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PJU-PLTS TECHNOLOGY AS A LIGHTING SOLUTION IN BATUBANTAR VILLAGE

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Abstract

Adequate street lighting is an important factor in improving security, comfort, and social activity, particularly in rural areas with limited access to electricity infrastructure. This community service program aims to provide an alternative lighting solution by installing Solar-Powered Street Lighting (PJU-PLTS) in Kampung Panday, Batubantar Village. The main problem faced by the community was the lack of street lighting facilities at night, which affected residents' mobility, environmental security, and economic activity. The program was carried out through several stages: site survey, energy needs identification, system design, equipment installation, and testing. The applied system relies on solar energy converted through solar panels to charge storage batteries, which then automatically power street lamps at night. The results show that the PJU-PLTS installation successfully provides an independent, environmentally friendly, and energy-efficient lighting source that operates without depending on the conventional electricity grid. For the partner community, the program delivered concrete outcomes: improved environmental security along previously dark roads, increased nighttime mobility and socio-economic activity, and reduced dependence on monthly electricity costs. This community service activity is expected to serve as a model for solar energy technology implementation that can be replicated in other locations facing similar challenges.

Keywords: PJU-PLTS, Renewable Energy, Solar Power, Street Lighting, Community Service

INTRODUCTION

For modern society, electricity has become a basic necessity, supporting almost every aspect of daily life, from lighting and communication to economic activity. However, equitable access to electricity in Indonesia remains a challenge, particularly in rural and remote areas that are geographically difficult to reach by the State Electricity Company (PLN) electricity network. This situation means that many rural areas still experience limited lighting, particularly street lighting at night. Panday Village, located in Batubantar Village, is one of the areas that still lacks street lighting. Dark road conditions at night directly impact several aspects of community life. First, from a security perspective, the lack of lighting increases the potential for crime and the risk of residents falling into rice fields due to limited visibility. Second, from a mobility perspective, residents tend to limit outdoor activities at night, thus hampering social and economic activities, such as religious activities, education, and small-scale trade, which typically last until late at night. Third, limited electrical infrastructure makes installing conventional street lighting sourced from the PLN network less cost-effective, as it requires cable network expansion and monthly electricity usage costs that must be borne continuously by the village government and residents.

On the other hand, Indonesia's geographical location in the tropics means it is blessed with consistent exposure to sunlight throughout the year, thus offering significant solar energy potential. This situation opens up opportunities for Solar Power Plants (PLTS) to become a suitable renewable energy option for applications in areas that lack adequate electricity network service, including for supporting public street lighting. Solar Power Plant-based Public Street Lighting Systems (PJU-

PLTS) offer a stand-alone lighting solution without relying on conventional electricity supplies, while also being more environmentally friendly because they are sourced from clean energy that is carbon-free during operation. (Fathonah et al., 2023). The implementation of a similar system with automatic control has proven successful in increasing energy security in public street lighting in other rural areas, so it can be a reference in implementing this program.(Kusuma Wardhany et al., 2024).

Several community service studies on PJU-PLTS in rural areas are generally carried out by teams from only one field of engineering science, with the main focus on the installation aspects and technical testing of the system.(Mongi et al., 2024). Different from that pattern, this community service activity involves a cross-study program implementation team of Electrical Engineering, Communication Science, Industrial Engineering, and Information Systems within the framework of Student Work Lecture (KKM), so that the PJU-PLTS installation process is integrated with a participatory communication approach to residents and systematic documentation of activities. This multidisciplinary approach is what makes this program novel compared to similar studies that tend to focus solely on technical aspects, while also strengthening the sustainability aspect of the program through more comprehensive community empowerment.(Erina et al., 2026).

Based on these issues, this community service activity was carried out with three main objectives: first, to provide independent and sustainable street lighting solutions for residents of Panday Village, Batubantar Village through the installation of PJU-PLTS; second, to strengthen residents' sense of security and comfort when carrying out activities at night; and third, to involve residents directly in the installation process so that they can understand how the applied solar energy technology works. This program is expected to bring benefits beyond just the technical aspects of improving street lighting, by also opening residents' insights that clean energy can be a long-term answer to the limited electricity infrastructure in rural areas.

METHOD AND PROSEDURES

This community service program took place in Panday Hamlet, Batubantar Village, with residents, village officials, and the implementation team actively involved in every step of the process. The activities were implemented in several stages.(Hadi et al., 2025)The first stage is a site survey, conducted through on-site surveys to identify road points requiring lighting, geographic conditions, levels of sunlight exposure, and the availability of supporting structures for the installation of street lighting poles and solar power plants. This survey is also used to gather information from residents regarding vulnerable points that most need lighting, including through interviews with the local neighborhood association (RT) head regarding conditions and past incidents at the location.

Figure 1. The implementation team conducted a location survey in Panday Village, Batubantar Village.

The second stage is identifying energy needs. Based on the survey results, the implementation team calculates the electrical energy requirements, including lamp power, nighttime lighting operation time, storage battery capacity, and solar panel capacity required for optimal system operation, even in unfavorable weather conditions. The third stage is the design of the PJU-PLTS system, which includes designing the technical specifications for an integrated (all-in-one) PJU-PLTS lighting unit. This single lighting unit combines solar panels, energy storage batteries, and energy-efficient LED lights in one device, along with a support pole. The design is carried out by considering energy efficiency, system reliability, and ease of maintenance by the local community.(Mufti, Muladi, et al., 2023). The technical specifications of the PJU-PLTS units used in this program are presented in Table 1.

Table 1. Technical specifications of the installed PJU-PLTS unit

Parameter	**Specification**
LED light power	120 Watt
Light intensity	1200 Lumen
Battery capacity	10000 mAh
Solar panels	*Monocrystalline*, 8 Watt / 5 Volt

The fourth stage is device installation, which involves installing the poles and integrated (all-in-one) PJU-PLTS lighting units by the implementation team and the community at predetermined locations. The installation process takes into account the orientation of the solar panels to the sun to maximize sunlight intensity and ensures all electrical connections are securely installed.(Ramadan et al., 2023)The fifth and final stage is system testing and commissioning. After installation is complete, system functionality is tested, including testing battery charging during the day and automatically turning on the lights at night, to ensure all components are operating as designed.

RESULTS

Prior to the activity, the roads in Panday Hamlet, Batubantar Village, were completely dark at night without any street lighting. This made it difficult for residents to carry out their activities at night, increased the risk of falling or falling into rice paddies while walking at night, and raised concerns about environmental safety, especially for vulnerable groups such as children, women, and older people.

Figure 2. The road conditions in Panday Village were still dark before the installation of PJU-PLTS.

The installation of the PJU-PLTS system was successfully carried out at predetermined road points based on the survey results. The installed system works automatically: solar panels absorb solar energy during the day to charge storage batteries, and the stored energy is used to automatically turn on LED lights when sunlight conditions decrease in the afternoon until night, while the lights turn themselves off when morning arrives. Because it works automatically, this system no longer requires manual operation, making it much easier for residents in their daily use.(Kusuma Wardhany et al., 2024).

Figure 3.The installation process of integrated (all-in-one) PJU-PLTS poles and lamp units by the implementation team together with residents.

Figure 4. The PJU-PLTS system has been installed and is operating in Panday Village, Batubantar Village.

The evaluation results after installation showed several real benefits felt by the community.(Raziah et al., 2025). First, there is an increase in environmental security because roads that were previously pitch black are now well lit at night, so the risk of crime and incidents of residents falling or falling into rice fields can be reduced. Second, there is an increase in community mobility and social activities, such as religious activities, including Quran recitation, and social interactions that can take place more comfortably at night. Third, operational cost efficiency is achieved because the PJU-PLTS system does not require monthly electricity costs like PLN grid-based street lighting, so it is more economical in the long run. Fourth, this system is environmentally friendly because the energy source used comes from clean solar energy and does not produce carbon emissions in its operational process.

Table 2.Changes resulting from community service activities

Condition Before	Method	Condition After
The road conditions in Panday Village, Batubantar Village, are completely dark at night without public street lighting facilities, increasing the risk of residents falling into rice fields and raising concerns about environmental safety, especially for children, women, and older people.	Site survey and identification of energy needs, followed by the design and installation of a PJU-PLTS system using an integrated lighting unit (all-in-one: solar panels, batteries, and LED lights in one device), accompanied by a trial of the system's function with residents.	The roads in Panday Village are automatically lit at night by an energy-independent PJU-PLTS system; this improves environmental safety, increases residents' mobility and socio-economic activities, and makes operational costs more efficient because they are not dependent on the PLN grid.

Discussion

The smooth implementation of this activity is inseparable from the active role of village officials and community involvement, both during the survey and installation stages. However, the program implementation was not without several obstacles, including the challenging terrain in some

locations, as well as the limited initial understanding of solar power plant technology among residents. To overcome these challenges, the implementation team adopted a participatory approach by inviting residents to participate directly in the installation process, allowing them to become familiar with the components and how the system works. This participatory approach aligns with the principles of renewable energy-based community empowerment in rural areas, namely that program success is measured not only by technical aspects, but also by the extent to which the community is involved and empowered as subjects, not merely objects, of the program being implemented.(Erina et al., 2026).

Technically, the street lighting system installed in Panday Village uses a simple automatic control scheme based on a light sensor (Light Dependent Resistor/LDR), which turns the lights on when sunlight intensity decreases and turns them off when morning arrives. This scheme demonstrates fairly reliable performance for basic lighting needs. Still, when compared to more advanced approaches, such as the use of passive infrared (PIR) sensors to regulate light intensity based on the presence of road users (Eryk et al., 2024), or system capacity planning validated through lighting simulations such as DIALux(Yasa & Sarief, 2021), the system implemented in this program can still be further developed, for example, by adding an automatic dimming feature to conserve battery capacity on cloudy nights. This is a relevant development direction to recommend to partners and similar community service programs in the future.

The increase in environmental security reported by residents of Panday Village after the installation of PJU-PLTS is also in line with the findings of previous research, which shows that the lack of street lighting is correlated with an increase in the potential for crime in an area, so that the addition of lighting points is a relatively inexpensive preventive measure but has a significant impact on the sense of security of the community, especially for vulnerable groups such as children, women, and the elderly.(Febryani et al., 2025). Thus, the benefits of PJU-PLTS in this program are not only technical-infrastructural but also have a foundation that is in line with social studies regarding the relationship between public lighting and environmental safety.

To ensure the operational reliability of the system, the implementation team conducted repeated checks on the performance of the PJU-PLTS, namely monitoring whether the lights remained on automatically at night and whether the batteries were fully charged during the day. This activity took place from the system's installation on the 14th day of the KKM program until the end of the program on the 40th day, allowing for continuous system performance monitoring for approximately 26 days. This type of regular monitoring is important considering that experience with other community-based PJU-PLTS programs has shown that declining system performance is often caused by residents' limited capacity to perform routine maintenance, rather than solely due to component failure.(Wahyuddin et al., 2023). The results of this activity are expected to become a pilot project that can be replicated in other areas around Batubantar Village and other villages with similar problem characteristics, as part of efforts to expand the use of renewable energy in rural areas.(Ari Wibowo et

al., 2023)This potential for replication is supported by the success of similar programs in various regions, starting from coastal areas(Muslimin et al., 2025), mountainous areas(Sriwijaya et al., 2024), to villages with challenging geographical characteristics such as Kampung Banjar in Tanjung Pinang (Caroko et al., 2022), including similar programs that have been implemented in the Serang Regency area (Solar Powered Street Lighting System in Banjar Village et al., 2025)—shows that the PJU-PLTS model based on participatory assistance is flexible enough to be applied to various geographical and social conditions of rural communities.

Although this activity focuses on the infrastructure installation aspect, a number of community-based solar power plant service programs in other locations show that the community outreach and education components play an important role in increasing residents' renewable energy literacy.(Risqi et al., 2025),(Mufti, Ali, et al., 2023),(Utilization of Solar Power Plants as Renewable Energy for Educational Activities in Public Junior High Schools et al., 2026). This kind of educational component could be a relevant direction for further development of this program, ensuring that its benefits are not only infrastructural but also build long-term community independence in utilizing and maintaining clean energy technologies.

CONCLUSION

This community service activity demonstrates that a multidisciplinary approach that combines electrical technical aspects with participatory communication during the installation process can support the acceptance of PJU-PLTS technology by rural communities previously unfamiliar with solar energy systems. One important lesson from this activity is that the sustainability of PJU-PLTS benefits at the community level does not seem to be solely determined by the reliability of the technical components, but is also related to the extent to which maintenance knowledge is transferred to residents from the initial installation stage, as demonstrated by the active involvement of Panday Village residents in the installation process. The program's real contribution to partners is not only in the form of improving lighting infrastructure, but also the formation of a cross-study program collaboration model within the Student Work Lecture (KKM) framework that has the potential to be replicated for other renewable energy community service programs in rural Banten.

As a suggestion for further development, ongoing support from relevant parties is needed for system maintenance, additional lighting points in other locations with minimal lighting, and replication of the PJU-PLTS program in other villages with similar challenges. Support from local governments and the private sector is also needed to expand the reach and benefits of solar-based renewable energy programs in rural areas.

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