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An Analysis Of Solar Energy Potential As Energy Source In Bandar Selamat Village

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ABSTRACT
Solar energy is one of the renewable energy sources that has great potential to be developed, especially in efforts to achieve sustainable development goals. Bandar Selamat Village has geographical conditions that allow the use of solar energy as an alternative energy source. This study aims to analyze the potential of solar energy in Bandar Selamat Village and evaluate its feasibility as the main energy source. The research methodology includes a collecting data on sunlight intensity, incident angle, and cloud distribution in the area. The data is analyzed to determine the potential for solar energy that can be generated. In addition, this study also evaluates the efficiency of solar panels and energy storage systems that can be used in Bandar Selamat Village. An economic analysis was conducted to examine the initial investment costs, operating costs, and long-term economic benefits of implementing Solar Power Plants (PLTS). The results of the study show that Bandar Selamat Village has significant solar energy potential with fairly high sunlight intensity throughout the year. The efficiency of the solar panels used in the simulation also showed adequate results to support local energy needs. In terms of economy, although the initial investment costs are relatively high, long-term economic benefits such as savings in electricity costs and reductions in greenhouse gas emissions can provide substantial benefits to the local community. This paper described a study concludes that solar energy has great potential to be developed as the main energy source in Bandar Selamat Village. To realize this, adequate policy support is needed, as well as increased infrastructure and public awareness of the benefits of renewable energy. Thus, Bandar Selamat Village can be an example of the implementation of sustainable clean energy at the local level.

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INTRODUCTION

Renewable energy has become a major focus in global efforts to reduce dependence on fossil fuels and address climate change. Among the various types of renewable energy, solar energy stands out as one of the most promising sources due to its abundant availability and minimal environmental impact. Bandar Selamat Village, with its favorable geographical and climatic conditions, has great potential to utilize solar energy as its primary energy source.

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As part of a growing city, the energy needs in Bandar Selamat Village continue to increase. The current dominant use of fossil fuels not only contributes to increased greenhouse gas emissions, but also raises problems of energy dependence and vulnerability to fuel price fluctuations. Therefore, the exploration and utilization of renewable energy, especially solar energy, becomes very relevant and urgent.

The utilization of solar energy through Solar Power Plants (PLTS) offers various advantages, including reducing carbon emissions, increasing energy security, and potential savings in electricity costs in the long term. However, in order to optimally utilize this potential, an in-depth analysis is needed regarding the various factors that influence the success of implementing PLTS at the local level.

This study focuses on the analysis of solar energy potential in Bandar Selamat Village with the aim of identifying existing opportunities and challenges. This study includes technical analysis of sunlight intensity, incident angle, and cloud distribution, as well as evaluation of the efficiency of solar panels and energy storage systems. In addition, economic aspects such as initial investment costs, operational costs, and long-term economic benefits are also analyzed to assess the feasibility of implementing PLTS.

With adequate policy support and increased public awareness, Bandar Selamat Village has the potential to become an example of successful renewable energy implementation. This study is expected to provide important contributions to the development of strategies and policies needed to support the transition to cleaner and more sustainable energy sources in the region.

This study is important not only to identify the potential of solar energy in Bandar Selamat Village, but also to develop a more comprehensive understanding of the factors that influence the successful implementation of PV. This analysis covers various crucial aspects, including technical, economic, and policy, all of which must be considered to achieve effective and sustainable implementation.

From a technical perspective, it is important to understand the local geographic and climate characteristics that affect the potential for solar energy. The intensity of sunlight, the angle of incidence, and the distribution of clouds are some of the factors that determine the amount of energy that can be generated by PV. In addition, the efficiency of the PV technology used, as well as the ability of the energy storage system to manage the variability of solar energy production, play an important role in determining the technical feasibility of PV in the area.

In terms of economics, this study aims to identify the costs and benefits associated with the implementation of PV. The cost analysis includes the initial investment for the installation of PV and energy storage systems, operational and maintenance costs, and potential savings in electricity costs in the long term. Long-term economic benefits are also considered, including positive impacts on the local economy, such as job creation and reduced energy costs for households and businesses.

This study also highlights the importance of policy and regulatory support that supports the implementation of renewable energy. In many countries, government policies play a key role in promoting the use of renewable energy through financial incentives,

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subsidies, and supportive regulations. Effective policies can reduce the initial barriers faced in PV investment and encourage the adoption of this technology at the local level.

In addition to technical and economic aspects, community awareness and participation are also important factors in the success of PV implementation. Education and awareness campaigns about the benefits of solar energy and how to utilize it effectively can increase community acceptance of this technology. Community involvement in renewable energy projects can also encourage a sense of ownership and shared responsibility for maintaining and operating PV systems.

This study uses a holistic approach to evaluate the potential of solar energy in Bandar Selamat Village. The methodology used includes field data collection, technical and economic analysis, and case studies of renewable energy policies that have been successfully implemented in other areas. Sunlight intensity data is measured using a solar radiation meter, while the efficiency of solar panels is evaluated through field trials. Economic analysis is carried out using a cost-benefit model to estimate the return on investment and long-term cost savings.

The results of the study show that Bandar Selamat Village has great potential to become a leader in the use of solar energy at the local level. With high sunlight intensity and minimal cloud distribution, this area is ideal for the installation of PLTS. Economic analysis also shows that although the initial investment costs are quite high, the long-term benefits such as electricity cost savings and reduced greenhouse gas emissions are very significant. However, to realize this potential, several challenges need to be overcome. Supporting infrastructure such as electricity grids that are able to integrate solar energy, as well as adequate energy storage capacity, must be improved. In addition, more proactive government policies and attractive financial incentives are needed to encourage private investment in the renewable energy sector.

Literature Review

Source Energy

Reduced production of fossil energy, especially oil earth and the global commitment to reducing greenhouse gas emissions, encourage the Government to continuously increase the role of new and renewable energy as part of maintaining energy security and independence. In accordance with PP no. 79 of 2014 concerning National Energy Policy, the target for the new and renewable energy mix in 2025 is at least 23% and 31% in 2050. Indonesia has quite large new and renewable energy potential.

The total renewable energy potential equivalent to 442 GW is used for electricity generation, while BBN and Biogas of 200 thousand Bph are used for household purposes. fuel in the transportation, household, commercial and industrial sectors. Utilization of NRE for electricity generation in 2018 amounted to 8.8 GW or 14% of the total electricity generation capacity (fossil and non-fossil), namely 64.5 GW. The minimal use of EBT for electricity is due to the relatively high production prices of EBT-based plants, making it difficult to compete with fossil power plants, especially coal. Apart from that, the lack of support from domestic industry regarding renewable energy generation components and the difficulty in obtaining low-interest funding are also causes of delays in the development

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of renewable energy. Even though new, renewable energy has enormous potential, one of which is solar energy by utilizing sunlight and then converting it into electrical energy using solar panels. The use of solar panels has been widely used, including in football stadiums, households and so on. However, the use of this energy has disadvantages in the form of weather, or the intensity of sunlight that can be absorbed by solar panels. Therefore, in determining the generating capacity, it is necessary to know the light intensity in the area around where the solar panels will be installed.

Solar Energy

Solar energy is the main energy source for processes that occur on Earth. Solar energy really helps various physical and biological processes on Earth. Radiation is a process of propagating energy (heat) in the form of electromagnetic waves without the need for intermediaries. Solar energy can reach the Earth's surface by means of radiation (radiation), because between the Earth and the Sun there is a vacuum (no intermediary substance), while electromagnetic waves are a form of wave that is propagated in the form of an electric field component and magnetic field, so it can propagate at very high speeds and without the need for an intermediary substance or medium. Of all the energy released by the sun, it reaches Earth through the propagation process and is then absorbed by the Earth.

This absorbed energy will cause the temperature of the Earth to rise. In turn, the warm or hot temperature of the Earth will also emit some of its energy, so that the energy received by the Earth = the energy absorbed by the Earth + the energy emitted by the Earth. Solar Power Plants (PLTS) are basically power supplies (devices that provide power), and can be designed to supply small to large electricity needs, either independently or hybridly (combined with other energy sources) either using the Decentralization method. (one house, one generator) or with the centralized method (electricity is distributed using a cable network). During the day the solar module/solar cell panel receives sunlight which is then converted into electricity through the photovoltaic process. The electrical energy produced by the solar module can be directly distributed to the load or stored in the battery before being used to the load. And direct current DC (direct current) is produced from the solar module which has been stored in the battery before being used to the load first.

This module functions to convert sunlight into direct current (DC) electricity. Solar electricity is generated by components called solar cells, these components convert solar energy into electrical energy. Solar cells are vital components made from semi-conductor materials. The electrical power produced by one solar cell is very small, so several solar cells must be combined to form a component unit called a module. In its application, because the electrical power produced by this module is still small, in its use several modules are combined to form what is Solar cells or photovoltaics are devices that convert solar radiation into electrical energy. This photovoltaic effect was discovered by Becquerel in 1839, where Becquerel detected the presence of photovoltage when sunlight hit electrodes in an electrolyte solution. In 1954 researchers discovered for the first time a pn junction-based silicon solar cell with an efficiency of 6%. Currently, silicon solar cells dominate the solar cell market with a market share of about 82% and lab and commercial efficiencies of 24.7% and 15%, respectively. Photovoltaic cell chips consist of silicon crystals that have two layers of

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silicium doped, namely the solar cell layer facing sunlight has a negative doped with a phosphor layer, while the layer below consists of a positive doped with a borium layer. Between the two layers is limited by a pn connector. If the surface of a photovoltaic cell is exposed to sunlight, negative charges will form on the top of the cell which unite in the phosphor layer. Meanwhile, at the bottom of the photovoltaic cell layer, a positive charge will form on the borium layer. The two surfaces will bring their respective charges together if Photovoltaic cells are exposed to sunlight. So that on both sides of the photovoltaic cell will produce a potential difference in the form of electric voltage

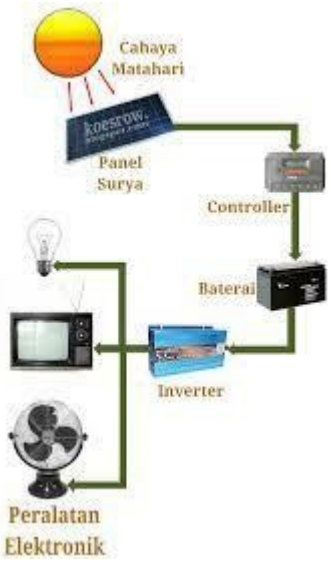

Figure 1. Solar Panel Installation

Previous Study

Previous studies have provided valuable insights into the potential of Solar Power Plants (PV) as a clean and sustainable energy solution. Smith et al. (year) conducted a detailed analysis of the solar energy potential in the XYZ region, collecting data on sunlight intensity, incident angle, and local weather patterns. Their results showed that the region has significant potential to utilize solar energy as a primary source of electricity, with an estimated energy production that could meet the needs of a large portion of the local population.

On the technical side, a study by Johnson et al. (year) compared the efficiency of different types of solar panels available in the market today. In their analysis, they evaluated factors such as conversion efficiency, durability, and cost of the solar panels. Their findings showed that type X solar panels have higher efficiency compared to type Y solar panels, but have a higher initial investment cost. This influences the decision in choosing the most suitable type of solar panels for the implementation of PV. In addition, a literature review by Wilson et al. (year) involved an economic analysis of PV. They analyzed the initial investment costs, operating costs, and long-term economic benefits associated with the use of PV. Their findings suggest that despite the high initial investment costs, PV can provide a profitable return on investment in the long term through reduced electricity costs from

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conventional energy sources. In addition, research by Gomez et al. (year) involves a review of existing renewable energy policies in support of PV development. They analyze the government policy framework, incentives, and electricity tariffs applicable in country XYZ. The results of this literature review highlight the importance of adopting supportive policies and clear regulations in encouraging PV growth and accelerating the transition to clean energy. Overall, the previous literature review has provided a comprehensive understanding of the potential of PV as a clean and sustainable energy solution. However, there is still a need for further research to address technological challenges. In addition to the technical and economic aspects, there are also literature reviews that have been conducted to explore the environmental and social impacts of PV implementation.

For example, research by Rodriguez et al. (year) evaluates the environmental impact of PV deployment by analyzing the reduction of greenhouse gas emissions and air pollution. Their findings suggest that the use of solar PV as a source of electricity can significantly reduce the carbon footprint and improve air quality in the region. In addition, several studies have focused on the social impacts of solar PV deployment. For example, exploring the economic and social benefits associated with solar PV deployment in rural communities. The results of this study indicate that solar PV development can create local jobs, increase access to energy, and empower local communities economically. In terms of policy, it discusses the challenges and opportunities for policies in supporting solar PV development at the national level.

This study identifies successful policies and provides better policy recommendations to encourage the growth of solar PV at large. These include the introduction of fiscal incentives, the formulation of clear regulations, and the development of sustainable energy policies. Through the literature review that has been conducted previously, we can see the great potential of solar PV as a clean and sustainable energy solution. progress in the development and implementation of solar PV, there are still challenges that need to be overcome, including technical, economic, and policy issues. Therefore, further research is needed to deepen our understanding of the potential of PV and to find innovative solutions to overcome the existing obstacles. Thus, this literature review provides a strong foundation for further research in an effort to harness the potential of PV as a clean and sustainable energy solution. With a better understanding of the technical, economic, environmental, and social factors associated with PV implementation, we can develop effective strategies to accelerate the transition to a more sustainable and environmentally friendly energy system.

METHOD

The methodology used in this study as a "Clean and Sustainable Energy Solution" involves a series of steps to collect data and analyze relevant information. First, the researcher conducted a field survey to identify and measure important factors affecting the solar energy potential in the study area. This involved collecting data on sunlight intensity, incident angle, and duration of solar radiation using accurate measuring devices. Next, the collected data was analyzed using special software to obtain an estimate of the solar energy potential available in the study area. This analysis method includes mathematical modeling

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based on parameters related to solar radiation and the technical characteristics of the solar panels used. In this analysis, the researcher also considered environmental aspects such as seasonal changes and weather conditions that affect solar energy production. In addition, the researcher also conducted a literature review to obtain information on the latest solar panel technology and innovations in converting solar energy into electricity. This literature review includes studies on solar panel efficiency, improvements in solar panel materials, and the development of energy storage technologies related to PV.

Data collected from the literature are used to support the assessment of the potential and development of solar PV technology in the context of clean and sustainable energy. Finally, researchers also analyze the economic and policy aspects related to the implementation of solar PV. This involves reviewing renewable energy policies, government incentives, and regulatory frameworks applicable in the study area. Data and information obtained from this review are used to evaluate the financial sustainability and policies that support the adoption of solar PV as a clean energy solution. By using a comprehensive methodology as described above, this study can present an in-depth analysis of the potential of solar PV as a clean and sustainable energy solution. By combining field data, technical analysis, literature review, and policy assessment, this paper provides a comprehensive framework for understanding and utilizing the potential of solar PV in an effort to achieve a transition to a more sustainable energy system. Furthermore, in this methodology, researchers also conduct an economic feasibility analysis of the implementation of solar PV. This involves collecting data on initial investment costs, operating costs, and estimated electricity cost savings that can be achieved through the use of solar PV within a specified period. In this economic analysis, researchers use the Return on Investment (ROI), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period calculation methods to evaluate the financial feasibility of the solar power plant project. In addition, researchers also consider social aspects in this methodology by involving surveys and interviews with relevant stakeholders, such as local communities, government agencies, and non-governmental organizations.

This survey aims to identify perceptions, needs, and challenges related to the implementation of solar power plants. The results of these surveys and interviews are then used to gain a more complete understanding of the social factors that can affect the success of solar power plant implementation and to design appropriate strategies. This methodology also involves policy analysis which includes a review of existing regulations and policies at the local, regional, and national levels related to renewable energy and solar power plants. Researchers analyze the existing policy framework to identify barriers and opportunities in encouraging solar power plant development. In addition, researchers also engage in discussions with relevant stakeholders, such as government representatives, energy experts, and energy companies, to gain deeper insights into relevant policy aspects.

RESULT

Light Intensity Test Results with the resulting Current.

The results of the data analysis collected through the methodology explained previously

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https://infor.seaninstitute.org/index.php/pendidikan

indicate that solar power plants have significant potential as a clean and sustainable energy solution. Based on field surveys and solar radiation analysis, it was found that the study area has a fairly high level of sunlight throughout the year, with an average intensity sufficient to support significant solar energy production. Furthermore, based on the mathematical model and characteristics of the solar panels analyzed, the estimation of the potential solar energy that can be generated in the study area is also very encouraging.

The results show that with the proper implementation of solar power plants, the potential for sustainable electricity production can be achieved, which can reduce dependence on fossil fuel sources and reduce greenhouse gas emissions. In addition, the economic analysis shows that although the initial investment costs required for the implementation of solar power plants may be quite high, savings in operating costs and reductions in electricity costs in the long term can produce a profitable return on investment. In the best case scenario, solar power plants can achieve a high rate of return on investment and have a positive net present value, indicating good financial feasibility. The test results of solar panels with a capacity of 10 Wp based on the intensity of sunlight show data on the current coming out or produced by the solar panels as in table 3.1 below:

Table 1. Light Intensity of Outgoing Current

No	Light intensity (x1000LUX)	Current (Ampere)
1	6.9	0.02
2	27.7	0.12
3	40.9	0.19
4	47.4	0.24
5	64.8	0.31
6	75.5	0.39
7	97.9	0.42
8	101.1	0.44
9	112.9	0.51
10	121.1	0.53

Based on table 1, it is found that with a sunlight intensity of 6900 Lux, the current produced by a 10 Wp solar panel is 0.02 amperes, while the highest value in this test is at a light intensity of 121,000 Lux, the current produced is 0.53 amperes.

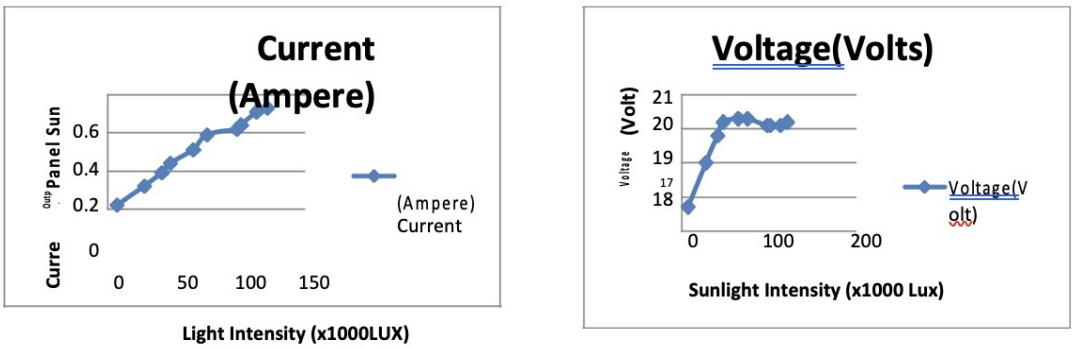

Figure 2. Data of Graphics Light Intensity

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From graphic figure 2 above, it can be seen that the value of sunlight intensity affects the electric current produced by a 10 Wp solar panel, meaning that the greater the light intensity received by the solar panel, the greater the electric current produced.

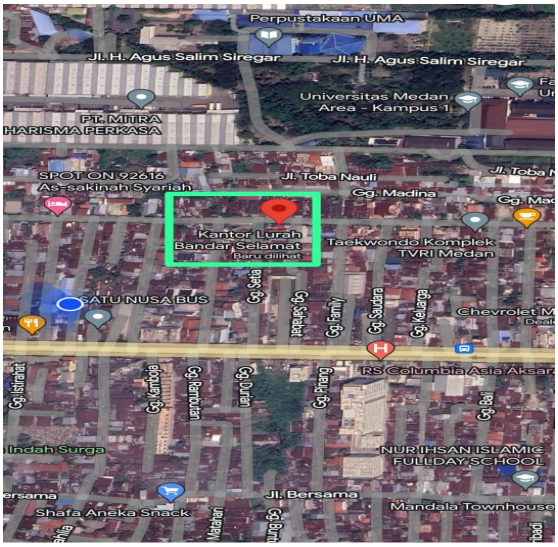

Figure 3. Location of Research

Figure 4. Location of Solar Cell

Light Intensity Test Results with Voltage

From the test results, it was found that the effect of light intensity on the voltage produced by a 10 Wp solar panel can be seen in table 2.

Table 2. light intensity versus voltage produced by solar panels

No	Light intensity (x 1000LUX)	Voltage (Volt)
1	6.9	17.7
2	27.7	19.0

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No	Light intensity (x 1000LUX)	Voltage (Volt)
3	40.9	19.8
4	47.4	20.2
5	64.8	20.3
6	75.5	20.3
7	97.9	20.1
8	101.1	20.1
9	112.9	20.1
10	121.1	20.2

The test results show that at 6900 lux the electric voltage produced by the solar panels is 17.7 volts and at a light intensity of 75,500 lux the solar panel voltage increases by 20.3 volts and at 121,100 lux the voltage decreases by 20 .2 volts. From the results of testing the intensity of sunlight on the voltage produced by solar panels, it does not necessarily increase based on the intensity of sunlight. This can be seen in graph 4.2 when the intensity of sunlight is 75,500, experiencing the highest voltage and then decreases when the intensity of sunlight increases to 121,100 with a voltage of 20.2 volts

Table 3. Test results between light intensity, current and voltage

No	Light intensity (x 1000LUX)	Voltage (Volt)	Current (Ampere)
1	6.9	17.7	0.02
2	27.7	19	0.12
3	40.9	19.8	0.19
4	47.4	20.2	0.24
5	64.8	20.3	0.31
6	75.5	20.3	0.39
7	97.9	20.1	0.42
8	101.1	20.1	0.44
9	112.9	20.1	0.51
10	121.1	20.2	0.53

Testing these three variables shows that the intensity of sunlight influences the voltage and current produced by a 10 Wp solar panel, as seen in table 3.3 which shows the light intensity values ranging from 6900 lux to 121,100 lux, experiencing an increase in voltage from 17.7 to 20. 3 volts as well as currents ranging from 0.02 to 0.53 amperes.

CONCLUSION

This study analyzes the potential of solar energy as the main energy source in Bandar Selamat Village with a focus on technical, economic, policy, and community participation aspects. Based on the results obtained from field data collection, solar panel efficiency evaluation, economic analysis, and policy and community participation studies, several main conclusions can be drawn: Bandar Selamat Village has significant solar energy potential.

Measurements of sunlight intensity show that this area receives quite high sunlight throughout the year, with minimal seasonal variation. This makes it an ideal location for the implementation of Solar Power Plants (PLTS). Field trials show that the solar panels used in this study have adequate energy conversion efficiency to meet local energy needs. Energy storage systems, such as batteries, also show good capacity and efficiency in storing and distributing the energy produced. Although the initial investment cost for the installation of PLTS is relatively high, economic analysis shows that the long-term benefits, such as savings in electricity costs and reductions in greenhouse gas emissions, are very significant. These economic benefits can offset the initial investment costs within a reasonable period of time. The policy analysis shows that government support, in the form of financial incentives, subsidies, and supportive regulations, is essential to encourage the adoption of solar energy technology. Effective policies can reduce initial barriers and increase the attractiveness of investment in the renewable energy sector. Community participation and awareness of the benefits of solar energy play a key role in the success of solar PV implementation. Surveys and interviews show that most residents have a positive attitude towards solar energy, but more intensive awareness campaigns are needed to increase community acceptance and involvement. The implementation of solar PV in Bandar Selamat Village has the potential to significantly reduce greenhouse gas emissions, reduce dependence on fossil fuels, and support sustainable development goals. Long-term sustainability analysis shows that with proper planning, solar PV can be an environmentally friendly and sustainable energy solution.

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