Dampening the Upshot of Inadequate Grid Power Supply in Nigeria; Rescue Role of Captive Power.

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Abstract - The wide gap between the demand and supply of electric power in Nigeria has occasioned a deleterious effect on all sectors of national development. The Energy Commission of Nigeria exercising its mandate in 2015 conducted a survey aimed at capturing the captive power capacity and utilization pattern in the household, informal, services and industrial sectors in the Federal capital territory of Nigeria.

This paper elucidates the result of the study as it relates to the captive power statistics, types and quantity of fuel used, usage pattern, cost implication comparison between grid and captive power supply and the energy consumption from each respectively. Questionnaire methodology was used in capturing data required from the field.

It is established from the study that the average monthly electricity consumed from captive power is over twice that from the grid from all sectors; hence, captive power generation is inevitable in meeting the power requirement of Nigeria [1]. Similarly, the comparative average electricity bill from grid in FCT for all the sectors is estimated to be 2.5times that of captive power yet captive power is still highly patronized further indication of the indispensability of captive power usage in meeting the demands [1].

These inferences drew from the study form dependable basis for planning and evaluating programmes to improve the design and overhauling of grid networks and other power facilities including the diversification of the Nigeria energy mix to include substantial renewable energy sources with the overall aim of revamping the sector.

Keywords: Captive Power, Electricity, Grid, Federal Capital Territory, Nigeria.

1.0 BACKGROUND

Energy is crucial to sustainable development and economic empowerment of citizen across the world. The epileptic nature of this energy supply in Nigeria has pushed it's citizenry to resort to captive power proliferation. Therefore, there is no gainsaying putting necessary mechanism to action so as to understand the energy capacity and utilization pattern from both grid system and captive generation in the various sectors of the economy since it is critical to effective policy making and intervention.

1.1 Conceptual Analysis

1.1.1 Grid supply system

The grid is a central supply system where electricity is generated from one or more sources and conveyed from those point/points of generation to another through the help of transmission networks (lines) and eventually transported to end users through the medium of distribution networks (lines).

1.1.2 Captive power

Captive power generation simply has to do with the self-generation of electricity for use by an individuals or group of persons as an alternative to central grid supply. It consists of smaller or integrated generators using a variety of generation technologies and fuel such as premium motor spirit (petrol), AGO (diesel), gas, solar, wind, biomass and small hydro. It is widely used in Nigeria as the power from grid is grossly inadequate. Report has shown that Nigeria is the higher importer of generators in Africa.

1.1.3 Captive power plant

Captive **power plants** are facilities that are devoted to offer confined sources of power to energy users. The plants are capable of operating in grid parallel mode with an implied ability to export surplus power to the local electricity distribution network. It is self-generated so therefore independently of the local electricity distribution system [2].

Some of the gains of Captive power are as follows;

- It offers dependability for supply of energy crucial for viable industrial activities with a significant peak shaving, and high power quality or voltage control needed for subtle industrial apparatus.
- It also diminishes line losses and voltage sag since proximity to load results in more efficient power transmission.
- It has high fuel efficiency, therefore, reduces cost particularly when in CHP arrangement.

- It serves as replacement for inadequate main supply access and source of power in area lacking grid supply, such as remote rural areas;
- Backup standby generation ensures regular supply and provision of ancillary services such as voltage or frequency control.
- Improved environmental performance resulting from fuel efficiency

The recent incessant vandalism of key power infrastructures across the country has also prompted the need for individuals, state governments, local governments and communities to resort to captive power mostly for remote isolated settlements. However, despite all these benefits from captive power it is not without drawbacks which include but not limited to:

- It is more expensive to generate power from captive sources than getting from the central grid.
- It is a source of noise pollution.
- It contributes significantly to climate change.

1.2 Energy Commission of Nigeria

Energy Commission of Nigeria is an apex organ of Government with the statutory mandate for strategic planning, co-ordination and monitoring of national policies in the field of energy in all its ramifications [3].

- Serve as a centre for gathering and disseminating information relating to national policy in the field of energy development;
- Serve as centre for solving any inter-related technical problems that may arise in the implementation of any policy relating to the field of energy;
- Advise the Government of the Federation or a State on questions relating to such aspects of energy, as the Government of the Federation or a State, may from time to time refer to it;
- Prepare after consultation with such agencies of government whose functions relate to the field of Energy development or supply as the Commission considered appropriate, periodic master plans for the balanced and co-ordinated development of energy in Nigeria ,
- Collate, analyze and publish information relating to the field of energy from all sources, where such information is relevant to the discharge of its function under the Act;
- Monitor the performance of the energy sector in the execution of government policies on energy; etc.[4]

Sequent to the above premise, Energy Commission Nigeria embarked on a study to capture the captive power capacity and utilization in the household, services (commercial/office buildings) and industries (agriculture, mining, construction and manufacturing) between December 2014 and February 2015.

1.3 Survey Specific Objectives:

- To assess the capacity of captive power generation in the FCT.
- To estimate the quantity and type of fuel used in generating these captive power.
- To determine utilization pattern of the captive power generated which would provide input to national policy development.

1.4 Scope of Study

The survey was carried out in the six area councils of FCT, namely Abaji, Kwali, Gwagwalada, Kuje, Bwari and Abuja Municipal Area Council (AMAC) which done as base (pivot) study towards a National coverage.

2.0 MATERIALS AND METHODS

2.1 Survey Tool Design

The questionnaire was tailored and designed towards capturing the objectives of the project and based on the data required.

Part A: Respondents information,
Part B: Generator Capacity statistic and fuel use,
Part C: Power Supply Option,
Part D: Captive Power Utilization Pattern).

2.2 Logistics Provision/motivation

All materials requirement needed for the survey were provided for the field officers which includes; questionnaires, back pack, writing materials, means of identification such as Faze caps, T-shirt and Badges.

2.3 Training of field officers

The enumerators were trained by seasoned professional to equip them on the content and administration pattern of the questionnaires.

2.4 Feasibility study

Two days was dedicated for Investigation and literature review on all the towns to be surveyed. This was done to ascertain and map-out the target areas and respondents needed in the survey and also to get the team conversant with the route and terrain of the locations intended for the study.

2.5 Main Field Work

One week was used for the administration of questionnaires and their retrieval from various sectors of the FCT.

2.6 Data Analysis

Questionnaires retrieved from the field were collated and then analyzed using a customized web-based software application developed and hosted on a highly secured database server which has the features of capacity to be reviewed periodically when deemed necessary.

3.0 RESULTS AND DISCUSSIONS

3.1 Questionnaire Statistics

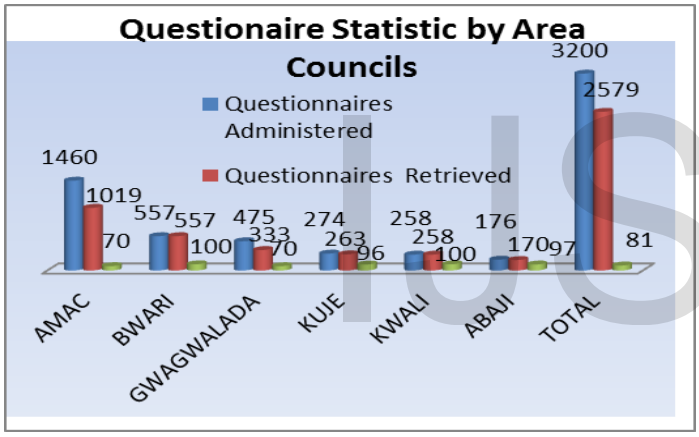


Fig.1 Questionnaire Statistic by Area Councils

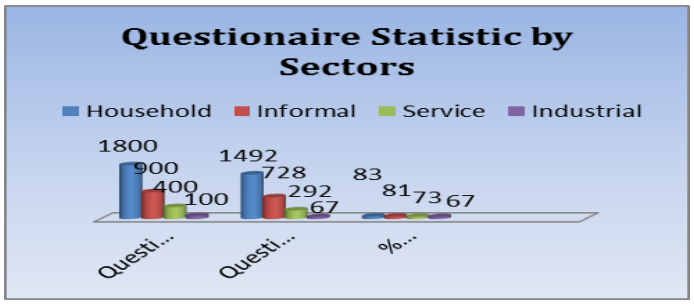


Fig.2 Questionnaire Statistics by Sectors

Fig.3 (b) *Number of Generators in Each Capacity size Group (informal Sector)*

3.2 Generator Statistics

Household Sector

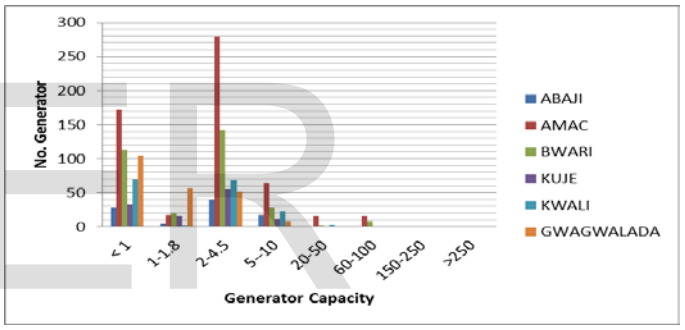
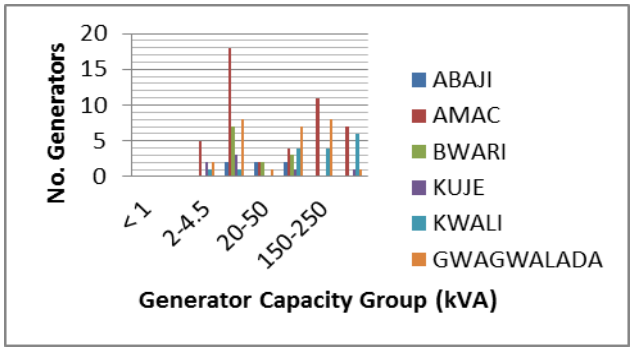


Fig.3 (a) Number of Generators in Each Capacity Size Group per Sector (Household)

Informal Sector



Service

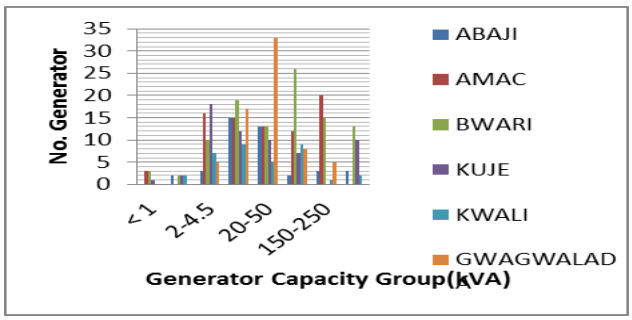


Fig. 3(c) Number of Generators in Each Size Group (Services Sector)

Industry

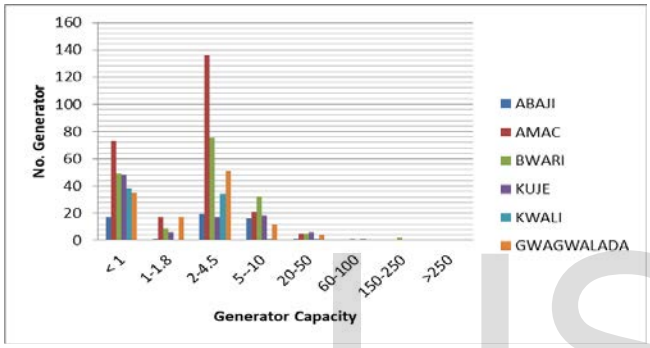
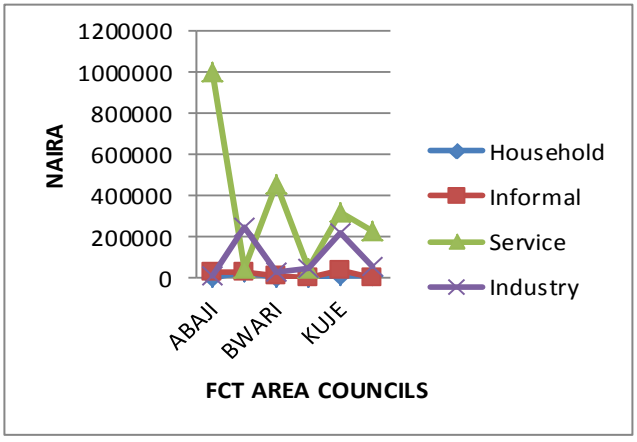


Fig.3 (d) Number of Generators In Each Size Group (Industrial Sector)

3.3 Peak Generator Maintenance Cost



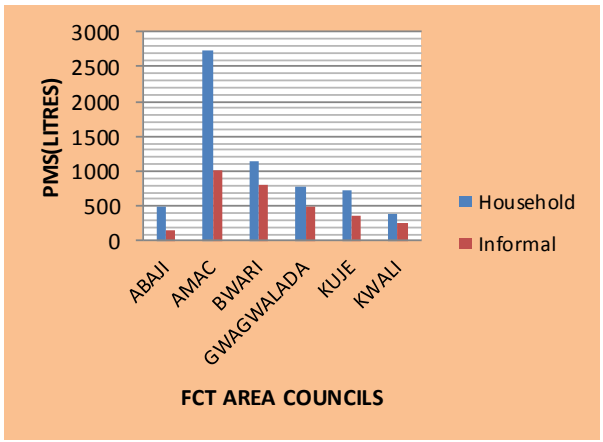


Fig. 4 Peak Generator Maintenance Cost per Area Council per sectors of FCT (2014)

3.4 Quantity of Fuel Used Per Sector in 2014 in FCT.

3.4.1 PMS

Fig. 5a (i) Quantity of PMS used (litres) in Household and Informal Sectors in the Area Councils of FCT in 2014.

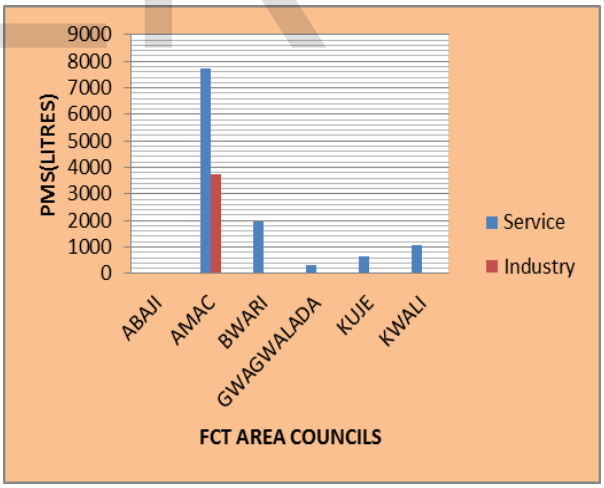


Fig. 5a (ii) Quantity of PMS Used (litres) in Service and Industrial Sector All Area Councils, FCT (2014)

3.4.2 AGO

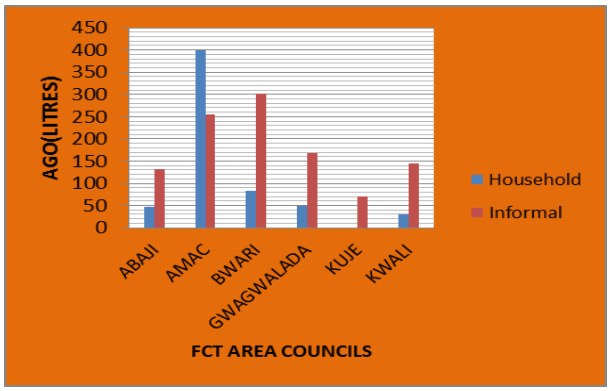


Fig. 5b (i) Quantity of AGO Used (litres) in Household and Informal Sectors, FCT (2014)

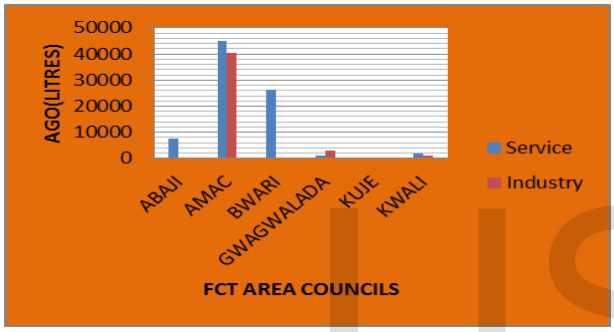


Fig. 5b (ii) Quantity of AGO Used (litres) in Service and industrial Sector in the FCT in 2014

DISCUSSIONS

Fig.1 Questionnaire Statistic by Area Councils

It is depicted in Fig. 1 above that over 80% of retrieval rate was recorded for the questionnaire administered which is remarkable as this tends to reduce the error margin.

Fig.2 Questionnaire Statistics by Sectors

Fig. 2 showed questionnaire administration in the four sectors under investigation vis-à-vis, household 56%, informal sector 28%, service sector about 12%, and industrial sector taking 3% of the aggregate. This was done proportionate to the sizes of the sectors in the FCT.

Fig. 3 (a) Number of Generators in Each Capacity Size Group per Sector (Household)

3.5 Average Estimated Electricity Demand per Day per Sector in FCT

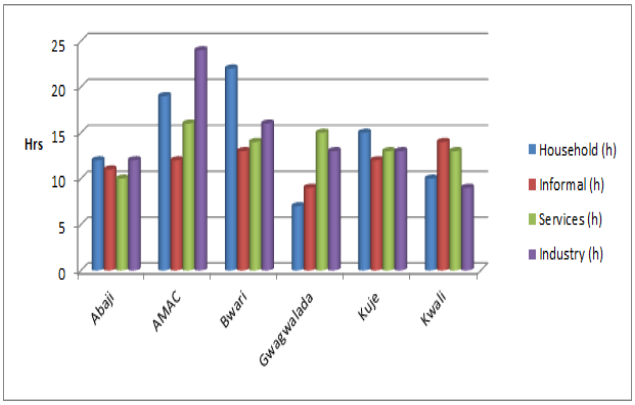


Fig.6: Average Estimated Electricity Demand per Day per Sector per Area Council (in hours)

Inferring from Fig. 3 (a), the mostly used generators in the household sector in the FCT is within the 2- 4.5 kVA range, which represented about 43%, followed by the less than 1kVa generator capacity range having 35%. This is probably because the major loads powered by household generators usage are mostly lighting and ventilation. The most used capacity group is recorded in AMAC of FCT.

Fig.3 (b) ***Number of Generators in Each Capacity size Group (informal Sector)***

As depicts in Fig. 3(b), generator usage pattern captured in the informal sector is quite similar to that of the household sector; indicative of similarity of the type of load being powered.

Fig. 3(c) Number of Generators in Each Size Group (Services Sector)

Fig.3(c) indicated that in the service sector the 20 – 50kVA and 5 – 10kVA range of generators have the uppermost usage rate of 23% each followed by the 60-100kVA generator with about 17%. This is quite unlike household and informal sector with lower ranges probably because of the higher powered load characteristics sector.

Fig.3 (d) Number of Generators In Each Size Group (Industrial Sector)

It is revealed in Fig.3 (d) that in the industrial sector, generator size range 5 -10kVA which accounted for 34% of total generator used is the most patronized in the sector followed by 150 -250kVA with 20%, the adducible reason might be due to the fact small or medium scale industries were mostly captured.

Fig. 4 Peak Generator Maintenance Cost per Area Council per sectors of FCT (2014)

The service sector across all the Area Councils of FCT retained the highest peak Maintenance cost followed by Industrial sector and then informal sector, the sector with the least peak generator maintenance Cost being household sector. The reason is not far-fetched FCT is a hub of central government offices.

Fig. 5a (i) Quantity of PMS used (litres) in Household and Informal Sectors in the Area Councils of FCT in 2014.

From Fig. 5a (i) above, approximately 61% of PMS used per day in the household and informal sectors of FCT is utilized in the household sector whereas 39% is used in the informal sector. This could be due to higher hours per day of generators usage in the sector and likewise the type of generators powered by PMS which are predominately patronized in the household sector.

Fig. 5a (ii) Quantity of PMS Used (litres) in Service and Industrial Sector All Area Councils, FCT (2014)

As seen in table 5a (ii) above, more quantity of PMS is used in Service sector than industry sector accounting for over 80% 0f the total PMS used in both sectors in FCT. While industries utilized barely about 14%. This is attributable to the fact that there are more service sectors as covered by the survey.

Fig. 5b (i) Quantity of AGO Used (litres) in Household and Informal Sectors, FCT (2014)

From Fig. 5 b (i), It is observed that Informal sector across the Area councils of FCT used more quantity of AGO which is over 70% of the total AGO used in both sectors in the period under consideration, except AMAC whose reverse is the case. This trend is maybe due to the fact that most informal sector components used AGO power generators than household sectors whereas in AMAC as the city centre houses affluent people who use predominately AGO powered generators.

Fig. 5b (ii) Quantity of AGO Used (litres) in Service and industrial Sector in the FCT in 2014

Over 75% of the aggregate AGO used in both service and Industrial sectors in FCT in the year 2014 was utilised in the service sector majorly in AMAC and Bwari, as shown in Fig.5b (ii) above, while industrial sector utilized 25%.

Fig. 6 Average Estimated Electricity Demand per Day per Sector per Area Council (in hours)

Fig. 6 above shown that in among the Area Council of FCT, AMAC industrial sector has the highest average estimated electricity demand per day of over 22hours, followed by Bwari household sector with slightly above 20hours, the least being Gwagwalada household sector with a little above 5 hours.

4.0 CONCLUSION

It is empirically evident from the survey that the average monthly electricity consumed from grid for average household and medium sized service sector is 1.34MWh while that of captive power generation is 2.14MWh which justifies the fact that captive power generation is unavoidable in order to meet the growing power demand in Nigeria..

Similarly, the comparative average electricity bill from grid in FCT for all the sectors having been estimated to be 2.5times that of captive power despite the multilevel expenditure, captive power is still being highly patronised also points to the indispensability of captive power in extenuating the power supply shortfalls as sourced from the grid.

5.0 RECOMMENDATION

1. There is need for Nigeria to develop a comprehensive policy guidelines regarding captive power which should be acceptable and

applicable and adopt a phase approach to develop and implement legal and commercial arrangements simple and devoid unnecessary intricacies.

2. Poor power supply has been a bane to economic prosperity of Nigeria. Therefore, Captive power plants vendors should be encouraged to have connectivity with the grid so as to sell their surplus capacity to customers in need.
3. It is imperative for Nigeria to expand the transmission line to evacuate a sizeable chunk of power generated installed capacity of 12,000MW as the current power transmission capacity of about 6870MW [4] is grossly inadequate and worrisome considering the robust Nigeria population size.
4. The power supply regulator should make it obligatory for Environmental Impact Assessment (EIA) to be submitted for captive power plant above 10MW capacity to mitigate any adverse environmental impacts during power plant construction and operation due to the prevailing climate change phenomenon issues.
5. High penetration of renewable energy technologies deployment is recommended and should be holistically embraced by Nigeria, to ensure energy security and climate change mitigation.
6. It is recommended that NERC adequately monitors the activities of participants in the electricity industry and ensure that all rules, regulations, and codes stated in the Power Sector Reform Programme are enforced in a transparent and equitable manner.
7. It is also important that ECN, SON and other stakeholders intensify advocacy to institutionalize and improve the relevant legal and policy framework. And further expedite serious commitment to developing and enforcing standards, regulations and codes for Renewable Energy Technologies [5].

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