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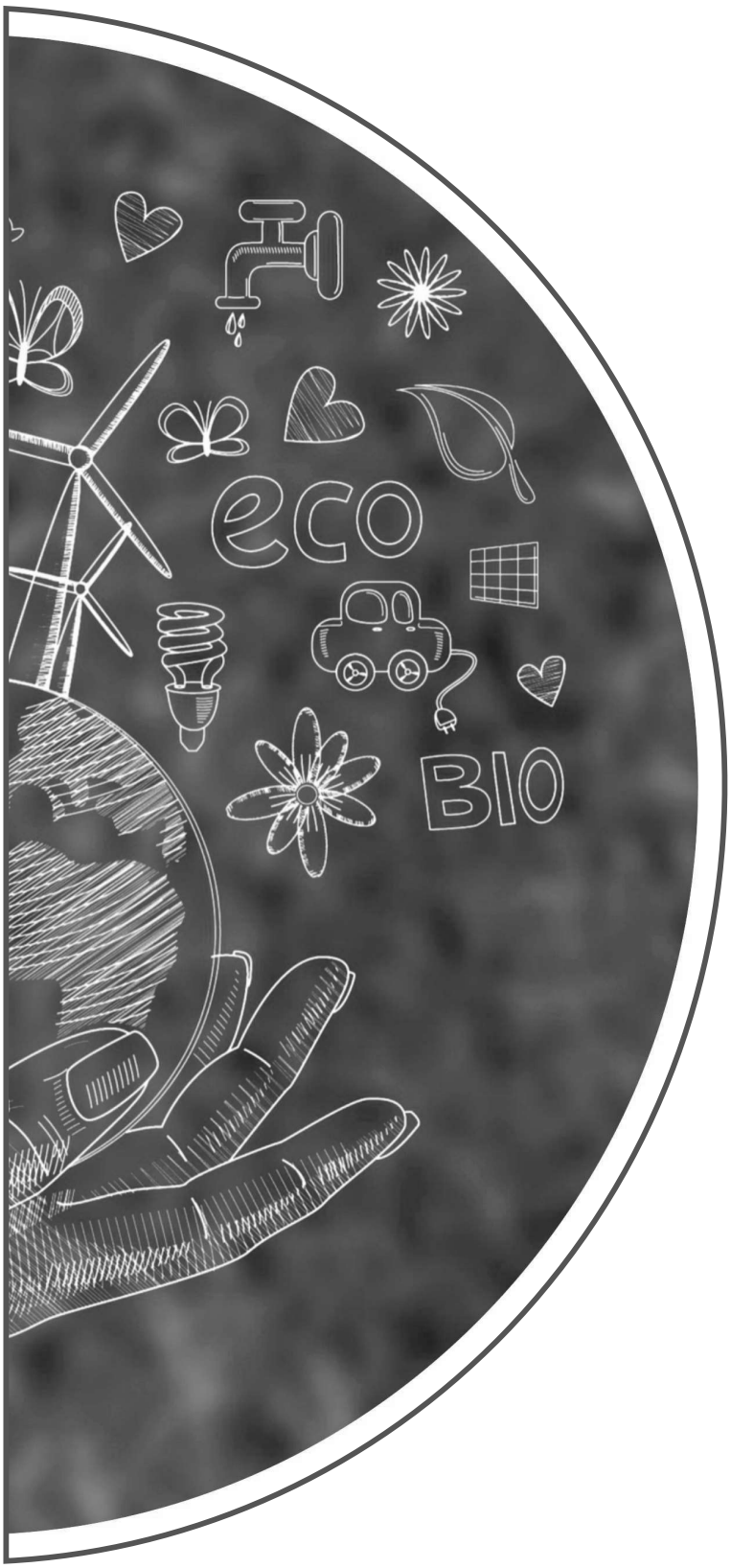

Transforming Business in ESG (Environmental, Social, Governance)

Proceedings of
GCeMP2k22
14th International Conference on Emerging Management Practices on Transforming Business in ESG (Environmental, Social, Governance)

Mahendra Sharma
Sourbhi Chaturvedi
Hiren Patel
Jayesh Patel
Nirav Halvadia
Editors

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02 A Study on Factors Influencing Rooftop Solar Installation for Electricity Generation in Residential Premises

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Abstract

Rooftop solar is a photovoltaic system with electricity-generating solar panels installed on the roof of a home or business. For achieving target of 100 GW solar power generations by 2022, it is important for Indian government to motivate Indian citizen for installing solar rooftop at their homes. For understanding and motivating Indian citizen for electricity generation by solar rooftop at their homes, it is important to study various factors which positively influence them for it. The 200 households were asked to rate each item on the questionnaire based on their level of influence, and six factors were discovered that influence Indian citizens' decisions to install rooftop solar at their homes. These factors were Support for 3N, Renewable, More and Independent Electricity Usage (RMI), 2S: Smartness and Status, Influencer, Investment and Cost Saving with Better Future. Understanding of these factors useful to Indian government and rooftop solar provided companies in making effective advertisement campaign or marketing strategy for increasing usage of solar electricity by rooftop solar.

Keywords: *Green Energy, Solar Energy, Rooftop Solar, EFA.*

Introduction

Solar power is a growing industry in India. India's solar installed capacity reached 25.21 GW at end of year 20181.[1] In 2015, new target for solar capacity was set by Indian Government and it was 100 GW by 2022.[2] This 100 GW target includes 40 GW solar energy generations from solar rooftop. Rooftop solar power currently accounts for 3.4 GW, with 70% of that being industrial or commercial.[3] Solar rooftops are solar panels that are installed on the roofs of commercial, institutional, or residential structures. They transform the sun's light energy into electrical energy by capturing it. Solar rooftop photovoltaic system is another name for this configuration. It generates a clean, environmentally beneficial kind of energy that does not emit any pollutants or dangerous gases.

It is very tough to achieve 100 GW solar power generation target by 2022 without support of Indian citizen.[3] For achieving this target, it is important for Indian government to motivate Indian citizen for installing solar rooftop at their homes.

Indian government has launched many schemes with subsidy to encourage Indian citizen for installing rooftop solar but usage of rooftop solar for getting electricity by Indian citizen is still less.

For understanding and motivating Indian citizen for electricity generation by solar rooftop at their homes, it is important to study various factors which positively influence them for it. No research has been conducted on identifying influencing factors for installation of solar rooftop at home in India.

Based on the understanding of the key influencing factors for installation of rooftop solar at homes, Indian government and rooftop solar provided company may make good advertisement campaign or marketing strategy for increasing usage of solar electricity by rooftop solar. Knowledge of influencing factors also helps to employees of government or private firms to convince Indian citizen for installation of rooftop solar at their homes. But for that, firstly, it is important to explore factors which influence installation of rooftop solar. There are very few efforts devoted to the area of exploring factors influencing rooftop solar installation for electricity generation in residential premises. This study identifies important influencing factors for installation of rooftop solar in residential premises.

Literature Review

Many factors influence consumer purchasing behaviour, and marketers have little direct control over these elements. Government and private enterprises can build a strategy, a marketing

[1] https://sustainabledevelopment.un.org/partnership

[2] https://india.mongabay.com/2021/06/

[3] https://www.ibef.org/industry/renewable-energy.aspx

message, and advertising campaigns that are more efficient and in accordance with the demands and ways of thinking of their target consumers by recognising and understanding the factors that impact customers of rooftop solar. It is also beneficial to them for understanding customer requirement and increasing sales. For exploring factors which are influencing installation of rooftop solar at home, literature review was conducted in the areas of consumer buying behaviour, buying behaviour for green products and buying behaviour for green energy.

Generating electricity using rooftop solar is new technology for Indian people. According to Veblen *et al*. (1992), the adoption of innovative products is frequently motivated by social advantages. Any product's social and communicative worth is greatly dependent on its social visibility and ability to be associated with superior organisations. Peer pressure encouraged investors to focus their investments on green energy technology, according to Masini and Menichetti (2013). According to Mignon and Bergek (2012), economic gains were not the only factor affecting people's decision to use green energy; social norms and values also played a role. As per Faiers *et a*l. (2007), Societal factors creates an impact on consumer choice for energy efficient products. Indian citizen can get social benefits like status, getting respect from others, establishing self as an initiator, showing own smartness to society, etc. by using rooftop solar at home.

Emotions play a vital part in the purchase process at every level. The emotional impact of green goods purchases outweighs the functional benefits of green items. According to Wüstenhagen and Bilharz (2006), one of the reasons people buy green electricity at premium prices is to feel better about themselves. The satisfaction derived from contributing to the environment is a major motivator for using green energy (Nunes and Schokkaert, 2003). By contributing to society, nation and the environment, customers of green power receive emotional benefits (Hartmann and Apaolaza-Ibáez, 2012). Consumers perceive acting in an environmentally friendly manner as part of a modern lifestyle and reputation (Grier and Deshpande, 2001). They will also be viewed as out-of-date in society if they do not act in an environmentally sustainable manner. Usage of green energy shows concern of consumers for environmental conservation (Park and Ha, 2012; Oliver and Lee, 2010). Indian citizen can get emotional benefits like contributing in society, nation or environment by installing rooftop solar.

Government incentives and subsidies for green energy creates an impact on its usage (Muñoz *et al*., 2009; Tsoutsos *et al*., 2009; Sovacool and Ratan, 2012). Conditional factors like shortage of electricity, electricity cut, discounts, grants, incentives, subsidies for using green energy motivate customers to invest for it (Muñoz *et al*., 2009; Tsoutsos *et al*., 2009; Sovacool and Ratan, 2012, Caird *et al*., 2008).

When consumers interact with others and gather information about products, they realise the importance of those products (Oliver and Lee, 2010). Consumers are impacted by the opinions of others when it comes to product selection and usage (Bearden and Rose, 1990). Because of that, decision regarding installation of rooftop solar can also influenced by friends, relatives, peer groups, past experience, etc.

Consumers who are rational always try to maximise benefits at the lowest cost. Customers' decisions about green energy use were influenced by the savings on electric bills, and the reduction of harmful waste and pollution in the long term (Ibáñez *et al*., 2006; Prakash, 2002). Price and saving are the important factors for usage of green energy. In a study by Kaenzig *et al*. (2013), they examined how different attributes of green energy are able to create value for customers, and concluded that consumers can pay a premium for using green energy.

Research Methodology

A list of items related to factors influencing rooftop solar installation decision were generated using qualitative research and literature review in area of customer values, buying behaviour for green products and buying behaviour for green energy. In-depth interviews with senior managers of renewable energy businesses and academicians were used in this qualitative study. Total 30 items were generated related to factors influencing rooftop solar installation decisions.

The scale items were rated on a Likert scale, where 1 indicated "not at all influential", 2 indicated "slightly influential", 3 indicated "somewhat influential", 4 indicated "very influential" and 5 indicated "extremely influential". Responses were collected from 200 households which are interested in installation of rooftop solar. In the questionnaire, each statement was rated in relation to its level of influence by respondents.

Data collected from this scale were analysed using exploratory factor analysis (EFA) and principal component analysis (PCA) using Varimax rotation.

Cronbach's alpha was used to measure reliability (Cronbach, 1951). The lower limit of acceptability is 0.6 Cronbach's alpha according to Hair *et al*. (2010). The combined scale reliability for the 30 was 0.932. Having a high alpha value suggests that the reliability of the scale and its convergent validity were both met (Parasuraman *et al*., 1991).

For finding out appropriateness of factor analysis, KMO statistic was used. Here, the value of KMO statistic was between 0.937 which indicates that with given data, factor analysis is appropriate. The hypothesis that the variables are uncorrelated in the population was tested by applying Bartlett's test of sphericity. In other words, the population correlation matrix represents an identity matrix. Factor analysis should be questioned if this hypothesis cannot be rejected. Here, Significance value for Bartlett's Test of Sphericity is 0.0. It was concluded that the variables are correlated in the population.

Total six factors were explored using exploratory factor analysis. 58.911% of the total variance was explained by these factors (Table 1), which is very much acceptable for the Principal Component Varimax rotation factor loading procedure of 50% (Johnson and Wichern, 2002). Interpreting factors requires the determination of which factor loadings are to be taken into account.

Table 1: Total Variance Explained

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %
1	11.458	35.805	35.805	11.458	35.805	35.805	6.040	18.877	18.877
2	2.284	7.137	42.941	2.284	7.137	42.941	4.623	14.448	33.325
3	1.817	5.679	48.620	1.817	5.679	48.620	2.569	8.028	41.353
4	1.375	4.296	52.916	1.375	4.296	52.916	2.550	7.970	49.323
5	1.087	3.397	56.312	1.087	3.397	56.312	1.680	5.250	54.573
6	1.024	3.198	59.511	1.024	3.198	59.511	1.580	4.938	59.511

Extraction Method: Principal Component Analysis.

The criterion given by Hair *et al.* (2010), for sample of 150 respondents, a factor loading of 0.4 and above has been considered significant. All items related to factors influencing Rooftop Solar installation decision had factor loading more than 0.4 (Table 2). Grouping of items were made using factor loading values.

Table 2: Rotated Component Matrix

	Component					
	1	2	3	4	5	6
S1	**0.748**	0.027	0.032	0.152	–0.268	0.355
S2	0.183	**0.745**	0.104	0.225	0.054	0.024
S3	**0.702**	0.088	0.025	0.099	–0.042	0.343
S4	0.137	**0.739**	0.118	0.254	0.059	0.146
S5	**0.699**	0.234	–0.077	0.112	0.229	0.037
S6	0.142	**0.702**	0.126	0.072	0.149	0.12
S7	**0.597**	0.358	0.118	0.133	0.122	0.048
S8	0.308	0.324	0.195	0.12	**0.53**	0.080
S9	**0.642**	0.212	0.302	0.079	0.268	0.019
S10	**0.716**	0.097	0.14	0.056	0.299	–0.024
S11	**0.567**	0.206	0.133	0.239	0.128	–0.062
S12	**0.667**	0.333	0.179	0.034	–0.059	–0.109
S13	**0.733**	0.206	0.069	0.112	0.264	0.027
S14	**0.542**	0.420	0.365	–0.046	0.156	0.085
S15	0.24	**0.588**	0.244	0.098	0.265	0.079
S16	0.329	**0.73**	0.162	0.103	0.09	0.05

S17	–0.084	0.123	**0.628**	0.086	0.087	0.472
S18	0.366	0.078	**0.528**	0.338	–0.179	0.192
S19	0.085	0.149	**0.542**	0.298	0.199	0.055
S20	0.153	0.284	**0.358**	0.323	0.285	0.148
S21	0.392	0.237	**0.502**	0.120	0.344	–0.135
S22	**0.514**	0.368	0.479	0.065	–0.057	0
S23	0.26	**0.546**	–0.009	0.025	0.122	0.254
S24	0.529	**0.577**	0.204	–0.023	0.129	0.026
S25	0.475	0.356	**0.508**	0.096	0.104	0.019
S26	0.053	0.097	0.324	**0.699**	–0.189	0.024
S27	0.158	0.203	–0.049	**0.725**	0.207	0.122
S28	0.039	0.175	0.096	–0.026	0.079	**0.789**
S29	0.208	0.265	0.239	0.075	0.348	**0.428**
S30	0.294	0.336	0.087	0.078	**0.583**	0.315

At the end of factor analysis, total six factors were explored with 30 items. Proper names were given to all factors after analysing all the items under each factor.

Table 3: Factors Influencing Installation Decision for Rooftop Solar

Factor No.	Item No.	Factor Name
Factor 1	S1, S3, S5, S13, S9, S10, S11, S12, S7, S14, S22	Support for 3N (Nation, Nature and National progress)
Factor 2	S23, S24, S2, S4, S28, S15, S16	Renewable, More and Independent Electricity Usage (RMI)
Factor 3	S17, S18, S19, S20, S21, S25	2S: Smartness and Status
Factor 4	S26, S27	Influencer
Factor 5	S8, S30	Investment
Factor 6	S28, S29	Cost Saving with Better Future

Findings and Managerial Implications

This research explored important factors which influence installation decision of rooftop solar. These factors are Support for 3N, Renewable, More and Independent Electricity Usage (RMI), 2S: Smartness and Status, Influencer, Investment and Cost Saving with Better Future.

Supporting nature and positive perception of electric users towards nation, nature and national growth influences installation decision for rooftop solar. Positive perception of electricity users towards reduction in pollution, CO_2 level and global warming influences decision about installation of rooftop solar. Positive attitude about nation, national growth and future

generation also influences decision about installation of rooftop solar. Smartness and Status create an impact on consumer choice for rooftop solar installation. Indian citizen can get social benefits like status, getting respect from others, establishing self as an initiator, showing own smartness to society, etc. by using rooftop solar at home. Electricity users prefer installation of rooftop solar because they want to prove themselves very smart compared to others in society by investing funds available for a productive long-term use, generating electricity even when not at home and using extra space available on terrace for revenue and electricity generation. Electricity users prefer installation of rooftop solar because they want to show their status by proving themselves as front-runner for accepting a new technology and by setting example for others. Some household consumes more electricity because they use more electrical instruments or they use electrical instruments with heavy electricity consumption. These type of household prefer installation of rooftop solar because they want high and independent use of electricity. Positive perception towards usage of renewable energy also influences decision regarding installation of rooftop solar. Consumer behaviour is influenced by the opinion of others for their product choices and usage (Bearden and Rose, 1990). Because of that, decision regarding installation of rooftop solar can also influenced by friends and acquaintances. Secure future with cost saving is an important factor related to installation of rooftop solar decision. Household prefer installation of rooftop solar at their home because they want to reduce current and future electricity bill and cost. People consider spending on installation of rooftop solar as an investment because it will generate income for many years. Installation of rooftop solar at home reduces dependency on power companies, and people become independent and self-sufficient in electricity generation. Shortage of electricity and electricity cut creates an impact on decision regarding installation of rooftop solar (Caird *et al*., 2008) and installation of rooftop solar makes electricity users' independent or less dependent in matter of electricity. So, investment and independence are important factors for decision regarding installation of solar rooftop.

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Appendix

The list of items influence decision regarding installation of rooftop solar is given below:

Table: Items Influencing Rooftop Solar installation Decision

Sr. No.	Name of Item	Sr. No.	Name of Item
S1	I want decrease in global warming.	**S16**	I want to take full benefit of use of electrical appliances installed at home.
S2	I want luxury of using the existing electrical equipments and assets with ease.	**S17**	I want to invest money in productive long-term use.
S3	I want decrease in environment pollution.	**S18**	I want to establish an example for others.
S4	I want to use more electric power.	**S19**	I want to use terrace space efficiently and effectively.
S5	I want to prevent release of CO_2 and other harmful gases.	**S20**	I want to generate electricity even when not at home.
S6	I want to use electrical equipment without any tension about increase in electric costs and bills.	**S21**	I want to be the front-runner for accepting a new technology.
S7	I want to contribute in construction of a solar nation.	**S22**	I want to establish an example for future generation.
S8	I want to become less dependent on the company providing electricity.	**S23**	I want to take benefit of government subsidy.
S9	I want to use successful new technology.	**S24**	I want to contribute to the cause of using renewable energy for a better future.
S10	I want to become a supporter of the concern of national interest.	**S25**	I want to establish myself as an initiator in the society of having accepted a new technology.

S11	I want to feel good by doing good.	**S26**	I have received strong recommendation by friends and acquaintances.
S12	I want to become contributor in country's growth.	**S27**	I want to take the benefit which was obtained by a friend.
S13	I want to support in generating renewable energy.	**S28**	I want to get cost savings by reduction in electricity bill.
S14	I want to support government policy for solar energy.	**S29**	Prevent future loss due to increase in electricity price supplied by power companies.
S15	Seeking energy independence and being self-sufficient in electricity generation.	**S30**	I want long-guaranteed return by investing in technology.