JIMESE
Journal of Innovation Materials, Energy, and Sustainable Engineering
JIMESE 1(2): 110–118
ISSN 3025-0307

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Energy transition: Utilization of solar energy as an energy source in smart building implementation as an effort to reduce the use of fossil energy

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Received Date: January 31, 2024 Revised Date: January 31, 2024 Accepted Date: January 31, 2024

ABSTRACT
The increase in population certainly greatly affects the amount of existing energy consumption. Based on data taken by the Indonesia Energy Outlook 2019, in 2018 Indonesia has a total final energy consumption (not considering conventional energy) of around 40% of the energy used for the transportation sector, then 36% for industry, 16% for households, commercial and other sectors respectively 6% and 2% respectively. Then, in 2019 the total final energy consumption was 989.9 million Barrels of Oil Equivalent. Then the use of fossil energy has an impact on sustainable life because fossil energy is one of the contributors to carbon emissions on earth. The increase in emissions has an impact on the increase in GHS that has been felt by the earth, namely, the occurrence of very drastic climate changes, as well as affecting temperature rises of up to 3◦C. For this reason, it is necessary to have the potential for renewable energy by utilizing solar energy, namely the process of converting energy produced by solar radiation into electrical energy and efficient use of this energy using smart buildings.. Objectives: The aims of the journal is to know another potential energy sourced to reduce the fossil fuel uses. Method and results: Literature review.

KEYWORDS: energy; climate change; renewable; smart building; solar energy

1. Introduction

Indonesia is one of the countries with the largest population in the world. This is based on the results of the population census conducted by the Indonesian Central Bureau of Statistics in 2020. Based on the results of the census, the Indonesian Central Bureau of Statistics stated that as of September 2020 Indonesia had a population of 270.20 million people, an increase of around 32.56 million from the population census conducted in 2010 (Badan Pusat Statistik, 2021a). Then, continuing from the trend of increasing population in Indonesia, the Indonesian Central Statistics Agency from population data in Indonesia, states that Indonesia has experienced an increase in the total growth rate of 2.39% in 2020 - 2022 (Badan Pusat Statistik, 2021c).

Furthermore, discussing the increase in population certainly greatly affects the amount of existing energy consumption. Based on data taken by the Indonesia Energy Outlook 2019, in 2018 Indonesia has a total final energy consumption (not considering conventional energy) of around 40% of the energy used for the transportation sector, then 36% for industry, 16% for households, commercial and other sectors respectively 6% and 2% respectively (Tim Sekretaris Jenderal Dewan Energi Nasional, 2019). Then, in 2019 the total

Cite This Article:
Irnawan, R. F., & Masjud, Y. I. (2024). Energy transition: Utilization of solar energy as an energy source in smart building implementation as an effort to reduce the use of fossil energy. Journal of Innovation Materials, Energy, and Sustainable Engineering, 1(2), 110-118. https://doi.org/10.61511/jimese.v1i2.2024.597

final energy consumption was 989.9 million Barrels of Oil Equivalent. Which will continue to increase every year along with population growth (BPPT Outlook, 2021).

In addition, along with the increasing amount of energy consumption, new problems arise from energy sources in Indonesia. Even though energy is an important factor that affects all activities in urban areas, including the economy, industry, transportation, infrastructure, housing, environment, and social justice (Hasanah & Setiawan, 2022). This is due to energy sources in Indonesia, 95% of which are fossil energy, of which 50% of the fossil energy used in Indonesia comes from petroleum (Putra et al., 2020). Even though the use of fossil energy has an impact on sustainable life because fossil energy is one of the contributors to carbon emissions on earth. The increase in emissions has an impact on the increase in GHS that has been felt by the earth, namely, the occurrence of very drastic climate changes, as well as affecting temperature rises of up to 3◦C. Which results in food conditions, ecosystems, health, and human habitation itself (Afriyanti et al., 2020).

Therefore, a solution is needed as a form of effort to reduce the impact of the problems caused by fossil energy by carrying out alternative energy transition steps that can reduce the impact of climate change (Mulyandari et al., 2022). Furthermore, discussing the potential for alternative energy, Indonesia has great potential for these resources. This is because Indonesia has many energy sources such as sunlight, sea waves, geothermal energy, and so on. This literature will discuss the energy potential that will be produced by sunlight. The utilization of solar energy is the process of converting energy produced by solar radiation into electrical energy (Putra et al., 2020).

The selection of solar energy itself as a source of energy by considering the duration of solar radiation in Indonesia. The duration of solar irradiation in Indonesia reaches 6 - 8 hours which has the potential for electrical energy that can be generated in a unit area of 4 kWh/m2, where this result is influenced by Indonesia's geographical location which is on the equator (Anroki., et al, 2019; Badan Pusat Statistik, 2021b). The process of converting solar energy into electrical energy uses a solar cell tool, as an energy conversion medium (Haryanto, 2021). The tools or technology used in the conversion process are semiconductor overlays that can absorb photons from sunlight and convert them into electricity (Buyung et al., 2022).

Then, to support the efficient use of the amount of energy even though it has used renewable energy sources, of course, it must still pay attention to the amount of existing energy use. As an effort to save energy efficiency in smart building innovation ideas. In addition, to the problems or impacts caused by fossil fuels, fossil fuel resources are also non-living natural resources, or non-renewable. Where the number is decreasing and not proportional to the need for fossil fuels as an increasing energy raw material. So new renewable energy sources are needed to support the availability of energy resources in Indonesia (Putra et al., 2020). As well as to support the Sustainable Development Goals number 7, namely clean and affordable energy.

Talking about Alternative Energy or Renewable Energy, the Indonesian government itself supports efforts to increase energy quality standards that are sustainable (Sardi et al., 2020). This is based on the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 39 of 2017 concerning the Implementation of Physical Activities for the Utilization of New Energy and Renewable Energy and Energy Conservation (Kementrian ESDM, 2017). As well as Regulation of the President of the Republic of Indonesia Number 6 of 2006 concerning National Energy Policy (PERATURAN PRESIDEN REPUBLIK INDONESIA NOMOR 5 TAHUN 2006). According to the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 39 of 2017 Article 1 paragraph 1. The physical activity of utilizing new energy and renewable energy and energy conversion is an activity that aims to utilize new energy sources and renewable energy for electricity and non-electric power generation (Modjo, 2019).

2. Methods

The writing method used in this study is a systematic literature review, in which this method collects metadata obtained from the journal database via https://www.dimensions.ai/ and https://scholar.google.com/ and visualizes it usingthe VOSviewer tool. This is intended to show research trends on the theme of energy transition in the last 10 years.

Fig.1. The graph show the trend of transition Energy [18]

Based on observations made by the VOSviewer application, the topic of energy transition remains a trend in research topics. This can be seen in the graphical figure which shows that from 2013-2022 research on renewable energy continues to increase every year around the world. According to the results of research publications discussing the energy transition until December 2022, there were 545,203 publications, which will continue to increase until the end of 2022 and are predicted to exceed research figures from 2021, namely 569,084. Thus, this topic continues to be the focus of future research as an effort to move towards more environmentally friendly energy. Therefore the title "Energy Transition: Utilization of Solar Energy as an Energy Source in the Implementation of Smart Buildings as anEffort to Reduce the Use of Fossil Energy" was chosen to be appointed.

3. Results and Discussion

3.1 Smart building

The Smart Building concept is a building that uses a building automation system or what is called a smart building system. That is, all devices in building technology can be designed and programmed according to needs, wishes, and automatically integrated controls (Binta & Maulana, 2021). Artificial intelligence technology utilized in smart buildingsutilizes IoT as the main controller to support the performance and efficiency of smart buildings (Hasanah & Setiawan, 2022).

IoT or Internet of Things is a device that is connected to the internet universally and can be connected seamlessly by connectivity systems on an international scale (Binta & Maulana, 2021). IoT technology functions as a translator of data originating from humans which are then translated into machine language. This aims to increase the level of effectiveness of smart building technology, as a parameter of the success of smart building implementation.

Then, as support for the implementation of a smart building, sensor technology is needed in the smart building configuration system. Sensor technology is building automation, security, and telecommunications technology that can be programmed as needed and controlled centrally so that it runs automatically (Handri et al., 2022).

3.2 Solar panel technology

Theoretically, solar power plants use the sun's heat to heat liquids, which are then used to drive turbines to generate electricity. In practice this is very difficult, considering the relatively small amount of heat received, low engine efficiency, and the amount of heat wasted in the process (Santibi., et al., 2019; Suherlan, 2019).

Solar cells are renewable energy that uses the sun's energy to generate electrical energy. Solar energy is a potential energy to be developed in Indonesia considering that Indonesia is geographically located on equatorial latitudes that receive sunlight throughout the year. This can be used as capital in generating electricity with solar power, namely to convert solar energy into electrical energy (Anrokhi et al., 2019). The energy produced from solar radiation with various wavelengths, ranging from ultraviolet, and visible light, to infrared from the electromagnetic spectrum (Artiningrum & Havianto, 2020). The design of a solar panel technology model uses three principles, namely, Input, Process, and Output (Harahap, 2020; Hidayati et al., 2020).

Then the solar cell itself functions to convert electric power with a DC flow system into AC (Priatam et al., 2021). Solar cell technology, or photovoltaic, is a technology that produces direct current from semiconductor materials when exposed to photons. As long as solar cells (called individual photovoltaic elements) are illuminated by light, theywill generate electricity. If there is no light, there is no electrical energy (Wahyuni et al., 2020). Converting sunlight into electricity with photovoltaic panels, mostly using PolyCrystalline Silicon as a photocell semiconductor material (Harahap, 2020).

Furthermore, Solar charge controllers are electrical devices that are used to regulate the direct current that is charged to the battery and drawn from the battery to the load. The solar charge controller regulates overcharging and overvoltage from solar panels/solar cells. The solar charge controller functions to maintain energy balance in the battery by adjusting the maximum and minimum voltage of the battery, this sensor also functions to provide security to the system. Protection against overcharging of the battery, protection against over-discharging of the load, preventing back current to the solar module, and protection against connection (Haryanto, 2021).

3.3 Utilization of solar energy for energy transition

The use of sunlight to generate electricity is called solar power generation. Applying solar energy generation technology to utilize the potential of available solar energy is the right solution. This is helped because Indonesia is located in a tropical area that gets continuous sunlight throughout the year (Ridwan et al., 2021).

In addition, the selection of solar energy as renewable energy is based on the amount of energy emitted which is around 3 x 1024 joules per year, and forIndonesia itself, the duration of solar lighting is around 6-8 hours per day. Which has the potential to produce an average insolation value of 4 kWh/m^2 (Anrokhi et al., 2019). Converting solar energy to electrical energy, of course, uses a solar panel mechanism, which consists of input, process, and output processes (Ridwan et al., 2021).

Then, taking into account the average efficiency of applying solar panels, which is 12% - 19% (Hasrul, 2021). Calculation of the estimated electrical energy that can be generated in a 4-story building with an area of 200 m2 where only 40% of the building area is installed with solar panels, as follows:

$$The\ area\ of\ the\ solar\ panel: 4 \times 200\ m^2 \times 40\% = 320 m^2$$

Next, after getting the area of the solar panels, namely, estimating thetotal electrical energy produced in one month:

$$Electricity\ potential\ :\ 320 m^2 \cancel{\times 4\ kWh/m^2 \times} \frac{24\ hours}{days} \times 30$$

$1\ day \qquad 1\ month$

So the total potential of electrical energy generated within one month is 9.216 × 10^5 kW/month. 9,216 × 10^5 kW/Month.

4. Conclusions

Based on the discussion on the topic of Energy Transition: Utilization of Solar Energy as an Energy Source in the Implementation of Smart Buildings as an Effort to Reduce the Use of Fossil Energy. the following conclusions can be drawn. Based on these problems, the Indonesian government has made regulations that state that it supports innovation in the implementation of renewable energy as an effort to reduce the impact of fossil fuels.The innovation provided is Energy Transition: Utilization of Solar Energy as an Energy Source in Smart Building Implementation as an Effort to Reduce the Use of Fossil Energy, as one of the efforts to overcome this problem, and support the Sustainable Development Goals 2030 and the Green Campus program. Smart Building technology aims to save electricity consumption in buildings thanks to automatic sensors designed to be connected to the internet, as well as the use of solar energy as a renewable energy source which is estimated to produce 9,216 × 105 kW of electrical energy in a month.

Acknowledgement

Praise be to the presence of Allah SWT for His mercy and abundance of grace so that the writer can complete the preparation of the journal entitled Energy Transition: Utilization of Solar Energy as an Energy Source in Smart Building Implementation as an Effort to Reduce the Use of Fossil Energy. This is to fulfill one of the requirements to complete the Climate Change Adaptation and Mitigation Final Exam in the Environmental Engineering Study Program, Faculty of Engineering, President University. The author's appreciation goes to President University as an institution that has enabled the writer to develop his knowledge to advance as a future leader. In addition, the authors also thank Ma'am Dr. Ir. Yunita Ismail Masjud, M.Si. As a lecturer and supervisor in the field of Change Adaptation and Mitigation. Finally, the writer realizes that writing this journal is not perfect. Therefore, the authors expect constructive suggestions and criticisms, which are useful for all readers.

Author Contribution

All authors contributed fully to the writing of this article.

Funding

This research received no external funding.

Ethical Review Board Statement

Not applicable

Informed Consent Statement

Not applicable

Data Availability Statement:

There's new data

Conflicts of Interest:

The authors declare no conflict of interest.

Open Access

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