully implemented will close the current metering gap with immense benefits to the power sector, one of the benefit, according to the publication is to address the challenges of installing 6.5 million consumers meter by 2023, improve indigenous metering capability and develop a smart metering platform.

Liberalizing customers metering would bring immense benefit to the NESI and to the electricity customers, who suffer the twin effect of poor services and high estimated billing. DisCos can then increase their allowable CAPEX requirement and deploy more investments to network improvement and reduce technical losses [51].

6. CONCLUSION

From the discussion on this paper, it could be informed that lack of or poor metering program of the federal government though the regulating body have been the cause of the poor performances of all the players in the NESI. For any successful improvement to be carried out in the power sector, attention should be given and directed to closing the metering gap. Metering of all connected to the grid network should be made sacrosanct and no customer without a meter should be allowed access to electricity supply.

7. RECOMMENDATION

Customers should be allowed to procure prepaid meters from accredited agents directly, which should be accompanied by meter certification from Nigerian Electricity Management Services Agency (NEMSA) to ensure that the integrity of the meters is not compromised.

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