

An Empirical Study to Analyze Challenges Associated with Solar Products Purchase Intention for Domestic Usages in Telangana

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Abstract

Solar energy and other renewable energy technologies have a great potential to solve long-term electricity and climate problems in India and across the world. This study was aimed to look into the challenges and factors which may influence customers' buying decision for solar energy for domestic purposes in the state of Telangana. This study is completely based on quantitative methodology where we used questionnaires to collect the data through Google Forms.

We gathered some demographic information along with survey data from 130 respondents who were analyzed to find a concluding result. The findings suggest that environmental concern, performance perception, and ease of use play a vital role in customers' attitude towards solar energy. This study may hopefully be helpful for policymakers and researchers to further explore customers' purchase behavior and challenges in wide-scale adoption of solar panels for domestic purposes.

Key-words: Solar Energy, Telangana, Renewable Energy, Survey, Purchase Intention, Challenges, Domestic Usage.

1. Introduction

Energy sector is one of the important industries playing a vital role in the economic growth of the country. Power sector must play a more vital role in formulating, defining, and implementing the projects related to research by involving all the utilities closely, including the benefits for the end user [1]. A lot of electric utilities across the world in the nineties would have turned the way of business and operation, i.e. from integrated and vertical mechanism to open market. The rise in power consumption, especially over the past decades, has increased concerns of exhausting the natural reserves of fuel resources and petroleum in the next few decades. The significant dependence on fossil fuels has led to the visible signs of climate change in different ways. Around 8 billion MT of

carbon is dumped to the environment by human activities, around 1.5 billion tonnes from deforestation, and 6.5 billion tonnes from increasing use of fossil fuels [2].

In 1998, the Electricity Regulatory Commissions Act was established in India considering the global change in the energy industry to promote efficiency, competition, and economy in energy industry activities. In addition, Orissa electricity board was the first to apply restructuring followed by other states [3]. Fastest growing economy and population of the country poses a significant challenge for India to extend the share of renewable resources in the overall energy consumption. Currently, India stands sixth among the leading countries in terms of power generation, i.e. 177 GWs of aggregate capacity and 65% comes from thermal, 3% from nuclear, 21% from hydro, and around 11% from renewable sources of energy [4]. There has been a 5x rise in the capacity of the power sector in India over the years, i.e. from 30,000 MW in 1981 to a whopping 3,82,730 MW by April, 2021 [4]. But energy demand and generation still has a huge gap in India. Hence, generation plants are required more and more by several private and government organizations [7].

There has been a great demand for energy generation using renewable sources considering the vast and adverse effects on the environment by power generation from non-renewable sources like fossil fuels [7]. Significant attention has been given in project development, policy making, and operations to manage environment and social impacts [5]. Environmental concern is growing more than ever against the ways coal-fired power stations leave carbon emissions, especially because of high ash content, over 40% of ash content on average in the air, and the use of cheap quality coal. Coal-fired electricity generation also results in low efficiencies. Around 33% of coal plants generate huge chunks of ashes and emit other harmful gases to the environment like sulphur dioxide (So₂), carbon dioxide (Co₂), and Nitrogen oxide (NO_x). The future trajectory of economic development may cause accelerated and rapid growth in growing power consumption and energy demand from traditional sources of energy, and it may cause emissions of gases, causing the rise in greenhouse emissions and pollution [6].

There are four categories of power sector in Telangana, viz. Generation, Regulation, Transmission, and Distribution. The “Telangana Electricity Regulatory Commission (APERC)” [8] is the regulatory body of “Telangana Power Generation Corporation Limited (APGENCO)” which deals with power generation and maintenance and proposes new upgrades and projects [9]. The “Telangana Green Energy Corporation Limited (APGECL)” is the recently formed 100% APGENCO subsidy. The state would use the 10 GW solar power projects to meet the entire energy demand of the agricultural sector during day time for the duration of nine hours [10]. Telangana is one of the few states in India emerging as the leader in solar-based off-grid installations of agriculture pumps. The

state government has also announced an export policy for renewable energy for installation of 120 GW wind, solar-wind hybrid, and solar energy parks spread over 0.5 million acres [11].

APGECL has made a positive move by finalizing the tender for the construction of 5.8GW solar plants to provide free and unlimited power supply in daytime for farming activities. This decision is a part of the plan to achieve the target of 10GW solar energy for agriculture in Telangana. For successful bids, the tariffs were ranging from Rs. 2.47 to Rs. 2.49 per kWh and some of the successful bidders were “Shirdi Sai Electricals Limited” with 2.2 GW, “Adani Renewable Energy Holding” with 2.4 GW, “Torrent Power Ltd” with 0.3 GW, NTPC with 0.6 GW, and “HES Infra” with 0.3 GW. Under 6.4GW, the tariffs were 52% lower than the actual procurement of the state government and they are expected to lighten the financial issues on the exchequer. Adani is yet to finalize a bid for “Chandrasekharapuram Solar PV Park” with 600 MW capacity in Prakasam district because of a tariff of Rs. 2.58/kWh which is quite higher. Hence, it is important for the state government to come up with ambitious solar projects and restore the confidence of investors [12].

All governing bodies, registered organizations, partnership firms, and individual consumers in APDISCOM can set up solar rooftop projects or SRPs for self-consumption or sale of power supply to captive use or DISCOM according to the Electricity Act 2003 and timely amendments. SRPs would also be provided to societies or groups of individuals with SPV technology for power supply and self consumption. With capacity ≤ 56 kW, SRP must be connected at a distribution network of LT level. With > 56 kW of capacity, solar rooftop projects of 1000 kW or below can be connected at 33 kV or 11 kV distribution. However, the APERC will amend the SRP’s installed capacity for distribution network connectivity [13].

There is still a lack of research in domestic application of solar energy for daily usage as an alternative source. This is a novel study to analyze challenges related to proactive use and purchase intent of customers in Telangana about domestic solar energy usage. The use cases of solar energy have widened from internet radio, lighting, ironing clothes, and computers to solar tubewell, cooling and heating, and other purposes. Sometimes, solar energy is also used as a backup to other sources of electricity [14]. The consumer perception on the cost of the product is based on education and financial background, their social exposure, and other related factors. The value of cost is not all about finance, but also on customers’ perception of the benefits. Around 66% people in Scotland have shown interest in green energy and solar PV but high costs are the major demotivating factor [15].

One of the major challenges for early adopters of solar energy is that it takes too long to earn returns from investing in solar PV systems as compared to its lifespan. The cost benefit from solar

panels in China is achieved after 21 years while its lifespan is 25 years. Along with high cost, heavy maintenance is another major challenge which may prolong the expected return. Customers' awareness is one of the factors affecting their decision-making process. It is also up to how they collect information, manage and analyze things [15].

Background

Telangana is a tropical area, it has sunshine throughout the year, still people are not using solar energy. The main motive of the paper is to find the reasons.

Importance of the Study

This study is designed to analyze the challenges in adoption of solar energy for domestic purposes in the state of Telangana. This is completely a novel study which aims to determine whether there are implications in purchase intentions and the common causes behind them.

Research Questions

Q. What are the Challenges Associated with Solar Products Purchase Intention for Domestic Usages in Telangana?

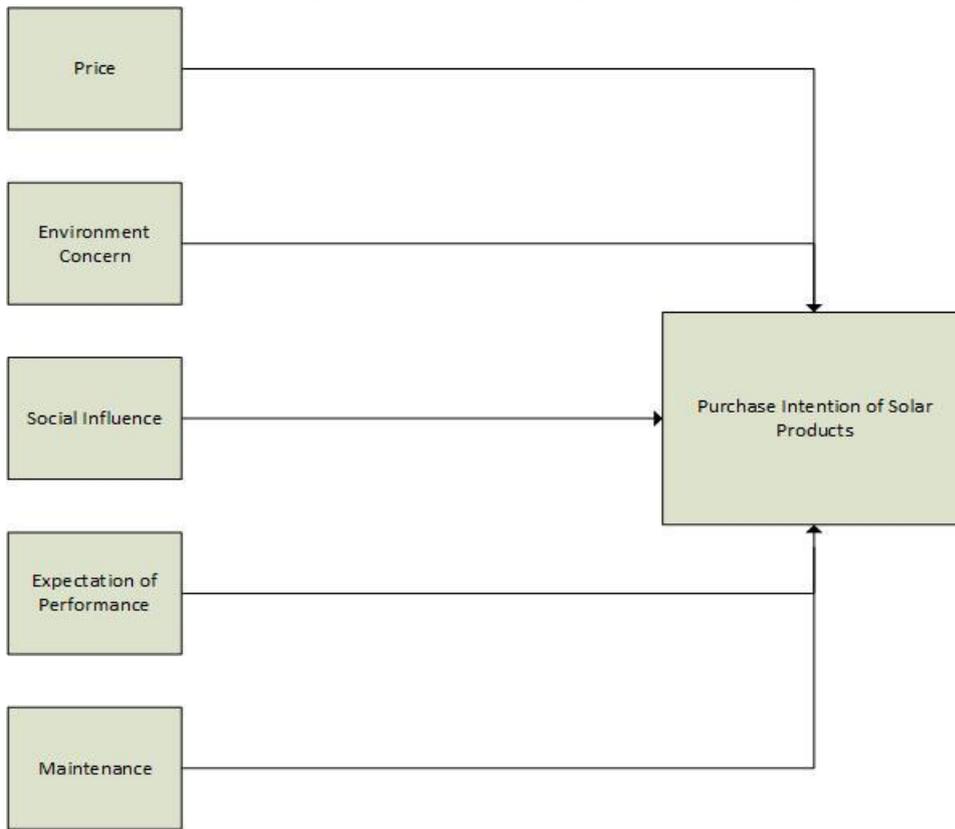
Research Objectives

To Study Key Challenges Associated with Solar Products Purchase Intention For Domestic Usages In Telangana.

Research Framework

This study has one dependent variable and five independent variables. We have adopted independent variables like price, environmental concern, performance, social influence, and maintenance because many models could not determine the role of these variables in customer perception.

Fig. 1 – Factors Influencing Customers’ Buying Intention



Factors Associated with Buying Intention of Solar Energy Usages in Telangana

2. Review of Literatures

Solar energy is a promising sector growing with significant rise in efficiencies, usage conveniences, deployments, and decline in commercial pricing. **Aggarwal et al. [16]** determine the key factors driving the purchase decision for rooftop solar energy. It will help policymakers to boost the use of this promising and eco-friendly technology. With exploratory factor analysis, it is found that the purchase intention of consumers about rooftop solar is shaped by environmental concerns, hedonic motivation, social influence, price value, performance perception, effort expectancy, and self-efficacy. The study also suggests policy measures like developing and boosting emergence of solar groups. **Kumar et al. [17]** determine the factors affecting farmers’ purchase intention for “solar water pumping systems”. The findings suggest that cost, government initiatives, and performance significantly influence buying behavior of customers. However, there are insignificant effects of factors like product and company details, eco-friendly product, social influence, and environmental concern.

Kumar et al. [18] explore the consumer behavior for solar energy products in India by collecting evidence from a sample of 510 respondents based in the rural areas of Punjab with convenient sampling and structured research design. They found several factors that can affect customer attitudes collectively for solar energy products. Government efforts and green shopping behavior affect the consumer attitude for solar energy products. On the other hand, advertisement and promotions, environmental awareness, environmental concerns, and public influence had not played any major role in consumer attitudes for such products.

Renewable energy technologies and sources can resolve long-term power cut problems and provide various solutions to the issues being faced by India and other developing economies. Along with adding new sources of energy, solar energy can also boost energy security, make India a huge market for clean energy, and deal with environmental concerns. According to **Sharma et al. [19]**, concentrating solar power (CSP) or solar thermal energy (STE) are modern technologies generating renewable energy and they can have great potential for large-scale power generation in the country. The authors summarized the existing status, availability, perspectives, strategies, key achievements, promotion policies, and potential for solar energy solutions in the country.

The solar and wind are the sources of renewable energy as they are not depleted after use. **Malik et al. [20]** determined the relationship between renewable energy equipment like solar panels and purchase intentions of customers with their perceived risks in buying those products and environmental concern as mediators. It was found that consumers can make their decisions about buying renewable energy items based on their environmental concern, knowledge about the product, and also risk involved. In addition, **Ayoub et al. [21]** observed that purchase intentions of consumers are impacted with perceived usefulness. Like the cost of acquiring and using solar energy products, customers' attitude towards buying solar energy and perceived ease of use have a positive impact on their purchase decisions at domestic level. They also found the barriers in using solar energy for domestic purposes in Pakistan and helped public organizations to know problems in applying solar energy for domestic purposes and customer expectations.

3. Methodology

This study follows quantitative methodology and collects primary data to answer the above research question. We used a questionnaire as a source to collect data and determine perceived usefulness of solar energy for domestic purposes. We collected the answers from 130 respondents through Google Forms.

4. Results

Energy is well regarded as the backbone and one of the most vital commodities of an economy Ahmad et al. [22]. There has been a significant and steep demand for energy over the past few years because of industrial growth and changing lifestyles of people across the world, Akroush et al. [23]. Due to the shortage of non-renewable energy sources, the concerns about the environment are growing and countries are looking for other sustainable and renewable energy sources. The concept of solar energy has truly changed the dynamics of the energy industry. Green energy is the product that truly reduces the risk of environmental damage. These days, renewable or green energy is widely used as an alternative to energy gathered from fossil fuels.

Demographics of the Study

Gender

Out of 130 respondents in total, there were 68 females and 60 males and two were those who didn't reveal their gender.

Table 1 – Gender of Respondents

S. No.	Gender	Numbers	Percentage
1.	Male	60	46.2%
2.	Female	68	52.3%
3.	Other	2	1.5%

Age

We interviewed 120 respondents from different age groups. Out of these, 43 were aged 15 to 25 years, 45 were aged 26 to 40, 35 were 41 to 55, and the rest 7 were aged above 55.

Table 2- Age of the Respondents

S. No.	Age Groups (years)	Numbers	Percentage
1.	15-25	43	33.1%
2.	26-40	45	34.6%
3.	41-55	35	26.9%
4.	Above 55 years	7	5.4%

Occupation

Table 3 – Occupation of the Respondents

S. No.	Occupation	Numbers	Percentage
1.	Engineer	16	12.3%
2.	Doctor	4	3.1%
3.	Housewife	27	20.8%
4.	Business Man/Self-Employed	33	25.4%
5.	Corporate Professional	9	6.9%
6.	Govt. Official	3	2.3%
7.	Student	15	11.5%

Regional Background

Out of 130 respondents, 113 people live in urban areas and the rest 17 people belong to rural areas.

Table 4 - Regional Background of the Respondents

S. No.	Regions	Numbers	Percentage
1.	Urban	113	86.9%
2.	Rural	17	13.1%

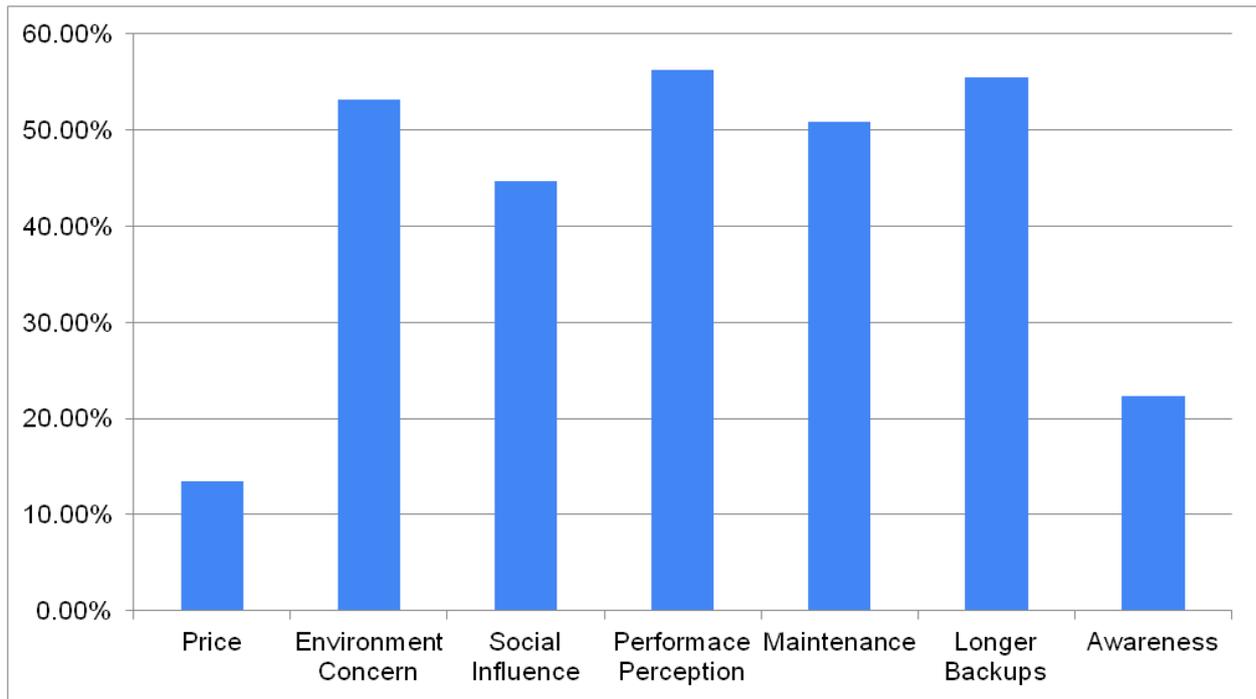
Survey Data Analysis

Table 5 shows different factors and their effects on consumers' purchase behavior for solar energy and its domestic usage in Telangana. There have been positive correlations with environmental concern, performance perception, and social influence.

Table 5- Factors Determining Customer Influence and Response

Factors affecting Customer Influence	Result	Response
Price	13.50%	Easy to buy on EMI
Environment Concern	53.10%	Positive
Social Influence	45%	Family and Friends
Performance Perception	56.20%	Very much effective in rural areas
Maintenance	50.80%	works even in rainy season
Longer Backups	55.40%	Negative
Awareness	22.30%	Pretty much

Fig. 1 – Consumer Perception towards Solar Energy



Price Value

Despite having a positive response in terms of performance and other factors, only 13.5% respondents remained positive when it comes to actually investing in solar energy. However, 65.4% of people responded that they choose solar energy to save electricity bills and 48.5% of people consider it as a value for money decision. Hence, it is observed that solar energy is widely considered for its perceived long-term benefits.

Environmental Concern

It goes without saying that solar energy is a great alternative to fossil fuels and it can save the environment to a great extent. This survey has made it clear that 53.1% of people perceive solar energy as an eco-friendly way to save power, remove carbon emissions, avoid environmental pollution, and resolve the long-term issue of global warming. On the other side, 30.8% and 10% of people agreed that solar energy can reduce pollution from the environment and save energy in an eco-friendly way.

Social Influence

In this survey, around 44% respondents switched to solar energy because they were recommended by their family and friends. In addition, society also played a vital role in influencing customers to choose an eco-friendly way to generate electricity for domestic purposes.

Performance Perception

Around 56.20% people believe that solar panels work effectively in rural areas because of the open environment and direct sunlight on the rooftop. In addition, 32.30% are also on the positive side as they perceive solar energy to be somewhat effective in rural areas. Hence, the government should focus more on those areas because they still face the problem of power cuts and lack of proper energy resources. This way, solar energy can be a boon to farmers and people living in rural areas.

Maintenance

Around 50.80% of people responded that solar panels work even in the rainy season. However, further research is still needed as the majority (29.2%) of people is still not sure as to whether it works effectively without sunlight.

Longer Backups

Backup is yet another problem perceived among the customers with solar panels. Only 44.6% of people said that these panels last longer without charge. On the other hand, 46.9% were still not sure about that.

Awareness

Lack of awareness is yet another challenge for wide-scale adoption of solar panels. This study also shows that solar energy still has a long way to go. Only 22.3% of people had proper knowledge about the PV technology of solar cell panels in this survey. So, private and public organizations should work together to spread awareness about the benefits of solar energy for domestic purposes.

5. Conclusion

Customers develop their purchase intentions despite having risks in investing on any product. They initially develop their knowledge about the products before making purchase decisions. In this study, it is also observed that environmental concerns play their part when buying solar energy products. We have found a lot of educated respondents in this survey for responses to our questionnaire. Awareness is yet another concern and challenge for solar product manufacturers and authorities to enhance the adoption of renewable energy products and save the environment. Hence, there is a strong need to push the knowledge and awareness of customers about the benefits of solar energy and efforts should be made to provide proper support to domestic customers, while cutting down the risks involved.

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Appendix

Q1. How aware are you about photovoltaic (PV) technology?

- Pretty Much
- Heard about it
- I have little bit of knowledge
- Don't know

Q2. According to you, what are the eco-friendly benefits of solar energy in domestic usage?

- Zero Carbon Emissions
- Eco-friendly way for power generation
- Solution for environmental pollution
- Helps resolve global warming issue
- All of the above

Q3. Why did you choose solar energy or why are you considering it for domestic usage?

- Value for money
- Saves electricity bills
- Higher resale value of the land or property
- Easy to buy on EMI basis
- High electricity costs made me switch to solar energy
- Other Economic benefits

Q4. Does your solar panel provide longer backups?

- Yes
 No

Q5. Does your solar panel works even in rainy season?

- Yes
 No

Q6. How much solar panels are effective in rural and distant areas according to you?

- Very Much
 Somewhat Effective
 Not much effective
 Not Effective at all

Q7. Who inspired you to switch to solar energy for domestic purposes?

- My society inspires me to take this decision
 My friends and family suggested me to opt for eco-friendly means for energy
 Many people I know who use solar energy
 I adopted it as a status symbol
 I wanted to set an example for everyone in my society to adopt eco-friendly solutions.