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Implementation of a Solar-Wind Hybrid System for the Posong Nature Tourism Food Court in Tlahab Village, Temanggung, Indonesia

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Abstract. The limited access to electricity faced by the community managing food courts in the tourist area is due to the lack of optimal PLN network coverage. This has an impact on low service quality, limited stall operating hours, and a lack of comfort for tourists. Therefore, the community service team presented a renewable energy-based solution in the form of a hybrid system of Solar Power Plants (PLTS) and wind turbines with a capacity of 1.500 watts and 5,000 Wh of energy storage. The method of implementing the activity was carried out through an energy needs survey, socialization, device installation, technical training, and monitoring and evaluation. Participants were given an understanding of renewable energy systems, maintenance techniques, handling electrical short circuits, and power usage management to prevent batteries from draining quickly. The results of discussions with the community showed that the application of renewable energy not only provides a solution to electricity needs but also increases the community's capacity to manage electrical engineering systems independently. Furthermore, the availability of electricity supports the development of food court businesses, tourist comfort, and strengthens Posong's image as an eco-tourism destination. This activity contributes to the achievement of the Sustainable Development Goals (SDG 7: Affordable and Clean Energy, SDG 8: Decent Work and Economic Growth, and SDG 13: Addressing Climate Change).

Keywords: eco-tourism; hybrid solar power plants; renewable energy; wind turbines; sustainable development

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INTRODUCTION

Posong Nature Tourism, located on the slopes of Mount Sindoro in Temanggung Regency (Yunizar et al., 2022), is a prime destination offering beautiful natural panoramas and the allure of a sunrise with eight mountains as a backdrop (Cemporaningsih et al., 2020). This location has become a magnet for tourists, both local and international, giving rise to economic activity through the presence of food courts and small shops. However, limited infrastructure, particularly access to PLN electricity, is a major obstacle to the sustainability of community businesses. Currently, shops in the Posong area rely solely on car batteries for lighting, which are limited in capacity, inefficient, and unsustainable.

Posong's geographical location, located in the highlands and far from the PLN electricity grid, makes building conventional electricity infrastructure very expensive and inefficient (Supari et al., 2024). However, the area has abundant renewable energy potential, in the form of solar energy in the morning and wind energy with an average speed of 6 m/s throughout the day. This potential is highly relevant for development into a clean energy-based electricity solution (Pinandita et al., 2025).

Universitas Negeri Yogyakarta (UNY), through its DRTPM BIMA community service program, is striving to provide an appropriate technological solution by designing a hybrid solar power plant (PLTS) and wind turbine system (Al Hakim, 2020; Myson, 2016). This system is expected to generate 1.500 watts of power with an energy storage capacity of 5.000 Wh, which is then distributed to the 15 food courts in the form of lighting and power outlets. The implementation of this program not only improves tourist comfort,

but also encourages community energy independence, reduces dependence on fossil fuels (Pinandita et al., 2023; (Pinandita et al., 2024), and supports the achievement of Sustainable Development Goals (SDGs), especially SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), and SDG 13 (Addressing Climate Change) (Adekoya et al., 2021).

Figure 1. Posong Nature Tourism Center and view of the mountain peak

Figure 2. One of the food courts among 15 grocery stalls at the Posong Nature Tourism

METHODS

The community service program in Tlahab Village, in the Posong Nature Tourism area, was implemented using a participatory and collaborative approach between the Universitas Negeri Yogyakarta (UNY) community service team, the food court management community, and the tourism destination management. This method was chosen so that the program would not only focus on technology transfer but also on empowering and increasing the capacity of the local community.

The activity began with a field survey and needs mapping, identifying existing conditions, renewable energy potential, and the main challenges faced by food court businesses. The identification results were then used as the basis for designing a hybrid solar power plant (PLTS) and wind turbine system with a capacity of 1.500 watts with 5.000 Wh of energy storage can be seen in Figure 3. Each food court was allocated 100 watts of electricity, equipped with 9 watts of lighting, three-hole power outlets, and digital kWh meters to monitor the needs of each food court stall (Rahmawati & Fajri, 2019; Sepdian, 2019). Furthermore, community outreach and mentoring were conducted, where the community service team provided an understanding of the importance of renewable energy, the working principles of the hybrid system (Myson, 2016), and its benefits for local economic development and improving the quality of tourism services. The community was also involved in the installation process, from solar panels and wind turbines to energy storage systems, with the aim of providing them with basic technical knowledge regarding system maintenance and operation (Prianto, 2017).

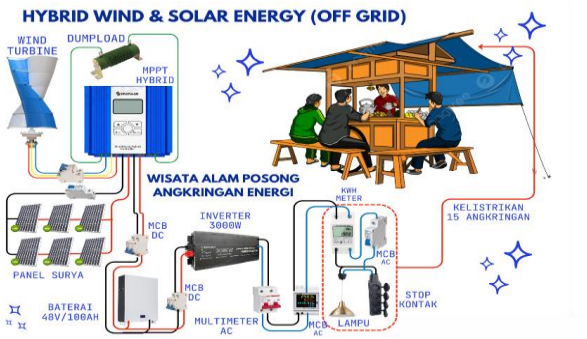

Figure 3. Block diagram of the hybrid wind and solar energy concept implemented for the Food Court at Posong Nature Tourism, Temanggung Regency.

The event was attended by the Head of Tlahab Village, the Head of the Posong Nature Tourism Management, 23 members of the tourism management, and the head and (Lubis & Gapy, 2019) members of the community service team consisting of Electrical Engineering lecturers from Yogyakarta State University and UNY students. Despite the cloudy and foggy weather, the event proceeded smoothly. In the main session, the public was provided with new knowledge in electrical engineering, specifically regarding handling electrical short circuits in small grocery stores, as well as an understanding of the factors that cause inverter problems (Li et al., 2017; Prianto, 2017). It was also explained that one of the main causes is an undercharged battery due to limited sunlight or unstable winds. Therefore, the public was given an understanding of the importance of electricity management, such as

turning off unnecessary lights to prevent rapid battery depletion.

The next activity was operational and maintenance training, where food court managers were provided with skills in routine maintenance, battery checks, and simple troubleshooting. This was done to ensure the sustainability of the program without complete dependence on external parties.

The final stage, evaluation and monitoring, was conducted to assess the effectiveness of the hybrid system in meeting the food court's electricity needs, while also measuring its impact on increasing economic activity and visitor comfort. Regular monitoring also provided a means for system improvements if technical issues were encountered. With this method, it is hoped that this community service program will not only produce renewable energy-based electricity infrastructure but also build energy independence for the Tlahab Village community and enhance the attractiveness of Posong Nature Tourism as an eco-tourism destination.

RESULTS AND DISCUSSION

The discussion between the Universitas Negeri Yogyakarta (UNY) community service team and the Posong Nature Tourism management group took place following a session on socialization and technical practice using the hybrid solar power plant (PLTS)-wind turbine system. The following is some documentation of community service activities at Posong Nature Tourism. The materials used to develop the solar power plant include cables, plugs, scissors, pliers, lamp cups, etc. The tools and materials are then assembled as needed. A diagram of the assembly of the tools and materials can be seen in Figure 4. Next comes the installation of the wind turbine, which includes welding and installing the windmill at the top of the tower shown in Figure 5.

The electrical control room at the Posong Nature Tourism office at Figure 6, A group photo with the tourism managers. They are enthusiastic about the availability of independent electricity. This energy is very helpful in providing electricity to the grocery stores in the tourist area for lighting and providing electricity to increase the economy of the shop owners who sell cell phone charging services (Pinandita et al., 2025). The next activity is discussion aimed to explore the community's perceptions, expectations, and commitment to the program's sustainability. The tourism management emphasized that the main priority for electricity use is lighting in the food court area and public facilities. This is because adequate lighting will improve tourist comfort and safety, especially in the early morning when visitors come to watch the sunrise.

The community recognizes that limited battery capacity necessitates proper energy management. They agreed to use electricity alternately according to need and turn off non-essential electrical devices to ensure a stable energy supply. The tourism management group agreed to appoint a small team to routinely check the solar panels, wind turbines, inverters, and batteries. The community service team from UNY provided simple technical guidance so that the community can perform maintenance independently without requiring assistance from outside technicians.

The potential of this technology is an effort to increase the electrical efficiency of stalls in Posong nature tourism, but also provides significant ecological and economic benefits for

Figure 4. Installation of installations at Posong Nature Tourism

Figure 5. Welding and assembly activities of wind turbines on the tower

the tourism management community, so that it can be a sustainable model for the development of energy-efficient stalls in the future (Rifandi et al., 2024). The tourism management expressed their commitment to maintaining and caring for the installed hybrid system. They hope that the program will not stop at the installation stage, but will continue through regular monitoring, further training, and the possibility of expanding power capacity in the future if tourist numbers continue to increase. Impact on the Local Economy: Food court managers are optimistic that electricity will enable them to expand their businesses, such as providing hot drinks, local culinary products, and tourist souvenirs. This is believed to increase community income and strengthen the appeal of Posong Nature Tourism as an eco-tourism destination.

Overall, the discussion was open and constructive. The tourism management team benefited from the knowledge transfer from lecturers and students of the UNY Electrical Engineering Department, particularly regarding handling electrical short circuits, the causes of inverter failure, and energy management strategies. The two-way communication established during this activity strengthened the community's sense of ownership of the installed renewable energy system, thus ensuring the program's sustainability.

Figure 6. Documentation of tourism management in the hybrid electricity provider control room at Posong Nature Tourism

CONCLUSION

Through the implementation of a hybrid solar power plant (PLTS) and wind turbine system, the community gained access to 1.500 watts of electricity with 5.000 Wh of storage, which can be used for lighting and basic food stall operational needs. In addition to installing the equipment, this activity also provided the community with practical knowledge about electrical engineering, including how to troubleshoot short circuits, understand the causes of inverter problems, and the importance of managing electricity usage to prevent battery drain. This knowledge transfer increased the community's capacity to perform self-maintenance and maintain system sustainability. The community recognized the direct benefits of electricity availability for improving tourism services, developing culinary and souvenir businesses, and enhancing visitor comfort.

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