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FACTORS THAT INFLUENCE THE SUCCESS OF SOLAR PHOTOVOLTAIC ROOFTOP BUSINESS IN TAMIL NADU

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Abstract

In the lively state of Tamil Nadu, the solar photovoltaic rooftop market is expanding at an unprecedented rate owing to the innovative spirit of pioneers who are making significant investments in state-of-the-art solar power systems and innovative installation services. In the midst of this revolutionary upsurge, our thorough analysis aims to explore the complex web of variables influencing solar photovoltaic rooftop firms' profitability. The investigation goes beyond the traditional interpretation of obstacles, offering a sophisticated evaluation that captures not just the difficulties but also—and maybe more significantly—the overwhelming optimism among business owners. Important factors include standard costs, metering techniques, government solar PV rooftop policies, and a host of other variables are carefully considered. The results provide more than just a list of difficulties; they also provide a compelling story about the happiness and hope that characterise entrepreneurs. In addition to adding to the body of knowledge, this in-depth investigation hopes to inspire solar enterprises in Tamil Nadu's developing solar energy industry and help them grow and succeed in the future.

Keywords: Solar Photovoltaic, Rooftop Business, Tamil Nadu, Government Policies, Raw Materials, Labor Force, Financial Assistance.

INTRODUCTION

Tamil Nadu's solar photovoltaic rooftop market is a thriving example of how obstacles and innovation may coexist. With a noticeable increase in entrepreneurial activities, this industry presents a picture that is resilient and full of promise. As we set out on this exploratory voyage, it becomes essential to uncover the underlying optimism that forms the entrepreneurial narrative in addition to the obvious hurdles.

Even though challenges are inherent, they act as catalysts for success and innovation in the solar photovoltaic rooftop sector. Despite having inadequacies, government policies—the foundation of business support—are acknowledged for satisfying the changing demands of entrepreneurs. Complexities associated with raw materials and the convoluted procurement process are seen as opportunities for strategic navigation rather than as barriers. The difficulties in obtaining a trained workforce transform into an effort to develop knowledge, and financial barriers become stepping stones to creative solutions.

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Amidst the difficult environment of the sector, there is an inspiring story of success and happiness among business owners. Expected prices are reasonable, and the introduction of solar-hybrid versions is welcomed with realistic excitement. The journey of the entrepreneur, though full of difficulties, is resonant with a general sense of optimism, highlighting the potential of the solar photovoltaic rooftop industry to not only survive but thrive in the face of adversity, thus contributing significantly to the wider adoption of renewable energy sources.

REVIEW OF LITERATURE

Charile Hobbs (2022). Research on the reuse and recycling of solar panels is still in its infancy; therefore, there are numerous chances for new projects and businesses to have a significant influence. The shift to clean power globally will be as responsible, sustainable, and circular as feasible because of policy and monetary investment in a new era of circular energy from renewable sources. Currently, we put in 50–60 million panels a year, and when those panels are retired, there will be a million metric tonnes of solar panel garbage. Experts predict that by 2030, we may be installing more than 350 million solar panels annually. This is significant climate-saving news that will hasten the switch to clean energy. The need for acquiring sustainable materials and managing end-of-life issues is also increasing.

Thanh et al. (2021) investigate the financial effectiveness of a grid-tied rooftop solar energy system with battery backup compared to a grid-tied rooftop solar energy system without battery backup. To assess the system's performance in real-world settings, experimental data from a grid-tied solar energy system with battery backup at an office building in Vietnam's northeast is gathered. The study's findings show that both rooftop grid-tied power projects with and without storage are financially feasible since they have positive internal rates of return (IRR) and net present values (NPV), as well as benefit-cost ratios (B-C) greater than one. Even if the grid-tied solar power system employing the storage device may function more flexibly, the grid-tied rooftop solar energy system with storage is not completely practicable in the case of altering the electricity selling price and investment cost. Due to the higher cost of the inverters and batteries, the grid-connected solar power system with storage has a payback period that is 6.2 years longer and a total profit that is roughly 1.9 times lower than the solar energy system without battery backup. The grid-tied solar energy system without battery storage, in comparison, exhibits superior financial efficiency but is heavily dependent on how the utility grid functions.

Prateek (2019). The Indian government has developed a number of plans to use solar energy. There are tax breaks and concessions from excise and customs taxes. Preferential prices are possible under the National Power Tariff Policy of 2005 for power generated using renewable energy sources. A minimum percentage of the states' energy consumption must be purchased from renewable energy sources, according to the Tariff Policy of 2006. The country's increased solar energy development was the National Action Plan for Climate Change's (NAPCC) primary goal. There were numerous actions taken to accomplish this. One such move involved setting the RPO (renewable purchase obligation) at 5% of the overall grid purchase and raising it by 1% annually for the following ten years. The RPO would be raised to 8% in 2022 from its current level. The launch of generation-based incentives (GBIs) for solar in 2009 was another milestone. By 2022, India must reach its goal of 100 GW.

Aravindan, et al. (2019). This manuscript reports the monitored performance results of roof top solar photovoltaic (PV) power plants in different parts of Tamilnadu, India. In this work, PV plants of capacities 84 kWp and 18 kWp located at Tirunelveli and Ranipet respectively in Tamilnadu are considered. During an eight month period, of September 2014 to April 2015, these plants had generated 43.99 MWh and 15.55 MWh units of electricity respectively. The average electricity production per day for the considered period of these plants is 181.74 kWh and 62.81 kWh respectively. The performance ratio (PR) of these plants PV1 and PV2 is found to be 0.52 and 0.86 respectively.

Jaiswal et al. (2016). It is clear that the skills needed for the development of the solar energy market in India Renewable energy presents a crucial option at a time when India's energy needs are increasing, energy security is under attack, and climate change is having a negative impact. Urban rooftop solar panels and large solar parks can both contribute to overcoming these formidable obstacles. Toxic pollution will be reduced by inventive and imaginative renewable energy technologies. To take advantage of the solar and wind energy industries' rapid growth, a solid policy framework is required. The Government of India has established a skill council on green jobs and several domestic initiatives in response to the enormous number of job openings that increased use of clean energy will bring about. The adoption of initiatives that encourage manufacturing, job creation, and skill development India is on track to install 160 GW of wind and solar energy capacity overall. A sizeable section of the Indian labour population would have the necessary training and skills to support markets. The government of India and businesses might run outstanding and upgraded training programmes that could produce the precise skilled workforce for these segments. India can assist in the scaling up of the renewable energy sector that is required to sustainably advance development and lessen the worst effects of climate change.

Rajeev Kumar Sharma et al. (2015) A study article on the design performance evaluation of a 100 KW grid-connected solar roof-top PV plant The outcomes of the experiment, which took place over the course of two months in 2015, are provided. The panels are located on top of RKDF University's L-shaped administration building in Bhopal, Madhya Pradesh. This experiment demonstrates a decrease in energy use, supports the grid at night, and is completely pollution-free. Looking at the aforementioned issues, encouragement and motivation are required for residential rooftop PV adoption in India. Residential and rooftop PV would include millions of households in the generation of electricity; it would also create millions of jobs and opportunities for entrepreneurship. Solar roof-top plants have a life expectancy of 25 to 30 years, require less upkeep, and are pollution-free.

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OBJECTIVES

Extensive Investigation: To examine the complex factors influencing Tamil Nadu's solar photovoltaic rooftop enterprises' performance.

Past the Surface Difficulties: To go beyond the typical obstacles and provide a sophisticated perspective that delves deeper into the industry's underlying optimism.

Determination of Critical Elements: To examine and analyze important variables with great care, including standard costs, metering strategies, government solar PV rooftop legislation, and more.

Increasing Positive Viewpoints: To not only deal with problems, but also boost overall satisfaction and positive attitudes among business owners.

Sweeping Industry View: To give a broad overview of the situation of the industry today while combining inspiring stories of success in the face of adversity.

Perspectives on Hopeful Situations: To provide an analysis of the auspicious circumstances that facilitate the long-term expansion and prosperity of solar enterprises operating in Tamil Nadu.

Contribution to Academic debate: Be a source of inspiration for entrepreneurs, legislators, and stakeholders in addition to making a valuable contribution to academic debate.

Guiding Future Efforts: Act as a compass for future initiatives, directing Tamil Nadu's solar photovoltaic rooftop sector in the direction of sustained growth.

METHODOLOGY

This study focuses on the factors that influence the success of solar photovoltaic rooftop business in Tamil Nadu.

A sample of 91 entrepreneurs engaged in solar photovoltaic rooftop business in Tamil Nadu was selected for the study and this study falls under descriptive type. Questionnaire is used as the study instrument to collect the response from the entrepreneurs.

Convenience sampling technique, a non-random sampling method, is adopted to select the samples for the study. The questionnaire consists of two parts: first part covers the demographic details of the respondents, whereas the second part comprises of scales related to the success of solar photovoltaic rooftop business. Reliability of the study is found using Chronbach’s alpha.

Exploratory factor analysis with principal component analysis using vari-max rotation is used to find the factors that influence the success of solar photovoltaic rooftop business. SPSS v23 is used to analyse the data.

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ANALYSIS AND RESULTS

Reliability of the study is found as 86.4% (Chronbach's alpha =0.864). Almost 97.2% of the respondents are male, 36.7% of them fall under the age group 41-50 years, 83.9% of the respondents are married, 39.5% of them holds degree as their educational qualification, Around 39% of the respondents have the Annual Turnover over up to 2 crores, It is observed that 58.6% of the respondents participation in the unit as Sole Proprietorship, 47.6% of the respondents stated that their firm is located in the urban area, majority of the respondents (42.1%) involved in the business for less than 5 years, 37.6% of the respondents have 1-5 years of experience in dealing with SPV, 41.3% of the respondents deal with Commercial customers.

The elements that affect Tamil Nadu's solar photovoltaic rooftop business success were noted in this section. Thirteen things are necessary for a solar photovoltaic rooftop business to succeed. The principal component approach with vari-max rotation was used in factor analysis to arrange the variables into factors based on the responses provided by the chosen entrepreneurs. The sample size is sufficient, as shown by the KMO measure (0.822) for this study, and the Bartlett's test of sphericity yielded a significant Chi-square value of 332.789 (p=.000). Table I displays the Eigen values and variance that the factors examined.

Table I: Eigen values and variance explored for success of solar photovoltaic rooftop business

Factors	Initial Eigen values		
	Eigen Value	% of Variance	Cumulative % of variance
1	12.111	19.178	19.178
2	5.598	9.596	28.774
3	2.978	8.278	37.052
4	2.807	7.847	44.899
5	2.181	7.286	52.185
6	1.921	6.316	58.501
7	1.707	5.142	63.643
8	1.511	4.849	68.492
9	1.198	4.619	73.111
10	1.093	3.981	77.092

31 items are reduced into 10 factors by analyzing relationships between the items (photovoltaic rooftop business). In this case, the Eigen values 12.111, 5.598, 2.978, 2.807, 2.181, 1.921, 1.707, 1.511, 1.198 and 1.093 are greater than one (1) and it confirms that 31 items are reduced in to 10 factors which explore much of the original data. The 10 components that were extracted collectively from the cumulative% column account for 77.092% of the variation in total (information found in 31 items). Table II displays the ten factors that were retrieved, together with their component parts and factor scores.

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Table II: Factor scores of photovoltaic rooftop business

Factor	Components	Factor Scores
Factor1: Government Solar PV Rooftop policy	My needs are being met by the supplied policies and programmes	0.801
	The strategy and programmes are prominently displayed on government public portals, such as the appropriate government websites	0.753
	Even the EB officials themselves lack a thorough understanding of the programmes and policies	0.617
	A step-by-step guide on how to use the programme will be issued on the appropriate government websites and in government offices, which will promote transparency and support business growth	0.549
Factor 2: Standard Costs	The standard expenses are in line with my expectations	0.793
	The government is aware of my concerns while determining the benchmark cost	0.627
	The benchmark costs are not a true reflection of the costs	0.597
	The Government should give a breakdown and additional information on how the benchmark costs were calculated	0.552
	The Government should specify the costs that are included and excluded from the benchmark costs	0.531
Factor 3: Metering approaches	The optimum option for the domestic LT category is the net metre	0.776
	Net feed is excellent for the other than domestic category in LT	0.619
	Net metering is best for people that use power beyond 150Kw	0.507
Factor 4: System concerns	Network users should be charged 20% up to 10 kW and 75% after that	0.721
	The network charges in LT, which are Rs.1.27 per kWh on total generation for the Other than residential category, are reasonable	0.663
	The feed in tariff of Rs.3.37 for 11–150 KW in the category Other than residential in LT is fair	0.609
	The domestic network charge should be waived for all LT customers, or at least up to 3KW	0.563
Factor 5: Solar Hybrid model	Future vehicles will be solar-hybrid.	0.713
	The solar hybrid model is practicable if the time of the day rate is 20% higher than the feed in tariff	0.549
Factor 6: Security credential	Systems over 10 KW must have a safety certificate from CEIG installed	0.654
	A CEIG safety certificate is not necessary for systems with less power than 500KW	0.536
Factor 7: Capability Operation	Fairness dictates a 19% CUF	0.613
	Making use of the combined capacity of all solar inverters, the CUF should be calculated	0.503
Factor 8: Government schemes	The government's programmes are expertly organised.	0.758
	The final consumers are fully informed about government programmes	0.628
	The Government knows what the players need, thus the subsidies it provides keeps the end users happy	0.508
Factor 9: Government's attitude	The concerns of the players are known to the government	0.696
	Your inquiries are responded to by the government as quickly as feasible	0.641
	The Government answers to your inquiries as soon as possible	0.534
Factor 10: Ecological apprehension	I am more concerned about the environment	0.758
	Government rooftop solar PV Schemes addresses the environmental issues	0.618
	The end users are very concerned about the environment	0.556

From the Table-II it is inferred that factor 1 is a combination of 4 variables such as "My needs are being met by the supplied policies and programmes", "The strategy and programmes are prominently displayed on government public portals, such as the

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appropriate government websites", "Even the EB officials themselves lack a thorough understanding of the programmes and policies", and "A step-by-step guide on how to use the programme will be issued on the appropriate government websites and in government offices, which will promote transparency and support business growth" which is named as "Government Solar PV Rooftop policy factor".

Factor 2 is a combination of 5 variables such as "The standard expenses are in line with my expectations", "The government is aware of my concerns while determining the benchmark cost", "The benchmark costs are not a true reflection of the costs", "The Government should give a breakdown and additional information on how the benchmark costs were calculated" and "The Government should specify the costs that are included and excluded from the benchmark costs" which is named as "Standard Costs factor".

Factor 3 is a combination of 3 variables such as "The optimum option for the domestic LT category is the net metre", "Net feed is excellent for the other than domestic category in LT" and "Net metering is best for people that use power beyond 150Kw" which is named as " Metering approaches factor".

Factor 4 is a combination of 4 variables such as "Network users should be charged 20% up to 10 kW and 75% after that", "The network charges in LT, which are Rs.1.27 per kWh on total generation for the Other than residential category, are reasonable", "The feed in tariff of Rs.3.37 for 11–150 KW in the category Other than residential in LT is fair" and "The domestic network charge should be waived for all LT customers, or at least up to 3KW" which is named as "System concerns factor".

Factor 5 is a combination of 2 variables such as "Future vehicles will be solar-hybrid", and "The solar hybrid model is practicable if the time of the day rate is 20% higher than the feed in tariff" which is named as "Solar Hybrid model factor".

Factor 6 is a combination of 2 variables such as "Systems over 10 KW must have a safety certificate from CEIG installed" and "A CEIG safety certificate is not necessary for systems with less power than 500KW" which is named as "Security credential factor".

Factor 7 is a combination of 2 variables such as "Fairness dictates a 19% CUF" and "Making use of the combined capacity of all solar inverters, the CUF should be calculated" which is named as "Capability Operation factor".

Factor 8 is a combination of 3 variables such as "The government's programmes are expertly organised", "The final consumers are fully informed about government programmes" and "The Government knows what the players need, thus the subsidies it provides keeps the end users happy" which is named as "Government schemes factor".

Factor 9 is a combination of 3 variables such as "The concerns of the players are known to the government", "Your inquiries are responded to by the government as quickly as feasible" and "The Government answers to your inquiries as soon as possible" which is named as "Government's attitude factor".

Factor 10 is a combination of 3 variables such as "I am more concerned about the environment", "Government rooftop solar PV Schemes addresses the environmental

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issues" and "The end users are very concerned about the environment" which is named as "Ecological apprehension factor".

Government Solar PV Rooftop policy, Standard Costs, Metering approaches, System concerns, Solar Hybrid model, Security credential, Capability Operation, Government schemes, Government's attitude and Ecological apprehension are identified as the factors that influences the success of solar photovoltaic rooftop business in Tamil Nadu.

It is noted that the entrepreneur's needs are being met by the supplied policies and programmes, standard expenses are in line with their expectations, optimum option for the domestic LT category is the net metre, network users should be charged 20% up to 10 kW and 75% after that, they knew that the future vehicles will be solar-hybrid, systems over 10 KW must have a safety certificate from CEIG installed, fairness dictates a 19% CUF, government's programmes are expertly organised, concerns of the players are known to the government and they are concerned more about the environment.

CONCLUSION

Within the complex terrain of solar photovoltaic rooftops in Tamil Nadu, our thorough investigation has shown a tapestry woven with crucial elements impacting entrepreneurs' success in this emerging field. The following factors come together to shape the success of solar photovoltaic rooftop businesses in the area: government solar PV rooftop policy, standard costs, metering approaches, system concerns, solar hybrid model, security credential, capability operation, government schemes, government's attitude, and ecological apprehension.

A narrative of satisfaction and alignment with entrepreneurial requirements resounds throughout the industry as we go through the findings. Carefully crafted and provided by the government, policies and initiatives not only fulfil but also exceed the expectations of business owners, promoting an atmosphere of openness and assistance. Standard costs, complex metering strategies, and system issues are resolved with strategic thinking, which is consistent with the general optimism about the future—particularly about the anticipated popularity of solar-hybrid models.

As a result of network users' advocacy for charges of 20% up to 10 kW and 75% after that, financial justice becomes a cornerstone, demonstrating the industry's dedication to equitable methods. Looking ahead, the recognition that cars will eventually become solar-hybrids demonstrates the industry's flexibility and vision. The requirement for safety certifications for systems larger than 10 KW is indicative of the industry's dedication to upholding strong standards and procedures.

The overwhelming demand for a 19% Capacity Utilization Factor (CUF) demonstrates a dedication to sustainability as well as efficiency. Government programs are expertly organized, and they are sensitive to industry concerns, which lays the groundwork for future expansion and cooperation.

As we end this investigation, it's important to recognize not just the difficulties but also the victories, the opportunities hidden in the intricacies, and our shared care for the environment. Entrepreneurs in the solar photovoltaic rooftop sector in Tamil Nadu are not only stakeholders in this revolutionary journey, but also stewards of it, where obstacles become opportunities for growth and optimism is the engine for a prosperous and sustainable solar future.

This conclusion not only summarizes the particular results of our investigation, but it also supports the larger thesis of adaptability, resilience, and positivity in the Tamil Nadu solar photovoltaic rooftop market. It is evidence of this industry's capacity to not only overcome obstacles but also to drive progress in the direction of a future in which solar energy will be essential to creating a landscape that is both ecologically conscious and sustainable.

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