RESISTOR (Elektronika Kendali Telekomunikasi Tenaga Listrik Komputer) Vol. 7 No. 2
e-ISSN: 2621-9700, p-ISSN: 2654-2684

Analysis of Renewable Energy Potential for Sustainable Tourism Development in Cipanas Galunggung Geothermal Area, Tasikmalaya Regency, Indonesia

Linda Faridah [1], M Aris Risnandar [2], Rian Nurdiansyah [3]
[1) 2) 3)] Teknik Elektro Universitas Siliwangi Tasikmalaya
Jl. Siliwangi No.24 Kahuripan Tasimalaya
Email: [1)] lindafaridah@unsil.ac.id, [2)] aris_elektro@unsil.ac.id, [3)] riannurdiansyah74@unsil.ac.id

ABSTRAK

This research analyzes the potential of renewable energy, particularly geothermal energy, for sustainable tourism development in the Cipanas Galunggung area, Tasikmalaya Regency, Indonesia. The study employs a qualitative approach with secondary data analysis and literature review. Results indicate that the Cipanas Galunggung geothermal area possesses significant potential for renewable energy development to support sustainable tourism. The existing 30 MW geothermal power plant serves as a foundation for further development. Integration of renewable energy in tourism development can enhance energy security, reduce environmental impact, and create new attractions. However, challenges remain in terms of investment, infrastructure, and policy coordination. This study recommends a collaborative approach involving government, private sector, and local communities to optimize the utilization of renewable energy for sustainable tourism growth in the region. The research provides empirical evidence that geothermal energy development in the Cipanas Galunggung area can be a sustainable solution to meet energy needs while enhancing tourist attractions. However, further studies are needed on the social and cultural impacts of geothermal energy development on local communities. Additionally, it is important to involve the community in planning and managing geothermal energy projects to ensure equitable distribution of benefits

Kata Kunci : Energy, Renewable Energy, Tourism, Sosio-Culture

ABSTRACT

Penelitian ini menganalisis potensi energi terbarukan, khususnya energi panas bumi, untuk pengembangan pariwisata berkelanjutan di kawasan Cipanas Galunggung, Kabupaten Tasikmalaya, Indonesia. Penelitian menggunakan pendekatan kualitatif dengan analisis data sekunder dan tinjauan pustaka. Hasil menunjukkan bahwa kawasan panas bumi Cipanas Galunggung memiliki potensi signifikan untuk pengembangan energi terbarukan guna mendukung pariwisata berkelanjutan. Pembangkit listrik panas bumi 30 MW yang sudah ada menjadi landasan untuk pengembangan lebih lanjut. Integrasi energi terbarukan dalam pengembangan pariwisata dapat meningkatkan ketahanan energi, mengurangi dampak lingkungan, dan menciptakan atraksi baru. Namun, tantangan masih ada dalam hal investasi, infrastruktur, dan koordinasi kebijakan. Studi ini merekomendasikan pendekatan kolaboratif yang melibatkan pemerintah, sektor swasta, dan masyarakat lokal untuk mengoptimalkan pemanfaatan energi terbarukan bagi pertumbuhan pariwisata berkelanjutan di wilayah tersebut. Penelitian ini memberikan bukti empiris bahwa pengembangan energi panas bumi di kawasan Cipanas Galunggung dapat menjadi solusi yang berkelanjutan untuk memenuhi kebutuhan energi sekaligus meningkatkan daya tarik wisata. Namun, diperlukan kajian lebih lanjut mengenai dampak sosial dan budaya dari pengembangan energi panas bumi terhadap masyarakat lokal. Selain itu, penting untuk melibatkan masyarakat dalam perencanaan dan pengelolaan proyek energi panas bumi agar manfaatnya dapat dirasakan secara merata.

Keywords : Energi, Energi Terbarukan, Pariwisata, Sosio-Budaya

1 INTRODUCTION

Global demand for energy continues to increase significantly, posing serious challenges related to energy availability and supply security. Renewable energy sources emerge as potential solutions to meet the increasingly pressing energy needs [1] [2]. The inevitable rise in energy demand and dwindling petroleum reserves have prompted humans to seek alternative energy sources. Energy has become a vital necessity in all aspects of human life, from economic activities and households to industries [3]. Rapid technological growth, especially the use of electronic devices, has drastically increased electricity consumption. Although the potential of

renewable energy sources is substantial, their development still faces numerous challenges, such as production fluctuations, high investment costs, and infrastructure limitations [4]. Indonesia is a developing country with a population of approximately 250 million people spread across more than 17,000 islands, therefore requiring a large electricity supply [5] [6]. Currently in Indonesia, about 2,519 villages do not have access to electricity [7]. The availability of electricity is crucial as it determines the quality of human life in a country [8] [9] [10].

Renewable energy presents a solution for electricity availability in Indonesia, particularly in remote areas that are difficult to reach by the main grid, by utilizing the potential resources of those regions. Renewable energy sources, being environmentally friendly, offer optimal efficiency in their use. This minimizes negative impacts on the environment, produces very little waste, and meets both current and future economic and social needs [2] . Therefore, the utilization of renewable energy becomes an important solution in addressing environmental and energy challenges. In 2018, the national use of new and renewable energy only reached 11.68%, falling far short of the target. To achieve the targets set for 2025 to 2050, the government must continue to explore the potential of new and renewable energy at the regional level and maintain investments in the new and renewable energy sector [11]. Biomass can serve as an environmentally friendly and sustainable alternative fuel, including its potential use in generating energy in tourist areas [12] [13].

Indonesia, as a country with the world's largest geothermal potential, plays a strategic role in the global energy transition. With a potential electricity production of 23.7 gigawatts from geothermal sources [14][15], Indonesia can contribute significantly to reducing greenhouse gas emissions and achieving sustainable development goals. However, the utilization of geothermal resources in Indonesia is still far from optimal. Therefore, more intensive efforts are needed in geothermal research and technology development, as well as increased investment to accelerate the development of this sector. Currently, the installed capacity of geothermal power plants in Indonesia has only reached around 2.28 gigawatts [16]. The utilization of renewable energy in tourism development can support the government's efforts in achieving national energy mix targets and reducing dependence on fossil fuels [17]

The Cipanas Galunggung tourist area in Tasikmalaya Regency possesses a significant potential for renewable energy resources, such as solar, wind, hydro, and biomass. Developing renewable energy in this region presents a solution to reduce fossil fuel dependency and can also enhance the local community's welfare through the utilization of local resources. The Cipanas Galunggung tourist area is well-suited for renewable energy development, particularly with the harnessing of wind energy. Wind energy is highly advantageous as it is an inexhaustible resource. Wind energy is an alternative energy source with promising prospects due to its constant availability in nature and its status as a clean and renewable energy source.

Cipanas Galunggung in Tasikmalaya Regency, West Java, is one of the regions with promising geothermal energy potential. With an estimated resource of 85 MW, this area has the potential to develop a 55 MW geothermal power plant (PLTP), targeted to operate by 2030 [18]. The development of PLTP in Cipanas Galunggung is expected to increase the supply of electricity and support the growth of the tourism sector. Sustainable tourism is an increasingly important concept, considering its impact on the environment, society, culture, and economy for both the present and future [19]. The integration of renewable energy development and sustainable tourism can create a mutually beneficial synergy, where clean energy can support the operation of tourist facilities while also becoming an attraction for environmentally conscious tourists [20]. However, the development of geothermal energy and sustainable tourism in Cipanas Galunggung faces several challenges.

This research aims to analyze the potential of renewable energy, specifically geothermal, for sustainable tourism development in the Cipanas Galunggung area. By understanding the existing potential and challenges, it is hoped that effective strategies can be formulated to optimize the utilization of renewable energy in supporting sustainable tourism in the region.

2 RESEARCH METHODOLOGY

Figure 1. Research Location

To gain a comprehensive understanding of the potential of renewable energy and its development opportunities for sustainable tourism in the Cipanas Galunggung area, this research adopts a qualitative approach with a descriptive-analytic method

A. Flowchat Research

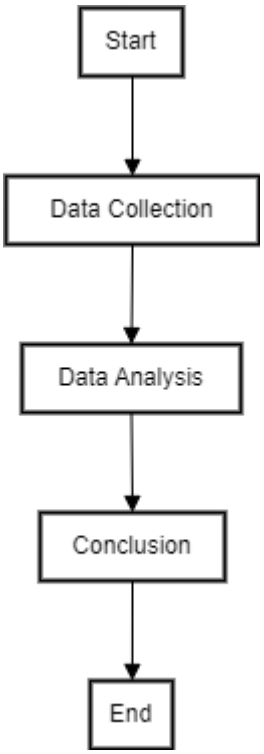

Figure 2. Flowchat Research

The primary objective of this study is to explore and assess the potential of renewable energy sources in fostering the growth of sustainable tourism within the Cipanas Galunggung geothermal region. The research commenced with a well-defined problem statement and specific objectives. A comprehensive literature review was conducted to establish a robust theoretical framework encompassing renewable energy, sustainable tourism principles, and the unique attributes of the study area. Data was gathered through a combination of field observations, in-depth interviews, focused group discussions (FGD), and document analysis. The collected data was subjected to a qualitative descriptive analysis to unveil patterns, correlations, and significant findings. Building upon the analytical outcomes, the researchers devised a strategic framework for sustainable tourism development that is grounded in renewable energy utilization. The credibility and dependability of the research findings were bolstered through data triangulation and rigorous validation against established theories and best practices. Ultimately, this research culminates in conclusions and recommendations that can serve as a valuable guide for stakeholders involved in advancing sustainable tourism in the Cipanas Galunggung region.

3 RESULTS AND DISCCUSSION

Figure 3. Galunggung Area

B. Geotermal Energy Potential

Based on data from the Ministry of Energy and Mineral Resources and direct field measurements, Cipanas Galunggung has a vast geothermal energy potential. The geothermal resource potential in this area reaches 160 Megawatts (MW), with a Geothermal Working Area (WKP) of 57,330 hectares. It is planned that this potential will be developed by 110 MW. The characteristics of geothermal in Cipanas Galunggung are quite unique. The surface temperature of geothermal manifestations varies between 40°C and 98°C, with the pH of hot water ranging from 6.5 to 8.2. The

flow rate of geothermal fluid is also quite high, reaching an average of 20-30 liters per second.

Geochemical analysis shows that the geothermal reservoir in Cipanas Galunggung is dominated by chloride water with an estimated temperature of 220-250°C. The relatively high content of dissolved silica (average 250 mg/L) indicates the potential for scale formation on production equipment, requiring special handling. Based on reservoir modeling, it is estimated that Cipanas Galunggung can support the generation of geothermal power plants (PLTP) with a total capacity of up to 100 MW for 30 years of operation. This means that the geothermal energy potential in this area is very promising for long-term utilization

C. Tourism Conditions

Based on tourist visitation data and field survey results, it can be concluded that tourism in Cipanas Galunggung has experienced quite significant fluctuations in recent years. The COVID-19 pandemic caused a drastic decline in the number of visitors in 2020. However, the tourism sector managed to recover in the following years and showed a positive growth trend. The majority of visitors to Cipanas Galunggung are domestic tourists. On average, they spend about one and a half days in this tourist area and spend around Rp500,000 per day. The main attractions that attract tourists are natural hot springs, climbing Mount Galunggung, nature and adventure tourism, as well as cultural and culinary tourism.

Although the number of visitors continues to increase, tourism infrastructure and facilities in Cipanas Galunggung still need to be improved. The number of hotels, restaurants, and other supporting facilities is still limited, and not all of them have adopted sustainability principles. Tourism in Cipanas Galunggung has enormous potential for development. However, there needs to be a more serious effort to improve the quality of tourism infrastructure and facilities, as well as implement sustainability principles in its management. In this way, tourism can become one of the main sources of income for local communities and contribute to regional development.

D. SWOT Analysis

The Cipanas Galunggung geothermal area has significant potential for renewable energy development and sustainable tourism. Its main strengths lie in abundant geothermal resources, pristine natural beauty, rich Sundanese culture, local government support, and strategic location. However, the area also faces challenges such as limited infrastructure, lack of integration between sectors, low public awareness about sustainability, and suboptimal environmental management. Development opportunities are wide open due to global trends towards renewable energy and ecotourism, potential for private investment, central government policy support, and supportive technological advancements. Nevertheless, several threats need to be anticipated, including competition with other tourist destinations, natural disaster risks, potential negative impacts on the environment and socio-cultural aspects, global economic uncertainties, and climate change impacts.

By understanding these factors, the development of Cipanas Galunggung can be directed to maximize its potential as a model for integrating renewable energy and sustainable tourism, while mitigating existing risks and challenges. An appropriate strategy is needed to leverage strengths and opportunities, while addressing weaknesses and anticipating threats, in order to realize the area's vision as a premier destination that combines clean energy technology with local wisdom and natural beauty.

E. Evironmental and Sosial Impact Analysis

The environmental and social impact analysis of geothermal energy development and tourism in Cipanas Galunggung reveals significant potential positive and negative effects. On one hand, geothermal energy utilization can reduce greenhouse gas emissions, create new job opportunities for local communities, increase regional income, and promote environmental conservation through more planned area management. Additionally, tourism development can raise public awareness about the importance of renewable energy and sustainability. However, on the other hand, this development also has the potential to cause negative impacts if not managed properly. Landscape changes due to infrastructure construction, water and air pollution, pressure on water resources, socio-cultural changes in the community, and land use conflicts are some of the challenges that need to be addressed.

To minimize negative impacts and maximize positive ones, careful planning and implementation of best practices in geothermal energy and tourism development are required. This includes comprehensive environmental feasibility studies, application of environmentally friendly technologies, and active community participation in the decision-making process. Thus, the development of Cipanas Galunggung can proceed sustainably and provide benefits for both the community and the environment.

F. Integrated Development Strategy

To achieve the vision of Cipanas Galunggung as a center for renewable energy and sustainable

tourism, a comprehensive integrated development strategy is required. This strategy encompasses the development of environmentally friendly geothermal power plants with significant capacity, diversification of renewable energy-based tourist attractions, empowerment of local communities, implementation of sustainable tourism principles, development of supporting infrastructure, strong promotion and branding, as well as support for research and development. The development of geothermal power plants with advanced technology and integration with educational tourist attractions will form the backbone of the area's development. Meanwhile, the diversification of renewable energy-based tourist attractions will attract environmentally conscious tourists. Empowering local communities through training and the establishment of cooperatives will ensure their active participation in tourism management. The implementation of sustainable tourism principles, such as ecotourism certification and good environmental management, will preserve the natural and cultural heritage of the area.

The development of supporting infrastructure, such as roads, accommodations, and environmentally friendly transportation, will improve accessibility and comfort for tourists. Intensive promotion through various digital platforms and participation in international exhibitions will increase the visibility of Cipanas Galunggung as a premier tourist destination. Additionally, support for research and development will ensure the sustainability of the area's development and generate new innovations in renewable energy and tourism. With the implementation of this strategy, Cipanas Galunggung will not only become an important renewable energy center but also a unique and sustainable tourist destination, providing economic, social, and environmental benefits to the local community.

G. Economic and Environmental Projections

The implementation of an integrated development strategy is projected to bring significant positive impacts over the next 10 years. Cipanas Galunggung will become a renewable energy hub that reduces emissions and increases regional income. The tourism sector will also experience rapid growth, creating new job opportunities and attracting more visitors. Intensive environmental conservation efforts will protect biodiversity and ensure the sustainability of the area's development.

4 CONCLUSION

The Cipanas Galunggung geothermal area has tremendous potential for integrated development of renewable energy and sustainable tourism. With the implementation of appropriate strategies, this development can become a model for integrating clean energy and eco-friendly tourism in Indonesia. The success of this project will provide significant economic, social, and environmental benefits, while contributing to the achievement of sustainable development goals.

DAFTAR PUSTAKA

[1] X. Shi, A. Dini, Z. Shao, N. H. Jabarullah, and Z. Liu, “Impacts of photovoltaic / wind turbine / microgrid turbine and energy storage system for bidding model in power system,” *J. Clean. Prod.*, vol. 226, pp. 845–857, 2019, doi: 10.1016/j.jclepro.2019.04.042.

[2] P. A. Owusu and S. Asumadu-Sarkodie, “A review of renewable energy sources, sustainability issues and climate change mitigation,” *Cogent Eng.*, vol. 3, no. 1, 2016, doi: 10.1080/23311916.2016.1167990.

[3] N. L. Panwar, S. C. Kaushik, and S. Kothari, “Role of renewable energy sources in environmental protection: A review,” *Renew. Sustain. Energy Rev.*, vol. 15, no. 3, pp. 1513–1524, 2011, doi: 10.1016/j.rser.2010.11.037.

[4] O. Ellabban, H. Abu-Rub, and F. Blaabjerg, “Renewable energy resources: Current status, future prospects and their enabling technology,” *Renew. Sustain. Energy Rev.*, vol. 39, pp. 748–764, 2014, doi: 10.1016/j.rser.2014.07.113.

[5] D. Gumintang, *Design and Control of PV Hybrid System in Practice*. 2020.

[6] Nasruddin *et al.*, “Potential of geothermal energy for electricity generation in Indonesia: A review,” *Renew. Sustain. Energy Rev.*, vol. 53, no. 2016, pp. 733–740, 2016, doi: 10.1016/j.rser.2015.09.032.

[7] A. Priasto and E. Ginting, “Summary of Indonesia ’ S,” *ADB Pap. Indones.*, vol. 02, no. October 2015, 2016.

[8] Y. H. Abram Wawi Putra , Egia Kamandika, Sahilaushafnur, Agus Purwadi, “Study and Design of Hybrid Off-Grid PV-Generator Power System for Administration Load and Communal Load at Three Regions in Indonesia,” *3rd IEEE Conf. Power Eng.*

Renew. Energy ICEPERE 2016, vol. 29B1-5, pp. 1–6, 2016.

[9] L. Faridah, M. Hadi Ibrahim, A. Purwadi, and A. Rizqiawan, "Study and Design of Hybrid Off-Grid Power System for Communal and Administrative Load at 3 Regions in Maluku, Indonesia System for Communal and Administrative Load at 3 Regions in Maluku, Indonesia," 2018.

[10] B. S. Hartono, Budiyanto, and R. Setiabudy, "Review of microgrid technology," *2013 Int. Conf. Qual. Res. QiR 2013 - Conjunction with ICCS 2013 2nd Int. Conf. Civ. Sp.*, no. June 2013, pp. 127–132, 2013, doi: 10.1109/QiR.2013.6632550.

[11] J. S. Setyoo and F. H. Mardiansjah, "Potensi pengembangan energi baru dan energi terbarukan di kota semarang," *J. RIPTEK*, vol. 13, no. 2, pp. 177–186, 2019.

[12] R. Saidur, E. A. Abdelaziz, A. Demirbas, M. S. Hossain, and S. Mekhilef, "A review on biomass as a fuel for boilers," *Renew. Sustain. Energy Rev.*, vol. 15, no. 5, pp. 2262–2289, 2011, doi: 10.1016/j.rser.2011.02.015.

[13] E. Yohana, N. Sinaga, I. Haryanto, V. R. I. Taufik, and E. Dharmawan, "Taperless Type Blade Design with Naca 5513 Airfoil for Wind Turbine 500 TSD," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 448, no. 1, 2020, doi: 10.1088/1755-1315/448/1/012006.

[14] P. Halim, S. Badruddin, M. I. Setiawan, and C. Z. Zulkifli, "Indonesia Tourism, Socio Renewable Energy, Socio Economic and Socio Tourism Research Trend," *IJEBD (International J. Entrep. Bus. Dev.*, vol. 7, no. 1, pp. 49–55, 2024, doi: 10.29138/ijebd.v7i1.2608.

[15] A. Fauzi, "Geothermal resources and reserves in Indonesia: an updated revision," *Geotherm. Energy Sci.*, vol. 3, no. 1, pp. 1–6, 2015, doi: 10.5194/gtes-3-1-2015.

[16] S. Ismail and C. Yang, "With its abundant geothermal reserves, Indonesia aims to harvest more green energy - CNA," *https://www.channelnewsasia.com/*, 2023. https://www.channelnewsasia.com/asia/indonesia-geothermal-energy-reserves-green-energy-sustainable-clean-electricity-renewable-climate-change-3874151.

[17] I. Kurniawan, R. Ichwani, R. Fionasari, A. Batubara, and A. Huda, "Indonesia's Renewable Energy Outlook: What to Expect in The Future Renewable Energy of Indonesia. A Brief Review," *Elkawnie*, vol. 8, no. 2, p. 298, 2022, doi: 10.22373/ekw.v8i2.18738.

[18] I. Istiadi, "Energy Transition and Tourism Prospects in Indonesia," *J. Indones. Tour. Policy Stud.*, vol. 7, no. 2, p. 2022, 2022, doi: 10.7454/jitps.v7i2.1090.

[19] A. C. Koty, "An Overview of Indonesia's Geothermal Energy Sector," *https://www.aseanbriefing.com/*, 2022. .

[20] A. D. W. M. Sidik and Z. Akbar, "Analyzing the Potential for Utilization of New Renewable Energy to Support the Electricity System in the Cianjur Regency Region," *Fidel. J. Tek. Elektro*, vol. 3, no. 3, pp. 46–51, 2021, doi: 10.52005/fidelity.v3i3.66.