

On solar power project facilitators and their tribulations in West Bengal: an empirical study

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Abstract

Objectives: To address the major obstacles and hindrances confronted by the solar power facilitators in the state of West Bengal, India to assure sustainability of energy.

Methods/Statistical Analysis: The period of our study spans for six years beginning from January, 2012 to December 2017 and we have utilized Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. Principal Component Analysis by applying Garrett's ranking technique has been also used to achieve the objectives of our study.

Findings: The expansion of the production of solar power has not achieved the anticipated dimension in India because of a few difficulties in its formative way. Nonetheless, there are a number of problems faced by the solar power facilitators that hinder the advancement of the solar business. Non-availability of financiers, not getting levy in due time, higher installation charges, and delay in payment of subsidies and elevated GST on components are considered to be the major obstacles that hinder the path of the growth of solar power business in the state of West Bengal. Rotated Component Matrix has extracted 4 factors out of 11 variables that have been utilized in our study. These 4 factors explained 61.03 % of the variability the obstacles faced by the facilitators.

Application/Improvement: This study can act as a policy document on the part of the government, to initiate plans and strategies for the growth of the solar power industries.

Keywords: Empirical, Facilitators, Solar Power Project, Tribulations, West Bengal.

1. Introduction

India, the third biggest power maker on the planet, is now being confronted with different limitations in the development strides. The main requirement is a deficiency of power that has been extensively vanquished by the endeavors of the Government. However, the increasing urbanization, widespread access to power, Government push for foundation advancement and neighborhood fabricating are representing a crisp interest for power. Besides, the request would rise while development and provincial territories are associated. Thusly, limit expansion remains an overwhelming test for the administration [1]. So as to guarantee comprehensive vitality, different elective vitality sources ought to be advanced; anyway, the accessible energies are either occasional or place-bound. Solar energy is the main lasting source in India as it is situated in the tropical zone of the earth and gets 4-7 kWh of sun oriented radiation per sq.m every day [2].

The Indian Government and the State Governments perceived the noteworthiness of solar power by starting their own solar power strategies. The Jawaharlal Nehru National Solar Mission (JNNSM) was propelled on eleventh January 2010, with a mission to fervently focus on conveying 20 GW of on-lattice and 2 GW of an off-matrix framework by 2022 out of three stages [3]. Be that as it may, now the objective has been expanded by multiple times, with a target to achieve 100 GW by 2022. The objective includes 60 GW through on-ground solar power activities and 40 GW from decentralized framework associated (sun based housetop trade)/solar farm [4]. The Indian Government's motivating plans contains Central Financial Assistance (CFA), immediate and backhanded tax reductions, feed-in-tax, Renewable Energy Certificate (REC), age-based impetus and reasonability hole subsidizing [5]. The West Bengal Government had likewise thought of a keen Solar Energy Policy in 2014, with a plan to accomplish 3 GW of solar power by 2017, of which 1.5 GW of utility-scale, 1.15 GW and 0.35 GW are from REC and sun based rooftop top separately (WBREDA, 2014).

The West Bengal Government additionally offered different supporting estimates; for example, sponsorship, feed-in-levy, Solar Purchase Obligation (SPO), net meter and exception from different cost (need to mention the year). Notwithstanding, the achievement of the objective is a long way from the truth as there are different obstructions in front of facilitators, that largely affect solar power production. Facilitators are the associating join between the legislature and the clients to put into practice solar power business. Notwithstanding their assuming a significant role in putting into practice of solar power trade, there are a number of problems which hinder the development of the solar power business. The Central Government and the State Government sponsorships are spread through the State nodal organization named West Bengal Renewable Energy Development Agency (WBREDA). Postponement in the settlement of subsidies makes the clients to be held up for quite a while, which makes a negative impression about solar power. The different limited time measures referenced in the solar power arrangement, for example, net meter and SPO, are not being executed appropriately. The attention to the present financial aspects of solar power needs among different partners [6]. Solar power organization would confront a noteworthy monetary problem until the Reserve Bank of India (RBI) pronounces solar division as a need part to loan or the spotless vitality is dealt with independently from power [7]. Most importantly, inaccessibility of framework association puts the engineers in a bad position to transmit the created power from the solar ranch. These are the different methods of the reasoning behind the log jam of solar power business, in this way the facilitator finds the business dubious. Therefore, this examination has been completed to deal with the obstructions of solar power facilitators in order to urge them to take up a functioning job in bridling solar power.

The solar power facilitators are the associating bond between the legislature and the clients to install solar power business. Regardless of their normal work of installing solar panels, the facilitators also assume an essential job in the organization of solar power business, although, there might be some dilemma, which could impede the development of the solar power business. The Indian Government and the Government of West Bengal sponsorships are being delivered through the State nodal office named West Bengal Renewable Energy Development Agency (WBREDA). Postponement in the settlement of appropriation makes the clients sit tight for quite a while, which makes a negative impression about solar power. The different special measures referenced in the solar power approach, for example, net meter and SPO, are not being executed appropriately. The familiarity with the present financial aspects of solar power are lacking among different interested parties [6]. Solar power organization would confront a noteworthy money related problem until the Reserve Bank of India (RBI) pronounces solar power division as a need area to give loan or the clean energy is dealt with independently from power [7]. Most importantly, due to the less accessibility of network association, the engineers face problems to transmit the power from the solar firm. These are the different difficulties behind the deceleration of solar power business and in this manner the facilitator finds the business questionable. Thus, in this paper an analysis and assessment has been done to identify the problems and techniques to deal with those hindrances that are being confronted by the facilitators engaged in generation of solar energy in order to motivate them to take up a functioning job in utilizing solar power.

We believe that this paper can act as a policy document on the part of the government, to initiate plans and strategies for the growth of the solar power industries in the state of West Bengal as well as in country as a whole. The remainder of the article embraces four areas: segment 2 introduces short records of the procedure which incorporates prior examinations regarding solar power strategies, data source, the time period of the investigation and the measurable statistical instruments utilized in the present study. Empirical structure of the study is presented in section 3 and the output of the investigation is talked about in segment 4. Segment 5 presents the conclusion and effects of the policy to overcome the hindrances faced by the solar power facilitators.

2. Literature survey

From the literature review it has been observed that not many researches in India has been conducted by the experts and researchers in this area to see the effectiveness of solar power policy and limited time measures as well as for the arrangement of the uplift of solar power business as it is offered by the Indian Government. Therefore, it is comprehended from the above that there is no exhaustive examination from the point of view of facilitators.

In [8] discussed the advantages and disadvantages of solar energy technology. They have pointed out that incentives and rebates are necessary for the uplift of the solar energy market because the overall cost of producing solar power remains high regardless of a rapid decrease in solar energy innovation cost. They have concluded that though solar energy technology has some problems, solar energy innovation would become one of the most encouraging sustainable energy sources to meet the future worldwide energy demand. In [9] examined the present scenario of conventional energy sources and the hindrances regarding the improvement of solar power and wind power technology in India. They have concluded that the synergy between solar power and wind power would be the best choice to dispose of regular energy sources in India in the coming days.

In [10] did a comparative study on various solar drying i.e. direct, indirect, the mixed mode of solar dryer, for different uses in industrial as well as agricultural sectors. The investigation has demonstrated that solar dryer would be the best option to replace the conventional energy-based drying system. They have concluded that the industrial sector is using less solar drying technique than the agricultural sector. They have also suggested that out of three solar dryers, mixed mode solar dryer technology is better than the rest of solar dryer techniques. In [11] investigated about the Solar Energy from Sunlight and talked about their future pattern and perspective and also attempted to examine solar panel types; underline the different applications and technique to elevate the advantages of solar energy. They have concluded that solar energy has more advantages contrasted with different types of energy form like fossils power and petroleum deposits because solar energy can give electricity for 24 X7 even on overcast days and during the night and it can also be used for battery backup. In [12] studied the influence of solar power energy storage in the household, on the reduction of utilizing conventional energy. They have shown that if the solar energy could storage in a typical battery system then it would be able to cut down high power demand by 8-32% and high power injections by 5-42%.

In [13] discover a new system of solar heating with solar radiation and electricity. They have done the research study in Porsgrunn City in south of Norway. They have used a passive solar building house where energy can be stored by using phase change materials which are mounted on the floor and discharge the warmth when the temperature of the house diminishes. They have found out that a solar heating system which is working with electricity can give an adequate temperature to the house in winter time. The volume of energy we are getting from the sun is thousands of times better than all the commercial energy sources of this green planet. The best source of energy from the sun is not gaining more familiarity due to the huge amount of primary investment, high cost per unit of solar power and less convertibility of sun ray into solar power [14]. There is a high level of arrangement and administrative vulnerability and no inter-institutional synchronization, which diminishes the willingness of financial promoters in wandering into clean vitality [15]. In addition, unambiguous arrangement targets, purchaser mindfulness and societal contribution, the institutionalization of innovation; and innovative work are crucial to dispose of non-monetary obstructions [16]. In India, the group sunlight based power approach condition has made a ton of equivocalness for the task designers to pick a correct plan to stop their venture [17]. The primary period of The Jawaharlal Nehru National Solar Mission (JNNSM) could not perform up to the desires; anyway, the state level arrangements have performed well to fill the hole. Generally, permeability of solar power has been improved subsequent to changing the objectives of the second period of JNNSM to include more urban areas under the coverage of solar power distribution [18].

It is felt that much stronger association is needed between the Central Government and State Government to have unified and coherent solar power vision for India [19]. A great deal of consideration must be paid for making solar power generated house to moderate the hazards and risk of developers and investors. The Government of India ought to guarantee a simple method for getting clearances, land procurement and arrangement of a perfect vitality store to help solar power projects. Moreover, the Government of India need to enhance small size off-grid and rooftop projects alongside high megawatt solar power ventures to improve solar power generation capacity [7]. Moreover, government needs to give tax incentives and rebates to solar power projects and low-cost base at the primary level is necessary to flourish solar power business in India. Furthermore, to have a successful solar power business, towering commitment and better understanding of local dynamics are needed [20]. The solar power energy generation system in India has not achieved the normal dimension attributable to a few difficulties in its formative way [21]. Photovoltaic Levelised Cost of Electricity (LCOE) keeps on turning down, network power cost proceeds to take off and producing knowledge advances, therefore photovoltaic can bite by bit transform into a monetarily valuable wellspring of power.

In this manner, with the execution of the proposed self-continuing financing plan, it is very much realistic to acquire framework equality in certain topographical locales [22]. More strong correlation and association is required among industry, foundation and the administration to pull in increasingly talented specialists to this industry so as to keep the development direction in a right path. In addition, broad arrangements with respect to clean energy ought to be made open to walk India towards comprehensive development.

3. Research design

This study unravels the viewpoint of solar power facilitators on solar power business as well as the facilitators who are managing solar photovoltaic projects in the state of West Bengal. The particulars of the facilitators were gathered from WBREDA under the register of facilitators enrolled in 2013. As the list was published by the WBREDA, data have been collected through the census survey method. The published list of facilitators by WBREDA consists of 293 facilitators out of which 25 manufacturers and 9 integrators are situated outside West Bengal. Apart from 25 manufacturers, 9 outsiders, and 18 defunct integrators, only 241 integrators have taken as the sample size in the present study. After communicating all the integrators only 133 integrators have given a complete response. So ultimately the sample size of this study becomes 133. This study plans to uncover the obstructions confronted by the facilitators engaged in managing solar power venture. Consequently, this study would be helpful for the administrative policy makers to roll out essential improvements to enhance the generation of solar power in West Bengal. The duration of the present study spans for six years from January, 2012 to December 2017 and we have utilized Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity. Principal Component Analysis by applying Garrett's ranking technique has been also used to achieve the objectives of our study.

The facilitators that have been selected in the study can be classified into three major segments: integrator, promoter and Engineering Procurement & Construction (EPC). The solar power projects are being installed by the Integrators at an agreed upon cost, which the client has to bear. Promoters contribute their very own cash to run the business in order to pitch the created capacity to the distributor organization or a private firm at a pre-decided cost. EPC functions similar to that of an establishment of promoters, which incorporates the undertaking as a developer.

4. Results and Discussion

1. Brief outline of the solar power facilitators

Table 1 demonstrates the statistic profile of the facilitator uncovered that 84.21% of the respondents are promoters, 51.88% fit in the age cluster of 40-49 years, 23.31% are graduate engineers, and 58.65% had related knowledge on renewable energy and environmentally friendly power projects.

Table 1. Brief outline of the solar power facilitators

Type of Facilitators	No. of Respondent	Percentage
Promoters	7	5.26
Integrators	112	84.21
EPC	14	10.53
Age	No. of Respondent	Percentage
Upto 29 years	06	4.51
30-39 years	25	18.80
40-49 years	69	51.88
50-59 years	33	24.81
Education Level	No. of Respondent	Percentage
HSC	02	1.50
Diploma	21	15.79
ITI	03	2.26
Engineering	31	23.31
Under graduation	21	15.79
Post graduation	55	41.35
Doctorate	00	00.00
Others	00	00.00

Experience in Renewable Energy	No. of Respondent	Percentage
Yes	78	58.65
No	55	41.35
Total	133	100

Source: Field Survey, Results computed

2. Obstacles faced by the facilitators

The solar power facilitators in the state of West Bengal are experiencing multiple and different obstacles which deter the advancement of the solar power business in the state. It is expected that the solar power business would pick up driving force while the obstructions of the facilitators are need to be solved. From Table 2, it is found that the main problems faced by facilitators are: non-availability of financiers (4.15), not getting levy in due time (4.01), lofty installation charges (3.99), not getting subsidies in due time (3.82), elevated GST on solar power components (3.69), inadequate client consciousness (3.66), inappropriate execution of strategies (3.59), interruption in getting permission (3.51), high market antagonism (3.25), insufficient profit (3.19) and lack of support for manufacturing solar panel and its components (3.11)

Table 2. Major obstacles of the solar power facilitator in West Bengal

Major Obstacles	SA	A	N	DA	SDA	Mean Score	Rank
Non-availability of financiers	91	29	7	6	-	4.15	I
Not getting levy in due time	98	11	16	8	-	4.01	II
Lofty installation charges	89	33	6	5	-	3.99	III
Not getting subsidies in due time	95	19	10	9	-	3.82	IV
Elevated GST on components	60	25	36	15	7	3.69	V
Inadequate client consciousness	85	31	13	4	-	3.66	VI
Inappropriate execution of strategy	101	16	10	6	-	3.59	VII
Interruption in getting permission	59	41	13	9	11	3.51	VIII
High market antagonism	47	46	30	5	5	3.25	IX
Insufficient profit	39	41	32	12	9	3.19	X
Lack of support for manufacturing solar panel and its components	40	31	31	21	10	3.11	XI

3. KMO & Bartlett's test

Kaiser-Meyer-Olkin (KMO) Test is a measure of how suited our data is for Principal component analysis. The test measures sampling adequacy for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. The lower the proportion, the more suited our data is to Principal component analysis. In most academic and business studies, KMO & Bartlett's test play an important role for accepting the sample adequacy. While the KMO ranges from 0 to 1, the world-over accepted index is over 0.6. Also, the Bartlett's Test of Sphericity relates to the significance of the study and thereby shows the validity and suitability of the responses collected to the problem being addressed through the study. For Principal component analysis to be recommended suitable, the Bartlett's Test of Sphericity must be less than 0.05.

Test hypothesis:

H_0 : There is no statistically significant interrelationship between the obstacles faced by the facilitators.

H_1 : There may be a statistically significant interrelationship between the obstacles faced by the facilitators.

The obstacles that the solar power facilitators are confronted with are categorized into eleven segments. All the eleven obstructions might not have the same characteristics; a portion of these obstacles might be interconnected. Thus, the things are put together as per the resemblance of the estimations. The fundamental reason for running Principal component analysis is to trim down the number of obstructions utilizing the connection between them. The KMO test inspects the sufficiency of the sample. The estimated value of KMO presented in table number 3 is 0.801 which demonstrates that the sample is adequate and we may proceed with the Principal Component Analysis.

At 95% significance level $\alpha = 0.05$ the p-value (Sig.) of $.000 < 0.05$, therefore the Principal component analysis is valid and the H_0 is rejected which implies that there may be statistically significant interrelationship between the obstacles faced by the solar power facilitators. Here, the estimated value of Chi-square is 534.515 with 147 degrees of freedom, which is significant at 0.05 significance level. The KMO statistic of 0.801 is also greater than 0.50, therefore, Principal component analysis is considered as a suitable method for advance investigation. Table 3 shows the results of the KMO test and Bartlett's test of Sphericity.

Table 3. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.801
Bartlett's Test of Sphericity	Approx. chi square
df	534.515
Significance	147
	.000

4. Eigen values

The underlying segments are the quantities of the factors utilized in the Principal component analysis. Nonetheless, all the 11 factors will not be held. In the present study just the 4 elements will be separated by joining the applicable factors. The Eigen values are the differences of the components. The all out segment contains the Eigen values. The principal factor will dependably represent the most change and henceforth have the most astounding Eigen values and only those components with Eigen values more than 1 will be selected. The following element will represent as a significant part of the left over change as it can and a similar will proceed till the last factor. In the study the first 4 factors explain 61.03% of variance which can adequately clarify each of the eleven obstacles. In this manner, the four obstacles alone have been chosen for further examination. The rotation sums of the squared loading represent the distribution of the variance after the varimax rotation with Kaiser Normalisation. The varimax rotation tries to maximize the variance of each of the factor. In this manner, the four obstacles alone have been chosen for further examination. Table 4 represents the Eigen Values by explaining the total variances.

Table 4. Eigen values - total variance explained

	Initial EigenValues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)
1	4.958	23.667	27.897	4.958	23.667	27.897	5.301	30.285	19.785
2	3.436	19.658	35.235	3.436	19.658	35.235	4.265	28.445	27.582
3	2.125	18.987	48.587	2.125	18.987	48.587	3.652	24.325	38.957
4	1.854	11.005	61.034	1.854	11.005	61.034	2.899	14.687	61.034
5	0.885	10.369	66.857						
6	0.771	9.681	72.081						
7	0.678	7.897	77.594						
8	0.607	6.589	81.362						
9	0.505	5.698	85.021						
10	0.489	5.005	89.779						
11	0.331	4.025	95.253						

Extraction Method: Principal Component Analysis

5. Rotated component matrix

The Rotated Factor Matrix speaks to the turned factor loadings, which are the connections between the factors and the variables. The factor segment speaks to the turned components that have been extricated out of the all-out factor. These are the center variables, which have been utilized as the last factor after information decrease. As per the gathering of the variables, each gathering of elements is named which will speak to the gathered factor and speaks to the components. On the basis of Varimax Rotation with Kaiser Normalisation, 4 factors have been extracted. Every factor is make up of variables which has factor loadings more than 0.5. 11 variables are merged into 4 factors.

These 4 factors are extracted from 11 variables that have been utilized in our study. These 4 factors explained 61.03 % of the variability the obstacles faced by the facilitators. This explains over three-fourth of the variability. From Table 5, it is clear that the first component consists of five obstacles and the rest components consists two obstacles each. The factors can be grouped based on the obstacles involved.

Table 5. Rotated component matrix

Obstacles	Components			
	1	2	3	4
Not getting subsidies in due time	0.887			
Lofty installation charges	0.713			
Not getting levy in due time	0.658			
Non-availability of financers	0.614			
Elevated GST on components	0.549			
Inappropriate execution of strategy		0.759		
Interruption in getting permission		0.483		
Lack of support for manufacturing solar panel and its components			0.890	
High market antagonism			0.617	
Insufficient profit				0.715
Inadequate client consciousness				0.528

5. Suggestions and Conclusions

Solar power has gained its momentum after 2008 on becoming an integral portion of the eight missions picked up by National Action Plan on Climate Change (NAPCC) to control carbon emission in India [23]. Though there are different troublesome factors which make the facilitators less interested toward solar power business, the Indian Government has taken various steps to enhance the generation of solar power. But, if these advisory measures are not executed properly then they would become distressing factors.

In most of the developed countries, the direct subsidy is the most important instrument to improve the solar power business. However the facilitators do not get the direct subsidy on time, along these lines the majority of the facilitators need the administration to withdraw sponsorship as it has a negative effect about solar based power. Hence, the Government needs to streamline the payment of subsidies in connection with solar photovoltaic materials in order to cheer up the solar power project facilitators.

A couple of provisions referenced in the strategy are still in the record. Nevertheless the Government need to take initial steps for implementing a complete policy to reduce the problems associated in the solar power market. Installations of net meters are very much essential to put surplus solar power generation to the grid. If a promoter has net meter facility, he can bank up the excess power generation to grid for twelve months and this excess power than can be distributed in many places by the West Bengal State Electricity Distribution Company Limited (WBSEDCL).

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