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Research Original Article

Renewable Energy Power Generation Design Modeling Simulation on Solar Energy Sources and Coconut Shells Using Homer

Nefertiti Widiarini[1], Astrid Noviana Paradhita[✉2], Ni Komang Septia Noriska[3]
[1]Vocational School, Universitas Sebelas Maret, Jebres, Surakarta, 57126, Indonesia,
nefertitiwidiarini22@student.uns.ac.id
[2]Vocational School, Universitas Sebelas Maret, Jebres, Surakarta, 57126, Indonesia,
astrid.noviana@staff.uns.ac.id
[3]Vocational School, Universitas Sebelas Maret, Jebres, Surakarta, 57126, Indonesia,
myrta@staff.uns.ac.id
✉Corresponding Author: **astrid.noviana@staff.uns.ac.id | Phone: +6289674586807**

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Abstract
Using fossil fuels contributes to carbon dioxide and methane emissions that increasingly damage nature. Innovations in renewable energy that are more environmentally friendly with good energy supply chain management need to be implemented immediately. Indonesia is an archipelagic country with an imbalance in energy sufficiency figures in several regions, including Balikukup village in East Kalimantan. This condition hinders people's daily activities and is a significant obstacle to business activities. This research was conducted to design a zero-carbon renewable hybrid energy innovation that can preserve the environment and improve the community's economy using solar energy and coconut shells. The design was simulated using the HOMER application to find out how much potential and electricity the residents of Balikukup village would get. This study obtained a system configuration scenario: the marine product drying machine, which has a total production of 4,106 kWh/yr. This machine requires a PV capacity of 7,627 kW/yr, 18 batteries, and an inverter capacity of 1.62 kW. In addition, coconut shell briquettes can also optimize the marine product drying machine where 100 - 150 kg of coconut shell waste can increase the drying temperature to 60° - 70° C in a faster time of around 3 - 4 hours to reduce the weight of marine products from 5 - 8 kg to 1 - ½ kg.
Keywords: Renewable Energy, Solar System, Coconut Shell, Biomassa, Homer

Introduction
Energy is something that humans need very much. All activities in life always require energy to run correctly. It is starting from electrical energy needed in everyday life to renewable energy, which is currently getting much attention from various parties. Dat et al. (2020) stated that increasing and developing the human population, industrial scale, and world technology require increasing energy consumption daily. Therefore, energy supply chain management is very much needed. This condition is supported by the opinion of Hmouda et al. (2024), who said that the energy supply chain is a vital asset for the progress of people's lives. Pliousis et al. 2019) also said that the energy supply chain must be able to fulfill the energy trilemma concept, which includes energy equity, energy security, and environmental sustainability.

The energy supply chain that is attempted to be available must be accessible and affordable to all levels of society (Lennon et al., 2019). Efforts to provide energy also need to pay attention to the ability to meet increasing demand by providing reliable infrastructure (Graziano et al., 2020). Therefore, developing renewable energy-based infrastructure always requires providing low-carbon energy sources. In addition, renewable energy needs to pay attention to increasing energy efficiency as a massive step in preserving nature and the environment.

The issue of environmental pollution is a real problem that is increasingly receiving attention in various studies. The increasingly severe global warming conditions also worsen environmental pollution and can threaten human life. The composition of carbon dioxide (CO_2) and methane (CH_4) gases in the Earth's atmosphere has increased significantly from year to year. This condition is quite worrying, considering the impacts caused by these two gases are pretty dangerous for the environment and society (K Ghosh & K Ghosh, 2020). Global warming and environmental pollution that are not immediately handled wisely will cause various problems. Starting from the greenhouse gas effect, decreasing the quality of clean water, and health problems are some examples of the impacts of using energy that is not environmentally friendly (Mar et al., 2022). Therefore, renewable energy innovation needs to be carried out immediately by considering the benefits that can be provided and the consequences of the energy installation for society and the environment.

Simamora & Tampubolon (2021) stated that the energy transition from fossil-based energy sources to zero-carbon energy sources needs to be done immediately. Several countries have already innovated, procuring new energy sources that are more environmentally friendly. Figure 1 shows the energy transition carried out by several countries worldwide.

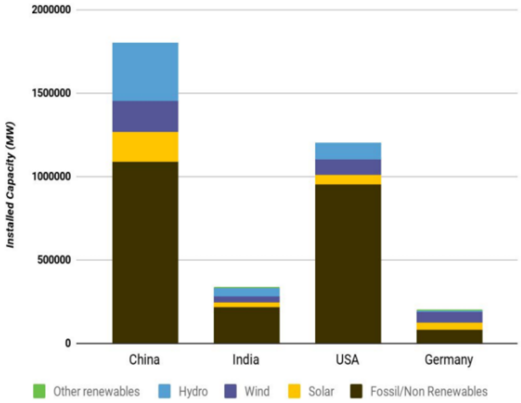

Figure 1. Energy Transition

Figure 1 shows that China is a country that is very massive in carrying out energy renewal using environmentally friendly raw materials. Not lagging behind China, Indonesia has also renewed energy using more environmentally friendly raw materials. Figure 2 shows a graph of new energy resource installations in several Southeast Asian countries.

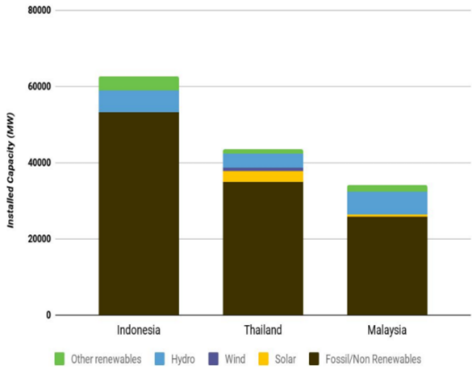

Figure 2. New Energy Resource Installations in Southeast Asian Countries.

Based on Figure 2, it can be seen that Indonesia has also started to innovate more environmentally friendly renewable energy by using hydro and other energy. IESR (2017) stated that Indonesia has installed new wind, waste, and solar energy. As an archipelagic country with a population of 280 million people spread across various regions with diverse geographical conditions, Indonesia has its own challenges in providing energy sources needed by the community. Pradnyana (2016) stated that until now, there has been an imbalance in energy availability in Indonesia, especially between areas on the island of Java and areas outside Java. This is undoubtedly homework for the government to resolve immediately because energy is one of the bridges for people to meet their life needs.

Balikukup is a village in Batu Putih sub-district, Berau regency, East Kalimantan, Indonesia. Balikukup is located on the coast and is also known as Balikukup Island. Maryanto et al. (2015) stated that Balikukup is one of Indonesia's regions with good coral reef ecosystem potential. Good coral reef maintenance also helps the fish ecosystem to grow and develop well on this island. This condition makes the majority of Balikukup residents work as fishermen.

Marine resource management in Balikukup village certainly requires sufficient energy. However, it is regrettable because Balikukup village is still insufficient in terms of energy availability. Electricity in Balikukup village is only available for nine hours from 15.00 to 00.00 WITA. The electricity consumed by the people of Balikukup village is driven by diesel fuel. Based on an interview with one of the residents of Balikukup village, information was obtained that the availability of energy in Balikukup village is not good, and this condition is hampering the community's efforts to improve their economic conditions.

In addition to the lack of electrical energy in Balikukup, diesel fuel is also not environmentally friendly. Diesel fuel energy can contribute to a CO_2 emission coefficient of 0.062 GJ for every ton of diesel used. It also impacts CH_4 emissions of 4.75 GJ and N_2O of 0.57 GJ for every gram of diesel used (Andalia et al., 2018). The effectiveness and efficiency of using diesel fuel as an energy source are also considered lacking by the community. This is because only 1 liter of diesel can provide energy equivalent to 1 kWh of electricity (Yusuf & Budi, 2017). PT PLN Indonesia (2020) stated that the average daily electricity needs of Indonesian households in rural areas are around 300 - 650 Watts per day. Thus, diesel fuel energy sources can only meet the electricity needs of one house for 1.5 hours to 3 hours per liter. This makes efforts to increase renewable electricity sources in Balikukup very necessary.

Several more environmentally friendly energy innovations have been widely implemented in Indonesia. Renewable electrical energy innovations are expected to be a solution to improve the quality of life and economy of the community, especially the Balikukup village community. Figure 3 shows the potential for renewable electrical energy owned by

Indonesia and the percentage of utilization that has been carried out.

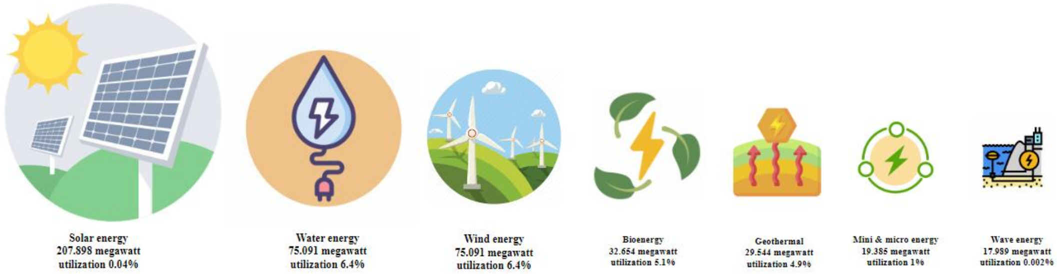

Figure 3. Energy Potential and Utilization in Indonesia

Figure 3 shows that solar energy has the greatest potential in Indonesia. Based on geographical conditions, Balikukup village also has the potential to develop renewable energy sources using sunlight as its energy source. Maka & Alabid (2022) stated that solar-powered energy sources are referred to as efficient, low-carbon, and sustainable energy sources. Adelakun & Olanipekun (2019) also stated that solar-powered energy is one of the applications of environmentally friendly energy supply chain technology and has a significant role in improving environmental conditions. Solar energy, which has so far only been emitted in vain and reflected into the Earth's atmosphere, can now be used to facilitate all human activities and work.

Four essential components can be used to develop solar-powered energy sources. Sasikumar & Sivasangari (2021) stated that solar panels are the most critical essential component in developing solar-powered energy. Solar panels are tools that can act as semiconductors by using solar cells to convert solar energy into electrical energy (Irena, 2019). In addition to solar panels, a charge controller is also needed in solar energy installations. A charge controller is a tool needed to prevent excessive battery charging. The charge controller controls and prevents high voltage that can damage the battery (Fofang & Tanyi, 2020). The next component is the deep-cycle battery. Deep cycle batteries are used to store solar energy reserves. Solar batteries are tube-shaped and are widely used in solar energy installations to supply household electricity (Vadiyala, 2020). The last component is power inverters. Power inverters function to produce electricity from solar energy that has been stored in the battery. The electrical energy produced by power inverters is of the direct current type, which generally has a voltage of 12V, 14V, 48V, etc., depending on the type of power inverter used (Parti et al., 2020).

In addition to solar energy, Balikukup Village has the potential for other energy sources with a supply chain that can guarantee opportunities for developing green energy sources. This energy is biomass energy. This village, located on the coast, has natural resources like coconuts. The villagers use coconuts for their water consumption. With the development of technology, these coconuts can be used as other energy sources for power plants.

Biomass energy sources by Papilo et al. (2015) are defined as energy sources that utilize waste materials ranging from agricultural waste, livestock waste, or forestry waste. Pramudiyanto & Suedy (2020) added that biomass energy sources play an active role in reducing the effects of greenhouse gases and extreme climate change in Indonesia. Biomass energy sources in Balikukup village can be developed by utilizing coconut shells as an energy source. Coconut shells, usually thrown away and becoming waste, can now be developed into a renewable energy source that can benefit villagers. The modification of these two types of energy is called hybrid energy. Hybrid energy is the provision of renewable energy by simultaneously using more than one energy source as a generator (Tharo et al., 2019).

Several studies have been conducted previously regarding developing hybrid energy installations using solar and biomass power. The first study was conducted by Khalil et al. (2020), who conducted research by analyzing the development of power plants with hybrid energy. From this study, it can be concluded that developing hybrid energy to meet electricity needs can save consumption costs that the community must pay. Further research was conducted by Suprajitno et al. (2022), who optimized power plants using hybrid energy. The study results showed that hybrid power could supply 43.07 Watts of electricity to support household electricity needs. Similar research was also conducted by Azizah & Purbawanto (2021), who designed a hybrid power plant in Kebumen using 15 energy panels. This study shows that with proper installation and optimal configuration, using hybrid energy sources on 15 energy panels can produce 385 kW of electricity to meet household electricity needs.

According to several previous studies, using hybrid energy sources will provide significant benefits as one of the steps to improve people's lives. In addition, the use of hybrid energy can reduce fossil fuel consumption and preserve the environment. This study will focus on designing renewable energy source installations in Balikukup village using two natural potentials. The hybrid energy developed combines solar-powered energy sources and biomass derived from coconut shell waste.

Literature Review

Solar System

Solar energy is a source of energy that comes from solar radiation. Sunlight that produces heat can stimulate chemical reactions that can produce electrical energy when combined with other compounds. The most common thing to do is collect solar energy and convert it into heat energy. In addition, solar energy radiation can also be collected and then stored in an iron vessel first. Furthermore, the collected heat energy is converted into electrical energy using solar cells, photovoltaic cells, or solar ovens. Some of these tools can help to collect solar radiation so that it is more concentrated at one central point. In this way, electrical energy can be generated faster and more optimally.

Using solar energy as a generator of electricity can provide many benefits. Solar energy sources can periodically and significantly improve air quality. Sa'diah & Sudarti (2023) state that solar radiation converted into electrical energy can reduce the earth's temperature. Periodically, this condition can improve the weather cycle and avoid extreme weather changes. Afif & Martin (2022) add that solar energy installation, which can be done using various methods, has been added. Each method used must be based on the character of the area and the purpose of its use. The design of solar energy installations commonly used in Indonesia is the design recommended by Hermanu et al. (2019), it is a large solar panel arranged sequentially with various components to convert heat energy into electrical energy. Figure 4 shows the design of a solar energy installation that is widely adopted in Indonesia.

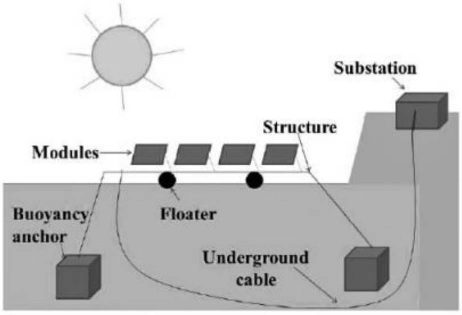

Figure 4. Solar Energy Installation Design

Coconut Shells

Coconut shell is waste from coconuts. Coconut shell is the hard part of the coconut fruit that protects the flesh and water in the coconut fruit. Coconut shells have a myriad of benefits that Indonesians widely use. Coconut shells are commonly used to produce coconut charcoal. Coconut charcoal can be used as traditional fuel. In addition, coconut shells can also be used as raw materials for handicrafts such as bags, wallets, hats, and so on. The content of coconut shells, which are rich in phosphorus, potassium, sodium, and magnesium, also makes coconut shells a raw material for making organic fertilizers.

Apart from the myriad benefits of coconut shells, this object also has a content that can become a source of biomass electrical energy when operated using the thermoelectric generator principle (Rabi et al., 2022). Coconut shells have the main content of lignin, cellulose, and hemicellulose. This content is a source of biomass energy stored in coconut shells so that it can be converted into energy (Ajien et al., 2023). Converting energy in coconut shells into electrical energy plays a vital role in obtaining the required energy. Azeta et al. (2021) A mentioned that converting biomass energy into electrical energy requires chemical reactions from biochemical and thermochemical conversion. Biochemical conversion involves fermentation and hydrolysis to extract chemical content from coconut shells. Thermochemical conversion is a process that involves gasification, direct combustion, and pyrolysis to extract heat energy from coconut shells. In simple terms, the flow of biomass energy changes is shown in Figure 5.

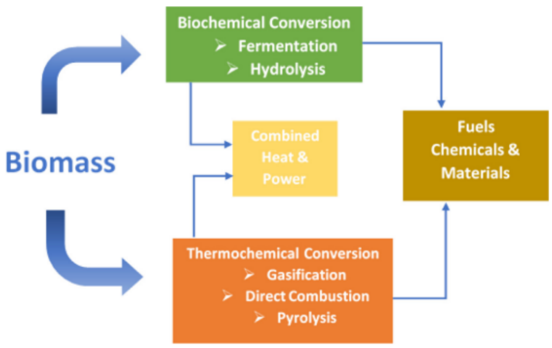

Figure 5. Biomass Energy Source Conversion Process

Materials & Methods

This research was conducted using a case study research design. The data collection needed in the study was carried out through observation and interviews with local villagers. Meanwhile, the discussion and analysis methods used qualitative descriptive methods. The design simulation of the hybrid energy source installation design in Balikukup village was carried out using the HOMER application. HOMER is an application developed by the UL Solution company that is specifically used to simulate the development of hybrid energy (Arif et al., 2023). In summary, the overall flow of the research implementation carried out can be seen in Figure 6.

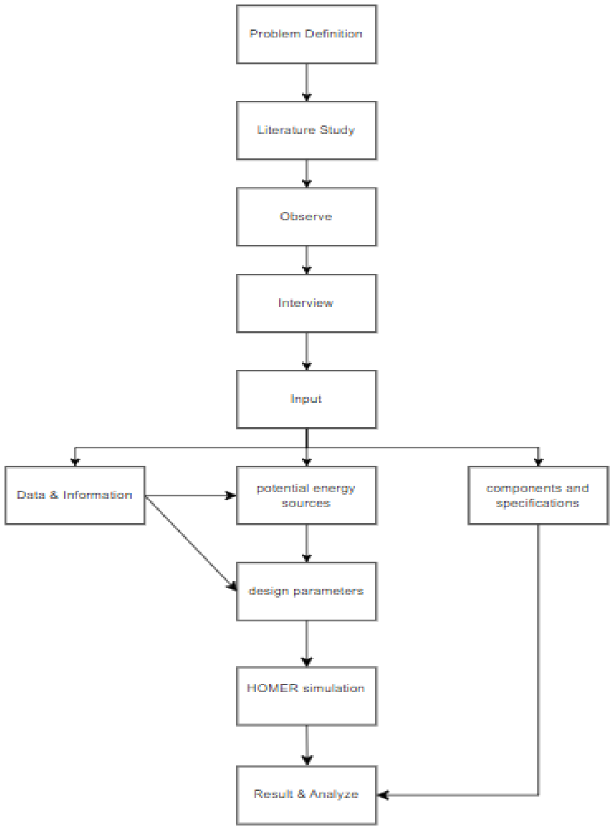

Figure 6. Research Methodology Flow

Problem Definition

This study began with an in-depth study of environmental problems. In the study, researchers found that there is still an imbalance in energy availability in Indonesia. This is reinforced by a survey by Lauranti & Djamhari (2017), which showed that the energy sufficiency figure outside Java in Indonesia has not been achieved, including in Balikukup Village. In addition, the increasing demand for electrical energy, which is increasing every year, needs to be anticipated immediately so that Indonesia has energy in the future. The problem of environmental conditions, especially the world's increasingly worse greenhouse gases, is also a determining factor in why this study needs to be conducted.

Literature Study

The next step in this research is to conduct a literature study to find the most possible solution to the existing problems. A literature study is needed to find the latest and most up-to-date solutions to solve a problem. In this stage, researchers read journals, books, and scientific works in other forms to obtain the right solution to overcome problems related to the availability of electrical energy in Balikukup Village.

Observe

In the observation stage, researchers observe the main problem, the factors that cause the problem, and the resources available to overcome the problem. Researchers also project the possibility of how far this research can be carried out with the available resources.

Interview

The next stage is the interview. In the interview stage, researchers interact with residents to determine the needs most in demand by the community. Researchers also learn about culture, natural conditions, activities of most residents, and the economic conditions of the Balikukup village community.

Input

At the input stage, researchers determine the type of input that will be used for research purposes. Input is obtained based on data and information from the problem definition, literature study, observation, and interview stages. The data and information obtained become the basis for researchers in determining research parameters. Data and information are also used to determine the components and specifications to implement the resulting solution recommendations.

Simulation

At this stage, researchers use predetermined parameters based on the input obtained. Simulations are carried out using the HOMER application. HOMER stands for Hybrid Optimization of Multiple Energy Resources. HOMER is a software that can simulate the navigation of interconnected microgrid complexity. HOMER can simulate the needs of an energy installation. In addition, HOMER can also predict the power output generated based on the input parameters provided (Manullang et al., 2020).

Result & Analyze

The final stage is to draw the simulation results and analyze the results obtained. The analysis was conducted on the simulation results of developing hybrid energy sources with the HOMER application. The analysis results will show the potential for developing hybrid energy sources using solar power and coconut shell waste. The analysis results will also provide an overview of the advantages and benefits that the residents of Balikukup village can enjoy.

Results and Discussion

This research was successfully conducted using the method flow in Figure 4. From this research, the following results were obtained:

Village Location and Economic Conditions

The case study was conducted in Balikukup Village, Batu Putih District, Berau Regency, East Kalimantan, precisely at coordinates N1° 23' 26.2" E118° 32' 10.5" obtained through Google Earth. This village has a population of 1,273 people, consisting of 330 families. Balikukup Village is one of the villages that has diverse potentials, some of which are marine products, tourism, and coconut shell waste biomass. Figure 7 shows the location of Balikukup Village taken from the HOMER application.

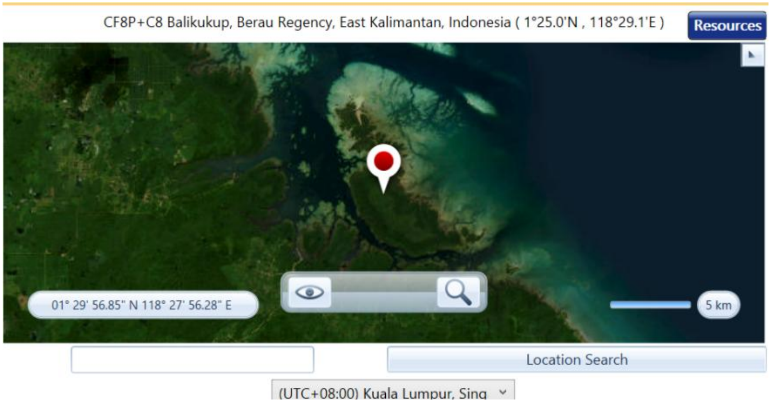

Figure 7. Balikukup Village Location

This study focuses on providing electrical energy to help provide electricity to improve the economy of the Balikukup villagers. The majority of Balikukup residents work as fishermen. Balikukup villagers sell their seafood catches in two types. First, the seafood catch is sold fresh around the village. The catch is usually sold on the island on the coast of Balikukup as a typical snack for tourism on this island. In addition, the catch is also sent outside the island through unique posts that are already available and help village fishermen sell their catches. In addition to being sold fresh, the seafood caught by fishermen is also sold in other forms, such as dried fish, fish crackers, fish nuggets, and fish floss.

To improve the villagers' economy, the production of dried fish, fish crackers, fish nuggets, and fish floss also requires electrical energy. In addition to utilizing sunlight to dry seafood, villagers also need electrical energy to speed up the process of making dried products from fishermen's catches. The use of sunlight in drying seafood is highly dependent on weather conditions. When the weather is sunny, villagers generally need approximately 2-4 days to prepare the seafood caught by fishermen to be processed further. However, when the weather is cloudy, villagers need more time to dry their seafood. Even when the weather is not supportive for a long time, for example, in the rainy season, villagers, especially fishermen, experience a decrease in income because fishermen cannot dry their seafood. Therefore, fishermen need supporting machines to dry seafood. Fishermen can use a seafood drying oven to support production activities.

Electrical load

Villagers can use seafood drying ovens as one of the main tools to process fishermen's catches. Based on materials and components used for renewable energy, we produce the design of a seafood drying oven. Figure 8 shows the design of a seafood drying oven that can be used by fishermen in Balikukup village.

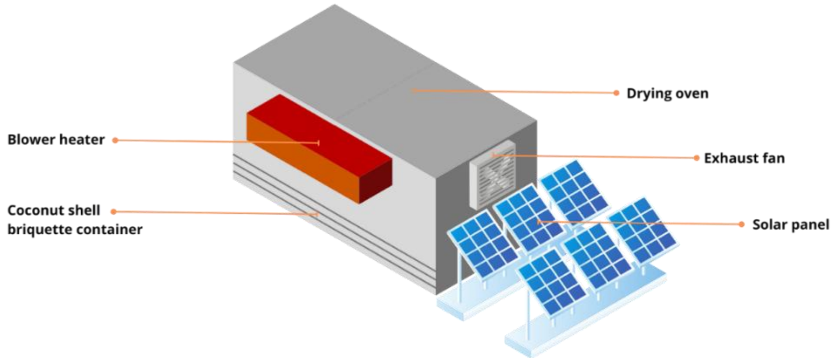

Figure 8. Seafood Drying Oven Design

Based on the device analysis, the electrical load data and the electrical flow requirements in the design of the seafood drying oven used can be known. The electrical load data is calculated based on the duration of use of the electrical device. The electrical load data for the use of the seafood drying oven is shown in Table 1.

Table 1. Electrical Load

Loading Time	Total Load (Kw)	Loading Time	Total Load (Kw)
00.00 - 01.00	3	12.00 - 13.00	1.050
01.00 - 02.00	3	13.00 -14.00	1.050
02.00 - 03.00	3	14.00 - 15.00	1.050
03.00 - 04.00	3	15.00 - 16.00	1.050
04.00 - 05.00	3	16.00 - 17.00	1.050
05.00 - 06.00	3	17.00 - 18.00	1.050
06.00 - 07.00	3	18.00 - 19.00	1.050
07.00 - 08.00	3	19.00 - 20.00	3
08.00 - 09.00	1.050	20.00 - 21.00	3
09.00 - 10.00	1.050	21.00 - 22.00	3
10.00 - 11.00	1.050	22.00 - 23.00	3
11.00 - 12.00	1.050	23.00 - 00.00	3

Table 1 shows that when the seafood drying oven is used at 19.00 - 08.00, the oven requires an average of 3 Kw of electrical power; the electricity is used to flow the main component, namely the blower heater. At 08.00 - 19.00, the oven requires an average of 1,050 Kw of electrical power to flow the exhaust fan component.

Electrical load data collection in Balikukup Village by calculating the number of existing electrical devices and the duration of their use with the main electrical load. The main electrical load in the seafood drying oven is on the blower heater and exhaust fan components. The blower heater is designed to dry seafood products, such as fish, shrimp, seaweed, and others, using a combination of airflow generated by the blower and heat generated by the heater. The primary function of the blower heater is to speed up the drying process by flowing hot air evenly over the entire surface of the product, removing moisture efficiently without damaging product quality. Meanwhile, the exhaust fan is a mechanical ventilation device designed to remove hot, humid, or odorous air from inside a room to the outside. This tool draws air from inside and pushes it out through a duct or directly into the atmosphere, allowing better air circulation and replacing fresher air from outside. Figure 9 shows the appearance of the blower heater and the exhaust fan.

Figure 9. Blower Heater (Left) and Exhaust Fan (Right)

Homer Simulation

Based on the observations the researchers have carried out, they have sufficient data to simulate renewable energy. Researchers use the electrical load data in Table 1 as the input required in the HOMER application. Electrical load data is used because, from this data, researchers can understand the projection of energy needs required by villagers, especially fishermen, to operate the seafood drying oven machine.

Figure 10. Electrical Load Settings on Homer

From Figure 10, researchers can find out how much electrical energy consumption is needed by the seafood drying oven machine. The analysis results show that the electrical load consumed in one seafood drying oven machine is 50.55 kW per day. The lowest electrical load consumption occurs at 08.00 - 19.00 WITA (UTC + 8) of 11.55 kW. The peak load occurs at 19.00 - 08.00 WITA (UTC + 8), with electricity usage of 39 kW.

In addition to the energy load requirements, the HOMER simulation also obtained data showing solar radiation and air temperature. The data was obtained from NASA's Prediction of Worldwide Energy Resources (POWER) in the HOMER application. The value of radiation power per unit area or irradiance value can be used as a parameter to see the level of lighting or solar energy radiation captured by solar panels.

Figure 11. Solar Radiation Analysis on Homer

Figure 11 shows solar radiation and air temperature data obtained from NASA's Prediction of Worldwide Energy Resources (POWER). The value of radiation power per unit area or irradiance value can be used as a parameter to see the level of lighting or solar energy radiation captured by solar panels. Based on figure 9, Balikukup has enough radiation energy daily to with the average of 4.81 kWh/m^2/day.

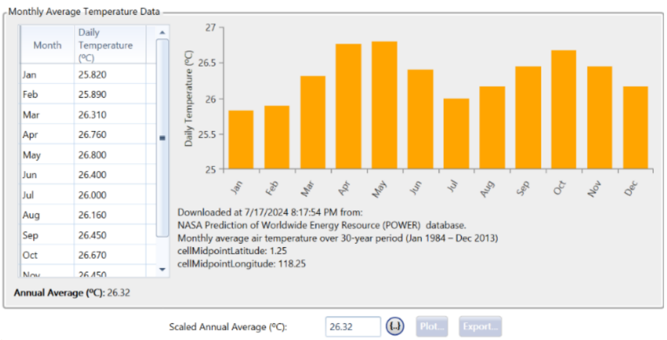

Figure 12. Temperature Analysis in Homer

Based on Figure 12, it can be seen that Balikukup Village has an average temperature of 26.32°C. Based on this value, it can be said that Balikukup Village has excellent potential to apply solar panels as alternative energy to support seafood processing production activities, especially in the drying process. HOMER simulation also shows photovoltaic data that needs to be considered when developing solar energy. Photovoltaics, or solar modules, are semiconductor materials that directly convert sunlight into electrical energy. The change of sunlight into electrical energy is called the photovoltaic effect.

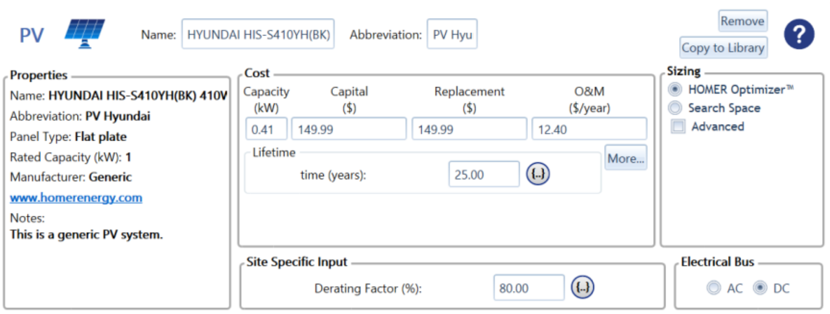

Figure 13. Solar Panel Model Recommendations

Figure 13 shows a simulation of the use of solar panels. Based on the simulation results, Balikukup villagers can use Hyundai HIS S410YH (BK) solar panels. This solar panel is a 410W Bifacial PV type made of Poly-crystalline with a 400 W or 0.4 kWh capacity. Thus, one solar panel can absorb 400 W of electrical energy from sunlight radiation. The price of one Hyundai solar panel is $ 149.99, which, when converted into Rupiah, is Rp 2,400,000. At the same time, the maintenance cost is $ 12.40 or Rp 200,000 per year, calculated at 20% of the total initial investment cost.

Next is the energy storage system, called the storage system in renewable energy installation. Simulation is done using the BAE SECURA SOLAR 12V 3 PVV 210 battery shown in Figure 12.

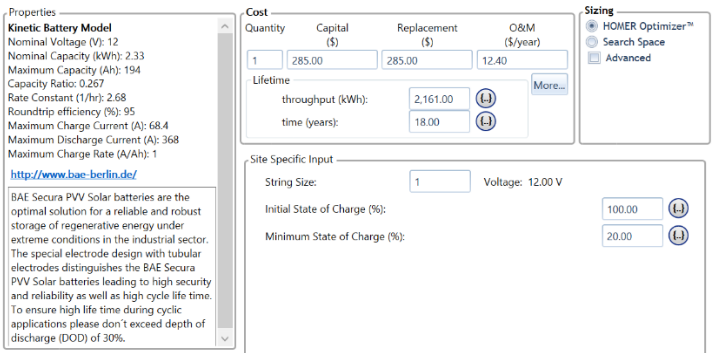

Figure 14. Energy Storage Battery

Figure 14 shows that this type of battery has an energy capacity of 2.33 kWh with a usage period of up to 18 years. One battery costs $ 285.00, which, when converted into Rupiah, is Rp 4,600,000. Meanwhile, the maintenance cost is $ 12.40 or Rp 200,000 per year, calculated at 20% of the total initial investment cost. The use of solar-powered electricity also requires an electric current converter. In this case study, a converter or device is used to change the DC supply to AC, called inversion, or change the AC supply to DC, called rectification.

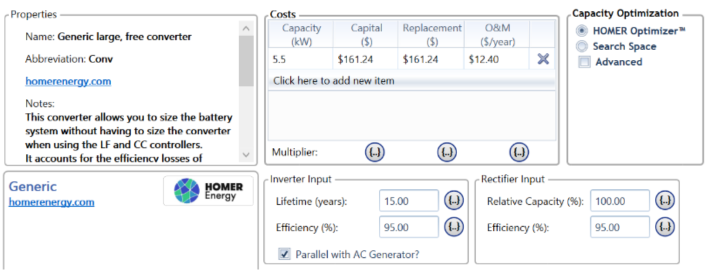

Figure 15. Electric Current Converter

Based on the simulation results shown in Figure 15, the converter used is a Generic Large Converter with a capacity of 5.5 kW. This converter has an energy storage efficiency of up to 95%. The unit price of this converter is $161.24, or equivalent to Rp2,600,000. In addition to using solar energy as a power generator in the seafood drying oven machine. Balikukup Village also has other potential, namely coconut shells. Villagers and residents also sell many coconuts. Coconut shells are usually just trash that villagers throw away. Coconut shells can be used as a source of biomass energy. Therefore, using coconut shell briquettes can support the processing of marine catches, especially in drying marine products.

Coconut shell is one of the complex layers in coconut after the fiber. The hard layer comprises cellulose, lignin, methoxyl, and various minerals. Coconut shell is an activated carbon material with relatively good quality when used as activated charcoal. This is because coconut shell has a calorific value of around 6,500 - 7,600 kcal / g (Carnaje, 2018). Briquettes made from coconut shells provide high combustion heat, producing less combustion smoke. This study also helped design a rack-type seafood drying machine with a 100 - 150 kg capacity, which can increase the drying temperature to 60 ° - 70 ° C. With this design, the drying process only takes ± 3 - 4 hours to reduce the weight of seafood from 5 - 8 kg to ½ - 1 kg. The design of the seafood drying briquette is shown in Figures 16 and 17. The design is shown by the Figure 14.

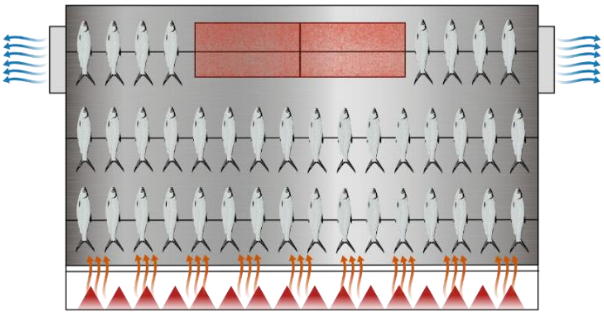

Figure 16. Briquette Heat Flow Design

The development of a marine product drying oven using solar energy and coconut shell briquettes has an external appearance, as shown in Figure 17.

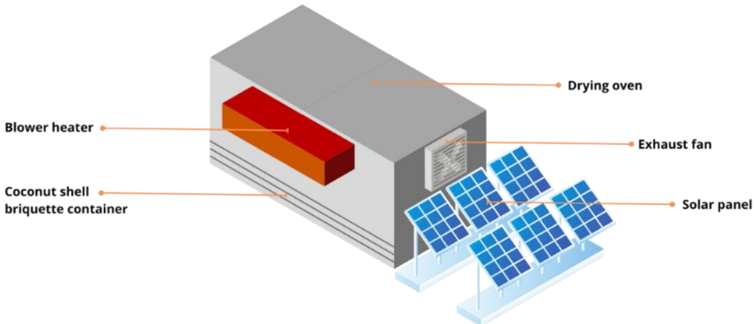

Figure 17. Green Energy Seafood Drying Oven Design

Figures 16 and 17 show the design of the oven chamber made of light steel in the form of plates, and the inside is coated with Hollow Iron sheets with a thickness of 0.3 mm and a horizontal length of 3 m, a width of 2 m, and a height of 2 m. The seafood to be dried is hung on hangers with a cross arrangement to optimize contact with hot air and smoke. Around 100 kg of seafood is installed in the drying chamber for one drying process. The working principle of this machine is that at 09.00 - 16.00 WITA (UTC + 8), the solar panel captures solar radiation and stores it in the energy storage chamber battery. Hot air that is relatively light compared to the air in the drying chamber flows into the drying chamber to evaporate the water in the seafood. The air in the drying chamber flows to the top of the drying chamber and exits through the ventilation. Sunlight also increases the heat in the seafood in the drying chamber directly through the Hollow Iron. In simple terms, the specifications of the seafood drying oven machine using solar energy and coconut shell briquettes are shown in Table 2.

Table 2. Machine Specifications

Type Specification	Information
Total Size	3m x 2m x 2m
Machine Capacity	± 100kg - 150kg
Machine Frame Material	Hollow Iron
Container/Hanging Tank Material	Iron Plate Hole
Air Circulation	Blower Fan
Heat Source	Coconut Shell Briquette
Control System	a. Manual b. *Controller heater* dan blower
Coconut Shell Briquette Tank	Iron Plate Hole

Analysis of the Role of Hybrid EBT Drying Machines in Seafood Processing Production

Balikukup Village has abundant natural resources that have great potential to be developed to improve the welfare of the local community. This potential can be utilized by processing and producing seafood into finished products ready to be consumed. Along with abundant resources, increasing the production of seafood products is expected to increase fishermen's income in Balikukup Village.

Increasing seafood production by village MSMEs will open up greater opportunities for the Balikukup community to obtain higher profits and income. However, this income is influenced by the volume of production, the price of fishery commodities, and the available infrastructure and production facilities. The development of adequate infrastructure and production facilities can bring various benefits, as shown in Table 3.

Table 3. Benefits of Using Solar Energy and Coconut Shell Briquettes in Seafood Drying Oven Machines

Benefit	Information
Production Efficiency and Quality	Improving infrastructure and production facilities allows for a more efficient production process and produces high-quality products. Drying machines that use renewable energy, such as the hybrid system developed with HOMER, can support sustainable production throughout the year.
Energy Stability and Availability	The implementation of renewable energy ensures the availability of stable and environmentally friendly energy so that production activities are not disrupted by limited electricity supply. This allows for continuous operations and reduces dependence on fossil fuel sources.
Reducing Costs and Environmental Impacts	The use of a hybrid system can reduce operational and maintenance costs. In addition, by minimizing carbon emissions, negative impacts on the environment can be minimized, supporting the sustainability of the local ecosystem.
Increasing Income and Community Welfare	With more efficient and stable production, the income of business actors can increase, which ultimately positively impacts the economic welfare of the Balikukup community as a whole.

The design results of the drying machine with a hybrid renewable energy system can be a reference for the machine that will be implemented in Balikukup Village. This machine is expected to overcome the constraints of the drying process and make the operating system more practical. Thus, the production of marine products can run more efficiently, support the improvement of product quality, and increase the competitiveness of products in the market.

The development of adequate infrastructure and production facilities, supported by stable renewable energy, will strengthen the economy of the village community. In addition, using renewable energy also helps maintain environmental sustainability, which aligns with global efforts to reduce carbon emissions and promote sustainability. Implementing this technology in Balikukup provides economic, social, and environmental benefits, ultimately improving the community's welfare.

Conclusions

After planning, designing, and testing, several conclusions can be drawn on the design of a combination of renewable energy in Balikukup Village using Homer Pro software. Simulation using HOMER for the system configuration scenario produces a seafood drying machine with a total production of 4,106 kWh/yr, requiring a PV capacity of 7,627 kW/yr, 18 batteries, and an inverter capacity of 1.62 kW. It has an NPC value of $23,042.25, which is, when converted to Rupiah Rp 372,423,821. Operational and Maintenance costs of $597.17, which is, when converted to Rupiah Rp 9,651,849. And a Levelized Cost of Energy of $0.3464/kWh or equivalent to Rp. 5,598/kWh. The results of the design and construction of a rack-type seafood drying machine with a capacity of 100 - 150 kg can increase the drying temperature to 60 ° - 70 ° C; it takes ± 3 - 4 hours to reduce the weight of seafood from 5 - 8 kg to ½ - 1 kg. This study succeeded in producing a hybrid energy system configuration that can significantly contribute to the production of seafood processing in Balikukup Village. The total energy production of 4.106 kWh / yr optimizes the operation of the seafood drying machine, improving the quality and quantity of seafood processing production. Production activities can run more efficiently and sustainably with a more stable energy availability.

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