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A Study of Problems of Implementing Authority towards Solar Roof Top Panel in Haryana

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Abstract *: Energy is necessary for both human survival and the development of human societies. With the centuries-long advancement of human society, there is no doubt that the need for energy has been steadily growing. The fastest rise has been recorded in the years after Industrial Revolution when fossil fuels were put to multiple purposes like electricity and engines. To encourage the usage of solar panels and solar energy a new scheme is designed by the central government that assisted in the development of solar premises in India. SRISTI, a flagship program under India's National Solar Mission, seeks to give a push to the installation of grid connected rooftop solar power plants in support of renewable energy revolution. In Haryana, the program has been amalgamated with state-level sops to promote solar in the residential and the agricultural verticals. This paper assesses the challenges faced by implementing authorities in six district of Haryana. It is concluded from the study that various implementing authorities have to face operational, financial, supply chain and technical problems while implanting solar roof top panels. There is significant difference in the respondent's operational problems and Financial and supply chain problem based on the registration and agency of the respondents but reject the hypothesis based on registration of the respondents, also for technical problems. The study suggested that the implementing authorities should keep high qualities part for replacement, drone based helioscope analysis of sites for installation of solar roof top panel and high speed internet should be used to cope up these challenges.*

Keywords:*, Rooftop Solar, implementing agency, DISCOM, HAREDA, Solar Energy, Haryana, operational and technical problem.*

1.1.Introduction

Solar energy is a vast notion, and using it to generate power is a difficult and complicated procedure. There are several ways to accomplish this. Such a project could be as big as a solar park or as little as solar LED charging inverters. These many kinds of solar equipment can be built and used depending on the location, availability of subsidies, grid accessibility, solar potential of an area, and attention of government and other organizations. Solar lamps, for instance, are more well-known in impoverished areas, solar batteries in rural ones, and hybrid systems among upper-middle-class individuals. Solar rooftop panels are hybrid and can be linked to the grid and batteries. It indicates that they have the option of being directly linked to the grid, storing electricity in batteries, or combining the two into a hybrid system (Kumar et al. 2025).

It is well known that solar energy will be a powerful substitute for the current fossil fuels utilized to generate electricity in the future. This is due to the fact that the current resources are a source of pollution and are expected to increase as the demand for power rises to extinction if not utilized carefully (Ghosh et al. 2023). Additionally, society must be freed from the inequality of electricity's haves and have-nots. Decentralization within the sector can help achieve this. There are many advantages for the environment, and only each person's carbon footprint on the earth may be reduced. Every living thing on the world has the right to access clean air and water, and the alarmingly high levels of pollution are robbing them of this. Because Haryana is close to New Delhi, one of the most polluted cities in the world, pollution is spreading through the state. Additionally, the need for power, transportation vehicles, and land for homes and businesses is growing quickly. Conventional energy generation techniques alone cannot meet these expectations. Diversifying energy production techniques that rely on renewable resources have to be the main goal. For Haryana, solar energy is the most common of these renewable options.

1.2 The State of Implementation in Haryana

Under the direction of Haryana Renewable Energy Development Agency (HAREDA), the implementation at the state level is carried out by two major DISCOMs namely Uttar Haryana Bijli Vitran Nigam (UHBVN) and Dakshin Haryana Bijli Vitran Nigam (DHBVN). Under the "Dual Subsidy Model" which has been implemented by the state, citizens are eligible to be a part of the State Financial Assistance (SFA) and the Central Financial Assistance (CFA). Antyodaya families - those with annual incomes of less than 1.80 lakh - are particularly affected, as they receive a huge amount more support to ensure the transition to green energy is inclusive.

1.3 The Fundamental Issue: Execution vs. Intent

The "transfiguration" of the electrical system in Haryana has significant hurdles in its operation in spite of these ambitious goals and financial protection. Although a lot of technical potential, in reality, adoption is often hindered by: Regulatory obstacles include: Technical inspection by DISCOMs and delay in net meter synchronization.

Awareness Gaps: Rural people have a poor awareness about the online application portals and about the schedules of disbursement of subsidies. The lack of localized maintenance services for after-installation servicing and bi-directional meters are operational limitations. Haryana, mostly an agrarian economy and having high solar insolation (approx. 330 sunny days), is a fertile ground for solar transfiguration. The SRISTI scheme (Rooftop Phase II) was conceived to make the process of subsidy more straightforward and include DISCOMs as the main implementing agencies. In Haryana, the Department of New & Renewable Energy (HAREDA) has further decentralized these efforts to achieve the state's target of 6 GW of solar capacity by 2030. This evaluation delves into the question of whether the financial incentives are being translated in the real energy independence of the rural and urban population of Haryana or not.

1.4 Purpose of the research

This critical evaluation seeks to analyze how the solar roof top panel plan affects Haryana's energy mix and implementing authority behavior is the goal of this critical evaluation. It investigates the different problems faced by the authority to implement the scheme and its operationalisation. The study evaluates the various issues in diverse districts of state Haryana and to overcome the issue faced by the authorities.

2.1 Literature Review

According to Rogers (1995), if the world wants the new power generation methods to thrive and displace the existing systems, the wealthy should be the first to adopt solar technologies.

According to Ghosh et al. (2002), the intermittent nature of solar energy necessitates the requirement for storage and backup facilities, which raises the cost of solar PV systems and lengthens the developer's payback period. Additionally, they recommended combining the solar program with rural electricity and regional development.

Wolde-Giorgis (2002) looked into a variety of measures that could encourage the use of renewable technologies in Ethiopia's rural areas. This study suggests that in order to further encourage the use of renewable energy, the budget allocation for renewable energy should be increased. Additionally, the current institutional structure needs to be modified.

New electrical technologies can lower indoor pollution, according to Bhide & Monroy (2011). In the field of agriculture, solar energy can be useful, particularly for drying. Rural homes may also benefit from it in terms of lighting, as it offers a little amount of nighttime illumination.

India has a lot of promise in this regard, but the government should prioritize the more isolated regions. The article's conclusion makes the case that encouraging the production of electricity from renewable sources is one way to end energy poverty.

According to Kumar et al. (2020), there is a lack of financial support and product expertise in the Indian context when it comes to the implementation of solar energy initiatives. Customers' decisions to buy solar energy goods are influenced by government subsidies. Aspects of finances. The sector's lack of funding and consumer credit for solar energy product installation were identified as the primary obstacles.

According to a statistics study by the International Renewable Energy Agency (2021), the capacity of renewable energy has increased by 7.4% overall, with a net capacity gain of 176 GW in 2019, of which 54% is installed in Asia alone, with 90% of itbeing new solar and wind energy capacity.

2.2 Objectives

- To study the problems faced by implementing authorities toward solar roof top panel in the state of Haryana
- To make viable suggestions for addressing the issues

3.1 Research Methodology

3.1.1Research Design: To determine the study's findings, descriptive research has employed surveys and various fact-finding inquiries in addition to analytical research.

3.1.2Data Collection: The study collect primary data with the help of the questionnaire having 14 statements from the different district of state Haryana and secondary data from HAREDA yearly reports, releases from the Ministry of New and Renewable Energy (MNRE).

3.1.3Population: All solar roof top panel implementing authorities of all district of Haryana and comprise the population of the study.

3.1.4Sample: Using purposive sampling, the study focuses on six important districts—Hisar, Karnal, Gurugram, Faridabad, Kurukshhetra and Sonepat from six administrative zone of Haryana.

3.1.5Tools: The data was assessed using the tables, graph, frequency, percentage, exploratory factor analysis, Kruskal Wallis H test and Mann Whitney U test.

3.2 Hypothesis

H01: There is no significant difference among the problems faced by implementing authorities towards operational problems based on registration, district and agency.
H02: There is no significant difference among the problems faced by implementing authorities towards financial and supply chain problems based on registration, district and agency
H03: There is no significant difference among the problems faced by implementing authorities towards technical problems based on registration, district and agency

3.3 Demographics of the respondents

Table 1.1 : Registration of the respondents

Registration	Frequency	Percent
Registered Dealers	85	94.4
Not registered Dealers	5	5.6
Total	90	100.0

Source: Complied with the help of primary data

It is shown by the table 1.1 and figure 1.1 that registered dealers comprises 94.4 per cent whereas unregistered dealers having 5.6 per cent out of total sampled dealers.

Figure 1.1

Table 1.2 : District of the respondents

District	Frequency	Percent
Kurukshetra	15	16.7
Faridabad	15	16.7
Gurugram	15	16.7
Hisar	15	16.7
Karnal	15	16.7
Sonepat	15	16.7
Total	90	100.0

Source: Complied with the help of primary data

It is shown by the table 1.2 and figure 1.2 that each of the sampled district comprises 16.7 per cent.

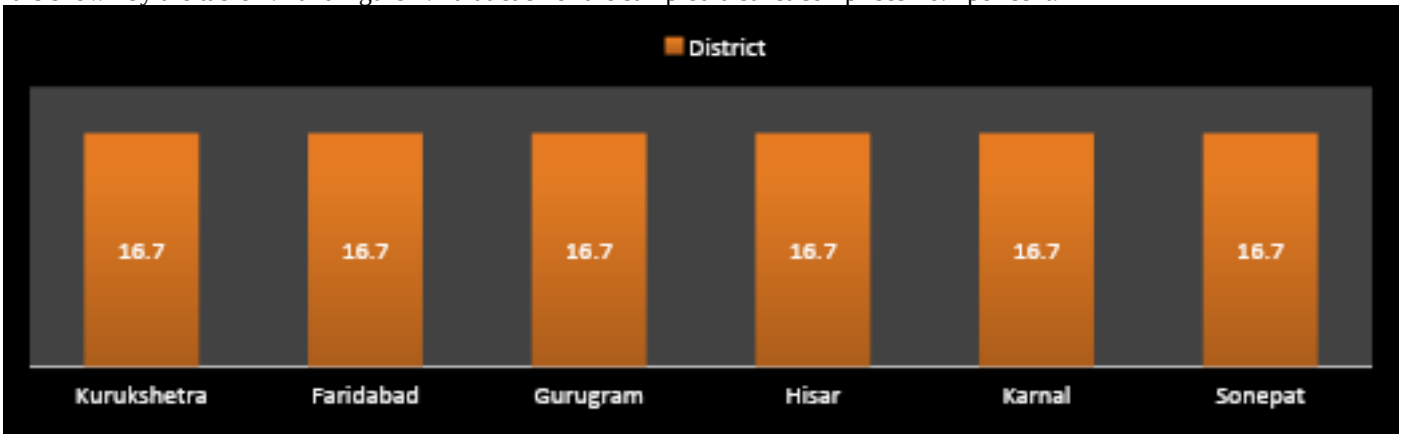

Figure 1.2

Table 1.3 : Agency of the respondents

Agency	Frequency	Percent
HAREDA	8	8.9
DISCOM	22	24.4
Third Party	28	31.1
HSIIDC	32	35.6
Total	90	100.0

Source: Complied with the help of primary data

It is shown by the table 1.3 and figure 1.3 that HAREDA comprises 8.9 per cent, DICOM, Third party and HSIIDC having 24.4 per cent, 31.1 per cent and 35.6 per cent respectively.

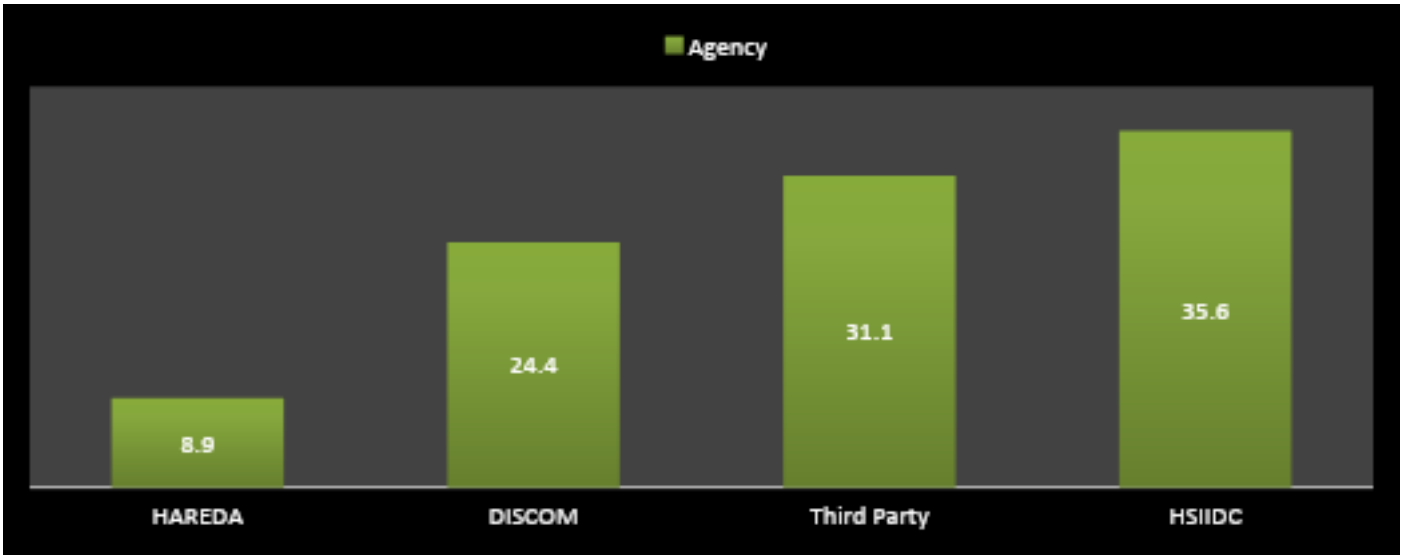

Figure 1.3

4.Analysis

The data was collected with the help of questionnaire employed a five-point Likert scale, with 1 denoting strongly agree, 2 agree, 3 neutral, 4 disagree, and 5 strongly disagree, from the implementing authorities of rooftop solar panels and examine problems faced by them. To meaure the reliability, Cronbach Alpha was used having value 0.726 which is greater than 0.50 regarded fair values.

Table 1.4 : KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.882
Bartlett's Test of Sphericity	**Approx. Chi-Square**	2209.173
	df	91
	Sig.	0.000

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

To measure the reliability, Cronbach's Alpha is used former to factor analysis as shown by table 1.4. "A value greater than 0.70 is seen to be satisfactory. However, a rating more than 0.50 is likewise regarded as satisfactory when the items on a scale are less than 10". The value 0.882 and sig. value 0.000 (less than 0.05) reveals that the collection of data for the study can acquiesce unswerving findings when applied to the same sample under diverse settings.

Table 1.5 : Communalities

Statements	Initial	Extraction
Upfront cost is high	1.000	.920
Delayed Government subsidies	1.000	.739
Expensive complaint modules	1.000	.954
Shortage of meters	1.000	.874
Delayed DISCOM inspection	1.000	.824
Poor quality of ancillary components	1.000	.794
Expensive roof reinforcement	1.000	.775
High population density	1.000	.710
Initial site assessment is poor	1.000	.572
Technical problems faced while using central or state solar portal	1.000	.606
Data entry is not accurate	1.000	.868
Mismatch of electricity bill and adhaar card	1.000	.822
Poor pre sale education	1.000	.738
Difference between actual and expected generation of energy	1.000	.809

Extraction Method: Principal Component Analysis

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

According to Zillmer and Vuz (1995) "value should be more than 0.30 and in this table all the values are more than 0.30". The above table 1.5 illustrates the variance degree in the study's variables that might be accounted for by the set of study-related factors.

Table 1.6 : Total Variance Explained

Component	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	7.533	53.807	53.807	7.533	53.807	53.807	4.181	29.865	29.865
2	2.205	15.752	69.559	2.205	15.752	69.559	3.899	27.850	57.715
3	1.267	9.052	78.611	1.267	9.052	78.611	2.925	20.896	78.611
4	.997	7.121	85.732						
5	.656	4.683	90.415						
6	.479	3.423	93.838						
7	.374	2.669	96.507						
8	.204	1.454	97.961						
9	.119	.848	98.809						
10	.073	.525	99.334						
11	.053	.382	99.715						
12	.036	.258	99.973						
13	.004	.026	99.999						
14	.000	.001	100.000						

Extraction Method: Principal Component Analysis

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

The above table 1.6 explained that Principal Component Analysis Method was used to achieve the eigen values which confirm the variances of the extracted variables. The table shows the number of factors used in data, which help in classification of the elements and identifying components, the table 1.6 is crucial. Since eigen values of three of the variables have more than 1, only these sets of variables will be taken into deliberation going forward. With the help of the SPSS, three components derived having cumulative percentage of 78.611, meaning that they account for 78.611 percent of the overall variation.

Table 1.7 : Component Matrix

Statements	**Component**		
	1	**2**	**3**
Upfront cost is high	.853	.224	.378
Delayed Government subsidies	.801	-.305	.062
Expensive complaint modules	.653	-.545	.481
Shortage of meters	.810	-.317	.343
Delayed DISCOM inspection	.872	.101	-.230
Poor quality of ancillary components	.870	-.194	.001
Expensive roof reinforcement	.730	.216	-.442
High population density	.770	.000	-.343
Initial site assessment is poor	.692	-.030	.305
Technical problems faced while using central or state solar portal	.232	.719	.186
Data entry is not accurate	.544	.743	.142
Mismatch of electricity bill and adhaar card	.666	.615	.029
Poor pre sale education	.700	-.270	-.419
Difference between actual and expected generation of energy	.824	-.221	-.286

Extraction Method: Principal Component Analysis, 3 components extracted

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

The table 1.7 reveals that factor loadings of every statement used in the data to the detected or extracted components which are highlighted through the Component Matrix. If the value is higher i.e. -1 to 1, it will be better. The statements' incapability to replicate the notorious component is indicated by lesser or blank values. The majority of the statements show a high value, as can be seen from the table above 1.7.

Table 1.8 : Rotated Component Matrix

Statements	Component		
	1	2	3
Upfront cost is high	.283	.682	.612
Delayed Government subsidies	.531	.674	.045
Expensive complaint modules	.151	.956	-.129
Shortage of meters	.335	.867	.103
Delayed DISCOM inspection	.750	.354	.369
Poor quality of ancillary components	.611	.629	.157
Expensive roof reinforcement	.795	.077	.369
High population density	.773	.259	.213
Initial site assessment is poor	.253	.644	.306
Technical problems faced while using central or state solar portal	-.051	-.045	.775
Data entry is not accurate	.191	.111	.905
Mismatch of electricity bill and adhaar card	.369	.170	.811
Poor pre sale education	.808	.283	-.072
Difference between actual and expected generation of energy	.791	.426	.050

Extraction Method: Principal Component Analysis, Rotation converged in 5 iterations
Source: Researcher's Calculations through IBM SPSS Statistics Version 21

The table 1.8 explains the results of factor analysis, in which the Rotated Component Matrix creates a crucial matrix that specifically divides the statements of given data set into numerous components. The matrix also points out which of the statement relates to which component. The statements are divided into three parts based in the table 1.8. The greatest factor loading for agreed factor was to be grouped under that factor, according to the segregation criterion. Three hypotheses were framed and tested with the help of non-parametric tests based on these three groups shown by the table 1.9 and 1.10 as follow:

Table 1.9 : Component Transformation Matrix

Component	1	2	3
1	.681	.626	.380
2	-.102	-.432	.896
3	-.725	.649	.230

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
Source: Researcher's Calculations through IBM SPSS Statistics Version 21

Table 1.9 shows that three component were derived with the help of exploratory factor analysis.

Table 1.10 :

Component 1 (Operational Problem)	Component 2 (Financial and supply chain problem)	Component 3 (Technical Problem)
Delayed DISCOM inspection	Upfront cost is high	Technical problems faced while using central or state solar portal
Poor quality of ancillary components	Delayed Government subsidies	Data entry is not accurate
Expensive roof reinforcement	Expensive complaint modules	Mismatch of electricity bill and adhaar card
High population density	Shortage of meters	
Poor pre sale education	Initial site assessment is poor	
Difference between actual and expected generation of energy		

Source: Researcher's Calculations

Table 1.10 highlights the three components derived with the help of the analysis of data, in which component 1 is termed as operational problem having six statements, component 2 is termed as financial and supply chain problem having five statements and component 3 is termed as technical problem having three statements.

Table 1.11 : Hypothesis Test Summary

	Null Hypothesis	Test	Chi Square	Sig.	Decision
1	The distribution of Operational Problem is same across categories of District of the Respondents.	Independent Sample Kruskal Wallis H Test	12.064	.034	Reject the null hypothesis
2	The distribution of Financial and supply chain problem is same across categories of District of the Respondents.	Independent Sample Kruskal Wallis H Test	18.223	.003	Reject the null hypothesis
3	The distribution of Technical Problem is same across categories of District of the Respondents.	Independent Sample Kruskal Wallis H Test	19.063	.002	Reject the null hypothesis

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

At level of Significance of 5 per cent the Kruskal Wallis H test twirls out to be inconsequential. Hence it can be concluded with the help of the table 1.11 that:

- There is no significant difference in the respondent's operational problems, Financial and supply chain problem and technical problems based on the district of the respondents as p value is 0.034, 0.003 and 0.002 which is less than 0.05 respectively.

Table 1.12 : Hypothesis Test Summary

	Null Hypothesis	Test	Chi Square	Sig.	Decision
1	The distribution of Operational Problem is same across categories of Agency of the Respondents.	Independent Sample Kruskal Wallis H Test	5.723	.126	Retain the null hypothesis
2	The distribution of Financial and supply chain problem is same across categories of Agency of the Respondents.	Independent Sample Kruskal Wallis H Test	5.011	.171	Retain the null hypothesis
3	The distribution of Technical Problem is same across categories of Agency of the Respondents.	Independent Sample Kruskal Wallis H Test	9.639	.022	Reject the null hypothesis

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

At level of Significance of 5 per cent the Kruskal Wallis H test twirls out to be inconsequential. Hence it can be concluded with the help of the table 1.12 that:

- There is significant difference in the respondent's operational problems and Financial and supply chain problem based on the agency of the respondents as p value is 0.126 and 0.171 which is higher than 0.05 respectively.
- There is no significant difference in the respondent's technical problems based on the agency of the respondents as p value is 0.022 which is less than 0.05.

Table 1.13 : Hypothesis Test Summary

	Null Hypothesis	Test	Z	Sig.	Decision
1	The distribution of Operational Problem is same across categories of Registration of the Respondents.	Independent Sample Mann-Whitney U Test	-.979	.328	Retain the null hypothesis
2	The distribution of Financial and supply chain problem is same across categories of Registration of the Respondents.	Independent Sample Mann-Whitney U Test	-1.272	.203	Retain the null hypothesis
3	The distribution of Technical Problem is same across categories of Registration of the Respondents.	Independent Sample Mann-Whitney U Test	-2.731	.006	Reject the null hypothesis

Source: Researcher's Calculations through IBM SPSS Statistics Version 21

At level of Significance of 5 per cent the Mann-Whitney U test twirls out to be inconsequential. Hence it can be concluded with the help of the table 1.13 that:

- There is significant difference in the respondent's operational problems and Financial and supply chain problem based on the registration of the respondents as p value is 0.328 and 0.203 which is higher than 0.05 respectively.
- There is no significant difference in the respondent's technical problems based on the registration of the respondents as p value is 0.006 which is less than 0.05.

5.Conclusion and Suggestion

The various implementing authorities have to face operational, financial, supply chain and technical problems while implanting solar roof top panels. There is significant difference in the respondent's operational problems and Financial and supply chain problem based on the registration and agency of the respondents but reject the hypothesis based on registration of the respondents, also for technical problems. The various dealers face problems due to delayed subsidies released by Government. Also the administration cost is very high in case of residential projects of solar roof top panel. Delay in inspection, shortage of meters, poor qualities ancillary parts for replacement, mismatch of adhaar card of the respondent and their electricity bill make the scheme more complicated. In urban areas due to high population density and power cut, solar roof top panel are not working properly. The implementing authorities should keep high qualities part for replacement, drone based helioscope analysis of sites for installation of solar roof top panel and high speed internet should be used to cope up these challenges. Low interest loan should be available for working capital so that the gap between apply and receive the subsidy from Government could be short out.

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