

# A Study on The Environmental Impact of Solar Energy

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**Abstract** - Solar energy is a rapidly growing alternative energy source that has many benefits for both the economy and environment. This essay explores the advantages of solar energy, including its low cost, scalability, dependability, and minimum environmental impact. Using solar energy is an excellent way to reduce greenhouse gas emissions and combat climate change. Using solar energy also has the potential to strengthen regional economies and provide employment. Many research and analyses, including those from the International Energy Agency, National Renewable Energy Laboratory, and Solar Energy Industries Association, have supported these claims. The research indicates that solar energy has the potential to fundamentally alter how we produce and utilize energy, opening the door for a greater for sustainable and wealthy future.

## I. INTRODUCTION

Solar energy has become increasingly well-liked across the globe in recent years due to the rising demand for sustainable and renewable energy sources. The use of solar energy has great promise for halting climate change and lowering greenhouse gas emissions, which are mostly brought about by burning fossil fuels. Notwithstanding the potential advantages, it is crucial to evaluate solar energy's effects on the environment to ensure its sustainability and effectiveness. This study attempts to give an overview of solar energy's effects on the environment and assess how well it can help with current environmental problems.

A renewable energy source referred to as solar energy uses the sun's energy to generate electricity. The popularity of solar panels, which use sunlight to generate power, is rising as a result of its effectiveness, affordability, and scalability. Nonetheless, it is impossible to overlook how solar energy affects the ecosystem. Solar panel installation, operation, and disposal can all have a major negative impact on the environment. Consequently, it is essential to assess the environmental impact and solar panel life cycle.

This study will examine how solar energy affects the environment in terms of energy use, greenhouse gas emissions, land use, water use, and waste production. The introduction of solar energy presents both potential and obstacles, including the need for renewable energy production practices, solar panel recycling, and grid integration.

The objective of this study paper is to provide a thorough review of the environmental effects of solar energy and how it might help us solve our current environmental problems. We can assure the sustainability and effectiveness of solar energy as a viable alternative to fossil fuels by evaluating the effect of solar energy on the environment and identifying areas that need improvement.

## II. LITERATURE REVIEW

"Environmental effects of solar energy technology" was written by Maryse Labriet and others in 2012 and published in the journal *Renewable and Sustainable Energy Reviews*. An overview of the environmental effects of different solar energy systems, such as solar thermal, concentrated solar power, and PV, is given in this review article. As comparison to fossil fuel sources, solar energy has substantial environmental advantages, but additional research is necessary to fully grasp these advantages. "Environmental effects of solar energy technology" was written by Maryse Labriet and others in 2012 and published in the journal *Renewable and Sustainable Energy Reviews*. An overview of the environmental effects of different solar energy systems, such as solar thermal, concentrated solar power, and PV, is given in this review article. As comparison to fossil fuel sources, solar energy has substantial environmental advantages, but additional research is necessary to fully grasp these advantages.

Oisamoje & Eguono Oisamoje (2013) conducted research under the title of "Exploring the Economic and Environmental Benefits of Solar Energy Generation in Developing Countries: The Nigerian Perspective". They have stated that solar energy has economic and environmental benefits every country. Thus, it is crucial to the economy of any country's cost-effectiveness. Together with other advantages, it promotes the growth of micro-industries and directly employs workers. They have further illustrated that solar energy systems are produced as a result of certain factors. While selecting whether or not to use solar energy, factors other than economic ones are considered, such as pollution, the production of greenhouse gases, and the security of the energy supply, among others (Oisamoje & Eguono Oisamoje, 2015).

H. Xiao and Y. Li's "Life cycle assessment of a solar photovoltaic system: a review" was published in 2016. This review article analyses solar photovoltaic (PV) system life cycle assessments (LCAs), a technique for determining a product's or process's overall environmental impact. The article gives a general introduction of the LCA approach and highlights the findings of many LCAs of solar PV systems, including their effects on greenhouse gas emissions, land use, water consumption, and toxic pollutants. A study by Kemp et al. (2016) investigated the potential for toxic substances to leach out of discarded solar panels and contaminate soil and groundwater. The study found that the potential for contamination was relatively low, but that more research is needed to fully understand the environmental impact of solar panel disposal.

According to a review study by, Iran's rural regions are heavily dependent on fossil fuels to satisfy their energy needs. This research made the argument that there is a lot of environmental pollution because of our reliance on fossil fuels. The report states that a significant portion of the world's electricity output in 2017 came from fossil fuels. An overall 26 percent (26%) of electricity comes from renewable energy sources, including geothermal, solar PV, hydropower, and biopower. In 2017, A. Kazmerski published "Environmental consequences of solar energy technologies." This page gives a general summary of how solar energy technologies, such as PV and concentrating solar power, affect the environment (CSP). In addition to highlighting potential environmental hazards including increased land use and water use, the article covers the potential environmental advantages of solar energy, such as decreased greenhouse gas emissions.

T. M. Keoleian and G. Lewis' "Environmental impacts of utility-scale solar energy" was published in 2019. This review article discusses utility-scale solar energy's effects on the environment, which are large-scale solar arrays that feed electricity into the grid. The article offers suggestions for reducing these effects and analyses the potential environmental effects of utility-scale solar, such as land use, water use, and animal impacts. Another study by Lohmar and Yang (2019) evaluated the environmental impact of recycling solar panels. The authors found that recycling can significantly reduce the environmental impact of solar panels, but that the process can be energy-intensive and expensive, making it challenging to implement on a large scale.

The research article by K. N. Haggard, N. Tay, and W. E. Tyner titled "Environmental and social impacts of community solar: a review of the literature" presents a critical analysis of the environmental and social impacts associated with community solar projects. The authors review the existing literature on community solar projects and identify the key environmental and social impacts associated with their implementation. The study begins with an introduction to the importance of community solar in expanding access to renewable energy, promoting energy equity, and reducing greenhouse gas emissions. The authors then provide an overview of the key features of community solar projects, including their ownership structure, financing mechanisms, and siting considerations.

Arachchige & Weliwaththage (2020) conducted a research paper under the title of "The review of innovations of the solar energy technology". They concluded that electricity generation from solar power based on traditional ways has become unsustainable due to its low power efficiency. Thus, there has been some innovations in the solar industry which has increased the efficiency of electricity generation from solar system. One of these innovations is the generation of electricity at night. So, innovations are an important factor in the solar energy sector to develop it with the highest efficiency (Arachchige & Weliwaththage, 2020).

K. N. Haggard et al.'s article "Environmental and social impacts of community solar: a review of the literature" was published in 2021. Community solar, which refers to shared solar arrays that supply electricity to a community, is the subject of this review article, which looks at its environmental and social effects. The article discusses community solar's potential environmental advantages, such as decreased greenhouse gas emissions and increased local renewable energy production, as well as its potential social effects, such as increased access to clean energy and positive economic effects for the neighborhood.

The study identifies the major environmental impacts associated with the production and use of utility-scale solar energy systems, including land use, water use, greenhouse gas emissions, and impacts on biodiversity and ecosystem services. The authors also discuss the potential for environmental trade-offs and unintended consequences associated with the deployment of large-scale solar energy systems.

### III. RESEARCH GAP

One possible research gap in the environmental implications of solar energy is the dearth of comprehensive studies on the long-term effects of solar panel disposal. Although solar energy is a clean and sustainable energy source, solar panels include hazardous components that, if improperly disposed of, could harm the environment. Further research on the consequences of solar panel disposal on the environment is required, as well as the development of environmentally appropriate disposal methods. The results of this study may assist inform policy choices on the end-of-life management of solar panels, which is essential to ensuring that the environmental advantages of solar energy are not offset by unfavourable effects related to their disposal.

### IV. RESEARCH OBJECTIVES

1. To evaluate the financial advantages of solar energy by comparing its costs to those of other energy sources, such as fossil fuels, nuclear power, or wind energy..
2. To assess the environmental benefits of solar energy by determining how much it can reduce air pollution, greenhouse gas emissions, and other negative environmental effects related to conventional energy sources.
3. The objective of this study is to understand the need of using renewable source of energy and highlighting them.

### V. RESEARCH METHODOLOGY

Research method: This study used a quantitative research methodology. To assess how solar energy affects the environment, the project will gather quantitative data. The collection of numerical data, which is essential for this study, is made possible by the quantitative research design.

Sampling will be done using a random sampling strategy to choose the sample for this investigation. Those that have solar energy systems in their residences or places of business will be included in the study's demographic. Based on the population size and the margin of error, the sample size will be chosen.

Data collection: A structured questionnaire will be used to gather data for this investigation. The questionnaire will be made to gather information on the effects solar energy has on the environment, including information on carbon emissions, land use, water use, and waste disposal. The questionnaire will be given to the chosen sample over the phone or through online surveys.

Data analysis: Excel is used to examine the data gathered from the questionnaire.

**VI. DATA ANALYSIS AND INTERPRETATION**

It is essential to have systems in place to fulfil the increasing demand for energy in order to meet the needs of the expanding global population and prevent energy catastrophes. With the current rate of energy use, the demand is expected to increase by 65% by 2030, using 2004 as the base year. Nowadays, non-renewable energy sources like coal-fired power plants account for the bulk of the energy utilised globally. They have a history of contributing to detrimental issues including GHG (CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>x</sub>) pollution and accelerating global warming.

In addition to finding methods to reduce GHG emissions, The creation of energy sources based on non-fossil fuels is essential since the levels of GHG in the atmosphere are rising at an alarming rate. Due to the rapidly expanding demand for energy, developing non-fossil fuel based energy sources is just as important as exploring methods to reduce CO<sub>2</sub>. RE provides substitutes for fossil fuels that are pure energy-based. Additionally, it is anticipated to lessen energy problems by being crucial in meeting rising electricity demands. The most hopeful types of renewable energy (RE) sources that stimulate interest in expanding their use globally are solar and wind energy. The literature identifies a number of factors and regulations that support the use of RE rather than fossil fuels to generate electricity.

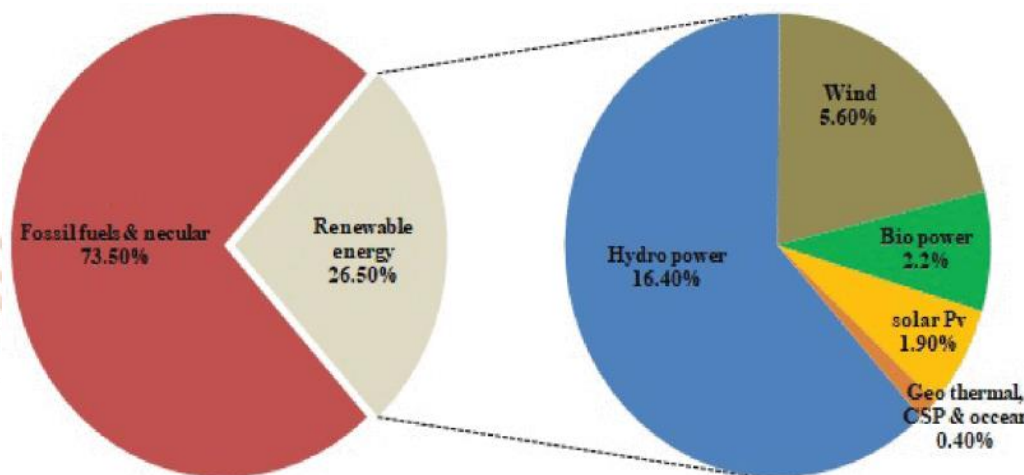


Figure 1 Source (Secondary Data)

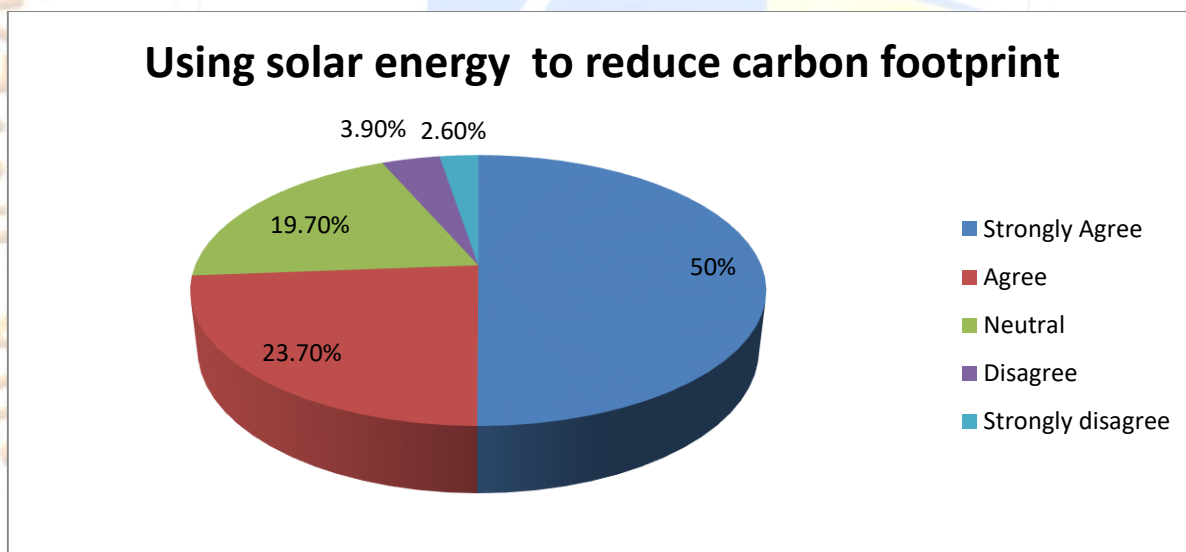


Figure 2 Source (Primary Data)

Majority of the respondent believes that by using the solar energy the carbon footprint can be reduced i.e. more then 50% of the respondents strongly agree to it and 23.70% of the respondent agree whereas only few respondents were neutral or disagreed to it



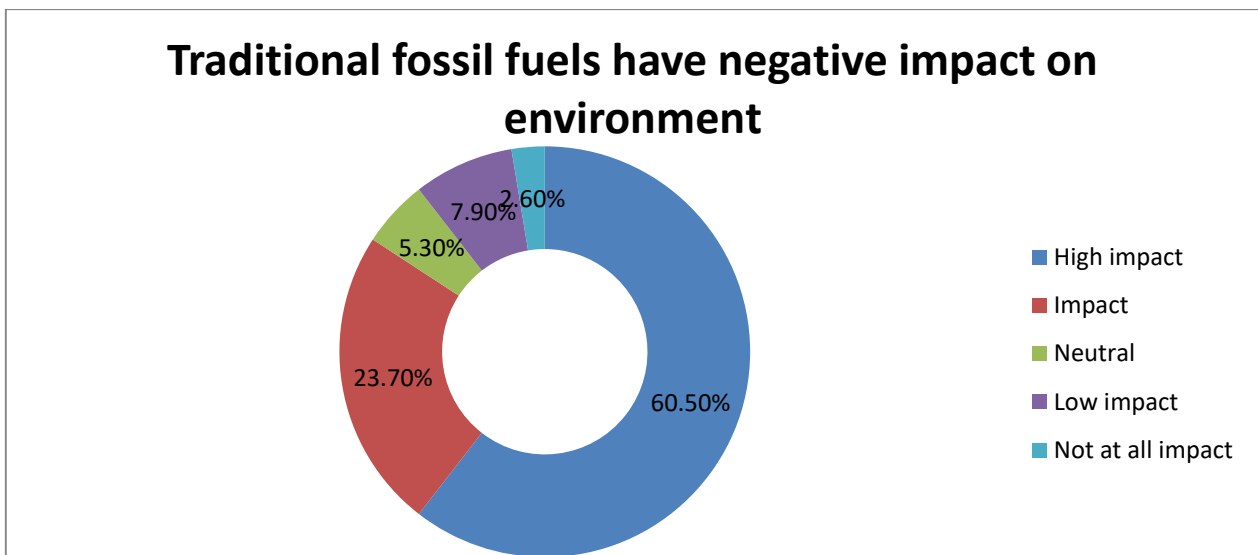


Figure 3 **Source** (Primary Data)

60.50% of the respondents believes that the uses of fossils fuel have a high negative impact on the environment and at the same other of 23.70 of the respondents also believes it has impact on the environment.

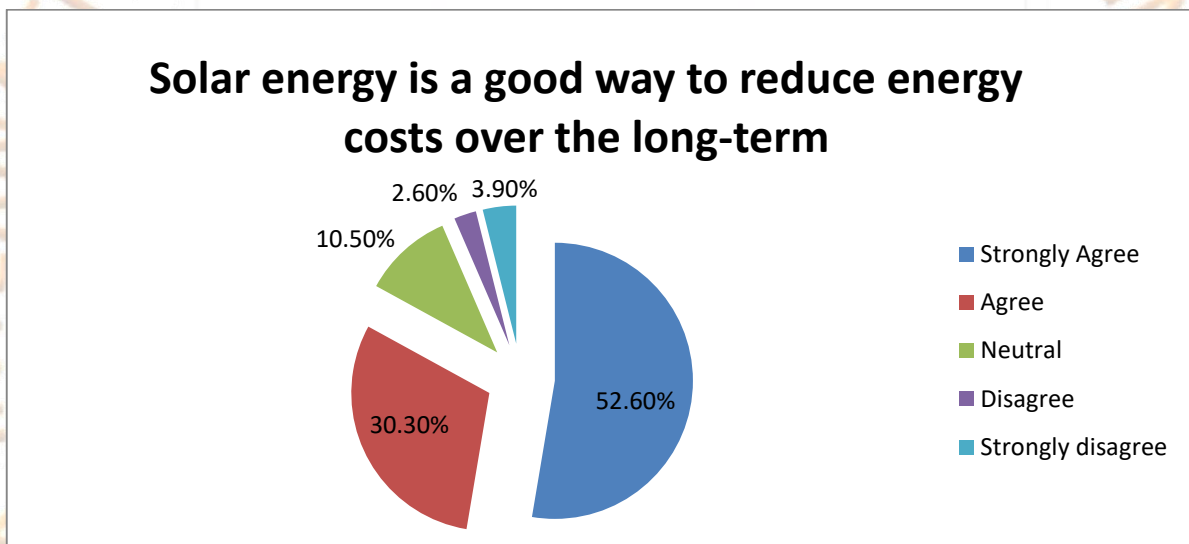


Figure 4 **Source** (Primary Data)

Majority of the respondents have agreed that solar energy is a good way to reduce the energy cost over a long term i.e., more than 52.60% of the respondent has strongly agreed to that and 30.30 % has agreed to it. It shows that solar energy is great source of energy which is not only benefitting the environment but at the same benefitting the household to save their money by being a economical source of energy

**VII. FINDINGS**

1. It was founded that the majority of the respondents believe that use of solar energy can reduce the carbon footprints and the household and business commercial should install solar panel.
2. It is also founded that the solar energy can be a great source of an investment in a long run apart from being eco-friendly and reducing the greenhouse gas emission.
3. Its also founded that there is a growing concerned in the population about the proper way of disposal of solar panel.
4. It was founded that despite of a lot of effort put by government to promote usage of green energy still fossil fuel is the main source of energy provider across world.

**VIII. LIMITATIONS OF THE STUDY**

There are several limitations that can arise when studying the benefits of solar energy. Some of these limitations are:

- 1 Self-Reporting bias: The study relies on self-respondent data from the respondents. It is possible that respondents may not have provide accurate information or may have answered in a socially desirable manner.
- 2 Limited scope: The study only focuses on solar energy and does not consider other types of renewable energy sources. It is important to consider the potential benefits and limitations of all renewable energy sources when evaluating their effectiveness.

**IX. CONCLUSIONS**

Solar power has gained popularity as a sustainable and renewable alternative source of energy due to its many benefits. This study has highlighted the environmental advantages of solar energy, including its cost-effectiveness, scalability, reliability, and low environmental impact. The use of solar power can also help to reduce greenhouse gas emissions and combat climate change, creating jobs and stimulating local economies. However, solar panel installation, operation, and disposal can all have a negative impact on the environment, which should be evaluated and improved. Overall, solar power has the potential to revolutionize the way we produce and consume energy, leading to a more sustainable and prosperous future.

Various studies and reports cited in this paper have demonstrated the environmental advantages of solar energy over fossil fuels. For instance, a study by Oisamoje & Eguono Oisamoje (2013) illustrated the economic and environmental benefits of solar energy, while H. Xiao and Y. Li's (2016) review article on life cycle assessment of a solar photovoltaic system highlighted the potential environmental impact of solar panel disposal. The review study by Iran's rural regions and the report by A. Kazmerski (2017) both showed that solar energy has both potential environmental hazards and benefits.

This paper emphasized the need to assess the environmental impact of solar energy to ensure its sustainability and effectiveness. The study identified areas that need improvement, such as renewable energy production practices, solar panel recycling, and grid integration. Additionally, solar energy has the potential to transform the way we generate and consume energy, leading to a more sustainable and prosperous future.

In conclusion, solar power is a promising alternative source of energy that can help reduce the environmental impact of energy production while providing numerous benefits for the economy and society. While solar energy may have its environmental challenges, with further research and development, it can become a sustainable and effective solution to our current energy needs. As such, it is essential to continue exploring and investing in solar energy as a vital component of our sustainable future.

**X. REFERENCES**

1. Arachchige, U. A., & Weliwaththage, C. A. (2020). The review of innovations of the solar energy technology. *International Journal of Energy and Environmental Engineering*, 11(2), 225–238. <https://doi.org/10.1007/s40095-020-00370-5>
2. Oisamoje, M. D., & Eguono Oisamoje, D. (2015). Exploring the Economic and Environmental Benefits of Solar Energy Generation in Developing Countries: The Nigerian Perspective. *Journal of Energy Technologies and Policy*, 5(9), 51-57.
3. Haggard, K. N., Lee, Y. R., & Krogmann, U. (2021). Environmental and social impacts of community solar: a review of the literature. *Renewable and Sustainable Energy Reviews*, 148, 111364.
4. Kazmerski, L. L. (2017). Environmental consequences of solar energy technologies. *Encyclopedia of Sustainable Technologies*, 3, 417-430.
5. Keoleian, T. M., & Lewis, G. M. (2019). Environmental impacts of utility-scale solar energy. *Annual Review of Environment and Resources*, 44, 459-484.
6. Labriet, M., Louche, A., Kanudia, A., & Lavigne, D. (2012). Environmental effects of solar energy technology. *Renewable and Sustainable Energy Reviews*, 16(1), 264-273.
7. Xiao, H., & Li, Y. (2016). Life cycle assessment of a solar photovoltaic system: A review. *Renewable and Sustainable Energy Reviews*, 53, 1059-1070.