

The Potential of Utilizing Solar Power Plants in the City of Gorontalo in Supporting a Green City

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Gorontalo Province is developing and utilizing new and renewable energy to support a green city due to the increasing demand for electricity, which exceeds the available supply of existing electric energy. Power outages still occur frequently and are a sign that the existing electricity supply, which is interconnected with the Minahasa system and the existing Gorontalo system, is no longer able to meet the electricity needs of the community and the industry. This demand will only continue to increase, which calls for greater development in the field of renewable energy. Therefore, in the development of new renewable energy, an analysis of electricity, in terms of the economy and the environment is necessary as the dynamics of the development process will have an impact on society, both positive and negative. Based on this background, this study will examine how the construction of an electric power plant utilizing new renewable energy will impact the people in Gorontalo Province. From monitoring of Thursday, September 26, 2019, we obtained data on the ultraviolet index, 3.5 (moderate), and wind speed: moderate breeze, southeast: 4-11 km / h, moderate wind, southeast: 18-25 km / h and moderate wind, south-east: 18-25 km / h. Based on predicted irradiation, the sun in Gorontalo City will intensify until 2022 with UV values: 51.1%.

Key words: *Solar power, wind power, Gorontalo city, green energy.*



Introduction

Gorontalo Province is developing and utilizing new and renewable energy to support a green city due to the increasing demand for electricity, which exceeds the available supply of existing electric energy. Power outages still occur frequently and are a sign that the existing electricity supply, which is interconnected with the Minahasa system and the existing Gorontalo system, is no longer able to meet the electricity needs of the community and the industry. This demand will only continue to increase, which calls for greater development in the field of renewable energy. Therefore, in the development of new renewable energy, an analysis of electricity, in terms of the economy and the environment is necessary as the dynamics of the development process will have an impact on society, both positive and negative.

Renewable energy is non-fossil energy that can be renewed and managed properly. Therefore, renewable energy resources will be sustainable. Those that can be classified as renewable energy are geothermal, water, solar, wind, biomass, marine, fuel cells, and nuclear. (Lubis, 2007)

The Indonesian territory around the equator is the meeting area of Hadley, Walker and local circulation. This condition is suspected to have wind potential that can be used for the development of renewable energy as an alternative to power plants that have been using more petroleum fuels. The Sulawesi and Maluku regions are located in the eastern part of Indonesia, which consists of hundreds of small islands, most of which are populated. In line with the times, the electricity demand in the area is increasing. There is meeting the demand for electricity is a problem, particularly in the wake of diesel power plants that are highly dependent on fossil fuels and have the potential to cause pollution to the environment (Habibie, Sasmito, & Kurniawan, 2008).

The availability of reliable energy is one of the prerequisites to guarantee Indonesia's sustainable economic growth. The National Energy General Plan (RUEN) is a central government policy regarding national energy management plans, which elaborate the implementation plan of cross-national National Energy Policies (KEN) for the sector to achieve national energy policy goals that aim to realize energy security and independence. (Dinas ESDM, 2019)

Gorontalo Province was formed as a result of the division of the North Sulawesi region, so that Gorontalo Province is the youngest province on Sulawesi Island. As the youngest province of existing facilities can be felt to be insufficient, so development is still needed in all sectors. Development in all sectors of the Gorontalo Province is intended to encourage an increase in the economy which will ultimately increase regional income. (Nurdyastuti, 2000)

The condition of the city of Gorontalo, which is a coastal suburb, has the potential of wind energy that is available almost every day. Noting this situation, a study is needed to examine the potential of wind power in this region with the aim of converting it to electric energy that can be generated. (Alimuddin, Daud, Sam, & Patabang, 2005)

The availability of energy in a sustainable and integrated manner can be accomplished if it is supported by long-term energy planning in the Province of Gorontalo. Limited energy can be supplied by the data on potential local energy resources. Alternative uses of energy technology are needed to support success in the long-term of the energy supply strategy (Nurdyastuti, 2000)

Indonesia actually has a large number of potential renewable energy sources. Some of them can be immediately applied in the country, such as: bioethanol as a substitute for gasoline, biodiesel to replace diesel, geothermal power, micro hydro, solar power, and wind power. Indeed, even garbage and waste can be used to generate electricity. Almost all of these energy sources have been applied on a small scale in the country.

The benefits of this research are statements about its usefulness for the development of knowledge and its application in society. This section contains a description of new findings and their benefits for both people's lives and the development of science, which can be used by other scientists to develop existing projects, technology, and art (IPTEKS), as well as other benefits for society.

To predict the potential for new and renewable energy power plants, the most optimal view, in respect to electricity, economy, and the pollution generated, of electrical sources in this case is the State Electricity Company (PLN) in Gorontalo City. Accordingly, researchers take the topic of the potential in solar energy utilization in Gorontalo City in supporting a Green City.

Research Methods

This paper is non-experimental using quantitative methods. The primary data was obtained from processed data sourced from agencies and institutions of the Central Statistics Agency (BPS) and the ESDM Office related to the utilization of solar and wind energy. Researchers conducted direct monitoring as primary data using the BMKG website, which was conducted in realtime. This research examines the potential of renewable energy, especially solar and wind energy, in Gorontalo City (Ms, Ibrochim, & Belakang, 2002).

The research method used in this paper comprises several stages: the study of the potential prediction of solar and wind energy sources in Gorontalo City, the prediction study of

ultraviolet ink (UV) and wind speed in Gorontalo City, the study of the potential of solar energy and wind energy as alternative energy in the City Gorontalo, and system design.

Simulation with the input data in the form of ultraviolet index (UV) data and wind speed data was then conducted. The limitation in this study is the ultraviolet (UV) index data and wind speed data. The results of data collection considered the three (3) year period of March 2016-March 2018.

Result

Renewable energy resources are easily accessed by humans throughout the world. Renewable energy is not only available in a wide range, but is also abundant in nature. The renewable energy sector currently fulfills 13.5% of global energy demand. The renewable energy sector is now growing faster than the growth of the overall energy market in India. Switching to renewable energy sources for electricity generation benefits the economy, as well as those in the establishment of regulatory commissions from an environmental perspective. (Sahoo, 2016) As technological advances cannot be denied, the need for electricity continues to grow, while oil and gas will not be able to maintain their share of supply so far in the future. Oil and natural gas will contribute significantly for 30 years at most at the current rate of use, but do not have the prospect of long-term expansion. A double increase in world energy demands with the use of oil and gas maintained at current levels would require three and a half times the increase from other sources. So, there will be an increase in extra energy requirements that can only be present from coal, nuclear or renewable energy sources, and possibly from the mixing of the three. Meanwhile, nuclear power as an alternative source of diversification of electrical energy is still overshadowed by the dangers of radioactive pollution and the handling of complicated and expensive waste, introducing for some a very high level of risk. (Arif Febriansyah Juwito, Sasongko Pramonohadi, 2012)

Indonesia is abundant with natural resources that can be utilized for renewable energy with the large potential for 75,000 MW of hydro, 29,475 MW of geothermal, 32,000 MW of biomass, 4.80 kWh / m² / day for solar, 3-6 m / s for wind and hybrid, 61 MW for ocean, and 3,000 MW for uranium. Including the Gorontalo Province, Indonesia is developing ways of utilizing new and renewable energy due to the increasing demand for electrical energy, which at this time is not comparable with the available supply of existing electrical energy. Power outages still often occur and is a sign that the existing electricity supply, which is interconnected with the Minahasa system and the Gorontalo system, is no longer able to meet the electricity needs of the community and an industry which continues to increase. The local government is tirelessly attempting to develop the field of New renewable energy. The projects being developed are: PLMH 2.30 MW, PLTS 2 MWp, PLTBM 500 KW, PLTG 100 MW and PLTB 20 MW. Therefore, in the development of renewable energy, an analysis of the environment is needed,

as, in the dynamic development process, it will always have an impact on society, both positive and negative.

Table 1: Average solar irradiance index, and solar radiation by month in Gorontalo City, 2016 – 2018

N0	Month	Index UV (%)		
		2016	2017	2018
1	Jan	65,84	49,5	45.1
2	Feb	61,00	52,8	51.7
3	Mar	74,65	53,6	60.1
4	Apr	73,53	58,0	59.6
5	May	74,35	55,6	68.4
6	Jun	64,22	42,7	55.3
7	Jul	84,94	45,9	67.1
8	Aug	83,00	48,2	76
9	Sep	91,80	46,0	79.9
10	Oct	82,65	51,6	70.8
11	Nov	71,33	59,6	63.3
12	Dec	73,65	50,9	44.8

Based on observers of the Gorontalo Province Meteorology and Geophysics Agency in 2016, solar irradiance in Gorontalo City experienced a drastic increase from January to December, with the lowest percentage of 61% in February and the highest percentage of 91.8% in September.

The average index of solar radiation, and solar radiation by month in Gorontalo City, 2017, shows that solar radiation in Gorontalo City has decreased with the lowest percentage of 42.7% in June and the highest percentage of 59.6% in November.

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Solar Energy Potential

Solar energy is the energy produced by the sun. In many parts of the world, direct solar radiation is considered one of the best prospective energy sources. Solar radiation, the main pathway to energy, is an active and passive solar design. Passive solar design is often based on the optimal design of the output build-energy of the module. To identify the electrical

parameters of solar cells and photovoltaic modules is to determine the appropriate maximum power point of the voltage-current characteristic that lights up. To present an optimization algorithm is to design a linear concentrate solar collector using stochastic programming and Monte Carlo techniques to measure the performance of the collector design in terms of objective functions, which are then minimized using an modified Kiefer-Wolfowitz algorithm that uses sample size and step size control (Reviews, Ba, & Antonio, 2011).

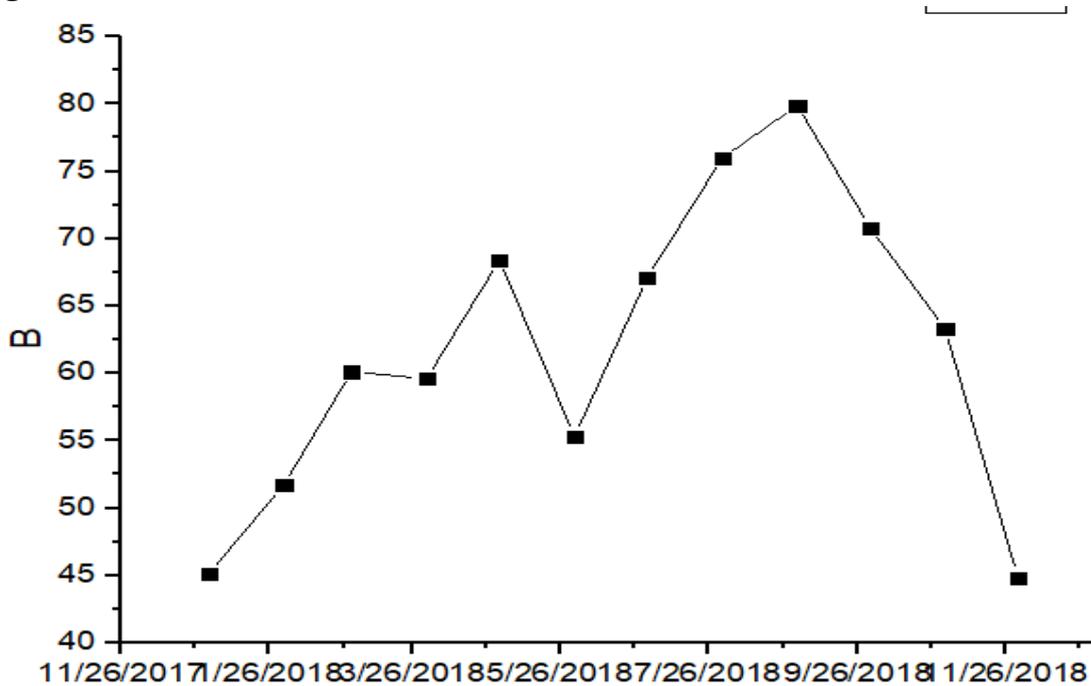
The placement of solar panels on rooftops, or the roofs of buildings by utilizing the roof area as a PLTS device, especially solar panels, is considered to be very effective because it can be exposed directly to the PLN rays. Network disruptions, however, may disturb electricity supplies. This is due to the occurrence of software issues that need to be updated and problems with the protection system where the system has failed on the battery inverter so that it cannot supply the already sunny PLN network. Rooftop PLTS is currently one of the PLTS utilization programs from the Ministry of Energy and Mineral Resources and is mostly used to increase the efficiency or to optimize electricity usage in a building. (Panunggul et al., 2018)

Figure 1. Solar power generation (personal documentation)



From Figure 2. The graph below shows solar radiation in Gorontalo City from 2016 to 2018 has decreased in sunlight.

Figure 2. Data on solar radiation in 2016 – 2018



We did an ultraviolet index and wind speed monitor:

Figure 3. Data on wind speed and ultraviolet index in Gorontalo City.



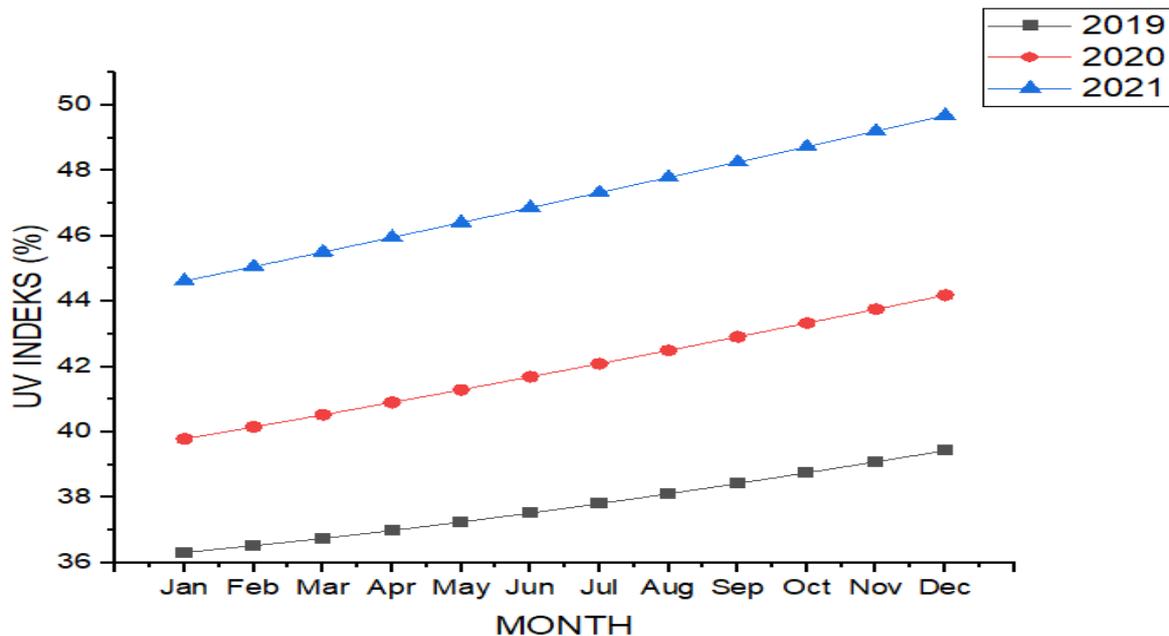
From the monitoring of Thursday, September 26, 2019, we obtained data on ultraviolet index 3.5 (moderate) and wind speed: moderate gusts, south-east: 4-11 Km / h, moderate gusts, south-east: 18-25 km / h and moderate breeze, southeast: 18-25 km / h.

After monitoring directly, the researcher made a prediction based on the ultraviolet index data starting from 2016 to 2018, the data obtained is as shown in table 4.

Table 2. Prediction data for solar radiation.

N0	Month	UV Index (%)		
		2016	2017	2018
1	Jan	36.3	39.8	44.6
2	Feb	36.5	40.2	45.1
3	Mar	36.7	40.5	45.5
4	Apr	37.0	40.9	46.0
5	May	37.2	41.3	46.4
6	Jun	37.5	41.7	46.9
7	Jul	37.8	42.1	47.3
8	Aug	38.1	42.5	47.8
9	Sep	38.4	42.9	48.3
10	Oct	38.8	43.3	48.7
11	Nov	39.1	43.8	49.2
12	Dec	39.4	44.2	49.7

Figure 4. Prediction data for solar radiation.





Based on the graph in Figure 4. The solar irradiation index has increased because of that Gorontalo City has the potential to develop solar power plants.

Conclusions

1. Average solar radiation from years:
 - a. 2019 = 37,7
 - b. 2020 = 41,9
 - c. 2021 = 47,1
2. Monitoring results of the ultraviolet index 3.5 (moderate) and wind speed: moderate gusts, south-east: 4-11 Km / h, moderate gusts, south-east: 18-25 km / h and moderate gusts, south- east: 18-25 km / h.
3. Gorontalo City uses renewable energy in order to apply energy security in the utilization of its electricity resources based on: Availability, Accessibility, Affordability, and Sustainability.

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