**International Conference on Mechanical, Manufacturing and Process Engineering (ICMMPE – 2022)**

# The Use of Portable Electricity Generators in Edo State Nigeria

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## ABSTRACT

**The use of backup power supplies such as generators fueled by petrol or diesel, as well as solar powered generators, has resulted from the constant power failure or epileptic power supply from the electrical distribution company. The goal of this study was to determine the amount of usage of the aforementioned backup power supplies in Edo State, Nigeria. The state has eighteen local government units that are divided into three senatorial districts: Edo North, Edo Central, and Edo South. For the investigation, a two-stage sampling approach was used. Each of the state's three senatorial districts had one Local Government Area (LGA) picked at random. Their headquarters were chosen at random from the studied LGAs, with Benin city coming from Oredo, Ekpoma from Esan-west, and Auchi from Etsako-west. Out of target populations of 1200, 800, and 1000 households, 1000 households were randomly picked from Benin city, 750 households from Ekpoma, and 840 households from Auchi. In the study area, 2590 questionnaires were distributed as part of the instrument. Only 2579 copies of the questionnaire were completed and utilized for descriptive statistical analysis (%) of the respondents' use of portable generators or other power sources. According to the findings of the study, everyone uses a generator, with 70.7 percent using it solely for domestic purposes, 25% using it for both domestic and business purposes, and 4.3 percent using it solely for business purposes, with 91.8 percent serviceable and 8.2 percent non-serviceable generators. The majority of people (80.2%) use petrol generators with rated power between 2500 and 3000W**.

**Keywords:** Generator; Gasoline; Questionnaires; People; Power; Edo state.

## 1. INTRODUCTION

In order to keep pace with the rise in social economic activities and demand for uninterrupted power supply, in developing economies, many people have resulted in the use of fossil fuel (gasoline and diesel) generators. Electric generators, as in [1], are in high demand in Nigeria today. Generator sales are gradually increasing in Nigeria since they are considered essential commodities. This increase in demand for power generators is a result of continuous power outages in some places and lack of power in other areas of Nigeria, as well as population growth. Nigeria's power generation capacity is now around 4,000MW, significantly less than the expected national demand of over 40 000MW. Fossil fuel fired generators are mostly used as backup power sources in most nations when the national grid is underutilized or unavailable, or to provide power in remote locations that are not linked to the national grid [2]. A gasoline generator is a type of engine-generator that combines an electrical generator and an engine into a single self-contained unit. The majority of the engines used are piston engines. However, a gas turbine can be utilized for small-scale power or electricity production, fueled with gasoline or petrol. Engine generators have the advantage of being able to supply electricity on their own, making them ideal for backup power [3].

However, determining the viability of using a generator fueled with gasoline as well as one fueled with diesel based on fuel consumption, energy or power quality, and efficiency is critical, so as in [4], comparison of generators fueled with gasoline, liquefied petroleum gas, and biogas were individually carried out . This was done in order to determine the quality of power used in electricity generation. According to the researchers observations, there was no discernible variation in power quality between the aforementioned fuels. Investigation of the variation in energy and exergetic efficiency for gasoline, diesel, and natural gas generators was carried out as in [5]. According to the researchers findings, energy/exergetic efficiencies ranged from 0.19 percent to 16.20 percent, with average energy/exergetic efficiencies of 9.59 percent, 4.43 percent, and 0.27 percent for diesel, gasoline, and natural gas generators, respectively. As in [6], investigation of the effects of ethanol, butanol, and methanol mixes with gasoline in various quantities on engine performance was carried out. The engine's performance was assessed using the power generated by the electrical generator. It was stated that when the engine was operated with a 1:10 ethanol gasoline blend, the engine performance rose by 6%, and when ran with regular gasoline, the engine performance increased by 6%.

Performance of a single cylinder four-stroke spark-ignition engine with a compression ratio of 10:1 on the one hand and 11:1 on the other, using unleaded fuel and a blend of unleaded gasoline and ethanol, respectively was studied as in [7]. The emissions from the engine's exhaust were also investigated. The usage of a blend of unleaded gasoline and ethanol resulted in an improvement in torque, power, and fuel consumption of the engine, as well as a reduction in CO, NOx, and HC emissions. According to the author, using a mixture of ethanol and gasoline increases compression ratio and eliminates knocking. In the researchers' work, as in [8], used methanol with a high compression ratio (CR) to improve the performance and lower emissions of a single-cylinder engine. The engine with a CR of 6/1 was first tested using gasoline and methanol at full load and at various speeds. The CR was gradually increased from 6/1 to 8/1 to 10/1 after that. The researchers reported that knock was not noticed at the CRs of 8/1 and 10/1 when using methanol, but it was noticed at the CR of 8/1 when using gasoline. The researchers used cylinder pressure time curves to determine the knock. The researchers also stated that when they used methanol with a CR of 6/1, the results demonstrated some reductions in CO, CO2, and NOx emissions without any notable power loss.

Due to the extremely low supply from the national grid in Nigeria, generators have become the principal source of energy for most businesses and households. These generators are either gasoline or diesel or solar powered type with different power ratings. The generator is chosen depending on the fuel or source of energy for operation, the designed power requirements of the lighting, appliances, and other equipment. In developing nations such as Nigeria, however, most people buy generators without considering the designed power requirements of whatever function they are used for but with some consideration for the sort of fuel or energy used for operation. In the literature, the motivations for this action are unknown. The goal of this study is to identify the most popular or demanded generator type based on the fuel or source of energy utilized for operation, its power rating and the reasons for this. This is done with a view to providing would be marketers information about the most sought and engineers who would like to improve on the performance of the generators that is widely used by all and sundry.

## 2. METHODOLOGY

### 2.1 Research Area

The research area is Nigeria's Edo State, which is divided into eighteen local government areas. Edo state is located between 40 45' and 70 40' north latitude and 50 00' and 60 45' east longitude of the Greenwich Meridian [9]. The state is divided into three senatorial districts, notably Edo North, Edo Central, and Edo South Senatorial Districts ([9], [10]). Edo State has a population of 3,233,366 persons according to the 2006 national census[10]. Benin city has a population of 1,719,258 people [11], whereas Ekpoma and Auchi have 77,483 and 108,346 people respectively[10].

### 2.2 Design of Experiments

The study used a multistage sampling strategy similar to that used as in [9]. The first stage entailed taking a basic random sample of one LGA from each of the state's three senatorial districts. Oredo in Edo-south, Esan-west in Edo-central, and Etsako-west in Edo-north were the LGAs. In the second stage, a purposive sample of an LGA headquarters was used as a proxy for urban centers, with Benin City representing Oredo, Ekpoma representing Esan-west, and Auchi representing Etsako-west.

### 2.3 Techniques for Taking Samples and Sampling

Out of a target population of 1200, 800, and 1000 houses, 1000 households were randomly picked from Benin city, 750 households from Ekpoma, and 840 households from Auchi, using the method described as in [9], but multiplying the number of households by a factor of ten.

### 2.4 The Research Instrument

A structured questionnaire was used to collect data in this study because the respondents were limited to certain response alternatives, the utilization of portable electrical generators" was the title. The instrument was divided into two portions, Section A and Section B. The respondents' demographic information was collected in Section A. The respondents' level of use of a portable generator was measured in Section B, which included ten questions.

### 2.5 The Instrument's Administration

In the study area, 2590 questionnaires were distributed as part of the instrument. To achieve a 100% return rate, the surveys were collected on the same day they were given out. Only 2579 copies of the questionnaire were completely filled out, while 11 copies were incomplete and were not included in the study. This represents 99.6% of the surveys delivered across the same research area.

The respondents' level of use of a portable generator was analyzed using descriptive statistics such as percentage.

## RESULTS AND DISCUSSION

The demographic data of the respondents is shown in Table 1

**Table 1:** Demographic data of Respondents

| Age | | Sex | | Educational Status | |
|---|---|---|---|---|---|
| 18-35 | 1121(43.5%) | Male | 1767(68.5%) | Illiterate | 725(28.1%) |
| 36 and above | 1458 (56.5%) | Female | 812(31.5%) | Literate | 1854(71.9%) |
| Total | 2579 | | 2579 | | 2579 |

As seen in Table 1, the biggest percentage of respondents to the survey were those aged 36 and up (56.5%). This is due to the fact that the majority of homeowners are in this age group. Only 28.1 percent of the respondents were illiterate, whereas 71.9 percent were literate, as seen in Table 1. Literacy is defined as the capacity to read and write, whereas illiteracy is the opposite. Table 1 shows that male respondents outnumber female respondents by 37%. Table 2 shows the replies of the evaluated respondents regarding the level of use of a portable energy generator.

**Table 2:** The evaluated respondents responses   to the level of use of portable electricity generators

| S/N | Level of use of portable electricity generators | | |
|---|---|---|---|
| | Items | YES | NO |
| 1 | What type of house do you live?<br>(A) single room apartment<br>(B). Two bedroom apartment<br>(C), three bedroom apartment<br>(D) Four bedroom apartment and<br>(E ) a bungalow. | 256(9.9%)<br>458(17.8%)<br>982(38.1%)<br>231(8.9%)<br>652(25.3%) | 2323(90.1%)<br>2121(82.2%)<br>1597(61.9%)<br>2348(91.1%)<br>1927(74.7%) |
| 2 | Do you use electricity generator? | 2579(100%) | 0(0%) |
| 3 | Is your generator serviceable? | 2367(91.8%) | 212(8.2%) |
| 4 | What do you use generator for?<br>A.    domestic purposes<br>B.    business only<br>C.  both domestic and business | 1824(70.7%)<br>110(4.3%)<br>645(25%) | 755(29.3%)<br>2469(95.7%)<br>1934(75%) |
| 5 | Do you use the same generator for both domestic and business purpose? | 120(18.6%) | 525(81.4%) |
| 6 | What type of generator do you use?<br>A. petrol generator<br>(B) diesel generator<br>(c) solar | 2069(80.2%)<br>442(17.2%)<br>68(2.6%) | 510(19.8%)<br>2137(82.8%)<br>2511(97.4%) |
| 7 | If it is A or B or C above which of the range of power rating does it fall.<br>(A) less than or equal to1200W,<br>(B) 1800-2400W,<br>(C) 2500-3000W<br>(D) 3500-5000W<br>and (E) Above 5000W | 238(9.2%)<br>466(18.1%)<br>1201(46.6%)<br>538(20.9%)<br>136(5.2%) | 2341(90.8%)<br>2113(81.9%)<br>1378(53.4%)<br>2041(79.1%)<br>2443(94.8%) |
| 8 | Why the choice of the power rating?<br>(A) it is because of affordability although it is not meeting with your lightings and  appliances power requirement.<br>(B) it is because of affordability and its meeting with your appliances power requirement. | 1743(67.6%)<br><br>836(32.4%) | 836(32.4%)<br><br>1743(67.6%) |
| 9 | If it is yes in in 6A above, what do you do to make up the power requirement?<br>(A). Nothing.<br>(B). Switching off some lightings and appliances.<br>(C) Using solar for make up. | 765(43.9%)<br>932(53.5%)<br>46(2.6%) | 978(56.1%)<br>811(46.5%)<br>1697(97.4%) |
| 10 | Will you welcome development of alternative power supply to boost the power requirement of your home or business. | 2559(99.2%) | 20(0.8%) |

Table 2 shows that single, two, three, four, and five bedroom flats, as well as a bungalow, are occupied by 9.9%, 17.8%, 38.1 percent, 8.9%, and 25.3 percent of the population, respectively. More specifically, generators are used in every household in Edo state's metropolitan regions, with 91.8 percent serviceable and 8.2 percent non-serviceable generators, respectively. The epileptic power supply from the electrical distribution corporation or national grid is causing this widespread use of generators. As shown in Table 2, 1,824 individuals (70.7 percent) use generators for residential purposes, 110 people (4.3 percent) for business, 645 people (25 percent) for both domestic and business purposes, and 18.6 percent use the same or one generator for both domestic and business purposes.

Around 80.2 percent, 17.2 percent, and 2.6 percent of people utilize gasoline generators, diesel generators, and solar energy, respectively. The power ratings of the generators of 9.2 percent, 18.1 percent, 46.6 percent, 20.9 percent, and 5.2 percent users, respectively, are less than or equal to 1200W, 1800-2400W, 2500-3000W, 3500-5000W,

## 4. CONCLUSION

Many Nigerians have turned to backup power sources such as petrol generators, diesel generators, and solar-powered generators due to fluctuations in power supply and, in certain cases, a lack of power from the electrical distribution company or the national grid. According to the findings of this study, generators are used in every household in Edo state's urban zones, with 91.8 percent of serviceable generators and 8.2 percent of non-serviceable generators, respectively. Gasoline generators are the most regularly used or requested backup power source, with generators having a rated output of 2500-3000W being the most typical. To fulfill the increased demand for electricity in homes and businesses, almost everyone in Edo state supports the development of alternative energy sources and over 5000W, as indicated in Table 2. According to 67.6% of generator users, the choice of generator power rating is based on affordability, even though it does not meet the power requirements of lighting and appliances, while the remaining 32.4 percent indicated that it is because of affordability and meeting the power requirements of their appliances, as shown in Table 2. Around 43.9 percent of users do nothing to compensate for the power shortage, while 56.1 percent do something to compensate, namely 53.5 percent load share by not using certain appliances at the same time, for example, not using a pressing iron and a refrigerator at the same time, and 2.6 percent use solar energy to compensate, as shown in Table 2. 99.2 percent of people support the development of alternative power sources to meet the growing demand for electricity in households and businesses.

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