

# Innovations

## Integration of Corporate Social Responsibility in the Solar Energy Sector with Sustainable Development Goals for Community Development, Environmental Protection, and Market Competitiveness

<sup>1</sup> Dr. Kiran Sawant; <sup>2</sup> Dr. Atul Pise; <sup>3</sup> Mr. Abdul Muhammed Nafea

<sup>1</sup> Assistant Professor, Kirloskar Institute of Management, Pune, India

<sup>2</sup> Associate Professor, Sandip Institute of Technology and Research, Nashik, India

<sup>3</sup> Research Scholar, Ajinkya DY Patil University, Pune, India

---

**Abstract:** *This research investigates the role of Corporate Social Responsibility (CSR) as a strategic tool for sustainability in the solar energy sector, with a specific focus on its integration with Sustainable Development Goals (SDGs) in India. The study examines the impact of CSR initiatives on community development, environmental protection, and market competitiveness, and assesses the overall satisfaction of beneficiaries in the states of Maharashtra, Telangana, and Rajasthan. Data were collected using convenience sampling from individuals directly impacted by the CSR activities of solar energy companies. The analysis was conducted using Smart PLS 4.0, revealing that CSR programs focused on environmental protection, community development, and market competitiveness significantly influence the overall satisfaction and well-being of beneficiaries. The findings suggest that CSR initiatives in the solar sector not only contribute to sustainable development but also strengthen the market position of firms by addressing key social and environmental challenges. This research provides a valuable framework for other industries looking to align CSR activities with business growth and sustainability goals.*

**Keywords.** *Sustainable Development Goals, Corporate Social Responsibility, Community Development, Environmental Protection, Market Competitiveness*

---

### Introduction

Solar energy is one of the best forms of energy as it is renewable and uses the sun to generate electricity. Given that the current state of the Indian economy is experiencing a boom with major foreign investments and national investments in this sector considering increased future demand for electricity.

It is to take note that most of the electrical energy in the country is produced through non-renewable resources. However, with the increased usage of solar energy in the country, the damage to the environment could be greatly reduced. It can mutually benefit the environment, community and the marketplace. This boom in the solar

sector in the country has been promoted by companies such as Tata Power Solar, Adani Solar (derivation of Tata and Adani) and Suzlon. They have introduced CSR programs such as improving the lives of the consumers overall, reducing the landfill waste, educating the young generation about clean energy, etc. This study delves into such initiatives and the impact it has on the environment, community, and marketplace.

This study aims at assessing how effectively these companies address the social and environmental issues using solar energy in India. Additionally, the study would also investigate whether these initiatives contribute to the well-being of the communities and if the companies can enhance sustainable and equitable future of India. Finally, the study will explore how responsible practices can influence the overall competitiveness of the solar industry within the country.

### **Solar Energy and the Sustainable Development Goals**

Solar energy has become more important for accomplishing the Sustainable Development Goals (SDGs) that the UN has put forth. By 2030, these enormous goals aim to build a more just, sustainable, and prosperous community, and solar energy provides a viable answer to many of the problems society encounters. Addressing climate change is one of the main areas where solar energy may have significant impact. We may decrease the effects of global warming by lowering our reliance on fossil fuels, which increase greenhouse gas emissions. Solar power plants are an essential component of a low-carbon future since they generate electricity without emitting any harmful emissions. (Goal 11, 13 | Department of Economic and Social Affairs, n.d.)

Sustainable Development Goals to ensure access to affordable and clean energy using solar and clean renewable energies. Many developing countries face electricity crunch which is the main reason for an obstacle to economic growth and development. Solar power can be a sustainable solution to overcome electricity problems in developing countries for improving quality of life. Solar energy plays a crucial role in promoting sustainable development by integrating solar panels into building and infrastructure. Environmental issues such as carbon footprint and pollution can be reduced with the use of solar energy. It will also help in improving power public services e.g. street lighting, and transportation in urban areas. (Goal 7 | Department of Economic and Social Affairs, n.d.)

Besides climate change, and energy access, solar energy can substantially contribute to other Sustainable Development Goals. Clean water and sanitation in rural areas can be provided by using solar-powered pumps. Solar Energy can also help agriculture and food security by supporting irrigation systems and food processing activities. (Goal 6 | Department of Economic and Social Affairs, n.d.)

There are several challenges as well apart from advantages of using solar energy. One of the biggest obstacles to installing solar panels is its expensiveness. Many governments and International Organizations are addressing this obstacle by supporting people with financial incentives and subsidies. The other issue with solar

energy is its intermittent nature. During the day time solar energy is abundant whereas it's not available during the night and cloudy atmosphere. The solution for this issue is energy storage. The stored energy can be used during the night and cloudy atmosphere.

There are many potential benefits of solar energy besides these challenges. Solar Energy investment can create a sustainable, equitable, and prosperous world for the next generations. Solar Energy is ready to play a central role in achieving the Sustainable Development Goals. (Goal 11 | Department of Economic and Social Affairs, n.d.)

### **Literature Review**

#### **Corporate Social Responsibility Programs of Solar Energy Companies in India**

Solar Energy companies in India are substantially contributing sustainable development of communities, Market, and the environment through their Corporate Social Responsibility Programs. The Corporate Responsibility Programs of Solar energy companies are well aligned with the Sustainable Development Goals to cater to the local community needs.

### **Environment Protection**

Solar energy companies in India have adopted renewable technologies to reduce greenhouse gas emissions and environmental pollution, especially in rural areas of India to reduce dependency on fossil energy. Some companies support biodiversity conservation by protecting wildlife habitats and promoting sustainable land usage. Waste management is one of the challenges faced by society across the globe. Solar companies in India implement waste management programs to reduce their carbon footprint and promote sustainable practices. (Sharma, Tiwari and Sood, 2012)

The main objective behind implementing effective CSR programs, solar energy companies in India is aiming to contribute to sustainable development of their communities, enhance their market competitiveness, and protect the environment. These corporate social responsibility programs can help solar energy companies in India to build a positive brand image and strengthen the company's relationship with stakeholders. (Raina and Sinha, 2019)

However there are some eminent studies on effectiveness of corporate social responsibility programs in other different countries. The study conducted in Nigeria challenges the one-size-fits-all approach to CSR, arguing that institutional environments (regulatory, economic, social, and political) significantly impact CSR practices in developing countries. The research focused on renewable energy firms in Nigeria, finding that the regulatory environment of a country influences environmental protection, the economic environment shapes product and service innovation, the social environment impacts social innovation, and the political environment affects local and national cluster development. Interestingly, the study also found that managers' international exposure influenced their approach to CSR, suggesting a need for further research on this topic. (Motilewa, et al., 2016)

According to other notable studies, Corporate Social Responsibility (CSR) is more than just philanthropy and instead focuses on how companies manage their environmental, social and economic impacts in addition to managing stakeholder relationships. It highlights that CSR can be a strategic tool to manage risk, citing the oil and gas industry as an example. CSR programs in this sector can help address environmental risks and gain social approval in order to benefit customers and consumers through the programs. (R.K and Sarkar, 2017)

The study conducted in Vietnam contributes to the understanding of how corporate social responsibility (CSR) influences sustainable energy development (SED) by introducing the mediating effects of sustainable energy supply (SES) and usage of renewable energy resources (URR). The research design, employing PLS-SEM statistical software on data from Vietnamese experts, economists and executives in 2020, confirms a positive direct effect of CSR on SED. Additionally, the findings reveal that SES and URR both play mediating roles in this relationship. This study highlights the importance of CSR initiatives that promote both increased reliance on renewable energy sources and a more sustainable energy supply system, ultimately leading to greater progress in achieving sustainable energy development in the country of Vietnam. Lastly, this move increased the electricity demand in the country as a whole and furthermore made more entrepreneurs and companies operating be aware of CSR. (Tiep, Huan, and Hong, 2021)

The noteworthy study conducted in Bulgaria and Georgia highlights the growing tension in the energy sector in Eastern European countries such as Bulgaria and Georgia, fulfilling rising energy demands and ensuring environmentally responsible practices. Globalization and modern lifestyles scale energy consumption to the greatest lengths, which causes concerns about climate change and pollution. This necessitates a shift towards sustainable energy sources. Corporate Social Responsibility and Sustainability principles emphasize responsible resource use, encompassing social, ecological, and economic aspects. They have explained how countries can achieve this balance by developing and utilizing renewable resources alongside efficient energy use. It examines the role of energy companies in integrating sustainability into their strategies, using examples from Bulgaria and Georgia, by generating electricity through solar and wind through solar panels/grids and windmills, and generating hydropower through dams. (Gigauri and Vasilev, 2022)

An extensive review of literature describes that many studies have been carried out to understand the effectiveness of Corporate Social Responsibility programs of energy sectors on the environment in other countries. Therefore, researchers have developed the following hypothesis in order to understand the effectiveness of such programs on Environmental protection in India, especially Corporate Responsibility Programs of Solar Energy Companies in India.

**H1:** The CSR programs of solar energy companies about environmental protection significantly contribute to overall satisfaction and impact on beneficiaries in India.

### **Corporate Social Responsibility and Community Development**

The community development is one of the important agenda of Solar Energy Companies. They substantially invest in education and skills development, Healthcare, Infrastructure Development and social welfare programs. These companies strongly believe in Gandhian Trusteeship theory of community development. These companies have Corporate Social Responsibility Programs through which they conduct various community development activities such as providing scholarships, vocational training, financial literacy and workshops on renewable energy technologies. (Singh and Misra, 2020)

As a part of community development, Solar Energy companies have supported healthcare sector by building hospital and clinics, providing medical equipments and arranging health camps in rural area ensuring the medical assistance should reach to each and everyone in the interior areas of country. Some of the solar energy companies are supporting infrastructure development in local communities such as construction of roads, bridges and water supply system. Apart from healthcare, infrastructure development, social welfare programs such as providing food and shelter to the socially and economically backward people, promoting women education and empowerment and child welfare initiatives. (Gautam et al., 2023)

There are several other eminent study focuses mainly on Corporate Social Responsibility Programs and socio economic development. One such study conducted in India explores CSR initiatives and their impact on rural socio-economic development. The study finds that when corporations consider rural communities as stakeholders and implement effective CSR practices, these communities benefit them as a whole. The study suggests that CSR can be a successful business strategy, with positive impacts in focus areas like education, infrastructure, and livelihood development. (Hussain, 2014)

The another notable study carried out in South-east Asian Countries finds that solar energy has significant potential to meet the needs of rural communities in Southeast Asia, but successful implementation requires targeted development modules that consider local needs and capacities. The LAMTIB Initiative (Leapfrogging Autonomous Micro Technopolis in Boxes), a specific solar energy project, demonstrates strong alignment with the UN's Sustainable Development Goals (SDGs), particularly goals related to poverty reduction, clean energy access, and education. This suggests that solar energy initiatives can contribute to broader development objectives in the region. (Aunemo, 2015)

The study in South Africa identified a gap in the definition of community development, hindering its effective execution. This lack of clarity extends to the private sector's implementation policies for community development, resulting in inconsistent approaches by businesses fulfilling their corporate social responsibility. Furthermore, political influence can negatively impact progress by introducing a bias aimed at addressing inequality, potentially creating unintended consequences for both parties. (NDELA, 2020) The studies were conducted in different countries to understand the impact of Corporate Social Responsibility on societal development.

However, very limited studies have been carried out on Corporate Social Responsibility programs of companies dealing with Solar Energy and their effect on the overall socio-economic development of India. Thus, we intend to study the effect of CSR programs of Companies dealing with Solar Energy in India.

**H2:** The CSR programs of solar energy companies about community development significantly contribute to overall satisfaction and impact on beneficiaries in India.

### **Corporate Social Responsibility and Market Competitiveness**

The other important initiative of Solar Companies in India is to invest in research and development to enhance products and technologies. This initiative will help to improve competitiveness in the market. Few Solar companies have heavily invested in research and development to innovative solar energy solutions. The solar energy companies support the development of supply chain for energy components and services in the local markets. They create jobs opportunities and promote economic development. Companies may support the development of local supply chains for solar energy components and services, creating job opportunities and promoting economic growth. (Kiran Batool et al., 2023)

Various policies for the growth of Solar Energy Sector have been designed by Solar Energy companies in India. The policies such as subsidies, tax incentives, grid integration are advocated by Indian Solar Energy Association to promote the adoption of solar energy in India. A few of the notable studies carried out denotes the strong correlation between Corporate Social Responsibility and Market competitiveness. (Gautam et al., 2023)

The key findings of research conducted in India enunciate that private companies outperform public sector entities in their approach to CSR. While both sectors acknowledge the importance of social responsibility, private companies dedicate more resources and implement more strategic CSR programs. Public sector companies, on the other hand, tend to focus on reactive, issue-based initiatives rather than a long-term strategic approach for the benefit of the public. The study suggests a need for the public sector to adopt a more proactive and strategic approach to CSR, potentially inspired by successful models from the private sector in the country. (Mahapatra, 2019)

One more notable study conducted in India examines the role of private companies in providing off-grid energy solutions in India, where millions lack access to grid electricity despite government efforts. By interviewing ten such firms, the study identified two key perspectives. Firms worried about competition from expanding grid connections tended to be more socially integrated within the communities they serve, possibly to mitigate risk. Conversely, firms less concerned about the grid focused on affordability and operated in remote areas. This highlights the diverse approaches private companies take in addressing energy poverty in India. (Heynen, 2019)

The researchers in Malaysia aim to examine the impact of implementing CSR programs in the Malaysian power generation industry through a qualitative approach. The literature review suggests that Corporate Social Responsibility (CSR) programs, also referred to as corporate sustainability programs, encompass an organization's interactions with the community, environment, workplace, and marketplace. CSR is seen as a way to enhance business performance, acting as both an internal policy and a broader business strategy. Some consider CSR a form of self-regulation, promoting social accountability across various stakeholders. For the energy industry specifically, CSR extends beyond core business functions and emphasizes community empowerment, environmental responsibility, a positive workplace, and high ethical standards. (Salmi, et al., 2019)

The study conducted in India had a key finding that the commercial and industrial (C&I) applications are the driving force behind India's rooftop solar market, but the pandemic slowed installations. However, commercial and industrial applications are expected to recover and grow due to a need for cost optimization. Rooftop solar with battery storage is seen as a solution, with falling battery prices making this technology even more attractive. This combination is ideal for behind-the-metre applications in India, given the country's existing power capacity. (Singh, et al., 2022) Thus, after having reviewed several studies conducted in India and abroad on CSR programs and their effect. There is a scope for conducting further research to understand the effect of CSR programs on Market competitiveness pertaining to CSR programs of companies dealing with solar energy sector.

**H3:** The CSR programs of solar energy companies about market development and competitiveness significantly contribute to overall satisfaction and impact on beneficiaries in India.

It is evident from the extensive review of literature that there had been a lot of research done in the area of Corporate Social Responsibility initiatives and programs undertaken by the solar energy sector pertaining to environment, community, and marketplace in various other parts of the world, however, this is not much reciprocated in India. Since Indian companies are rapidly promoting solar energy resources through various states recently, still there is a scope to carry out a detailed study on such topics to understand the effectiveness of CSR programs of Solar Energy Companies in India and their alignment with Sustainable Development Goals to foster the overall betterment of society.

## **Methodology**

### **Research and Sampling Design**

The research utilizes a descriptive framework to evaluate the influence of constructs such as community development, market development and competitiveness, and environmental protection on overall satisfaction and the impact on beneficiaries of a solar project. Secondary data were gathered through a literature review, while

primary data were collected via a structured questionnaire, predominantly using a Likert scale. A total of 450 sampling units were considered for the study, yielding 403 valid responses, resulting in a 90% response rate. Multivariate analysis techniques, including Principal Component Analysis (PCA) and regression analysis, were used to analyze the data and test the hypotheses within the conceptual framework. Smart PLS 4.0 was utilized for data analysis and interpretation.

**Table No. 1. 1** Sample Demographic Profile

<b>Demographic Analysis</b>			
<b>Demographics</b>		<b>No. of Respondents</b>	<b>Percentage</b>
State	Telangana	150	37
	Maharashtra	150	37
	Rajasthan	103	26
Total		403	100
Gender	Male	153	38
	Female	250	62
Total		403	100
Age	18-25	75	19
	26 - 30	123	31
	31 – 40	125	31
	40 & above	80	20
Total		403	100
Qualification	12th	150	37
	Bachelor	163	40
	Masters	90	22
Total		403	100
Profession	Self Employed	225	56
	Employment	178	44
Total		403	100

The above table no. 1.1 of demographic analysis is a comprehensive overview of the sample population. As far as geographical distribution is concerned, Telangana and Maharashtra has major proportions of respondents, each with 37% and Rajasthan has 26% of the respondents out of overall population. This study has been conducted in these three states based on the parameters viz. Geographical location, gender, Age, Qualification, and profession. Female respondents outnumbered male respondents with 62% of the sample as many Solar Energy companies support self-help groups (SHGs) and micro credits to uplift economic conditions of women from rural areas in these three states. The male respondents made up 38%. The age distribution is relatively balanced, with the largest age group being 26-40 as respondents in this group are very active in enhancing employability and entrepreneurial skills, representing 31% of the respondents. The next largest age groups of respondents are

31-40 and 18-25, each accounting for 31% of the sample. The remaining 20% of respondents are aged 40 and above. The level of education of the respondents is relatively high, with 40% holding a bachelor's degree and 22% possessing a master's degree. Finally, the professional landscape is dominated by self-employed individuals as this group has entered into startup businesses by exploring opportunities for venturing new start ups. Especially self help groups and micro credits supported by Solar Energy Companies have boosted entrepreneurship development in these three states. The self employed respondents are 56% of the sample, while 44% are engaged in employment.

**Table No. 1. 2** Descriptive statistics

	N	Missing	Mean	Median	SD	Minimum	Maximum
Q1	403	0	3.98	4	0.976	1	5
Q2	403	0	4.15	4	1.039	1	5
Q3	403	0	4.00	4	0.961	1	5
Q4	403	0	3.87	4	1.028	1	5
Q5	403	0	3.96	4	0.887	1	5
Q6	403	0	4.10	4	0.939	1	5
Q7	403	0	3.91	4	1.104	1	5
Q8	403	0	4.00	4	0.937	1	5
Q9	403	0	3.99	4	0.944	1	5
Q10	403	0	3.87	4	0.910	1	5
Q11	403	0	3.83	4	0.904	1	5
Q12	403	0	3.96	4	0.908	1	5
Q13	403	0	3.97	4	0.939	1	5
Q14	403	0	3.82	4	0.993	1	5
Q15	403	0	3.84	4	1.038	1	5
Q16	403	0	3.77	4	1.012	1	5
Q17	403	0	3.84	4	1.032	1	5
Q18	403	0	3.85	4	1.042	1	5
Q19	403	0	4.02	4	0.960	1	5
Q20	403	0	3.64	4	1.085	1	5

The descriptive statistics reveal a clear pattern of positive responses of 403 respondents to the 20 Likert scale items. The values of mean and median are

consistently indicating favourable responses, while the standard deviations suggest some individual variation in the intensity of positive responses. The mean value ranging from 3.64 to 4.15 indicates positive sentiments of respondents. It suggests that majority participants have favourable opinions and experience towards Corporate Social Responsibility programmes of Solar Energy companies in India. The median values further reinforce the positive trend of the respondents towards CSR programmes of Solar Energy Companies. It shows that the middle point of the Likert scale, representing a neutral response, is less frequently selected. The standard deviations values are moderate and denote some variability in responses across the items. This exhibits overall positive trend of data. The above table exhibits valuable information about the overall attitudes and perceptions of the participants towards the CSR programs of Solar Energy Companies in India.

**Table No. 1.3** Assumption Checks

<b>Bartlett's Test of Sphericity</b>		
$\chi^2$	Df	P
6459	190	< .001

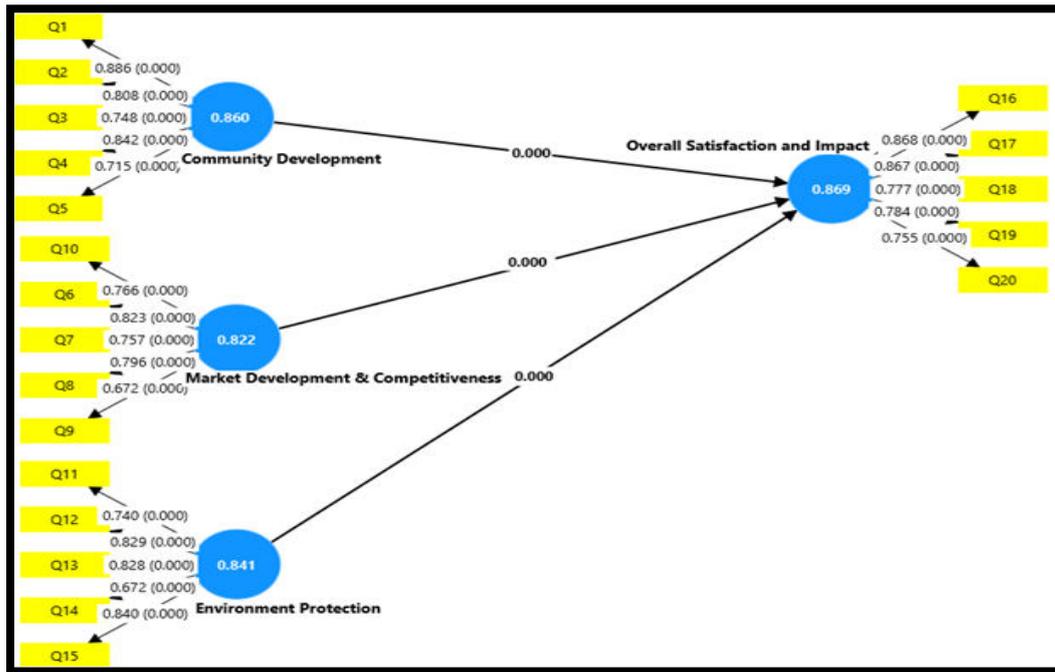
The outcome of Bartlett's Test of Sphericity denotes that there is a significant correlation between the variables in the dataset. The chi-square value of 6459 with 190 degrees of freedom is significant at a p-value less than 0.001, suggesting that there is a significant difference between the correlation matrix and an identity matrix. This justifies the use of factor analysis for this dataset.

**Table No. 1.4** KMO Measure of Sampling Adequacy

<b>Overall</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>	<b>Q8</b>	<b>Q9</b>	<b>Q10</b>
<b>0.879</b>	0.852	0.83	0.856	0.869	0.788	0.913	0.933	0.84	0.868	0.863
	<b>Q11</b>	<b>Q12</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>	<b>Q16</b>	<b>Q17</b>	<b>Q18</b>	<b>Q19</b>	<b>Q20</b>
	0.887	0.92	0.901	0.928	0.931	0.832	0.85	0.915	0.929	0.913

The above Table No. 1.4 denotes the outcome of the KMO test. It is a measure of sampling adequacy. The KMO test outcome indicates that the data are suitable for factor analysis. The overall KMO values in the above table range from 0.788 to 0.933. These KMO values are above the recommended threshold of 0.5. It suggests that the variables in the dataset are highly correlated and can be effectively explained by a common factor structure. These results indicate that the factor analysis will provide meaningful and interpretable results.

**Figure No.1.1**Structural Model



Construct Reliability and validity				
	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CD	0.86	0.868	0.9	0.644
EP	0.841	0.849	0.888	0.615
MDC	0.822	0.832	0.875	0.585
OSI	0.869	0.875	0.906	0.658

**Table No. 1.5** Construct Reliability and Validity

The above table no. 1.5 demonstrates the reliability and validity of a constructs. The Cronbach's alpha values indicate high internal consistency. The values are ranging from 0.822 to 0.869. It suggests that the items within each construct are measuring and representing the same underlying concept. The composite reliability values are ranging from 0.832 to 0.875. They further support the reliability of the constructs. Moreover, the composite reliability (rho\_c) values are 0.875 to 0.906, which denotes the overall reliability of the constructs. Finally, the average variance extracted (AVE) values, ranging from 0.585 to 0.658, denotes that the constructs are adequately different from each other. It shows good convergent validity. Overall, the results denote that the constructs in this study are both reliable and valid.

**Table No. 1.6** Discriminant Validity HTMT Matrix

<b>Discriminant Validity HTMT Matrix</b>				
	CD	EP	MDC	OSI
CD				
EP	0.826			
MDC	0.822	0.814		
OSI	0.814	0.823	0.835	

The above table no. 1.6 of the HTMT matrix exhibits adequate discriminant validity among the constructs, viz. Community Development Program (CDP), Environment Protection Program (EPP), Market Competitiveness (MC) and Overall Satisfaction and Impact (OSI). All HTMT values are below the recommended threshold of 0.90, showing that each construct is different from the others. Specifically, the Community Development Program and Environment Protection Program show the highest degree of differentiation, with an HTMT value of 0.826. MC and OSI also denote strong discriminant validity, with HTMT values below 0.90. The outcome suggests that the constructs in this study are adequately measured and do not overlap excessively with each other.

**Table No. 1.7** Variance Inflation Factor

<b>Variance Inflation Factor</b>									
Q1	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
3.211	1.622	1.592	2.36	2.42	1.462	2.171	3.502	3.76	1.955
Q19	Q2	Q20	Q3	Q4	Q5	Q6	Q7	Q8	Q9
1.846	2.785	1.927	2.159	2.354	1.923	2.03	1.501	2.024	1.426

The table no. 1.7 demonstrates the Variance Inflation Factor (VIF) for different variables viz. Community Development Programs (CDP), Market Competitiveness (MC), Environment Protection (EP), and Overall Satisfaction and Impact (OSI). VIF is used to measure multicollinearity in regression models. High VIF values denote that a variable has high multicollinearity with other variables, which can affect the reliability of the model. A VIF value greater than 10 is generally considered a high degree of multicollinearity, whereas values less than 5 show little to no multicollinearity, which is acceptable to carry out further analysis. However, the above table indicates all VIF values are much below the threshold value i.e., 5, hence in this case there is little to no multicollinearity among the variables.

**Table No. 1.8** Goodness of fit

	<b>Saturated model</b>	<b>Estimated model</b>
<b>SRMR</b>	0.096	0.096
<b>d_ ULS</b>	1.93	1.93
<b>d_ G</b>	1.191	1.191
<b>Chi-square</b>	2330.084	2330.084
<b>NFI</b>	0.646	0.646

The above table exhibits model fit indices for both the saturated and estimated models. These indicators help to understand how well the model fits the data, and it also show the goodness-of-fit indices for a structural equation model (SEM) analysis. The SRMR (Standardized Root Mean Square Residual) value in the above table is 0.096 for both the saturated and estimated models, indicating a good fit. The d\_ ULS (unadjusted d) and d\_ G (adjusted d) values are 1.93 and 1.191, respectively, which shows reasonable fitness of the model. The NFI (Normed Fit Index) value is 0.646, which is less than 0.9 that suggesting a moderate fit. However, overall results signify that the model provides a reasonable fit to the data, although there is scope for improvement.

**Table No. 1.9 Outer Loading**

<b>Outer Loading</b>				
	<b>CD</b>	<b>EP</b>	<b>OSI</b>	<b>MDC</b>
<b>Q1.</b> The solar electrification program has significantly improved the quality of life in my community.	0.886			
<b>Q2.</b> I have gained valuable skills and knowledge from the solar installation and maintenance training programs.	0.808			
<b>Q3.</b> The solar-powered schools and health centers in our area have been beneficial for our community.	0.748			
<b>Q4.</b> The water and sanitation facilities provided by the solar company have improved our community's health and hygiene.	0.842			
<b>Q5.</b> The women empowerment programs have provided new opportunities for women in our community.	0.715			
<b>Q11.</b> The solar company's environmental protection initiatives, such as tree plantation drives, have positively impacted our environment.		0.742		
<b>Q12.</b> I have noticed a significant reduction in the community's reliance on non-renewable energy sources due to the promotion of solar energy.		0.829		
<b>Q13.</b> The water conservation projects, such as solar-powered irrigation and rainwater harvesting, have been beneficial to our local agriculture.		0.828		
<b>Q14.</b> The waste management initiatives by the solar company have improved cleanliness and		0.772		

waste disposal practices in our community.				
<b>Q15.</b> I believe that the company is genuinely committed to protecting the local environment and biodiversity.		0.840		
<b>Q16.</b> Overall, I am satisfied with the CSR programs provided by the solar company.			0.868	
<b>Q17.</b> I believe the CSR programs of the solar company have positively impacted my community's development and sustainability.			0.867	
<b>Q18.</b> I would recommend other communities to participate in similar CSR programs by solar companies.			0.777	
<b>Q19.</b> The company communicates effectively with the community about its CSR initiatives and their benefits.			0.784	
<b>Q20.</b> I feel that the CSR programs are well-planned and implemented according to the needs of the community.			0.755	
<b>Q10.</b> I believe the company's efforts to build local supply chains have made solar products more accessible and affordable.				0.766
<b>Q6.</b> The awareness programs about solar energy have increased my understanding of its benefits.				0.823
<b>Q7.</b> The financial support provided by the solar company has helped me or others in the community adopt solar technology.				0.757
<b>Q8.</b> I feel there are more local job opportunities now due to the support for local entrepreneurs in the solar energy sector.				0.796
<b>Q9.</b> The training and support provided by the company have helped me start or grow my own business.				0.723

The above table no. 1.9 provides outer loadings matrix shows the strength of the relationships between the observed variables (Q1-Q20) and the latent constructs (CD, EP, MDC, and OSI). Higher loadings suggest a stronger relationship between a variable and a constructs. The loadings shown in the above table show strong relationships with their respective constructs. For example, Q1 has a strong loading on CD, Q10 has a strong loading on MDC, and Q16 has a strong loading on OSI, Q14 with CD, Q11 with EP, and Q9 with OSI. In a nutshell, the loadings matrix shows that the constructs are being measured and well represented by a combination of strong and moderately strong indicators. The outer loadings show how well each question

corresponds to and represents its respective construct. Loadings above 0.7 are generally considered strong, while those below indicate weaker relationships.

**Table No. 1.10** Hypotheses testing and total effect

Total effects	
<b>CD -&gt; OSI</b>	0.691
<b>EP -&gt; OSI</b>	0.458
<b>MDC -&gt; OSI</b>	0.467

The above table no. 1.10 denotes **total effects** between constructs, particularly the effect of **CD, EP, and MDC** on **OSI**. The values of total effects signify the overall impact of each independent variable (CD, EP, and MDC) on the dependent variable (OSI). CD has a total effect of 0.691 on OSI, EP has a total effect of 0.458 on OSI, and MC has a total effect of 0.467 on OSI. These results suggest that CD has the strongest direct and indirect influence on OSI, followed by MDC then EP.

**Table No. 1.11.** Path Coefficient

Path coefficient				
	<b>CD</b>	<b>EP</b>	<b>MDC</b>	<b>OSI</b>
<b>CD</b>				0.691
<b>EP</b>				0.458
<b>MDC</b>				0.467
<b>OSI</b>				

The above table shows the path coefficients of direct relationships between the constructs and their impact on **OSI** (Overall Satisfaction and Impact). Specifically, (CD) **Community Development** has the strongest influence on **OSI**, with a path coefficient of **0.691**, shows that it plays a significant role in shaping overall satisfaction and impact, likely due to the CSR programs about community development of Solar Energy Companies. However, Environment Protection and Market Competitiveness show a positive effect on **OSI** with a path coefficient of **0.458 and 0.467 respectively**.

**Table No. 1.12.** Hypothesis Testing Summary

<b>Hypothesis Outcome</b>	<b>Path Coefficient</b>	<b>Sig. Value</b>	<b>Decision (Alternative Hypothesis)</b>
<b>CD -&gt; OSI</b>	0.691	0.000	Accepted
<b>MDC -&gt; OSI</b>	0.458	0.000	Accepted
<b>EP -&gt; OSI</b>	0.467	0.000	Accepted

### **Practical implication**

Solar companies in Maharashtra, Telangana, and Rajasthan have enhanced stakeholder satisfaction by integrating community development into their CSR initiatives, focusing on attaining Sustainable Development Goals viz. Affordable and clean energy (SDG7), Quality Education (SDG4), Climatic Action (SDG13), and overall sustainable cities and communities (SDG 11). Managers should prioritize stakeholder engagement and tailor CSR efforts to regional needs, fostering long-term social impact and stronger relationships with communities and key stakeholders

Integrating environmental protection and community well-being into CSR strategies strengthens solar companies' market position and aligns them with Sustainable Development Goals (SDGs). Managers should view CSR as a strategic tool to boost brand reputation, attract investors, and create new market opportunities, beyond just compliance or philanthropy.

Social Responsibility initiatives in solar companies can drive business growth while positively impacting communities, making it essential for managers to align social responsibility with business objectives for long-term sustainability and market expansion in underserved areas.

The research offers a guiding framework for industries beyond solar, showing how CSR can balance social responsibility with business performance, providing a roadmap for sectors like manufacturing, IT, and construction, particularly in regions with similar socio-economic and environmental conditions.

CSR initiatives in the solar sector contribute to a sustainable and equitable future by addressing energy access, environmental protection, and social inclusion, making it essential for managers to evolve CSR strategies to support long-term business sustainability and equitable growth while aligning with global sustainability goals.

### **Recommendations**

The scope of the present study is limited to Solar Companies in selected states of India. It highlights that companies addressing community development, environmental protection, and market competitiveness can positively impact on well-being of beneficiaries. The conceptual framework from this study can be applied to other sectors as well, providing insights into how CSR initiatives in industries such as manufacturing, technology, or retail can drive positive social and environmental change.

The researchers can conduct a multi-stakeholder analysis, including government agencies, corporations, local communities, and environmental groups, to measure the impact of CSR initiatives by the companies in India. Multi-group analysis can be performed to understand the difference between the effects of CSR initiatives on community development, environmental protection, and market competitiveness on beneficiaries in India and overseas countries.

## Conclusion

The study reveals that solar companies in India are uniquely positioned to address social and environmental challenges through their CSR initiatives, with a significant impact on community well-being and environmental protection. Companies that integrate community development, market competitiveness, and responsible environmental practices into their core strategies not only enhance overall satisfaction and impact on beneficiaries of CSR Initiatives but also strengthen their market position. Furthermore, the framework and insights from this research can guide other sectors in designing CSR initiatives that balance social responsibility with business growth, contributing to a sustainable and equitable future.

## References

1. Aunemo, H., 2015. *Implementing Off-Grid Solar Solutions in Southeast Asia-A CSR- based Approach to Rural Development (Master's thesis, NTNU)*.
2. Gautam, R.S., Bhimavarapu, V.M., Rastogi, S., Kappal, J.M., Patole, H. and Pushp, A. (2023). *Corporate Social Responsibility Funding and Its Impact on India's Sustainable Development: Using the Poverty Score as a Moderator. Journal of Risk and Financial Management, 16(2), p.90.*
3. Gigauri, I. and Vasilev, V., 2022. *Corporate social responsibility in the energy sector: towards sustainability. In Energy Transition: Economic, Social and Environmental Dimensions (pp. 267-288). Singapore: Springer Nature Singapore.*
4. Heynen, A.P., Lant, P.A., Sridharan, S., Smart, S. and Greig, C., 2019. *The role of private sector off-grid actors in addressing India's energy poverty: An analysis of selected exemplar firms delivering household energy. Energy and Buildings, 191, pp.95-103.*
5. Huan, N.Q. and Hong, T.T.T., 2021. *Role of corporate social responsibility in sustainable energy development in emerging economy. International journal of energy economics and policy, 11(2), pp.172-186.*
6. Hussain, S., 2014. *Corporate social responsibility: Initiatives and its impact on socio economic development of rural areas in India. Asian Journal of Multidisciplinary Studies, 2(4), p.103.*
7. JASP Team (2024). *JASP (Version 0.18.3)[Computer software]*.
8. Kiran Batool, Zhao, Z., Irfan, M., Ullah, S. and Cem Işık (2023). *Assessing the competitiveness of Indian solar power industry using the extended Five Forces Model: a green innovation perspective. Environmental Science and Pollution Research, 30(34), pp.82045–82067.*
9. Kothari, C.R. (2004). *Research Methodology : Methods and Techniques. [online] New Delhi: New Age International. Available at: ccsuniversity.ac.in.*
10. Mahapatra, M., 2019. *CSR practices among public and private sector companies: A community development approach in Indian context. Journal of Management and Public Policy, 10(2), pp.33-42.*

11. Mishra, R.K. and Sarkar, S., 2017. Addressing social and environmental risks through CSR—An Indian perspective. *IPE Journal of Management*, 7(1), pp.149-158.
12. Motilewa, B.D., Worlu, E.R., Agboola, G.M. and Olokundun, A.M., 2016. An analysis of institutional environments on corporate social responsibility practices in Nigerian renewable energy firms. *Eng. Technol., Int. J. Social., Behav., Educ., Econ., Bus. Ind. Eng*, 10(8), pp.2410-2416.
13. Ndlela, Y.Z., 2020. Development of a community through a solar energy plant in a rural town (Doctoral dissertation, University of the Free State).
14. Raina, G. and Sinha, S. (2019). Outlook on the Indian scenario of solar energy strategies: Policies and challenges. *Energy Strategy Reviews*, 24, pp.331–341.
15. Rajendra Nargundkar (2008). *Marketing research : text and cases*. New Delhi ; Singapore: Tata Mcgraw-Hill.
16. Salmi, S., Sukur, A.L.A. and Norlena, H., 2019. The need of Corporate Social Responsibility (CSR) implementation in energy industry: proposition development. *International Journal of Recent Technology and Engineering*, 8(2S), pp.201-207.
17. Sharma, N.K., Tiwari, P.K. and Sood, Y.R. (2012). Solar energy in India: Strategies, policies, perspectives and future potential. *Renewable and Sustainable Energy Reviews*, 16(1), pp.933–941.
18. Singh, A.K., Kumar, V.P. and Krishnaraj, L., 2022. Emerging technology trends in the C&I rooftop solar market in India: Case study on datacentre–Retrofit with BIPV by U-Solar. *Solar Energy*, 238, pp.203-215.
19. Singh, K. and Misra, M. (2020). Linking Harmonious CSR and Financial Inclusion: The moderating effects of financial literacy and income. *The Singapore Economic Review*.

### **Electronic Resources:**

Goal 11 | Department of Economic and Social Affairs. (n.d.). [sdgs.un.org](https://sdgs.un.org).

Goal 13 | Department of Economic and Social Affairs. (n.d.). [sdgs.un.org](https://sdgs.un.org).

Goal 6 | Department of Economic and Social Affairs. (n.d.). [sdgs.un.org](https://sdgs.un.org).

Goal 7 | Department of Economic and Social Affairs. (n.d.). [sdgs.un.org](https://sdgs.un.org).

IUCN. (n.d.). UN Sustainable Development Goals. [online] Available at: [www.iucn.org](http://www.iucn.org).

Journal, T.C. (2023). Green initiative: 11 government schools running on solar at Warangal, Telangana. [online] *The CSR Journal*. Available at: [thecsrjournal.in](http://thecsrjournal.in).

Tata Power Solar. (n.d.). CSR. [online] Available at: [www.tatapowersolar.com](http://www.tatapowersolar.com).

[www.adani.com](http://www.adani.com). (n.d.). Sustainability | Adani Group. [online] Available at: [www.adani.com](http://www.adani.com).

[www.suzlon.com](http://www.suzlon.com). (n.d.). Suzlon CSR | Suzlon