CHAPTER ONE

1.1 INTRODUCTION

In developing countries like Nigeria, interrupted power supply has posed a serious threat to economic development. That is to say, where there is an irregular power supply, there is no development. This is because uninterrupted or regular power supply is essential to promote and boost the economy of a country (Singh and Manga 2012).

Nevertheless, most companies, industrial, commercial, and even domestic, are dependent on public power supply, which has erratic supply such as phase failure, phase imbalances, or total power failure due to one or more technical problems or imbalances in power generation, transmission, or distribution (Adedokun and Osupidan, 2010).

In addition, electricity plays a major role in the economic development of any nation, but the supply keeps dwindling and is sometimes not enough in Nigeria. The increase in urbanization, development and offshoots of industries and companies keeps adding to the power instability and collapse Majority of industries. Nigeria suffers a lot of economic loss and revenue due to power instability and failure. Most of the time, the voltage supplied by the power companies is very low to power the load. The power plants are subjected to the usage of diesel engines to power them. This requires a lot of money to keep the engine running. Also, power instability and failure result in voltage surges, and they result in equipment/load failure or damage. Sometimes the impact of power disturbances and interruptions on a plant's equipment and processes caused by voltage sag may require a complete restart of the load with hours of interrupted production. This causes substantial economic loss and load that are automated and have suffered a lot of setbacks due to power instability and failure.

The world's increasing demand for electricity has traditionally been met by grid-connected power plants. However, this reliance has led to numerous environmental, economic, and social challenges, including the depletion of fossil fuels, high energy costs, and the emission of greenhouse gases contributing to climate change. Additionally, the lack of skilled personnel to maintain and operate these conventional power systems further reduces the reliability and availability of electricity, with the growing dependency on electrical power for various aspects of human endeavors, such as sophisticated medical life-saving equipment, accurate data and processing machines, and the need for a more reliable and efficient power source, becoming crucial. In response, renewable energy sources, particularly hybrid inverter systems, have emerged as viable alternatives to address these challenges.

A hybrid solar inverter system integrates solar panels with battery storage, allowing electricity generation during the day and energy storage for later use, especially during power outages. This technology is particularly beneficial in developing countries like Nigeria, where unreliable grid

power remains a persistent issue. By reducing dependence on the national grid.hybrid inverter system provide a stable and sustainable power solution, ensuring energy availability for households, businesses, and essential services.

This project focuses on the installation and comprehensive performance analysis of a 4.2 kVA hybrid solar inverter system designed to provide reliable power to the Institute of Technology, Kwara State Polytechnic, Ilorin. The system will consist of 12 solar panels with a combined peak power output of 6 kW, a battery bank with a capacity of 5.28 kWh, and a 4.2 kVA hybrid inverter. This installation aims to demonstrate the feasibility and effectiveness of hybrid inverter technology in mitigating the impact of frequent power outages, thereby reducing operational costs associated with diesel generators and minimizing revenue loss. The performance analysis will include data logging of power generation, consumption, and battery state of charge, as well as a cost-benefit analysis to evaluate the system's economic viability. This project will contribute to the understanding of the long-term potential of hybrid inverter systems as a sustainable and economically viable solution to Nigeria's persistent power challenges and also serve as a practical teaching aid for the students of the institute.

1.1 Aim of the project

This project aims to improve the Institute of Technology, Kwara State Polytechnic, Ilorin's energy sustainability and resilience through the integration of a reliable 4.2 kV hybrid solar inverter system and provide a practical educational platform for students, promoting the development of skills in renewable energy technologies.

1.2 OBJECTIVES OF THE PROJECT

- Install a 4.2 kVA hybrid solar inverter system, including [Number] solar panels, a [Capacity] kWh battery bank, and a 4.2 kVA inverter, tailored to the Institute of Technology's energy consumption profile.

Analyze the impact of the hybrid solar inverter system on the availability and reliability of power for specific critical loads within the Institute of Technology, such as computer labs, workshops, and research equipment.

Evaluate the system's performance under varying weather conditions (e.g., during the rainy season, dry season, and periods of high solar irradiance) to determine its robustness and adaptability.

Develop a safety protocol for the system, and teach the maintenance officer how to safely operate and maintain the system.

To provide a source of electrical power with no running cost and low maintenance.

1.3 PROBLEM STATEMENT

The current state of electricity in Nigeria is a major hindrance to economic development and quality of life. Power outages are a daily occurrence, leading to disruptions in businesses. loss of productivity and inconvenience. Reliance on diesel generators as a backup power source is not only costly but also harmful to the environment. Installation of this 4.2 kVA hybrid inverter will help to address these challenges by providing a more reliable and sustainable source of electricity.

1.4 SCOPE OF THE PROJECT

This project covers the installation of 4.2 kVA hybrid inverters to provide a reliable and efficient power backup solution. The work includes site assessment, procurement of the inverters and battery bank, electrical wiring and connection, system configuration, and testing. The hybrid inverter will be set up to automatically switch between grid, battery, and solar power, ensuring seamless operation and documentation of the installation for future reference.

1.5 JUSTIFICATION

- This system provides a stable and uninterrupted power supply, reducing reliance on the national grid.
- This integration ensures better energy management, leading to improved efficiency and sustainability.
- By reducing dependence on the grid electricity and fuel-powered generators, long-term savings on energy costs can be achieved.
- This project will provide valuable insights into the feasibility of hybrid inverters, contributing to research on renewable energy adoption and energy management.