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# Solar Powered Street Lighting in Rural Areas: A Value-Use Analysis of Green Technology Axiology

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## Abstract

This study aims to analyze the utility value and axiological implications of the application of green technology, namely Solar Powered Street Lighting (PSL), in Duri Village, Slahung District, Ponorogo Regency. The main problem in the village is the lack of a public street lighting system due to the limited PLN electricity network on the connecting roads between villages. Through an axiological review, this solar power plant technology is analyzed not only from a technical aspect, but also from its beneficial value for community life. The research method includes field studies, planning, implementation of independent Public Street Lighting technology equipped with automatic sensors, implementation testing, and mentoring. The results of the implementation of one Public Street Lighting unit using solar electricity using Smart Bright Solar cell technology with 4000 lm lighting show that this technology provides an independent lighting solution for the general public, improves security, and supports environmental sustainability. The application of solar power plant on Public Street Lighting in rural areas realizes the axiological value of science as a means to improve the quality of life and create energy independence in remote areas.

**Keywords:** Axiology; Solar Power; Street Lighting; Utility Value; Green Technology

## 1. Introduction

Previous studies on solar street lighting mainly focus on technical feasibility and energy efficiency. However, limited research examines this technology through

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an axiological perspective that evaluates ethical, social, and ecological value in rural electrification [1]. This study addresses this gap by analysing the value dimension of solar powered street lighting implementation in rural Indonesia [2], [3].

Axiology serves as a reference or tool for assessing the extent to which a science or technological product provides positive benefits for human life and the environment. Etymologically, axiology comes from the Greek word *axios*, meaning value, and *logos*, meaning theory. Simply put, axiology is a theory of values. Terminologically, axiology is defined as a theory of values, which relates to the usefulness of acquired knowledge. Values are something humans possess to make various considerations about what is valued. These values help humans form patterns of facts and identify the significance of those facts. According to Rokeach<sup>6</sup>, values are defined as internalized concepts of interest, truth, and goodness intended to provide direction for attitudes and behavior, including in choosing behaviors that have been or will be taken. One example of a case is Duri Village, Slahung District, Ponorogo Regency, East Java Province, Indonesia, which has a 500 meter long main road that is pitch black at night, because it is not accessible by the PLN electricity network [4].

This situation poses a security risk and hinders nighttime activities for the local community. The implementation of street lighting using solar power plant technology is not merely a technical solution, but rather a manifestation of academics' social responsibility to apply science for the welfare of the community. This study contributes to electrical engineering philosophy by proposing an empirical value-use framework that connects rural electrification technology with ethical responsibility, social empowerment, and ecological sustainability [5].

The development of modern science and technology cannot be separated from the moral and social responsibility for the sustainability of human life. From a philosophical perspective, the axiological aspect positions science not only as a tool for understanding nature but also as a means of providing tangible benefits for human well-being and environmental [6].

Axiology focuses on the values, goals, and ethical implications of the application of science and technology, thus demanding a balance between technological progress and the social responsibility of its users. One concrete form of the application of the axiological values of science can be seen in the development of green technology such as Solar Power Plants . Solar Power Plants, have high axiological value because they offer clean and sustainable energy solutions. In the study of the philosophy of science, especially the aspect of Axiology, examines the value, utility, and ethical implications of science. In the context of development and technology, Axiology becomes a lens for assessing the extent to which a science or

technological product provides positive benefits for human life and the environment [7], [8].

One example is the case of Duri Village, Slahung District, Ponorogo Regency, East Java Province, Indonesia, where a 500-meter main road is pitch black at night because it is not connected to the PLN electricity grid. This situation poses a security risk and hinders nighttime activities for the local community. The implementation of PSL (Public Street Lighting) using solar power plant technology is not merely a technical solution, but rather a manifestation of academics' social responsibility to apply science for the welfare of the community [9].

This article will analyze how the implementation of a street light system with automatic control in Duri Village embodies the axiological values of electrical engineering. This technology offers a clean and sustainable energy solution by utilizing renewable and environmentally friendly natural resources. In the context of sustainable development, solar power plants not only provide energy efficiency but also reflect ecological ethics that align with the principles of nature conservation [10].

A real-life case illustrating this occurred in Duri Village, Slahung District, Ponorogo Regency, East Java Province, where a 500-meter stretch of main road was pitch black at night due to the lack of PLN electricity. This situation poses a security risk and hinders residents' social and economic activities at night. To address this issue, scientists and academics have proposed a solution by implementing a solar-powered street lighting system (PSL) with automatic control as an alternative energy solution.

The application of this technology is not only technical but also contains profound axiological values. This research reflects the social responsibility of academics in translating electrical engineering knowledge into a means of improving the quality of life of the community. Thus, the implementation of the street lighting and solar power system in Duri Village is a concrete example of how science functions ethically, socially, and ecologically in realizing community welfare while maintaining environmental sustainability.

## **2. Methods**

This research uses a qualitative-descriptive approach with an empirical basis from community service activities carried out in 2024. The methods in this research include the following steps:

1. Situation analysis and field survey in Duri Village to determine road points without lighting.
2. Planning of public street lighting technology based on solar power plants.
3. Installation of street lighting at strategic points in selected locations.

4. esting of PJU-PLTS Technology from implementation activities during the day and night during two seasons (rainy and dry seasons).
5. The axiological evaluation uses three indicators: perceived safety improvement, community participation in maintenance, and environmental impact based on fossil fuel substitution.

Data was collected through direct observation and documentation of the installation process. Analysis was conducted by examining the suitability of the activity results with the axiological values of science [11], [4], [12].

### 3.Results and Discussion

The results and discussion contain the results of the research implementation in accordance with the research method and the discussion of the results obtained in this research consists of several stages of implementation.

#### 3.1 Presenting the Results

The results are presented systematically to demonstrate how the solar power plant (PLTS) technology design can provide an effective solution to lighting problems in rural areas not yet covered by PLN electricity. The research results are presented in this section, following the steps in the research methodology, as explained below.



**Figure 1.** Location of a Rural Road Without Lighting

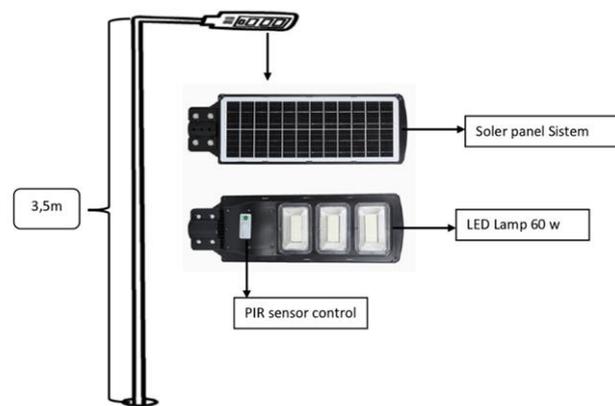
#### Situation analysis and field survey

From the results of the field study, initial data was obtained where one of the main road locations connecting Duri Village with Ngilo-Ilo Village, entered the

Jenggring Hamlet area of Duri Village, precisely in RT 01 / RW 01, the 500 meter long road passed through a rice field area, there was no lighting because there was no PLN electricity network so this route was very dark at night, so street lighting was needed. The results of the observations were carried out as explained in the [Figure 1](#).

### Planning of public street lighting technology based on solar power plants.

Technology in the form of public street lighting with solar power plant energy sources equipped with automatic control. Street lighting uses LED technology with a power of 25 Watts capable of producing a light intensity of 4000 lumens, solar power plant technology that has a PV voltage specification of 4.5V with a power of 13 W, Lithium iron Phosphate battery 3.2 V / 15 Ah. This lamp is equipped with an automatic control system that is able to manage the performance of Public street lighting - solar power plant. The lighting is installed on the roadside using a 2-inch iron pipe pole with a height of 3.5 meters. The description of Public street lighting technology is as explained in [Figure 2](#). [13].



**Figure 2.** Design of a Public Street Lamp with Solar Power Generation  
**Installation of Public Street Lights**

Installation of Public Street Lighting - Solar Powered in accordance with the initial design plan, The installation process demonstrated community participation as a key implementation outcome. Local residents contributed to pole installation and system setup, indicating knowledge transfer and community engagement. The installation of the lights was carried out through mutual cooperation without requiring installation service fees for researchers or the community involved. Installation of the lights starting from casting the foundation to installing the poles and lights took 2 hours. The installation process is as explained in the [Figure 3](#). [13].

### Technology Testing

Technology testing is carried out after the process of installing public street lighting has been perfectly installed, testing is carried out in the evening when the sun has set and the road conditions are starting to get dark, testing includes the ability of the lights to turn on automatically when the conditions start to change from

day to night, when the sunlight is gone and is unable to provide electrical energy, the solar cell lights turn on automatically with very bright light. The next test is about automatic or intelligent systems in the regulation of public street lighting that has been implemented automatically, including the lights will turn on when the conditions start to get dark and the lights will turn on brightly for 30 seconds and after 30 seconds the lights will turn on dimly, the lights will turn on brightly automatically when the sensor detects movement which is assumed to be people passing around the street lighting. and this condition will last until the morning when the sun starts to rise again, the lights will automatically turn off and the solar powered lights will recharge the battery again. Testing public street lighting - solar power plants as explained in the [Figure 4](#).



**Figure 3.** The Process of Installing Street Lighting with Solar Power Generation at a Rural Road Location

The second test is a periodic test of the performance of street lighting against changes in weather and lighting conditions to the activities of road users every day as well as the surrounding environmental conditions that can affect the performance of the application of solar-powered street lights in Duri Village. Periodic testing includes testing street lighting when implemented on rural roads on the first day the battery current lasts until morning the lights can be lit for 12 hours, the activity of road users passing the street lights is low intensity so that the lights in bright conditions are not many, Testing on the 2nd day is still the same as the first day's test. Testing on the 3rd day the lights are on until 3 am because this 3rd test gets more road user activity compared to the 2nd test, Testing on the 4th The lights are on until 23.00 after being observed it was found that the lights are often bright so that the battery current runs out quickly, the results of this observation are caused in addition to the traffic activities of road users also due to the movement factors of nocturnal animals such as bats flying so that the control system equipped with print sensors detects movement to manage the.



**Figure 4.** Testing Street Lighting at Night

### 3.2 Create a Discussion

The discussion of the results of this study demonstrates the successful implementation of a solar-powered street lighting system in Duri Village, Slahung District, Ponorogo Regency, as an effective solution to address limited access to electricity in rural areas. The findings are not only technical in nature but also possess high axiological value because they reflect the application of science that provides tangible benefits to humans and the [15].

Empirically, the test results show that the solar street lighting system is able to operate stably for 10 to 12 hours every night. The 25 W lamp produces up to 4000 lumens of light with two operating modes: bright mode when there is movement around the sensor and dim mode when the road is quiet. The public street lighting system uses a 15 Ah lithium iron phosphate battery charged via a 13 W solar panel. When sunlight is no longer available, the system will automatically turn on the lights independently without requiring electricity from PLN (National Electricity Grid). Based on field testing, the system is able to operate efficiently and provide lighting in a radius of approximately 25 meters.

The significance of these findings goes beyond mere technical success. Within the context of the philosophy of science, these findings must be understood through an axiological perspective, namely the dimension of value and the usefulness of science for human life. Empirical findings demonstrate that the technology produces measurable social benefits such as improved night mobility and community participation. These outcomes support axiological theory that technological knowledge gains legitimacy when it produces tangible social value [1].

First, the ethical value of this research's findings is evident in the effort to utilize environmentally friendly technology without damaging the ecosystem. The power plant represents a concrete application of green technology principles, reducing dependence on fossil fuels and carbon emissions. Therefore, this research embodies the moral value that scientific advancement should not disrupt the balance of nature but rather support the sustainability of human life [13].

Second, this finding has social value because it has a direct impact on improving security and community activities at night. The installation of solar-powered lights along the main road in Duri Village transformed the darkness, which initially caused fear and hampered nighttime economic activity, into a safe and productive environment. Community involvement in the installation and maintenance process demonstrates the transfer of knowledge and the strengthening of social participation. This demonstrates that wisely applied knowledge can strengthen social ties and foster community independence.

Third, there is ecological value arising from the implementation of a solar-powered public street lighting system. This technology requires no external energy source and adapts to environmental conditions through an automatic sensor system. With its energy-efficient mechanism and motion-detection-based control, this technology not only saves energy but also supports sustainability principles. This demonstrates how electrical engineering can contribute to environmentally conscious development.

Thus, the results obtained and claimed as research findings represent not only the technical success of the solar power system in providing lighting in areas without

electricity, but also a philosophical finding, demonstrating that science has social, moral, and ecological significance when applied responsibly. Through an axiological approach, this activity demonstrates that science and technology should be directed toward ennobling human life, not merely achieving energy efficiency.

Overall, these findings reinforce the view that the highest value of science lies in its ability to deliver tangible benefits to people and the environment. The implementation of a solar-powered street lighting system in Duri Village demonstrates that electrical engineering developed in universities can transform from mere theoretical knowledge into a moral and social force that builds energy independence in rural communities.

#### **4. Conclusion**

Research on the implementation of a solar-powered street lighting system in Duri Village, Slahung District, Ponorogo Regency, yielded several important findings, both technically and axiologically. Technically, the system, designed with 25 W of power and 4,000 lumens of light, is capable of operating automatically for 10–12 hours each night with high efficiency. The combination of a 13W solar panel, a 15Ah lithium iron phosphate battery, and an automatic motion sensor has proven effective in adjusting lighting according to environmental conditions. Tests show the system can operate stably in various weather conditions and provides a lighting solution in areas not covered by the National Electricity Grid (PLN).

From a philosophical perspective, particularly axiology, these results demonstrate that the application of electrical engineering is not only functional but also socially, morally, and ecologically meaningful. The application of this green technology reflects the ethical responsibility of academics to provide environmentally friendly, sustainable technology that directly benefits society. Social value is evident in the increased safety and comfort of residents at night and the active participation of the community in system maintenance. Meanwhile, ecological value is reflected in efforts to reduce carbon emissions and conserve energy through the use of renewable natural resources.

Thus, the findings of this study confirm that solar power technology is not merely an energy innovation, but also a manifestation of the axiological value of science, that knowledge, applied responsibly, can function as a social force that promotes energy independence and sustainable development. Future research should investigate hybrid solar lighting systems with adaptive smart control and conduct comparative studies across multiple rural regions to validate scalability.

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### Authors' Declaration

**Authors' contributions and responsibilities** - The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation, and discussion of results. The authors read and approved the final manuscript.

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**Competing interests** - The authors declare no competing interest.

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### References

- [1] M. Noer Fadli Hidayat, D. D. Prasetya, T. Widiyaningtyas, and S. Patmanthara, "Anatomy of Sentiment Analysis in Ontological, Epistemological, and Axiological Perspectives," *J. Online Inform.*, vol. 10, no. 1, pp. 105–121, 2025, doi: 10.15575/join.v10i1.1228.
- [2] M. Nagatsu et al., "Philosophy of science for sustainability science," *Sustain. Sci.*, vol. 15, no. 6, pp. 1807–1817, 2020, doi: 10.1007/s11625-020-00832-8.
- [3] S. Patmanthara, "Pembelajaran di Perguruan Tinggi melalui Internet," vol. 14, 2009, [Online]. Available: <https://consensus.app/papers/pembelajaran-di-perguruan-tinggi-melalui-internet-patmanthara/14ebcd9917b45082be925d9951e4fe4e/>
- [4] D. Riyanto, M. Muhsin, and J. S. Habiby, "Penerapan PLTS 200 WP Pada Rumah Hunian Masyarakat Pedesaan Sebagai Listrik Hybrid," pp. 21–27.
- [5] C. Brunet et al., "Impacts Generated by a Large-Scale Solar Photovoltaic Power Plant Can Lead to Conflicts between Sustainable Development Goals: A Review of Key Lessons Learned in Madagascar," *Sustainability*, 2020, doi: 10.3390/su12187471.
- [6] D. Prista, M. N. Haq, and A. Winarno, "Peran Aksiologi Sains Terhadap Kehidupan Sehari-hari," *J. Bintang Manaj.*, 2024, doi: 10.55606/jubima.v2i4.3439.
- [7] S. Batel, "Research on the social acceptance of renewable energy technologies: Past, present and future," *Energy Res. Soc. Sci.*, vol. 68, p. 101544, 2020, doi: 10.1016/j.erss.2020.101544.
- [8]: Ach. Khatib et al., *FILSAFAT ILMU Manajemen Pendidikan Islam*. 2021.

- [9] W. Sutopo, I. S. Mardikaningsih, R. Zakaria, and A. Ali, "A Model to Improve the Implementation Standards of Street Lighting Based on Solar Energy: A Case Study," *Energies*, vol. 13, p. 630, 2020, doi: 10.3390/en13030630.
- [10] L. Gumilar, A. N. Afandi, D. E. Cahyani, E. H. Sanjaya, and A. A. B. A. Samat, "Application of Line Reactors and Harmonic Filters in Electric Power Systems are Integrated Renewable Energy in Mesh Topology," in *2022 4th International Conference on Cybernetics and Intelligent System (ICORIS)*, 2022, pp. 1–5. doi: 10.1109/ICORIS56080.2022.10031463.
- [11] R. Ghoni et al., "IMPLEMENTATION OF SOLAR ENERGY FOR PUBLIC STREET LIGHTING IN SEGOROGUNUNG VILLAGE, KARANGANYAR REGENCY," *Abdi Masya*, 2024, doi: 10.52561/abdimasya.v5i2.402.
- [12] D. Riyanto, Y. Winardi, and M. Muhsin, "M Pengembangan Pompa Irigasi Pertanian Menggunakan Energi Listrik Tenaga Surya di Desa Duri, Slahung, Ponorogo," vol. 7, pp. 162–167, 2021, doi: 10.29244/agrokreatif.7.2.162-167.
- [13] A. N. Afandi, I. Fadlika, L. Gumilar, M. R. Andriansyah, and E. Mistakim, "ISBN : 978-623-5650-02-9 Sumenep , 1-2 Desember 2021 RANCANG BANGUN OFF-GRID SYSTEM PEMBANGKIT LISTRIK TENAGA SURYA ( PLTS ) SEBAGAI MODUL PEMBELAJARAN BAGI MAHASISWA UNIVERSIDADE ORIENTAL DE TIMOR LOROSA ' E ( UNITAL ) Prosiding Webinar Nasional Peneliti," pp. 1–2, 2021.
- [14] A. Aripriharta, A. Hamdan, N. Mufti, I. Fadlika, A. N. Afandi, and H. Amri, "Penerapan Teknologi Lampu Bertenaga Surya Di Gading Kasri Sebagai Pilot Project Kampung Mandiri Energi," *Tanjak J. Pengabdi. Kpd. Masy.*, vol. 1, no. 1, pp. 1–9, 2020, doi: 10.35314/tanjak.v1i1.1594.
- [15] M. Yusuf et al., "PENERAPAN PHOTOVOLTAIC (PV) SEBAGAI ENERGI LISTRIK ALTERNATIF PADA RINTISAN DESA WISATA WIDARAPAYUNG WETAN CILACAP," *LOGISTA - J. Ilm. Pengabdi. Kpd. Masy.*, 2022, doi: 10.25077/logista.6.1.36-44.2022.