Utilization Of Solar Energy As An Environmentally Friendly Source Of Electricity In Karang Taruna, Gambir District

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Abstract.

This community service program titled "Socialization and Training on the Utilization of Solar Energy as an Environmentally Friendly Electricity Source in Karang Taruna, Gambir District" aimed to address the critical issues faced by the community due to their heavy reliance on unstable and costly fossil energy from PLN (the state-owned electricity company). The program also targeted the low understanding and practical skills related to solar energy and the underutilization of solar energy potential in urban settings. The implementation comprised two core components: socialization of solar energy and climate change impacts, and hands-on training on mini solar panel systems. Using interactive lectures, demonstrations, direct practices, and discussions, the program was conducted on March 16, 2025, involving 31 participants mainly from Karang Taruna members. A significant improvement in participants' comprehension was observed, with average pre-test scores rising from 45 to 82, indicating an 82.22% increase. Furthermore, participant satisfaction reached 90.32%, alongside a 70.96% enhancement in practical ability to operate mini solar panel setups. Key outputs included teaching materials, posters, and scientific articles, collectively contributing toward enhanced community energy independence, reduced electricity costs, and promotion of clean energy adoption in urban areas.

Keywords: *Community service; solar energy; youth organization and Gambir District.*

I. INTRODUCTION

The global energy landscape is witnessing a critical transition due to escalating challenges such as energy crises and climate change. The reliance on fossil fuels, which are finite and environmentally detrimental, deeply impacts national energy security and ecological sustainability. Indonesia, enriched with abundant solar radiation averaging 4.8 kWh/m² per day [3, 9], holds vast untapped potential for solar energy utilization. Despite this, only a marginal fraction of its renewable energy potential—approximately 0.3%—has been converted into active energy generation as of 2021 [1]. Jakarta's Gambir District, specifically, records a solar energy potential of about 40.4 GWh per year, yet current exploitation remains minimal [7]. Karang Taruna, a youth organization in Gambir District, represents a vital segment of the urban community facing high dependency on unreliable and expensive fossil-fueled electricity supplied by PLN. This dependency has led to issues such as fluctuating electricity supply and elevated operational costs for small-scale enterprises and households. Moreover, the community exhibits limited awareness and low practical competence regarding renewable energy technologies, specifically solar energy [12]. These factors collectively highlight an urgent need for educational and practical interventions that emphasize eco-friendly, cost-effective energy alternatives, aligning with national energy transition goals and the United Nations' Sustainable Development Goals (SDGs) [2, 4, 7].

The key issues identified in Karang Taruna, Gambir District, center on the community's substantial reliance on fossil-sourced electricity from PLN, which is both costly and prone to supply instability, posing significant challenges for local productivity and economic sustainability. Compounding these difficulties are the limited awareness and practical skills among youth organization members regarding the principles, benefits, and real-world applications of renewable energy, particularly solar technology [2, 4, 7]. This underpins a broader problem of underutilized solar energy potential in urban Jakarta, especially considering the substantial available solar irradiance that remains largely untapped. Furthermore, high operational electricity costs burden micro-businesses and households, making them vulnerable to price fluctuations and

supply disruptions, while minimal hands-on knowledge in implementing clean energy solutions stymies efforts to transition toward sustainable urban power [12]. The primary objectives of the community service program in Karang Taruna, Gambir District were to enhance the understanding and awareness of 31 youth and community members regarding solar energy and its associated environmental and economic benefits through targeted socialization and hands-on training sessions.

The program aimed to improve practical skills in assembling and operating mini solar panel systems, thereby enabling participants to adopt renewable technologies in their daily lives and to foster greater environmental consciousness. By emphasizing the significance of sustainable energy practices, the initiative sought to reduce reliance on unstable and costly fossil-based electricity from PLN, lower household and microbusiness operational expenses, and pave the way for increased utilization of solar energy in urban settings. Additionally, the program was designed to support government-led energy transition policies and to empower Karang Taruna members as change agents capable of initiating clean energy projects within their community. This initiative supports community empowerment by transferring relevant knowledge and enhancing technical skills in renewable energy usage. By creating youth agents of change within Karang Taruna, this program fosters sustainable energy practices at the grassroots level, potentiating wider community adoption.

II. METHODS

The community service activity employs various implementation methods, including:

a. Preparation

The program followed a well-structured, phased approach beginning with thorough planning between October and November 2024. This stage involved proposal submission detailing objectives, methods, expected outputs, budgets, and schedules. The PKM (Pengabdian Kepada Masyarakat) team consisted of four faculty members from the Department of Petroleum Engineering and Mining Engineering, two students, and one administrative staff. Coordination meetings established task distribution, and ensured administrative compliance.

b. Survey and Problem Identification

A field survey and pre-event questionnaire were conducted between January and February 2025 to assess the community's baseline knowledge, interests, and needs concerning renewable energy. The survey revealed that 45% of targeted participants had limited understanding of renewable energy sources, especially solar energy, exacerbated by heightened greenhouse gas emissions from conventional energy usage [6]. Based on this, the material and methods were tailored to meet the specific capacity and interests of Karang Taruna members.

c. Educational and Training Activities

The activity took place on March 16, 2025, on-site at Karang Taruna Gambir and involved multiple interactive educational techniques:

- Interactive Lectures: Facilitators presented comprehensive solar energy theory, including the urgent need for energy transition, solar potential in Indonesia, technology principles of photovoltaic (PV) systems, and climate change impacts. The presentations encouraged active participant questioning and dialogue to ensure contextual understanding.

Fig 1. The PKM team and participants

- Demonstrations: Using mini solar power system units, trainers demonstrated component identification, system assembly procedures, wiring, and operation. Participants observed the conversion process from solar radiation to usable electrical energy.

Fig 2. Mini Solar Power System

- Hands-on Practice: Under direct supervision, participants connected components such as solar panels, solar charge controllers (SCC), batteries, and inverters. They operated lighting loads to experience firsthand system functionality and basic troubleshooting.

Fig 3. The PKM's Activity

- Discussion Sessions: Facilitators addressed technical and economic inquiries, guided calculation exercises on system sizing, and outlined maintenance and safety protocols.

The training emphasized experiential learning principles to reinforce confidence and skills for autonomous system deployment.

d. Evaluation

Pre- and post-tests assessed cognitive gains, while practical assessments evaluated participant capability in system operation. Satisfaction surveys measured perceived value and engagement level. The program also included plans for post-activity follow-up to support sustained implementation and to monitor community adoption progress.

III. RESULT AND DISCUSSION

The results of this community service activity is as follows:

a. Knowledge and Skill Improvement

Results showed a remarkable increase in theoretical understanding, with average test scores rising from 45 to 82 post-training, equivalent to an 82.22% improvement. Practical skills improved significantly, as participants able to correctly use mini solar panel systems rose from 16.13% to 87.09%, reflecting a 70.96% increase. Participants demonstrated competence in correctly wiring solar panels to SCCs, connecting batteries and inverters, operating lighting systems safely, and interpreting system indicators. Moreover, the training positively shifted attitudes toward renewable energy, fostering perceptions of solar power as an accessible, economically viable solution rather than a complex or cost-prohibitive technology.

Table 1. Results of the PKM Implementation Evaluation

Evaluation Aspect	Benchmark / Test	Before Program	After Program	Achievement Level
Theoretical Understanding	Pre-test (5 questions) and Post-test (14 questions) in the form of a short quiz	Average pre-test score: 45	Average post-test score: 82	Increase in understanding = 82.22%
Practical Skills	Direct observation of the ability to correctly use a mini solar panel system and understand the process of converting solar energy into electrical energy	16.13% of participants (or about 5 people) were able to correctly use the mini solar panel system and understand the process of converting solar energy into electrical energy	87.09% of participants (or about 27 people) were able to correctly use the mini solar panel system and understand the process of converting solar energy into	Increase in ability = 70.96%
Participant Satisfaction	Satisfaction questionnaire (scale 1-5)	-	Average satisfaction score: 4.9	Participant satisfaction level "Very High" (about 28 people were very
Direct Output	Attendance and active participation	30 participants attended and were active	31 participants attended and were active in discussions	Achieved (100%)

b. Community Impact and Organizational Capacity

The program strengthened Karang Taruna's organizational capacity by equipping members with valuable knowledge assets, positioning them as potential leaders and advocates for sustainability within their community. This empowerment is expected to catalyze local initiatives such as installing solar systems for basecamp lighting or social activities, thus reducing reliance on unstable fossil-fuel grids and mitigating environmental footprints. The transformation of participants into change agents also enhances the community's readiness to adapt to climate commitments and clean energy policies, reflecting a promising model for urban renewable energy dissemination.

c. Institutional Contributions

For the implementing team, comprising university faculty and students, this program offered experiential opportunities to apply engineering expertise in a community context. It also enhanced pedagogical abilities, particularly in translating complex technical content into accessible formats suitable for non-expert audiences. The integration of this community service with ongoing education and research activities fostered a synergistic academic environment, supporting the university's mission and wider sustainability agendas.

IV. CONCLUSION

The community service program successfully delivered comprehensive socialization and practical training on solar energy utilization to 31 members of Karang Taruna Gambir, producing measurable gains in knowledge, skills, and positive attitudes toward renewable energy. These outcomes demonstrate the viability of hands-on, community-based interventions to bridge the gap between solar energy potential and real-world adoption in urban areas. Additionally, the initiative contributed to building local organizational capacity for sustainable energy advocacy and action.

The program highlights the essential role of academic institutions in facilitating technology transfer and community empowerment within urban environments. To sustain and amplify these benefits, future activities should include longitudinal monitoring, extended training sessions, and support for project implementation, such as proposal development for solar installations in communal spaces. Such efforts will further advance energy independence, economic savings, and environmental stewardship in line with national and global sustainability goals.

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REFERENCES

[1] Ahdiat, Adi. (2022). Potensi Energi Terbarukan Indonesia Baru Tergarap 0.3% Sampai 2021. Diunduh pada tanggal 28 Oktober 2023: https://databoks.katadata.co.id/datapublish/2022/10/25/potensi-energi-terbarukan-indonesia-baru-tergarap-03-sampai-2021

[2] Darma, S., Lubis, H., dan Husni, R. (2019). Mendorong Transisi Menuju Energi Terbarukan Demi Masa Depan Yang Berkelanjutan. Diunduh pada tanggal 28 Oktober 2023: http://pojokiklim.menlhk.go.id/read/mendorong-transisi-menuju-energi-terbarukan-demi-masa-depan-yang-berkelanjutan

[3] Direktorat Jenderal EBTKE. (2023). *Potensi Energi Baru Terbarukan di Indonesia*. Kementerian Energi dan Sumber Daya Mineral

[4] Erdiwansyah, E., Mahidin, M., Husin, H., Nasaruddin, N., Khairil, K., Zaki, M., dan Jalaluddin, J. (2021). Investigation of Availability, Demand, Targets, and Development of Renewable Energy in 2017-20150: A Case Study in Indonesia. ***International Journal of Coal Science & Technology***. 8(4). Pp. 483-499. https://doi.org/10.1007/s40789-020-00391-4

[5] Fransisca, Lydia. (2021). Melihat Potensi Besar Energi Terbarukan Indonesia. Diunduh pada tanggal 28 Oktober 2023: https://www.goodnewsfromindonesia.id/2021/10/08/melihat-potensi-energi-baru-terbarukan-indonesia

[6] IPCC. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press

[7] Kementerian ESDM. (2024). *Potensi energi terbarukan Indonesia*. Direktorat Jenderal EBTKE.

[8] Kementerian ESDM. (2024). *Rencana Strategis Kementerian ESDM 2024-2025*. Jakarta: Kementerian ESDM RI.

[9] Lestari, E., Kinasti, M.A., Sofyan, M., Kustanrika, I.W., Ahsan, M., dan Pantouw, J.P. (2022). Pemanfaatan Sel Surya Sebagai Sumber Daya Energi Terbarukan Terkoneksi Dengan Wastafel Sensor Untuk Menunjang Pembelajaran Tatap Muka Di SMA Muhammadiyah 5 Jakarta. Proposal PKM. Diunduh pada tanggal 26 Oktober 2023: https://repo.itpln.ac.id/306/

[10] Manan, Saiful. (2009). Energi Matahari, Sumber Energi Alternatif yang Efisien, Handal, dan Ramah Lingkungan di Indonesia. Paper. Semantic Scholar. Corpus Id: 107348862. Diunduh pada tanggal 26 Oktober 2023: https://www.semanticscholar.org/paper/ENERGI-MATAHARI%2C-SUMBER-ENERGI-ALTERNATIF-YANG-DAN-Manan/9839429b81eefdd72ef7055c52b7d51897d72063

[11] Nehru, Naswir, M., dan Harmes. (2020). Implementasi PLTS Pada Kelompok Tani Surya Sosial Di Desa Renah Kayu Embun Kota Sungai Penuh. Prosiding AVoER XII

[12] Pabumnews (2022). Pengetahuan Masyarakat Terkait Energi Terbarukan Masih Rendah. Diunduh pada tanggal 28 Oktober 2023: https://www.panasbuminews.com/pengetahuan-masyarakat-terkait-energi-terbarukan-masih-rendah/

[13] STEM Prasetya Mulya. (2019). Ini Alasan Mengapa Harus Beralih Ke Energi Terbarukan. Diunduh pada tanggal 28 Oktober 2023: https://stem.prasetiyamulya.ac.id/blog/ini-alasan-mengapa-harus-beralih-ke-energi-terbarukan/

[14] Sun Energy. (2021). 5 Manfaat Hemat Energi Listrik yang Bisa Anda Dapatkan. Diunduh pada tanggal 26 Oktober 2023: https://sunenergy.id/blog/manfaat-hemat-energi-listrik

[15] Sun Energy. (2023). Transformasi Energi: Menuju Masa Depan Berkelanjutan Indonesia Melalui Renewable Energy. Diunduh pada tanggal 26 Oktober 2023: https://sunenergy.id/blog/perusahaan-renewable-energy-indonesia .