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Identification of Computation of Solar and Wind Energy Potential for Off-Grid Electric Motorcycle Battery Charging Stations

I Wayan Adiyasa
Automotive Engineering Departement
Universitas Negeri Yogyakarta
Indonesia
https://orcid.org/0000-0002-8645-9212

Mohd Azri Hizami Bin Rasid
Mechanical and Automotive
Engineering Technology
Universiti Malaysia Pahang
Malaysia
https://orcid.org/0000-0002-0061-7540

I Wayan Warsita
School of Mechanical Engineering
University of Ulsan
South Korea
warsita@mail.ulsan.ac.kr

Zainal Arifin
Automotive Engineering Departement
Universitas Negeri Yogyakarta
Indonesia
https://orcid.org/0000-0001-5115-1309

Arif Devi Dwipayana
Automotive Mechanics Technology
Politeknik Transportasi Darat Bali
Indonesia
https://orcid.org/0000-0001-5966-9794

Rai Pramesti Suteja
Electrical Engineering
Universitas Brawijaya
Indonesia
raipramesti@student.ub.ac.id

***Abstract*—Transportation is an important necessity for traveling long distances. Today's transportation, such as battery electric vehicles, is a developing technology to reduce fossil fuel consumption and exhaust emissions. In Indonesia, motorbikes are private vehicles owned by every individual. Battery electric motorbikes (BEM) are a type of electric vehicle that is widely used to travel to other places. However, public infrastructure related to battery charging is not yet fully ready. Most of the energy in 2023 will still come from fossil fuel power plants. This condition shows that the source of emissions is moving from roads to power plants and must be changed by using renewable energy sources (RES). The paper shows the identification of the potential for solar and wind energy that can be applied to replace fossil energy. Energy from solar and wind is converted into electrical energy to be used to charge batteries at the BEM. The results of identifying energy potential show the possibility of using photovoltaics (PV) and wind turbines (WT) for the BEM battery charging process. Average daily energy shows production of up to 14,461 kWh/year for solar energy and 8,327 kWh/year for wind energy. The energy produced by RES shows a reduction in CO_2 gas emissions of up to 2,560 kg/year.**

Keywords—battery electric motorcycle, photovoltaic, renewable energy sources, wind turbine

I. INTRODUCTION

Today's conditions, transportation in Indonesia has started to use electric propulsion sources. The issue of increasing greenhouse gases is driving electric transportation to grow and have many users. The large impact of greenhouse emissions has prompted the government to formulate regulations regarding the use of electric transportation. Government support is contained in legal regulations from 2020 to 2023. These regulations cover the use of electric vehicles, conversion of conventional vehicles to electric vehicles, import purchasing of electric vehicle components, and provision of infrastructure for electric vehicles. The potential for providing infrastructure such as charging stations provides enormous opportunities in the fields of research and economics. However, electrical energy from electric vehicle charging stations still comes from fossil fuel power plants.

The current use of charging stations only moves the source of emissions from the road to the power generation source. The emission problem is not solved by using electric transportation, but the energy source still comes from fossils. The increasing use of electric vehicles certainly has an impact on increasing emissions produced by fossil fuel power plants. The issue of electric vehicles being a solution to reducing emissions will turn into increasing carbon emissions at power plants. This condition must be changed by using renewable energy sources (RES) as an energy source at charging stations. The use of RES can completely reduce emissions produced by fossil fuel power plants. RES for charging stations such as solar [1], wind, micro hydro, biomass, and others [2]–[5]. If a charging electric motorbike (BEM) unit requires 2.7 kW of power, then the carbon emissions that can be produced are 1.68 kg.CO_2 assuming 0.623 kg.CO_2/kWh for electricity generation emissions in Indonesia [6]. Meanwhile, BEM units in Indonesia can reach more than 1000 units, so that the emissions produced per day reach more than 1,680 kg.CO_2. This large value can increase the greenhouse effect and damage the environment.

The need for charging stations increases as the number of vehicles increases every year. Based on research [4], [7]–[11], shows that the use of RES can replace fossil energy sources for charging stations. Charging stations which are still common are designed for 1-3 electric vehicles. The unpreparedness of battery charging station infrastructure will have an impact on the decline in electric vehicle users. This paper focuses on analyzing the potential of photovoltaic (PV) and wind turbine (WT) for BEM charging stations. BEM is a type of private electric vehicle with the most users. The general charging station for BEM will charge the swapping battery. This type of battery is very widely used because it is more practical. If the battery runs out, the vehicle owner simply exchanges the vehicle battery at a charging station. The advantage of using swapping batteries is that when you are at a charging station, you can charge more batteries and don't use a large space. RES at BEM charging stations will make a significant contribution to reducing carbon emissions.