

CHAPTER I. INTRODUCTION

1.1. Background

Society today is heavily dependent on electricity. From the economy sector, to air conditioning and cooking, it has become a necessity, especially in big cities for the community to function. In Indonesia, blackouts still happen, especially in underdeveloped areas, but it also happens often in big cities. This could cause discomfort especially when the society today is increasingly dependent on electricity into fulfilling their daily needs, such as water pumps, cooking, water heating, and air conditioning and ventilation.

In remote areas where access to electricity is scarce, this could become a problem. Communication to one's family could lag behind, air conditioning will not be functioning, or even, at worst, no water, since many communities are heavily reliant on water pumps. These underdeveloped areas usually use diesel generators to provide for their electricity needs.

In Indonesia, interruptions often occur regularly within a yearly basis. On average, Indonesian households experiences more than four times of blackouts with an average duration of more than an hour every year (Kementrian ESDM, 2023). In addition to electricity demand in rural areas, the use of diesel or gasoline electric generators for non-emergency use is still quite popular, such as for camping, stargazing, and for remote infrastructure work.

Based on the data from 2023, Indonesia is powered by 54.58% coal and 25.46% from gas. Solar Power Plants only account for 0.66% (Kementrian ESDM 2023, p.21). Furthermore, the largest source of renewable electricity source, hydropower, accounts for only 7.21% of the national total electricity generation capacity. This data indicates that Indonesia is still powered by mostly fossil fuels, mostly by coal.

On the most recent studies, it is estimated that if no new coal reserves are found and the consumption rate stays about the same, Indonesian coal reserves will be completely depleted in less than 50 years (Coal Metal Asia, 2024). Indonesia as a country needs to broaden its energy mix and establish more infrastructure to support new and renewable energies.

Furthermore, current governmental policies are still in favor of fossil fuels, including the petroleum fuel subsidies and electricity subsidies (The Diplomat, 2024). The economic logistics still rely on vehicles that are powered by fossil fuels, such as diesel trucks, cargo ships and planes. Society today still consumes a lot of petroleum fuels for trade, and increasing the fuel prices will cause inflation and the economy will slow down significantly. In addition to that, the infrastructure to support new and renewable energies are not widely available yet. EV charging stations are not widely available yet, and using EVs to deliver goods is considered unreliable for many. This is also true for road trips with civilian cars (The Jakarta Post, 2023).

In the future, it is hoped that new policies can be implemented to make renewable energies cheaper, such as subsidizing solar panels, batteries, or allowing households and businesses to sell green energy to the grid and thus speeding up the energy transition process.

For tackling power interruptions, whether if the duration is long or short, many businesses, small home offices, and minimarkets use diesel or gasoline electric generators. This is due to the fact that no other alternatives are available, and even LNG/LPG generators are also very rarely used.

By using a portable generator that is using renewable energy sources, this could help to reduce over-reliance on fossil fuel electric generators, and in the long run provide a sustainable source of electricity, and thus supporting the long-term energy sustainability goals. Small households can rest assured that in times of power outages, this portable solar-powered battery generator can be a reliable substitute for small petroleum based generators.

1.2. Research Problems

Electricity from the grid is not always reliable and oftentimes in rural areas will go offline quite often and randomly. Households and businesses in general often have backup generators that provide electricity when the grid power is unavailable. These generators, ranging from their size of scale, are oftentimes powered by fossil fuels, which most of the time are diesel fuels. These generators are not only loud, it is quite polluting the air and also could be quite expensive to run. This means that unexpected power interruptions aren't covered with renewables yet. By utilizing

solar panels and batteries, one can be independent of these blackouts while also removing the hassle of having to buy fuel to run traditional petroleum based generators.

1.3. Research Objectives

Renewable energy, in this particular case photovoltaic cells, are to be harvested, stored and then deployed as a portable energy source. The system is to be assessed whether it can power a typical household load during a blackout. It can also be deployed for non-critical applications, such as camping or other recreational uses. The system's design and components performance are to be evaluated and potential areas for optimizations are to be identified.

1.4. Study Significance

The concept of this project involves the utilization of battery banks that can supply power in times of power interruptions. This accounts for blackouts that still happen in Indonesia, affecting households. In remote areas with limited or no electricity access, the device can be utilized and setup with relative ease to provide electricity for the local community. In addition to that, the device can be used for recreational use such as camping. This is to tackle abrupt power interruptions that may occur and provide a greener solution to petroleum generators meant for small loads.

The research will offer valuable insights into an accessible energy solution that aims to provide a reliable and portable electricity source for underserved areas for lighting, communication, and other small appliances.

Furthermore, this study will provide a practical real-world data of portable PV battery banks, potentially providing the industry into developing a more efficient, robust, and user-friendly products tailored to the needs of the community.

1.5 Research questions

- a) Can the device provide electricity for the entire duration of a typical blackout in Indonesia?
- b) How is the portable solar panel battery bank going to convert solar energy into practical usable electricity?
- c) Will there be losses from leaving the battery not charging overnight?
- d) How much of the total battery charge can be delivered to the load?

1.6 Hypothesis

- a) The device is able to supply enough electricity for the entire duration (about one hour) of a typical household blackout in Indonesia (0.18kWh) if the battery bank is fully charged.
- b) The energy captured by the solar panels is converted into dc electrical current using a controller and the electric current can be stored safely and efficiently in the battery arrays, then inverted to ac current for the load.
- c) The battery arrays will discharge slowly when left not charging overnight.
- d) The device is expected to be able to deliver 70% of the total battery charge under normal conditions and conservative parameters, considering losses from the inverter.

