An Empirical Study to Analyse Contribution Of Solar Energy In Subduing Carbon Footprint

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Abstract

The study tries to explore the potential of solar energy from the economic prosperity of the industrial sector and how it plays a crucial role in accomplishing sustainable development. The study also identified how higher economic growth could be attainable through better institutional quality and a lower carbon footprint. Carbon footprint can be widely evaluated and applied as the activities conducted by an individual, organization, or over entirely. It is usually expressed in tons of carbon emissions annually. Solar power is one of the advanced renewable energy sources due to its cost-effectiveness. It emitted zero-emission, and more limited noise and other associated characteristics make it more inherent and reliable to meet the requirement for energy and power for a giant population. The research adopted an empirical methodology based on a sample survey process to evaluate the objection and obtain relevant outcomes. The survey was conducted among the 102 participants based on numerous questions. The acquired outcome shows that solar energy has immense potential in subduing the carbon footprint as well as intensifying the company's innovative measures and other resources. It also encourages the company to intensify its wealth by reducing fossil fuel expenses, generating carbon offset during carbon emissions, and obtaining carbon tax relaxation from the government.

Keywords: Solar Energy, Carbon Footprint, Significance of solar energy in reducing the Carbon footprint, solar energy and economic growth.

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Chapter 1 - Introduction

Global warming and climate change produce drastic risks over the countries, specifically developing countries suffering enormously, which will worsen food security, water unavailability, health issues, and the extent of biodiversity. India is a country that is facing enormous challenges because devastating climate change had its social, economic, and environmental vulnerable impact (Kumar, R. et al., 2019). India holds the fourth position among the largest carbon dioxide emission countries in the world. It was estimated that if India is rising at the same speed, its carbon emission quantity will double in 2030. About 85% of the country's thermal power generation is coal-based, responsible for the most significant carbon emission, and the world's fourth-largest emitter. Around 65% of the Indian electricity generation capacity comes from thermal power plants (Gupta, A., & Paul, A., 2019).

The necessity for energy demands has enormously increased because of population and insufficient supplies of energy or power, which typically depend on fossil fuel burning for thermal and coal-based plants. Renewable energy technology has grown mainstream through the last three decades. The decision-makers were allowed to ascertain renewable energy as a global resolution to determine the difficulties such as energy deficiency, climate change, global warming, amongst others (Kannan, N., & Vakeesan, D., 2016).

Solar power is one of the advanced renewable energy sources due to its cost-effectiveness. It emitted zero emission, and more limited noise and other associated characteristics make it more inherent and reliable to meet the requirement for

energy and power for a giant population (Jain, A. et al., 2020). There is a necessity to competently practice alternate sources, which is a more substantial energy source, where the highest solar radiation is obtainable everywhere the year. Solar energy is also a reliable source of energy and support to diminish the vulnerable impact of global warming (Kabir, E et al., 2018). It is free from carbon and other destructive greenhouse gases and, through power generation, does not wreck the ecosystem (Baitule, A. S., & Sudhakar, K., 2017).

Carbon footprint is the amount of greenhouse gases, usually carbon dioxide, which is emitted into the environment by anthropogenic activities. Carbon footprint can be widely evaluated and applied as the activities conducted by an individual organization or over entirely. It is usually expressed in tons of carbon emissions annually (Carvalho, M., & Delgado, D., 2017). Fossil fuel burning acts as a prominent role in enhancing the carbon footprint of an individual organization or country. It is effectively calculated based on the amount of carbon emitted by the organization through various means like vehicle or transportation, electricity, food consumption, and so on (Lombardi, M. et al., 2017). The study related to carbon footprint is frequently increased because of global warming challenges and identifies climate change mitigation policies that are based on the methodology for implementing particular plans.

Significance of solar energy in reducing the Carbon footprint

The social and economic benefit of carbon elimination is appropriately estimated based on the carbon price. The carbon price is the business methodology that is an emerging challenge in managing the uncertainty of climate change in corporate sustainability (Sharif, A., et al., 2021). The market estimation of greenhouse gas is the cost of the emission based on the carbon taxes trading system and crediting mechanism. The carbon tax is applied to organizations or firms based on their carbon footprint, and the value varies from nation to nation (Hu, A. H et al., 2017). The price in the trading system is identified to be low because the market price of carbon does not reflect non-trading carbon cost, fuel taxes subsidies for fossil fuel elimination, and low carbon technology assistance (Nair, M et al., 2020). Solar Power plants have the capability and potential to reduce the carbon footprint by up to 2%. Solar power generation technology is also utilized because of its cost-effective mechanism, zero carbon emission.

Possible links between solar energy and economic growth

- Solar energy has dynamic potential to enhance organizational sustainability in every sphere comprising social, economic, wellness, and environmental.
- Solar energy is a cost-effective approach.
- Solar energy meets the energy demand of the company.
- Solar energy assist in generating carbon offset
- Solar energy reduces carbon footprint, which increases company brand value.
- Companies can reduce transportation costs by promoting solar vehicles.
- Solar energy saves human resource productivity by providing a clean and green environment which is beneficial for their health.
- Good health eventually intensifies the productivity of the workforce, which increases the company turnover.
- It helps to reduce the carbon tax applied to the organization by the government.

1.1 Background

Solar heat is utilized to generate electricity by harnessing advanced technology, and this technology can be classified as solar cell photovoltaic and solar thermal collectors. Photovoltaic technology transforms sunlight into electrical power while the solar thermal receiver warms the solution relating the sunlight heat to generate thermal energy (Gong, J., et al., 2019). The photovoltaic technology would be performed with different silicon corporealities set up to a distinct arrangement and established in diverse conditions (Devabhaktuni, V et al., 2013).

There is a necessity to competently practice alternate sources, which is a more substantial

energy source, where the highest solar radiation is obtainable everywhere the year. Solar energy is also a reliable source of energy and support to diminish the vulnerable impact of global warming (Creutzig, F et al., 2017). It is free from carbon and other destructive greenhouse gases and, through power generation, does not wreck the ecosystem (Baitule, A. S., & Sudhakar, K., 2017).

India was the earliest country globally to introduce the Ministry for non-conventional power sources in the 1980s. Solar, wind, and tidal are the freely attainable energy, and it is environmentally beneficial, cost-effective, with technological progressions and aided approach (Kapoor, K., et al., 2014). Solar energy is the most significant renewable resource possible in most of the country mainly because India came beneath the subtropical belt and the Tropic of Cancer crosses through, which makes it tremendous potential to use solar radiation as a resource to convert it into electrical utility (Tyagi, R., et al 2018). Even its technically achievable potential is extremely more distinguished than the contemporary total primary power demand. India is an emerging and developing country with respect to the solar industry. It is manifest from the prime minister's solar mission that the solar energy production proportion will be up to 30% by 2024 among the entire energy formation since independence. Indian extended its solar generation ability eight times from 2.6 MW in the year 2014 to stretched upto 20 GW by the year 2018. The Ministry of new and renewable energy (MNRE) contributes a subsidy of thirty percent to install solar photovoltaic systems (MNRE, 2020). The estimated potential of renewable energy sources in 2022 is 175 GW, out of which 100 GW holds for solar power plants, 60 gigawatts for wind, 10 GW for biomass, and 5 for small hydropower plants (Irfan, M. et al., 2020). With this ambitious objective, India will become one of the most comprehensive reliable energy producers in the world among several developed countries.

1.2 Literature Reviews

The paper (Kılıç, E., et al., 2018) comprehensively analyses the mechanism with sustainable play a crucial role in reducing carbon emission and environmental impact in industrial production of Turkey to produce itself as an innovative global green Market. The paper took Leather Market to conduct the study, and the prominent factors of the study were greenhouse gases, carbon emission, carbon footprint, and the government strategy to reduce the global warming challenges and meet the energy demand by using alternative resources such as solar power. The outcome demonstrates that there is an essentiality to promote corporate carbon footprint evaluation in the country to analyze the ground reality appropriately. Because of a lack of information, the assessment is incomplete. Intending to subdue or mitigate the immense and exploiting utility of fossil fuel and there was the impact on the environment perspective, solar energy, which acts as a green toxic-free resource, is acting as a game-changer in various countries (Kannan, N., & Vakeesan, D., 2016). The motive of the research was to offer a business environment analysis model for the social energy sector in the land of Iran. The paper (Massihi, N., et al., 2021) focuses on eight dimensions that play a significant role in obtaining efficiency in the solar energy marketplace. The findings demonstrate challenges bottleneck loopholes and provide promising opportunities for solar power potential to meet the electricity demand in an economically efficient and ecological sustainability manager for a long-term benefit from a market perspective.

Carbon emission became one of the significant challenges as it plays a crucial and most influential role in global warming and climate change which devastatingly harms the quality of human life and financial progress of the globe (Onat, N. C., & Kucukvar, M., 2020). Intending to subdue or eliminate the carbon footprint, many developed and developing economies have taken initiative measures based on advanced technology to make institutional reforms to obtain economic and clean sources of energy as compared to traditional fossil fuel-based energy, which is not economically feasible besides affecting the environment (Carvalho, M., & Delgado, D., 2017). The study emphasizes institutional quality carbon dioxide emission and financial development in developing countries by implementing granger causality tests. The outcome (Nair, M., et al 2020) demonstrated that the policymakers of the country performed a significant role in the solar energy sector. This

should promote robust policy to mitigate the challenges and provide a better opportunity for the industrial environment to adopt clean and green energy resources to meet their energy demand and reduce their carbon footprint. The paper highlights the economic and ecological challenges that come in front of greenhouse gas emissions, which play a crucial role in generating carbon offset and play a vital indispensable role in global warming and climate change (Osama, B. M., & Taylor, R. A., 2018). The urban carbon footprints are determined as the most pivotal and meaningful decisions to take by the government, public and private institutions in order to obtain environmental sustainability and economic feasibility in the City. The results demonstrate that carbon footprint can be divided into two segments, spatial and direct to meet the financial and lifecycle-based data. The outcome indicates that there is a demand and the need to produce a robust framework to meet the climate and economic changes at the international level (Lombardi, M et al., 2017).

1.3 Research Gap

The gap of the study is the implementation of google survey method although it is an innovative method but still acts as the limited survey data.

1.4 Research Question

Q. Evaluate the role of solar energy in reducing carbon footprint from an industrial perspective and its role in economic upliftment?

1.5 Importance of the Study

Carbon emission became one of the significant challenges as it plays a crucial and most influential role in global warming and climate change which devastatingly harms the quality of human life and financial progress of the globe. Intending to subdue or eliminate the carbon footprint, many developed and developing economies have taken initiative measures based on advanced technology to make institutional reforms to obtain economic and clean sources of energy as compared to traditional fossil fuel-based energy. The study tries to explore the potential of solar energy from the economic prosperity of the industrial sector and how it plays a crucial role to accomplish sustainable development. The study also identified how higher economic growth can be attainable through better institutional quality and a lower carbon footprint.

1.6 Research Objectives

The intention of the paper is to identify the contribution made by solar energy in subduing the carbon footprint and its economic feasibility from industrial benefit.

1.7 Hypothesis

H0: Solar energy is correlated with increasing the financial resources of a company .

H1: Solar energy has no correlation with the financial resources of a company.

Chapter 2 - Research Methodology

2.1 Research Method & Design

The topic is related to identifying the contribution made by solar energy in subduing the carbon footprint and its economic feasibility from industrial benefit. Subsequently, the quantitative methods appropriately suited to obtain the desired outcomes.

2.2 Research Approach

Primary Data

Primary data is a data type that is real and authentic. Primary data is usually collected from real-time sources such as surveys, questionnaires, experiments, and interviews. These are not concentrating on exploring the existing articles that mean it is singular and peculiar. This is because specific types of theories, methodology are used in every research. In this research, the researcher implements primary data to obtain accurate results. In this research, the investigator has conducted a Google survey, including close-ended questions. The survey was conducted among the 102 participants based on numerous questions. First, it is not time-consuming, and it is very reliable considering objectives. Through research, investigators examine in-depth the

contribution made by solar energy in subduing the carbon footprint.

Secondary Data

The secondary is data which many scholars use in their research. In simple terms, some investigators have already collected and documented for its persistence and not for the current research challenge. It is accessible from various sources such as government publications, books, journal articles, websites, and reports. These are concentrating on exploring the existing theme. They are less reliable and less suitable. This research selected data from several journals such as Sciencedirect, Web of Science, JSTOR, Emerald Insight, and others. The researcher has used secondary data to upgrade their knowledge. Secondary data is also crucial as a primary empirical method to conduct this study in this methodology section. It assists in enhancing the knowledge and significant role in determining the hypothesis.

To enhance the knowledge and perception regarding the topic and try to determine the question, the study selected broader perspectives and gathered data from the related terms encompassing solar energy and its significance in subduing the carbon footprint. All the relevant data should contain any one of the key components in search, such as under the abstract, title, or comes under keywords.

2.3 Sampling Technique

Researchers used Google forms to collect as a sampling method. There are two reasons to do so: the first is a pandemic (Covid-19) going on, and secondly, it is an easy and efficient way to collect fast results.

2.3 Research Limitation

The limitation of the research is the sample size, as the study concentrated on very small data. Moreover, about one hundred and one samples were retrieved from the survey based on the questionnaire.

Chapter 3 - Analysis of Data

Q. Evaluate the role of solar energy in reducing carbon footprint from an industrial perspective and its role in economic upliftment?

Factors	Strongly Agreed & Agreed	Neutral	Strongly Disagreed & Disagreed
Carbon footprint helps to increase company credential and brand value	70.3%	19.8%	9.9
Company generates wealth by reducing carbon emission	69.3%	10.9%	19.8%
It has a potential to attain ecological efficiency and sustainability	76.2%	17.8%	6%
It ultimately reduces greenhouse gases	79.2%	18.8%	2%
Companies depend on solar energy to meet their electricity demand.	49.5%	29.7%	20.8%
Company promoting solar vehicle technology for transportation	39.6%	10.9%	49.5%
Company generates wealth from carbon offset	69.3%	19.8%	10.9%

T test

P-value and analytical importance:

The two-tailed P value = 0.0054

By conservative standards, this variation is recognized to be notably statistically important.

Assurance interval:

The average of all the factor and their agreed and disagreed mean= 47.857

95% confidence interval of this variation: From 20.27 to 75.43

Intermediate values implement in calculations:

t = 4.2458

df = 6

Standard error of variation = 11.272

When the value of P is near to 0.5, then it demonstrates that Hypothesis H0 (Null hypothesis) is correct; however, when the value of P is bending far away from the mean value, then it is assumed that Hypothesis H1 (alternative hypothesis) is correct.

The above description shows that the value of P=0.0054 means H0 is correct and accepted, and H1 is rejected.

Hence, H0, that is, Solar energy is correlated with increasing the financial resources of a company is accepted. While H1, the Solar energy has no correlation with the financial resources of a company is rejected.

This shows that solar energy has potential to enhance the financial stability of the company, which can be proven by the sample collected from the survey and implementation of T-test that companies can effectively appropriately utilize solar resources to enhance their economic wealth and ecological sustainability.

Chapter 4 - Results & Findings

The results demonstrate that solar energy has the potential to reduce the carbon footprint generated by the company as the study revealed that around 49% of the participants agreed, as well as around 30% of the participants, were strongly agreed while 99.8% of the respondent work in the neutral condition. Another questionnaire was whether the company promotes solar vehicle technology for promoting transportation services or not and the results demonstrate that about 50.5% of the participants strongly agreed and agreed. In comparison, 49.5% of the respondents were neutral that the company has paid attention to encouraging solar transportation facilities, which reduce the employee's transportation costs and expenses.

Because solar technology is one of the most innovative and advanced technologies utilized to reduce carbon emissions and utilize alternative energy sources to meet the electricity demand. Henceforth for utilizing solar energy resources, the company endeavors for an innovative mechanism for boosting financial growth. The data illustrate that around 49.5 percent of the participants agreed while 39.6 percent were neutral compared to 10.9 percent who disagreed with this content that the company is different for innovative mechanisms.

One of the prominent questionnaires, solar energy, assists in subduing the carbon tax applied on the organization by the government; the data reveals that about 69.3% of the participants were agreed and strongly agreed, while 30.7 % worked in neutral conditions. This demonstrates that when companies enhance their alternative resources to meet the energy need and reduce the fossil fuel burden, the government can promote them in terms of attaining subsidies in their carbon tax.

Among all the other significant points, solar energy has immense potential to reduce greenhouse gas, subdue carbon emissions, encourage the company to take innovative measures, and invest in research and development. It also encourages the company to intensify its wealth by reducing fossil fuel expenses, generating carbon offset during carbon emissions, and obtaining carbon tax relaxation from the government. Other than all these environmental and financial sustainability, solar energy also reduces greenhouse gas and climate change challenges, which positively impact humans. This also improves the operational performance of the employee when they get a green environment; their body and their health worker automatically work more prominently as

they obtain a non-toxic environment to live and work in.

The prominent factors highlighted in the study that plays a significant role in the economic growth obtained by the organization while utilizing solar energy such as.

- Reduce fossil fuel dependency, which reduces the buying expenditure on fossil fuel.
- Solar energy is a cost-effective approach.
- Solar energy meets the energy demand of the company.
- Solar energy assists in generating carbon offset.
- Solar energy reduces carbon footprint, which increases company brand value.
- Companies can reduce transportation costs by promoting solar vehicles.

Chapter 5 - Conclusion

Ecological challenges are among the most alarming and vulnerable barriers facing the world through every sphere of life. The masses should focus on sustainable measures to mitigate the challenges facing ecology exploitation like global warming. It inspires humanity to take appropriate means to better the ecosystem without harming or exploiting the fundamental resource and pave the way for a better and alternate resourceful world. Humans and the environment are directly correlated as humans are indispensable dependent on the environment for every work. This correlation has an adverse impact on nature because of its exploiting and encroaching nature on humans. Solar energy is one such alternative sustainable method for protecting the natural and fiscal resources of the world.

Solar power production contributes to minimizing the interdependence on fossil fuels, overcoming greenhouse emissions, increasing energy security, and producing employment possibilities. Solar energy is a precise, reliable, and non-conventional source of power gained by taking profit from the sun radiated energy. To obtain the most out of this resource, a megastructure is installed that is seated on the onshore and offshore and furnished with the most developed and innovative technologies to produce or generate electricity from the available resources appropriately. India is an emerging and developing country concerning the solar industry. It is manifest from the prime minister's solar mission that the solar energy production proportion will be up to 30% by 2024 among the entire energy formation since independence. Indian extended its solar generation ability eight times from 2.6 MW in the year 2014 to stretched upto 20 GW by the year 2018.

Eventually, Solar energy has immense potential to reduce greenhouse gas, subdue carbon emissions, encourage the company to take innovative measures, and invest in research and development. It also encourages the company to intensify its wealth by reducing fossil fuel expenses, generating carbon offset during carbon emissions, and obtaining carbon tax relaxation from the government. Besides all these environmental and financial sustainability, solar energy also reduces greenhouse gas and climate change challenges, positively impacting humans.

Chapter 6 - Future Scope

The future study will focus on the relevant techniques utilized by the company to enhance the wealth based on solar technology like implementing Rooftop solar photovoltaic cell power plants in working premises, solar vehicle charging stations inside the premises, and others.

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Appendix

Q. Gender

a. Male
b. Female
c. Transgender

Q. Age

a. 18-25
b. 26-30

c. 31-35
d. 36-40
e. Above 40

Q. Annual Income
a. Below 4 Lakhs
b. 4 Lakhs and above but below 8 Lakhs
c. 8 Lakhs and above but below 20 Lakhs
d. 20 Lakhs and above

Q. Education level
a. Post Graduate
b. Graduate
c. Senior Secondary
d. Others

Q. Occupation
a. Student
b. Service
c. Business
d. Home-maker

Q. Is your company implementing solar energy power generation technology in company premises?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Is your company dependent on solar energy to meet their electricity demand?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Do you know whether your company generates wealth from carbon offset by reducing carbon emission?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Do you think solar energy is a cost effective approach and your company saves its economic resources?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Carbon footprint helps to increase company credential and brand value in a competitive world?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Can carbon footprint be reduced by solar energy?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Is your company promoting solar vehicle technology for transportation?
a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Companies can reduce transportation costs by using solar vehicles?
a. Strongly disagree

b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Is the company endeavouring for an innovative mechanism for enhancing economic growth based on solar energy?

Strongly disagree

a. Disagree
b. Strongly Disagreed
c. Neutral
d. Agree
e. Strongly agree

Q. Reducing fossil fuel dependency by using solar energy can generate financial wealth for companies?

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

Q. Does solar energy help to reduce the carbon tax applied on the organization by the government?

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree