Comparison of Solar Panel Usage with Conventional Electricity in Factories

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Abstract
This study aims to compare the use of solar panels with conventional electricity in a factory environment with a focus on energy efficiency, operational costs, and environmental impacts. This study uses a quantitative method by conducting interviews with energy experts from Solar Jaya Energi (SJE). The data collected was analyzed to find the advantages and disadvantages of each system. The results of this study indicate that the use of solar panels has significant advantages compared to conventional electricity. This is because solar panels utilize sunlight, which is a renewable energy source that will not run out as long as the sun shines. This, solar panels are a more environmentally friendly solution than conventional electricity sources. Although the initial installation costs of solar panels are relatively high, in terms of maintenance, this technology is very economical and efficient. The series of benefits of using solar panels as an alternative energy source contributes to the effectiveness and efficiency of electricity management in factories.

Keyword:
Solar Panels, Conventional Electricity, Energy efficiency

1. INTRODUCTION

Electrical energy is one of the things that is really needed in people's lives, such as industry, households, government offices, and lighting. road general (Faediyah et al., 2024). The increasing population growth will certainly have an impact on the increasing need for electrical energy which will actually create new challenges related to meeting these energy needs. Coal, which is the main fuel for electrical energy, is increasingly depleted and causes problems. other environments (Kharisma et al., 2024). According to data presented by the National Energy Council in the 2023 National Energy Balance Analysis Report, CO2 emissions grew by 6.1% annually from 2017-2022 and the highest growth came from the industrial sector, which was 20.6% annually . the year (Secretariat General of the National Energy Council, 2023). If the power generation system in Indonesia continues to rely on non-environmentally friendly fuels, more serious environmental impacts will continue. One step that can be taken to overcome this problem is to switch to the use of clean energy. Solar panels is one of the environmentally friendly renewable energies, this energy comes from sunlight and can be used continuously and does not have a negative impact. to environment (Safii et al., 2024) . Solar panels can be a solution to answer the problem of large electrical energy needs for industry, such as factories. Solar panels can also reduce environmental problems related to CO2 emissions because this energy is environmentally friendly. Although the use of solar panels offers many advantages, it is undeniable that the transition from conventional electricity to solar energy still faces various challenges. Some of the obstacles faced by factories include high initial installation costs, the need for adequate area for installation, and energy efficiency that can vary depending on weather conditions and geographic location. Therefore, it is important to conduct a comparative study between the use of solar panels and conventional electricity in the context of factories, especially in terms of the environmental impacts caused. This study aims to analyze the differences between the use of conventional electricity and solar panels in factories on the environment. The results of the study are expected to provide useful information for the industrial sector in designing strategies related to sustainable energy and supporting climate change mitigation efforts.

Solar Panel Theory

Indonesia should accept the implementation of new and renewable energy (EBT), namely electricity generation through solar power, because Indonesia has a tropical climate and high sunlight intensity . (May et al., 2020). Renewable energy is very helpful for daily electricity needs because it can be an alternative to existing natural resources and can last a long time. There are various types of new and renewable energy sources, namely wind power plants (PLTB), hydroelectric power plants (PLTA), steam power plants (PLTU), solar power plants (PLTS) and other types of power plants that have been built in various regions. Solar power generation is a type of power generation system that uses renewable energy to generate electricity using energy sun (Rajagukguk et al., 2023) . To collect and convert solar energy into usable electricity, PLTS uses solar photovoltaic (PV) technology. Solar energy has the highest energy potential, with a supply of 3 times 1024 joules/year, which is equivalent to 10,000 times the use global energy (Rahmaniar et al., 2023). According to (Liun, 2011) There are two most popular technologies for generating electrical energy from the sun, namely:

1. Photovoltaic (PV) components
   The main components of photovoltaic cells or solar modules include semiconductor materials with positive and negative charge carriers. The two main types of modules are flat sky modules, where the entire illuminated area is filled with solar cells (solar cells). Photovoltaic modules, where optical elements, such as mirrors and lenses, concentrate the light into a small area of solar cells, thus saving the use of expensive semiconductor materials. However, the efficiency of solar panels is only about 20% of the total energy produced by sunlight to be converted into electricity.
2. Solar Thermal
   Five systems are used for solar thermal technology, namely parabolic concave, parabolic dish, centralized receiver, hemispherical bowl, and solar pond. Solar thermal systems consist of five basic components of concentrator (*collector*), receiver, energy transport system, heat energy conversion system, and regulator system. The Resource Assessment for Solar and Wind Energy (SWERA) data in the United States provides resolution data on DNI. The DNI dataset includes monthly and annual average data for the Middle East, Arabian Peninsula, and Africa. To the south, MENA (*Middle East and North Africa*) countries have great solar thermal potential. Experts estimate that concentrating solar power (CSP) technology requires a DNI of at least 5kWh/m2/day or more, usually in the North African desert. A good solar thermal system can generate electricity with an efficiency of up to 40%. However, the reality will be much lower if the system calculation is added with a time function which means that solar energy is only obtained during the day. Solar panels are usually placed on open ground or on the roof of a building with optimal exposure to sunlight (Hidayatullah et al., 2024) . In solar power plants, it occurs after going through a solar energy conversion process with several stages, the first of which is that solar panels capture sunlight on their surface. Each solar cell in a solar panel contains a semiconductor material, which produces an electric current when exposed to ray sun (Panulisan et al., 2023) . The second stage is solar power generation. In this process, electrons move inside the semiconductor material, which produces an electric current that flows through the connected circuit. The resulting current can then be used to meet your immediate needs or stored in batteries for use when needed. Some solar power systems are also connected to the public electricity grid. In this way, unused electricity can be channeled to the grid for use by others, and the electricity provider can compensate for that (Hasibuan et al., 2023).

According to Purwoto et al., (2000) in Mirdawati et al., (2024) the types of solar panels are:

1. Monocrystal *(Monocrystalline)*
   Monocrystalline *is* the most efficient panel produced with the latest technology and produces the highest electrical power per unit area. Monocrystalline is made for use that requires large electrical consumption used in environments with extreme climates and harsh natural conditions.
2. Polycrystalline
   Polycrystalline *is* a panel that has a random crystal structure because it is made using a casting process that has an efficiency of up to 15%.
3. Thin Film Photovoltaic
   Thin Film Photovoltaic is a solar panel that has two layers with a thin layer structure of microcrystalline silicon and amorphous with a module efficiency of up to 8.5%.

Conventional Energy Theory

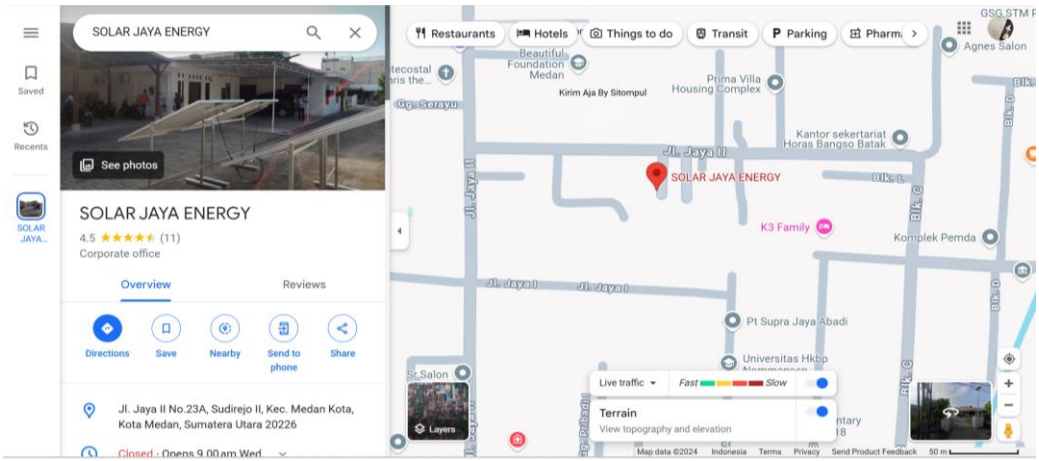
Electrical energy is a very necessary need in everyday life. There are two types of electrical energy generators, namely conventional and non-conventional energy sources. Currently, the need for electrical energy is met by conventional energy sources such as petroleum, coal, diesel, nuclear. Conventional energy sources have disadvantages, namely coal-fired power plants produce CO2 gas which has a negative impact on the environment, and nuclear power plants require high costs, and nuclear energy waste is dangerous. for man (Babu et al., 2010). The availability of conventional energy will run out day by day, so that searching for other energy sources must be done because conventional energy sources will run out and become extinct. (Harmini et al., 2018). New energy sources should be economical, pollution-free, and reliable. Non-conventional energy should be an alternative to conventional energy. Some non-conventional energy sources include geothermal, wind, solar, ocean waves, and so on. The disadvantage of ocean wave energy is that it can only be used in the ocean, while geothermal energy requires a long process to extract heat from the earth's crust. Wind and solar energy can be provided in all conditions so that energy becomes a good alternative energy source to be applied. One of the disadvantages of solar and wind energy sources is that they do not produce significant amounts of energy during the rainy or cloudy season. To overcome this problem, one way is to create a hybrid system that combines both energy sources. In case one of the energy sources cannot produce energy, the other energy source will produce energy and produce energy addition (Udayakanthi, 2015).

2. RESEARCH METHODOLOGY

Research methods used in this study is method qualitative. Where the this research use studies literature like collection and analysis information from various source written , such as books, journals and articles in do research. Research qualitative is an investigative process naturalistic seeking understanding deep about phenomenon social in a way experience. This study use a number of technique data collection, such as :

1. Observation

   One of techniques that can used for know or investigate behavior nonverbal behavior namely with use technique observation . According to Sugiyono (2018) in Yasifa , et al (2022) observations is technique collection of existing data specific characteristics when compared to with other techniques . Observation is also not limited to people, but also objects other nature. Observation in study This that is with do observation directly in the field For know solar panel appearance in a way direct



Picture 1. Research Location Map

2. Interview

   Interview is communication between two or more parties that can be done face to face where one party acts as an interviewer and the other party acts as an interviewee with a specific purpose, for example to obtain information or collect data. The interviewer asks a number of questions to the interviewee to get answer (Fadhallah, 2021). Here is a list of questions in interview as following:

Table 1. Questions Interview

No	A list of questions
1.	What is the difference main between electricity conventional and solar panels in matter material standards and management waste ?
2.	How impact term long use electricity conventional and solar panels to environment especially environment industry factory ?
3.	Anything obstacles that cause solar panels Still seldom used by the community ?

3. Literature review

Literature Review According to J. Supranto as quoted by Ruslan in his book method public relations and communication research. Study literature is done search for data or information research through read journal scientific, books references and materials material publications available in the library (Ruslan, 2008) Researcher take source study or object from document or notes from events that have occurred passed , okay in written form , images , or monumental work of someone . Can be taken from notes daily, history life, biography, rules , and so on (Ruslan, 2010)

3. RESULT AND DISCUSSION

Based on results interview with Solar Jaya Energy Engineering Staff that difference main between electricity conventional and solar panels in matter material standards and management waste, namely :

1. Conventional Electricity
   a) Raw materials used Enough requires a large amount of capital start from usage electricity during one month in scale factory and supply material sufficient diesel fuel competent moment blackout electricity happen
   b) PLN electricity only depend on with infrastructure that has been there is like material burn fossil and water energy, which can become source limited power and can experience problem supply If happen lack or disturbance
   c) Conventional electricity can produce waste dangerous which requires management special for prevent impact negative to environment surrounding.
2. Panels
   a) Expensive raw materials start from battery, glass, solar charge controller, diverter, Solar Inverter which Still imported from abroad as material making for solar panels
   b) Management the waste no walking as good as maybe, because no can solar panels that have damaged like consequence improper use awake in its maintenance like caught mold or damage in journey like glass outside broken inner material protector no can recycled repeat return will but party from solar panel supplier usually responsible answer on waste from the solar panels.

Impact term long use electricity conventional and solar panels to environment especially environment industry factory, namely :

1. On electricity conventional there is a number of things that become the impact, namely : (a) When blackout electricity time for control it moment he blackout need starting the generator manually takes a long time all component machines in the industry the must dead moreover formerly before the generator is turned on after that new we turn on machines that return (b) Requires a lot of diesel the amount as generator supply (c) Use PLN electricity contributes to greenhouse gas emissions glass and pollution environment consequence burning material burn fossils, while
2. On solar panels there is a number of things that become the impact , namely : (a) When solar panel blackout almost no have spare time in his life , we can set at 0.1 seconds even for lang time livelihood transition from PLN to to PLTS so for turn it on that already located in a way complete in one a box that can be called a smart inverter setinggung where already there are inputs all already screen -screened already description we only stay plug-plug just his work more he's simple (b) No need material burn even a little bit because of solar panels Alone get source free energy from ray sun (c) Can not surrounded by trees surrounding because shadow a leaves will also interfere with the absorption process ray solar panel sun so that will no maximum in filling source power battery inside it (d) Can reduce greenhouse gas emissions influential glass to change

climate. In addition, it can reduce greenhouse gas emissions the glass that will produce pollution air so that can bother health like sulfur dioxide and matter particulate other (Solar Jaya Energy, 2021a).

Obstacles that cause solar panels Still seldom used by the community is limitations will cost installation at the beginning because of solar panels alone is considered very expensive for cost installation, quantity mushrooms that will hinder the absorption process consequence no existence maintenance against solar panels, the lack of education about energy renewable as replacement electricity conventional, PLN's role in life everyday is very big and is considered not yet fully can replace from PLTS will but for solar panel maintenance alone classified as minimal because normal part for maintenance only like cleaning the glass is affected dirt birds, dust and particles small other enough only on the lap or doused using running water just usually. As for the advantages in solar panel installation for in the future now and the future come, namely :

1. E- energy sources light power solar no will once finished, because originate from ray the sun that doesn't exist know end. In addition, energy this is very friendly environment, no produce waste or pollution.
2. Light power solar is friendly choice environment because utilise energy sun. With so, lights this no produce emission carbon as is the case with materials burn fossil. solar energy become the most sustainable and environmentally friendly alternative environment.
3. Installation light park power Surya is very easy ; just place in an open area that is not obstructed, so that the light can maximum catch ray sun. Advantages other is without need cable additionally, so that the installation more safe and display more neat.
4. Component light power solar known durable and not easy damaged, making it profitable investment
5. Use light power solar is also very economical. The costs incurred only for installation if you don't install it own and cost replacement light if happen damage. However, in general, the lights this designed for durable and not need lots maintenance
6. Lastly, the lights power solar no will burdensome your finances, because can save up to 60% of cost electricity which is usually paid for electricity commercial. (Solar Jaya Energy, 2021).

Can concluded that that use of solar panels own significant advantages compared to with electricity conventional. This is due to solar panels utilise ray the sun, which is source energy renewable that will not finished during sun shine. With thus, solar panels become more solutions friendly environment compared to source electricity conventional. Although cost installation solar panel start classified as high, deep matter care, technology this is very economical and efficient. The series benefit from use of solar panels as source energy alternative contribute to effectiveness and efficiency management electricity in factories Following is documentation about condition of solar panels at the Solar Jaya Energy office :

Figure 2. Solar Panel Shape

Figure 3. Group photo with component solar panel charger in warehouse storage

Figure 4. Solar Panel Waste

4. CONCLUSION

Based on the analysis carried out can concluded that use of solar panels own significant advantages compared to with electricity conventional. This is due to solar panels utilise ray the sun, which is source energy renewable that will not finished during sun shine. With thus, solar panels become more solutions

friendly environment compared to source electricity conventional. Although cost installation solar panel start classified as high, deep matter care, technology this is very economical and efficient. The series benefit from use of solar panels as source energy alternative contribute to effectiveness and efficiency management electricity in factories. The performance of Solar Power Plants (PLTS) or solar panels is greatly influenced by conditions environment, including intensity ray sun, temperature, and factors default from manufacturer like the efficiency of the panel itself . In addition, the power The electricity generated by solar panels is also affected by various factors. factor external, such as existence shadows blocking the panels, orientation and tilt installation, as well as condition weather. PLTS has various diverse and versatile applications used in lots sector. Research result show that factor economy, such as cost beginning installation and location placement of solar panels, as well as impact environment, plays a role important in decision factory for still use electricity conventional instead of switch to the solar panels. Based on findings this, it is suggested that the government consider solar panel efficiency in context environment. Policy the can covering education about use of solar panels for term long, and affirmation that source power this won't finished. Rays the sun, as source energy for light power solar, is source that is not limited and friendly environment, because no produce waste or pollution.

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