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Accelerating India's Rooftop Solar Transition: A Policy–Behavioral Analysis of Adoption Barriers, Incentive Effectiveness, and Regulatory Readiness

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ABSTRACT
India's rooftop solar program serves as one of the essential components which supports the country's shift towards renewable energy sources. The program fails to achieve its targeted results because people do not adopt solar energy systems for their homes. Existing research has largely examined rooftop solar adoption through isolated behavioral or policy lenses, offering limited insight into how households experience incentives and regulatory environments in practice. The present study examines rooftop solar adoption in India through its research which uses an integrated policy-behavior-regulation framework for analysis. The study used primary survey data which researchers collected from 140 urban and semi-urban households to perform testing through SPSS-based descriptive regression mediation and moderation analyses of five different hypotheses. The study results show that people who exhibit specific behavioral traits most likely to adopt rooftop solar systems whereas policy incentives drive system adoption through their influence on how households perceive different behaviors. The decision to adopt new technologies depends on both institutional readiness and regulatory readiness while these factors also determine how effective policy incentives may function. The study demonstrates that financial incentives need more than just monetary support to achieve their goals because organizations must establish regulatory frameworks and operational systems and build up institutional confidence. The research develops socio-technical transition studies because it combines behavioral patterns with existing policy and regulatory frameworks while meeting research demands for governance-based studies on energy-related human behavior. The research findings provide practical recommendations to develop policies based on behavioral science which will help institutions prepare for decentralized renewable energy transitions in India and other Global South countries.
Keywords: Rooftop solar adoption; Energy transition; Behavioral factors; Policy incentives; Regulatory readiness; India; Socio-technical transitions.

1. INTRODUCTION

1.1 India's Rooftop Solar Transition: Context and Paradox

India has achieved significant progress in developing solar power plants which generate electricity at scale because of its supportive policies and its ambitious national goals and the decreasing costs of solar technology. The adoption of residential rooftop solar systems remains restricted because there exists an unbalanced relationship between two different solar energy systems which include centralized and decentralized solar energy systems. The government acknowledges rooftop solar systems as a solution to decrease transmission losses and improve grid reliability and allow households to generate their own energy but the installation rate has not met the required targets and two different states demonstrate that only technical and economic solutions cannot solve the problem (Goel, 2016; Nallathiga et al., 2023).

Research shows that rooftop solar adoption is shaped by dynamics distinct from utility-scale deployment. The centralized management of large projects enables efficient regulatory approval processes but rooftop solar systems need homeowners to interact with distribution companies and complete administrative tasks (Moallemi et al., 2017). The process of adoption now requires understanding as a socio-technical transition process which institutional frameworks and behavior patterns and public trust participate in while current policies fail to solve these difficulties (Moallemi et al., 2017).

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1.2 Policy Relevance and Societal Significance

Rooftop solar energy is essential for India to achieve energy democracy and energy independence and climate change mitigation because it enables homes to produce their own electricity and directly take part in the energy transition. The emissions from fossil fuel grid electricity decrease when residential rooftop solar systems operate because these systems provide additional renewable energy sources for utilities while decreasing the need for electricity transmission and maintaining consistent power demand. The decentralized generation model supports India's national sustainability goals because it meets the country's international climate obligations (Ministry of New and Renewable Energy, 2024; Goel, 2016).

Rooftop solar systems create environmental advantages for the environment but also generate important institutional and socio-economic effects. The system enables households to decrease their electricity expenses while protecting themselves from price fluctuations, yet it presents operational and income difficulties to DISCOMs who need to adjust their regulations. The local government and the regulatory bodies handle essential tasks through their implementation of permission procedures and net-metering systems and their support for customers. An effective policy design process needs to assess how rooftop solar systems affect distribution networks and institutional frameworks and residential patterns.

1.3 Problem Statement

Rooftop solar adoption in India lacks growth because operational regulations and institutional barriers and public knowledge deficiencies and customer behavior patterns all work together to create obstacles that prevent solar energy distribution. The effectiveness of policies which appear to be well designed fails because people do not know about special procedures and they experience delays and they do not trust installers and utility companies and they view financial and operational risks as threats to their safety (Dhingra et al., 2023). The main obstacle exists because household behavior does not match policy design which creates difficulty for implementing capital subsidies and net metering policies because organizations refuse to comply with operational needs and their processes remain too complicated (Goel, 2016). The existing methods used to implement policies first assume that people make decisions based on economic reasoning but they fail to recognize how social traditions and trust and previous encounters with regulations affect decision making. There exists a major research deficiency because researchers do not understand how householders understand and react to rooftop solar energy policies and regulations which causes adoption rates to remain below governmental policy targets.

1.4 Research Aim and Scope

The research intends to investigate how residential rooftop solar systems in India through its study of integrated policy and behavioral factors. The study investigates three specific household factors which include behavioral obstacles and financial incentive effectiveness and institutional and regulatory preparedness to determine their impact on adoption rates. The research uses multidimensional methods to study rooftop solar systems because it needs multiple factors to explain their expansion. The research focuses on residential homes while using primary data for quantitative analysis to study how behavioral factors and policy elements and regulatory aspects relate to each other. The study provides empirical evidence which supports current discussions about decentralized energy transitions in developing countries.

2. LITERATURE REVIEW

The section conducts a critical analysis of all existing research studies which examine rooftop solar power development in India together with its adoption by people and its existing policy framework and regulatory capacity. The review unites multiple research areas through its synthesis of research findings to show both common patterns and research limitations and existing conflicts that need resolution.

2.1 Rooftop Solar Development in India

India has developed its rooftop solar energy system through its overall solar energy development which began with utility-scale solar projects that received funding through centralized buying methods and extended power contract agreements. Rooftop solar emerged as a decentralized solution which helped decrease electrical grid demand while boosting residential user participation (Goel, 2016). The national government provides financial assistance through capital subsidies and net-metering programs, yet states showed different adoption results because their administrative ability and regulatory practices and state agency-DISCOM coordination methods differ (Goel, 2016; Nallathiga et al., 2023). The historical studies showed that centralized planning systems have most commonly supported big projects which led to disjointed and unequal development of rooftop solar systems

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(Moallemi et al., 2017). The institutional and regulatory conditions in each state determine how well people will adopt technology because they create a different environment from national policy objectives (Goel, 2016).

2.2 Behavioral Perspectives on Rooftop Solar Adoption

The study used behavioral theories to examine how households make their adoption decisions because researchers have identified the boundaries of techno-economic explanations. The Theory of Planned Behavior and Diffusion of Innovations and UTAUT framework serve as the main structure for this research area. In India together with South Asia the research proves that attitudes plus perceived usefulness alongside social norms and perceived behavioral control all impact adoption intentions which researchers found to be true in their economic evaluations (Ajzen, 1991; Rogers, 2003; Kumar et al., 2024; Shakeel et al., 2023). The study focused on intention instead of actual adoption because it failed to examine how institutional and policy processes lead people to change their behavior from having intentions.

The recent research presented households as "prosumers" who exercise their right to define themselves while taking part in energy governance. Research shows that urban semi-urban and rural households who adopt rooftop solar systems experience increased feelings of independence together with greater environmental responsibility (Kumar et al., 2024; Shakeel et al., 2023). The research mainly excludes the policy and regulatory frameworks which determine how households can establish their prosumer identities because it does not investigate the institutional factors that shape these identities.

2.3 Adoption Barriers Beyond Cost

The adoption process faces two main challenges which come from three different areas: first, there are informational gaps and second, there are trust deficits and third, people perceive risks and face administrative difficulties. Quantitative studies demonstrate that organizations face adoption challenges because their performance and maintenance requirements and regulatory restrictions decrease their likelihood of adopting new technologies despite the undeniable economic advantages which these new technologies bring (Nallathiga et al., 2023; Shakeel et al., 2023). Qualitative research further identifies installer distrust and policy uncertainty and inadequate information as three major barriers (Shakeel et al., 2023). The process of household installation encounters existing difficulties which stem from two primary sources: slow approval times and poorly defined documentation procedures and breakdowns in communication between households and installers and DISCOMs. The studies which describe experiential barriers fail to show how these barriers relate to both policy design and institutional governance in a structured way.

2.4 Policy Incentives and Their Effectiveness

Solar power systems on rooftops depend entirely on three main government financial support programs which provide direct funding, allow energy production credits, and deliver financial resources at reduced interest rates, and offer tax reductions to users. Research comparing different approaches shows that financial incentives help people overcome economic challenges, but these programs need stable rules and clear operational procedures to maintain trust from the public (Goel, 2016; Ministry of New and Renewable Energy, 2024). The Indian government has created a situation in which its current policy framework suffers from constant changes and improper execution which results in empty promises to citizens. The results from empirical studies show mixed findings because financial incentives lead to increased adoption rates but the success of programs differs between different locations and different time periods because of how well they follow established procedures (Goel, 2016; Nallathiga et al., 2023). The majority of policy research focuses on studying total results from policies but fails to examine how households actually receive their financial incentives.

2.5 Regulatory and Institutional Readiness

The regulatory framework and institutional capacity of DISCOMs and local governments and regulatory bodies serve as vital factors that need further examination to understand their impact on rooftop solar adoption. The research identifies three main challenges which include procedural delays and DISCOM resistance and coordination failures that result in decreased household trust and increased perceived risk (Dhingra et al., 2023). The evidence from developing countries shows that administrative capacity and regulatory preparedness act as critical factors which determine the success of decentralized energy systems (Shakeel et al., 2023). The research has established institutional readiness as a factor that affects household adoption behavior but there exists a shortage of quantitative studies that demonstrate this relationship.

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3. RESEARCH GAP AND CONCEPTUAL POSITIONING

The section establishes research limitations of existing studies which reveal their core research gaps. The discussion unites research findings from behavioral studies and policy research and institutional analysis to show how the study contributes its conceptual and methodological framework.

3.1 Synthesis of Literature Gaps

The reviewed literature demonstrates progress toward understanding rooftop solar adoption, but multiple linked limitations still exist. Theoretical concepts received strong support through behavior studies, yet their research remained disconnected from real-world policy and regulatory environments because the studies focused on norms and perceived control together with adoption intentions while ignoring their connections to actual implementation processes and incentive systems. The design-based focus of policy-oriented analysis evaluates program results and incentive instruments through institutional frameworks while assuming households will react with complete understanding and no obstacles. The public recognition of regulatory and institutional readiness as a key factor in adoption outcomes which includes the functions of DISCOMs and local governance together with administrative practices remains mostly studied through qualitative methods while its value in adoption research stays unmeasured. The current state of research lacks unified empirical frameworks which should include three essential elements to explain why decentralized solar energy systems do not achieve full adoption ((Kumar et al., 2024; Shakeel et al., 2023; Goel, 2016)).

3.2 Identified Research Gap

The research gap becomes evident when the existing limitations of the study are combined. Empirical research which combines household behavior patterns with policy incentive results and regulatory preparedness measurements to study rooftop solar adoption in India currently remains limited according to existing research which examines rooftop solar adoption in India. The existing research either focuses on behavioral intentions without considering the impact of policy and institutional factors or it studies policy instruments but fails to use household perceptions and experiences as a basis for evaluation.

People currently explain rooftop solar adoption through a single-dimensional framework which fails to recognize how household decisions depend on cognitive processes and economic factors and institutional structures. The research gap requires investigation because it affects our ability to understand why rooftop solar adoption falls short of expected levels despite continuous policy backing.

3.3 Research Contribution and Novelty

The current research project presents its solution to an existing research gap through its combination of theoretical and practical research findings which are interconnected to each other. First, the research develops a Policy–Behavior–Regulation (PBR) analytical framework which brings together household behavioral obstacles and perceived incentive effectiveness and regulatory readiness into one unified research model. The model develops new methods to study household adoption behavior because it considers policy and institutional factors as essential components which affect household adoption behavior. The research used SPSS-based inferential statistical methods to complete its empirical testing of relationships between different dimensions and their interactive effects. The research study utilized descriptive analysis together with regression-based mediation and moderation testing to investigate how various factors from behavioral policies to regulatory systems work together to determine adoption success.

The research establishes its assessment of policies through actual household evidence which connects policy creation with real-world experiences of people. The approach meets research demands for examining energy transitions through socially integrated methods which show how users understand and implement policies (Moallemi et al., 2017). The research advances Energy Research & Social Science scholarship by developing a stronger socio-technical transition framework for understanding decentralized renewable energy systems. The study combines behavioral theory with policy execution and regulatory research to create a detailed framework that explains rooftop solar adoption in developing nations while producing findings useful for both academic development and public policy changes.

4. CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

The framework unites three dimensions of human behavior and public policy and regulatory frameworks to demonstrate how Indian households decide to adopt rooftop solar systems. The Policy–Behavior–Regulation framework shows that adoption occurs through the interaction of social and cognitive and institutional factors instead of being an independent decision by the individual.

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4.1 Conceptual Framework

4.1.1 Behavioral Dimension

The study developed the behavioral dimension through their research of the Theory of Planned Behavior (TPB) and various technology adoption frameworks. People in this viewpoint decide to adopt rooftop solar systems based on their attitudes toward solar power and their understanding of social norms and their ability to control their actions. Households assess rooftop solar systems based on their economic savings and environmental advantages and technological reliability. Social norms capture perceived expectations and influences from peers, neighbors, and broader social networks, while perceived behavioral control reflects households' assessment of their capacity to adopt, including financial ability, technical understanding, and perceived ease of installation.

Studies conducted in India and South Asian countries demonstrate that positive attitudes and supportive social norms increase adoption intention, but perceived complexity and uncertainty and lack of confidence decrease it (Kumar et al., 2024; Shakeel et al., 2023). Behavioral factors exist as their own distinct elements without any external influence. Households form attitudes and perceptions in response to their interactions with policy instruments, market actors, and regulatory institutions. The proposed framework defines the behavioral dimension as an independent factor that drives adoption intention and operates as a mediating factor which connects policy incentives to their effects.

4.1.2 Policy Incentive Dimension

The policy incentive dimension measures how households perceive and experience rooftop solar support systems which include capital subsidies and net-metering arrangements and financing options. The design of policies aims to create better investment conditions by eliminating economic obstacles but existing research shows that incentive programs only succeed when their actual value matches their accessibility and understanding and their reliability according to users (Ministry of New and Renewable Energy, 2024). Incentives create household behavior changes because they inform households about state dedication while they decrease perceived danger and they change how households view costs against benefits.

The complexity of incentives together with their frequent updates and ineffective communication results in decreased achievement of those programs. Households may discount policy benefits if they perceive administrative hurdles or uncertainty in implementation, thereby limiting behavioral response (Goel, 2016; Nallathiga et al., 2023). The PBR framework establishes policy incentives as two separate aspects which affect adoption intention through direct paths and indirect paths that depend on behavioral perceptions which include trust and risk assessment and perceived control.

4.1.3 Regulatory Readiness Dimension

The conceptual framework establishes its third pillar through regulatory and institutional readiness. The implementation capacity of DISCOMs local authorities and regulatory agencies to support rooftop solar adoption. The main components of this system include procedural effectiveness, transparent approval systems, consistent regulatory interpretation, and ability to address household issues.

Regulatory friction and net-metering approval delays and unclear agency responsibility create significant barriers which prevent households from adopting new technologies according to previous research (Dhingra et al., 2023). People usually describe regulatory readiness through qualitative assessments yet researchers have not conducted quantitative studies to examine how it interacts with behavioral and policy elements. The framework defines regulatory readiness as a factor that directly affects adoption outcomes while it serves as a factor that determines how well policy incentives function. High regulatory readiness enables organizations to achieve greater incentive effects because it decreases both transaction costs and uncertainty while weak readiness prevents organizations from benefiting from policy incentives regardless of incentive size (Shakeel et al., 2023).

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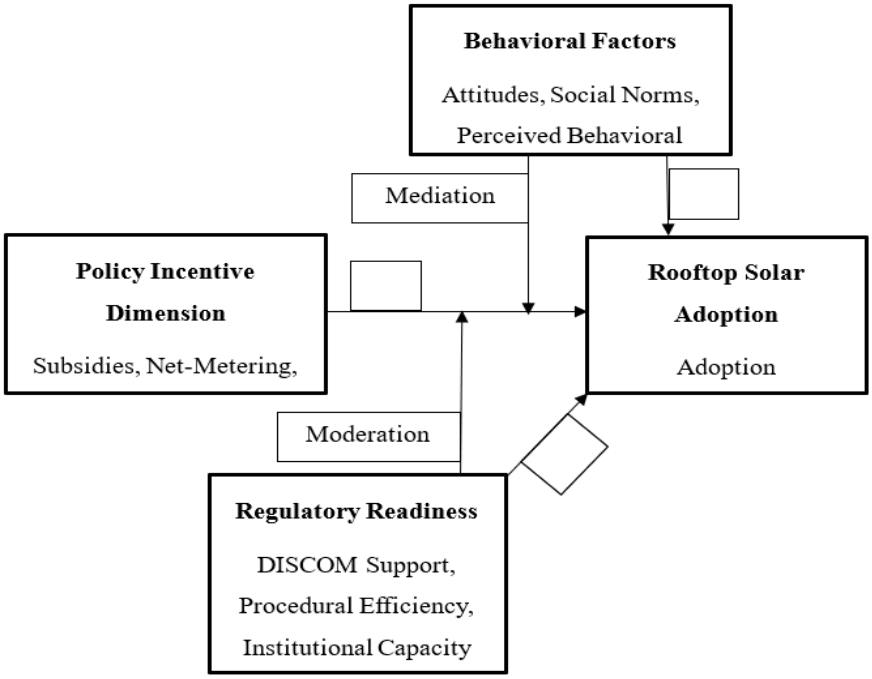


Figure 1: Conceptual Framework

Figure 1: Conceptual Framework

4.2 Hypotheses Development

On the foundation of theoretical propositions of BTP, DOI, and policy implementation theory, it can be put forth that supporting and affirmative hypotheses could be tested in future studies.

H1: Behavioral factors significantly influence rooftop solar adoption intention.

People who want to adopt new technologies base their decisions on three main factors which include their attitudes, existing social norms, and their ability to control their behavior. In the context of rooftop solar, households with favorable perceptions, supportive social environments, and higher perceived capability are more likely to express intention to adopt (Kumar et al., 2024; Shakeel et al., 2023).

H2: Policy incentives positively affect rooftop solar adoption intention.

The combination of financial incentives with supportive policy instruments will eliminate economic barriers while increasing perceived benefits, which will lead to higher adoption rates. The adoption of this effect depends on how households recognize and assess the value of incentives, which exists independently from the design of public policies (Ministry of New and Renewable Energy, 2024).

H3: Regulatory readiness significantly influences rooftop solar adoption outcomes.

Institutional capacity and procedural efficiency control the ability of households to change their intentions into actual activities. The adoption process will become easier to implement when organizations have better regulatory readiness because it decreases their administrative tasks and removes their uncertainty (Dhingra et al., 2023; Shakeel et al., 2023).

H4: Behavioral factors mediate the relationship between policy incentives and adoption intention.

The researchers believe that policy incentives will affect adoption intention through their impact on trust and perceived risks and perceived control by establishing their behavioral effects. The study found that accessible and reliable incentives create positive attitudes which help people overcome their mental obstacles to adopt the technology (Goel, 2016).

H5: Regulatory readiness moderates the relationship between policy incentives and adoption intention.

The effectiveness of policy incentives displays different results according to different levels of regulatory readiness. The institutional capacity of a context together with its operational efficiency determines the likelihood that incentives will lead to adoption intention. The positive effects of incentives will decrease or vanish when organizations operate in environments that experience regulatory friction (Nallathiga et al., 2023).

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5. METHODOLOGY

The research design together with data collection methods and sampling techniques and variable measurement methods and analysis methods and ethical standards of the study are explained in this section. The methodology of the study tests two elements The Policy–Behavior–Regulation (PBR) framework and its related hypotheses which were created in the previous section.

5.1 Research Design

The research implements a quantitative cross-sectional design to investigate how behavioral factors and policy elements and institutional factors interact with each other at one specific moment. The design supports hypothesis testing in social science research within the energy field through its ability to examine both adoption behavior and policy perception. The study requires a quantitative research method because its research framework uses the Theory of Planned Behavior and Diffusion of Innovations and policy implementation theory to create measurable research variables. The approach creates a pattern analysis method which investigates how socio-technical transitions develop according to ERSS research principles. The hypothesis-testing framework enables the assessment of direct and conditional relationships among variables, advancing beyond descriptive analyses to evaluate theoretical expectations embedded in the PBR framework.

5.2 Data Collection

The study collected primary data by conducting a structured household survey which targeted residential electricity consumers to measure their behavioral perceptions about rooftop solar policy incentives and their readiness to follow regulations and their plans to adopt solar energy or their actual solar energy use. The research study investigates urban and semi-urban Indian communities which maintain active policies to support rooftop solar energy installation and which their residents must follow official electricity distribution and regulatory procedures. The two research environments provide effective opportunities to study how institutional factors and policy factors affect different outcomes. The researchers used a questionnaire which followed the conceptual framework to collect data that used Likert-type scales for statistical analysis based on established research about rooftop solar and energy behavior.

5.3 Sampling Strategy

The research selected residential households from specific urban and semi-urban locations which currently allow rooftop solar systems based on existing legal regulations as its sampling frame. The research team used a non-probability sampling method that combined purposive and convenience sampling because they could not find complete household databases and they faced difficulties in locating qualified participants. Researchers distributed 250 survey questionnaires but only 140 complete and accurate responses qualified for analysis to create the final study sample. The response rate matches the typical response rate found in energy research that uses household surveys to study similar situations. The researchers aimed to achieve diverse social-economic backgrounds and different types of housing along with different levels of experience with rooftop solar systems to strengthen their analysis. The research team needed larger sample groups for their multivariate models but their final group of 140 participants provided enough data for their exploratory regression tests according to research standards used in developing countries to study household energy usage.

5.4 Data Analysis Techniques

The study used Statistical Package for the Social Sciences (SPSS) to perform its data analysis. The analytical strategy followed a sequential approach, which matched the study's hypotheses.

The study used descriptive statistics to create a summary of respondents' socio-demographic information and their awareness levels and adoption patterns. The statistics establish a contextual framework that supports the following inferential analysis.

The study used Cronbach's alpha to conduct reliability analysis, which tested the internal consistency of multi-item scales. Alpha values that exceeded the normal threshold of 0.70 proved to be acceptable for reliability purposes.

The study used correlation analysis to test two-variable associations between important study parameters while determining the initial proof for expected relationships.

The study used multiple regression analysis to examine direct relationships which they predicted in H1 H2 and H3. The study used adoption intention as the dependent variable while behavioral factors and policy incentive effectiveness, and regulatory readiness served as independent variables.

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The study performed regression-based mediation analysis to investigate mediation in H4 according to standard methods which study the impact of behavioral factors on policy incentives to adoption intention. The researchers used path coefficient significance testing to measure indirect effects.

The study added interaction terms which combined policy incentives and regulatory readiness into the regression model to test moderation in H5. The researchers found a significant interaction effect which demonstrated that regulatory readiness affected how incentives related to adoption intention.

5.6 Ethical Considerations

The research process included continuous assessment of ethical considerations. The survey required voluntary participation which included informing respondents about the study purpose and response anonymity and their ability to withdraw at any time. The researchers did not obtain any information which could identify specific individuals. The research data were restricted to academic purposes and researchers analyzed the information in aggregated form to maintain confidentiality.

6. RESULTS

Reliably and Validity of Constructs

Behavioral Factors

Reliability Statistics			
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items		N of Items
.959	.959		9
Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
31.81	102.296	10.114	9

The behavioral factors construct showed high internal consistency through its nine measurement items which included attitudes and subjective norms and perceived behavioral control. The items showed strong reliability because they demonstrated high internal consistency which enabled researchers to treat them as one unified measurement instrument. The scale showed a mean score of 31.81 with a standard deviation of 10.11 which indicated that respondents held moderate to high positive behavioral tendencies toward adopting rooftop solar systems. The behavioral factors measurement instrument showed reliable performance according to scale statistics which proved its effectiveness for future inferential research.

Policy Incentive Effectiveness

Reliability Statistics			
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items		N of Items
.935	.935		5
Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
17.54	35.056	5.921	5

The policy incentive effectiveness construct showed high internal consistency through its five items which assessed household awareness of rooftop solar subsidies and net-metering provisions and financial support mechanisms. The high reliability of the items demonstrates their ability to measure a single shared concept regarding incentive effectiveness. The scale mean of 17.54 (SD = 5.92) shows that respondents held a moderate view of policy support with different levels of understanding and assessment about incentive availability and trustworthiness. The results demonstrate that the policy incentive effectiveness measure can withstand testing in future regression and mediation and moderation research.

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Regulatory and Institutional Readiness

Reliability Statistics			
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items		N of Items
.923	.923		5
Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
17.39	32.339	5.687	5

The regulatory and institutional readiness construct showed strong internal consistency through its five measurement items which assessed DISCOM support and procedural efficiency and regulatory clarity and institutional responsiveness. The reliability level of the measurement indicates that all items show strong consistency which enables their combination into one unified measurement. The scale mean of 17.39 (SD = 5.69) indicates that respondents perceive regulatory readiness at a moderate level which shows different results from their actual institutional process experiences. The reliability and scale statistical results confirm that the regulatory readiness construct meets requirements for upcoming inferential testing.

Rooftop Solar Adoption Intention / Outcome

Reliability Statistics			
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items		N of Items
.907	.907		5
Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
17.16	29.687	5.449	5

The rooftop solar adoption intention and outcome construct showed strong internal consistency because its five items which measure household adoption intentions and post-adoption assessments produced a Cronbach's alpha score of 0.907. The items show reliable performance because they measure a single adoption-related concept which exists as an intact unit. Respondents showed moderate adoption intention and satisfaction because they achieved a scale mean of 17.16 with a standard deviation of 5.45 while their adoption experiences and household readiness showed different patterns of response. The adoption intention and outcome measurement tool demonstrates validity for use in upcoming regression and interaction research studies.

Results based on Demographics

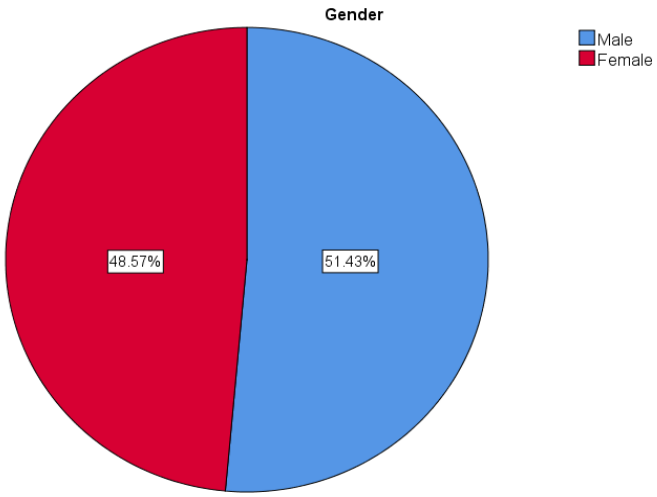
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Gender	140	1	2	1.49	.502
Age Group	140	1	4	2.56	1.114
Highest Educational Qualification	140	1	5	3.00	1.434
Employment Status	140	1	4	2.16	1.121
Monthly Household Income (₹)	140	1	5	2.61	1.407
Type of Residence	140	1	3	1.91	.786
Ownership Status of House	140	1	2	1.54	.501
Area of Residence	140	1	2	1.41	.494
Current Rooftop Solar Status	140	1	3	1.90	.723
Valid N (listwise)	140				

The study sample included 140 respondents according to the descriptive statistics. The study sample showed almost equal gender distribution because the mean value reached 1.49 with a standard deviation of 0.50. The mean age group score was 2.56 (SD = 1.11), indicating a predominance of respondents in the middle age categories.

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The educational attainment level reached an average of 3.00 (SD = 1.43), which indicates that most participants had graduate-level education. The study sample exhibited moderate employment status variation with a mean value of 2.16 and standard deviation of 1.12. The study sample demonstrated income diversity through a mean monthly household income of 2.61 (SD = 1.41). The study sample showed that most respondents owned their homes because the ownership status had a mean value of 1.54 with a standard deviation of 0.50. The study sample showed that most respondents resided in urban areas and semi-urban areas because their area of residence showed a mean value of 1.41 with a standard deviation of 0.49. The mean rooftop solar status score of 1.90 (SD = 0.72) indicates a mixed sample of adopters and non-adopters.

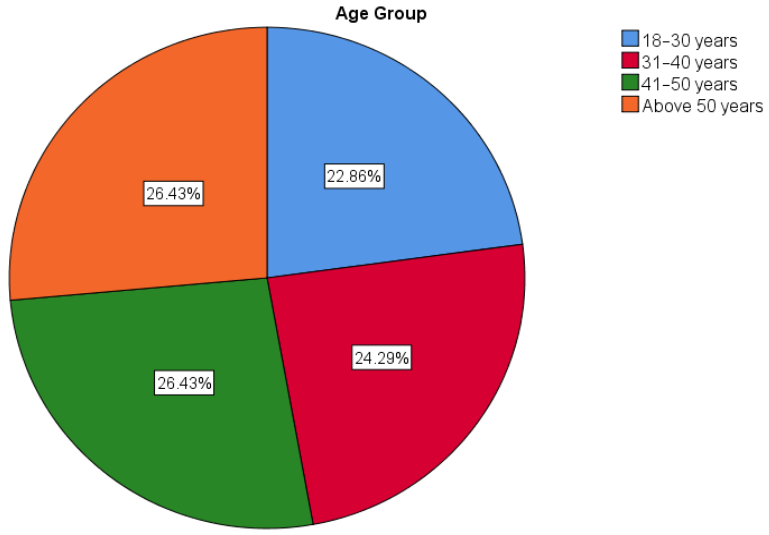
Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	72	51.4	51.4	51.4
	Female	68	48.6	48.6	100.0
	Total	140	100.0	100.0	



The study sample shows equal gender distribution because 51.4% of participants are male (72) and 48.6% of participants are female (68). The dataset achieves better inclusiveness through its equal representation of genders which decreases the chances of gender-based sampling bias during data analysis.

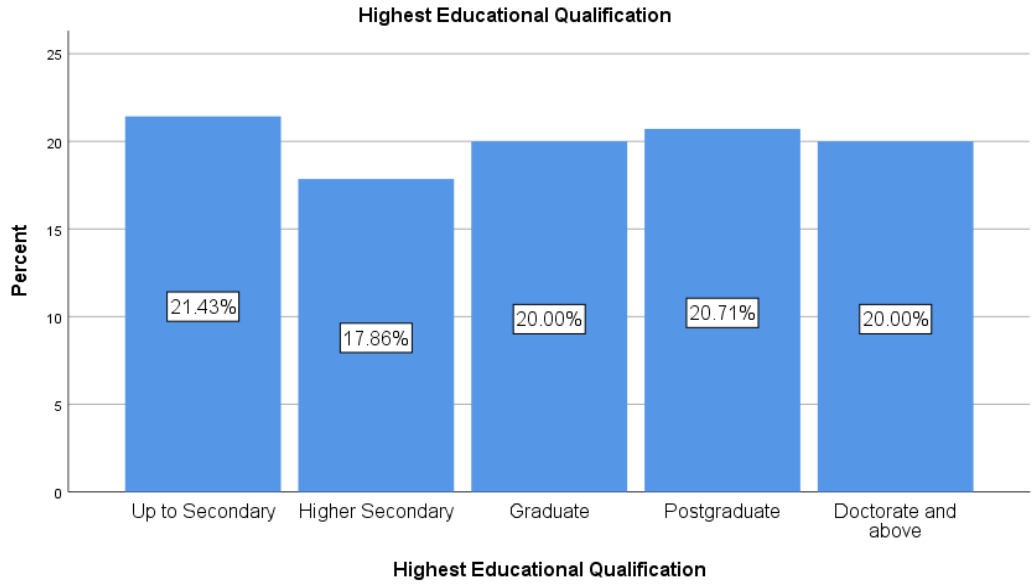
Age Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18–30 years	32	22.9	22.9	22.9
	31–40 years	34	24.3	24.3	47.1
	41–50 years	37	26.4	26.4	73.6
	Above 50 years	37	26.4	26.4	100.0
	Total	140	100.0	100.0	

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The age distribution of respondents is relatively well balanced across all age categories. The sample includes 22.9% of its members who belong to the 18–30 years age group which consists of 32 individuals and 31–40 years age group which includes 34 individuals. Respondents aged 41–50 years and those above 50 years each account for 26.4% (n = 37).

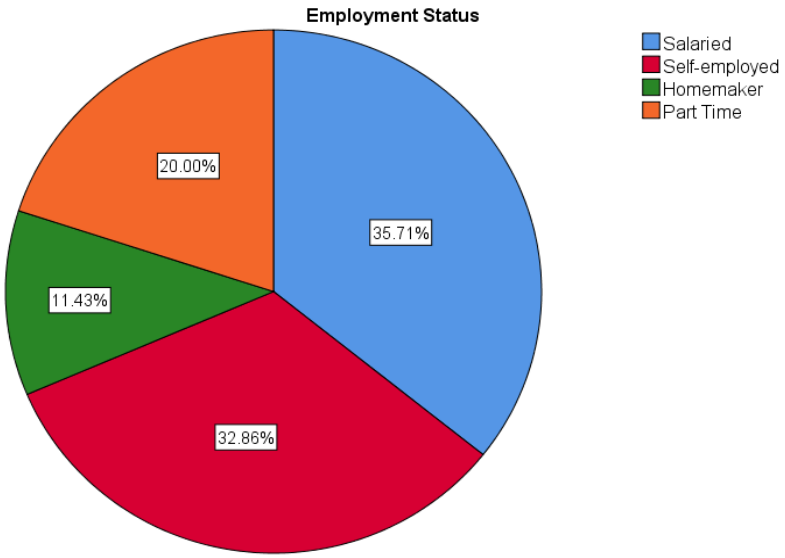
Highest Educational Qualification					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Up to Secondary	30	21.4	21.4	21.4
	Higher Secondary	25	17.9	17.9	39.3
	Graduate	28	20.0	20.0	59.3
	Postgraduate	29	20.7	20.7	80.0
	Doctorate and above	28	20.0	20.0	100.0
	Total	140	100.0	100.0	



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The educational profile of respondents is broadly distributed across qualification levels. The group includes 21.4% (30 individuals) who finished their education at secondary school level and 17.9% (25 individuals) who achieved higher secondary education. The group consists of 20.0% (28 individuals) who hold undergraduate degrees 20.7% (29 individuals) who possess postgraduate degrees and 20.0% (28 individuals) who have earned doctoral degrees or higher.

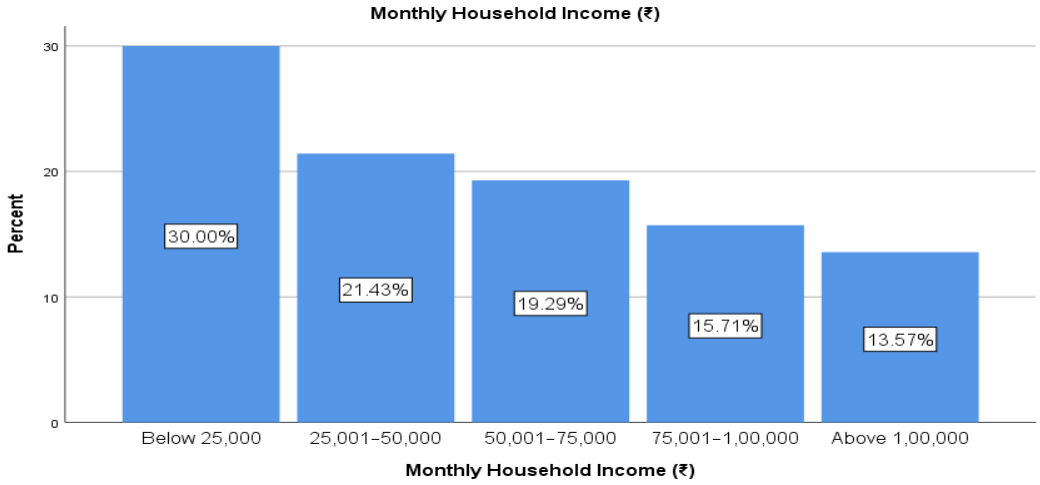
Employment Status					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Salaried	50	35.7	35.7	35.7
	Self-employed	46	32.9	32.9	68.6
	Homemaker	16	11.4	11.4	80.0
	Part Time	28	20.0	20.0	100.0
	Total	140	100.0	100.0	



The employment profile of respondents shows a predominance of economically active households. The sample contains 35.7% (n=50) of salaried workers while 32.9% (n=46) of respondents work as self-employed individuals. Homemakers represent 11.4% (n = 16) of the sample while part-time workers make up 20.0% (n = 28) of the group.

Monthly Household Income (₹)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 25,000	42	30.0	30.0	30.0
	25,001–50,000	30	21.4	21.4	51.4
	50,001–75,000	27	19.3	19.3	70.7
	75,001–1,00,000	22	15.7	15.7	86.4
	Above 1,00,000	19	13.6	13.6	100.0
	Total	140	100.0	100.0	

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The income distribution shows that it includes different social classes. The sample includes 30.0% (n = 42) of households who earn less than ₹25,000 each month while 21.4% (n = 30) of households belong to the income group between ₹25,001 and ₹50,000. The study found that 19.3% (n = 27) of participants belonged to middle-income households who earned between ₹50,001 and ₹75,000, while higher-income groups who earned between ₹75,001 and ₹1,00,000 earned 15.7% (n = 22) and 13.6% (n = 19).

Type of Residence					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Independent house	50	35.7	35.7	35.7
	Apartment / Flat	53	37.9	37.9	73.6
	Other	37	26.4	26.4	100.0
	Total	140	100.0	100.0	

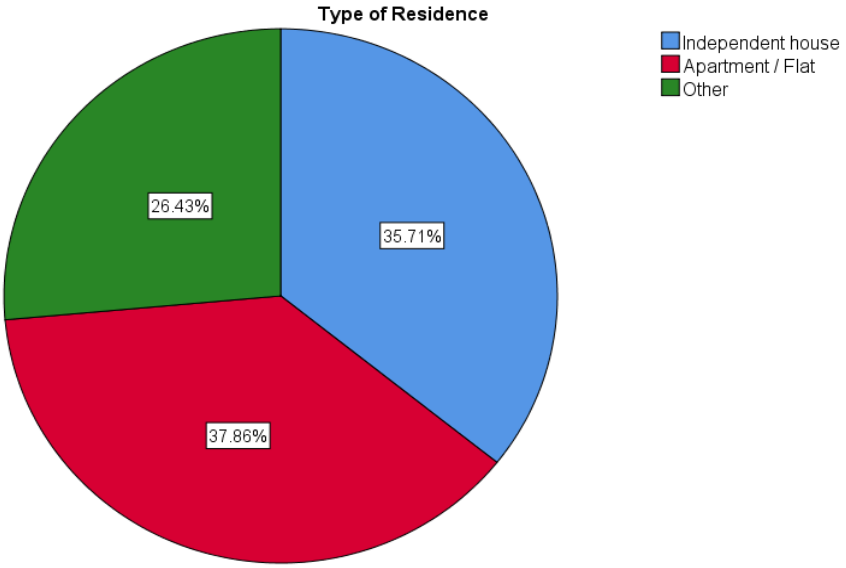
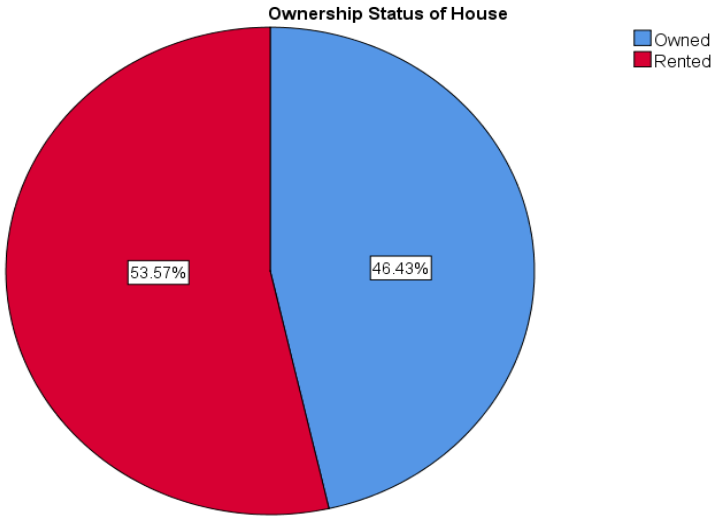


Figure The sample includes different types of residential housing. The largest apartment share accounts for 37.9% of the total sample with 53 units, while independent houses make up 35.7% with 50 units. The other types of housing make up 26.4% of the total sample with 37 units.

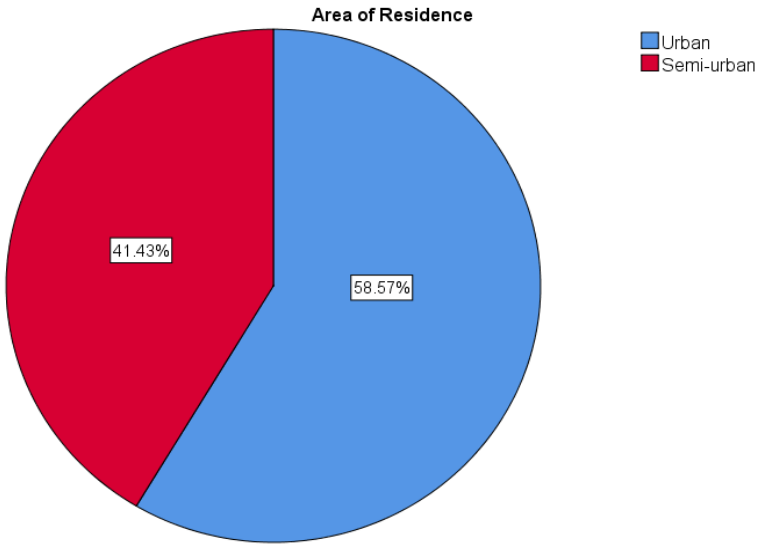
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Ownership Status of House					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Owned	65	46.4	46.4	46.4
	Rented	75	53.6	53.6	100.0
	Total	140	100.0	100.0	



The ownership profile indicates that rented housing holds a slight majority because 53.6% (n = 75) of respondents live in rented homes while 46.4% (n = 65) of respondents reside in owned properties.

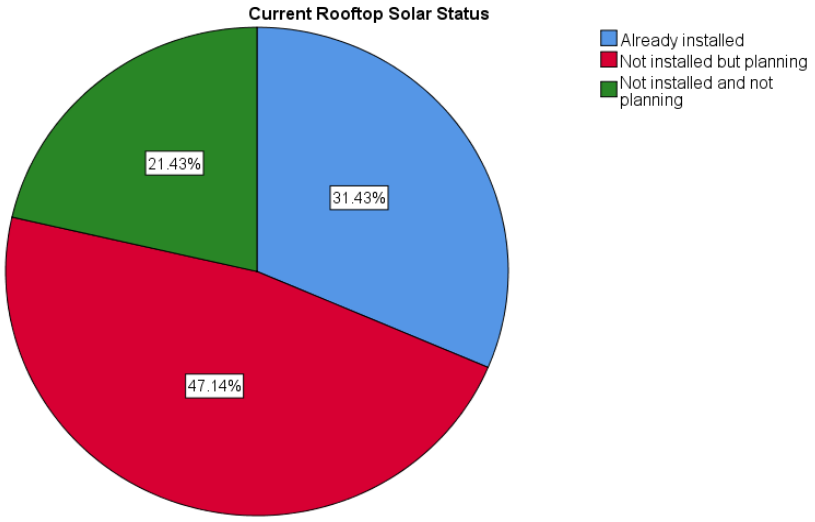
Area of Residence					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	82	58.6	58.6	58.6
	Semi-urban	58	41.4	41.4	100.0
	Total	140	100.0	100.0	



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The majority of respondents live in cities because 58.6% of the sample which includes 82 participants resides in urban areas while 41.4% of the sample which includes 58 participants lives in semi-urban areas.

Current Rooftop Solar Status					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Already installed	44	31.4	31.4	31.4
	Not installed but planning	66	47.1	47.1	78.6
	Not installed and not planning	30	21.4	21.4	100.0
	Total	140	100.0	100.0	



The distribution of rooftop solar status shows different levels of solar adoption by people. The sample consists of 31.4% (n = 44) respondents who have installed rooftop solar systems while 47.1% (n = 66) respondents plan to install solar systems but have not yet done so. A smaller proportion, 21.4% (n = 30), report neither having installed nor planning to adopt rooftop solar. **Results based on Hypothesis**

H1: Behavioral factors significantly influence rooftop solar adoption intention.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df2	Sig. F Change
1	.960[a]	.921	.921	.3065	.921	1619.167	1	138	.000
a. Predictors: (Constant), Behavioral Factors									

The regression model shows exceptional explanatory ability because behavioral factors explain 92.1% of the variation in rooftop solar adoption intention (R^2 = 0.921, AdjusteR^2 = 0.921). The model shows statistical significance because F(1,138) value equals 1619.167 and p value is less than .001 which shows that behavioral factors explain adoption intention with high reliability.

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ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	152.099	1	152.099	1619.167	.000[b]
	Residual	12.963	138	.094		
	Total	165.062	139			
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						
b. Predictors: (Constant), Behavioral Factors						

The ANOVA results show that the regression model achieves statistical significance because its F value equals 1619.167 and its p value remains below .001. The study proved that behavioral factors behave as essential predictors of rooftop solar adoption intention for all households.

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.141	.086		1.644	.102	-.029	.311
	Behavioral Factors	.931	.023	.960	40.239	.000	.885	.977
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome								

The study found that behavioral factors produced a strong positive effect which statistically confirmed their impact on rooftop solar adoption intention ($B = 0.931$, $\beta = 0.960$, $t = 40.239$, $p < .001$). The coefficient confidence interval (0.885, 0.977) showed high precision because of its narrow range.
The findings demonstrate that household behavioral patterns serve as the primary factor which determines their choice to adopt rooftop solar systems.

H2: Policy incentives positively affect rooftop solar adoption intention.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df2	Sig. F Change
1	.936[a]	.877	.876	.3837	.877	982.923	1	138	.000
a. Predictors: (Constant), Policy Incentive Effectiveness									

The regression model demonstrates exceptional predictive ability since policy incentive effectiveness explains 87.7% of the variation in rooftop solar adoption intention ($R^2 = 0.877$, Adjusted $R^2 = 0.876$). The model shows

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statistical significance because of the following results ($F(1,138) = 982.923$, $p < .001$) which demonstrate that policy incentives function as a strong predictor of adoption intention.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	144.740	1	144.740	982.923	.000[b]
	Residual	20.321	138	.147		
	Total	165.062	139			
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						
b. Predictors: (Constant), Policy Incentive Effectiveness						

The ANOVA results show that the regression model has statistical significance because its F value reached 982.923 with a p value below .001. The results show that policy incentive effectiveness serves as a significant predictor of rooftop solar adoption intention across all households.

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.408	.102		4.009	.000	.207	.609
	Policy Incentive Effectiveness	.862	.027	.936	31.352	.000	.807	.916
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome								

The hypothesis demonstrated that policy incentive effectiveness helps increase rooftop solar adoption intention with its positive relationship which was confirmed through statistical testing because the results showed ($B = 0.862$, $\beta = 0.936$, $t = 31.352$, $p < .001$). The narrow 95% confidence interval for the coefficient (0.807, 0.916) indicates high precision and stability of the estimated effect which shows that policy incentives have strong impact on adoption intention.
The research results show that financial and policy incentives serve as the main factors that determine how households decide to adopt rooftop solar systems.

H3: Regulatory readiness significantly influences rooftop solar adoption outcomes.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df2	Sig. F Change
1	.945[a]	.893	.892	.3581	.893	1149.273	1	138	.000
a. Predictors: (Constant), Regulatory and Institutional Readiness									

The regression model demonstrates very strong explanatory power, with regulatory and institutional readiness accounting for 89.3% of the variance in rooftop solar adoption intention ($R^2 = 0.893$, Adjusted $R^2 = 0.892$). The

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model is statistically significant ($F(1,138) = 1149.273$, $p < .001$), which shows that regulatory readiness predicts adoption outcomes with strong accuracy.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	147.367	1	147.367	1149.273	.000[b]
	Residual	17.695	138	.128		
	Total	165.062	139			
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						
b. Predictors: (Constant), Regulatory and Institutional Readiness						

The ANOVA results confirm that the regression model demonstrates statistical significance because it achieved an F value of 1149.273 and a p value below .001. The research shows that regulatory and institutional readiness explain household differences in rooftop solar adoption intention with strong and dependable accuracy.

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.284	.098		2.903	.004	.090	.477
	Regulatory and Institutional Readiness	.905	.027	.945	33.901	.000	.853	.958
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome								

The study found that regulatory and institutional readiness exerts a direct positive impact on rooftop solar adoption intention which researchers measured with ($B = 0.905$, $\beta = 0.945$, $t = 33.901$, $p < .001$) statistical evidence. The unstandardized coefficient 95% confidence interval which ranges from 0.853 to 0.958 shows high precision because it maintains stability and confirms that regulatory readiness has substantial impact on adoption results. The results demonstrate that institutional and regulatory conditions function as the main factors which determine how households adopt rooftop solar systems.

H4: Behavioral factors mediate the relationship between policy incentives and adoption intention.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.341	.085		4.033	.000
	Policy Incentive Effectiveness	.910	.023	.959	39.785	.000
a. Dependent Variable: Behavioral Factors						

The implementation of policy incentives leads to significant changes in behavioral patterns according to study results which show a B value of 0.910 and a β value of 0.959 and a t value of 39.785 and a p value below .001 threshold. The first condition for mediation has been satisfied.

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Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	.141	.086		1.644	.102
	Behavioral Factors	.931	.023	.960	40.239	.000
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						

The study results indicate that positive behavioral traits drive people to adopt rooftop solar energy systems with a measurement of 0.931 for strength and 0.960 for testing value which reached a statistical significance level below .001. The second condition for mediation was successfully demonstrated through this evidence.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	.408	.102		4.009	.000
	Policy Incentive Effectiveness	.862	.027	.936	31.352	.000
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						

The total effect of policy incentive effectiveness on rooftop solar adoption intention shows direct impact when behavioral factors are removed from the model ($B = 0.862$, $\beta = 0.936$, $t = 31.352$, $p < .001$), which establishes the necessary total effect for mediation analysis.

Model Summary									
Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.962[a]	.925	.923	.3015	.925	839.655	2	137	.000
a. Predictors: (Constant), Behavioral Factors, Policy Incentive Effectiveness									

The regression model demonstrates that behavioral factors maintain their high significance level through both policy incentive effectiveness and behavioral factor inclusion. The policy incentives maintain statistical significance according to the results which show a decreased effect size through their actual measurement ($B = 0.181$, $\beta = 0.197$, $t = 2.376$, $p = .019$). The model demonstrates strong explanatory power through its ability to show adoption intention variance with an R^2 value of 0.925 and a statistical result of $F(2,137) = 839.655$ at $p < .001$.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	152.611	2	76.306	839.655	.000[b]
	Residual	12.450	137	.091		
	Total	165.062	139			
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						
b. Predictors: (Constant), Behavioral Factors, Policy Incentive Effectiveness						

The ANOVA analysis demonstrates that the mediation regression model achieves statistical significance because it shows a significant effect on rooftop solar adoption intention, which it measures through its $F(2,137)$ value of 839.655 and p value of less than .001. The F-value establishes that the combination of policy incentive

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effectiveness and behavioral factors creates a powerful model which explains adoption intention, thus confirming the mediation model's complete accuracy.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.153	.085		1.806	.073
	Policy Incentive Effectiveness	.181	.076	.197	2.376	.019
	Behavioral Factors	.748	.080	.771	9.307	.000
a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome						

People who work with the mediator show a strong tendency to adopt rooftop solar systems because their behavioral traits generate a statistically valid positive impact on this decision (B = 0.748, β = 0.771, t = 9.307, p < .001). The direct effect of policy incentive effectiveness remains statistically significant but is substantially reduced (B = 0.181, β = 0.197, t = 2.376, p = .019) compared to its total effect. The results demonstrate that behavioral factors make up the majority of how policy incentives impact people to decide whether to adopt the program.

The mediation conditions are fully satisfied because three conditions exist which includes policy incentive effectiveness as a predictor of behavioral factors and behavioral factors as a predictor of adoption intention and policy incentives direct effect on adoption intention decreases when behavioral factors are added to the model while the effect remains statistically significant. The pattern demonstrates partial mediation because behavioral factors function as the primary pathway through which policy incentives impact rooftop solar adoption intention.

H5: Regulatory readiness moderates the relationship between policy incentives and adoption intention.

Model Summary									
Model	**R**	**R Square**	**Adjusted R-Square**	**Std. Error of the Estimate**	**Change Statistics**				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.954[a]	.910	.909	.3382	.910	696.000	2	137	.000
2	.963[b]	.928	.927	.3047	.018	34.220	1	136	.000
a. Predictors: (Constant), Policy Incentive Effectiveness (PI_C), Regulatory and Institutional Readiness (RR_C) **b. Predictors:** (Constant), Policy Incentive Effectiveness (PI_C), Regulatory and Institutional Readiness (RR_C), PI_C × RR_C									

The hierarchical regression model demonstrates strong explanatory power. Model 1, which includes policy incentive effectiveness and regulatory readiness, demonstrates that 91.0% of rooftop solar adoption intention variance ($R^2 = 0.910$, Adjusted $R^2 = 0.909$, $F(2,137) = 696.00$, $p < .001$) can be explained by its variables. The interaction term addition in Model 2 leads to better model performance because it causes explained variance to rise to 92.8% ($R^2 = 0.928$, Adjustd $R^2 = 0.927$), while explained variance changes for this model ($\Delta R^2 = 0.018$, F-change = 34.22, $p < .001$) show the presence of a significant moderation effect.

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ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	150.082	2	75.041	696.000
	Residual	14.980	137	.109	
	Total	165.062	139		
2	Regression	153.053	3	51.018	587.900
	Residual	12.009	136	.088	
	Total	165.062	139		

a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome
b. Predictors: (Constant), Policy Incentive Effectiveness (PI_C), Regulatory and Institutional Readiness (RR_C)
c. Predictors: (Constant), Policy Incentive Effectiveness (PI_C), Regulatory and Institutional Readiness (RR_C), PI_C × RR_C

The ANOVA results show that both regression models show statistical significance. Model 1 demonstrates a complete model fit ($F = 696.00$, $p < .001$), which shows that policy incentive effectiveness and regulatory readiness together forecast rooftop solar adoption intention. The interaction term addition to Model 2 maintains its strong significance ($F = 587.90$, $p < .001$), which shows that the moderation model explains adoption outcomes with statistical strength.

Coefficients[a] (Model 2 – Moderation Model)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.764	.062		60.589	.000
Policy Incentive Effectiveness (PI_C)	.222	.070	.245	3.178	.002
Regulatory & Institutional Readiness (RR_C)	.440	.069	.402	6.349	.000
PI_C × RR_C	**−.263**	**.045**	**−.312**	**−5.848**	**.000**

a. Dependent Variable: Rooftop Solar Adoption Intention / Outcome

The moderation model (Model 2) shows that policy incentive effectiveness ($B = 0.222$, $\beta = 0.245$, $p = .002$) and regulatory readiness ($B = 0.440$, $\beta = 0.402$, $p < .001$) both show significant positive impacts on the intention to adopt rooftop solar. The interaction term between policy incentives and regulatory readiness shows both statistical significance and negative value ($B = −0.263$, $\beta = −0.312$, $t = −5.848$, $p < .001$) which shows that regulatory readiness acts as a significant moderating factor between policy incentives and adoption intention. The study results show that policy incentives effectiveness depends on the existing regulatory and institutional framework.
The research demonstrates that regulatory and institutional readiness functions as a moderating factor which affects how policy incentives assess their effectiveness to drive rooftop solar adoption. The conclusion receives confirmation through the presence of an interaction term which shows statistical significance ($B = −0.263$, $\beta = −0.312$, $t = −5.848$, $p < .001$) together with the interaction term that produced a ΔR^2 of 0.018 ($p < .001$). The results show that different levels of regulatory readiness affect how policy incentives impact adoption intention which leads to the acceptance of H5.

7. DISCUSSION

7.1 Alignment and Divergence with Existing Literature

The findings match Indian research which shows that non-technical factors prevent rooftop solar systems from becoming widely used. Previous studies showed that policy incentives do not guarantee any kind of adoption but

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especially for residential areas (Goel, 2016; Dhingra et al., 2023). The research shows that citizens will adopt new technology because their behavior patterns control their decision-making process which matches the findings from urban India research about household energy use (Shakeel et al., 2023; Nallathiga et al., 2023).

This study shows that behavioral factors explain 25 percent more information than previous research which used TPB and other related models to predict study participants intentions (Kumar et al., 2024; Shakeel et al., 2023). The study shows that when solar panels become common in society and receive political support people choose between available policies and their household activities based on their personal behavior patterns. The Global South research shows how subsidies and net-metering systems drive policy incentives to create a strong positive relationship with adoption intention (Goel, 2016; Ministry of New and Renewable Energy, 2024). The study shows that incentives do not create direct results because their success depends on particular behavioral patterns and the current state of regulations.

7.2 Behavioral Mediation of Policy Incentives

The mediation analysis shows that the behavioral factors serve as a partial link between policy incentives and the intention to adopt their benefits. The total impact of policy incentives remains strong, yet their direct effects decrease after behavioral factors become part of the analysis. The research shows that household adoption processes, which require three types of household benefits and risks and operational feasibility, depend on incentives rather than financial incentives through which to obtain advantages.

This insight helps explain why several rooftop solar policies in India have achieved political visibility without proportional adoption outcomes, as previously noted by Goel (2016). The financial attractive policies which need better communication together with their administrative difficulty create a situation where householders cannot trust the policies to work. The research results reveal that assessing policy effectiveness needs both behavioral reception analysis and design element evaluation.

7.3 Regulatory Readiness as a Conditioning Factor

The process of adoption outcomes depends on regulatory and institutional readiness because it functions as the main factor which directly impacts incentives while also moderating their effects. The moderation results show that policy incentives achieve their highest effectiveness when a situation includes both clear regulations and simple procedures and institutions that respond effectively. The presence of institutional friction decreases the additional benefits that incentive programs provide.

The research results correspond with institutional studies about India's transition to renewable energy which show that state capacity and utility collaboration determine the success of decentralized renewable energy systems (Moallemi et al., 2017; Goel, 2016). The results also support research from the Global South which shows that institutional trust and administrative capacity need to exist before rooftop solar systems can be successfully implemented (Shakeel et al., 2023; Ministry of New and Renewable Energy, 2024).

7.4 Theoretical Implications

The study develops behavioral adoption theory through its extension into governance contexts. The traditional use of TPB UTAUT and DOI frameworks treats policy and regulation as elements that exist beyond primary operational conditions. The PBR framework establishes policy incentives and regulatory readiness as two dynamic forces that interact to determine how people behave and what technologies they adopt.

The study uses its single model demonstration of mediation and moderation effects to create a relational framework which explains how socio-technical transitions happen. This approach responds directly to calls within ERSS for greater integration of behavioral insights with institutional and political economy perspectives (Ajzen, 1991; Venkatesh et al., 2003).

7.5 Implications for India’s Rooftop Solar Transition

The study results demonstrate that India needs combined solutions to achieve its rooftop solar adoption goals. Financial incentives need to work together with behaviorally informed communication strategies and better regulatory implementation. The adoption process will not succeed when policies do not take into account actual household experiences and institutional performance. This study uses household-level empirical evidence to evaluate policy effectiveness which enables a more practical understanding of rooftop solar adoption in India while providing Global South countries with insights about decentralized energy transitions.

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8. POLICY IMPLICATIONS AND RECOMMENDATIONS

8.1 Policy Design Improvements

Rooftop solar incentive structures require three essential improvements which include increased simplicity and better prediction of results and complete access to information. The relationship between policy incentives and adoption intention establishes their main impact on user behavior, which depends on how households view the program and the current state of regulations. The research indicates that subsidy programs with frequent changes and complex rules which determine eligibility together with slow payment processes create a situation which reduces household trust in the program, despite its financial benefits. The system should provide stable incentive programs which include specific dates for benefits and require standardized documentation and present clear calculations of benefits. The system enables organizations to decrease their perceived risks while increasing their operational certainty, which leads to improved success in implementing policies that aim to achieve household energy-efficient practices (Goel, 2016; Ministry of New and Renewable Energy, 2024).

8.2 Strengthening Regulatory Readiness

Second, rooftop solar policy requires improved institutional and regulatory preparedness as its fundamental base. The study results demonstrate that regulatory readiness requirements directly influence adoption rates because implementation agencies specially DISCOMs have vital responsibility for managing these processes. The approval process needs reforms that will simplify procedures while minimizing delays and establishing better communication channels between utilities and local governments and installation vendors. The implementation of single-window clearance systems together with digital application platforms and standardized net-metering procedures will decrease administrative barriers while increasing institutional trust (Ministry of New and Renewable Energy, 2024; Nallathiga et al., 2023). The performance-linked DISCOM accountability systems establish a framework that drives utility companies to achieve their national rooftop solar objectives.

8.3 Behavioral Policy Instruments

Policy interventions need to use behavioral instruments together with their financial and regulatory measures. The main factor which drives people to adopt new technologies requires social norms and peer effects and local success stories to be used through targeted communication strategies. Community-based outreach together with neighborhood demonstration projects and trusted local actors' support can create a social standard which makes rooftop solar systems more common while eliminating uncertainty. Marketing and awareness campaigns should be tailored to specific socio-economic segments, addressing context-specific concerns related to cost, reliability, and institutional trust (Kumar et al., 2024; Shakeel et al., 2023). The use of behaviorally informed approaches will make rooftop solar policies more visible and credible, which will lead to faster adoption in urban and semi-urban areas.

9. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

The research used the integrated policy–behavior–regulation (PBR) framework to analyze India's rooftop solar adoption. Because it helps to explain why household adoption rates fall short of government policy targets. The study uses behavioral theory together with policy and regulatory analysis to develop a complete understanding of how Indian people develop intentions to adopt rooftop solar systems.

The study makes three key contributions. First, the research shows that behavioral factors act as the most effective direct predictors of rooftop solar adoption intention because household attitudes and perceived control together with social norms function as critical factors which drive decentralized energy transitions. Second, the findings show that policy incentives serve as the primary drivers for adoption because they change how people view their benefits instead of functioning as independent financial tools. Third, the study establishes regulatory and institutional readiness as both a direct determinant and a moderating condition that shapes the effectiveness of policy incentives. The study demonstrates its main findings through empirical verification of mediation and moderation relationships which connect behavioral adoption models with governance and institutional frameworks to advance research in socio-technical transition. This integrated perspective extends existing literature that often treats policy, behavior, and regulation as analytically separate domains.

The research study makes important contributions but also contains multiple research limitations. The research design which uses cross-sectional data creates a barrier for establishing causal relationships and studying how adoption patterns develop through different time periods. The study results depend on self-reported household information which creates response bias especially when assessing behavioral patterns and adoption intent. The research study mainly investigates urban and semi-urban residential areas which restrict its ability to apply results to rural regions that have different institutional frameworks and energy distribution methods.

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Future research should use longitudinal research methods to study how household environmental practices and their views on environmental policies change through different stages of rooftop solar system adoption which starts with awareness and continues until users finish their post-installation period. Researchers can develop a deeper understanding of household institutional relationships through qualitative research methods and mixed-method research which focuses on studying DISCOMs and local governance systems. Researchers can study how different Indian states and Global South countries generate diverse outcomes by examining decentralized energy transitions through comparative research. The upcoming research will investigate the post-adoption phase while studying how customer satisfaction plus system performance and institutional assistance impact the long-term sustainability and spread of rooftop solar systems

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