

Analyzing the Potential for Utilization of New Renewable Energy to Support the Electricity System in the Cianjur Regency Region

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Abstract—Energy is one of the basic human needs to support activities whose numbers continue to increase along with population and economic growth. On the other hand, most of the energy used today comes from fossil-based energy which has non-renewable properties so its reserves will run out if used continuously. Indonesia in general and the Cianjur region of West Java Province, in particular, has a wide variety of potential for new and renewable energy spread over most of its territory, including solar energy, wind energy, bioenergy, marine energy, and geothermal. This study aims to map the potential of New Renewable Energy in the Cianjur area to support the government's target of achieving the national energy mix and encourage energy diversification in the electricity system. The results of the study indicate that there is a large potential for renewable energy from various types of energy in the Cianjur area which can be utilized in the conversion process into electrical energy.

Keywords—New Renewable Energy, Potential, Cianjur

I. INTRODUCTION

Energy is one of the basic needs that can support various activities carried out by humans in all parts of the world. The need for energy continues to increase in line with population growth and the increasingly complex economic activities carried out by humans in the modern era. Several sectors require large amounts of energy, ranging from the industrial, transportation, commercial, to household sectors. In general, energy consumption in Indonesia still relies on the use of conventional energy sources. This condition shows that fossil-based energy resources will run out due to limited reserves and the formation process which takes a very long time. On the other hand, the demand for fossil-based energy resources is increasing, causing higher oil prices [1].

Fossil-based fuels currently have the most dominant portion in the energy mix to meet national energy needs. The composition of the installed capacity of power plants per type of energy currently is 50% coal, 29% gas, 7% oil, and a combination of various types of new and renewable energy at 14% [2]. Amid the current increasing demand for energy [3], it is necessary to diversify energy by developing other energy sources as alternative energy to supply domestic energy consumption.

Indonesia has a variety of abundant energy resources, especially from the type of New Renewable Energy including solar energy, wind energy, bioenergy, marine energy, geothermal, to various other types of New Renewable Energy. The potential of NRE resources tends to be spread over various regions in Indonesia according to their characteristics and geographical conditions. It is known that Indonesia has a tropical climate so that it does not experience winter, which causes the sun to shine throughout the year [4]; countries with long coastlines and wide oceans as a source of energy from waves, flow in the middle and deep seas, differences in sea layer temperature, offshore wind energy, and floating solar electric energy; large urban areas that are densely populated as a source of energy from household waste and waste; a range of volcanoes (ring of fire) as a source of geothermal energy; mountainous landscapes as natural pathways for wind energy; has many rivers and irrigation canals as a source of water energy (pico-hydro, micro-hydro, mini-hydro, to power plants that use large-scale reservoirs); as well as the national agricultural and livestock sectors which are large as a potential for bioenergy development. The process of transitioning energy to new and renewable energy can certainly be achieved with good cross-sectoral cooperation.

Based on this background, this literature research will discuss various kinds of NRE potential within the sovereign territory of the Republic of Indonesia, specifically in the Cianjur area of West Java Province to support the government's efforts to achieve the target of the NRE mix specifically in the electricity sector. The results of this research are also expected to be a reference for the government, PT. PLN (Persero), industry, to the wider community to take advantage of the potential of New Renewable Energy and convert it into electrical energy.

II. NEW RENEWABLE ENERGY

A. Condition of New Renewable Energy in Indonesia

Indonesia as a country located on the equator has abundant energy resources, including fossil and non-fossil-based energy sources or NRE. However, until now, most of the energy produced and used is dominated by fossil-based energy. With the decreasing production of fossil-based energy, especially oil, and the global

commitment to reducing the impact of greenhouse gas emissions, the government seeks to increase the portion of New Renewable Energy as part of maintaining energy security and independence. The target for the NRE mix in 2025 is at least 23% and 31% in 2050. Indonesia has a fairly large renewable energy potential, reaching 417.8 gigawatts (GW). The Ministry of Energy and Mineral Resources notes that this potential comes from various renewable energy sources as shown in Table 1. The abundant potential of NRE is an opportunity as well as a challenge for electric power system managers to diversify energy sources by paying attention to technical aspects, operations, to financial [5]–[7].

Tabel I Potency New Renewable Energy in Indonesia [2]

Types of Renewable Energy	Potency
Hydropower	94,3 GW
Geothermal	28,5 GW
Bioenergy	PLT Bio : 32,6 GW dan BBN : 200.000 Bph
Solar energy	207,8 GWp
Wind	60,6 GW
Ocean Energy	17,9 GW

The realization of the New Renewable Energy target in the national energy mix until the end of 2020 has reached 14%. Referring to this figure, an optimal strategy is needed to achieve the target of the New Renewable Energy mix in 2025. The Electricity Supply Business Plan (RUPTL) is a reference document to increase the use of renewable energy, especially for the electricity system, issued by PT. PLN (Persero) for ten years [8]. NRE development must synchronize various aspects ranging from potential, capacity, to economic factors. Until 2030, Indonesia will pursue the target of NRE through the construction of power plants whose energy sources come from hybrid solar energy, wind, bioenergy, ocean waves, geothermal, to various other types of New Renewable Energy.

In planning the electric power system, it must also accommodate the trilemma of energy in the form of energy security, equity (energy equity), and environmental sustainability. Energy security includes primary energy management [9], reliability of infrastructure [10]–[12] and operations [13], and the ability to meet current and future needs [14], [15]. Of course, it is important to pay attention to electricity assets so that they can continue to operate optimally [16]–[19]. Energy equity talks about the affordability of energy for all people, both in terms of physical (accessibility) to price (affordability). Environmental sustainability is energy mitigation in an effort to prevent potential environmental damage, including climate change.

B. New Renewable Energy in Cianjur

Cianjur Regency has a strategic location because it is traversed by a regional route that connects the capital city of West Java Province, namely Bandung and the capital city of Jakarta. Geographically, Cianjur Regency can be divided into 3 regions, namely the northern, central and southern regions. The northern region includes 16 districts: Cianjur, Cilaku, Warungkondang, Gekbrong, Cibeber, Karangtengah, Sukaluyu, Ciranjang, Bojongpicung, Mande, Cikalongkulon, Cugenang, Sukaresmi, Cipanas, Pacet and Haurwangi. The Central Region includes: Sukanagara, Takokak, Campaka, Campaka Mulya, Tanggeung, Performances, Leles, Cijati and Kadupandak. The southern region includes: Cibinong, Agrabinta, Sindangbarang, Cidaun, Naringgunl, Cikadu and Pasirkuda [20].



Figure 1. Map of Cianjur

III. NEW RENEWABLE ENERGY POTENTIAL IN THE CIANJUR AREA

New Renewable Energy is a type of environmentally friendly energy where this type of energy does not produce emissions that can pollute the environment and also does not contribute to climate change and global warming. This is because NRE comes from sustainable (renewable) natural processes and is available in large quantities. Indonesia has the potential for non-hydro New Renewable Energy spread in various places throughout Indonesia, especially Cianjur in West Java Province, including solar energy sources, wind energy sources, bioenergy sources, ocean wave energy sources, and also geothermal energy sources. These local renewable energy sources can also be integrated using a microgrid system and supporting infrastructure to electrify

areas that have not been reached by the distribution network [21]–[23].

A. Solar energy

Indonesia is a tropical country located on the equator. This causes Indonesia to have a very abundant potential for sunlight and is also available throughout the year so that it can be converted into renewable energy-based electrical energy [24]. The technology used to convert primary energy in the form of sunlight into secondary energy in the form of electricity is photovoltaic cells known as photovoltaic (PV). PV cell technology has developed rapidly from the time it was first discovered in 1883 until now. There has been an increase in efficiency followed by a very significant price reduction in the last few periods.

Solar power generation or known as PLTS is a technology that can be applied throughout Indonesia, even in 3T areas (frontier, remote, and underdeveloped) though. Some areas in Cianjur are currently still not covered by the distribution system owned by PT. PLN (Persero). The use of PLTS technology is very easy in terms of installation, operation, and maintenance [25]. In the process of observing potential, the selection of configurations such as household (small residential), industrial (medium size commercial), PLTS system (ground-mounted large scale), and PLTS floating (floating large scale) need to be considered to obtain an estimated energy expansion that can be produced annually. It is known that the average solar radiation in Indonesia reaches 4.80 kWh/m² per day as shown in Figure 2.

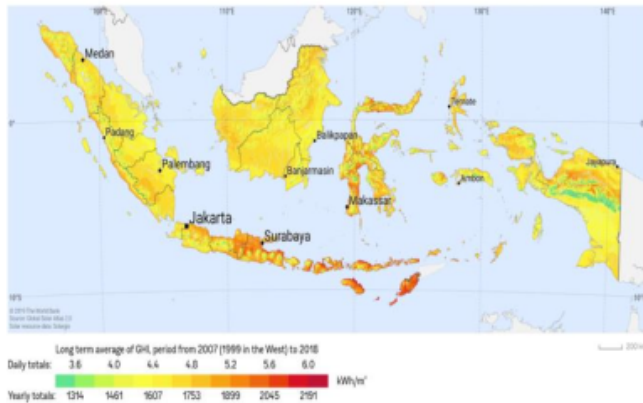


Figure 2. Potential of Solar Energy in Indonesia [26]

Specifically for the Cianjur Regency area (-06.824096°, 107.137401°) with a household or residential configuration, it is known that there is a potential of 1,409 Mwh per year or 1,850.3 kWh/m² [27]. The complete parameter of the potential of solar energy in Cianjur Regency is shown in Table II. This value will be greater depending on the configuration and area of land to be used.

Tabel II Potential Data Of Solar Energy In Cianjur [27]

Parameter	Value
Direct normal irradiation	1.205,4 kWh/m ²

Global horizontal irradiation	1.825,5 kWh/m ²
Diffuse horizontal irradiance	916,0 kWh/m ²
Global tilted irradiation at optimum angle	1.851,4 kWh/m ²
Optimum tilt of PV modules	11 / 0°
Air temperature	24,6 °C
Terrain elevation	454 m

One of the challenges in utilizing solar energy on a large scale (large scale) is the intermittent characteristics or changes in the magnitude of the irradiation in a very short time [28], [29]. These characteristics can cause harmonics, power factor fluctuations [30], voltage fluctuations, current fluctuations, and system frequency fluctuations [31]–[33]. These conditions can disrupt the stability of the electric power system. It is therefore important for the system planner to calculate the penetration level of the intermittent NRE generator [34] and prepare a compensator to compensate for the dynamics of the system [35]. In addition, the shading factor around the solar module needs to be considered so that the energy produced is maximal [36].

B. Wind Energy

Geographically, Indonesia has less wind potential from various altitude levels compared to four seasons countries. However, specifically in several areas in Indonesia, such as coastal areas and mountainous expanses, they have the potential for wind energy that is capable of being converted into electrical energy as shown in Figure 3. Power plants that utilize wind energy as their energy source are called Wind Power Plants. Bayu is a phenomenon of air movement due to changes in temperature and pressure caused by heating from sunlight.

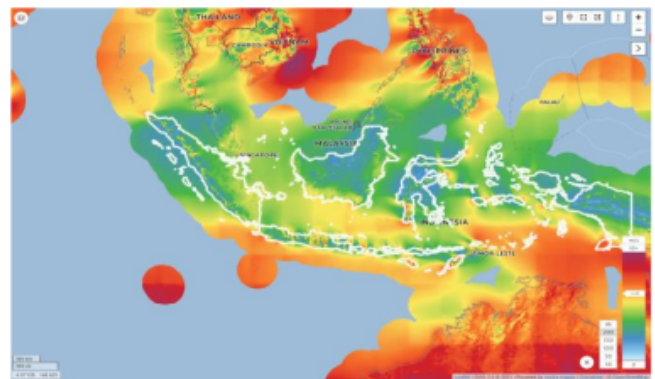


Figure 3. Wind Energy Potential in Indonesia [37]

For the Cianjur area (-06.824096°, 107.137401°), with reference to the wind speed index data as shown in Figure 4, it shows that the wind potential is quite high at the beginning of the year and towards the end of the year [37]. It is necessary to pay attention to its operation by providing other alternative sources of NRE so that it can sustainably meet load requirements.

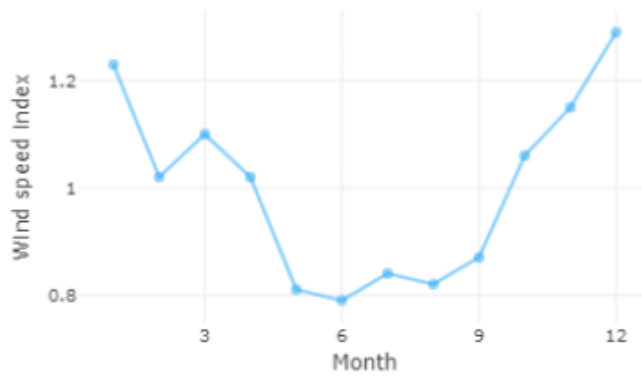


Figure 4. Wind Speed Index in Cianjur [37]

C. Bioenergy

Bioenergy New Renewable Energy is one type of alternative renewable energy source that is currently used to reduce the use of fuel oil for various strategic sectors. Bioenergy generally consists of three types, namely biogas, biofuel, and solid fuel or known as biomass. In particular for biofuels, the government encourages the acceleration of the use of bioethanol and biodiesel as fuel to replace gasoline and diesel for transportation, industry, commercial, and power generation through the Minister of Energy and Mineral Resources Number 12 of 2015 which states that Indonesia has a target in 2025 the utilization of biodiesel is 30% and bioethanol by 20%. Furthermore, in 2050 the target for biodiesel utilization is increased to 30% and bioethanol 50%. Rice husk is a type of solid fuel bioenergy that can be used together with coal as a fuel for steam power plants (PLTU) [38]. Rice husk itself can be further processed to make co-firing so that it becomes one of the promising types of New Renewable Energy in the future. Husk biomass has quite a lot of potential in the Cianjur area to be converted into electrical energy as shown in Table III.

Tabel III Rice Rice Production Data In Cianjur [39]

Districts	Rice Harvest Area 2018 (hectare)			Total 2018
	January- April	May- August	September- December	
Kadupandak	4.116	3.318	954	8.393
Agrabinta	5.072	2.929	941	8.942
Leles	1.491	179	29	331
Sindangbarang	6.113	2.444	427	8.984
Cidaun	5.316	4.681	1.941	4.277
Naringgul	1.698	3.567	2.291	7.556
Cibinong	3.061	1.847	798	5.706
Cikadu	2.065	1.717	364	4.277
Tangeung	1.902	1.692	587	4.206

D. Ocean Energy

Indonesia is one of the countries that have the largest marine area in the world. Almost two-thirds of Indonesia's territory is the sea. Mainland Indonesia is directly opposite the South China Sea, the Pacific Ocean, and also the Indian Ocean. Therefore, the sea is an extraordinary energy potential for Indonesia. Ocean energy can be generated from ocean waves, tidal streams, deep ocean currents, and ocean thermal energy conversion.

The area of the island of Java, especially the south of West Java, which is directly opposite the Indian Ocean, has the potential to develop energy from ocean waves as shown in Figure 4. The height of waves in one year is obtained in March, which is between 1.95 m to 3.1 m and the smallest is found in February, which is between 0.54m to 1.04m. This large potential for ocean waves is caused by wind and wave characteristics based on seasonal (quarterly) patterns due to monsoons [40].

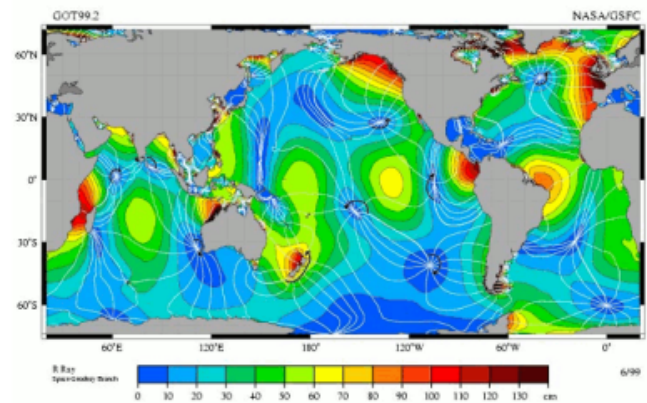


Figure 5. Ocean Wave Potential [41]

E. Geothermal energy

As a volcanic area, most of Indonesia's territory is rich in geothermal energy sources as shown in Figure 5. The ring of fire stretches in Indonesia from the north of Sumatra island along with the islands of Java, Bali, East Nusa Tenggara, West Nusa Tenggara, towards the Banda islands, Halmahera, to the island of Sulawesi as shown in Figure 5. Along the volcanic route, the prospect of geothermal energy is very high.

Currently, there are three types of geothermal power plant technology (PLTP), including direct steam plant technology, double flash plant technology, and binary plant technology. In the Cianjur area itself, there are several potential geothermal working areas (WKP) that can utilize PLTP technology. The Gunung Gede Pangrango geothermal field covers Sukabumi, Cianjur and Bogor. Its resource (presumed) reaches 85 MW. This geothermal field was designated as WKP with SK 2778 K/30/MEM/2014 dated 3 June 2014. The government plans to build a geothermal power plant in this location with a capacity of 55 MW by 2025[42].



Figure 6. Geothermal Potential in Indonesia [43]

IV. CONCLUSION

Through this research, a literature review has been carried out on the potential of NRE in the administrative region of the Republic of Indonesia. In general, Indonesia has abundant renewable energy potential, including solar energy, wind energy, bioenergy (bioethanol, biodiesel, biomass), marine energy, and geothermal energy. In general, in the Cianjur area of West Java province, there is potential for solar energy scattered in the Cianjur area which can be utilized as PLTS both on a household and large scale, wind energy which has the characteristic of blowing hard at the beginning of the year and the end of the year which can be used as a source of energy. energy for PLTB, high rice husk production and can be processed into biomass for co-firing PLTU, sea energy is quite large in the form of waves due to monsoon patterns, and there is a lot of geothermal potential in the Cianjur area.

REFERENCE

- [1] S. Sulistyono, "Pengurangan Subsidi Bbm Fosil Sebagai Momentum Pengembangan Energi Alternatif Jenis Biofuel," *Swara Patra*, no. Vol 4 No 4 (2014): Swara Patra, 2014, [Online]. Available: <http://ejournal.ppsdmmigas.esdm.go.id/sp/index.php/swarapatra/article/view/98/103>
- [2] DEN, "Outlook Energi Indonesia." 2019.
- [3] A. P. Purnomoadi et al., "Safety for Electric Shower Water Heater installation in Indonesia," vol. 1098, no. 4, p. 042047, Mar. 2021, doi: 10.1088/1757-899x/1098/4/042047.
- [4] H. B. Tambunan, *Sistem Pembangkit Listrik Tenaga Surya*. Deepublish, 2020.
- [5] H. B. Tambunan et al., "The Challenges and Opportunities of Renewable Energy Source (RES) Penetration in Indonesia: Case Study of Java-Bali Power System," *Energies*, vol. 13, no. 22, 2020, doi: 10.3390/en13225903.
- [6] H. B. Tambunan, P. A. A. Pramana, B. B. S. D. A. Harsono, A. A. Kusuma, J. Hartono, and B. S. Munir, "Future Challenges of Grid-Connected Photovoltaic in Java Bali Power System," in 2019 5th International Conference on Science and Technology (ICST), 2019, vol. 1, pp. 1–4. doi: 10.1109/ICST47872.2019.9166258.
- [7] H. B. Tambunan, P. A. Aditya Pramana, B. B. Satriaji D A Harsono, A. A. Kusuma, N. W. Priambodo, and B. S. Munir, "Multicriteria Decision Approach for Selection of Fault Current Limiters Technology," in 2019 Asia Pacific Conference on Research in Industrial and Systems Engineering (APCoRISE), 2019, pp. 1–5. doi: 10.1109/APCoRISE46197.2019.9318797.
- [8] H. B. Tambunan et al., "Review Proses Perencanaan Jangka Panjang Sistem Tenaga Listrik," *EPIC J. Electr. Power Instrum. Control*, vol. 4, no. 1, Art. no. 1, Jun. 2021, doi: 10.32493/epic.v4i1.10879.
- [9] M. Ridwan, H. B. Tambunan, K. G. H. Mangunkusumo, A. S. Habibie, and P. A. A. Pramana, "Review of digital substation equipment and technical specification in Indonesia," vol. 1098, no. 4, p. 042053, Mar. 2021, doi: 10.1088/1757-899x/1098/4/042053.
- [10] A. S. Surya, B. B. S. D. A. Harsono, H. B. Tambunan, and K. G. H. Mangunkusumo, "Review of Aerial Vehicle Technology for Transmission Line Inspection in Indonesia," in 2020 10th Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS), 2020, pp. 49–54. doi: 10.1109/EECCIS49483.2020.9263423.
- [11] N. W. Priambodo, H. B. Tambunan, B. B. S. D. A. Harsono, P. A. A. Pramana, and A. A. Kusuma, "Case Study of Medium Voltage Load Break Switch Failure in Indonesia," in 2018 3rd International Conference on Information Technology, Information System and Electrical Engineering (ICITISEE), 2018, pp. 174–179. doi: 10.1109/ICITISEE.2018.8720997.
- [12] P. A. A. Pramana, A. A. Kusuma, B. S. Munir, and H. B. Tambunan, "Covered conductor burn-down prevention for distribution line in Indonesia," *MATEC Web Conf*, vol. 197, p. 11003, 2018, doi: 10.1051/mateconf/201819711003.
- [13] A. A. Kusuma, P. A. A. Pramana, B. S. Munir, and H. B. Tambunan, "Evaluation of Auto-reclose Performance of 500kV Transmission Line with Shunt Reactor in Indonesia," in 2018 10th International Conference on Information Technology and Electrical Engineering (ICITEE), 2018, pp. 320–324. doi: 10.1109/ICITEE.2018.8534908.
- [14] H. B. Tambunan, D. H. Barus, J. Hartono, A. S. Alam, D. A. Nugraha, and H. H. H. Usman, "Electrical Peak Load Clustering Analysis Using K-Means Algorithm and Silhouette Coefficient," in 2020 International Conference on Technology and Policy in Energy and Electric Power (ICT-PEP), 2020, pp. 258–262. doi: 10.1109/ICT-PEP50916.2020.9249773.
- [15] J. Hartono, A. S. Surya, R. Utami, B. B. A. D. Harsono, H. B. Tambunan, and A. P. Purnomoadi, "Long Term Load Demand Forecasting in Bali Province Using Deep Learning Neural Network," in 2020 International Conference on Technology and Policy in Energy and Electric Power (ICT-PEP), 2020, pp. 174–178. doi: 10.1109/ICT-PEP50916.2020.9249940.
- [16] P. A. A. Pramana et al., "Voltage stress reduction for distribution line covered conductor," vol. 1098, no. 4, p. 042058, Mar. 2021, doi: 10.1088/1757-899x/1098/4/042058.
- [17] B. B. S. D. A. Harsono et al., "Technical and economical evaluation of distribution transformer with amorphous metal core in Indonesia," vol. 1098, no. 4, p. 042059, Mar. 2021, doi: 10.1088/1757-899x/1098/4/042059.
- [18] A. S. Habibie et al., "A Journey of Asset Management in Java-Bali Transmission System," in 2020 10th Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS), 2020, pp. 27–30. doi: 10.1109/EECCIS49483.2020.9263427.
- [19] B. S. D. A. Bramantyo Harsono, H. B. Tambunan, B. S. Munir, and N. W. Priambodo, "The Evaluation of Ceramic Insulator Performance around Thermal Power Plant in Indonesia," in 2018 International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS), 2018, pp. 77–81. doi: 10.1109/ICSGTEIS.2018.8709112.
- [20] "Website Resmi Pemerintah Kota Sukabumi – Portal Resmi Kota Sukabumi." <https://jabarprov.go.id/> (accessed Nov. 06, 2021).
- [21] P. Pramana, K. Mangunkusumo, H. Tambunan, and D. Jintaka, "Revitalisasi Pembangkit Listrik Tenaga Surya (PLTS) Pada Sistem Microgrid Pulau Tomia," *J. Technopreneur JTech*, vol. 9, pp. 28–37, May 2021, doi: 10.30869/jtech.v9i1.724.
- [22] K. Mangunkusumo, A. S. Surya, D. Jintaka, and H. B. Tambunan, "Guidance on Communication Media Selection for Advanced Metering Infrastructure in Indonesia," 2021.
- [23] K. Mangunkusumo, A. S. Surya, D. Jintaka, and H. B. Tambunan, "NB-PLC Performance Evaluation for Advanced Metering Infrastructure," 2021.
- [24] H. B. Tambunan et al., "A Preliminary Study of Solar Intermittency Characteristic in Single Area for Solar Photovoltaic Applications," *Int. J. Electr. Eng. Inform.*, vol. 13, no. 3, pp. 581–598, Sep. 2021, doi: 10.15676/ijeei.2021.13.3.6.

- [25] A. A. Simaremare, H. B. Tambunan, P. A. A. Pramana, and B. S. Munir, "Optimization of Renewable Energy Penetration for Microgrid System – Case Study of Tomia Island," in 2018 3rd International Conference on Information Technology, Information System and Electrical Engineering (ICITISEE), 2018, pp. 180–183. doi: 10.1109/ICITISEE.2018.8720965.
- [26] "Global Solar Atlas." <https://globalsolaratlas.info/download/indonesia> (accessed Oct. 30, 2021).
- [27] "Global Solar Atlas." <https://globalsolaratlas.info/map?s=-6.919929,106.926509&m=site&c=-6.933925,106.706085,10&pv=small,0,11,1> (accessed Oct. 30, 2021).
- [28] H. B. Tambunan, A. A. Kusuma, and B. S. Munir, "Maximum Allowable Intermittent Renewable Energy Source Penetration in Java- Bali Power System," in 2018 10th International Conference on Information Technology and Electrical Engineering (ICITEE), 2018, pp. 325–328. doi: 10.1109/ICITEE.2018.8534845.
- [29] H. B. Tambunan, P. A. A. Pramana, and B. S. Munir, "Intermittent Renewable Energy Source (IRES) model of solar energy in Cipayung microgrid system," vol. 1402, p. 033103, Dec. 2019, doi: 10.1088/1742-6596/1402/3/033103.
- [30] D. R. Jintaka, A. Adi Kusuma, H. B. Tambunan, M. Ridwan, K. G. H. Mangunkusumo, and B. Sofianto Munir, "Analysis of Voltage and Power Factor Fluctuation due to Photovoltaic Generation in Distribution System Model," in 2019 International Conference on Technologies and Policies in Electric Power Energy, 2019, pp. 1–5. doi: 10.1109/IEEECONF48524.2019.9102497.
- [31] H. B. Tambunan, P. A. A. Pramana, and B. S. Munir, "Analysis of Maximum Intermittent Renewable Energy Source Penetration on South of Sulawesi Power System," in 2018 Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS), 2018, pp. 32–35. doi: 10.1109/EECCIS.2018.8692960.
- [32] J. Hartono, P. A. A. Pramana, H. B. Tambunan, and B. S. Munir, "Disturbance Magnitude Estimation using Artificial Neural Network Method," in 2019 International Conference on Electrical Engineering and Informatics (ICEEI), 2019, pp. 570–573. doi: 10.1109/ICEEI47359.2019.8988903.
- [33] D. R. Jintaka, H. B. Tambunan, J. Hartono, B. B. A. D. Harsono, K. M. Tofani H. S., and B. S. Munir, "Integration of Intermittent Renewable Energy Source (IRES) to The West Kalimantan Grid," in 2018 2nd Borneo International Conference on Applied Mathematics and Engineering (BICAME), 2018, pp. 317–320. doi: 10.1109/BICAME45512.2018.1570505928.
- [34] H. B. Tambunan, K. G. H. Mangunkusumo, B. B. S. D. A. Harsono, A. A. Simaremare, N. W. Priambodo, and B. S. Munir, "Intermittent Renewable Energy Source (IRES) Penetration Level into Bangka Power System," in 2018 International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS), 2018, pp. 91–94. doi: 10.1109/ICSGTEIS.2018.8709119.
- [35] A. S. Surya, M. Partahi Marbun, M. Marwah, K. G. H. Mangunkusumo, B. B. S. D. A. Harsono, and H. B. Tambunan, "Study of Synchronous Condenser Impact in Jawa-Madura-Bali System to Provide Ancillary Services," in 2020 12th International Conference on Information Technology and Electrical Engineering (ICITEE), 2020, pp. 234–238. doi: 10.1109/ICITEE49829.2020.9271782.
- [36] H. B. Tambunan, A. P. Purnomoadi, P. A. Aditya Pramana, B. Bramantyo SDA Harsono, A. S. Surya, and A. Syarif Habibie, "Performance of Ground Mounted PV System Affected by Near Shadings Losses," in 2020 2nd International Conference on Industrial Electrical and Electronics (ICIEE), Oct. 2020, pp. 46–51. doi: 10.1109/ICIEE49813.2020.9276862.
- [37] "Global Wind Atlas." <https://globalwindatlas.info/area/Indonesia> (accessed Oct. 30, 2021).
- [38] I. Pujotomo, "Potensi Pemanfaatan Biomassa Sekam Padi Untuk Pembangkit Listrik Melalui Teknologi Gasifikasi," Energi Kelistrikan, no. Vol 9 No 2 (2017): Energi&Kelistrikan, pp. 126–135, 2017.
- [39] "Badan Pusat Statistik Kabupaten Cianjur." <https://cianjurkab.bps.go.id/indicator/53/87/1/luas-panen-padi-menuru-t-kecamatan-di-kabupaten-cianjur-hektar-2018.html> (accessed Nov. 06, 2021).
- [40] N. P. Purba, "Variabilitas Angin dan Gelombang Laut Sebagai Energi Terbarukan di Pantai Selatan Jawa Barat," J. Akuatika, vol. 5, no. 1, Art. no. 1, Mar. 2014, Accessed: Oct. 17, 2021. [Online]. Available: <https://jurnal.unpad.ac.id/akuatika/article/view/3699>
- [41] "Tidal Energy." <http://large.stanford.edu/courses/2010/ph240/chenw1/> (accessed Oct. 30, 2021).
- [42] KESDM, Buku Potensi Panas Bumi. Humas EBTKE, 2017.
- [43] "Gunung berapi Indonesia peta - gunung berapi Indonesia peta (Selatan-Timur Asia - Asia)." <https://id.maps-indonesia.com/gunung-berapi-indonesia-peta> (accessed Oct. 30, 2021).