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# Potential Integration of Renewable Energy Ocean Power Technologies and Wind Power Plants to Realize Energy Independence

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**Abstract:- The increasing population in Indonesia makes energy consumption also higher. The most widely used type of energy is the type of fossil energy. Indonesia Energy Outlook 2021 notes that final energy consumption in 2019 is 989.9 million BOE. The increasing use of fossil energy makes fossil energy reserves also dwindle. The availability of energy must continue to be maintained in the future because oil in Indonesia will run out in the next nine years, natural gas will run out in 22 years and coal will last in 65 years. For gas and new coal which are still relatively abundant, if there is no exploration, it will be close to an energy crisis. In addition, the excessive use of fossil energy has an impact on the environment such as climate change. Indonesia has committed to participating in the global carbon emission reduction movement. One of the actions taken is the application of new and renewable energy. New and renewable energy as alternative energy as well as sustainable energy that can be renewed and environmentally friendly considering that Indonesia is very active in the use of fossil energy which has an effect on world climate change and global warming. The types of NRE used are sunlight, wind, water, biofuel and geothermal heat. In 2016, the Energy Journal stated that Indonesia has great potential in developing NRE, such as 11 Gigawatts of solar power, 75 Gigawatts of hydropower, 950 megawatts of wind energy, 60 Gigawatts of ocean waves, 32 megawatts of biofuel, 32 megawatts of biomass and geothermal energy of 32 megawatts. 29 Gigawatts. The paper discusses further Ocean Power Technology using Wind power plants with literature study methods sourced from the internet, books and research journals. The results of the literature study show that wind power plants are still not suitable for use in Indonesia because the investment costs are expensive and the electrical energy produced is also very minimal.**

***Keywords:-*** *Energy, Fossil Energy, Renewable Energy, Ocean Power Technology, Wind power plant.*

## I. INTRODUCTION

The Indonesian Central Statistics Agency recorded the results of the population census in September 2020 of 270.20 million people. There was an increase in the population of 32.56 million people compared to 2010 with a population growth rate of 1.25 per cent, which can be said to have decreased from the rate of 1.49 per cent in 2010 [7]. Seeing population growth like this, it is possible that Indonesia's energy consumption is also getting higher. The most widely used type of energy is fossil energy. This statement is in line with what was written in the 2021 Indonesia Energy Outlook [6], the final energy consumption in 2019 was 989.9 million BOE (equivalent to barrels of oil) which was dominated by BBM. The fuels in question include avgas, avtur, gasoline, kerosene, diesel oil, diesel oil and fuel oil. Not only that, but the increase in fuel consumption also affects the consumption of biofuel as a fuel substitute, such as biodiesel which is not only used in transportation modes but also the industrial, commercial and power generation sectors. Coal is also widely used in the industrial and power generation sectors.

Fossil energy sources that are continuously used along with increasing demand also make fossil energy reserves also deplete. As anticipation, there is a need for an energy transition from fossil energy to New and Renewable Energy. In line with the statement by the Minister of Energy and Mineral Resources, Arifin Tasrif, who stated that energy availability must be maintained in the future because oil in Indonesia will run out in the next nine years, and natural gas will run out in 22 years and coal will last in 65 years. For gas and new coal which are still relatively abundant, if there is no exploration, it will be close to an energy crisis.

In addition to referring to the energy crisis, the energy transition to the use of fossil energy also considers the environmental impact. Excessive use of fossil energy has an impact in the form of climate change. Climate change in Indonesia can affect 5.8 million $km^2$ of Indonesian waters that are dangerous for fishermen, 1,800 km of coastline are in the very vulnerable category and rice production will decline in some areas [3]. In addition, a severe impact will be the potential for economic losses due to climate change which will reach 115 T in 2024, as a prevention, there is a need for climate resilience policy interventions in 4 priority sectors (water, health, marine, fisheries and waters).

Arsjad Rasjid, Chairman of the Indonesian Chamber of Commerce and Industry (Kadin), stated that the Indonesian government is also committed to reducing carbon emissions. Indonesia is committed to achieving net zero emissions by 2060, with the first scenario being a 29 per cent reduction in greenhouse gas emissions independently or 41 per cent with

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international assistance [2]. The principle of calculating the net zero emission scenario is as follows [9]:

1. In accordance with the target of Indonesia's 2045 vision, the net zero emission policy must still be in line with that vision.
2. Target compliance in 2030, namely by reducing Greenhouse Gases by 29%
3. Calculations use a system-wide and comprehensive cross-sectoral approach
4. The net zero emission target should not trade off with green economic growth
5. Taking into account the negative externalities of development in the economy and the impact of the Covid-19 pandemic
6. Respective Capability and CBDR according to capabilities and responsibilities.

As an action to reduce emissions in Indonesia. The government has launched an energy transition from fossil energy to new and renewable energy.

## II. METHOD

The method used in this work is a qualitative approach, which is a literature study. Kinds of literature study is a series of actions that include methods of collecting library data, reading and taking notes, as well as organizing research sources for this type of research [21]. Literature studies also include research and can be classified as scientific activities because data collection is carried out according to a plan in the form of a research methodology [15]. The processes that have been completed are: (1) problem conceptualization, (2) literature search, (3) data review, and (4) analysis and interpretation of the results [25].

In the analysis step, look for similarities (compare); inconsistencies (contrast); express opinions (criticizing); make comparisons (synthesis) and provide a concise summary (summarize) [22]. The sources used in the literature study method are journaled articles, papers, theses, dissertations, journals and/or conference results, websites; mass media, government websites, internet and so on that are relevant and have clear validity.

## III. RESULT AND DISCUSSION

### *A. New Energy and Renewable Energy*

Referring to the government's plan to reduce greenhouse gas emissions, one of the measures taken is the transition from fossil energy use to new and renewable energy. Government Regulation Number 79 of 2014 concerning National Energy Policy (KEN) is the foundation of government policy as an effort to manage energy with the principles of justice, environmental insight and sustainability. The main policies of KEN include the availability and utilization of national energy and energy development priorities as well as supporting policies in the form of energy conservation, energy diversification, the environment, institutions, financing, and energy infrastructure [8].

New and renewable energy as alternative energy as well as sustainable energy that can be renewed and environmentally friendly considering that Indonesia is very active in the use of fossil energy which affects world climate change and global warming. The types of NRE used are sunlight, wind, water, biofuel and geothermal heat. In 2016 [11], the Energy Journal stated that Indonesia has great potential in developing NRE, such as 11 Gigawatts of solar power, 75 Gigawatts of hydropower, 950 megawatts of wind energy, 60 Gigawatts of ocean waves, 32 megawatts of biofuel, 32 megawatts of biomass and geothermal heat of 29 Gigawatts.

Dr. Ir. Imam Supriyadi, M.M. as a lecturer in energy systems lectures at the Indonesian Defense University defines new energy and renewable energy. According to him, new energy is energy obtained from new technology, either from renewable energy sources or non-renewable energy sources, such as nuclear, hydrogen, coal methane gas, liquefied coal and gas coal. While renewable energy is energy sourced from natural resources that have sustainable potential, for example, such as geothermal, wind and sunlight. These two energies are also referred to as primary energies. Here are the differences in energy sources by type:

Table 1. Type of Energy Source

| **Fossil Energy** | **New Energy** | **Renewable Energy** |
|---|---|---|
| Oil | CBM | Geothermal |
| Gas | Oil Shale | Solar Radiation |
| Coal | Gas Shale | Biomass |
| | Hydrogen | Ocean Power |
| | Thorium/Uranium | Wind Power |
| | | Hydro Power |

In this paper, we will explain more about renewable energy, namely Ocean Power Technology and Wind power plant. Then, the characteristics of renewable energy are as follows:

- Renewable energy is always available and never runs out.
- Environmentally friendly and does not contribute to emissions
- The current price of renewable energy is still not able to compete with fossil energy. Renewable energy has not been widely used because storage and transportation are still relatively expensive which is then more suitable for local use only.

Renewable energy has a role in power generation. Starting in 1831, Faraday invented a DC electric generator that can convert mechanical energy into electricity. From this discovery, scientists began to utilize renewable energy sources that were integrated with generators so that they could produce electricity. Biomass and geothermal renewable energy is managed to produce steam which is used to drive an electric generator through a turbine. Renewable energy such as water, wind, and ocean waves are directly used through turbines or windmills to drive generators. In contrast to renewable energy, solar heat absorbs solar energy into electricity through the photovoltaic process.

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Renewable energy is not only proclaimed but to realize energy independence. In accordance with Government Regulation Number 79 of 2014 article 1 states that energy independence is ensuring the availability of energy and utilization of domestic resources as much as possible. Renewable energy can be further developed to meet energy in the 3T area and military bases in the 3T. However, the case in Indonesia is the abundance of renewable energy resources but the tools to produce energy depend a lot on imports.

*B. Ocean Power Technology*

Ocean Power Technology, which when translated into Indonesian is Ocean Energy Technology, is a type of renewable energy. The potential of seawater energy in Indonesia is still largely untapped by the community. One of the energies used is the temperature of sea and ocean water. Ocean energy is classified as terrestrial which means it comes from the earth produced by the kinetic energy of water and the difference in ocean heat. The process of ocean energy is also inseparable from the help of solar energy because of the sun's gravity. Ocean energy can be converted into electrical energy developed by technology.

Indonesia as an archipelagic country that has an area of 5.8 million square km or three-quarters of the total area, has marine energy reserves stored in ocean waves, tides, sea heat and ocean currents. The potential of ocean waves, when converted into electric current, is 17.98 GW, sea heat is 1.99 GW and tides are 41 GW. Meanwhile, the measurement of ocean currents in terms of speed is 1.3 – 3 m/second which produces a power of 1.38 – 13.84 kW per square meter. So that the potential of the four marine energy reserves can reach 60.98 GW [13].

According to the Center for Hydrodynamic Technology, ocean currents and ocean waves can be converted together or individually, either kinetic energy in the form of current speed or potential energy from ocean waves into electrical energy. The ocean current and ocean wave power plant is a combination of the Wells turbine and the Darrieus turbine [14]. The advantages of ocean wave energy are that it has a large energy density, very consistent and continuous wave propagation that can be predicted in advance, and has a very minimal environmental impact [24].

Ocean thermal energy can also be converted into electrical energy. The principle developed is the conversion of seawater temperature differences for the process of running a heat engine. The difference in temperature required to run a heat engine is 25 degrees C. A well-known technology is Ocean Thermal Energy Conversion (OTEC). The following picture shows a summary of the potential for marine energy in Indonesia.

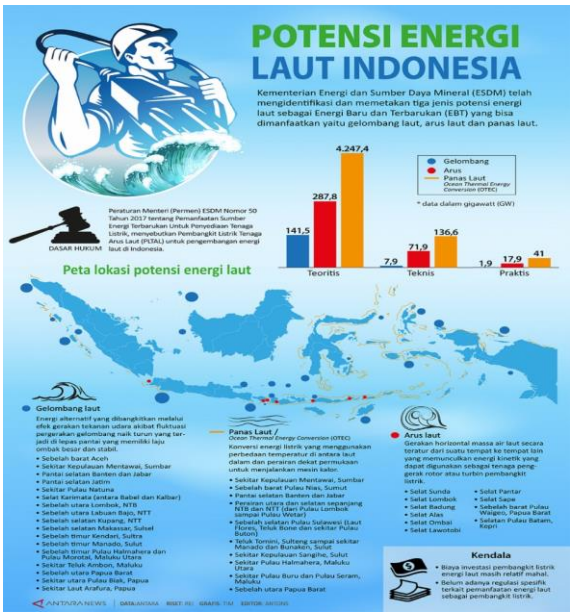

Fig 1. Potensi Energi Laut di Indonesia [1]

*C. Wind power plant*

Wind power plants are the utilization of energy sourced from the wind. Wind when given a simple meaning is the air that moves from high pressure to low pressure or from low air to high air temperature, which is caused by the sun's heating of the atmosphere and the earth's surface [5]. The working principle of a wind power plant is to convert air kinetic energy into electricity through a generator. Wind energy rotates the blades of a generator at the back of the windmill to produce electrical energy. Wind power plant efficiency is 40% of the received wind power. However, wind energy sources are less reliable due to their unpredictable availability.

For example, a study conducted by Novrita (2021) [16] conducted research to analyze the potential for wind energy in ponds to produce electrical energy. He revealed that the good wind speed for the pond to be used as a source of electricity is in the afternoon to evening and then evening to morning. The electrical energy that can be generated is about 89-170 watts per square meter which lasts for 5 hours. That is, the use of wind energy locally can generate electrical energy.

The target capacity of the Wind Power Plant in 2025 is 255 MW. However, until 2020 the Wind Power Plant has only installed around 135 MW with details of 75 MW in the Sidrap area and 60 MW in the Janeponto area. This means that the development of wind energy in Indonesia is a national challenge. According to P3TKEBTKE (2021) [17] conducted a pre-feasibility study at two locations of wind measuring towers on the islands of Sabu, NTT and Saumlaki, Maluku. On Sabu Island, the average wind at an altitude of 50 m, 30 m and 20 m respectively was 5.82 m/s, 5.69 m/s and 5.23 m/s. Meanwhile in Saumlaki, Maluku, the heights are the same as in Sabu, which are 5.20 m/s, 4.37 m/s, and 3.66 m/s.

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**Fig 2.** Indonesia Wind Speed Map (50 Meter Altitude)

*D. Integration of Ocean Power Technology and Wind power plant in Meeting the Energy Needs of Military Bases in the North Natuna*

The sea is the object of study in the hydrosphere and sea water is always moving. The movement of seawater is not always the same, it can be horizontal, vertical or a combination of both. Seawater movement is the movement of water masses from one place to another. The types of seawater movement are ocean waves and ocean currents. Factors causing seawater movement include wind, seawater salinity, density and moon gravity [18].

The mass transfer of seawater which is essentially driven by solar energy causes ocean currents to occur. The circulation of ocean currents is divided into two, namely sea surface circulation and deep-sea circulation. Currents on the sea surface are generated by the wind, while currents in the sea are caused by thermohalines. Thermohaline is a large-scale movement of ocean currents caused by the temperature and salinity of the ocean. The thermohaline circulation can transport heat energy, nutrients and solid particles and other materials over long distances in the oceans. The coastal climate of high latitude countries is also caused by the thermohaline circulation because it brings warmer surface water to the poles from subtropical oceans (Satria, 2020) [20]. The thermohaline circulation scheme is shown in Figure 3.

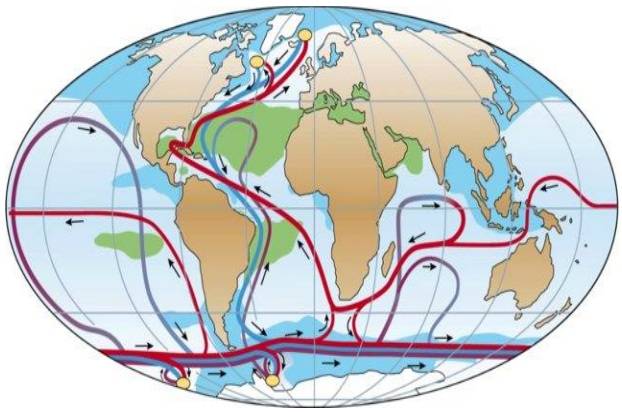

**Figure 3.** Scheme of Thermohaline Circulation [27]

Sea surface currents, which are driven by wind, do not make currents in the direction of the water but are deflected to the right in the northern hemisphere and to the left in the southern hemisphere. This is due to the rotation of the earth or the Coriolis force. The current generated by the wind will decrease in speed with increasing depth and the opposite direction to the direction of the current at the surface.

Ocean waves are the process of moving up and down water in a direction perpendicular to the sea surface which forms a curve or graph. The cause of the waves is the wind which transfers energy to the waters which results in a hill-like shape [26]. Factors for the occurrence of waves include:

- Wind, which consists of wind speed, length/distance of wind gusts, and time (duration) of wind gusts.
- Marine geometry, namely the topography of the sea or the profile of the sea and the shape of the coast
- Earthquake, this happens when there is a tsunami.

Waves can also be classified according to their nature, size and cause. Based on nature, ocean waves form the coast and destroy the coast. The formation of the coast is intended to occur because of the small height and when the waves break on the beach they will carry sediment. Coastal destroyers are waves with great heights and propagation speeds, then transport coastal materials to the middle of the sea.

Based on their size and cause, there is such a thing as a capillary wave with a characteristic wavelength of 1.7 meters and a period of fewer than 0.2 seconds, which is caused by not too strong winds. Then there are wind waves with wavelengths reaching 130 meters, period 0.2-0.9 seconds and the causes are strong winds, long winds blowing (swell waves), and gravity of the sun and moon. The benefits of ocean waves are to maintain climate and temperature stability in the world, gas exchange, increase adaptation and biodiversity, and help form and maintain beaches.

Seeing some explanations about the process of ocean currents and ocean waves above, most of them are caused by wind. This means that it can be integrated between sea energy and sea wind by building a Sea-Wind Power Plant. However, based on the results of research from Sandika (2019) [19], the analysis of wind speed on the coast of Monpera produces a total power of 125,092 Watt with a wind speed of 5.66 m/s. Then the results of the research on Wind Potential by the Bappeda of Banda Aceh City offshore in Ulee Lheue Village stated that it was still relatively small and only sufficient for street lighting. It needs to be studied and investigated further if the PLTL Laut-Wind can be built in the middle of the sea so that the potential for electrical energy generated is greater [4].

*E. Renewable Energy Potency in Indonesia*

On November 2, 2021, Indonesia is committed to reducing emissions as confirmed at COP 26. A forming step to accelerate emission reduction is to diversify fossil energy with renewable energy by 23% by 2050 [12]. Minister of Energy and Mineral Resources Arifin Tasrif said that until 2020, the new renewable energy mix in Indonesia was only 11.2%. The new renewable energy that is currently being focused on is Solar power plant. The target of rooftop solar

power plants in 2025 is 3.61 gigawatts. A floating Solar power plant has a potential of 26.35 GW, and a large-scale Surya power plant is targeted at 4.68 GW in 2030 [10].

Reporting from the website jabarprov.go.id., for the construction of the Ciemas Wind power plant, which began in 2016 until now, the total investment is Rp. 3.3 trillion. The Ciemas wind power plant stands on private land owned by the community, BUMN and Forestry. The description of the Wind power plant has a 3.3 MW EN143 turbine with a height of 127 meters and a propeller length of 72.5 meters and produces 100-150 MW of electricity [23].

Seeing the explanation above, the construction of a wind power plant requires large funds and the potential for generating electrical energy is not large enough. The Ministry of Energy and Mineral Resources also focuses on Solar Power Plants compared to other renewable energy.

## IV. CONCLUSION

The Indonesian Central Statistics Agency recorded the results of the population census in September 2020 of 270.20 million people. There was an increase in population of 32.56 million people compared to 2010 with a population growth rate of 1.25 per cent which can be said to decrease from the rate of 1.49 per cent in 2010. Seeing this population growth, it is possible that Indonesia's energy consumption is also getting higher. The most widely used type of energy is fossil energy.

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- Environmentally friendly and does not contribute to emissions
- The current price of renewable energy is still not able to compete with fossil energy
- Renewable energy has not been widely used because storage and transportation are still relatively expensive which is then more suitable for local use only.

The focus of Renewable Energy in this paper is Ocean Power Technology and Wind power plants. Looking at the paragraphs above, the obstacles faced are technology and the resulting investment. Given also, the potential of wind energy can not be relied on. Further research is needed if the Wind power plant is integrated with marine energy.

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