

GAS TURBINE AS AN ALTERNATIVE STRATEGY FOR SUSTAINABLE ELECTRICITY POWER STABILITY IN EKITI STATE, NIGERIA

ADAMEJI, James Oluwasola

Department of Vocational and Technical Education

Ekiti State University, Nigeria

adamejiolusola@gmail.com

Abstract

This study examined gas turbine as an alternative strategy for sustainable electricity power stability in Ekiti state, Nigeria. A survey research method was used for the study. The population for this study consisted of 153 staff of Benin Electricity Distribution Company (BEDC) in Ekiti State. The sample for this study was 111 respondents. The data collected from the field were answered using descriptive analysis method (mean and standard deviation). The hypothesis was tested at 0.05 level of significance using simple regression analysis. From the analysis, it was revealed that the factors delimiting the sustainable electricity power supply in Ekiti State include ineffective energy management structure, government's inconsistent and misguided power reform policies, inefficiency in power generation, transmission, distribution and consumption, incompetent labour force and inadequate fund supply. It was revealed that there is a significant impact of gas turbine on sustainable power supply in Ekiti State. It was unveiled that the measures adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State include potential evaluation of all primary energy source in the state, restructuring of the energy sector, employment of skilled staff, training of employees and proper accountability of funds management. Based on the findings of this study, it was concluded that there is a significant impact of gas turbine on sustainable power supply in Ekiti State. It was recommended that government should introduce a well-defined legal framework to guide all the stakeholders of the energy sector in the state

Keywords: Gas Turbine, Electricity, Power Stability, Benin Electricity Distribution Company (BEDC)

Introduction

In Nigeria, energy serves as the pillar of wealth creation evident by being the nucleus of operations and engine of growth for all sectors of the economy. The output of the energy sector such as electricity usually consolidates the activities of the other sectors which provide essential services to direct production activities in agriculture, manufacturing, mining,

commerce among others. Nigeria is endowed with abundant energy resources but suffers from perennial energy crisis which has defied solution.

Electricity is a type of energy that involves the flow of electrons usually generated from either renewable or conventional energy sources. Electric power is the engine that drives industrialization, which improves communication, helps innovation in

science and Technology, provides sound healthcare delivery system and improves citizen's standard of living (Olaoye, 2019). Since Electric power is the engine that drives industrialization, a stable Electric power supply is the key for Nigeria to become one of the most 20 developed economy in the world (Emovon & Kareem 2018). But it seems unfortunate that the biggest problem in Nigeria is electricity crisis, a crisis without end.

It is very clear that electrification is a prerequisite to modern industrialization; hence we cannot minimize the importance of this notion. It is quite clear that there is no nation which can develop and industrialize without sound electric base. Today, many depend on electricity for basic needs such as food, water, shelter, communication, employment and health care. Those needs are served by infrastructures for food preservation, water treatment, heat and light, phone service, Internet, offices, factories, hospitals and emergency response, to name a few. Yet all of those essentials are without electricity. We could easily argue that population growth is fueling the growth in electricity demand.

Electricity is an essential commodity required for the future development of the society (Adeyemo, 2019). This good must be supplied on a continuous basis in order to cover the daily requirements. To this end, the performance and efficiency of power generation industry (Power Sector) is of great importance towards achieving quality and reliable supply of electricity. Continuous access to quality energy infrastructure is an essential ingredient for sustaining economic growth and development. Inadequate supply of electricity has the capability to retard development of industries, small scale businesses,

hospitals and establishment of other infrastructural facilities in the urban and rural settlements (Oyedepo et al., 2012). Several strategies have been put in place to enhance the sustainable power supply in Nigeria. One of this strategy is, gas turbine.

A gas turbine is a *type of engine in which a shaft is made to rotate by burning gas moving past arrays of blades arranged in circles*. A gas turbine, also called a combustion turbine, is a type of continuous flow internal combustion engine (Ajewole, 2019). The main parts common to all gas turbine engines form the power-producing part (known as the gas generator or core) and are, in the direction of flow; a rotating gas compressor, a combustor and a compressor-driving turbine. Additional components have to be added to the gas generator to suit its application. Common to all is an air inlet but with different configurations to suit the requirements of marine use, land use or flight at speeds varying from stationary to supersonic. A propelling nozzle is added to produce thrust for flight.

The basic operation of the gas turbine is a Brayton cycle with air as the working fluid: atmospheric air flows through the compressor that brings it to higher pressure; energy is then added by spraying fuel into the air and igniting it so that the combustion generates a high-temperature flow; this high-temperature pressurized gas enters a turbine, producing a shaft work output in the process, used to drive the compressor; the unused energy comes out in the exhaust gases that can be repurposed for external work, such as directly producing thrust in a turbojet engine, or rotating a second, independent turbine (known as a *power turbine*) that can be connected to a fan, propeller, or

electrical generator. This strategy enhances the supply of electricity to different households.

Statement of the Problem

The Nigerian government have spent so much and still spending huge amount of money on the electricity generation and power supply in Nigeria, allocation made to it is relatively equal to the allocation of education which means that much money is put in to electricity. The epileptic nature of electricity has led to scarcity of petrol and kerosene because the citizens have resulted in using generators and kerosene powered equipment to provide energy for use at homes. Also, import content of our domestic fuel usage has grown over the years to about 75%. This has resulted in the use and overdependence on fuel-wood which has led to deforestation and attendant degradation of the environment and worsening desertification.

A country experiencing energy poverty can be said to be a situation where its citizens lack electric power to meet their basic needs such as lighting and cooking. In this situation, a large number of people in the developing countries like Nigeria are negatively affected by their very low consumption of energy use, while some use dirty polluting fuels and others spend excessive time to obtain fuel in order to meet their basic needs. Access to energy is fundamental to improve the quality of life and is a key imperative for economic development. Poor access to energy in Nigeria obviously translates into increased poverty, poor economic performance, limited employment opportunity and complicated prospects for institutional development. The high growth rate of the population is an indication that the country's energy demand will continue to rise, similar to how the increase in

global population and industrial transformation of the 20th century tremendously increased energy demand.

The energy crisis situation in Nigeria has considerably affected the public users of electricity. This phenomenon has undeniably compelled the majority of households in both rural and urban segments of the country to significantly depend on combustible Renewable Energy sources especially for domestic heating and cooking. Fuel wood and charcoal are widespread energy sources commonly used in Nigeria. Universally accessible energy services in the form of renewable energy resources that are adequate, affordable, reliable, of good quality, safe and environmentally conscious beings are a necessary condition for sustainable development and poverty reduction in the country. This study intends to examine the efficiency of gas turbines as an alternative strategy for sustainable electricity power stability in Ekiti state, Nigeria.

Purpose of the Study

The main purpose of this study is to examine gas turbine as an alternative strategy for sustainable electricity power stability in Ekiti state, Nigeria. The specific purposes are to: determine the current level of electricity power supply in Ekiti State; examine the factors delimiting the sustainable electricity power supply in Ekiti State; investigate the contribution of gas turbine to sustainable power supply in Ekiti State; ascertain the measures to be adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State.

Research Questions

The following questions will be answered in the course of this study:

- What is the current level of electricity power supply in Ekiti State?
- What are the factors delimiting the sustainable electricity power supply in Ekiti State?
- What are the measures to be adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State?

Research Hypothesis

The following null hypothesis is formulated:

H₀: There is no significant contribution of gas turbines to sustainable power supply in Ekiti State

Methodology

A descriptive research of the survey design was used for the study. The population for this study covered all the staffs across all the eight departments of Benin Electricity Distribution Company (BEDC), Ado Ekiti, Ekiti State. There are 153 staff in Benin Electricity Distribution Company (BEDC) in Ekiti State (Manager of the BEDC branch, Ado Ekiti, 2024). According to Yamane (1964) model, the sample size for this study was 111 respondents. The

Yamane model (1964) formula is given as:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N = the population size

e = level of significance

For the population of 111, the sample size based on the formula is:

$$n = \frac{153}{1 + 153(0.05)^2} = 111$$

The study adopted a random sampling technique. The instrument for data collection was a structured questionnaire. The instrument was validated by experts in vocational and technical education, Ekiti State University, Ado Ekiti. The data collected were analyzed using descriptive and inferential statistics. Descriptive statistics of mean and standard deviation were used to answer the research questions while the hypothesis was tested at 0.05 level of significance using simple linear regression.

Result and Discussion

Results

Research Question 1: What is the current level of electricity power supply in Ekiti State?

Table 1: Current Level of Electricity Power Supply in Ekiti State

S/N	Items	Mean	Std. Dev.	Remark
1	Electricity Power is supply often in Ekiti State	2.65	1.398	Agreed
2	Irregular power supply is experienced in some rural areas of the state	2.58	1.267	Agreed
3	Unstable power supply has affected many business in the industrial sector of the state	2.87	1.485	Agreed
4	High costs are incurred to ensure power supply in the state	2.99	1.307	Agreed

Table 1 above showed that all the respondents agreed that aforementioned items with their means and standard deviation revealed

the current level of electricity power supply in Ekiti State.

Research Question 2: What are the factors delimiting the sustainable electricity power supply in Ekiti State?

Table 2: Factors Delimiting the Sustainable Electricity Power Supply in Ekiti State

S/N	Items	Mean	Std. Dev.	Remark
1	Ineffective energy management structure	2.98	1.324	Agreed
2	Government's inconsistent and misguided power reform policies	2.73	1.268	Agreed
3	Inefficiency in power generation, transmission, distribution and consumption	2.69	1.274	Agreed
4	Incompetent labour force	2.80	1.332	Agreed
5	Inadequate Fund supply	2.74	1.422	Agreed

Table 2 showed that all the respondents agreed that the factors delimiting the sustainable electricity power supply in Ekiti State include ineffective energy management structure, government's inconsistent and misguided power reform policies, inefficiency in power generation, transmission, distribution and

consumption, incompetent labour force and inadequate fund supply.

Research Question 3: What are the measures to be adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State?

Table 3: Measures to be adopted by the Management of BEDC in Ekiti State to achieve a Sustainable Power Supply in Ekiti State

S/N	Items	Mean	Std. Dev.	Remark
1	Potential Evaluation of all primary energy source in the State	2.76	1.339	Agreed
2	Restructuring of the energy sector	2.84	1.438	Agreed
3	Employment of skilled staff	3.03	1.376	Agreed
4	Training of employees	2.91	1.459	Agreed
5	Proper accountability of funds management	2.94	1.330	Agreed

Table 4 showed that all the respondents agreed that the measures adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State include potential evaluation of all primary energy sources in the state, restructuring of the energy sector,

employment of skilled staff, training of employees and proper accountability of funds management.

Test of Hypothesis

Hypothesis I: There is no significant contribution of gas turbines to sustainable power supply in Ekiti State

Table 4: Simple Linear Regression Result on the impact of Gas Turbine to the Sustainable Power Supply in Ekiti State

Model	Unstandardized Coefficients		Standardized Coefficient		Sig
	B	Std. Error	Beta	t	
(Constant)	5.030	0.403		12.490	0.000
Gas Turbine	0.355	0.068	0.320	5.204	0.000

Dependent Variable: human resources management decision *p < 0.05 R = 0.320; R² = 0.102; Adjusted R² = 0.098; F = 27.082; Sig = 0.000

The outcome above in table 3 revealed that the correlation coefficient was 0.320 and this implies a moderate relationship between gas turbine and sustainable power supply in Ekiti State. The R² (0.102), which shows the overall explanatory power of the model, reveals that gas turbine explain about 10.2% of the systematic variation in sustainable power supply in Ekiti State. The remaining 89.8% might be due to other variables not included in this study. The overall fitness of the model as shown in the F statistics of 27.082 with a probability of 0.000 is statistically significant as it is less than the standard critical p-value of 0.05. This indicates that there is enough evidence to reject the null hypothesis, reflecting that there is a significant impact of gas turbine on sustainable power supply in Ekiti State.

Discussion of Findings

An attempt has been made to examine gas turbine as an alternative strategy for sustainable electricity power stability in Ekiti state, Nigeria. From the analysis, it was revealed that the factors delimiting the sustainable electricity power supply in Ekiti State include ineffective energy management structure, government's inconsistent and misguided power reform policies, inefficiency in power generation, transmission, distribution and consumption, incompetent labour force and inadequate fund supply. This

outcome is in agreement with the conclusion of Jane (2016) that ineffective energy management structure, incompetent labour force and inadequate fund supply affects the sustainable electricity power supply in Nigeria. Also, it was revealed that there is a significant impact of gas turbine on sustainable power supply in Ekiti State. This implies that an increase in the usage of gas turbine would cause an increase in sustainable power supply in Ekiti State at a significant level. This is in tandem with the objective of gas turbine which is, to ensure the stability of energy supply. This outcome agrees tandem with the findings of Olukayode (2015) that the usage of gas turbine significantly enhance steady power supply in the state. It was unveiled that the measures to be adopted by the management of BEDC in Ekiti State to achieve a sustainable power supply in Ekiti State include potential evaluation of all primary energy source in the state, restructuring of the energy sector, employment of skilled staff, training of employees and proper accountability of funds management. This outcome supports the findings of Elisha (2019) that the best measure to ensure steady power supply in Nigeria is to evaluate all the primary energy source in the state and restructure the energy sector.

Conclusion

From the findings made, it was concluded that the factors delimiting the sustainable electricity power supply in Ekiti State include ineffective energy management structure, government's inconsistent and misguided power reform policies, inefficiency in power generation, transmission, distribution and consumption, incompetent labour force and inadequate fund supply. It was also established that there is a significant impact of gas turbine on sustainable power supply in Ekiti State.

Recommendations

The following recommendations were made based on the findings of the study.

- i. To ensure sustainable electricity power stability in Ekiti State, a thorough evaluation of primary energy sources like natural gas, solar, and biomass is essential. Advanced tools such as GIS and stakeholder collaboration can help identify areas for investment. Partnering with research institutions will enhance resource mapping and analysis for informed decision-making.
- ii. Restructuring the energy sector should prioritize technical and economic feasibility over political influences. Independent advisory committees and feasibility studies can ensure sound investments. Public awareness campaigns will foster support for evidence-based policies, and regular monitoring can ensure policy adherence to data-driven approaches.
- iii. A robust legal framework tailored to the state's energy sector is crucial for stakeholder accountability and collaboration. It should clarify roles, set regulatory standards, and provide mechanisms for monitoring and

dispute resolution. Clear laws will attract investments and ensure sustainable energy development.

- iv. PHCN's involvement in energy activities is critical for improving infrastructure, grid management, and distribution. Collaborative projects, staff training, and capacity-building initiatives will enhance operational efficiency. PHCN's active participation will promote an integrated approach to achieving energy stability.
- v. Combining resource evaluations, data-driven decisions, strong legal structures, and stakeholder engagement offers a sustainable path for Ekiti State's energy stability. These strategies can effectively leverage gas turbines to address energy challenges and create long-term economic and energy security.

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