Integrated Waste Management and Green Jobs Ecosystem for Sustainable Rural Development

Tomi Ihwanto[1], Johan Johan[1], Dimas Wardani[1], Faiz Rahmatullah[1], Habiburrahman Habiburrahman[1], Priawansyah Priawansyah[1], and Arya Wibowo Wirabumi[1,*]

[1] PT Pertamina Hulu Rokan Zona Rokan, Riau, Indonesia
arya.wirabumi@pertamina.com

Abstract. The transition toward a green economy requires integrated approaches capable of simultaneously addressing environmental degradation, rural unemployment, and limited access to sustainable energy. However, empirical evidence on how corporate community development programs create sustainable green jobs through integrated rural empowerment remains limited, particularly in developing countries. This study aims to analyze the implementation and impacts of the Green Jobs initiative within the *Desa Energi Berdikari* program implemented by PT Pertamina Hulu Rokan Zona Rokan in Riau Province, Indonesia, since 2022. The study employed a qualitative descriptive approach. Primary data were collected through semi-structured interviews with ten key informants consisting of program implementers and community empowerment beneficiaries. Secondary data were obtained from program implementation reports, Social Return on Investment (SROI) analysis, biogas waste monitoring and evaluation reports, and community business sales records. The findings indicate that integrating renewable energy utilization, circular economy practices, and structured youth entrepreneurship development has generated natural, economic, and social benefits simultaneously. Organic waste has been transformed into renewable energy and productive agricultural inputs, while community members, particularly rural youth, have developed green enterprises that generate additional household income and strengthen local economic resilience. The integration of capacity building, business incubation, and circular resource management has also enhanced community participation, institutional capacity, and the sustainability of local enterprises. This study demonstrates that a community-based green jobs ecosystem can serve as a replicable model for sustainable rural development by linking environmental innovation with inclusive economic empowerment through multi-stakeholder collaboration.

Keywords: Green Jobs, Renewable Energy, Youth Entrepreneurship, Community Development, Organic Waste Management

1 Introduction

The global green economy transition aims to harmonize environmental protection with economic growth and social equity, the benefits of green employment remain unevenly distributed, primarily benefiting urban-industrial centers while leaving rural populations in developing countries structurally marginalized (Loiseau et al., 2016; Unay-Gailhard & Bojnec, 2019). Overcoming this disparity requires moving beyond

© The Author(s) 2026
W. G. S. Parwita et al. (eds.), *Proceedings of the International Conference on Sustainable Green Tourism Applied Science - Social Applied Science 2026 (ICoSTAS-SAS 2026)*, Advances in Social Science, Education and Humanities Research 1041,
https://doi.org/10.2991/978-94-6239-809-2_47

isolated employment schemes toward integrated ecosystems that synthesize renewable energy, circular economy practices, entrepreneurial development, and institutional support (Sher et al., 2019; Geissdoerfer et al., 2017). By replacing linear production with resource recovery loops, local organic waste can be converted into productive economic assets, framing green jobs as a holistic driver of rural development. This systemic approach is particularly vital in resource-dependent regions like Riau Province, where reliance on extractive oil and gas alongside monoculture oil palm plantations has resulted in concentrated, vulnerable economic structures that urgently require diversification to support rural resilience amidst the national low-carbon transition.

Socio-economic vulnerabilities in Rokan Hilir and Kampar Regencies which the primary operational zones for PT Pertamina Hulu Rokan Zona Rokan, are compounded by an open unemployment rate of 4.3% (surpassing the 3.7% provincial average), a workforce dominated by low educational attainment, 60–70% with junior high education or below (BPS Kabupaten Rokan Hilir, 2022), heavily underutilized agricultural biomass despite accounting for 40% of the regional economy, and persistent reliance on costly LPG. Furthermore, unmanaged free-grazing livestock practices trigger severe social friction, lethal landowner disputes, road safety hazards, industrial asset encroachment, and environmental degradation through methane emissions. The community-based circular bioenergy ecosystem strategically bridges these complex rural grievances with corporate sustainability objectives, transforming multi-faceted local liabilities into shared socio-economic and environmental value.

While previous studies highlight the distinct benefits of renewable energy, circular economy practices, and rural entrepreneurship (Geissdoerfer et al., 2017; Sher et al., 2019; Unay-Gailhard & Bojnec, 2019), these interventions are often fragmented, limiting their long-term impact in resource-dependent rural areas. Addressing this empirical gap, this study evaluates Desa Energi Berdikari program in Rokan Hilir and Kampar regencies, which integrates biogas technology, organic waste management, and structured green jobs incubation into a cohesive rural empowerment ecosystem. Using a qualitative-dominant mixed-methods approach—combining semi-structured interviews, corporate monitoring data, Social Return on Investment (SROI) metrics, and enterprise financial records—the research demonstrates how coupling bioenergy infrastructure with participatory governance creates viable employment. Ultimately, the study proves that synthesizing renewable energy, resource recovery, and local business incubation establishes a self-sustaining green jobs framework for rural decarbonization and socio-economic resilience.

2 Methodology

This study employed a qualitative-dominant mixed-methods approach within a single embedded case study design to examine the implementation and impacts of the Green Jobs initiative within the Desa Energi Berdikari program implemented by PT Pertamina Hulu Rokan Zona Rokan. A qualitative-dominant mixed-methods approach was considered appropriate because qualitative inquiry served as the primary analytical component, while quantitative evidence was incorporated to provide complementary

breadth and corroboration of the qualitative findings (Johnson et al., 2007; Schoonenboom & Johnson, 2017). This approach enabled the study to understand how renewable energy utilization, circular economy practices, and community empowerment were integrated to create sustainable green employment opportunities, while also examining the measurable environmental, economic, and social outcomes generated by the program. The study adopted a single embedded case study perspective by focusing on the PT Pertamina Hulu Rokan's *Desa Energi Berdikari* program, implemented since 2022 in Rokan Hilir and Kampar Regencies, Riau Province, with analysis encompassing its interconnected biogas, circular economy, and green jobs components.

This study employed a qualitative-dominant mixed-methods design incorporating primary and secondary data streams to evaluate the green jobs ecosystem. Primary data were gathered through purposively sampled in-depth interviews with key stakeholders, including program beneficiaries, youth enterprise leaders, facilitators, and gender-diverse community representatives, alongside focus group discussions (FGDs) with all 60 active members across three biogas and green jobs groups. Secondary data comprised monthly monitoring records via the company's internal Community Involvement and Development (CID) Taxonomy system, a 2024 Social Return on Investment (SROI) assessment executed by CECT Sustainability Trisakti, program documentation, and enterprise operational records.

Data analysis integrated thematic coding of qualitative transcripts and field observations with descriptive statistics derived from quantitative secondary datasets to evaluate socio-economic and environmental outcomes. Methodological rigor and credibility were maintained through systematic data triangulation across interviews, FGDs, observations, and institutional reports. This combined analytical approach enabled a comprehensive investigation into the developmental dynamics of the circular economy framework, specifically examining how the convergence of renewable energy, entrepreneurial incubation, and participatory empowerment produced measurable impacts on local livelihoods and decarbonization.

3 Result and Discussion

3.1 Result

Developing a Community-Based Green Jobs Ecosystem through the Desa Energi Berdikari Program. The Green Jobs initiative under the Desa Energi Berdikari program (Figure 1), supported by PT Pertamina Hulu Rokan (PHR) as a strategic enabler, operationalized an adaptive, community-centric empowerment model that converted local environmental liabilities, such as organic waste, soaring synthetic fertilizer costs, and crop-raiding livestock, into productive circular economy assets. By deploying biogas technology as a foundational entry point, the initiative simultaneously mitigated household fuel expenses and yielded nutrient-rich bioslurry to lower agricultural inputs, while actively addressing early community skepticism regarding technological reliability and youth managerial capacity. Through an iterative learning

approach incorporating participatory assessments, continuous facilitation, and practical demonstrations, the program successfully transitioned local stakeholders from passive technology recipients to self-governed green entrepreneurs, proving that sustainable green employment depends on building local capacity to leverage indigenous resources rather than relying solely on top-down infrastructure deployment.



Figure 1. Focus Group Discussions (FGD) with local community and stakeholders



Figure 2. Installation of a Biogas Reactor.

The implementation phase (Figure 3) demonstrated that technological adoption followed a non-linear, highly iterative pathway where initial technical setbacks, such as uncalibrated IoT irrigation sensors and inconsistent bioslurry formulations, were overcome through community-led experimentation and collaborative troubleshooting rather than top-down technology transfer. Supported by technical facilitators, local youth groups systematically refined sensor parameters and composting protocols and transforming operational failures into optimized. As local adaptive capacity strengthened, this iterative problem-solving process catalyzed the emergence of three distinct youth-led collectives that expanded the foundational bioenergy infrastructure into a scalable, diversified green enterprise ecosystem, proving that capability building and contextual adaptation are vital prerequisites for long-term project sustainability.



Figure 3. Crop Damage Caused by Long Tailed Monkey (Macaca Fascicularis).

The first youth group focused on IoT-based smart horticulture, applying digital technologies to improve irrigation efficiency and crop management. Despite experiencing repeated technical failures during the pilot phase, the group continued refining the system until it became operational, eventually encouraging wider adoption among village farmers. The third youth group explored opportunities for oil palm waste valorization by utilizing empty fruit bunches (EFB) as cultivation media for straw mushrooms (*Volvariella volvacea*). Given the abundance of oil palm plantations surrounding the villages (Figure 4), this initiative transformed agricultural residues into marketable products while creating an alternative income source for young entrepreneurs. In parallel, community members also designed an automatic wildlife deterrent system to reduce crop losses caused by long-tailed macaques (Figure 3) without harming wildlife, illustrating how technological innovation was directed toward solving locally identified problems.



Figure 4. Oil Palm Empty Fruit Bunches (EFB) Used as a Cultivation Substrate for Straw Mushrooms.

Continuous monitoring and evaluation, executed through regular mentoring, field observations, community reflections, and data analysis using the (CID) taxonomy, served as an adaptive decision-making mechanism to identify constraints and track enterprise progress rather than merely measuring static technical metrics. The continuous refinement of IoT systems (Figure 5), fertilizer processing, and micro-business development empirically demonstrates that green job creation relies on iterative cycles of experimentation and local learning rather than immediate, linear success. Ultimately, the program's primary breakthrough was establishing a community-led innovation ecosystem where rural youth evolved into active agents capable of converting local environmental liabilities into economic opportunities, proving that sustainable green employment depends on fostering an enabling environment for contextualized, community-driven experimentation rather than simple technology dissemination.



Figure 5. IoT Installation in Smart Farming Initiatives

Sustainability Outcomes of the Green Jobs Initiative. Empirical data from the *Desa Energi Berdikari* program (2022–2025) compiled from monitoring reports, Social Return on Investment (SROI) documentation, and biogas records, demonstrate significant environmental and economic outcomes. The integrated ecosystem annually processes 2,000 tons of mixed organic waste (60% livestock manure, 20% human waste, 20% household waste) into bioslurry fertilizer and renewable energy. Calculating with a conservative mean anaerobic digestion yield of 0.045 m^3/kg, the system generates 90,000 m^3 of raw biogas annually. Given a lower heating value (LHV) of 6 kWh/m^3, the potential thermal capacity stands at 540,000 kWh_{th}, which, when converted via localized, small-scale generator units at a 22.5% mechanical-to-electrical efficiency mathematically derives a net electricity output of around >120.00 kWh/year. This technical derivation substantiates the empirical metrics and an annual greenhouse gas mitigation of around 60–65 tCO^2e confirming the circular resource efficiency claimed within the rural intervention zones. Lastly, based on the SROI results, this initiative generates 1:1.78 ratio. This means, that every Rp1 invested could generate Rp1.78 outcomes.

One livestock farmer explained that before joining the program, animal waste accumulated around the livestock sheds and was considered a sanitation problem. After the construction of the biogas system, the waste became part of their daily energy source. "Before the program, livestock manure was simply discarded behind the barns. Now we use it to produce gas for cooking, and the remaining slurry is applied to our crops. Nothing is wasted anymore. Otherwise, we did not only receive training, but we were also accompanied in preparing business plans, calculating production costs, and marketing our products. That gave us confidence to start our own business " (Suparman, 48, Leader of Kelompok Tani Bangko Jaya Sejahtera).

Similar observations were expressed by a program facilitator, who explained that the intervention was designed to encourage communities to recognize waste as a productive resource rather than an environmental burden. "The objective was not only

to install biogas units but also to change people's perspective that organic waste has economic value when managed properly." (Raihan, 25, Field Facilitator).

Empirical evaluation confirms that the Green Jobs initiative delivered substantial socio-economic and environmental dividends by coupling technical renewable energy training with structured entrepreneurship development, continuous mentoring, and circular resource management. At the household level, biogas utilization generated annual energy savings exceeding Rp900,000 per household by offsetting LPG consumption, while bioslurry application reduced agricultural input costs by Rp3,000,000–Rp3,500,000 per cultivation cycle. Simultaneously, the diversion of previously unmanaged biomass into community-operated bioenergy systems catalyzed market-driven youth enterprises, including organic produce, mushroom cultivation, and maggot farming, yielding cumulative annual revenues between Rp80,000,000 and Rp140,000,000. These financial and operational metrics substantiate the commercial viability and transformative impact of converting localized organic waste loops into productive, youth-led micro-enterprises. The summary of environmental, economic, and social performance indicators is presented in Table 1.

Table 1. Key Environmental, Social, and Economic Performance Metrics (2022–2025)

Impact Dimension	Evaluated Parameter	Quantified Program Output
Nature	• Organic waste treated (annual) • Renewable energy generated • Greenhouse gas (GHG) reduction	• > 2.000 tons (20% human, 60% livestock, 20% household) • >120.00 kWh per year • ~60 to 65 tCO_2e annually
Economic	• Average household LPG savings • Agricultural production input cost reduction • Cumulative youth enterprise income	• > Rp900,000 per household / year • ~Rp3,000,000 to Rp3,500,000 per cultivation cycle • Rp80,000,000 to Rp140,000,000 per year (forecasted)
Social & Well-being	• Direct and indirect beneficiaries • Youth professional capacity building	• 289 direct beneficiaries; > 860 indirect beneficiaries • > 70 rural youths trained across 3 cycles/year

Empirical evaluation via secondary data demonstrates that over 70 rural youths completed three annual training cycles in renewable energy, circular economy, entrepreneurship, and digital marketing, directly benefiting 289 individuals and indirectly impacting more than 860 residents across participating villages. Community enterprise records confirm the operationalization and sustained growth of green micro-ventures, including bioslurry organic farming, residue-based mushroom cultivation, and maggot production, generating a cumulative annual revenue potential between Rp80,000,000 and Rp140,000,000. Beyond direct economic yields, this expansion

fundamentally upgraded local human capital in clean technology, waste management, and climate-smart agriculture, while simultaneously strengthening institutional governance through the formal legal establishment of three community-based organizations capable of independently managing sustainable assets, securing external funding, and ensuring long-term operational resilience.

3.2 Discussion

Advancing Indonesia's Green Transition through Community-Based Green Jobs. This study expands the community-based biogas initiative (Desa Energi Berdikari) in Kampar and Rokan Hilir Regencies, transitioning it from localized household energy substitution into an integrated, youth-driven Green Jobs ecosystem. While prior technical adoption demonstrated high sustainability across economic (96.44%), social (92.89%), and environmental (92.00%) dimensions (Paramita et al., 2024), long-term community-based renewable energy projects often fail due to institutional, financial, technical, and social barriers rather than resource scarcity (Situmeang et al., 2022).

To operationalize Indonesia's Net Zero Emissions 2060 agenda in rural contexts, this framework integrates biomass waste processing (biogas and bioslurry) with structured business incubation, youth entrepreneurship, and circular supply chains, transforming waste management into a catalyst for local economic diversification and community-led governance (Fatimah et al., 2020). By establishing self-governing models like Kelompok Biotama Agung Lestari, the initiative addresses a persistent structural weakness in Indonesia's rural energy landscape, namely, the high failure rate of renewable energy projects stemming from deficiencies in managerial capacity, technical skills, and market access (Situmeang et al., 2022).

Aligning directly with corporate ESG strategies, this framework advances environmental decarbonization (E), social empowerment and gender inclusion (S), and transparent community governance (G) while yielding measurable dividends such as household fuel savings, reduced agricultural input costs, and youth enterprise creation. Although grounded in the specific empirical context of Kampar and Rokan Hilir, enabled by abundant biomass, PT Pertamina Hulu Rokan's corporate sponsorship, and technical partnerships, the core operational model interconnecting waste recovery, renewable bioenergy, circular business incubation, and multi-stakeholder governance offers an adaptable, scalable blueprint for broader rural contexts across Indonesia. Rather than serving as a rigid universal solution, this ecosystem functions as a customizable framework, underscoring the necessity for future empirical research across diverse rural settings to delineate the critical institutional, political, and capacity conditions required for widespread replication and long-term socio-environmental resilience.

Beyond CSR: Green Jobs as a Shared Value Strategy in the Upstream Oil and Gas Company and Global Relevance. Responding to the ongoing global energy transition, the oil and gas sector is increasingly shifting from conventional Corporate Social Responsibility toward strategic Creating Shared Value (CSV) frameworks that

reconcile corporate imperatives with community development (Ranängen & Zobel, 2014; Hilson, 2012; Porter & Kramer, 2011). The Green Jobs initiative under PT Pertamina Hulu Rokan Zona Rokan's Desa Energi Berdikari program operationalizes this evolution through a systematic seven-stage decision framework, comprising contextual analysis, social mapping, mutual dialogue, alternative assessment, shared value decision-making, operational design, and community ownership (see Figure 6). By systematically converting acute rural vulnerabilities, such as high youth unemployment, costly LPG and synthetic fertilizer dependence, and unmanaged livestock waste, into productive bioenergy assets, the model concurrently mitigates critical operational risks, including facility encroachment, social friction, and methane emissions. Ultimately, this structured CSV strategy demonstrates that extractive industries can align corporate asset protection and operational continuity with verifiable ESG performance, establishing a scalable paradigm for generating shared socio-environmental value.



Figure 6. Shared Value Scheme for Social and Business Risks

Globally, community-based renewable energy is shifting from mere technological provision toward integrated frameworks that combine technical innovation, local self-governance, multi-stakeholder collaboration, and circular resource management (Koirala et al., 2016). Moving beyond conventional bioenergy initiatives that measure success strictly through physical outputs (Surendra et al., 2014), PT Pertamina Hulu Rokan's Desa Energi Berdikari Green Jobs initiative operates as a contextual, participatory innovation that converts organic waste and local social friction into shared socio-economic value. By pairing biogas digesters and advanced processing infrastructure (e.g., solar dryer houses) with structured youth business incubation (e.g., smart farming, fertilizer processing, mushroom, and maggot production), the framework yields multi-tiered dividends, reducing household LPG and synthetic

fertilizer expenses while reinvesting enterprise revenues into a self-sustaining operation and maintenance fund. From a corporate perspective, this self-governed model converts traditional CSR expenditure into a high-return strategic Creating Shared Value (CSV) investment that secures the social license to operate, mitigates operational risks, and elevates local residents into active economic partners who protect corporate infrastructure, advance regional decarbonization, and ensure robust ESG alignment (Damayanty et al., 2025; Rodrigues et al., 2019; Ranängen & Zobel, 2014; Koirala et al., 2016).

The international relevance and scalability of this systemic governance model are demonstrated by its institutional expansion via the Rokan Greenpreneur Awards, a regional initiative scaling incubation principles across Riau Province. Having attracted over 100 applicants from grassroots green business ideas and site-level sustainable enterprises, the program provides structured mentorship and operational refinement, selecting top finalists for direct corporate incubation. This trajectory directly addresses the empirical gap identified by Berka and Creamer (2018) regarding how community energy drives localized impacts. Ultimately, the Riau experience empirically proves that when energy transitions are grounded in adaptive governance, contextualized problem-solving, and entrepreneurship, community empowerment becomes a self-sustaining driver of rural decarbonization.

4 Conclusion

This study demonstrates that the *Desa Energi Berdikari* program provides an integrated community-based approach to Green Jobs development by connecting renewable energy, circular economy practices, entrepreneurship, and continuous community facilitation. The key finding is that the Green Jobs Ecosystem is not generated by renewable energy infrastructure alone, but through an ecosystem that enables communities, particularly rural youth, to transform shared problems and locally available resources into shared value outcomes through productive economic activities. It supports the central argument that community ownership, entrepreneurship development, and sustained facilitation are critical for translating environmental innovation into inclusive rural economic opportunities.

Despite its contributions, this study acknowledges inherent limitations: the observed socio-economic and environmental outcomes were enabled by favorable local conditions, including high biomass availability, institutional backing, active participation, and sustained facilitation, while certain financial metrics relied on corporate records and revenue projections. Consequently, future initiatives must prioritize adaptive replication rather than rigid duplication, customizing the model to regional biomass profiles, institutional readiness, market access, and technical capacity across diverse resource-dependent contexts. Longitudinal research and operational enhancements should focus on tracking long-term employment quality, enterprise survival, income trajectories, and verified greenhouse gas mitigation, supplemented by robust digital monitoring systems, expanded local business networks, and strengthened community-led governance to ensure scalable, enduring ecosystem sustainability.

At a broader level, the findings position community-based Green Jobs as a potential bridge between environmental sustainability and inclusive development within the Environmental, Social, and Governance (ESG) framework. The environmental dimension is reflected in renewable energy generation, organic waste recovery, and emissions reduction; the social dimension is reflected in youth capacity building, livelihood diversification, and community empowerment; while the governance dimension is supported through multi-stakeholder collaboration and institutional oversight. For upstream oil and gas companies, this approach suggests that community investment can extend beyond conventional CSR toward a more strategic contribution to climate action, social resilience, and a just energy transition. In this sense, the green jobs initiative offers an adaptive pathway that may inform broader efforts to align corporate sustainability strategies with the global transition toward low-carbon and inclusive economies.

References

Badan Pusat Statistik Kabupaten Rokan Hilir. (202). *Kabupaten Rokan Hilir Dalam Angka*. Bagansiapiapi: BPS Kabupaten Rokan Hilir.

Berka, A. L., & Creamer, E. (2018). Taking stock of the local impacts of community-owned renewable energy: A review and research agenda. Renewable and Sustainable Energy Reviews.

Bößner, S., Devisscher, T., Suljada, T., Ismail, C. J., Sari, A., & Mondamina, N. W. (2019). Barriers and opportunities to bioenergy transitions: An integrated, multi-level perspective analysis of biogas uptake in Bali. Biomass and Bioenergy, 122, 457–465.

CECT Sustainability Universitas Trisakti. (2024). Laporan SROI (Social Return on Investment) Desa Energi Berdikari: Desa Energi Berdikari berbasis biogas. PT Pertamina Hulu Rokan.

Damayanty, S., et al. (2025). A Creating Shared Value Approach to Sustainability in Extractive Company. Indonesian Journal of Geography.

Geissdoerfer et al. (2017). The Circular Economy – A new sustainability paradigm? Journal of Cleaner Production. Elsevier.

Hamann, R., Smith, J., Tashman, P., & Marshall, R. (2014). An assessment of corporate social responsibility practices in the mining and oil and gas industries. Journal of Cleaner Production, 84, 256–270.

Hilson, G. (2012). Corporate Social Responsibility in the extractive industries: Experiences from developing countries. Resources Policy, 37(2), 131–137.

Koirala, B. P., Koliou, E., Friege, J., Hakvoort, R. A., & Herder, P. M. (2016). Energetic communities for community energy: A review of key issues and trends shaping integrated community energy systems. Renewable and Sustainable Energy Reviews, 56, 722–744.

Loiseau et al. (2016). Green economy and related concepts: An overview. Journal of Cleaner Production. Elsevier.

Paramita, D., Handayani, K. U., & Harahap, R. N. (2024). Mempromosikan efisiensi sumber daya melalui eco-lokalisme: Analisis keberlanjutan Desa Energi Berdikari berbasis biogas. JASINTEK, 6(1), 1–19.

Porter, Michael E., and Mark R. Kramer. "Creating Shared Value." Harvard Business Review 89, nos. 1-2 (January–February 2011): 62–77.

Ranängen, H., & Zobel, T. (2014). Revisiting the 'how' of corporate social responsibility in extractive industries and forestry. Journal of Cleaner Production, 84, 299–312.

Rodrigues, M., et al. (2019). Corporate sustainability and indigenous community engagement in the extractive industry. Journal of Cleaner Production, 235, 701–711.

Schoonenboom, J., Johnson, R.B. How to Construct a Mixed Methods Research Design. Köln Z Soziol 69 (Suppl 2), 107–131 (2017). https://doi.org/10.1007/s11577-017-0454-1

Surendra, K. C., Takara, D., Hashimoto, A. G., & Khanal, S. K. (2014). Biogas as a sustainable energy source for developing countries: Opportunities and challenges. Renewable and Sustainable Energy Reviews, 31, 846–859.

Unay-Gailhard & Bojnec (2019). Green economy measures and rural employment. Journal of Cleaner Production. Elsevier

Yayasan Rumah Energi. (2025). Laporan tahun 2024 - 2025 Desa Energi Berdikari (DEB): Program Tanggung Jawab Sosial dan Lingkungan (TJSL) PT Pertamina Hulu Rokan - WK Rokan. PT Pertamina Hulu Rokan.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

