

An Innovation of Eco Flow Power Max to Generate Voltan with Internet of Things (IoT)

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Abstract

Generators are now commonly utilized as an alternate source of electricity during power outages or in places without an electrical supply. In response to this demand, a new innovation has emerged: the Eco Flow Power Max, a more productive and practical portable generator. This product is designed to be smaller than traditional generators and includes wheels at the base for transportation. Furthermore, the Eco Flow Power Max is available at a lower and more accessible price, which benefits notably rural populations. One of the main advantages of this generator is that it does not require fuel, such as gasoline or diesel. Instead, it runs on a 12 volt (V) battery that is transformed to 213V via an inverter system. This eliminates the need for fuel while also lowering oil usage and operational costs. The generator frame is made of mild steel, cut to precise specifications, and bonded using welding processes. The 12V battery powers a Direct Current (DC) motor, which helps recharge the battery. The electrical output is then routed through an inverter, which converts the power to 213V, and distributed via a conventional 3-pin socket. To summarize, the Eco Flow Power Max represents a substantial advancement in portable power generation by prioritizing user convenience, cost-effectiveness, and environmental sustainability. This project emphasizes the need of constant product enhancement in meeting the changing needs of current users.

Keywords: *Generator, Electric, Power, Voltan*

1.0 Introduction

1.1 Eco Flow Power Max Project as a power supply

This project started when floods caused a lack of electricity. As is known, a major flood will cause the electricity to be switched off. Thus, the main goal of this project is to offer an appropriate electrical connection given the current availability. Among them is charging the phone for an emergency. This project can also be used when camping in a suitable location and when there is an unexpected lack of electricity at home resulting from several other reasons. That is why this project is built using three pins and a Universal Serial Bus (USB) port. Thus, a project was developed whereby Eco Flow Power Max may be employed anywhere and help consumers by supplying electricity. Its straightforward form lets consumers carry it with ease. This project is using an alternator in a vehicle and produces a voltage of 12 volts. When an alternator is used with an inverter, the inverter converts the alternator's output and produces 213Volts ac. This project only supports small voltage devices such as mobile phones lamp and fans and does not support devices of higher voltage usage. The total power supplied by motor DC capable of producing 4V-14V and the limitation consumption is only 1.2 hours for each use to avoid overheating. This project's primary goals are to simplify night market sellers' selling at night and enable rural residents to use their electricity conveniently. Besides, this generator is simple to carry about for usage as necessary. All things considered, consumers of this DC motor do not have to spend a lot of money and do not produce loud noise pollution or manufacturing smoke. Consequently, the environment and customers are unaffected negatively by this auto charge generator. Thus, the project lets consumers acquire electricity to be used both inside and outside.

1.2 Objectives

- i. To design a compact generator
- ii. To develop mobile electricity
- iii. To design generators that do not cause noise pollution

1.3 Scopes

- i. This project can only be used for mobile phones, fans and lamps only.
- ii. Does not support devices with high capacity.
- iii. Motor DC capable of producing 12V-14V.
- iv. The usage is only 1.2 hours for each use to avoid overheating.

1.4 Issue and Challenge

According to the current scenario in Malaysia, rising petrol prices have a substantial impact on the use of fuel-powered generators. Furthermore, natural disasters such as floods can come suddenly, causing power outages or disruptions. As an alternative, the Eco Flow Power Max, which operates using alternator with connect inverter provides a sustainable and efficient energy solution. Unlike standard generators, this system does not require fuel, resulting in lower operating costs and less environmental effect. Using the principle of electromagnetic induction, the system may convert stored electrical energy into usable power while requiring minimal maintenance (Chen et al., 2021). The Eco Flow Power Max is also simple to install and suited for rural locations with little infrastructure, making it excellent for off-grid applications. Its dependability in supplying energy while lowering reliance on expensive and environmentally hazardous fuels makes it a feasible alternative to traditional fuel-powered generators in Malaysia. Furthermore, the expanding global emphasis on renewable energy technology reinforces the project's significance. Alternative generating systems that use clean energy can be used to power electrical devices, particularly during crises like floods, power outages, and outdoor activities (Aziz et al. 2018). This highlights the feasibility of incorporating green energy solutions into everyday life and national energy strategies.

2.0 Literature

This project utilizes the electromagnetic concept, which occurs as a result of the cutting of magnetic flux. Magnetic flux refers to the lines of the magnetic field that pass through a surface. The process of cutting this magnetic flux generates electrical energy used in various daily applications. Faraday's law is applied in this context. Michael Faraday discovered an important relationship between electricity and magnetism, known as electromagnetic induction, which was first identified in 1831. Faraday's law states that the electromotive force induced in a circuit is directly proportional to the rate of change of the magnetic flux cutting through it. An electric current is induced even in the absence of a dry cell when electromagnetic induction occurs. Electromagnetic induction is caused by the relative motion between a magnet and a conductor. An electromagnet is formed when an electric current passes through a coil wound around a magnetic iron core. Consequently, a magnetic field is generated when current flows through a conductor. The direction of the magnetic field produced by the current in a solenoid is determined by the direction of the current and can be predicted using the right-hand grip rule and Maxwell's screw rule

2.1 Concept of DC Booster.

A DC booster, or DC–DC boost converter, is an electronic power converter designed to step up a lower input DC voltage to a higher output DC voltage efficiently. This type of converter is widely applied in power management systems where the available source voltage is insufficient to drive the load directly (Kazimierczuk, 2014). The working principle of a boost converter relies on the energy storage capability of an inductor and the switching control of semiconductor devices. When the switch (usually a transistor) is closed, current flows through the inductor, storing energy in its magnetic field. When the switch opens, the

inductor releases this stored energy, causing the output voltage to rise above the input voltage. A diode prevents the reverse flow of current, and a capacitor smooths the output voltage to supply a steady DC output (Erickson & Maksimovic, 2001).

The output voltage V_{out} in continuous conduction mode is related to the input voltage V_{in} and the duty cycle D by the formula:

$$V_{out} = \frac{V_{in}}{1 - D}$$

where $0 < D < 1$ represents the fraction of the switching period during which the switch is ON (Kazimierczuk, 2014).

The main components inductor, transistor switch, diode, and output capacitor play vital roles in determining the efficiency and performance of the converter. Advances in semiconductor technology and converter topology have led to boost converters capable of achieving efficiencies above 90%, making them suitable for portable devices, renewable energy systems, and electric vehicles (Rahim et al., 2016; Hasan et al., 2020).

2.2 Concept of IoT and Arduino

Arduino is an open-source electronics platform that integrates both hardware and software designed for ease of use and accessibility. The hardware component typically consists of a microcontroller board, such as the widely used Arduino Uno, which serves as the central processing unit to execute programmed instructions. The software component includes an Integrated Development Environment (IDE) that allows users to write, compile, and upload code directly to the microcontroller via a simple USB connection. The open-source nature of Arduino fosters a large and active global community of developers, educators, and hobbyists who contribute to a vast repository of libraries, tutorials, and project examples. This extensive support network significantly lowers the barrier for beginners and accelerates learning and innovation in embedded systems development (Banzi & Shiloh, 2014).

The Internet of Things (IoT) refers to an ecosystem of interconnected physical devices embedded with sensors, actuators, software, and communication technologies that enable these devices to collect, transmit, and exchange data over the internet or other communication networks. IoT facilitates enhanced automation, remote monitoring, and intelligent decision-making across various applications such as smart homes, healthcare, industrial automation, and environmental monitoring (Atzori, Iera, & Morabito, 2010).

In the context of Arduino, IoT implementations often involve equipping Arduino microcontroller boards with communication modules like Wi-Fi, Ethernet, or Bluetooth to connect to cloud services or other networked devices. This connectivity enables real-time data acquisition, remote control of physical systems, and integration with online dashboards or mobile applications for monitoring and automation purposes (Gubbi et al., 2013). The versatility and modularity of Arduino make it an ideal platform for prototyping and deploying IoT solutions, especially for educational and small-scale commercial applications.

2.3 Sustainable Development Goals (SDGs) and Project Relevance

The Sustainable Development Goals (SDGs) consist of 17 interlinked global objectives adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals are designed to address pressing global challenges including poverty, inequality, climate change, environmental degradation, and access to

clean energy, with a vision to foster peace and prosperity for people and the planet by the year 2030 (United Nations, 2015).

The Eco Flow Power Max project, which focuses on an innovative electricity generation system utilizing the principles of electromagnetic induction and enhanced with Internet of Things (IoT) capabilities, aligns directly with several SDGs. Most notably, it supports:

- **Goal 7: Affordable and Clean Energy** – By introducing a portable, fuel-free energy solution that operates on battery power and reduces reliance on non-renewable energy sources, this project contributes to ensuring access to affordable, reliable, sustainable, and modern energy for all (Murni, Ridwan, & Hasan, 2020).
- **Goal 9: Industry, Innovation and Infrastructure** – The integration of IoT in Eco Flow Power Max demonstrates how smart technologies can be embedded into energy systems to promote sustainable industrialization, foster innovation, and improve infrastructure, especially in off-grid rural settings (Dlodlo & Kalezhi, 2015).
- **Goal 13: Climate Action** – The reduced dependence on fossil fuels such as diesel and petrol minimizes greenhouse gas emissions and contributes to climate change mitigation, supporting urgent action to combat climate impacts (Rahman et al., 2019).

Through this innovation, the Eco Flow Power Max enhances the potential for clean energy generation in remote or disaster-prone areas, enables intelligent energy monitoring via IoT, and reduces environmental impact. These factors make the project a practical contribution to global sustainability initiatives and demonstrate how technological innovation can address societal and ecological needs simultaneously.

2.4 Importance of Generators in Disaster and Off-Grid Situations

Generators serve as vital infrastructure in ensuring energy access during emergencies, particularly in tropical countries like Malaysia where natural disasters such as flash floods, severe thunderstorms, and landslides occur frequently due to the equatorial climate and year-round heavy rainfall. These events often lead to significant damage to the national power grid, including collapsed transmission towers, substation failures, and waterlogged transformers, resulting in prolonged power outages in affected regions (Aziz et al., 2018). In such conditions, backup power systems like generators become essential to ensure the continuity of critical services, especially those related to public safety, communications, and healthcare..

- i. **Ensure emergency power supply.** During disasters, damage to electrical infrastructure affects regular energy delivery, which can paralyze critical services such as hospitals, relief centers, and water treatment plants. Traditional generators primarily use fossil fuels to provide temporary electricity, but they have constraints such as fuel dependency, high emissions, and operating costs (Nfah et al., 2008). The Eco Flow Power Max, a portable power system that runs without gasoline and uses magnetic flux cutting in conjunction with IoT monitoring, offers a sustainable option. It provides an uninterrupted power supply while minimizing reliance on finite resources and contributes to environmental sustainability.
- ii. **Supporting Emergency Communication** Reliable communication lines are critical for coordinating disaster response, distributing information, and maintaining public safety. Mobile phones, radio networks, satellite systems, and emergency broadcasts all require power to function properly. Generators provide electricity to base stations, broadcasting equipment, and communication device charging hubs. The Eco Flow Power Max's IoT connection improves usability by offering remote diagnostics, consumption tracking, and

predictive maintenance, making it ideal for distant deployment and emergency circumstances (Saha et al., 2018).

- iii. Addressing Basic Human Needs In times of crisis, electricity is essential for meeting basic human requirements. It's necessary for lighting, cooking, heating, and water purification. Lack of lighting during catastrophe recovery raises safety concerns and affects daily routines. The Eco Flow Power Max's portability and ease of deployment enable it to be quickly mobilized to evacuation centers or rural areas, providing a dependable power supply that meets basic demands sustainably. The system's clean energy profile contributes to SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) by providing a low-emission, fuel-free option in energy-constrained scenarios (Murni, Ridwan, & Hasan, 2020).

3.0 Methodology

3.1 Flow chart and block diagram

Figure 1 shows a block diagram, the panel can visually grasp the overall overview of the project, making it easier to understand the flow of processes, key components, and the relationships between each element in the system. This not only helps speed up comprehension but also ensures that all parties involved can follow the project's progress more clearly and systematically. The procedures and methods used to build this project. Starting with problem analysis and progressing to solution.

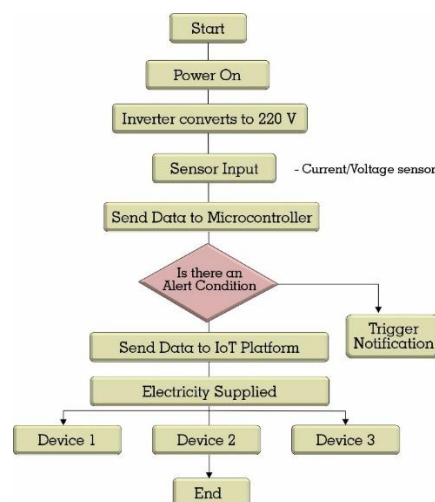


Figure 1: The flow chart of project

3.2 Design Selection Process Hardware

In the development of the Eco Flow Power Max, the methodology began with a structured engineering design process to ensure a practical, efficient, and sustainable solution. This approach involved identifying user needs, analyzing technical requirements, and generating a range of conceptual designs for the portable generator. Engineering design served as the first and fundamental method, allowing systematic evaluation of possible solutions based on functionality, cost-effectiveness, portability, energy efficiency, and environmental impact. Figure 2 illustrates the initial stages of this development process, which include early hand-drawn sketches, CAD drawings generated after the selection process using the morphology chart method, and ultimately the construction of the actual prototype. This phase ensured that the selected design met both performance objectives and user expectations, forming a strong foundation for subsequent development and testing.

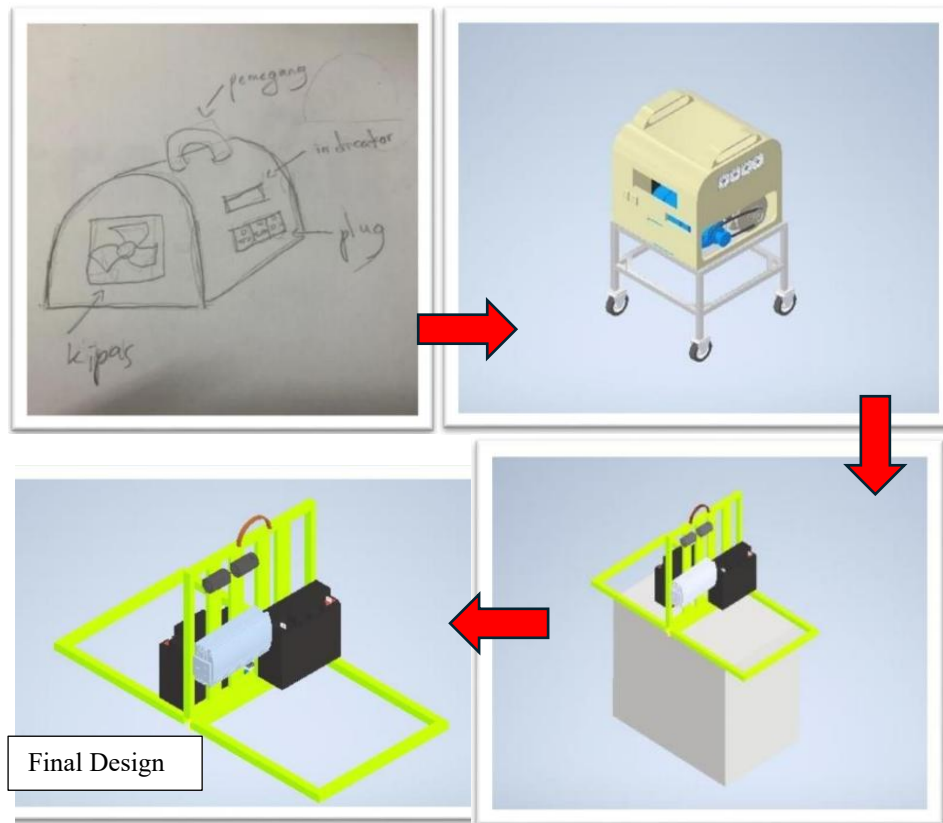


Figure 2: The Process of design eco flow power max

3.3 Design Selection Process for IoT System

In the design selection process for the IoT system integration in the Eco Flow Power Max, the methodology focused on selecting a platform that supports real-time monitoring, user-friendly interfacing, and reliable data transmission. Blynk was chosen as the core IoT platform due to its compatibility with microcontrollers, ease of mobile dashboard creation, and ability to handle sensor data visualization. The main output interface for this system consists of voltage and current readings, which are critical for monitoring the performance of the generator while powering up to three electrical devices. Various design options were considered during this phase, and Blynk was selected based on its simplicity, scalability, and efficient communication with the microcontroller via Wi-Fi. This selection process ensured that the IoT system would provide accurate, real-time feedback to users, thus enhancing the usability and safety of the generator system.

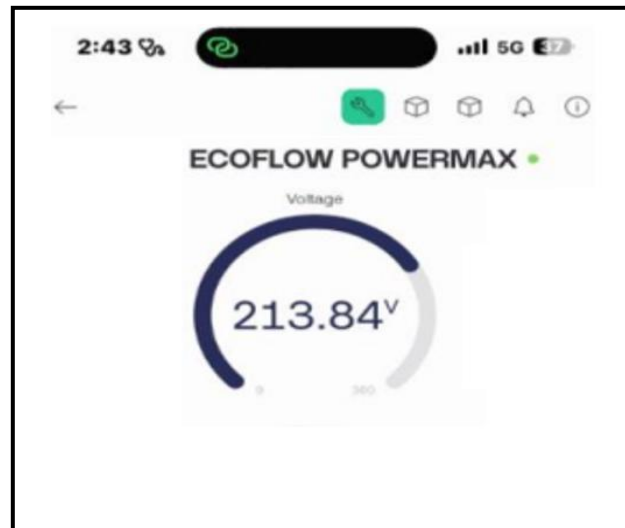


Figure 3: Interface on Blynk Apps for Voltage and Current Reading

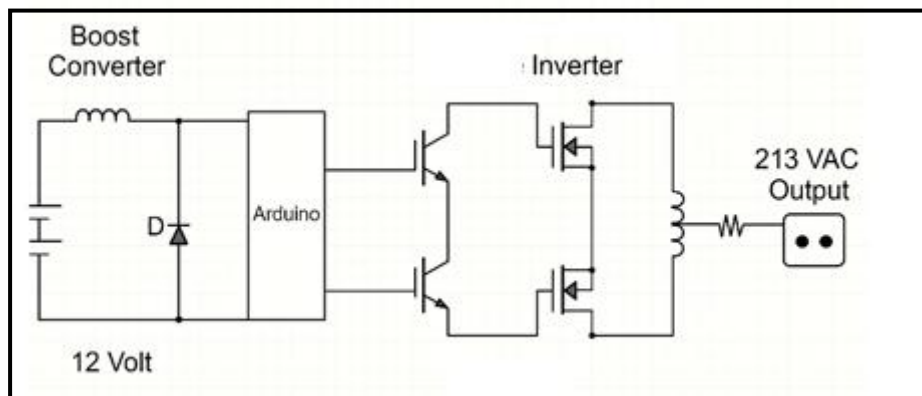


Figure 4: The circuit of eco flow power max

This project obtain 213V from a car alternator using a step-up transformer, the process begins with the alternator outputting a three-phase AC voltage, typically around 12–14V. This low-voltage AC is first converted into DC using a bridge rectifier, providing a relatively stable DC voltage. The DC voltage is then fed into a DC-to-AC inverter, which generates an AC output with controlled frequency and voltage. This AC output is then supplied to a step-up transformer, which increases the voltage to the desired 220V. Finally, the 220V AC output from the transformer is connected to the intended load, support basic household appliances, such as mobile phone chargers, fans, and light bulbs.

4.0 Result and Analysis

The voltage analysis conducted has successfully proven that the third project objective has been achieved. Through testing of the Eco flow Power max system, it was found that the system not only generates a stable voltage but also provides enough power to operate various electrical appliances. The voltage readings indicate that the Eco flow Power max is capable of supplying sufficient energy to power daily household items such as mobile phones, fans, and light bulbs, which are among the most commonly used electrical devices in everyday life.

In this project, the input voltage is recorded at 5V, which is then converted to an output range between 12V and 14.8V using an inverter system. To estimate the power available for use, the standard electrical formula is applied:

$$P = V \times I,$$

where P represents power in watts, V is voltage in volts, and I is current in amperes. Assuming a battery capacity of 5Ah and an output voltage of 12V, the resulting power is:

$$P = 5Ah \times 12V = 60W.$$

This result indicates that the Eco Flow Power Max possesses sufficient capability to support basic household appliances, such as mobile phone chargers, fans, and light bulbs. According to Rahman et al. (2020), battery-based inverter systems offer a sustainable solution for decentralized energy generation, particularly in rural or underserved regions. Furthermore, the Eco Flow Power Max fulfills key energy efficiency benchmarks outlined in the project's scope. Additionally, this outcome highlights the project's alignment with the United Nations Sustainable Development Goals (SDGs), particularly Goal 7: Affordable and Clean Energy. The system reduces dependence on fossil fuels and supports more resilient, responsible, and sustainable energy consumption, as emphasized by Kumar & Alok (2021) in their study on green energy systems for portable applications.

In conclusion, the Eco Flow Power Max demonstrates successful integration of renewable power conversion, user safety, and environmental responsibility. Its ability to supply critical electrical loads using battery-powered sources reinforces its relevance as a viable alternative power solution for sustainable development and climate resilience.

4.1 Reading Analysis

Table 1 presents a selection of typical household appliances and their estimated power ratings in watts, along with a suitability analysis for use with the Eco Flow Power Max system, which outputs 220V AC. This evaluation is critical in determining whether the inverter and battery setup in the project can support real-life energy demands. Most low-to-medium power devices such as LED bulbs (5–15W), phone chargers (5–15W), and laptops (45–90W) are deemed highly suitable for the system due to their low power consumption and stable operational characteristics. These devices can run efficiently without overloading the inverter, making them ideal for use during power outages or in off-grid environments. Medium-power appliances such as table or wall fans (30–60W) and mini refrigerators (70–150W) are not suitable, need extra support battery. High-power appliances, such as blenders (200–400W) and mini washing machines (200–500W), are also not suitable using this generator. In conclusion, the analysis confirms that the Eco Flow Power Max system is best suited for low only.

Table 1: Device that can be use with 213V Output

Appliance Type	Power Rating (W)	Suitability Notes
LED bulbs / lamps	5W – 15W	Highly suitable, low power consumption
Table / wall fan	30W – 60W	Suitable
Phone charger	5W – 15W	Suitable, as long as voltage is stable
LED TV	40W – 150W	Not suitable, need extra support battery
Blender / food processor	200W – 400W	Not suitable, need extra support battery
Laptop	45W – 90W	Not suitable, need extra support battery
Mini refrigerator	70W – 150W	Not suitable

The duration for which a 12V battery can operate after being converted to 213V - 220V depends on several critical factors, including the battery's capacity (measured in ampere-hours), the total power consumption of connected devices, and the efficiency of the inverter

used in the system. For example, a 12V 100Ah battery theoretically stores 1200 watt-hours (Wh) of energy. However, when factoring in an inverter efficiency of approximately 85%, the usable energy is reduced to around 1020Wh. If this system powers electrical loads such as a lamp (50W) and a fan (60W) simultaneously, totaling 110W, the estimated operational time would be approximately 9.2 hours ($1020\text{Wh} \div 110\text{W}$). As the total power consumption increases, the available runtime decreases proportionally. Devices with higher power demands such as blenders or irons, will deplete the battery at a much faster rate, often within one to two hours depending on their wattage. It is also important to note that regularly discharging a battery to zero can reduce its lifespan; hence, most deep-cycle batteries are recommended to be used within 50% to 80% of their capacity. This analysis confirms that the Eco Flow Power Max system is suitable for powering low to medium power devices for a reasonable period, but proper load management is essential to maintain efficiency and ensure continuous operation. From Figure 4, here is a bar graph illustrating the estimated operating time for different electrical appliances powered by a 12V 100Ah battery with 85% inverter efficiency. This visual representation supports the analysis that lower power devices (like lamps or fans) can operate for longer durations, while high-power appliances (such as blenders and irons) drastically reduce the runtime. This emphasizes the need for proper load management in the Eco Flow Power Max system.

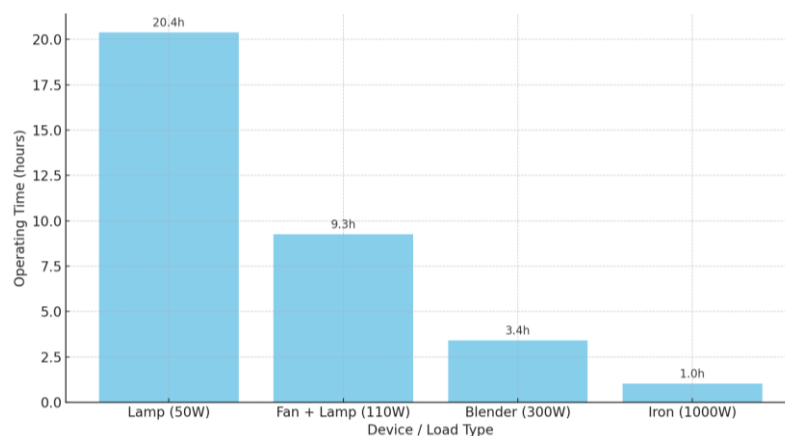


Figure 4: Estimated operating time for different electrical appliances powered by a 12V 100Ah battery with 85% inverter efficiency

5.0 Discussion

The Eco Flow Power Max project shows how effectively electromagnetic ideas combined with Internet of Things (IoT) technologies might produce a portable, fuel-free generator system. The system generates voltage varying from 12V to 14.8V by means of the cutting of magnetic flux, which is subsequently transformed to 220V AC via an inverter. The findings validate that low to medium wattage items such LED lights, cell phone chargers, laptops, and tiny fans may be consistently powered by this system. These results confirm how well the electromagnetic induction approach generates electricity for off-grid and emergency needs (Chen et al., 2021).

Furthermore, underlined in the study are the vital importance of power conversion efficiency and energy storage. For a 110W load, for example, the usage of a 12V 100Ah battery with 85% inverter efficiency was calculated to sustain almost 9.2 hours. This supports earlier studies on the dependability of battery-based inverter systems in remote locations (Rahman et al., 2020). Eliminating the need for fossil fuels, which are typically utilized in conventional generators but cause noise pollution and greenhouse gas emissions, the system's design also stresses user safety, simplicity, and sustainability. Furthermore, real-time voltage and current

reading monitoring made possible via IoT integration using Blynk This helps consumers to properly control loads and evaluate the functioning of the generator, therefore fostering operational safety and energy economy. Particularly in rural or disaster-prone locations, where remote monitoring and low maintenance are crucial, IoT connectivity improves the system's adaptability. Among the Sustainable Development Goals (SDGs) the project's design and execution satisfy Goal 13 (Climate Action), Goal 9 (Industry, Innovation and Infrastructure), and Goal 7 (Affordable and Clean Energy).

6.0 Conclusion

Particularly in terms of sustainability, user safety, and cost-effectiveness, the results of this experiment confirm that the Eco Flow Power Max marks a major progress over traditional fuel-based generators. In many important respects, including environmental friendliness, the use of rechargeable batteries, cost-effectiveness, and suitability for users across all age groups, the Eco Flow Power Max excels over conventional generators, as the comparison table details. Unlike traditional systems that mostly rely on petrol or diesel and release significant levels of noise and pollutants, the Eco Flow Power Max runs silently, generates zero emissions, and makes use of stored battery energy, hence it is quite in line with world green energy targets. This invention advances several Sustainable Development Goals (SDGs). It immediately helps to (Table 2):

- SDG 7 (Affordable and Clean Energy) by offering a fuel-free, clean energy source
- SDG 9 (Industry, Innovation, and Infrastructure) through the incorporation of IoT technologies and advanced design processes
- SDG 12 (Responsible Consumption and Production) via its cost-effective and reusable energy model
- SDG 13 (Climate Action) by reducing greenhouse gas emissions and reliance on fossil fuels
- SDG 3 (Good Health and Well-being) by minimizing noise pollution and ensuring user safety.

Especially for off-grid or disaster-prone populations, the system's twin benefit of smart monitoring via IoT integration and clean energy generation makes it a realistic and sustainable solution. Conventional generators, on the other hand, although still widely used, are progressively antiquated because of their reliance on non-renewable fuels, negative emissions, and poor connection with contemporary technologies. All things considered, the Eco Flow Power Max offers a dependable, mobile, and user-friendly substitute that not only satisfies minimum electricity needs but also advances a more sustainable and resilient energy future. In tackling present and future energy issues, its design, utility, and environmental compatibility make it a very pertinent breakthrough.

Table 2: Eco Flow Power Max Vs Conventional Generator Comparison and SDG Goals

	ECOFLOW POWERMAX	CONVENTIONAL GENERATOR	SDG GOALS
Fuel Usage		✓	
Environmentally friendly	✓		SDG 7
Batteries that can store energy	✓		SDG 13
Rechargeable batteries	✓		SDG 9
Cost-effective	✓		SDG 12
Safe and suitable for any age groups	✓		SDG 3
Safety (wiring arrangement)	✓	✓	
High noise production		✓	

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