# Tidal Energy Potential Of Sea Water (Case Study In Kelabat Bay, Bangka Island)

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**Abstract**

Alternative energy is a renewable energy source, such as solar, wind, water, biomass, and geothermal. Indonesia is one of the many countries in the world that has a wealth of abundant energy resources. Various energy sources exist in Indonesia, which can then be used as a source or power plant. Tidal energy is the utilization of the energy generated in the mass transfer of water due to tides with the effects of the earth's rotation and the moon's gravity. This energy is widely available in the strait because the strait is narrowing the space for current movement so that the current speed becomes faster. One of them is the Kelabat Bay; Bangka Belitung Islands Province is located at 104°50' to 109°30' East Longitude and 0°50' to 4°10' South Latitude. The method used in this study is the Qualitative Method, which only requires processing the available data. This study aims to determine the potential energy that can be generated from tides. The shortage of electrical energy supply in Indonesia demands a solution through the procurement of renewable energy power plants in Indonesia, one of which is utilizing the tides of seawater as potential electrical energy. Using renewable energy (renewable) can be one solution to the limitations of fossil energy; therefore, renewable energy (renewable) is very beneficial for people around the coast. From the results of tidal observations during October, the highest tide was 2.8 m and the lowest ebb was 0.2 m. With the biggest difference in height that is 2.6 m and the lowest is 0.8 m. With an average height difference of 1.73 m and a pool area of around 87267.735 m2 the per cycle energy potential is 6000 kJ per cycle per day. If in a year there are around 700 cycles, the total energy potential in 1 year is around 3.9 GJ. The electric potential that can be generated in 1 cycle is around 24kW. If the power is calculated in hours and calculated per day, then the available electricity potential is around 68 MW per day and will produce around 2400 MW per month.

***Key words*** : Pollution Reduction, Renewable Energy, Tidal Energy, Tidal Power, Tidal Potential

## 1. Introduction

The energy crisis is a very fundamental problem in Indonesia, especially the problem of electrical energy. Electrical energy is energy that is very necessary for modern humans. It is inconceivable that during this incident what would happen if suddenly the electricity went out, then all activities related to electricity could stop instantly. Power outages in various areas/places, due to the inability of the available power to be less than the peak load requirement. Some of the existing generators are sometimes not all operational, due to damage or annual repairs. A new innovation by utilizing alternative energy sources which until now has not been used as a solution to overcome electricity problems was developed through this research (Sangari, 2014). Alternative energy is a renewable energy source that will always be

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available, for example solar, wind, water, biomass and geothermal. Unlike petroleum or coal, it is a fossil energy that can run out. In addition, in the long term, alternative energy does not produce waste that will harm the environment. If production costs are not a priority, then this energy does not need to be purchased, because it only requires costs for installation, which can then be operated without using fuel. This is of course different from fossil fuel generators in that the operation requires quite a large amount of money (Agus Mahardiananta et al., 2017).

Increasing energy needs lead to reduced energy that is important in everyday life. So that most of Indonesia uses conventional energy. Conventional energy is energy that cannot be renewed (Unrenewable) and if it is used continuously it will run out like petroleum. The use of conventional energy not only has an impact on the energy shortage crisis but also has an impact on the environmental crisis because it is non-renewable (Maulani et al., 2012). Energy is one of the most important needs for human life and a reliable supply of energy is essential for the survival of modern society. Currently, around 80% of global energy consumption is provided by fossil fuels (Orhan et al., 2015). Conventional energy sources in the form of fossil energy which is the main energy source in Indonesia are increasingly limited in reserves so that it is very difficult for people to obtain in meeting their daily needs as well as for power plants. Most of the electricity demand in Indonesia is still supplied by fossil fuel power plants. Crude oil still ranks highest in dependence on fossil-fuel energy consumption and has not yet utilized new, renewable energy sources. One way out of this problem is to utilize the surrounding energy to become renewable energy (Haurissa & Aibekob, 2016).

To get fossil energy sources, you have to go through various processes and it is difficult to get them, because they are generally found on the surface of the earth. In addition, reserves of fossil energy resources are starting to decrease, because these energy sources are non-renewable. Energy sources known as renewable energy sources as mentioned above include water energy, wind energy, solar energy, geothermal energy, and nuclear energy. All of these energies meet the criteria so that in their utilization they can save the limited use of fossil energy. Indonesia is an archipelagic country located on the equator which has abundant potential sources of new and renewable energy, while those that have been utilized are still very small, so it is possible to increase the utilization of energy sources that are environmentally friendly, inexpensive and renewable. Therefore we need a generating system that is efficient, easy to distribute and environmentally friendly in each region in Indonesia and promotes the use of energy sources other than fossil fuels for generation processes such as water and ocean currents. Indonesia is an archipelagic country that has a long coastline, most of Indonesia's territory is in the form of waters, has an area three times larger than the land area. Indonesia has great potential for the power of ocean currents and tides. As an archipelagic country, Indonesia is surrounded by the Indian and Pacific oceans (Agus Mahardiananta et al., 2017).

Along with the ever-increasing times, the need for energy is also increasing, so that energy is a very important element in the development of a country or a region. Therefore the utilization of energy in an appropriate manner will be a powerful way in the development of this era. In most countries in the world, including Indonesia, the supply of electrical energy still relies on generators from fossil fuels, namely petroleum, natural gas and coal which are limited in nature and will run out one day, while the demand for electrical energy continues to grow. Therefore the use of energy at this time has been directed at the use of renewable energy that exists in nature. Renewable energy is an alternative energy source with very promising potential to be used as a source of electrical energy in the future. Indonesia's geographical position between two oceans and continents and on the equator, so that it has abundant potential for renewable sources (Lopulalan et al., 2016). If not paid special attention, the use of electrical energy in Indonesia may experience a crisis. The use of oil, coal and natural gas power plants needs to be treated wisely, because these energy sources can run out due to dwindling supplies. To help overcome this, it is necessary to look for alternative sources of electrical energy (Al Ghifari et al., 2017)

Water energy is a cheap energy source and relatively easy to obtain. Electrical and mechanical energy is a form of utilizing water energy. The energy possessed by water can be harnessed and used in the form of mechanical energy or electrical energy. Energy included in the water energy category is river energy, wave energy, ocean thermal energy (OTEC), tidal energy, and ocean current energy. River hydropower harnesses the energy of water moving from high to low levels. The amount of electricity that can be generated depends on the amount of water falling and the speed of the water flow, a small hydro system captures the energy of the river without taking a lot of water from its natural flow, so that the use of this energy is environmentally friendly. Waves are the movement of sea water up and down or rolling. Utilization of energy from waves is obtained from the effects of air pressure movements due to fluctuations in wave movements. Places that have the potential to have large and stable wave rates are places where this energy generation can be carried out. One of the renewable energies is tidal energy. In principle, this energy is the same as hydroelectric power. Tidal energy is the utilization of energy generated in the mass transfer of water due to tides with the effects of the earth's rotation and the moon's gravity. In the ocean there is a very wide movement called currents. The wind that blows over the surface of the sea will generate surface currents. In addition, the movement of surface currents is also influenced by the topography of the sea surface (Agus Mahardiananta et al., 2017).

Apart from having an endless supply, this technology is also friendly to the environment and can be obtained free of charge. Indonesia, with a water area of nearly 60% of the total area of 1.929,317 km², should have been able to apply this alternative technology. Moreover, with an east to west stretch of 5,150 km and a north to south stretch of 1.930 km, Indonesia has been positioned as the country with the longest coastline in the world. During the rainy season, the wind generally moves from the north to the northwest with moisture from the South China Sea and the Bay of Bengal. During the western monsoon, sea waves rise more than usual around the island of Java. This natural phenomenon makes it easier to manufacture the tidal technique. The tides can also be predicted by the BMKG so that it also makes it easier to make the tidal technique. Tides are a phenomenon of the periodic rise and fall of sea levels caused by a combination of gravitational forces and the attractive forces of astronomical objects, especially the sun, earth and moon. Therefore, sea level is not static but dynamic and always moving. Indonesia is an archipelagic country surrounded by two oceans, namely the Indian Ocean and the Pacific Ocean and its position is on the equator so that the conditions of tides, wind, waves and sea currents are quite large (Haurissa & Aibekob, 2016).

According to Pariwono (1989), the phenomenon of tides is defined as the periodic rise and fall of sea level due to the gravitational pull of celestial bodies, especially the sun and moon, against the mass of water on earth. Likewise, according to Dronkers (1964) sea tides are a phenomenon of the periodic rise and fall of sea levels caused by a combination of gravitational forces and the attractive forces of astronomical objects, especially by the sun, earth and moon. The influence of other celestial bodies can be neglected because they are farther away, and smaller in size. Ocean tides are the result of gravitational attraction and centrifugal effect. Centrifugal effects is a push to outside of the center of rotation. Gravity is directly proportional to mass, but inversely proportional to distance. Even though the moon is smaller than the sun, the moon's gravitational pull is two times greater than the sun's pull in generating ocean tides. This is because the moon is closer than the sun is to Earth. The gravitational pull pulls the ocean water toward the moon and sun and produces two gravitational tidal bulges in the ocean. The latitude of the tidal bulge is determined by the declination, the angle between the earth's axis of rotation and the orbital planes of the moon and sun (Gross, 1990).

The factors that cause tides based on the theory of equilibrium are the rotation of the earth on its axis, and the revolution of the moon to the sun, the revolution of the earth to the sun. While based on the dynamic theory is the depth and breadth of the waters, the influence of the earth's rotation (Coriolis force), and bottom friction. In addition, there are also several local factors that can affect tides in certain waters, such as the topography of the seabed, the width of the strait, the shape of the bay, and so on, so that various locations have different tidal characteristics (Wyrtki, 1961). According to Wyrtki (1961), tides in Indonesia are divided into 4, namely: single daily tides (Diurnal Tide), double daily tides (Semi Diurnal Tide), mixed single daily inclined tides (Mixed Tide, Prevailing Diurnal), and mixed tides. Mixed Tide, Prevailing Semi Diurnal Single daily tide (Diurnal Tide) Is a tide that only occurs once and only once in one day, this is in the Karimata Strait. Double daily tides (Semi Diurnal Tide) are tides that occur twice highs and two lows of almost the same height in one day, this is from the Malacca Strait to the Andaman Sea. Mixed Tide, Prevailing Diurnal) are tides that occur one high and one low each day, but sometimes with two highs and two lows which are very different in height and time, this is found on the South Coast Kalimantan and the North Coast of West Java. Mixed Tide, Prevailing Semi Diurnal, are tides that occur two highs and two lows a day, but sometimes there is one high and one low low with a different height and time, this is found on the beach. Southern Java and Eastern Indonesia. Ocean tides are the relative motion of the material of a planet, stars and other celestial bodies caused by the gravitational force of the celestial body from outside the material is located, so that the rise and fall of sea level occurs accompanied by horizontal movements of water masses.

The non-astronomical factors that affect the height of the tidal wave are the water depth and meteorological conditions and other hydrographical factors. Tides are not only a phenomenon of the rise and fall of seawater vertically but also a phenomenon of horizontal seawater movement (Haryono, et al., 2007). Tides move large amounts of water every day and their use can generate relatively large amounts of energy. In a day there can be up to two tidal cycles. Since cycle times are predictable (approximately every 12.5 hours), the electricity supply is also more reliable than wave power plants. The basic principle of tidal power generation is the dynamics of the turbine movement which is technically installed at the confluence of the river mouth and the sea, the utilization of potential energy from tide to ebb and vice versa is used to drive the turbine, which is shown in Figure 1.

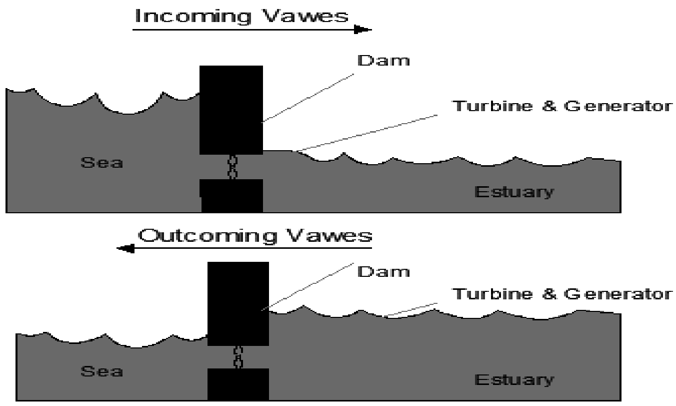


Fig. 1 Tidal scheme.

Tidal power has several advantages. Among them is that tidal power is a renewable energy source because the tides on our planet are caused by the interaction of the gravitational forces between the Moon and the Sun, as well as the rotation of the earth, which means that tidal power is inexhaustible. One big advantage that tidal power has over some other renewable energy sources (especially wind energy) is that tidal power is a very reliable source of energy. This is understandable because we can predict when the tide will rise and then recede, because the tides are much more cyclic than random weather patterns. Also, tidal power does not produce greenhouse gases like fossil fuels. Hazardous waste like this is also feared to occur in the use of nuclear energy. Small reservoirs and dams needed to harness tidal power can also play a very important role in protecting nearby towns or harbors from the dangerous waves during a storm (Sangari, 2014).

Tidal power is a very efficient energy source, with an efficiency of 80.00%, this means that the efficiency of tidal energy is almost three times greater than that of coal and petroleum which have an efficiency of 30.00%. Likewise significantly higher efficiency of solar and wind energy. The main drawback of tidal energy is that tidal power plants are very expensive to build. Tidal power when compared to the construction of power plants/fossil fuels is more expensive. However, tidal power plants are built only once and maintenance costs are relatively low. Likewise in real life, tidal energy can only be generated on beaches with good tidal differentials, meaning that there are not many locations that are really suitable for this type of tidal power generation, and only generate electricity during a tidal wave that averages approx. 10 hours every day (Sumotarto, 2012).

Research on the characteristics of ocean currents with the aim of knowing the characteristics of ocean currents in each layer of water depth, knowing the correlation of wind and current movements, and knowing how big the alternative energy potential is (power density). Eulerian method used with ADCP. Currents are recorded simultaneously and continuously at each depth layer at one point location. Primary data processing uses currentrose software, while the calculation of power density uses the Fraenkel equation (Wijaksono et al., 2012). Another research on the energy of ocean currents for power generation with the aim of knowing the morphology of the seabed and hydro-oceanographic properties as a reference for the right location in the utilization of ocean current energy. The research method consists of measuring currents, observing tides, observing meteorological parameters and morphological conditions of the coast and seabed in the study area (Yuningsih & Madsuki, 2011). In research, the study of the energy potential of ocean currents with the aim of knowing the potential for electrical energy originating from the sea is based on its velocity value. Current measurement using the Lagrangian method at various research location points. Moving current measurements use GPS and transducers to obtain speed and depth data as a function of time. The measurement results were analyzed and a modeling approach was carried out using SMS (Surface-water Modeling System) to describe currents during high and low tide conditions (Aryono et al., 2014).

In addition to this, research on the characteristics of the tides and current patterns is aimed at studying the dynamics of the tidal currents and residual currents. The method used is Adiralty to obtain the harmonic constants. Harmonic analysis was carried out using the IOS method using the MIKE 21 Toolbox software to obtain the tidal current components (Surbakti, 2012). In research on the potential of Arlindo using secondary data. This study used the LADCP (Lower Acoustic Doppler Current Profiler) method mounted on the Marion Dufresne research vessel. The data is processed using MATLAB 7. The modeling approach of this study uses POM (Princeton Ocean Modeling) (Purba et al.,2010). The Indonesian Ocean Energy Association / ASELI (2011), states that the practical potential of Indonesia's marine energy is 49 GW, which consists of tidal energy potential, ocean waves and ocean heat respectively of 4.8 GW, 1.2 GW and 43 GW . Based on Indonesia's marine energy roadmap, the planned installed capacity for 2025 is 1.650 MW with details of energy coming from wave energy of 50 MW, tidal energy of 1000 MW, ocean current energy of 500 MW, and OTEC of 100 MW. Based on the roadmap, it can be seen that these four types of energy can be developed, but by looking at the installed capacity, most of them are directed at the development of tidal energy (ESDM, 2011).

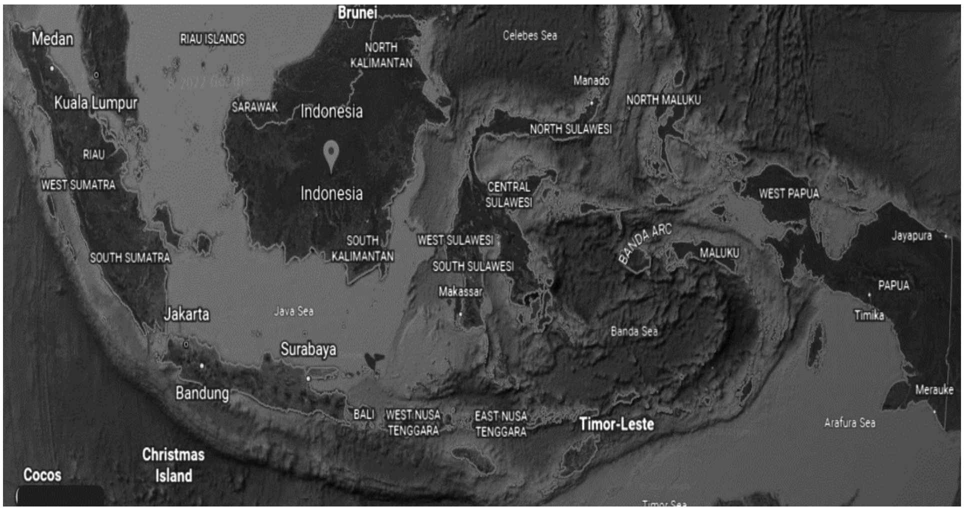


Fig. 2 Indonesia map.

The results of measuring the height of the tides in the Indonesian sea area show several offshore coastal areas of Indonesia that have quite high tides, including the sea area in East Riau, the sea and river estuaries between South Sumatra and Bangka, the sea and straits around Madura Island, the coast of East Kalimantan, and river mouths in Papua. Around Jayapura Regency, there are coastal areas that have estuaries, namely Amai Beach, Bukisi Beach and Tablanusu Beach. so that in this study an analysis of the tidal energy potential of Amai Beach, Bukisi Beach and Tablanusu Beach will be carried out. This research serves as a source of information for designing a Tidal Power Plant which will later be useful as a supplier of electricity for the local community (Haurissa & Aibekob, 2016).

By analyzing the potential of the tides it can also provide information about the potential of the tides in the estuary and can be used as renewable energy. Limited energy supply will certainly hamper the rate of industrial growth in a region. With the problem of electrical energy being resolved on the island of Bangka, it is hoped that this province can develop more, especially in the aspects of industry and trade. Furthermore, after the industry advances, it is hoped that the standard of living of the people in this area will further improve. The aim of the research is to produce a design for a tidal power plant in the Kelabat Strait.

## 2. Methodology

The method used in this research is a quantitative method. Qualitative research is research with inductive and objective methods. The data used in this research is secondary tide data using the help of the web on the Internet for 1 month of October. The research was conducted by measuring tidal data to determine the value of the highest and lowest ebb in obtaining tidal energy potential. The results of the calculation of tidal harmonic constants, obtained a high value of tidal energy potential based on the highest high water level (HHWL) and lowest low water level (LLWL) in meters. Electrical energy can be generated when filling the pool or during high tide or emptying the pool or when the sea water recedes. In this method the electrical energy generated depends on the length of production time utilization. The area of the pond used is 87267.735 $m^2$ taking into account the area of the research location. Estimates of electrical energy can be calculated from the magnitude of the pool area function and the resulting difference in tide height and discharge, namely the pool inflow volume ($m^3$):

V = A x h (1)

Information :

V : Pool volume (m3)

A : Pool area ($m^2$)

h : Tidal height difference (m)

The average water discharge can be found by the Equation:

Q =V/T (2)

Information :

T : Tidal period (seconds)

V : Pool inflow volume ($m^3$)

Q : Flow rate ($m^3$/second)

The amount of water power available from a water source depending on the size of the head and water discharge. In relation to the water reservoir, the head is the height difference between the water level in the reservoir and the water level leaving the water wheel/water turbine. The total energy available from a water reservoir is the potential energy of air, that is:

$$E = mgh \quad (3)$$

Calculation of Energy and Electrical Power can be explained as follows. The amount of energy generated per cycle, as in this equation:

$$E = \ \rho g H^2 A \quad (4)$$

By substituting P against (E/t) and substituting PQ against (m/t) then:

$$P = \rho Q h g \quad (5)$$

## 3. Data

Research on tidal potential was carried out in Kelabat Bay, Bangka Island, Bangka-Belitung Province with latitude coordinates 1 ° 35'42.50 "- 105 ° 39'52.97". Determining the location point using the help of the Google Earth Pro software. The data used is secondary data from the web https://Pasanglaut.com/. Secondary data is needed for an understanding of the condition of the research area regionally to then become a reference in field activities to retrieve primary data. Data was taken for 1 month of October. These locations are presented in Figure 3.

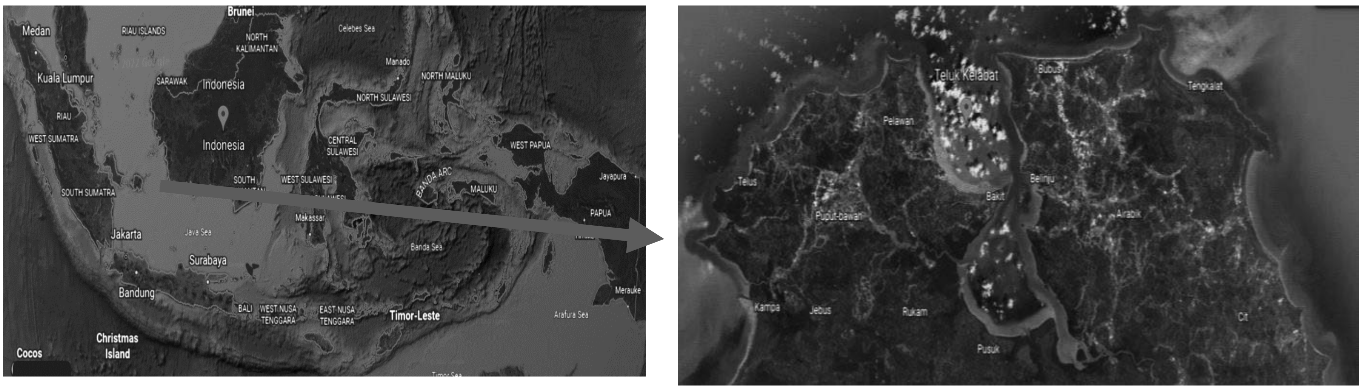


Fig. 3 Research Location.

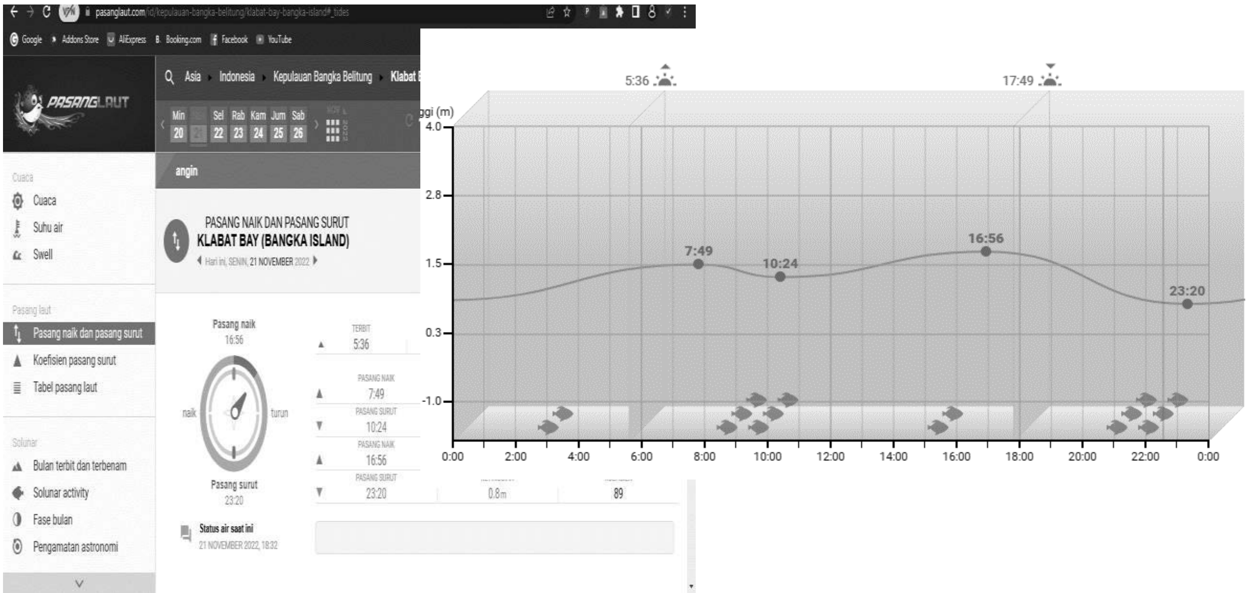


Fig. 4 Secondary data.

Table 1 Tidal measurement data.

| No | Date | Highest (M) | Lowest (M) | Average (M) |
|---|---|---|---|---|
| 1. | 01-10-2022 | 2.3 | 0.6 | 1.7 |
| 2. | 02-10-2022 | 2.4 | 0.5 | 1.9 |
| 3. | 03-10-2022 | 2.5 | 0.4 | 2.1 |
| 4. | 04-10-2022 | 2.6 | 0.4 | 2.2 |
| 5. | 05-10-2022 | 2.6 | 0.4 | 2.2 |
| 6. | 06-10-2022 | 2.7 | 0.5 | 2.2 |
| 7. | 07-10-2022 | 2.6 | 0.6 | 2 |
| 8. | 08-10-2022 | 2.5 | 0.8 | 1.7 |
| 9. | 09-10-2022 | 2.3 | 0.9 | 1.4 |
| 10. | 10-10-2022 | 2.1 | 0.9 | 1.2 |
| 11. | 11-10-2022 | 1.8 | 1 | 0.8 |
| 12. | 12-10-2022 | 1.9 | 0.9 | 1 |
| 13. | 13-10-2022 | 2.2 | 0.8 | 1.4 |
| 14. | 14-10-2022 | 2.3 | 0.8 | 1.5 |
| 15. | 15-10-2022 | 2.5 | 0.6 | 1.9 |
| 16. | 16-10-2022 | 2.5 | 0.5 | 2 |
| 17. | 17-10-2022 | 2.5 | 0.4 | 2.1 |
| 18. | 18-10-2022 | 2.5 | 0.4 | 2.1 |
| 19. | 19-10-2022 | 2.5 | 0.4 | 2.1 |
| 20. | 20-10-2022 | 2.5 | 0.5 | 2 |
| 21. | 21-10-2022 | 2.4 | 0.7 | 1.7 |
| 22. | 22-10-2022 | 2.2 | 0.8 | 1.4 |
| 23. | 23-10-2022 | 2.1 | 1 | 1.1 |
| 24. | 24-10-2022 | 1.8 | 1 | 0.8 |
| 25. | 25-10-2022 | 1.8 | 1 | 0.8 |
| 26. | 26-10-2022 | 2.1 | 0.8 | 1.3 |
| 27. | 27-10-2022 | 2.3 | 0.7 | 1.6 |

| | | | | |
|---|---|---|---|---|
| 28. | 28-10-2022 | 2.5 | 0.6 | 1.9 |
| 29. | 29-10-2022 | 2.7 | 0.4 | 2.3 |
| 30. | 30-10-2022 | 2.8 | 0.3 | 2.5 |
| 31. | 31-10-2022 | 2.8 | 0.2 | 2.6 |

## 4. Result and Discussion

Tidal energy is obtained from the process of sea tides and ebbs. During high tide, the reservoir will be filled with seawater through the water holes. While at low tide the water will flow out of the reservoir through water turbines and water holes. The time of this ups and downs process is 24 hours. When the sea water is at its highest tide it is called spring tide and at its lowest tide it is called neap tide (mande). This includes a review of the potential for tidal energy to generate electrical energy. Our study focuses on calculating the electrical energy generated from the tides using Dam equipment to be used in Kelabat Bay, and calculating the number of homes that can use electricity. From the results above, it can be seen that the tidal range in Bangka waters can reach almost 3 meters, so that the tides at that location have the potential to be developed as an energy generator. This means that in one day there is one ups and downs. The energy and electrical power from the tides have been calculated according to the method in the previous section. In table 2 below, the total amount of electrical energy per month that can be obtained from tidal energy in Kelabat Bay is calculated. The power column is the amount of potential tidal energy that can be converted or generated into electrical energy.

Data collection on tidal potential was carried out in Kelabat Bay using assistance from Google Earth Pro. Tidal Potential data collection was carried out at these places because these three places have estuaries that have great potential as sources of renewable energy. The results of retrieval of tidal data are taken daily from the web that has been explained. The high and low tide data is taken based on the data in table 1.


Fig. 5 Pool area.

Depth and width data where data is taken, taken using the website https://www.navionics.com/aus/. The Navionics® brand of electronic cartography for the leisure boating market was established in 1984 in Viareggio, Italy. It all started with a revolutionary idea: the world's first electronic chart display — the chartplotter. Data on the depth and width of the place where the data is collected is needed to calculate the cross-sectional area of the place where the data is taken.

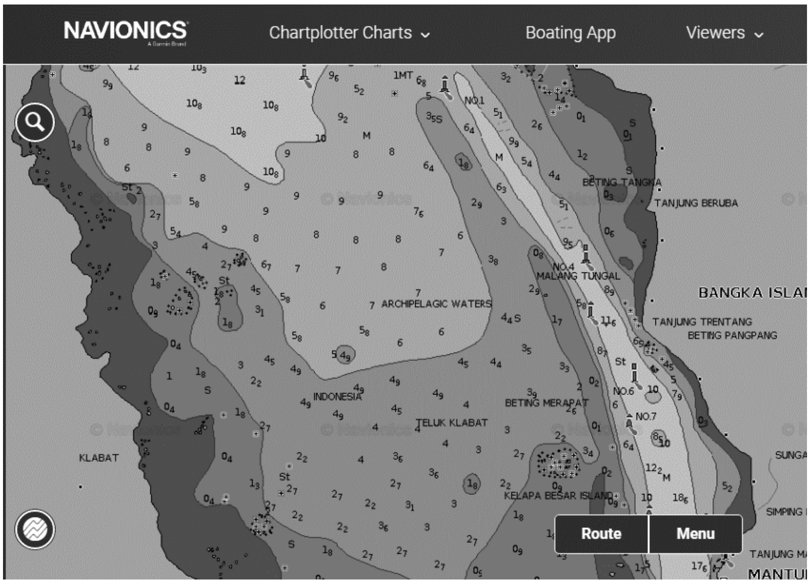


Fig. 5 Depth data.

Based on the results of data collection, the highest tide was on October 30 and 31, namely 2.8 m and the lowest was on October 31 of 0.2 m. This data will be calculated mathematically using a formula in order to get how much Tidal potential the location of the data is taken from. From the results of calculations of potential tidal data at the data collection location, the following results are obtained which are entered in Table 2.

Table 2 Energy potential.

| **No** | **Date** | **Height (m)** | **Volume (m^3)** | **Debit (m^3/s)** | **Energy (kJ)** | **Power (Watt)** | **Energy Conversion** |
|---|---|---|---|---|---|---|---|
| 1. | 01/10/2022 | 1,7 | 148355,150 | 41,210 | 4311,152 | 704,437 | 493,106 |
| 2. | 02/10/2022 | 1,9 | 165808,697 | 46,058 | 6018,765 | 879,936 | 615,955 |
| 3. | 03/10/2022 | 2,1 | 183262,244 | 50,906 | 8126,517 | 1074,936 | 752,455 |
| 4. | 04/10/2022 | 2,2 | 191989,017 | 53,330 | 9343,608 | 1179,749 | 825,824 |
| 5. | 05/10/2022 | 2,2 | 191989,017 | 53,330 | 9343,608 | 1179,749 | 825,824 |
| 6. | 06/10/2022 | 2,2 | 191989,017 | 53,330 | 9343,608 | 1179,749 | 825,824 |
| 7. | 07/10/2022 | 2 | 174535,470 | 48,482 | 7019,991 | 974,999 | 682,499 |
| 8. | 08/10/2022 | 1,7 | 148355,150 | 41,210 | 4311,152 | 704,437 | 493,106 |
| 9. | 09/10/2022 | 1,4 | 122174,829 | 33,937 | 2407,857 | 477,749 | 334,425 |
| 10. | 10/10/2022 | 1,2 | 104721,282 | 29,089 | 1516,318 | 351,000 | 245,700 |
| 11. | 11/10/2022 | 0,8 | 69814,188 | 19,393 | 449,279 | 156,000 | 109,200 |
| 12. | 12/10/2022 | 1 | 87267,735 | 24,241 | 877,499 | 243,750 | 170,625 |
| 13. | 13/10/2022 | 1,4 | 122174,829 | 33,937 | 2407,857 | 477,749 | 334,425 |
| 14. | 14/10/2022 | 1,5 | 130901,603 | 36,362 | 2961,559 | 548,437 | 383,906 |
| 15. | 15/10/2022 | 1,9 | 165808,697 | 46,058 | 6018,765 | 879,936 | 615,955 |
| 16. | 16/10/2022 | 2 | 174535,470 | 48,482 | 7019,991 | 974,999 | 682,499 |
| 17. | 17/10/2022 | 2,1 | 183262,244 | 50,906 | 8126,517 | 1074,936 | 752,455 |
| 18. | 18/10/2022 | 2,1 | 183262,244 | 50,906 | 8126,517 | 1074,936 | 752,455 |
| 19. | 19/10/2022 | 2,1 | 183262,244 | 50,906 | 8126,517 | 1074,936 | 752,455 |
| 20. | 20/10/2022 | 2 | 174535,470 | 48,482 | 7019,991 | 974,999 | 682,499 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21. | 21/10/2022 | 1,7 | 148355,150 | 41,210 | 4311,152 | 704,437 | 493,106 |
| 22. | 22/10/2022 | 1,4 | 122174,829 | 33,937 | 2407,857 | 477,749 | 334,425 |
| 23. | 23/10/2022 | 1,1 | 95994,509 | 26,665 | 1167,951 | 294,937 | 206,456 |
| 24. | 24/10/2022 | 0,8 | 69814,188 | 19,393 | 449,279 | 156,000 | 109,200 |
| 25. | 25/10/2022 | 0,8 | 69814,188 | 19,393 | 449,279 | 156,000 | 109,200 |
| 26. | 26/10/2022 | 1,3 | 113448,056 | 31,513 | 1927,865 | 411,937 | 288,356 |
| 27. | 27/10/2022 | 1,6 | 139628,376 | 38,786 | 3594,235 | 623,999 | 436,799 |
| 28. | 28/10/2022 | 1,9 | 165808,697 | 46,058 | 6018,765 | 879,936 | 615,955 |
| 29. | 29/10/2022 | 2,3 | 200715,791 | 55,754 | 10676,529 | 1289,436 | 902,605 |
| 30. | 30/10/2022 | 2,5 | 218169,338 | 60,603 | 13710,920 | 1523,436 | 1066,405 |
| 31. | 31/10/2022 | 2,6 | 226896,111 | 63,027 | 15422,921 | 1647,748 | 1153,424 |

The height column is the subtraction between the highest high tide and lowest low tide in 1 day. Volume is the multiplication of the area of the olam with each difference in elevation on different dates. Debit is Volume per unit time. In this case the unit of time is converted into seconds, which is 3600 seconds. From the calculated data contained in the table above, it can be seen that the research site has the potential for renewable energy, namely tidal energy which is very good with percyclic energy produced if the average is 5581,091 kJ per day, the largest is 15,422,921 kJ and the smallest is 449,279 kJ. The potential that occurs in 1 month on average is around 173013.82 kJ per cycle. The tidal energy potential obtained based on the simulation of making a tidal pool for one month with a predetermined area obtains an energy conversion for one month of 24 KW/S per cycle.

The greater the area of the pond formed and the length of time obtained in production operations, the greater the energy potential that will be produced, so that the known energy utilization can be used as a reference in future planning development to obtain maximum tidal energy. After knowing the tidal harmonic constant value and the Kelabat Bay value, then the value of the tidal range obtained from the difference between the HHWL value minus the LLWL value is entered into the tidal energy formula. After obtaining the tidal range value, it can be said that Kelabat Bay has the potential as a place to utilize tidal energy as an alternative energy for generating electricity. The ebb and flow value is then entered into the tidal energy formula and the potential value of tidal energy is obtained using 1 month of observational data that can be generated into electrical energy is around 17 KW/S per cycle. The tidal range obtained from observations for 1 month proves that Kelabat Bay has a fairly high tidal range. After obtaining these results, this proves that the tidal range in Kelabat Bay is above 2 meters. The tidal range value can be said to have the potential as a reference for alternative energy generation derived from tidal energy. As a comparison, the tidal range value in Kelabat Bay can already be said to be large when compared to potential tidal energy areas in Indonesia. For example, the largest tidal values are found in the Bagan Siapi api area where the tide values are above 6 meters, the Madura Strait which has a tidal range of more than 3 meters, and in Eastern Indonesia also has a tidal range above 5 meters which has great potential if used as an alternative energy generator derived from tidal energy.

The greater the area of the pond that is made, the greater the energy potential produced, so that the known energy utilization can be used as a future reference in the development of electricity generation planning by utilizing the potential of tidal energy to obtain maximum tidal energy. The relationship between the magnitude of the tidal yield value affects the magnitude of the potential value of tidal energy with a graph that is directly proportional between the two. This is because one of the important factors triggering the existence of energy potential is the magnitude of the tidal range in these waters.

## 5. Conclusion

The potential of tidal energy that can be obtained depends on the area of the pool and different height of tidal. The larger area and the greater different height, the greater the potential value of tidal energy and the power that can be generated. If it is assumed that in 1 year there are approximately 700 cycles, then the energy potential that can be generated is around 3.9 GJ per year. If the power is calculated in hours and calculated per day, then the available electricity potential is around 68 MW per day and will produce around 2040 MW per month.

Electrical data is needed in the area that will be selected for the construction of a tidal power plant in order to estimate the area of pool used to meet the electricity needs in that area. With the tidal power electricity generator, it can increase the electricity capacity in the Bangka Islands area.

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