Study Of Sultan Iskandar Muda Airport In Banda Aceh With An Eco-Airport Concept

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Abstract. The author's analysis will consider the influence of solar panel implementation on several challenges related to power supply failures from the national power utility (PLN) at Sultan Iskandar Muda International Airport. The purpose of implementing solar panels is to address the power supply failures from PLN, save electricity costs, and reduce carbon emissions towards the environment, in line with the airport's concept of green energy or Eco-Airport. The calculation method includes component analysis, temperature effects, and economic aspects in terms of the initial investment of the project

Keywords : Energi, PLN and green energy.

1 Introduction

The Sultan Iskandar Muda Airport, located in Banda Aceh, serves as a crucial air gateway for the province of Aceh in Indonesia. As air travel continues to play a vital role in connecting people and facilitating economic activities, it is imperative to address the environmental impact associated with airport operations. In recent years, there has been a growing global awareness of the urgent need to adopt sustainable practices and reduce carbon emissions in various sectors, including the aviation industry.In response to this pressing environmental concern, the concept of an eco-airport has emerged as a promising approach to make airports more environmentally friendly and socially responsible[1]–[3]. An eco-airport is designed to minimize its ecological footprint, reduce energy consumption, and lower greenhouse gas emissions while maintaining efficient operations. This research aims to explore and analyze the potential benefits and challenges of implementing eco-friendly initiatives, particularly the integration of solar panels, at Sultan Iskandar Muda Airport. By harnessing green energy sources, such as solar power, we aspire to overcome the existing limitations associated with electricity supply failures from the national power utility (PLN) in the region. Additionally, the adoption of renewable energy at the airport aligns with the vision of transforming it into an Eco - Airport, showcasing sustainable practices in the

R. Andrie Asmara et al. (eds.), *Proceedings of the 5th Annual Advanced Technology, Applied Science, and Engineering Conference (ATASEC) 2023*, Advances in Engineering Research 229,
https://doi.org/10.2991/978-94-6463-358-0_7

aviation industry.The integration of solar panels holds great promise for not only mitigating the environmental impact of the airport but also reducing electricity costs and promoting long-term economic sustainability[4], [5]. By assessing various components, considering temperature effects, and conducting economic analyses, we seek to determine the feasibility and potential benefits of this sustainable energy solution for Sultan Iskandar Muda Airport.In this study, we aim to shed light on the potential positive effects that the implementation of solar panels can have on the airport's operational efficiency, cost savings, and environmental performance[6]–[9]. The findings of this research will contribute to the growing body of knowledge in the field of sustainable aviation and offer valuable insights for other airports seeking to embrace green energy solutions.Ultimately, our goal is to support the transition of Sultan Iskandar Muda Airport towards a more sustainable and environmentally responsible future, contributing to the broader global efforts in combating climate change and fostering a greener aviation industry[10]–[13].

2 Research Methodology

This study on the Sultan Iskandar Muda Airport in Banda Aceh with an eco-airport concept employs a systematic research methodology to achieve its objectives. The research methodology includes the following steps :

1. Literature Review: Conduct an extensive review of relevant literature, academic papers, reports, and case studies on eco-airports, sustainable aviation, and renewable energy implementation in airports. This will provide a comprehensive understanding of the existing knowledge, best practices, and challenges related to eco-airport concepts and solar panel integration.
2. Data Collection: Gather data on the current energy consumption, electricity supply failures, and operational aspects of Sultan Iskandar Muda Airport. Collect information on the airport's infrastructure, energy requirements, electricity costs, and environmental impact. This may involve reviewing historical data, conducting interviews with airport authorities and stakeholders, and analyzing available reports.
3. Assessment of Solar Panel Integration: Evaluate the technical feasibility and potential benefits of integrating solar panels at Sultan Iskandar Muda Airport. This includes analyzing the airport's energy needs, available space for solar panel installation, solar potential assessment, and estimating the capacity and output of solar power generation.
4. Environmental Impact Analysis: Assess the potential environmental benefits of implementing solar panels, including the reduction of greenhouse gas emissions and the ecological footprint of the airport. Use appropriate methodologies to quantify the environmental impact and compare it with the current energy supply from PLN.
5. Economic Analysis: Conduct an economic evaluation to determine the financial viability and cost-effectiveness of solar panel integration. Consider factors such as initial investment costs, potential savings on electricity bills, payback period, return on investment, and long-term economic sustainability.

6. Stakeholder Engagement: Engage with relevant stakeholders, including airport authorities, energy providers, environmental agencies, and local communities. Seek their input, gather insights, and address any concerns or challenges related to the implementation of solar panels and the eco-airport concept.
7. Risk Assessment: Identify potential risks and challenges associated with the implementation of solar panels, such as technical issues, maintenance requirements, regulatory constraints, and financial uncertainties. Develop mitigation strategies to address these risks and ensure a smooth transition to sustainable energy sources.
8. Comparative Analysis: Compare the findings of the study with existing eco-airports or similar renewable energy projects in airports globally. Identify lessons learned, best practices, and innovative approaches that can be applied to Sultan Iskandar Muda Airport.
9. Recommendations: Based on the research findings, provide recommendations and guidelines for the implementation of solar panels and the broader eco-airport concept at Sultan Iskandar Muda Airport. Consider the technical, environmental, economic, and social aspects to ensure a comprehensive and practical approach.
10. Conclusion: Summarize the key findings, limitations, and implications of the study. Highlight the potential benefits of implementing the eco-airport concept and solar panel integration at Sultan Iskandar Muda Airport, as well as the broader significance for sustainable aviation and environmental stewardship. By employing these research methods, the study aims to provide valuable insights and recommendations for the successful implementation of the eco-airport concept at Sultan Iskandar Muda Airport in Banda Aceh

3 Discussion

To calculate the technical aspects of a Photovoltaic Solar Power System (PLTS), several factors need to be considered. These factors include power loss when the panels are not at standard temperature, panel efficiency, and the area of the panels. These factors can be used to determine the maximum power output of the PLTS, the number of panels required, and the amount of battery storage for the PLTS. The area of the solar array is calculated to determine the module's size required for constructing the PLTS. One fundamental calculation in a PLTS system is to calculate the maximum power output of a single solar panel when there is a temperature increase surrounding the solar power generator. The estimated electrical power supply from the PLTS is 321,790 Watts. The average daily solar insolation value (Gav) for the year 2022 is 4.8 kWh/m2. The selected panel for use is a 410 Wp capacity solar panel of the TSM-DEG15M type with an efficiency specification of up to 20.2%. The reason for using this solar panel is because monocrystalline panels are the most efficient, generating the highest power per unit area. By taking into account these factors, this study aims to provide a better understanding of PLTS and estimate the potential electrical power that can be generated by the PLTS at Sultan Iskandar Muda Airport.

To find the actual output power of the solar module, the Maximum Power Voltage ($VMPP$) will be multiplied by the Maximum Power Current ($IMPP$) for the TSM-

DEG15M 410Wp solar module. Based on the calculation, the Maximum Power Output ($PMPP$) of the TSM-DEG15M 410Wp solar module is 409.84 Wp. Ideally, solar panels operate at the standard temperature of 25℃. However, field conditions are always changing. Therefore, for every 1℃ increase in temperature from the standard temperature of the solar panel, the power generated by the solar panel will decrease by approximately 0.5%. The temperature data in the Banda Aceh area during the year 2022 is 27.5℃. This data shows that there is a temperature increase of 2.5℃ from the standard temperature (25℃) required by the solar panel. The installed capacity of the PLN power plant based on the power subscription profile is 1,744,000 Watts. The average electricity load used per day, as shown in Table 4.2, is 188.15 kWh per day, 5,463.18 kWh per month, and 32,759.15 kWh per year. The calculation of CO2 emissions from the electricity supplied by PLN to Sultan Iskandar Muda Airport can be done by referring to the emission factor (EF) data in (Appendix 5) and the determined GWP CO2 (Giga Watt Peak) value. This will help determine the amount of CO2 emissions generated by PLN electricity. The calculation results in a power reduction of 5.125 Wp due to the 2.5℃ increase in temperature from the standard temperature.Next, the maximum power output of the solar panel when the temperature increases to 27.5℃ will be calculated. The calculation of CO2 emissions from PLN electricity reveals that the daily emissions amount to 176.861 kg CO2, the monthly emissions amount to 5,305.83 kg CO2, and the yearly emissions amount to 30,793.6 kg CO2. Therefore, based on the Guidelines for Greenhouse Gas Emission Calculation for a PV Solar System, where there are no emissions or emissions equal to zero, the emissions that can be avoided or reduced are 30,793.6 kg CO2 per year.

4 Conclusion

With the total load of the airport facilities, this study focuses on the Critical Load, specifically the APP load and the Runway load, which amounts to a total of 321,790 Watts. Considering the specifications and field conditions, the solar panel efficiency of the TSM-DEG15M type with a capacity of 410 Wp is calculated to be 19.94% under temperature influences. The required area is determined to be 396.93 m2, with a need for 192 solar panels, 11 inverters with a capacity of 33,000 Watts, and 88 batteries. The power supplied by the Photovoltaic Solar Power System (PLTS) with battery storage is 337,879 Wh.

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