Reasons For and Against Solar Rooftop Adoption: A Behavioral Reasoning Theory Approach

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Abstract: India's ambitious renewable energy targets face significant challenges in rooftop solar adoption, despite favorable policies and economic incentives. This study investigates the psychological and behavioral factors influencing consumer intention to purchase solar rooftop photovoltaic (PV) systems using Behavioral Reasoning Theory (BRT). Employing Covariance-Based Structural Equation Modeling (CB-SEM) on data from 415 respondents across North India, we examine how environmental concern (reason for) and perceived risk (reason against) influence consumer attitudes and purchase intentions. The results enumerated that environmental positively influences attitude, which fully mediates its impact on purchase intention. Conversely, perceived risk demonstrates both direct and indirect negative effects on purchase intention through attitude. The results highlighted perceived risk as a complex barrier that operates through both attitudinal and direct mechanisms, underscoring attitude's crucial mediating role in converting environmental consciousness into purchase intentions. These findings give policymakers and marketers vital information for promoting solar rooftop photovoltaic technology.

Keywords: Solar rooftop PV, Renewable energy, Behavioral Reasoning Theory, Environmental Concern, Purchase Intention

1. Introduction:

Global carbon emissions reached 37.8 Gt CO_2 in 2024, with India contributing 8% of energy sector emissions (*CO2 Emissions – Global Energy Review 2025 – Analysis - IEA*, n.d.). Coal-based power generation remains India's primary electricity source at 223.07 GW, despite growing solar capacity of 119.02 GW. India committed to achieving 500 GW non-fossil capacity by the year 2030 and net-zero emissions by 2070 under international climate agreements. Solar photovoltaic technology offers emission-free energy generation with exceptional reliability and minimal operational costs (*Press Release:Press Information Bureau*, n.d.). However, adoption rates remain slow despite government initiatives like Pradhan Mantri Surya Ghar Yojana, which achieved only 13.1% of its target by July 2025 (*PMSGY Accelerates Residential Rooftop Solar, yet Supply and Financing Hurdles Remain | IEEFA*, n.d.). In addition of financial and technical obstacles, behavioral and psychological aspects have a major role in consumer adoption decisions. This study employed Behavioral Reasoning Theory (BRT) to investigate how consumer attitudes and purchase intentions for residential solar rooftop systems are affected by perceived risk and environmental concern, addressing a critical research gap in understanding both promoters and barriers of renewable energy adoption in India.

2. Review of Literature:

2.1 Behavioral Reasoning Theory

To comprehend human behavior, behavioral intention models have long relied on the theories of TRA and TPB (Ajzen, 1991). Previous behavioral theories like TAM and UTAUT considered factors that only contribute to behavioral intention. BRT posits to offer a more thorough understanding of consumer decision-making by including context-specific reasons, which serve as important linkages between consumers' values, attitudes and behavioral intentions (Westaby, 2005a). BRT incorporates context-specific reasons that function as critical

connections between personal values, attitudes, and behaviors (Claudy et al., 2014; Westaby, 2005b). BRT as a framework covers both barriers and drivers and states that reasons that go in favor and against adoption may not be opposites of each other (Sahu et al., 2020). Reasons are defined as "specific subjective factors people use to explain their anticipated behavior and can be conceptualized as anticipated reasons, concurrent reasons and post hoc reasons" (Westaby, 2005a). BRT considers that individuals' values can influence the reasons for (RF) and reasons against (RA) adoption, which consequently influence their attitudes and behaviors (Sahu et al., 2020). These reasons act as connecting links between beliefs and values, attitude, and intention (Fatah Uddin et al., 2024). Scholars have utilized BRT for investigating consumer behavior in different areas, such as organic food (Tandon et al., 2020), resistive or favorable consumer perceptions towards innovations (Claudy et al., 2013, 2014) and in the case of mobile banking adoption (Gupta & Arora, 2017).

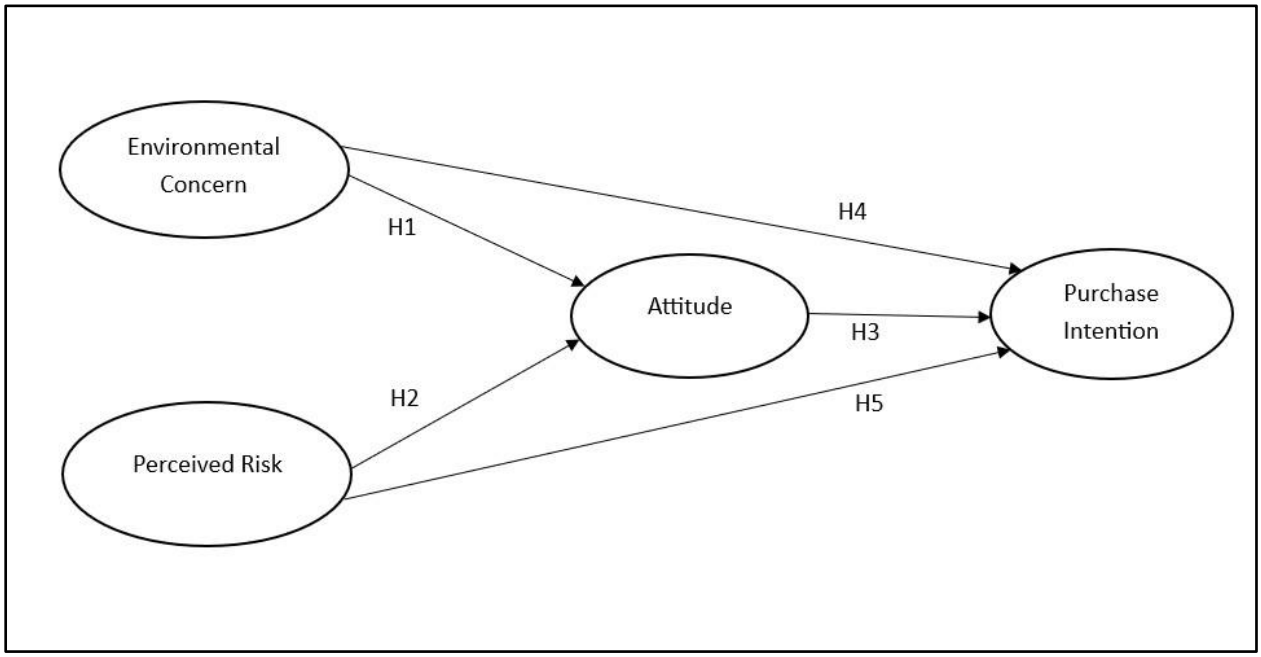

Figure 1: The Conceptual Framework
Source: The Authors

2.2 Reasoning and Attitude

Reasons are important in the development of attitudes, according to BRT. When people have sufficient reasons to support and justify a choice, they tend to positively evaluate that choice (Westaby, 2005b). The reasons taken here are environmental concern as 'reason for' and perceived risk as 'reasons against'. Environmental concern (ENC) is characterized as people's awareness of environmental problems and their desire to resolve these issues (Hoang et al., 2020). The decision to use solar energy is highly affected by environmental factors like the environmental concern of users, the environmental benefits of innovation, etc. (Parsad et al., 2020). (P. Kumar et al., 2024) found that environmental concern as a critical driver of solar energy adoption. Researchers discovered that consumers having higher environmental concern have more favorable attitude towards green products (Hansla et al., 2008; Tang et al., 2014), they also linked environmental concern with consumer attitudes (Dhir et al., 2021).

According to risk theorists, risk perceptions are defined as the possibility of there being unwanted events such as accident (Howard, 2011; Rohrmann & Renn, 2000). Customers' perception that solar PV technology is risk-oriented is known as perceived risk (Tanveer et al., 2021), the study confirmed that consumers' perceptions of risk had an adverse influence on their adoption of solar PV. Wu & Chen (2014) found that consumer's attitude was negatively influenced by perceived risk. Risk perception refers to the ability of the concerned individual to discern the amount of risk involved or associated with a particular activity (Komendantova et al., 2012). Therefore, we propose the following hypothesis:

H1 = Environmental concern positively influences attitude towards purchasing solar rooftops.
H2 = Perceived risk negatively influences attitude towards purchasing solar rooftops.

2.3 Attitude and Intention

Attitude has been recognized as a predictor of behavior (Casaló & Escario, 2018). The adopter's and non-adopter's decisions are determined by their attitude, which is the antecedent of behavioral intention (Di Falco & Sharma, 2018; Jansson, 2011). Greaves et al. (2013) determined that attitude towards behavior represents a person's total behavior assessment, based on the conviction that the action will yield the intended outcomes. The most significant predictor in research on renewable energy is attitude, which favors sustainable development (Greaves et al., 2013; Tan et al., 2017). According to previous research, individual's attitude influence the purchase intention of efficient-energy items such as rooftop solar and PV panels (Abreu et al., 2019; Aggarwal et al., 2019a; V. Kumar et al., 2022). So, the following hypothesis was proposed:

H3 = Attitude has a significant impact towards purchasing solar rooftops.

2.4 Reasoning and Intention

People having higher environmental concerns have higher tendency of buying pro-environmental products (Junior et al., 2015). Kim & Choi (2005) had demonstrated a strong link between consumers' inclination to purchase eco-friendly products and their degree of environmental concern, indicating that consumers who care about the environment prefer to purchase products that reflect that concern. Users' willingness to pay for green power is highly connected with environmental concern (Bang et al., 2000). Some studies confirmed that environmental concerns affect consumers' purchasing decisions for eco-friendly products (Balderjahn, 1988; Roberts & Bacon, 1997).

A study by (Rahmani et al., 2023) revealed that households' perceived risk significantly and negatively influences their intentions to invest in RE projects. The theory of perceived risk, posits that an increase in perceived risk will decrease consumers' willingness to buy (Mitchell, 1999). (Tanveer et al., 2021) asserts that customers' desire to adopt solar PV was adversely impacted by perceived risk. Customers are unlikely to buy and install a home PV system if they believe it has serious security issues (Adenle, 2022). If consumers perceive a high risk for a product, they are unlikely to purchase it (Chang & Chen, 2008). Therefore, we hypothesize the following proposed hypotheses:

H4 = Environmental concern positively influences solar rooftop purchase intention
H5 = Perceived risk negatively influences solar rooftop purchase intention.

2.5 Mediating Role of Attitude between Reasons and Purchase Intention

(Claudy et al., 2013) suggest that market researchers should study the attitude's mediation role between consumers' 'reasons for' (RF) and 'reasons against' (RA) and purchase intention. Examining how attitude functions as a mediator can also help identify factors influencing customers' decision-making process in a particular context (Tandon et al., 2020). Attitude has been shown to function as a mediator between reasons (for and against) and purchase intention. (Huang & Qian, 2021; Prathansong & Kananurak, 2023). Therefore, it can be hypothesized that:

H6 = Consumers' attitude towards solar rooftop purchase intention mediates the relationship between 'reason for' and solar rooftop purchase intention.
H7 = Consumers' attitude towards solar rooftop purchase intention mediates the relationship between 'reasons against' and solar rooftop purchase intention.

3. Methodology

3.1. Questionnaire Design and Data Collection.

Google Form was used to create the questionnaire, which was circulated via emails, WhatsApp, Instagram, and Telegram. The questionnaire consists of two sections. The first section covers demographic profiles of the respondents which includes age, education level, profession and annual family income. Next section includes the 'Reasons for' purchasing solar rooftops. The last section includes the 'Reasons against' attitude and purchase intention. Last two sections include the level of agreement and disagreement of consumers on different variables taken under the study.

We used the purposive convenience sampling technique to empirically investigate the suggested hypotheses since it was suitable and fit the study's structure, also because our research was exploratory. Since rooftop solar in India is in early stages, urban consumers make up the majority of "early adopters" who have the resources and knowledge to use the technology. Furthermore, rather than generating precise population estimates, the study's main goal is theory-testing, or confirming the BRT framework (Calder et al., 1981). 415 of the 450 responses that were collected were deemed suitable for the study. According to earlier research, 415 was a suitable fit for using SEM, as recommended by (Hair et al., 2021). The sample size for the present study was 415, with 4 constructs of 12 items considered to be fit and above (415 > 12*15 = 180). The data used in this study came from the main cities of North India, which includes, Delhi NCR, Haryana, Uttarakhand and Uttar Pradesh. Data collection period was between June to August 2025.

3.2 Measurements of Scale

The study used a seven-point Likert Scale, wherein 1 denotes strongly disagree, while 7 denotes strongly agree. The items were modified from earlier research to meet the study's goals and fit the context of solar rooftop buying intention. The items of environmental concern (3 items) was adapted from (Abdullah et al., 2021; Kar et al., 2024; Lee, 2009), perceived risk (3 items) from (Tanveer et al., 2021). The items of attitude (3 items) and purchase intention (3 items) were adapted from (G. Kumar & Nayak, 2024).

4. Analysis and Results

Covariance-Based Structural Equation Modeling (CB-SEM) with AMOS 23.0 was employed to test the proposed hypotheses and evaluate the linkage between constructs (Biswas et al., 2022; Hair Jr. et al., 2014). CB-SEM was used over Partial Least Squares (PLS-SEM) because it can evaluate intricate relationships while taking measurement imperfection into consideration. It validates pre-defined theoretical frameworks like Behavioral Reasoning Theory (BRT) and this technique is commonly employed to examine direct and indirect relationships in social sciences and marketing (Hair Jr. et al., 2014; Kline, 2016).

4.1 Measurement Model

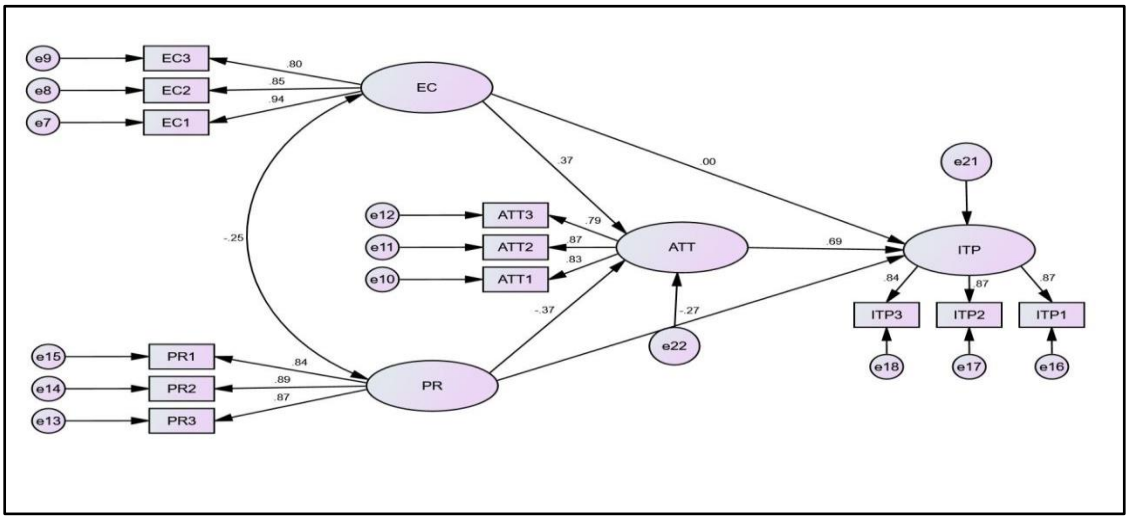

Figure 2: The Measurement Model
Source: The Authors

The CMB was checked by using Harman's one factor test by loading items onto a single common factor. The test confirmed that the total variance was 40.81% below the 50% threshold value confirming CMB does not significantly impact the study's validity (Kuperstein-Blasco & Mäkinen, 2023). Confirmatory Factor Analysis (CFA) was used to analyze the measurement model, to determine construct reliability and validity. In Table 1, all factor loadings surpassed the threshold limit of 0.70, ranging from (0.786 to 0.900), Cronbach's alpha (α) being above the threshold limit of 0.70 (Kant & Jaiswal, 2017; Nunnally, 1978) confirming construct validity and reliability. The CR of each construct exceeds the standard value of 0.70, ranging between 0.866 to 0.901 and the AVE for each construct was greater than the standard value of 0.50, hovering between 0.690 to 0.751 indicating that the convergent validity was supported (Hair et al., 2021; Lavuri et al., 2023).

Table 1

Variable	Construct	Item	Loading	Cronbach's alpha	CR	AVE
Attitude	ATT1	ATT	0.831	0.866	0.869	0.690
	ATT2		0.872			
	ATT3		0.786			
Environmental Concern	EC1	EC	0.939	0.897	0.899	0.748
	EC2		0.851			
	EC3		0.799			
Perceived Risk	PR1	PR	0.844	0.900	0.901	0.751
	PR2		0.890			
	PR3		0.866			
Intention to Purchase	ITP1	ITP	0.874	0.896	0.898	0.746
	ITP2		0.873			
	ITP3		0.843			

Source: The Authors

The Fornell-Larcker criterion was used to evaluate discriminant validity (Fornell & Larcker, 1981), ensuring theoretical distinctness between constructs. For every latent construct, the square root of the Average Variance Extracted (AVE) was higher than the sum of the associated inter-construct correlations., as shown in Table 2. These findings validate the constructs for further structural path analysis by demonstrating the measurement model's good internal consistency and validity (convergent and discriminant) (Kant et al., 2019).

Table 2

Discriminant validity results of the measurement model				
	PR	**EC**	**ATT**	**ITP**
PR	**0.867**			
EC	-0.254	**0.865**		
ATT	-0.468	0.464	**0.830**	
ITP	-0.593	0.393	0.820	**0.863**

Source: The Authors

4.2 Model Fit Test

The measurement model's goodness-of-fit was assessed using multiple fit indices as recommended by (Hair et al., 2021; Kant & Jaiswal, 2017). The results in table 3 demonstrated that model is fit and within the acceptable limit, i.e. chi-square/df = 1.954, goodness-of-fit index (GFI) = 0.964, adjusted GFI (AGFI) = 0.941, incremental fit index (IFI) = 0.987, normed fit index (NFI) = 0.974, comparative fit index (CFI) = 0.987, root mean square error of approximation (RMSEA) = 0.048. This demonstrates that the actual survey data and the suggested theoretical

framework are compatible.

Table 3

Model Value			
Indicators	**Results**	**Norm**	**Judgements**
Chi square/df	1.954	<4	Yes
GFI	0.964	>0.9	Yes
AGFI	0.941	>0.9	Yes
IFI	0.987	>0.9	Yes
NFI	0.974	>0.9	Yes
CFI	0.987	>0.9	Yes
RMSEA	0.048	<0.08	Yes

Source: The Authors

4.3 Results of Hypothesis Testing: The Direct Effect

The Table 4 provides the results of the testing of the proposed hypotheses. Most of the hypotheses were identified to be statistically significant. The hypothesis H1 (β=0.369, $p<0.005$) demonstrated that environmental concern had a positive effect on attitude and H2 (β=-0.374, $p<0.001$) showed a negative effect of perceived risk on attitude. The hypothesis H3 (β= 0.694, $p<0.004$) showed a positive impact of attitude on intention to purchase. The hypothesis H4 (β= 0.003, $p<0.935$) discovered that environmental concerns had no substantial impact on purchase intention, hence there is no meaningful relationship between EC and ITP, so hypothesis H4 was rejected. The Hypothesis H5 (β= -0.267, $p<0.027$) stated a negative impact of perceived risk on intention to purchase. Overall, the structural model offered strong empirical support for most of the proposed hypotheses.

Table 4

Hypotheses	**Paths**			**Estimate**	**p-Value**
H1	ATT	<---	EC	0.369	0.000
H2	ATT	<---	PR	-0.374	0.000
H3	ITP	<---	ATT	0.694	0.000
H4	ITP	<---	EC	0.003	0.935
H5	ITP	<---	PR	-0.267	0.000

Notes: EC = environmental concern, ATT = attitude, ITP = intention to purchase PR = perceived risk, PV = personal value, SV = social value.
Source: The Authors

4.4 Mediation Analysis

For performing the mediation analysis, bootstrapping procedure was employed as recommended by (Preacher & Hayes, 2008). The three-stage technique recommended by (Baron & Kenny, 1986) and (Jaiswal et al., 2022) was employed to analyse the mediation effect. Full mediation happens when the direct path loses significance in the presence of the mediator, while partial mediation happens when both the direct and indirect paths continue to be significant (Jaiswal et al., 2021).

Table 5

Mediation							
Hypotheses	**Path**		**Effect**	**BootSE**	**Bootstrap 95% Cis**		**Mediation**
					Lower	**Upper**	
H6	**EC-ATT-ITP**	**Indirect**	0.3569	0.0665	0.2217	0.4829	Full Mediation
		Direct	-0.0199	0.0213	-0.0617	0.0218	

H7	**PR-ATT-ITP**	**Indirect**	-0.3676	0.0666	-0.4901	-0.2307	Partial Mediation
		Direct	-0.2402	0.0228	-0.2851	-0.1954	

Source: The Authors

As presented in Table 5, the analysis revealed both full and partial mediation effects across multiple pathways. In hypothesis H6 it revealed that attitude (β=0.3569) fully mediates the connection between buying intention and environmental concern, suggesting that environmental concern does not directly translate into purchase intentions, rather, it must first shape consumers' attitudes toward the product or behavior. In Hypothesis H7 (β=-0.3676) the linkage between perceived risk and purchase intention is partially mediated by attitude, indicating that perceived risk degrades adoption intention both directly and indirectly, as its negative influence is partially channeled through the consumer's attitudinal evaluation.

5. Discussion and Implications

5.1 Discussion

Solar rooftop PV technology has gained quite momentum in the past decade and has grabbed substantial attention from various researchers. Prior studies carried out in the reign of solar rooftop purchase intention (Agarwal et al., 2023; Aggarwal et al., 2019; S. Ahmad et al., 2017; Parida et al., 2011). Most of the studies inculcated either TPB theory or extended versions of it and no study was found employing BRT theory to study consumer's purchase intention of solar rooftop PV. This study used BRT Theory to better understand the role of reasoning (reasons for and against), attitude, and consumers' purchasing intention towards solar rooftop. The impact of reasons on attitude and purchase intention, and impact of attitude on purchase intention, were investigated in this study. It further explains the mediating role played by attitude between reasons and consumers' purchase intention. The inferences of this research add to the corpus of previous knowledge and offer a comprehensive knowledge of the variables influencing Indian customers' intentions to purchase solar rooftop PV.

5.2. Theoretical Implications

This research gives various theoretical implications by extending the BRT theory to assess consumers' purchase intention towards solar rooftops in the specific circumstances of a growing country like India which is aiming towards shifting towards green and clean energy.

Environmental concern positively influenced attitude coinciding with prior research (Dhir et al., 2021; Mostafa, 2007), contrary to some earlier study, it was discovered that environmental concerns had no discernible effect on purchasing intention (Hartmann & Apaolaza-Ibáñez, 2012; Sun et al., 2020), arguing that environmental concern must first shape consumers' attitude before influencing their behavioral intention in decision making, aligning with the 'Value-Action Gap' in high-involvement purchases (Kollmuss & Agyeman, 2002).

Our knowledge of Behavioral Reasoning Theory (BRT) is improved by this study by showing that environmental concern doesn't automatically lead to action; rather, it acts as a distant motivator. While perceived risk demonstrated a negative impact on attitude aligning with (Choi et al., 2013; D. J. Kim et al., 2008), it also had negative influence towards purchase intention supporting earlier findings that risk adversely affects purchase intention (Rahmani et al., 2023; Tanveer et al., 2021).

Lastly, the mediating effect of attitude was studied to enhance the knowledge in consumers' purchase intention reign. Attitude fully mediates the linkage between environmental concern (H6) and purchase intention coinciding with prior research (Claudy et al., 2013; Westaby, 2005a), indicating that environmental concern must first shape attitude before influencing behavior. While the relationship between purchase intention and perceived risk (H7) is partially mediated by attitude, indicating that barriers function via two different processing mechanisms: affective and cognitive (via attitude), which equates the earlier studies (Huang & Qian, 2021; Tandon et al., 2020). These results go beyond BRT by showing that inhibitors (reasons against) and facilitators (reasons for) follow different processing routes, with facilitators depending only on systematic attitude construction and inhibitors triggering both heuristic and systematic processing.

5.3. Practical Implications

The study offers key practical ramifications for policymakers, business professionals and marketers for framing strategies for enhancing solar rooftop adoption in India. The finding that environmental concern impacts purchase intention only through attitude mediation, suggesting that along with educating consumers about environmental benefits of solar, focus should be to develop positive attitude of consumers. The negative influence of perceived risk on both consumer attitude and purchase intention, emphasizes upon the establishment of risk mitigation frameworks. Consumers trust should be gained through transparent pricing, standardized quality products, robust warranty systems and grievance redressal mechanism.

6. Conclusion

To meet India's renewable energy goals, we must understand the reasons behind consumer choices. Using Behavioral Reasoning Theory (BRT), this study reveals that attitude is a strong predictor of adopting solar technology. Environmental concerns drive purchase intention, only through attitude mediation. Perceived risk had both direct and indirect negative impact on purchase intention.

Our findings suggest that simply promoting "green values" isn't enough; policymakers and marketers must actively dismantle these fears. By establishing robust quality certifications and consumer protection frameworks, the industry can significantly reduce the perceived risk of solar PV systems. Ultimately, creating a secure, positive post-purchase experience will turn early adopters into community advocates. This shift from "interest" to "action" is essential for making clean energy accessible and desirable across India's unique social landscape.

7. Limitations and future research avenues

While this research offers a basis, its generalizability is limited due to its concentration on significant North Indian cities. Future research should expand into Tier-2 cities and rural areas, where unique factors like grid instability and budget constraints may alter the decision-making process. Additionally, longitudinal studies would allow us to track how intentions evolve into actual purchases over time. Finally, future researches could explore the effectiveness of varying communication strategies that promotes solar rooftop adoption. By addressing these areas, researchers can better understand how to bridge the gap between consumer interest and long-term renewable energy use.

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