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To Understand the Study of Carbon Footprint Reduction in Civil Engineering Projects

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Abstract

Reducing carbon footprints via optimal carbon capture and storage is an immediate and critical matter among several that may help build a sustainable future. Renewable energy sources may help decrease carbon footprints and fossil fuel costs, according to the KYOTO Protocol. Therefore, the carbon footprint is the primary concern of the proposed study.

Keywords: Carbon, Footprint, Sustainable, Development and Financial

Introduction

According to the World Bank, one of the United Nations' Sustainable Development Goals (UN-SDGs) is to guarantee that all people can rely on and afford energy that is both productive and dependable. To ensure the long-term viability of alternative energy solutions, it is crucial to have more widespread access to Financial Inclusion (FI). In order to enhance energy efficiency, it stimulates purchases of items that save energy. On a regular basis, FI significantly lessens ecological energy efficiency efforts in urban areas compared to urban regions. In addition, FI consistently backs efforts to lessen worries about measurements for maintainable energy capabilities.

Not only has the media made "carbon footprints" a popular "buzzword," but so have academics, policymakers, and the broader public. Ewing *et al*. (2008b) found that almost half of humanity's ecological footprint is attributable to carbon emissions. From 1961 to 2005, a tenfold increase in the world's carbon footprint, the largest demand that mankind has on the environment (WWF, 2008). It has been shown that different nations have different demands on Nature's resources and different biocapacity. This is especially true when looking at the carbon footprint, its causes, and the connection that follows.

The term "carbon footprint" is the sum of all greenhouse gas (GHG) emissions produced by a process, product, or service throughout its lifetime of its lifetime, measured in CO2 equivalents.

As a greenhouse gas, carbon dioxide (CO2) raises the average surface temperature of the Earth whenever its concentration in the atmosphere grows. Global warming is the name given to this phenomenon. Global warming is a well-documented phenomenon, with the Arctic and Antarctic areas showing the most pronounced warming trends (Ziock, 2010). A rise of 4 to 6 degrees Celsius in average world temperature is possible during the next half-century if current trends continue and atmospheric CO2 concentrations are not stabilized (Swamy et. al., 2004). According to Simbeck (2005), there will be significant environmental impacts from global warming. These include higher sea levels, the destruction of delicate ecosystems, more intense weather events, and more frequent and severe droughts and floods. There has to be a huge push to control carbon emissions and cut CO2 emissions in half if we want to slow the rate of global warming. A steady increase in atmospheric CO2 concentrations has been observed since the 1950s, according to continuous monitoring of these variables.

The disparity between India's energy supply and demand is far wider than in other developing nations. Solar power, one of numerous alternative energy sources, has shown great potential in India's climate. There are an average of around 78 sunny days per year in much of India. Despite India's 800 GW PV power generating potential, only around 7% of

India's total power production capacity is actually generated by SPV (Solar). Consequently, a considerable percentage of PV energy goes to waste all year round. India has risen to the top of the solar sector due to the pressing need to use PV electricity more efficiently.

Literature Review

Budes *et al*. (2020) [1] To meet the growing need for renewable energy, the hybrid plant incorporates photovoltaic (PV) and wind farm systems that are interconnected in a parallel configuration inside the grid. Specifically, the following were the three phases of the study: Finding potential spots for the energy system to use renewable sources of power was the first step. Finding a spot that could run more efficiently and cheaply was the second. Finally, using HOMER pro® software for optimization problems and calculations, the third step was to estimate how many solar panels and wind generators would be needed to make this spot work. The total expenditures linked with the use of power from thermoelectric plants are expected to be reduced by the suggested system, which would also reduce the system's overall impact on the environment.

Tahir and colleagues (2021) [2] This study recommends connecting residential areas in the district of Kotli in AJK, Pakistan, to the grid by the installation of a system that combines hydrokinetic, solar, and biomass energy. A comprehensive techno-economic analysis of a potential system requires, it is used HOMER as a modeling tool. To do this, we compare the available resources with the overall load demand of residential customers. By experimenting we can find the optimal system design by experimenting with different configurations and combinations of current energy producing systems and comparing the results in terms of net present cost, cost per unit, starting cost, and operating cost. To improve the accuracy of the results, a sensitivity analysis was used to the scheme in order to determine how different values of variables, such solar irradiation, water flow speed, and load demand, affected the system. The results show that the planned system can meet the load demand efficiently and cheaply.

The authors of the study are Seedahmed *et al*. (2012) [3] The importance of energy mix optimization as a tool for assessing RES efficacy is well recognized. Grid planning engineers and scientists have used a plethora of methods to ascertain the optimal size for grid-connected photovoltaic (PV) installations. Reducing the quantity of energy which are generated by conventional power stations and, therefore, the quantity of potentially dangerous pollutants released as a consequence, is one of the main benefits of optimizing grid-connected photovoltaic (PV) systems. As part of this study, a properly constructed and grid-connected solar system supplied electricity to a significant fraction of Makkah, Saudi Arabia's business demand. A BSS, or battery storage system, was also used. Considering both financial and electrical considerations, the HOMER program is used to choose system components at the first stage. Not only are the proposed systems undergoing extensive technical investigation, but three alternative configuration systems are also undergoing comparative testing.

Islam *et al*. (2020) [4] By addressing Optimal Power Flow (OPF) problems with several and one goal, introduced the Harris Hawks Optimization (HHO) technique for regulating fossil fuel emissions. To tackle the algorithm challenge, mathematicians looked at how hawks pounce on fleeing prey: by coordinating their movements and using dynamic chasing patterns. Because its exploration and exploitation capabilities are not balanced, the HHO algorithm converges too quickly and becomes stuck in local optima.

Barakat *et al*. (2020) [5] discussed the optimization of a grid-linked fusion WT or PV- based system to provide enough electricity to a rural region in Egypt throughout the year, regardless of the weather. In order to maximize the Renewable Energy Fraction (REF) of the system while minimizing power supply loss and cost, the multi-objective PSO approach was used to determine the ideal component combination. Environment, renewable energy, and economics were all factors included in the MOPSO research, which aimed to optimize particle swarm optimization with multiple objectives. When applied to high-dimensional problems, its sluggish convergence rate and ease of sliding into local optimum are major issues space, the PSO method is not ideal for iterative problems.

Research Methodology

The latest analysis of carbon dioxide emissions from 10 major global sites provides the first direct evidence from satellites that the amount of carbon dioxide emitted per person decreases as a city grows, with a notable exception, according to climate.nasa.org. The study also reveals how this effective greenhouse gas may be measured using satellite TV, which can provide rapidly developing areas new tools to track carbon dioxide emissions and assess how changes to plans and improvements to infrastructure affect their energy efficiency. More than 65% Urban power plants are responsible for a disproportionate share of global carbon dioxide emissions, both in terms of quantity and pace of this pollution are both rising due to rapid and consistent urbanization. On the other hand, certain cities with a lot of people living in them create more CO_2 per person than others.

Carbon Foot Printing (Cf)

The most recent normal rates of financial growth in India will exceed 6%. Assuming a growth rate of 8 to 10%, a lot of this rapid development goes into constructing the structure. It is possible that the trend of rising CO_2 emissions will persist, given the current total yearly development charge of the industry. However, a section jump in expansion of concrete capacity and merely production quantities may be the outcome of the projected big surge upward in the long-sought growth of the system in the coming years. Options to use the CDM to significantly reduce CO2 emissions will be presented in this way.

Midway through the 1980s, India debuted its comprehensive wind power program. The commercial foundation and structure that has contributed to the great industrial growth in this region was designed with the energetic involvement of electrical resources and trade characteristics. When it comes to the generation and use of renewable energy, India is now regarded as one of the world's leading nations, especially in the area of wind power. The production of wind power has really emerged as a viable option in the realm of renewable energy.

The minor cost-curve may be rather smooth, as shown by curve ABC, which is generally a supply curve for CERs, and poor nations have several affordable opportunities to preserve GHG emissions (see figure 1 below).

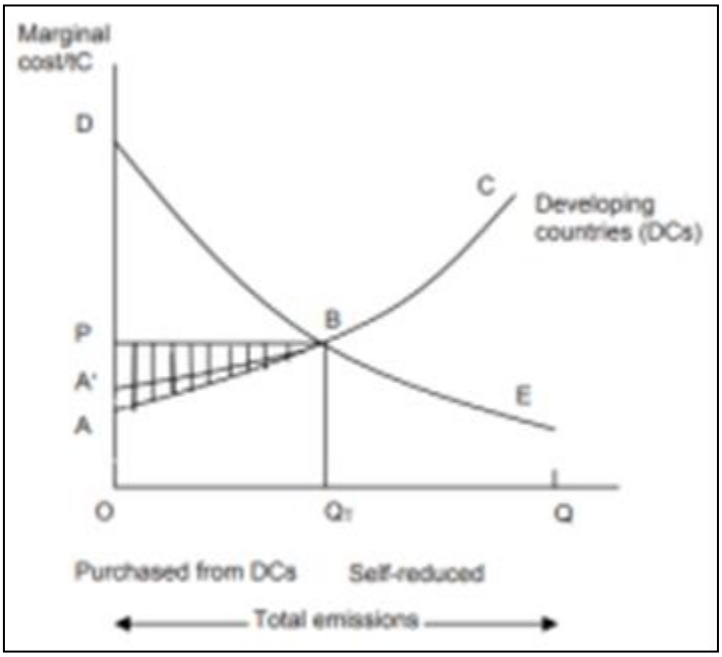

Fig 1: Carbon trading

In comparison to hydro and nuclear power plants, cold weather power plants are major contributors to greenhouse gas emissions from the power production industry. As a result, determining an emissions baseline for wind power projects requires careful consideration of thermal power plants' efficiency. Despite using the same basic design and using the same high-quality fuel, the efficiency of cold weather power plants varies greatly.

Kyoto Protocol

Although it was far from perfect, the United Nations Framework Convention on Climate Change (1993) was initially crucial for developing regions of the globe. In order to reduce the risk of climate change, it recognized the significance of planning for their growth and the need to halt GHGs. The Clean Development Mechanism (CDM) is an attractive means of bringing developing nations closer to a global environment of greenhouse gas reduction, which was a goal of the 1997 Kyoto Protocol. Several measures have been recently announced in different nations, despite the fact that the convention is not even ratified yet. All regions of the globe that have signed the Protocol may be covered by the subsequent phases of global carbon dioxide eradication. Signatory nations, including China and India, are also obliged to cut greenhouse gas emissions to a certain level. Regardless of whether businesses in a particular country are currently required or not to reduce carbon dioxide emissions to a certain extent under the Kyoto Protocol, stakeholders, particularly traders, may value information about a company's pollution functionality so they can accurately evaluate the company's efficiency and make predictions about its market performance.

As a result, businesses must typically provide thorough and reliable data pertaining to pollution, including details on their pollution-related activities, pollution-appropriate costs, strategies and objectives to reduce contamination, forthcoming initiatives to address the problem, etc. There are a number of different kinds of mandatory pollution disclosure requirements that have been established by various nations. Still, there are a lot of places where people are encouraged to voluntarily provide CO2 statistics. Voluntary air pollution disclosures are proposed to serve a useful purpose in market economies by guiding investors toward investment choices that significantly impact the dissemination of financial data across various industries. Moreover, experts will be incentivized to voluntarily disclose pollution tips in order to express positive indicators for the companies' future performance, demonstrate that the firm is taking its interpersonal and pollution responsibilities seriously, create a positive image among customers, and/or likely avoid disclosure legislation.

It is reasonable to assume that energy consumption in Malaysia would continue to rise in tandem with the country's rapid economic expansion, having risen sharply in recent years. An increase in greenhouse gas emissions would be the inevitable consequence of this surge in demand, given the heavy reliance of the Malaysian economy on fossil fuels for power production. Rapid economic growth, increased energy use, and rapid urbanization have caused significant geographical challenges in the nation.

Hybrid Energy Generation

The federal government estimates the future generation of renewable power and then puts it on the market to determine its worth as part of a renewable quota scheme. Tendering systems and inexperienced licensing devices are the two options for renewable quota systems in standard. The most cost-effective consumers will often get a fixed amount of renewable energy via long-term power order contracts announced as part of an authority program as a result of

bidding campaigns. Underbidding and then failure to complete assignments by earning bidders is the usual reason this scheme has failed and has since been forgotten. The Traceable License system is another option for quota systems.

It is common practice for electricity producers or end-users to be required to source or use a certain percentage of renewable energy in order to meet the amount of renewable power that is required by various government programs. They are required to provide the anticipated number of TGCs in order to demonstrate compliance. Agents in the TGC sector may purchase these certificates, or you can gain them by ordering and operating renewable energy herb or by obtaining certification from other renewable energy producers. How significant the TGC is at the moment is determined by the market. Regular energy trading allows individuals to decide on the advantages of electricity, and the TGC adds value to oriental electricity. In windy nations, the cost of wind energy is now cheap and will become even more so as power prices rise and value is offered. The current market price for fossil fuel plants is 8.64 cents per kilowatt-hour.

Using various software tools and techniques such as Genetic Algorithm, HOMER tool, Matlab, etc., the optimal design of PV-Wind hybrid devices is created by considering a range of system efficiency guidelines, such as total annual price, reduction of power source possibility, level of sensitivity evaluation, market demand part administration, reduction of deficits, and pollutant emissions.

Both the functioning and output power of HRES will be affected by the weather conditions that follow. Lower responsiveness from PV and wind source insight data has resulted in insufficient power from the hybrid program's output and battery backup to meet the requisite load demand.

There are a lot of moving pieces in an HRES, and each of those parts-a renewable source, a backup unit, and a DG-will have its own unique set of features. Consequently, managing the dynamic nature of each component of the system is very critical. It is possible to acquire an optimum solution at higher trustworthiness and lower HRES cost by using an appropriate control strategy. The controller is an essential component of HRES as it keeps an eye on and controls a variety of load-related variables, including the output voltage, frequency, and energetic power as a function of various power factors.

Whatever the case may be, the source provides its own controller, the focal point of attention on Substantial method of the associated component with current tips. The primary or centralized control planning in the central control setup handles the indicators of energy sources and the backup device of the HRES.

Data Collection

Primary data is information that we obtain directly from sources, such as people, things, or processes. Using this method, you may collect both quantitative and qualitative data. The primary goal of collecting most of this data is to identify a research problem that you can then investigate. Many benefits are offered by main data. We tailor it to our specific study question from the outset, so there won't be any changes needed to make the data useful. In addition, primary data might be trustworthy if you carefully examine the data collection process and maintain a close watch on its quality. Participating in primary data collection allows you to focus your efforts on gathering the exact information that is required. As a last thought, primary data is usually fantastic, so please save the efforts of those who are unable to get it. Secondary data is acquired when information becomes available after another expert or business that first gathered it has made it available. We surveyed power system experts, electrical engineers, and project managers to compile data for the feasibility assessment. A total of 32,000 individuals were recognized as belonging to certain domains, with the data being gathered via HRD in the state of Maharashtra. In the part that follows, we will talk about the data sample.

Data Sampling

N divided by 1 plus (N times e raised to the power of e)

N population sample size (n)

Where N is the population and e is the sample variance (0.05).

A sample size of n=32,000 divided by (1+(32000*0.05*0.05))

Once we round off, we have n= 3.999,

n = 400

Table 1: Sample size

Survey Population	No. of Total Population	Sample
Electrical engineers, project managers, power system professionals	32,000	400

Hypothesis

H1: Carbon Foot Printing can be reduced by implementation of renewable energy sources for energy generation by avoiding fossil fuel utilization in urban area.

H2: This hypothesis is developed to understand the hybrid renewable energy generation benefits for lowering GHG.

Data Analysis

A statistical test's likelihood of revealing differences between the treatment groups increases as the sample size is greater. Consequently, the accuracy of the statistic is often interpreted to increase as the sample size increases.

There is a crucial basic assumption in almost all inferential statistics. One may argue that any duplication condition eventually becomes neutral. To put it another way, the conventional wisdom is that no two values in a condition are related. For specialists in pet behavior, these forecasts of independence may cause a lot of problems. Below is a table displaying the results of the suggested analysis.

Table 2: Evaluation of Factors and Purposes

S. No.	Factor/Purpose	Cronbach's Alpha	Sample Size
1	The impact of carbon foot printing on society.	0.758	40
2	The impact of renewable energy sources on GHS.	0.712	40
3	The impact of hybrid renewable energy sources on carbon emission.	0.768	40
4	The impact of solar energy generation on cost of energy generation.	0.805	40
5	The impact of wind energy generation on cost of energy generation.	0.814	40
6	The impact of hydro energy generation on cost of energy generation.	0.744	40
7	The impact of fuel cell energy generation on cost of energy generation.	0.739	40
8	Impact of maximum power point tracking on energy efficiency.	0.856	40
9	The impact of the micro-grid on rural electrification.	0.889	40
10	There is a need of policy reform for efficient renewable energy generation and distribution.	0.871	40
11	There is a need of improvement in power quality of renewable energy.	0.728	40

The data utilized was originally organized according to the claim made about the situation, and the whole study feasibility is assessed using a significance threshold of 0.05. It is concluded that if the threshold of significance is considerably less than 0.05, then the null hypothesis is rejected. If the 2-tailed level is more than 0.05, we may accept the null hypothesis. Common uses for this significance level include selecting the null hypothesis and rejecting alternative hypotheses. The original 0.05 threshold was utilized for this one-of-a-kind investigation.

Hypothesis Testing

H1: Carbon Foot Printing can be reduced by implementation of renewable energy sources for energy generation by avoiding fossil fuel utilization in urban area

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1	1	2.741	1.151	0.007
Within Groups	99	399	1.165		
Total	**100**	**400**			

Since the p-value is less than 0.007, we may conclude that the null hypothesis is false.

H2: This hypothesis is developed to understand the hybrid renewable energy generation benefits for lowering GHG

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4	1	1.165	4.110	0.007
Within Groups	94	399	0.174	-	-
Total	100	400	-	-	-

Since the p-value is less than 0.007, we may conclude that the null hypothesis is false.

Conclusion

India is always innovating and setting new standards for the usage using renewable energy sources to combat global warming and increasing carbon emissions, all while improving air quality. Additionally, the Indian government has planned to drastically reduce the production of traditional automobiles and accelerate the adoption of EVs by 2025; thus, the country's energy demand is anticipated to surge significantly in the coming years. While funds are not always available, India has made use of most initiatives to promote the creation of alternative energy throughout the country. In this study, here, we take stock of where green energy power generation is right now and where we think it's going in the future in relation to other key options for reducing carbon emissions, such as sustainable energy, efficiency gains, and power sector ideals. Included in the thorough examination and assessment of these carbon reduction options are their potential, impact on fossil fuel preservation, cost of CO2 mitigation, and value-to-cost ratio.

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