Potential of New and Renewable Energy in Merauke Regency as the Future Energy

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Abstract. Electricity consumption in Merauke Regency increases every year in line with economic growth and population growth. Meanwhile, fossil energy reserves as fuel for power plants have decreased. To reduce dependence on fossil energy and offset the increase in electricity consumption it is necessary to develop alternative electrical energy sourced from renewable energy. Merauke Regency has great potential for renewable energy derived from biomass, solar, and wind. A study or analysis is needed to be able to estimate the energy potential that can be developed in an area. This study uses data collection techniques and analysis of the potential for renewable energy in Merauke Regency using RETScreen Expert. Analysis results show the potential of solar energy, and the most potential biomass energy to be developed.

Keywords: Biomass energy, clean energy, retscreen expert, solar energy, wind energy.

1 Introduction

One of the goals of the 2030 Sustainable Development Goals (SDGs) concept is affordable and clean energy. All countries have agreed on global actions to end poverty, reduce inequality and protect the environment [1]. The Government of Indonesia in this case the Ministry of Energy and Mineral Resources (ESDM) in (PP) Number 79 of 2014 in Article 11 paragraph 2 which explains the priorities of national energy development namely: maximizing the use of renewable energy by taking into account the economic level, minimizing the use of petroleum, utilize the use of natural gas and new energy, and use coal as a mainstay of the national energy supply. Determination of energy policy direction to increase the role of new and renewable energy in the energy mix from 5 % to 23 % in 2025 [2].

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The potential for new renewable energy in Indonesia is still very large and needs to be developed. The total energy is 443.2 GW with details: PLTA (*Pembangkit Listrik Tenaga Air* - hydroelectric power plant, PLTM / H (*Pembangkit Listrik Mikro Hidro* - Micro Hydro Power) = 75 GW; *Surya* (Solar Power Plant) = 207.8 GWp; Geothermal 19.6 GW; Wind = 60.6 GW; Bioenergy = 32.6 GW; and Marine energy 17.9 GW. While the total installed capacity of the plant is currently only 59 656 MW. Data from the Central Statistics Agency (BPS – *Badan Pusat Statistik*) in 2017 shows an installed capacity of 57 177 MW, electricity generated 262 661 GWh, electricity distributed 226 014 GWh spread in 34 provinces in Indonesia [3]. The increase in electricity consumption from year to year will continue to increase along with population growth.

Merauke Regency is one of the districts in South Papua Indonesia, whose electricity needs are supplied from PT PLN (*Perusahaan Listrik Negara* - State Electricity Enterprise). Based on 2014 BPS data, installed power has reached 25.42 KVA, with electricity production generated 99 829 053 KWh and electricity sold 91 343 583 Kwh. In 2017 the number of electricity customers in Merauke Regency has reached 63 607 consumers which every year experienced an increase from 2015 to 2017 reaching 6.7 %. While the main types of power plants used are diesel power. Diesel power plants rely heavily on petroleum from fossil energy which is currently running low and will run out. In addition to the population, transportation vehicles and manufacturing plants also use fossil energy to increase petroleum consumption.

Parenden and Cipto [4] have estimated vehicle emissions and the results show that increased vehicles also increase air pollution caused by exhaust emissions. Abdullah et al. [5] stated that renewable energy technology could be used for value added activities in rural areas, create small industries, provide job opportunities to the local people and create conditions for sustainable economic development. Therefore, the development of renewable energy power plants is needed to bring energy that is cheap and environmentally friendly. In this paper the authors will present the potential of renewable and renewable energy that can be developed in Merauke Regency as the energy of the future.

2 Research methods

2.1 Geography of Merauke Regency

Merauke Regency is located at the eastern end of the southern part of the Republic of Indonesia, bordering directly with Papua New Guinea and Australia. Merauke Regency is one of the regencies in the Papua Province region which is geographically located between 137° to 141° East Longitude and 5° to 9° South latitude with an area of 46 791.66 km^2. The population is 223 389 people with a population growth rate of up to 1.54 % yr^{-1} [6]. There are still some areas that have not been electrified because of the vast geographic conditions. While the vast potential of agricultural land and plantations has not been maximally utilized, this is due to the uneven distribution of the population in each region. The largest population only inhabits a small city compared to other areas.

Fig. 1. Map of Merauke Regency

2.2 Analysis with RETScreen

RETScreen Expert is a clean energy software developed by the Government of Canada. The first version of RETScreen was released on April 30, 1998. The current version of the RETScreen software was released on September 19, 2016. This software can be used to analyze the energy potential of a place or to calculate the installed power plant installation capabilities.

Fig. 2. Display RETScreen Expert

Figure 2 shows the appearance of the Retscreen Expert, this software enables comprehensive identification, financial feasibility of renewable energy potential and assessment and optimization of technical and energy efficiency projects [7]. Users can easily search for the location of the area they want to study online. The software will automatically display geographical conditions and climate conditions.

Fig. 3. Display map of measurement of climate conditions

Figure 3 shows the map display of climate conditions measurements taken online. The software will only be used to search for locations that will be examined and obtain data on solar radiation, wind speed, air temperature, earth temperature, and atmospheric pressure. These data will then be processed to analyse the potential of renewable energy sources in the Merauke Regency.

3 Results and discussion

3.1 Potential of solar energy

Solar energy is a renewable energy that is environmentally friendly, cost-effective and very abundant. The utilization process is much easier and can be adapted to geographic, installation, operation and maintenance conditions. The heat and thermal from solar energy can be converted into electrical energy using photovoltaic (PV) cells. Electricity generated by PV can be stored in batteries or batteries as power storage for use as needed.

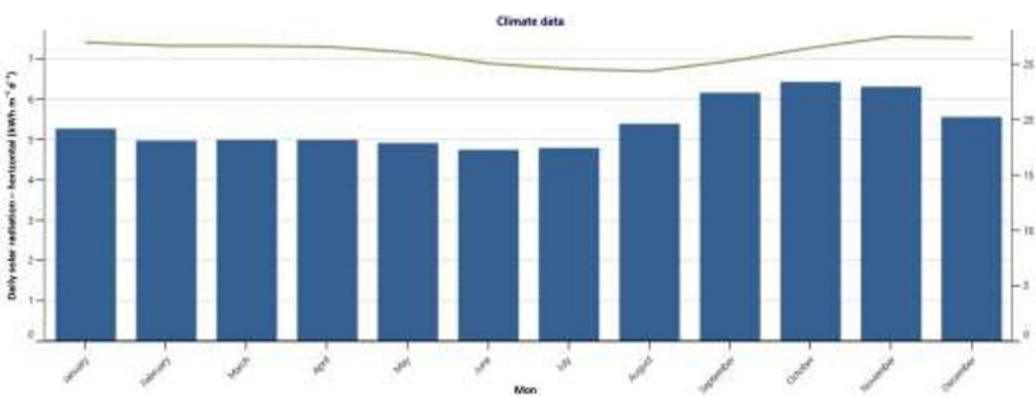

Fig. 4. Data measurement of solar energy per yr

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Figure 4 shows the potential of solar energy that shines every month. The average value of irradiation is 5.38 kWh m^{-2} d^{-1} and reached the highest rate of 6.43 kWh m^{-2} d^{-1} in October. Hariyanto et al. [8, 9] have conducted research on PV modeling and simulation to increase output power and efficiency. The results show that the amount of power generated is greatly influenced by the intensity of the absorption of photon energy from sunlight. The largest photon energy absorbed is then converted into electrical energy at a wavelength of 400 nm to 700 nm. While the average value of irradiation is 5.38 kWh m^{-2} d^{-1} if converted is equal to 242.88 W m^{-2}, so that the amount of power also shows the intensity of irradiation that occurs tends to be stable so it is suitable for the development of solar energy. Especially for remote areas or villages that are not reached by PLN with a low scale of electricity needs. In addition, the development of solar energy can also be used as a water heater and dryer for daily needs.

3.2 Potential of wind energy

Wind energy can be utilized by using a propeller or windmill. The wind will blow turning the wheel, then turn the rotor to the generator so that it is converted into electrical energy. The potential of wind energy must have an average speed of 5 knots to be generated. The results of wind speed measurements are aimed at Figure 5.

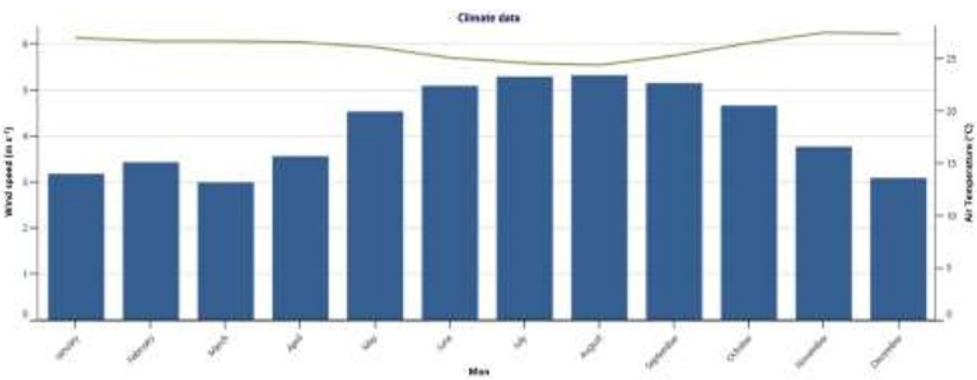

Fig. 5. Wind speed measurement data per yr

The average speed of measurement results is 4.2 m s^{-1} and reaches a peak of 5.3 m s^{-1} on August to September. Wullur et al. [10] has conducted research on the potential of wind power plants in the Merauke Regency using windmills of the P-200 W and JPS-200 models. The results show that the JPS-200 windmill model produces 39.46 W power better than the P-200 W windmill model with a power of 38.07 W.

These results indicate the potential of wind energy that can be applied to low scale needs. It needs to be redeveloped windmill models that can provide greater additional power. The potential for wind and solar energy can be realized through renewable energy-based smart microgrids, as has been done by several researchers [11, 12].

3.3 Biomass energy potential

Agricultural and plantation wastes are one source of raw materials for making and creating biomass. Sahupala and Parenden [13] have conducted research on the utilization of wood company waste at PT. Medco Papua in Merauke. The resulting wood waste is processed and used as fuel for steam power plants to meet electricity needs in the area of the company. While Prasetyo et al. [14] have conducted research on the utilization of rice straw waste which is processed into briquettes as an alternative fuel. The best briquette efficiency reaches 14.6 6 % with a low total production cost. Waste from agricultural and plantation land if properly managed has great potential as renewable energy as a biomass power plant.

Household scale biogas is a relatively cheap and easy application of biomass energy. This biogas digester can be built individually or communally, using feedstock, i.e. kitchen waste, tree leaves, grasses, and others. The digester can be connected to a drain from latrine(s) or livestock waste to improve environmental health and biogas productivity. The application of biogas multi-feed will result in multi-use recycling [5, 15, 16]

Merauke Regency has quite extensive oil palm plantations [17–19]. Palm oil mill produces waste that has great potential for biomass power generation [20, 21]. Sota Coffee is the name of a local coffee from the famous Merauke Regency [22]. The processing of coffee cherries into coffee beans produces waste that has the potential to pollute the environment [23]. Solid waste from coffee processing, namely husks and pulps, are suitable as feedstock for biogas [24]. The problem of husks and pulps, which have low density, can be overcome by two-stage digester [25]. The potensial technology of husks and coffee pulps into other bioenergy, including bioethanol and bio briquettes, has been described in Abdullah et al. [5].

4 Conclusion

The results of the analysis of the potential of renewable energy using the RETScreen Expert show that Merauke district has renewable energy potential that can be utilized as electricity generation, including solar energy, wind energy, and biomass energy. But of the three most potentials are solar energy and biomass. This is due to the abundance of raw materials and sufficient irradiation intensity. Local government assistance is needed to collaborate with designing policies to move away from dependence on fossil energy or petroleum.

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