Article

Indonesia's Readiness to Utilize Renewable Energy Wind Power Plants As Implementation of Sustainable Development Goals

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Abstract: Utilization of renewable energy as an alternative to provide clean energy is one of the priorities of the Sustainable Development Goal, which can reduce the use of carbon emissions. Without the utilization of renewable energy, the results of global carbon dioxide (CO2) emissions are projected to increase until 2030 (IPCC 2014; IEA 2015), global energy demand is expected to double by 2050 compared to 1991 (World Energy Council 2013). In today's world development, there are already thousands of Wind Power Plants (PLTB) or Wind power installed with a maximum capacity of 93,849 MW. Indonesia is one of the countries that has implemented it, also in South Sulawesi recently, namely in Sidrap and Jeneponto Regencies with a capacity of 75 MW and 72 MW respectively. The problem that arises is that the MNC that runs it has asked for an increase in PLN's purchase price for the wind power it produces, but the Government has not granted it, while as many as six million people in Indonesia who still lack access to electricity, especially in remote rural areas, are predicted to see an increase in demand for electricity of around 10% each year. The solution to this is the implementation of several things including the need for Government Policy in considering the economics of wind power plants, namely by making a Law on Renewable Energy including wind power and making a Presidential Regulation on the price of electricity purchased by PLN from companies that produce Renewable Energy including wind power; Transition in Government Practices and Community Institutions for the sustainable progress of humanity and the utilization of technological advances, especially the Internet of Things in Indonesia to help accelerate the implementation of wind power in Indonesia.

Keywords: *Renewable Energy, Wind Power Plant, Sustainable Development Goal, Internet of Things, Government Policy*

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1. Introduction

1.1 Background

The Sustainable Development Goals (SDG) were adopted in September 2015. The SDGs were set to determine the development of the next decade and deserve the attention of all stakeholders. Of the 17 Global Issue SDGs, one of the SDGs is related to energy savings or efficiency and the use of renewable energy (SDG 7 is related to Affordability and Clean Energy). According to the Global Risk Report (2020) energy demand continues to increase and much of the demand is still met by fossil fuels. Global energy demand rose 2.3% in 2018, with a 70% increase in China, the United States and India. This was driven by population growth, urbanization and increasing incomes. According to Business Time (2019) Coal-fired power plants built in Asia accounted for almost a third of the total increase in CO2 emissions in 2018. The use of clean renewable energy will increase. According to Egan, M. (2019) The cost per unit of electricity from wind and solar photovoltaic power has fallen by around 70% and 90%. In most countries, it is now cheaper to install new wind or solar power plants than new coal-fired power plants. The International Renewable Energy Agency estimates that the shift to renewables could grow the world economy by 1% a year until 2050.

Regarding wind energy as a form of renewable energy, Indonesia was colonized by the Dutch for 350 years, during this colonial era it was seen that our colonizers were very good at Wind Power Plants, but why wasn't it developed in this archipelago? After the Cold War era ended, Multi National Companies began to emerge, as did a wind power company from France called Angie, which began to look to the archipelago because it had succeeded in Africa. Wind Power Plants or often referred to as Wind Power Plants (PLTB) are one of the environmentally friendly renewable energy power plants. Based on data from the Global Wind Energy Council (GWEC), the number of PLTBs in the world currently reaches 157,900 MWatt and PLTB plants experience an increase in their construction by 20% -30% each year (IRENA 2019). The development of wind turbine generator (WTG) technology for wind power plants can currently convert wind kinetic energy into electrical energy with an average efficiency of 40%. The type of electric current obtained from the PLTB to the large power plant system will later be managed as a power plant that is distributed through transmission, while in PLTB for home scale, energy is usually stored in batteries as needed for the night.

To build a PLTB that can produce maximum electricity, there are several criteria that must be met, one of the most important is wind speed and stability. The expected wind speed is usually between 3 to 17 m / s constantly. But if it is too slow, the electricity produced is also not too large, even the wind turbine generator (WTG) cannot rotate. This is the opposite of the condition if the wind produced is too strong, such as a hurricane, it can damage or overthrow the wind turbine generator (WTG).

1.2 Reason for Choosing The Topic

The reason this topic is chosen is the utilization of renewable energy as an alternative to provide clean energy is one of the priorities of the Sustainable Development Goal, which can reduce the use of carbon emissions. As mentioned above, without the utilization of renewable energy, the results of global carbon dioxide (CO2) emissions are projected to increase until 2030 (IPCC 2014; IEA 2015), global energy demand is expected to double by 2050 compared to 1991 (World Energy Council 2013). The extraordinary increase in emissions will cause a global temperature increase of 4–6 °C as a result of self-reinforcing warming. While the adaptation of ecological, economic and social systems with an average increase in global temperature of 6 °C can trigger damage, floods, droughts, loss of biodiversity, coastal erosion, forest fires, new outbreaks of disease and decreased productivity. The International Energy Agency (IEA) defines energy efficiency as 'a way to manage and restrain the growth of energy consumption. The general operational definition of energy efficiency is using less energy to provide the same service (Lawrence Berkeley National Laboratory). The term 'sustainable energy' includes energy efficiency and renewable energy. Figure 1 shows the relationship between energy efficiency and several Sustainable Development Goals.

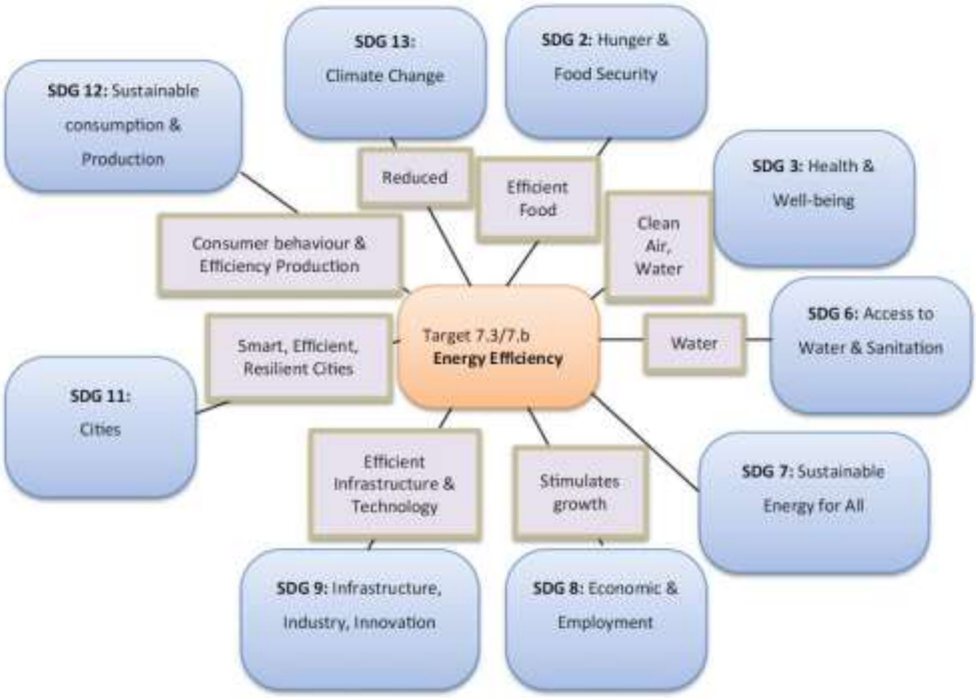

Figure 1: Relationship between energy efficiency and several other SDGs

In addition, in this era of globalization, FDI must enter Indonesia, perhaps wind power plants do not attract FDI. An intriguing question arises, why is there no wind power in Indonesia? while other renewable energies have been used in Indonesia for a long time.

1.3 Problems

In today's world development, there are already thousands of PLTB installed with a maximum capacity of 93,849 MW.This capacity will continue to increase due to the rapid development of PLTB in Europe and America. Germany is the leading country in the development of PLTB technology, followed by the United States, Spain, India and China. Indonesia is one of the countries that has implemented it, also in South Sulawesi recently, namely in Sidrap and Jeneponto Regencies with capacities of 75 MW and 72 MW respectively. The problems that arise are: the MNC that runs it has asked for an increase in PLN's purchase price for the wind power it produces, but the Government has not granted it.

Currently, it is estimated that there are still around six million people in Indonesia who still lack access to electricity, especially in remote rural areas where population growth is predicted to continue to increase, so it is predicted that the increase in demand for electricity will also increase by around 10% annually. The current electrification ratio of the Indonesian government's efforts is committed to targeting 97.5% by reducing 26% of greenhouse gas (GHG) emissions by prioritizing renewable energy (ESDM, 2019). It turns out that wind power is uneconomical in Indonesia because the wind speed is low, unlike in the Netherlands which has a wind speed above 7 m per second, so to be feasible it is necessary to find technology that can make the application of this technology cheap by providing an assessment and modeling of the average wind speed from mesoscale satellite data that can be downloaded by everyone. Imagine with conventional technology to get wind speed data in an area, it is necessary to build a wind tower with a height of 150 m and install a wind detector on it and measure the speed manually for 3 years. Using IOT is the solution, for the conversion of wind energy into electrical energy on a large scale, various assessments are needed such as the transmission of the PLN substation connection system, power distribution around the power plant location, the energy capacity to be installed, capacity factor Suharta, H., Pakpahan, S., & Martosaputro, S. (2014). The use of mesoscale satellite data to see the initial potential in the development of PLTB is possible to benefit investors because the measurement does not take a long time and the cost is not large.

The main problem of the feasibility of wind power resources that can be accepted based on the basics of the mesoscale data utilization method and its limitations can provide guidelines, especially the use of mesoscale modeling in the development of Wind Power Plants (PLTB). In the development of renewable energy by modeling wind speed from mesoscale satellite data for wind power plants is very helpful because verification using mesoscale data, the acceleration of the development of renewable energy-based electricity PLTB can be expected without requiring large time and costs. The growth of development for electricity needs in the last few years in the National Medium-Term Long-Term Development Plan (RPJMN) 2020-2024 sets a target for the EBT mix to reach 20% by the end of 2024 (16.3 GW) while the Electricity Supply Business Plan (RUPTL) sets a target of 23% (19.9 GW) by the end of 2025. Conditions at the end of this year 2019 EBT in Indonesia reached 7.8 GW. From the projection, the possibility of realizing the achievement of the renewable energy mix is 16%, namely 12.8 GW) at the end of 2024 and 19% (16 GW) at the end of 2025 (Bappenas, 2019).

This achievement is implemented by PLN, the state electricity company (PLN) which is very convinced that the electricity needs from renewable energy are expected to be achieved (Energy Academy Indonesia, 2019). To achieve the target of the Indonesian government, it is hoped that increasing Renewable Energy, especially the potential of PLTB, can help increase the growth of the energy mix target in Indonesia. Changes in regulations regarding power purchase agreements (PJBL) are very helpful with the Build-Own-Operate (BOO) scheme system to attract developers to invest in the development of renewable energy, especially PLTB in Indonesia.

The need for wind data and geographic data is very much needed in the development of wind power generation potential. Wind data simulation using supporting technology such as software and the use of turbine types will determine the energy that will be produced. The current challenge is that developers are still analyzing the average wind speed by establishing a meteorological tower to obtain an estimate of wind energy in the development of wind power generation. This in the study of finding a location for the development of wind power generation potential is ultimately still considered expensive. Therefore, wind model simulation without establishing a meteorological tower needs to be considered. An important component of mesoscale modeling requires several methods to determine the order of magnitude of uncertainty in modeling the results of wind data accumulation and the use of wind turbine generator (WTG) manufacturing and geographic factors of the area where the wind power plant is planned to be built.

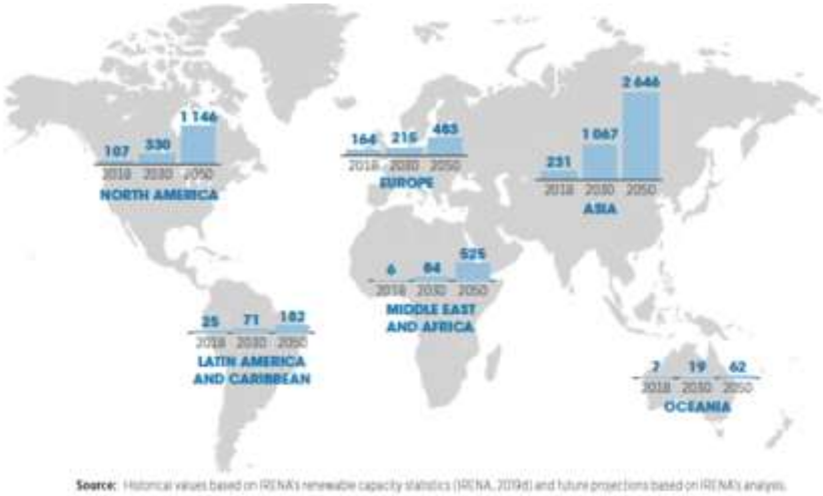

Figure 2: Distribution of wind turbine generators (WTG)e in the built world (IRENA, 2019)

Internet Of Things (IOT) technology is very helpful in obtaining wind speed simulation data in the right area to build a wind power tower. The level of wind speed greatly determines the economics of a PLTBayu project. Wind speed is very dependent on geographical factors and time in each area. Areas that have high wind speeds are not necessarily the same as other areas. So the search for potential locations for PLTBayu development is called a specific area because the area has a consistent wind speed for PLTBayu construction.

The average wind speed assessment data is sometimes beyond the prediction of the wind resource results. If the data has a much shorter period span of less than one year, the average wind speed cannot be used to reflect the diurnal variation of wind speed. If the data covers less than one year, it may be represented by other mesoscale data with a duration of approximately ten years to see the correlation of wind speed trends because it is possible that data that is only in one year produces bias in the average speed estimate.

2. Literature

The potential of renewable energy sources in Indonesia consists of geothermal energy, water energy, plant energy, ocean/sea energy, wind energy, solar energy and nuclear energy. PLTB (Wind Power Plant) is a generating system that requires or utilizes wind as a source that will be converted into electrical energy. PLTB is the main choice of power plant for areas and places that have relatively good wind energy potential (Putri et al. 2022). Utilization Several regions in Indonesia that are suitable as wind energy sources are East Nusa Tenggara (NTT), West Nusa Tenggara (NTB), South and Southeast Sulawesi, North and South Coasts of Java (Hesty, et.al, 2015) and Karimun Jawa (Lubis 2007). Based on Government Regulation No. 79 of 2014 concerning National Energy Policy, the target for new and renewable energy in 2025 is at least 23% and 31% in 2050. The target capacity of PLTB in 2025 is 255 MW. Meanwhile, until 2020, PLTB has only been installed around 135 MW with details of 75 MW in the Sidrap area and 60 MW in the Janeponto area. The development of wind energy in Indonesia is still a national challenge.

The transition to renewable energy is seen from various sides, namely from the supply side and from the demand side. The supply side consists of the generation process of potential, energy and development, while the demand side depends on social factors, namely humans and society, which include massive efforts by rural and urban communities in terms of use, publication and increasing awareness of environmental issues (Wardhana and Marifatullah 2020). It is hoped that the use of renewable energy will have an impact on reducing air and water pollution and reducing greenhouse gas emissions (Kundaryanti, Sari, and Kurniawati 2023).

With the development of technology, the use of the Internet of Things has become very powerful in monitoring the energy produced by wind power plants effectively and accurately and in real time, including by using Blynk software via the ESP8266 MCU node (Wicaksono, Djuniadi, and Apriaskar 2023). The advantages of utilizing IoT for energy management include real-time device monitoring and control data processing (Andal and Jayapal 2022). Several other studies use windographer software to estimate the output of wind turbine generators (Balakrishna, et.al 2017).

3. Methods

In this manuscript we collect data from many resources whether primary data or secondary data consist of:previous research publication, data from PLN, from Ministry Of Energy and Mineral Resources, and many others. Then using desk analysis and focus group discussion finally we have results towards our research in here and then giving suggestion on steps to be taken.

4. Results

Internet Of Things (IOT) technology is very helpful in obtaining wind speed simulation data in the right area to build a wind power tower.The appropriate location is in the South Sulawesi Province, which is east of about 98 km from Makassar City, assisted by IRENA (World Institute for Renewable Energy) in Jeneponto Regency. This area is an area that has very large potential characteristics with a flat contour and easy access to transport wind turbine generator equipment in the construction of wind power plants. The majority of land in the Jeneponto Regency area is rice fields and plantations, the majority of which have less productive land conditions due to dry land conditions, land elevations of 10 – 100.

This area is located in the lowlands with a distance of 6 km from the coast is a great potential for the construction of PLTB because it is not far from the coast as easy access to shipping goods for PLTB construction equipment. The height of the land ranges from 50 m to 100 m above sea level. The development of wind power plants has a high value in Jeneponto Regency because the access to land WTG equipment to the location is very easy with a flat land contour and besides that the dominant wind direction factor comes from the coast to the southeast towards the hills.

Turbine energy monitoring system based on average wind speed recorded for each set of turbines from wind data with time series analysis shows the usefulness of data for monitoring wind power plants daily in hours so that the lowest or unknown energy capacity can be analyzed. The daily turbine output performance from energy production is affected by the layout of the turbine position that has been planned according to the design. Analysis of wind data recording monitoring for wind power plant development plans is able to explain the causes of wind data deviations so that it can identify the possibility of optimizing during wind power plant operation. Time data analysis from the wind power plant data monitoring system allows for monitoring wind turbine control settings and identifying ways to optimize wind power plant operations. Energy losses due to unoptimized wind power plant operations in many cases can finally be detected.

Figure 3: Siemens Wind Turbine Generator

The location in Jeneponto Regency is a potential location suitable for the development of wind energy from large-scale wind power plants (PLTB). The transfer of electrical energy from wind power plants to the PLN South Sulawesi network system using wind turbine generator (WTG) technology applications is very possible with wind speeds of ≥ 7 m / sec.

4. Discussion

4.1 Discussion on Things to Do Government policy

the total share of renewable energy and accelerating the improvement of annual energy intensity levels. Some efforts for sustainable energy are to improve energy efficiency. Barriers and drivers for improving energy efficiency are divided into six main categories:

1. Economic barriers (investment risks, fossil fuel subsidies, and low energy costs);
2. Gap between public knowledge and awareness;
3. Cultural and behavioral barriers (apathy);
4. Governance (lack of leadership and institutions);
5. Aesthetics and environmental challenges.
6. Technical barriers.

Some of the key drivers for energy efficiency are awareness of the benefits to individuals and society (Reddy 2013), which can attract private investment and ensure market success. Other benefits of increased energy efficiency include reduced emissions at the national and consumer levels. At the national level, improved air quality and job creation.

Things that still need to be done by the Government are to consider the economics of wind power generation:

1. There needs to be a Law on Renewable Energy including wind power.
2. There needs to be a Presidential Regulation on the price of electricity purchased by PLN from companies that produce Renewable Energy including wind power.

If both of these steps are not implemented, Indonesia will not be attractive for MNCs to enter the country and conduct FDI in the wind energy sector, even in Jeneponto, companies conducting FDI lose money in terms of work units in Indonesia, but because they work in various countries, overall they still make a profit, their profit is only to be a pioneer in Indonesia, with the hope of getting the next project with a higher electricity selling price of US$ 6 cents / Kwh, all waiting for the new price from the Presidential Regulation which is still under review by the State Secretariat and related ministries. The price according to ESDM Regulation no. 50/2017 is still very low, which is 85% of the local PLN production cost, whereas in other countries renewable energy gets incentives, not discounts.

4.2 Transition Towards Renewable Energy

For the application of renewable energy, a transitional change or structural change is needed where an interdisciplinary field of study has emerged that focuses on transitions defined as long-term nonlinear processes of social change in which society is structurally transformed (de Haan and Jhi 2011). Transitions in Government Practices and Community Institutions for sustainable human progress require proactive government efforts with a multilevel transition framework (Macro, Meso and Micro levels) (Wardana 2020).

4.3 Utilization of Technological Advances

Technological advances, especially the Internet of Things, can be very beneficial for Indonesia to help accelerate the implementation of wind energy, considering that this technology allows faster data acquisition via satellite, so that suitable locations can be determined for the application of wind energy in Indonesia.

5. Conclusion and Recommendations

5.1 Conclusion

The conclusion of this presentation is:

1. In a globalized world, several government policies need to see SDGs as a priority and adjust all their policies to be able to support and implement them.
2. Not all difficulties and costs are barriers to the implementation of technology because with the existence of IOT, convenience will feel light, something that is impossible to implement will become feasible.
3. Geopolitics and geostrategy really need to be considered because they concern national resilience, for example if Indonesia is blockaded and does not receive supplies of petroleum that has become fuel from other countries, it will only last less than a week, while ideally 3 months like the USA. In order to be energy independent, it is necessary to look at the local energy potential that exists, such as wind power.

5.2 Recommendations

Suggestions for further steps:

1. The government needs to think about long-term strategic matters and national resilience together with the DPR to create a renewable energy law. Efforts to utilize wind energy as renewable energy need to be tried in several regions in Indonesia with characteristics that can produce quite large amounts of energy.
2. The economy of a strategic matter must be viewed in a macro way, it cannot be seen in a micro way with an example focusing on PLN's profit and loss, but the value of the nation's resilience needs to be maintained, this strengthens the need to create a Presidential Regulation on renewable energy prices.

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References

1. Andal, C. Kothai, and R. Jayapal. (2022). Design and Implementation of IoT Based Intelligent Energy Management Controller for PV/Wind/Battery System with Cost Minimization. *Renewable Energy Focus* 43: 255–62. doi:10.1016/j.ref.2022.10.004.
2. IRENA. (2019). Future of Wind - Deployment, Investment, Technology, Grid Integration and Socio-Economic Aspects.

3. Kundaryanti, Fadya Dwi, Pratiwi Ayu Retno Sari, and Wahyu Kurniawati. (2023). Upaya Peralihan Negara Indonesia Dalam Mengembangkan Terbarukan. *CAHAYA: Journal of Research on Science Education* 1(2): 60–69.
4. Lubis, Abubakar. (2007). Energi Terbarukan Dalam Pembangunan. *Teknologi Lingkungan* 8(2): 155–62.
5. Putri, Raihan, Arnawan Hasibuan, Misbahul Jannah, Robi Kurniawan, Teknik Elektro, Universitas Malikussaleh, Bukit Indah, et al. (2022). Pembangkit Listrik Tenaga Bayu Sebagai Sumber Alternatif Pada Mesjid Tengku Bullah Universitas Malikussaleh. *RELE (Rekayasa Elektrikal dan Energi): Jurnal Teknik Elektro* 5(1). doi:10.30596/rele.v5i1.10788.
6. Wardhana, Ahmad Rahma, and Wening Hapsari Marifatullah. (2020). Transisi Indonesia Menuju Energi Terbarukan. *Jurnal Tashwirul Afkar* 38(2): 269–83.
7. Wicaksono, Dwi Haryo, Djuniadi Djuniadi, and Esa Apriaskar. (2023). Monitoring Sistem Pembangkit Listrik Tenaga Angin Berbasis Internet of Things. *Jurnal Teknologi Elektro* 14(2): 118. doi:10.22441/jte.2023.v14i2.010.
8. The Business Times. (2019). China Firms Funding Coal Plants Offshore as Domestic Curbs Bite: Study. The Business Times, 22 January 2019.
9. Egan, M. (2019). Secretive Energy Startup Backed by Bill Gates Achieves Solar Breakthrough. CNN Business, 19 November 2019. https://edition.cnn.com/2019/11/19/business/heliogen-solar-energy-bill-gates/index.html.
10. World Global Risk Report. (2020). *World Economic Forum*.
11. Joachim Monkelbaan. (2019). *Governance for the Sustainable Development Goals - Exploring an Integrative Framework of Theories, Tools, and Competencies*. Springer Nature Singapore Pte Ltd.
12. Balakrishna, C., Balasubramanian, M. C., Deshmukh, M. K., Pilani, B., Birla, K. K., & Campus, G. (2017). Wind Wind turbin generator (WTG) Output Estimation using Windographer Software. *International Journal on Future Revolution in Computer Science & Communication Engineering*, *3*(11), 2454–4248. http://www.ijfrcsce.org
13. Wicaksono, N. A., Pandin, M., Hesty, N. W., Kav, R. (2012). *Weather Research And Forecasting Generating Wind Velocity Map Of Western Java Using*. 11(2), 137–150.
14. Hesty, N. W., & Hadi, T. W. (2015). Reanalisis Weather Research and Forecast - Four Dimension Data Assimiliation (Wrf-Fdda) Untuk Meningkatkan Akurasi Estimasi Potensi Energi Angin Di Daerah Lepas Pantai (Studi Kasus: Pantai Selatan Jawa Barat), 27–36.
15. Jha, A. R . (2011). *Wind turbin generator (WTG)e Technology*. Boca Raton CRC Press
16. W. R., Modeling, W. F., & Peninsula, I. N. B. (2013). *Wind Resource Assessment and Wind Farm Modeling*. September, 1–14.
17. Martosaputro, S., & Murti, N. (2014). Blowing the Wind Energy in Indonesia. *Energy Procedia*, *47*, 273–282. https://doi.org/10.1016/j.egypro.2014.01.225
18. Bappenas. (2019). Rancangan Teknokratik Rencana Pembangunan Jangka Menengah Nasional 2020 - 2024 : Indonesia Berpenghasilan Menengah - Tinggi Yang Sejahtera, Adil, dan Berkesinambungan. *Kementerian PPN/ Bappenas*, 313. https://doi.org/10.1017/CBO9781107415324.004