JARDIRA
(Jurnal Pengabdian Digital dan Rekayasa Informatika)
ISSN: 3110-016X (online)
https://journals.cognispectra.com/index.php/jardira/index
Vol 2, No. 1, pp. 30-40

Implementation of Sustainable Lighting Through Community Involvement to Support Clean and Affordable Energy in Puri Cikoneng Indah Housing, Bojongsoang District, Bandung Regency

Reza Rendian Septiawan [1,*], Ardiansyah Ramadhan [2], Ashri Dinimaharawati [3], Galang Adira Prayoga [4]

[1,2,3,4] Computer Engineering Study Program, Telkom University, Indonesia
[2] Center of Excellence for Intelligent Sensing-IoT, Telkom University, Indonesia
*Corresponding Author: zaseptiawan@telkomuniversity.ac.id

DOI : 10.65917/jardira.v2i1.56

Article history:

Received: January 8, 2025

Revised: January 19, 2025

Accepted: January 19, 2025

Keywords: Solar-powered lighting, Community service, Renewable energy, Residential safety, Sustainable development

ABSTRACT

Background: Inadequate environmental lighting in residential areas can increase safety risks and reduce community comfort, particularly during nighttime activities. This community service program was conducted in the Puri Cikoneng Indah Residential Area to address limited public lighting through the implementation of a sustainable solar-powered lighting system. The program aimed to improve environmental safety, support clean energy utilization, and empower the local community in managing renewable energy technologies.

Contribution: The contribution of this program lies in providing a renewable energy–based lighting solution that enhances nighttime visibility and security while increasing community awareness of clean energy practices. In addition, the activity serves as a practical and replicable model for neighborhood-scale renewable energy implementation.

Method: A community-based approach was employed by actively involving residents throughout all stages of the program. The implementation process included field surveys, identification of lighting needs, system design, socialization and technical education, installation of solar-powered lighting components, and monitoring and evaluation to ensure system functionality and sustainability.

Results: The results showed that an integrated solar-powered lighting system was successfully installed and operated independently from the conventional electrical grid. The residential environment became brighter and safer at night, and residents demonstrated improved understanding of the basic operation and maintenance of solar energy systems.

Conclusion: Overall, the program achieved its objectives by improving environmental safety, promoting clean energy adoption, and strengthening community participation, thereby contributing to sustainable development at the local level.

INTRODUCTION

This community service initiative was implemented in the Puri Cikoneng Indah Housing Complex, located in RT 2 RW 7, Bojongsoang Village, Bojongsoang District, Bandung Regency, West Java (−6.987617095190085; 107.6454661993997), as shown in Figure 1. The area consists of approximately 50 housing units and a local health clinic, with a population of 48 households or around 185 residents. As a residential area with diverse daily activities, adequate supporting infrastructure particularly outdoor lighting is essential to ensure safety, comfort, and quality of life.

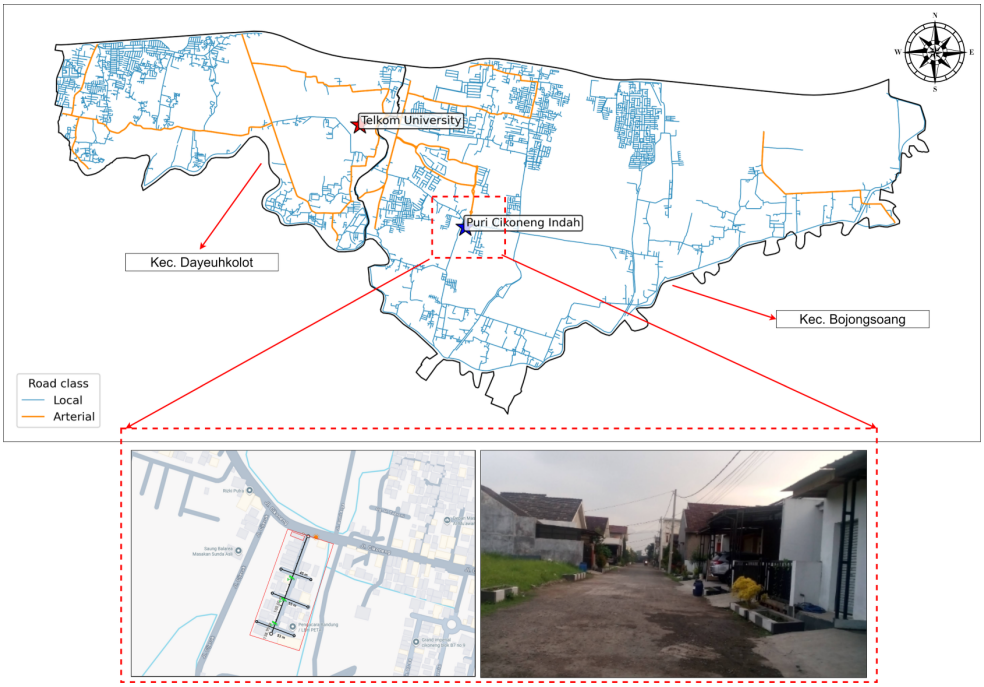

Figure 1. Implementation Site for Sustainable Lighting in Puri Cikoneng Indah Housing, Bojongsoang District, Bandung Regency.

The main problem faced by the community is inadequate outdoor lighting at night. Poorly lit streets and public spaces increase the risk of accidents for pedestrians and road users and reduce residents' sense of security, especially among vulnerable groups such as children and women [1], [2], [3], [4]. In addition, insufficient lighting may contribute to social problems, including an increased risk of criminal activity [9], [10]. Although solar-powered lighting systems have been successfully implemented in several other regions [5], [6], [7], [8], similar initiatives have not yet been applied in the Bojongsoang area.

If left unresolved, inadequate lighting will continue to negatively affect environmental safety, comfort, and community well-being [11]. Therefore, a sustainable lighting solution based on renewable energy is required to address these challenges. This community service program proposes the implementation of a solar-powered lighting system as an environmentally friendly, energy-efficient, and affordable solution aligned with the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) [12], [13].

Beyond improving nighttime visibility and safety, this program adopts a community-based approach that actively involves residents in planning, installation, and maintenance [13], [16], [17]. Such involvement aims to strengthen community capacity, foster a sense of ownership,

and support the long-term sustainability of clean energy utilization at the neighborhood level [7], [18].

The main problem in the Puri Cikoneng Indah Housing community is inadequate outdoor lighting at night. The dark conditions in streets and common areas increase the risk of accidents, affecting pedestrians, motorcyclists, drivers, and residents who remain active at night. Several other villages have successfully utilized solar-powered electricity systems. However, similar efforts in the Bojongsoang area are not yet. Insufficient lighting also creates a sense of insecurity, especially among children, women, and other vulnerable groups who need to move outside their homes at night. Moreover, poorly lit environments can trigger social issues, including a higher risk of criminal activity [9], [10].

If left unaddressed, this lack of lighting will directly affect residents' quality of life, particularly in terms of safety, comfort, and environmental security [11]. Therefore, an immediate, concrete initiative is needed to provide a lighting system that not only addresses nighttime visibility issues but also aligns with sustainability principles by using environmentally friendly, energy-efficient, and affordable technologies.

METHOD

The community service program was implemented through a series of systematic stages, as illustrated in Figure 1, beginning with problem identification and field surveys. This initial stage involved direct observation at the activity site located in RT 2 RW 7, Puri Cikoneng Indah Housing, Bojongsoang Village. The team assessed existing outdoor lighting infrastructure, identified accident-prone areas, and analyzed community needs related to nighttime illumination. In addition, social mapping was conducted by collecting information on the number of households, residents' nighttime activities, and the level of community support for the proposed program.

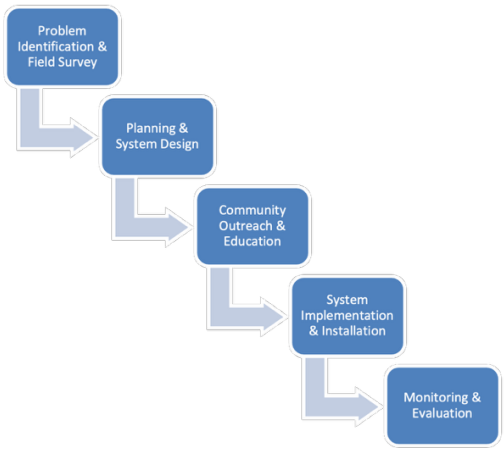

Figure 2. Method Framework of the Community Service Program

The second stage focused on planning and system design. This stage involved defining the system configuration and key components of the centralized solar-powered lighting system in accordance with site-specific requirements. The selection of installation points for the lighting units was based on field survey results, with priority given to locations requiring improved illumination. In addition, discussions with community members were conducted to ensure that the proposed design aligned with local conditions and community needs, thereby fostering mutual agreement and shared understanding, as illustrated in Figure 3.

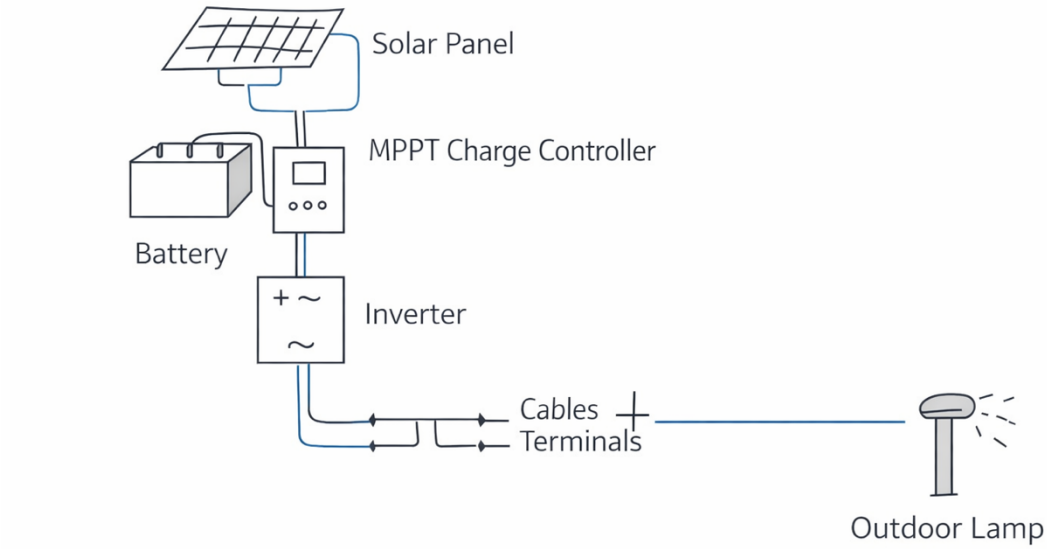

Figure 3. Block Diagram of a Centralized Solar-Powered Outdoor Lighting System

The third stage involved community outreach and education. Residents were provided with information on clean energy concepts, the benefits of solar panel use, and the importance of active participation in maintaining the program's sustainability. Simple technical training was also delivered, covering basic maintenance procedures for solar panels and the installed lighting system. This ensured that the community had the necessary knowledge to carry out routine upkeep independently.

The fourth stage centered on implementation and infrastructure installation. During this stage, solar panels, batteries, and LED lamps were installed at the predetermined locations. After installation, the system was tested to ensure optimal lighting performance. Community members actively participated in the installation process, allowing for knowledge and skill transfer. This involvement helped residents better understand the system's operational principles and how to address minor technical issues that may arise.

The final stage consisted of monitoring and evaluation. Periodic assessments were carried out to evaluate the performance of the lighting system, measure resident satisfaction, and identify the program's impacts, including energy savings and improvements in environmental security. The evaluation results also served as the basis for exploring opportunities to develop and replicate the program in other areas facing similar challenges, ensuring broader benefits and long-term sustainability.

RESULTS AND DISCUSSION

1. Identification of Community Needs

The initial stage of the community service program focused on identifying residents' needs related to inadequate environmental lighting in the Puri Cikoneng Indah Residential Area. This activity was carried out through field surveys, direct observation of existing lighting conditions, and focused discussions with local community representatives [19]. The results of this identification process indicated that insufficient lighting during nighttime posed potential safety hazards, reduced residents' sense of security, and limited community activities after dark.

(a) (b) (c) (d)

Figure 4. (a), (b), (c), and (d) Documentation of community needs identification

Figure 4 (a)–(d) illustrates the documentation of the community needs identification process, including observations of poorly lit areas and direct interactions between the service team and local residents. This stage served as a fundamental basis for formulating an appropriate technical solution that aligns with actual field conditions and the real needs of the community.

2. Lighting System Requirements

Based on the results of the community needs assessment and adjustments to the selected implementation method, a list of essential components required for the deployment of a solar-based environmental lighting system was determined.

Table 1. Required components for environmental lighting system implementation

No	Description	Specification
1	Solar panel	1 unit
2	Battery	1 set
3	Battery Management System (BMS)	1 unit
4	Balancer	1 unit
5	MPPT charge controller	1 unit
6	Inverter	1 unit
7	Battery cables	1 set (NYAF cables, cable lugs, spiral wrap, voltmeter, insulation tape)
8	LED lamps and cables	1 set (LED + pole, plug, 20 m cable)
9	Mounting rail	1 set
10	PV cables	1 set (PV cable, MC4 connectors, DC MCB)

The selection of these components considered sustainability aspects, energy efficiency, ease of maintenance, and compatibility with residential environmental conditions.

The listed components were designed to form an integrated solar-powered lighting system capable of operating independently without reliance on the conventional electrical grid. This configuration supports energy efficiency, operational reliability, and long-term sustainability in residential environments [20].

3. Socialization and Handover of System Components

The subsequent stage involved socialization activities and the formal handover of system components to the community as part of the empowerment process. The socialization sessions aimed to enhance residents' understanding of the function of each system component, the basic working principles of solar energy systems, and the importance of community involvement in system management and maintenance to ensure long-term sustainability.

Figure 5 presents the implementation of the socialization activities along with the handover of the lighting system components to community representatives at the service location. Through this activity, residents not only received physical assistance in the form of equipment but also gained essential knowledge and awareness that support the sustainable utilization of clean energy in residential areas.

(a) (b)

(c) (d)

Figure 5. (a), (b), (c), and (d) Socialization and handover of the lighting system components

4. Implementation and System Installation

The implementation stage focused on the installation of the solar-powered lighting system along with the preparation of a solar panel maintenance module as a practical reference for the community in managing street lighting in the residential area. The maintenance module was developed to support the sustainability of the installed system by providing clear and simple guidelines that can be easily understood and applied by residents [21]. All system components, as listed previously in Table 1, were assembled and installed during this community service activity in accordance with the planned system design.

(a) (b) (c)

Figure 6. (a), (b), and (c) System implementation and maintenance module delivery

Figure 6(a)–(c) illustrates the process of system implementation, including the installation of solar panels, lighting components, and the delivery of the maintenance module to community representatives. This stage ensured that the lighting system was properly installed, functioned as intended, and was accompanied by adequate technical guidance to support long-term operation and maintenance by the community.

Compared to previous studies on solar-powered lighting systems [5], which generally focus on technical design and performance evaluation, the present community service program places greater emphasis on a community-based implementation approach. In this program, local residents are actively involved from the stages of needs identification and system planning to installation, education, and maintenance, ensuring that the solution is well aligned with local conditions and community needs. In addition, this work introduces a solar panel maintenance module as a key output to support long-term sustainability, an aspect that is often not addressed in earlier studies. The program also incorporates social impact evaluation, including community perceptions of safety, comfort, and system usefulness, which complements the technical implementation. By integrating technical deployment with community empowerment and social evaluation, this program offers a more holistic and replicable model for sustainable residential-scale solar lighting implementation.

5. Evaluation

The evaluation phase was conducted to assess both the technical performance and the social impact of the implemented solar-powered lighting system on the local community. From a technical perspective, the system was designed using a 50 W LED lamp operating for an average of 13 hours per day (from 17:00 to 06:00), resulting in a daily energy demand of approximately 650 Wh. Considering an inverter efficiency of about 80%, the required energy supplied from the battery was estimated at approximately 800 Wh per day.

The energy storage system utilized a $LiFePO_4$ battery configuration with a nominal cell voltage of 3.3 V, arranged in four series cells to produce a total system voltage of 13.2 V. With a battery capacity of 100 Ah, the total stored energy reached approximately 1320 Wh. To ensure battery longevity and operational safety, the system was designed to operate within a safe depth-of-discharge range of 20% to 80%, providing an effective usable energy capacity of about 800 Wh, which closely matches the calculated daily energy requirement.

On the energy generation side, the installed solar panel had a maximum daily energy potential of approximately 2100 Wh, assuming an effective solar irradiation duration of 3.5 hours per day. This capacity significantly exceeds the daily energy demand, allowing a sufficient

energy margin and potential for future system expansion. Furthermore, the MPPT charge controller, with a maximum charging capability of 30 A at a nominal battery voltage of 13.2 V, enabled a daily energy conversion capacity of approximately 1400 Wh, ensuring efficient and reliable charging aligned with the system's energy requirements.

Based on interviews with community representatives, including the head of the Puri Cikoneng Indah residential association, the activity was perceived as highly beneficial and responsive to residents' needs. The implementation effectively addressed local lighting issues within a relatively short timeframe, while the delivered materials and training were considered clear and easy to understand. Moreover, the community expressed strong expectations that similar initiatives could be continued and expanded in the future.

From a social perspective, the results indicate that residents experienced positive benefits from the installation, particularly in terms of improved environmental lighting, increased safety, and enhanced comfort during nighttime activities. The availability of a maintenance module further strengthened community confidence in independently managing and maintaining the system.

Table 2. Community Feedback on the Implementation of the Solar-Powered Lighting Program

No	Question	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	The content of the activity matched the needs of the participants and community partners.	–	–	–	–	100
2	The duration and scheduling of the activity were appropriate and adequate.	–	–	50	25	25
3	The materials and activities delivered were presented clearly and were easy to understand.	–	–	–	50	50
4	The organizing team provided satisfactory support and services throughout the activity.	–	–	–	50	50
5	The community welcomed the activity and expressed an expectation for similar programs to be continued in the future.	–	–	25	25	50

Notes:
SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree

These findings are further supported by the community satisfaction survey presented in Table 2. All respondents (100%) strongly agreed that the activity content was aligned with the needs

of the participants and community partners. Regarding the implementation schedule, most respondents considered the duration and timing to be adequate, with 50% expressing a neutral response and 50% indicating agreement or strong agreement. The clarity of the delivered materials and activities received positive responses, with all participants reporting agreement or strong agreement. Similarly, the performance of the organizing team was positively evaluated, with 100% of respondents expressing agreement or strong agreement. Furthermore, most of the community welcomed the activity and expressed expectations for similar programs to be continued in the future, indicating a high level of acceptance and perceived relevance.

Overall, the evaluation demonstrates that the integration of robust technical system design with community empowerment through education and maintenance guidance plays a critical role in ensuring the sustainability, reliability, and long-term impact of community-based renewable energy programs.

CONCLUSION

This community service program successfully addressed the problem of inadequate environmental lighting in the Puri Cikoneng Indah Residential Area through the implementation of a technically reliable and sustainable solar-powered lighting system. The activity was carried out using a community-based approach that actively involved residents from the initial needs identification stage through system installation, socialization, and maintenance planning, ensuring alignment with local conditions and community requirements.

From a technical perspective, the installed system was designed to meet daily lighting demands using a 50 W LED lamp operating for approximately 13 hours per day. The energy storage and generation components, including a $LiFePO_4$ battery system, solar panels, and an MPPT charge controller, were appropriately sized to ensure safe operation, energy efficiency, and sufficient energy margins. The evaluation confirmed that the system operates within a safe battery usage range and that the available solar energy capacity exceeds daily consumption needs, providing reliability and potential for future expansion.

In addition to the technical outcomes, the provision of a solar panel maintenance module and direct community engagement significantly enhanced residents' understanding of renewable energy systems and their ability to manage and maintain the technology independently. The system implementation resulted in improved nighttime visibility, increased environmental safety, and enhanced residential comfort.

Overall, the program delivered both tangible infrastructure improvements and strengthened community capacity and awareness regarding clean energy utilization. The integration of sound technical system design with community empowerment supports long-term sustainability and provides a replicable model for similar residential areas. Consequently, this community service activity contributes meaningfully to renewable energy adoption, environmental safety, and sustainable development at the local level.

Acknowledgement

This community service activity is an output of the program funded under contract number 0600/ABD07/PPM-JPM/2025. The authors would like to express their sincere gratitude to Telkom University for the financial, administrative, and academic support that enabled the successful implementation of this program.

References

[1] A. Hossain, X. Sun, R. Thapa, M. M. Hossain, and S. Das, "Exploring association of contributing factors to pedestrian fatal and severe injury crashes under dark-no-streetlight condition," *IATSS Research*, vol. 47, no. 2, pp. 214–224, Jul. 2023, doi: 10.1016/j.iatssr.2023.03.002.

[2] R. L. Sanders, R. J. Schneider, and F. R. Proulx, "Pedestrian fatalities in darkness: What do we know, and what can be done?," *Transp Policy (Oxf)*, vol. 120, pp. 23–39, 2022, doi: https://doi.org/10.1016/j.tranpol.2022.02.010.

[3] S. M. Nasution, R. R. Septiawan, and A. Ramadhan, "Digital Transformation in Environmental Security Management in Calosa Cluster, Bandung Regency Article history," *Jardira (Jurnal Pengabdian Digital dan Rekayasa Informatika)*, vol. 1, no. 1, pp. 1–8, 2025, [Online]. Available: https://journals.cognispectra.com/index.php/jardira/index

[4] J. M. Wood, "Improving the conspicuity and safety of pedestrians and cyclists on night-time roads," 2023, *Taylor and Francis Ltd.* doi: 10.1080/08164622.2023.2174001.

[5] M. A. Shomad and Z. Nurisna, "Pemanfaatan Listrik Tenaga Surya Sebagai Penerangan Di Jalan Desa Pedukuhan Plumbon Banguntapan," *Prosiding Seminar Nasional Program Pengabdian Masyarakat*, Mar. 2021, doi: 10.18196/ppm.32.182.

[6] A. Setiawan, W. M. Lilbilad, E. Nurmanwala, S. D. Safitri, N. A. Syahra, and Q. Hidayah, "Tenaga Surya sebagai Solusi Penerangan Jalan Umum Di Desa Girikerto Kecamatan Turi Kabupaten Sleman," *Indonesian Journal of Community Empowerment and Service (ICOMES)*, vol. 2, no. 1, pp. 16–19, Jun. 2022, doi: 10.33369/icomes.v2i1.20786.

[7] N. Fatmi, I. Muhammad, P. pendidikan Fisika, P. Pendidikan Matematika, and J. Teknik Mesin, "RANCANGAN PANEL SURYA SEBAGAI SUMBER LISTRIK PADA PEMBINAAN PENGHEMATAN ENERGI BAGI MASYARAKAT KURANG MAMPU DI DESA BLANG PANYANG KECAMATAN MUARA SATU," Dec. 2021.

[8] A. Ridho'i, S. Santoso, N. Shidiq, and A. H. Andriawan, "Penyuluhan Tentang Penggunaan Sumber Alternatif Solar Panel untuk Penerangan di Desa Jebreng Wonosari," *Jurnal Pengabdian Masyarakat Bhinneka*, vol. 3, no. 4, pp. 302–307, Jul. 2025, doi: 10.58266/jpmb.v3i4.149.

[9] R. Virgatama, A. Suprayogi, and H. S. Firdaus, "Identifikasi Pengaruh Sistem Keamanan Lingkungan Terhadap Tingkat Kejahatan Pencurian Di Kota Surakarta Dengan Metode Sistem Informasi Geografis," *Jurnal Geodesi Undip*, Jan. 2019.

[10] A. P. Siahaan, D. C. Chairani, and M. A. Pradana, "Pengembangan Penguatan Keamanan Lingkungan Melalui Digitalisasi dan Partisipasi Masyarakat (Studi Kasus Desa Sambirejo Timur)," *Jurnal Pemberdayaan Ekonomi dan Masyarakat*, vol. 1, no. 3, p. 11, Jun. 2024, doi: 10.47134/jpem.v1i3.313.

[11] M. Al Qibtiya, R. Pramudita, M. R. Fauzan, W. S. Saputra, and S. Saripudin, "Perancangan Pemasangan Penerangan Jalan Umum Bagi Masyarakat Desa Cikalong Wetan Bandung Barat," *BANTENESE : JURNAL PENGABDIAN MASYARAKAT*, vol. 6, no. 2, pp. 489–498, Dec. 2024, doi: 10.30656/m848d559.

[12] T. Penulis *et al.*, *PENGEMBANGAN SUSTAINABLE DEVELOPMENT GOALS (SDGs)*. Bandung: Widina, 2025. [Online]. Available: www.freepik.com

[13] N. P. Hariram, K. B. Mekha, V. Suganthan, and K. Sudhakar, "Sustainalism: An Integrated Socio-Economic-Environmental Model to Address Sustainable Development and Sustainability," *Sustainability (Switzerland)*, vol. 15, no. 13, Jul. 2023, doi: 10.3390/su151310682.

[14] N. Humaida, M. Aula Sa'adah, H. Huriyah, and N. Hasanatun Nida, "Pembangunan Berkelanjutan Berwawasan Lingkungan (Sustainable Development Goals) Dalam Perspektif Islam," *Khazanah: Jurnal Studi Islam dan Humaniora*, vol. 18, no. 1, p. 131, Jun. 2020, doi: 10.18592/khazanah.v18i1.3483.

[15] Peni Rachmawati Hanifah and I. B. Putu Purbadharmaja, "Analisis Pengaruh Konsumsi Listrik dan Konsumsi Bahan Bakar Fosil Terhadap Eksternalitas Negatif Emisi Gas Rumah Kaca di Indonesia," *Jurnal Visi Manajemen*, vol. 11, no. 2, pp. 298–314, May 2025, doi: 10.56910/jvm.v11i2.548.

[16] T. Yigitcanlar *et al.*, "Digital technologies of transportation-related communication: Review and the state-of-the-art," *Transp Res Interdiscip Perspect*, vol. 23, p. 100987, 2024, doi: https://doi.org/10.1016/j.trip.2023.100987.

[17] A. K. Feroz, H. Zo, and A. Chiravuri, "Digital transformation and environmental sustainability: A review and research agenda," *Sustainability (Switzerland)*, vol. 13, no. 3, pp. 1–20, Feb. 2021, doi: 10.3390/su13031530.

[18] F. Shahzad, S. ur Rehman, A. Rehman Javed, Z. Jalil, and Y. Bin Zikria, "Future Smart Cities: Requirements, Emerging Technologies, Applications, Challenges, and Future Aspects," 2022.

[19] S. S. Ahari, S. Habibzadeh, M. Yousefi, F. Amani, and R. Abdi, "Community based needs assessment in an urban area; A participatory action research project," *BMC Public Health*, vol. 12, no. 1, 2012, doi: 10.1186/1471-2458-12-161.

[20] A. Hauashdh, J. Jailani, I. A. Rahman, and N. AL-fadhali, "Strategic approaches towards achieving sustainable and effective building maintenance practices in maintenance-managed buildings: A combination of expert

interviews and a literature review," *Journal of Building Engineering*, vol. 45, Jan. 2022, doi: 10.1016/j.jobe.2021.103490.

[21] Michael Ibukun Kolawole and Busayo Leah Ayodele, "Smart electronics in solar-powered grid systems for enhanced renewable energy efficiency and reliability," *International Journal of Science and Research Archive*, vol. 13, no. 2, pp. 2910–2930, Dec. 2024, doi: 10.30574/ijsra.2024.13.2.2512.