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Rooftop Solar Panels: A Sustainable Green Energy Solution

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Abstract: *A solar panel is an energy system that provides a sustainable alternative to conventional non-renewable sources. As a decentralized power solution, it captures solar energy and converts it directly into electricity through the photovoltaic effect. The primary advantage of installing solar panels lies in their eco-friendly nature, producing clean energy without emitting carbon or other harmful pollutants. Despite these benefits, consumer adoption of solar products remains relatively low when compared to traditional energy sources. Key barriers include high upfront installation costs, limited space availability, and inconsistent energy output due to changing weather conditions. This paper examines the potential of rooftop solar panels and investigates consumer perceptions and attitudes toward their adoption. The study is based on data gathered from 50 individuals in Indore, comprising both users and non-users of solar panels.*

Keywords: Solar rooftop Panels, Potentiality, consumer perspective, Utilization, Govt. initiatives, Government subsidies

I. INTRODUCTION

Solar energy is a clean energy resource that has become a viable option for replacing some fossil fuels at a certain level. Rooftop Panels could eliminate land costs when compared to ground-mounted Panel power stations, which require a large amount of land; this aspect is especially convenient in urban areas, so many countries are devoted to promoting rooftop PV to generate more renewable energy. The government's policy for escalating PV adoption has focused on providing financial incentives. It enables energy independence, and low electricity bills, and contributes to grid stability by generating energy at the point of consumption, also surplus power can often be fed back into the public grid under net metering policies, to provide economic benefits to the consumers. Though, many researchers have revealed that other factors affect the adoption of residential solar energy systems. The main motive for implementing small-scale PV electricity production is environmental concern. Solar and green energy programs appear to attract customers with diverse lifestyles. Beyond the government incentive policy, this body of literature demonstrated that personal traits such as environmental concern, an ecological lifestyle, and the attribute of innovation influence a consumer's PV adoption. This paper will examine the psychological impact of green energy products on users. Also, the intention of installing rooftop Panel and reasons, if not using Panel.

Status of solar rooftop in India

- This program has been started in 2010 by The Jawaharlal Nehru National Solar Mission.The original goal was to produce 20 GW of solar energy by 2022; though, this goal was later raised to 100 GW by 2022, which comprised 40 GW from RTS.
- In 2024, total rooftop installed capacity reached 11.87 GW, which raised to approximately 3 GW capacity with the expectation of 4 GW in 2025. States like Gujarat, Andhra Pradesh, and Telangana are foremost in the growth of solar rooftops.

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- In 2014, the Government launched a solar rooftop program, to promote rooftop solar systems. It targeted 40 GW installed capacity by 2022, but the goal wasn't touched. The deadline is now extended to 2026.
- As to the Council of Energy, Environment, and Water (CEEW), residential sectors now have only 20% of rooftop systems installed. By placing solar panels on their rooftops, India's 250 million households could produce 637 GW, meeting one-third of their domestic electricity needs.
- Recently, Pradhan Mantri Surya Ghar Muft Bijli Yojana was introduced to avail free monthly electricity for 300 units to 1 core household through rooftop solar system installation.
- This yojana was approved with a budget of Rs. 75021 crores to allot direct subsidies to the consumers.
- Many initiatives have been taken by the Government, to widen the awareness and adaptivity of harnessing energy through solar.
    - One Sun, One World, One Grid
    - Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya)
    - Green Energy Corridor
    - National Smart Grid Mission (NSGM), and Smart Gird National Programme.
    - International Solar Alliance
    - Solar Park Scheme
    - National Solar Mission
    - PM-KUSUM

Solar Rooftop System in Madhya Pradesh

Madhya Pradesh (M.P.) is making substantial progress in installing solar rooftops, as of April 2025.

- The rooftop solar systems have been installed across western M.P. including regions like Indore, Ujjain, and Malwa Nimar is over 25000 installations in 250 places. In west MP the maximum electricity from solar energy is being produced at 13800 places in Indore city.
- The state's total rooftop solar capacity has topped 220 MW, which helps households save money and produce significant quantities of electricity each month.
- By 2030, Madhya Pradesh wants 60% of its electricity generated from solar energy.
- One of the biggest rooftop solar installations in India was put into service by Godrej Electricals & Electronics for a textile factory in the state. The project has a capacity of 12.5 MWp.
- To increase the state's solar capacity in several sectors, Madhya Pradesh Urja Vikas Nigam Ltd. (MPUVNL) is seeking bids for 26 MW of rooftop solar projects.

Solar Rooftop System in Indore City

Indore is making significant progress in installing solar rooftops, as of April 2025.

- The Indore and Ujjain divisions have installed more than 15,500 rooftop solar systems, of which 8,500 are in Indore alone. These systems are mostly located in the ring road, bypass, super corridor, and core city areas.
- The combined capacity of these plants is around 130 MW, and after the monsoon season, it is expected to be an increase in output.
- Over a three-year period, the Indore Municipal Corporation intends to turn the city into a "Solar City" by producing 300 MW of electricity using rooftop solar panels.
- 25,000 to 30,000 rooftop solar systems will be installed in 22 colonies and 1,400 government buildings within a three-month period, with plans to gradually extend to 85 colonies.
- Homeowners installing solar systems on plots larger than 1,500 sq. ft. are eligible for a 6% rebate on building map fees.

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II. REVIEW OF LITERATURE

1. Purohit, S. S., Agrawal, A. K., & Shammi

In the book "Environmental Sciences A New Approach," the authors address the global market for solar energy and its utility. It is a non-conventional energy source that is inexhaustible. It is a long-lasting, non-polluting, and inexpensive source of power. The sun's energy has the potential to be a huge source of energy for a variety of applications. Solar energy in the amount of around 75000 TkWh is released into the atmosphere. Every day, the earth. Only 0.1 percent of this amount is required to meet global needs. A mere 0.1% of this astounding figure is sufficient to meet world energy needs. During the period 1990-2000, the use of solar energy increased by 16 percent. If the current trend continues, the solar market is predicted to reach 10600 MW. Every year, there is a 25% increase in Annual growth. Japan is a leading company in utilizing solar energy. Solar energy currently can be generated in three ways:

(a) Direct heating
(b) Solar Photovoltaic
(c) Solar Thermal

2. Meenakshi, P. (2012)

In this book, "Elements of Environmental Science and Engineering" the author discusses solar energy. Solar energy may be directly used by active or passive ways. Solar energy can also be directly utilized by solar cells or photovoltaics which coverts sunlight into electricity. India has consistently been a leading manufacturer of photovoltaic (PV) systems. Street lighting systems (SLS), domestic lighting systems (DLS), community lighting systems and TVs (CDs and TVs), water pumping systems, and small power plants are all examples of Panels currently in use. The sun is used to heat either water or a heat-transfer fluid, such as a water-glycol antifreeze mixture, in collectors that are often located on a roof. The heated water is then stored in a tank that looks like a regular gas or electric water tank. To circulate the fluid through the collectors, some systems use an electric pump.

3. Kumar, P. (2015)

In this paper "Green Marketing Products in India", the researcher has paid attention towards the significance green marketing. The researcher laid stress on creating awareness among the consumers about green products, also tried to get the consumer's opinion about green buying. Also, the obstacles of buying green products are examined. In this paper, it has been analyzed that consumers are ready to buy green products in premium products, but the major hurdle is their lack of knowledge about green energy products.

III. STATEMENT OF PROBLEM

In the market, the customer is king, he will purchase a product if it meets his needs. Currently, electricity usage is high, and its cost is also elevated, leading customers to turn to solar products as alternatives to electronic devices. Electronic products will be replaced by solar energy products. Despite this, the customer is hesitant to install a rooftop Panel. A survey has been conducted to determine customer satisfaction with solar energy products.

IV. OBJECTIVE OF THE STUDY

- Focus on customer satisfaction level toward Panel installation.
- Consumer awareness about the financial benefits of installing solar Panels.
- Consumer awareness about the environmental benefits of installing solar Panels.
- To examine the domestic electricity conservation pattern of consumer

V. RESEARCH METHODOLOGY

The process of conducting research and gathering data is referred to as research technique. Assessing consumer awareness and market potential, it normally entails a thorough explanation of all the options that have been selected. The text also includes the procedures and techniques used to conduct research effectively and evaluate the market for

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emerging renewable energies among domestic customers. This study uses convenience sampling, with a sample size of 50 participants of the Indore District. For this, primary data has been taken via filing up a questionnaire from the respondents of Indore District.

Limitations of the study

- The universe is huge and this research on solar Panel is limited to Indore District only
- This study is limited to 50 respondents. It may or may not justify the whole consumer's attitude towards solar Panel

VI. DATA ANALYSIS AND INTERPRETATION

The primary data was utilized for analysis. Following statistical methods were used:

- Simple percentage method
- Likert scale analysis

SIMPLE PERCENTAGE ANALYSIS

Simple percentage analysis is a method for representing raw data streams as a percentage to better understand the collected data. The percentage analysis used to generate a contingency table from frequency distribution and collected data representation for better comprehension.

Formula:

$$\text{Percentage} = \frac{\text{Number of respondents}}{\text{Total no. of respondents}} \times 100$$

TABLE NO. 1: DEMOGRAPHIC PROFILE OF THE RESPONDENTS

S.No.	Variable	Distribution	Frequency	Percentage
1	Gender	Male	29	58%
		Female	21	42%
2	Age	18-25	11	22%
		26-35	20	40%
		36-50	12	24%
		50 & above	7	14%
3	Academic Qualification	Doctorate	3	4.1%
		Masters	23	46.9%
		Bachelors	15	30.6%
		Diploma/Certifications	2	4.1%
		Higher Secondary	7	14.3%
4	Occupation	Professional	13	26.5%
		Businessman	3	6.1%
		Employed	20	40.8%
		Homemaker	8	16.3%
		Student	5	10.2%
5	Marital Status	Married	37	74%
		Unmarried	13	26%
6	Annual Income	Less than 3,00,000	17	38.6%
		3,00,000-6,00,000	12	27.3%
		6,00,000-9,00,000	6	9.1%

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		9,00,000-12,00,000	6	13.6%
		12,00,000-15,00,000	3	6.8%
		15,00,000 & above	2	4.5%

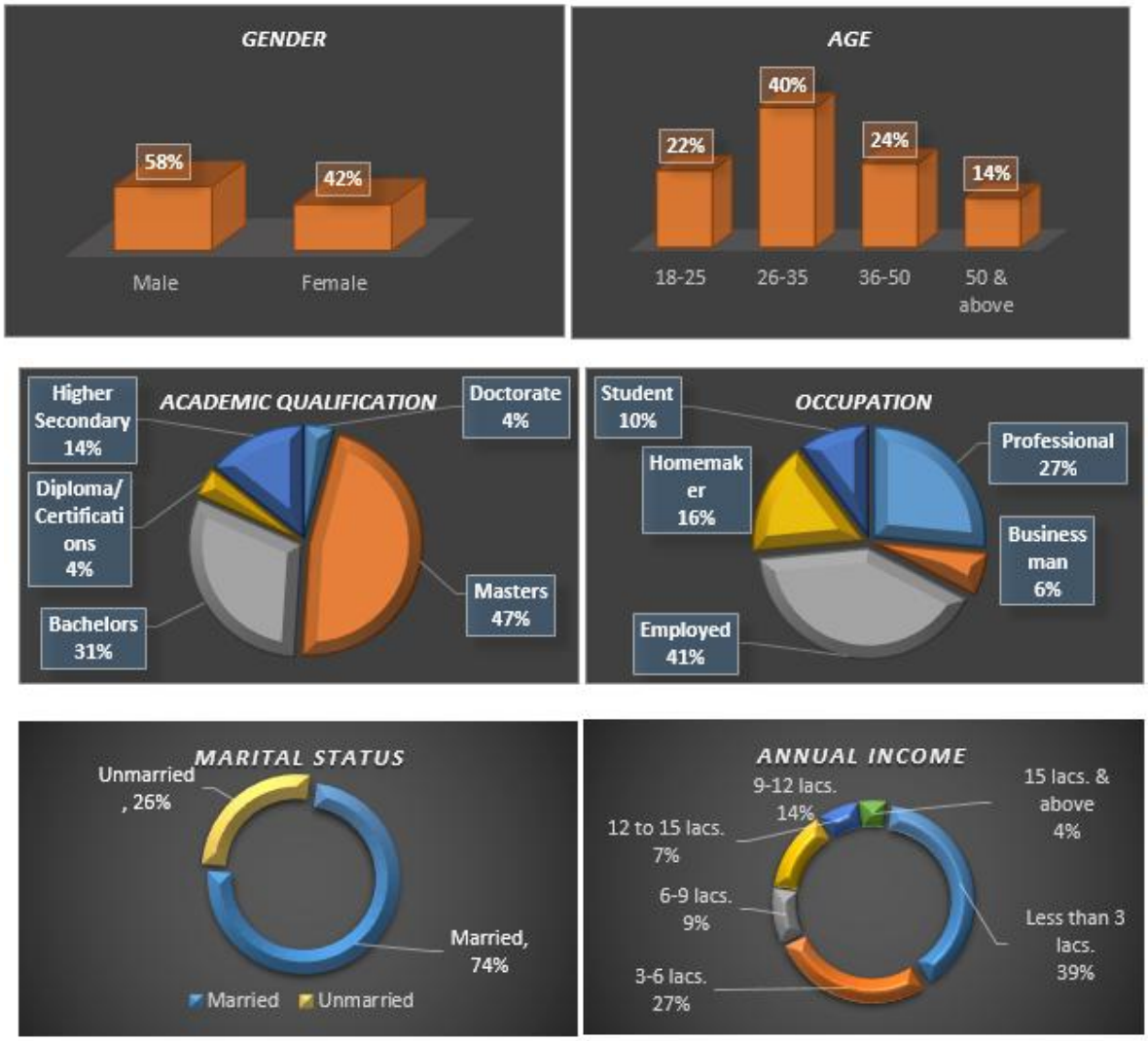

Figure 1: Charts showing Demographic Profile of the respondents

Interpretation

- From the table, it has been observed that 58% respondents are male and remaining are females
- It has been observed that majority of respondents come under the age group of 26-35, which is 40%, then 36-50, which is 24% and the nearby age group is 18-25, which is 22% and only 14% of respondents are from the age 50 & above
- The Academic background is 46.9% have done Masters, 30.6% are Bachelors, 14.3% are from Higher secondary, and only 4.1% have done doctorate and diploma/ certification

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- Out of the 50, 40.8% respondents are employed in some organization, 26.5% are professionals, 16.3% are homemakers, 10.2% are students, and 6.1% are running their own business.
- It has been found that 74% of respondents are married and the remaining are unmarried
- It indicates that 38.6% of respondents falls under the annual income group of less than INR. 3 lacs, 27.3% comes under 3 to 6 lacs, 13.6% are from 9 to 12 lacs, 9.1% comes under 6 to 9 lacs, 6.8% falls under the group of 12 to 15 lacs and only 4.5% are from 15 & above lacs.

TABLE NO. 2: GENERAL QUESTIONNAIRE FOR INSTALLATION OF SOLAR PANELS

S. No.	Variable	Yes (%)	No (%)
1	Whether respondent has already installed Solar Panel at home	40	80
2	Respondents' awareness about Solar Panel	74	26
3	Awareness about the subsidies provided by the Government for the solar Panel installation at home	62	38
4	Consumer preference to buy / install electric products instead of solar products.	52	48
5	Consumer's preference to buy / install green products even if they are expensive	42	58

Interpretation

- It has been observed that 80% of the respondents have not installed SPanel at home rooftop, remaining has installed it already.
- It has been observed that 74% of respondents already have knowledge about solar panels, and the rest are not aware of it.
- It is found that 62% of respondents keeps the knowledge of schemes run by the Government for the penetration rooftop Solar Panel, the other unaware of it.
- The data reveals that 52% of people agree to buy/installing solar products instead of electric products. The remaining 48% prefer to buy electric products comparatively.
- It has been found that 58% of respondents are not willing to buy/install green products, if they are expensive. The high price will not change the preference of green products to the rest 42%.

LIKERT SCALE ANALYSIS

The most popular technique for scaling responses in research studies is the use of Likert Scales. The Likert Scale is used in research questions, when you are asked to rate your level of agreement, from strongly agree or highly satisfied to strongly disagree or highly dissatisfied. In the Likert scale approach, a person's attitude is assessed by adding up (or averaging) all their responses to all the items. Mid-value indicates the middle most value of the Likert scale.

Formula: Likert scale = ∑fx / Total number of respondents

TABLE NO.3: CONSUMER'S LEVEL OF SATISFACTION FROM SOLAR PANELS

S. No.	Variable		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	TOTAL
1	They are too expensive to install	(f)	1	3	11	15	19	50
	Likert value	(x)	1	2	3	4	5	
		fx	1	6	33	60	95	195
2	Solar energy will soon		0	2	7	12	29	50

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	be cheaper than coal energy	(f)						
		(x)	1	2	3	4	5	
		fx	0	4	21	48	145	218
3	It is an effective way to bring electricity in rural areas	(f)	0	0	3	5	42	50
		(x)	1	2	3	4	5	
		fx	0	0	9	20	210	239
4	Solar energy devices are better than electrical devices	(f)	1	5	11	6	27	50
		(x)	1	2	3	4	5	
		fx	1	10	33	24	135	203
5	Solar Energy Products are clean and environment friendly	(f)	0	0	4	5	40	50
		(x)	1	2	3	4	5	
		fx	0	0	12	20	200	232

Interpretation

Likert = ∑ (fx) /Total Number of respondents

195/50 = 3.9, Likert scale is greater than 3, which indicates that most respondents believe that solar Panel is expensive to install.

218/50=4.36, it indicates that majority of respondents believe that solar energy will soon be cheaper than coal.

239/50=4.78, favorable response on the statement that solar energy is an effective way to bring electricity to rural areas.

203/50=4.06, favorable response on the statement that solar energy devices are better than electric devices.

232/50=4.64, favorable response on the statement that solar energy products are clean and eco-friendly.

VII. FINDINGS & SUGGESTIONS

Price: Majority of respondents have stated that the Solar Panel is too expensive to install, and respondents are less interested in installing if the prices remain high.

It is suggested that solar companies and the Government should take the initiative to reduce the prices by applying new innovative techniques and possible ways that can reduce the cost of manufacturing and installation. However, New schemes have been launched by the Indian government to reduce the price burden on consumers, such as the PM Surya Laxmi Yojana.

Awareness: Majority of respondents are aware of solar Panels.

It is suggested that more awareness programs should be conducted i.e. campaigning, advertisement, educational speech, etc. More emphasis should be laid on educating people in rural areas.

Government Subsidies: It is encouraging that most respondents are aware of government subsidies. Extra efforts should be emphasized to reach more people through promotional and awareness programs, so they can take advantage of the schemes provided by the government.

VIII. CONCLUSION

In all business markets, the consumer is the key player; if the consumer is satisfied, then a business's presence in the market becomes established. Identically, if solar energy products meet consumer needs and budgets, they will grow rapidly and gain a stronger market presence. This paper has identified many positive responses from participants

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regarding their consciousness about the environment, awareness of solar Panels, and their preferences. However, the sample size is still relatively small, indicating a need for additional awareness programs, efforts to reduce prices, and more beneficial government schemes to effectively capture the market and reduce fossil fuel consumption. The findings suggest that consumers are increasingly aware of the advantages of buying solar energy products. Residents of Indore District express a sense of responsibility for maintaining a green and clean environment and are willing to shift their choices from non-green to green alternatives

REFERENCES

[1]. Purohit, S. S., Agrawal, A. K., & Shammi, Q. J. (2004). Environmental sciences: A new approach. Agrobios (India).

[2]. Meenakshi, P. (2012). Elements of environmental science and engineering. PHI Learning Pvt. Ltd.

[3]. Kumar, P. (2015). Green marketing products in India. DAV Academic Review, 1(1), 1–12.

[4]. Times of India. (2024, April 4). Pay nothing to set up a 3 kW solar rooftop plant in Madhya Pradesh. https://timesofindia.indiatimes.com/city/bhopal/pay-nothing-to-set-up-a-3-kw-solar-rooftop-plant-in-madhya-pradesh/articleshow/112003038.cms

[5]. Drishti IAS. (n.d.). Rooftop solar in India's energy sector. https://www.drishtiias.com/daily-updates/daily-news-analysis/rooftop-solar-in-india-s-energy-sector

[6]. Aaj Tak. (2025, February 13). Electricity is being produced from solar energy in Western Madhya Pradesh i.e. Malwa-Nimar. https://www.aajtak.in/madhya-pradesh/story/electricity-is-being-produced-from-solar-energy-in-western-madhya-pradesh-ie-malwa-nimar-lcln-dskc-2166616-2025-02-13

[7]. PV Magazine India. (2024, December 20). Madhya Pradesh to meet 50% of its power needs through solar energy by 2030: Chief Minister Mohan Yadav. https://www.pv-magazine-india.com/2024/12/20/madhya-pradesh-to-meet-50-of-its-power-needs-through-solar-energy-by-2030-chief-minister-mohan-yadav/

[8]. The Economic Times. (2024, October 10). Godrej Electricals commissions 12.5 MW solar rooftop plants in Madhya Pradesh. https://www.energetica-india.net/news/mpuvnl-invites-bids-for-26-mw-solar-rooftop-plants-in-madhya-pradesh

[9]. Energetica India. (n.d.). MPUVNL invites bids for 26 MW solar rooftop plants in Madhya Pradesh. https://www.energetica-india.net/news/mpuvnl-invites-bids-for-26-mw-solar-rooftop-plants-in-madhya-pradesh

[10]. Energetica India. (n.d.). MPUVNL invites bids for 26 MW solar rooftop plants in Madhya Pradesh. https://www.energetica-india.net/news/mpuvnl-invites-bids-for-26-mw-solar-rooftop-plants-in-madhya-pradesh

[11]. Times of India. (2023, October 13). Power play: Rooftop solar panels put up at 6K places in Indore. https://timesofindia.indiatimes.com/city/indore/power-play-rooftop-solar-panels-put-up-at-6k-places-in-indore/articleshow/104412568.cms

[12]. The Print. (2023, May 28). Plan to transform Indore into solar city, target to generate 300 MW energy through rooftop panels. https://theprint.in/india/plan-to-transform-indore-into-solar-city-target-to-generate-300-mw-energy-through-rooftop-panels/1553995