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Exploring the Economic and Socioeconomic Factors that Influence the Adoption and Use of Renewable Energy Technologies Among SMEs in Peshawar, Pakistan

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Abstract

This study looks at what makes small and medium-sized businesses (SMEs) in Peshawar, Pakistan take up and use renewable energy tech. Even though there's a lot of sunlight and not enough electricity, less than 5% of these businesses use renewable energy because of money issues, how people feel about it, and the rules in place.

We used surveys from 250 SMEs and talked to 15 business owners, sellers, and people who make the rules to get our info. The numbers showed that big initial costs, not having enough money, and high-interest rates were the biggest problems. But knowing about renewable energy, thinking it's useful, and getting training made businesses want to use it more. What people told us showed that wrong ideas, what others think, how hard the tech is to use, and slow rules also get in the way. SMEs that did use renewable energy said they saved money on energy and could stay open longer.

The study says we need to give money to businesses that want to use renewable energy, tell people why it's a good idea, train everyone (including women), and make the rules easier so more SMEs use renewable energy and grow in a way that doesn't hurt the planet.

Keywords

Renewable Energy Technologies, SMEs, Adoption Barriers, Economic Constraints, Socioeconomic Factors, Peshawar

1. Introduction

Peshawar City, Pakistan's small and medium-sized enterprises (SMEs) deal with ongoing energy issues, namely chronic shortages caused by high electricity tariffs of around 40 PKR per kWh and a periodic blackouts lasting eight to twelve hours each day, resulting in an increase in operating costs of 20 to 30 percent for most businesses, and adversely affecting many industries, most notably textiles and food processing. However, there is significant potential for the utilization of renewable energy technologies (RETs), including solar photovoltaic (PV) systems, in Khyber Pakhtunkhwa (KPK) due to the high levels of available sunlight in the region, estimated at five to seven kilowatt hours per square metre per day, and more than 30,000 megawatts of available hydro-power [1].Despite this opportunity to adopt RETs as a means of reducing energy costs and enhancing competitiveness, currently less than five percent of SMEs in Peshawar City are using renewable energy sources.

1.1 Energy Crisis and SME Vulnerabilities

Peshawar's SMEs, comprising 90% of businesses and 80% of non-farm employment, incur PKR 100-200 billion in national productivity losses from unreliable power, with diesel generators adding PKR 50-100/kWh costs [2]. KPK's industrial clusters face exacerbated grid instability, contrasting with India's lower tariffs (6.5 cents/kWh), highlighting the urgency for RETs to enhance resilience (CDPR, 2025). Policy frameworks like the 2019 Alternative Energy Policy promote net metering, but bureaucratic hurdles persist [3].

1.2 Economic Barriers to Adoption

High upfront costs (PKR 50,000-100,000/kW for solar) and 5-8 year paybacks deter investment, compounded by 15-20% interest rates and collateral demands excluding revenue-constrained SMEs [4,5]. Import duties and fossil subsidies distort incentives, despite 30-50% savings potential; SMEDA pilots indicate microfinance could reduce ROIs to 3-4 years [6,7]. Punjab SME studies confirm financing gaps amplify 2-3 fold for smaller firms [8].

1.3 Socioeconomic and Behavioral Constraints

Low awareness affects 70% of Peshawar SMEs, fueled by misconceptions on dusty-climate durability and cultural preferences for conventional sources, particularly in family businesses [9,10]. Gender barriers limit female-led SMEs (<10%) access to training, while skill shortages hinder maintenance; awareness campaigns yield 15-20% uptake gains regionally [11,12]. Technological complexity moderates adoption, per green innovation models [8].

1.4 Theoretical and Empirical Frameworks

Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) posit perceived usefulness and social norms as key, with KPK pilots showing 20-40% cost cuts and 1 job/5 kW [13,14]. Abbottabad data mirror Peshawar prospects, but regulatory delays loom; SDPI reports forecast 21% renewable capacity growth to 13,686 MW by 2030 (SDPI, 2022). Green AI integration further mediates SME sustainability [15].

1.5 Policy Gaps and Research Imperative

KPK's 5,000 MW solar goal lacks SME tailoring, with sparse Peshawar data on ROI and attitudes; SMEDA's role in subsidies and training is pivotal (SDPI, n.d.; CDPR, 2025). This study fills gaps via surveys and econometrics, advocating blended finance for SDGs 7/9 alignment.

2. Methodology

2.1 Research Design

To better understand the economic and non-economic drivers of SMEs' decision to adopt renewable energy technologies in Peshawar, Pakistan, this study will take a mixed-methods research design approach that combines qualitative and quantitative research methods. Quantitative data on the costs associated with renewable energy technologies, awareness of renewable energy technology, barriers to financing renewable energy technology, and the behaviour of SMEs to adopt renewable energy technologies will be collected through a cross-sectional survey. Semi-structured interviews will be conducted with the representatives of SMEs to derive further understanding of their perception and attitudes towards renewable energy technologies, as well as any contextual and/or situational issues that may be acting as barriers to the adoption of renewable energy technologies. The utilizing of a mixed-methods approach will allow research findings to share a greater sense of depth and richness and provide a better avenue for data triangulation.

2.2 Area and Population Studied

This research examines Peshawar, the largest commercial centre of Khyber Pakhtunkhwa province (KPK), as a case study of where small and medium-sized enterprises (SMEs) constitute more than ninety percent of local businesses while encountering serious energy constraints. The target population consists of registered SMEs based on the most significant sector(s) of textiles, light engineering, food processing, retail trade, and service industry. The target populations of the study were all SMEs, regardless of whether they have adopted or have not adopted renewable energy technologies (RETs), in order to compare adopters with non-adopters.

2.3 Sampling Technique and Sample Size

A stratified random sampling technique was employed to ensure representation across SME categories (micro, small, medium). Based on Krejcie and Morgan’s sample determination table and the estimated SME population in Peshawar, a sample size of 250 SMEs was selected for the survey.
Additionally, 15 owners/managers were purposely selected for in-depth interviews to capture experiential insights, attitudes, and behavioral drivers.

2.4 Data Collection Instruments

2.4.1 Survey Questionnaire

A structured questionnaire was developed based on prior literature, SDPI reports, TAM and TPB constructs, and RET adoption studies. The questionnaire comprised five sections:

- Business Profile
- Economic Factors
- upfront cost, interest rates, payback period, access to finance
- Socioeconomics factors
- Awareness, Cultural preferences, gender dynamic, skills availability
- Technological Factors
- perceived usefulness, complexity, reliability
- Adoption Status and Future Intent

Items were measured using 5 points Liker scale ranging from "Strongly Disagree to Strongly Agree"

2.4.2 Interviews

Semi-structured interviews were conducted with SME owners, solar vendors, and policymakers. Interview guides focused on perceptions of RET benefits, financing obstacles, regulatory issues, and behavioral influences. Each interview lasted 20–30 minutes and was audio-recorded with consent.

2.5 Reliability and Validity

To validate the instrument, a pilot test with 20 SMEs was performed to improve the tool. All scale items achieved internal consistency as confirmed by combined Cronbach's alpha results being above 0.70). Content validity was confirmed through expert evaluations conducted from academia and by energy specialists. Construct validity was increased through a combination of quantitative and qualitative data triangulation.

2.6 Data Collection Procedures

Researchers visited the Industrial Zones and Commercial Clusters located in Peshawar, including Hayatabad Industrial Estate, Kohat Road, and University Road markets where they implemented the survey distribution methodology. The use of face-to-face questionnaires increased the accuracy of the respondent's answers. Through scheduled appointments made via telephone, the owners of SMEs and other Industry Experts were interviewed. Six weeks were needed to collect the data.

2.7 Data Analysis Techniques

In this study, quantitative analysis was done using SPSS/Stata. The statistical techniques included descriptive statistics (mean and frequency), correlation analysis, multiple regression analysis to identify predictors for renewable energy technology (RET) use, Analysis of Variance (ANOVA) for between sectoral comparison, and Logistic Regression for binary classification of RET adoption.

The independent variables were economic and social characteristics and RET use was the dependent variable.

Qualitative data from the interviews were analysed using a thematic analysis method where themes were created based on awareness, perceived benefits, cultural factors and government interventions (Barriers), and financial constraints. NVivo software was used to code the patterns that recurred during analysis.

2.8 Ethical Considerations

Ethical guidelines were followed in all aspects of this study. Participation was voluntary. Every participant was informed of the overall purpose of the study, consent was given verbally or in writing, and confidentiality was strictly maintained over the business data collected. Data will only be published for academic purposes.

2.9 Limitations

Limitations that may exist are: Self-reported data, limited ability to generalise results beyond Peshawar, potential bias in how the respondents answered questions. The limitations mentioned above are mitigated through mixed-method triangulation which provides increased validity of results.

3. Results

The purpose of this chapter is to outline the quantitative and qualitative results of the research study which evaluated what economic/social/economic/technology factors affect how SMEs in Peshawar, Pakistan, adopt (implement) renewable energy technologies (RETs). The results will show in a descriptive manner; by showing descriptive data analysis, regression analysis, comparison group data analysis and thematic analysis through interviews conducted with SME owners/managers. All of these combined provide an overall understanding of what drives or inhibits the use of RETs within SMEs.

3.1 Descriptive Analysis

3.1.1 Characteristic the Sample

The survey was completed by 250 SMEs from four market sectors, retail (32%), manufacturing (27%), services (24%) and food processing (17%). The sample's largest group (58%) was small enterprises. Micro and medium-level enterprises made up the remaining portions of the sample, at 26% and 16%, respectively. In total, only 11% of the businesses surveyed had any form of renewable energy system technology, primarily solar photovoltaic (PV) systems, which further reflects the low level of installation as reported previously.

Graphed data indicate that 72% of respondents rely on the national grid and 54% of respondents used diesel generators to supplement their power needs during load shedding. The average monthly electric bill for SME's ranged from PKR 60,000–150,000; it was not uncommon to see reports from SMEs that power outages had reduced their production capacity by 20–40%.

3.1.2 Economic Conditions and Firm Constraints

Findings reveal significant financial challenges hindering RET adoption:

- ❖ 78% of SMEs considered upfront installation costs too high.
- ❖ 66% reported difficulties accessing bank loans due to high interest rates (15–20%).
- ❖ 59% stated lack of collateral as the primary barrier to financing RETs.
- ❖ Only 14% had ever applied for energy-related financing programs.

Despite these constraints, 70% of SMEs agreed that RETs could substantially reduce long-term operating costs, indicating a perceived economic benefit but low investment capacity.

3.1.3 Socioeconomic s and Awareness Factors

- ✧ Awareness levels were found to be low:
- ✧ 68% had limited or no understanding of solar system performance in dusty climates.
- ✧ 61% expressed uncertainty about the payback period.
- ✧ 43% believed RETs require "complex maintenance."
- ✧ Only 22% had attended any energy-related training or awareness program.
- ✧ Gender-related disparities were also notable. Among the small number of female-led SMEs (<10%), only 2 had adopted RETs, citing limited access to technical support and financial services.

3.1.4 Technological Perceptions

Perceived technological usefulness and ease of use strongly varied:

- ❖ 74% agreed RETs reduce dependence on unstable grid electricity.
- ❖ 69% believed solar energy is reliable in Peshawar's climatic conditions.
- ❖ 52% found the technology "difficult to understand" due to complex terminology used by installers.
- ❖ 41% indicated fear of system damage or poor-quality installations.

Together, these descriptive results show that while perceived usefulness of RETs is high, economic and informational barriers remain strong deterrents.

3.2 Regression Analysis

To evaluate how key factors affect Renewable Energy Technology (RET) Adoption, multiple logistic regression analysis and multiple regression analysis were conducted based on adoption intention (two dependent variables) and RET adoption.

3.2.1 Predictors of RET Adoption Intention

Regression estimates of RET Adoption Expectation identify the following significant regression coefficients:

- ◆ Upfront Cost ($b = -0.41$; $p<0.01$): Higher upfront cost negatively impacts intentions to adopt RET technology.
- ◆ Access to Finance ($b = 0.36$; $p<0.01$): Access to financing products (e.g., loans) is strongly predictive of intent to adopt RET technology.
- ◆ Awareness Level ($b = 0.29$; $p<0.05$): Higher levels of RET Awareness predict higher Intentions to Adopt RET technology.
- ◆ Perceived Usefulness ($b = 0.38$; $p<0.01$): Perceived Usefulness is a strong positive predictor in accordance with the Technology Acceptance Model (TAM).
- ◆ Perceived Complexity ($b = -0.22$; $p<0.05$): Systems with higher perceived complexity reduce the likelihood of Adoption Intent.

These results suggest that while economic variables explain a greater percentage of the variance in Adoption Intent than other variables, Non-Economic Variables (Awareness, Perceived Usefulness) also significantly affect Adoption Intent.

3.2.2 Logistic Regression of Actual Adoption of RET Technology

Logistic regression analysis of predicted Adoption of RET Technology among Small and Medium Enterprises yielded the following significant logistic regression odds ratios (OR):

- ✧ Loan Availability $OR=2.82$ ($p<0.05$);

- ✧ High Electricity Prices OR=2.45 ($p<0.05$);
- ✧ Perceived Long Term Savings OR=1.93 ($p<0.05$);
- ✧ Training OR=1.71 ($p<0.10$).

Social Influence was identified as a moderate predictor of actual Adoption on a scale of impact ranging from 1.00 (e.g., Recommendation by Peers) to 1.48 which corresponds with The Theory of Planned Behavior (TPB).

While percentages for the Logistic Regression indicated that 62% of Adoption Intention Variability is accounted for by the Logistic Regression Models, a Model for Prediction classified 78% of all Adopters correctly indicating very good prediction validity.

3.3 Group Comparisons Between Adopters and Non-Adopters

3.3.1 Variations in the Economics of RET Adoption

The level of energy costs for adopters is approximately 32% lower than that of non-adopters. Adopters report their average payback period to be between 3 and 4 years, while non-adopters will typically see a minimum of 5 years or up to 8 years before realizing an investment's return. Therefore, because adopters report generating higher monthly revenues, the financial stability of adopters may be greater than those of non-adopters.

3.3.2 The Gap between Adopter and Non Adopter Awareness Knowledge

There were significant differences between adopters and non-adopters in their scores for awareness indicators; there is a difference of over 100% in the average of performance associated with solar between the two groups (i.e., an average of 4.1 for adopters and 2.6 for non-adopters) and over 100% in understanding of government policies (i.e., 3.8 for adopters and 2.3 for non-adopters). A difference of over 60% existed in terms of adopters' technical confidence concerning their use of RETs versus non-adopters (i.e., 3.9 for adopters and 2.5 for non-adopters). A measurable impact has been made by education and awareness campaigns for adoption of RETs.

3.3.3 The Discrepancy Between Sectors

The manufacturing sector expressed the greatest willingness to adopt RETs due to a possible reliance on energy and potential savings through the use of these technologies. Retail and service sectors expressed moderate willingness, although their self-imposed limits (i.e., limited rooftop area and lower utilization of power) served as a barrier for adoption of RETs.

3.4 Qualitative Insights

Interviews with SME owners and solar vendors as well as with policymakers provide greater context to the quantitative findings in this study.

3.4.1 Economic Pressures and Financial Barriers

Many SME owners voiced their frustrations over the fact that “the banks do not give loans unless there is a lot of collateral, and small businesses cannot meet the criteria required.” They also noted that while solar prices are dropping, the total that is required for the initial investment is still an insurmountable sum for them. Many solar vendors have reported that delays in financing arrangements through banks have dissuaded many prospective customers from going ahead with their purchase.

3.4.2 Misconceptions and Lack of Trust

Common misconceptions identified by interviewees were:

Dust “completely” reduces the performance of the system. This discourages adoption.

Maintenance is too “difficult” and/or requires a qualified engineer.

Imported solar modules are very expensive and pose a degree of risk.

Many SMEs do not trust the local solar installation contractors as they have received complaints from customers about the poor quality of their equipment. This implies a need for certification of the installer.

3.4.3 Cultural and Behavioral Norms

Owners of family-owned SMEs expressed, there is hesitation in adopting new technologies unless there is another SME in the area that they believe is a trustworthy firm that already has implemented the same product/technology. One of the owners stated, “We do what our neighbouring stores do,” while another said, “Why should we take a risk, if our competition does not use it?” This reflects the concept of social norms that is consistent with the Theory of Planned Behaviour.

3.4.4 Policy and Regulatory Challenges

Respondents have criticized the inefficiencies associated with obtaining net metering approval from the Government, by stating that "It takes months for one application to process," and that "This is not a friendly process for SMEs." Policymakers acknowledged this as an issue, and also stated that the government is introducing reforms to address these problems, however; respondents also noted that many of these delays still exist.

3.5 Summary of Key Finding

The Low Adopter Rate of 11% is mainly based on people having a greater sense of the Long-term Benefits of Solar Renewable Energy than they actually have.

The Upfront Cost is too high, Financing is Limited, and High Interest Rates were found to be the most significant barriers to adoption.

Increased awareness and training will improve adoption rates dramatically; in fact, SMEs trained are nearly 2 times more likely to adopt.

Although Perceived Usefulness and Technology Complexity are significant determinants of adoption, the economic benefits that adopters receive will be greater than the upfront costs and training required for the adopter to adopt the system/system, and have experienced how they increase electricity production hours and decrease their electricity bills.

While some sociocultural influences and misconceptions will always play a role in expected behaviour, regulatory issues surrounding net-metering and the approval process inhibit motivation for adopting renewable energy technology.

4. Discussion

This chapter interprets the findings of the study and situates them within existing literature, theoretical frameworks, and policy contexts. The discussion highlights how economic, socioeconomic, and technological factors shape renewable energy technology (RET) adoption among SMEs in Peshawar, Pakistan, and explains why adoption remains low despite strong potential benefits.

4.1 Economic Constraints as the Dominant Barrier

Economic factors were found to be the most important influence of RET adoption with high up-front costs and limited access to financing being the most significant barriers. These findings were supported by research from SDPI and CDPR, which demonstrate that SMEs are financially vulnerable due to the costs of unreliable electricity and the use of diesel fuel. From the regression analysis, we can conclude that the up-front cost had the largest negative impact on the intention to adopt RETs at ($\beta = -0.41$), indicating that SMEs have tight financial structures and simply cannot afford long-term investment "locks" because of other major costs.

Although SMEs recognize that RETs could provide savings of 30% to 50% on energy costs, the perception of long payback periods has a negative impact on investment decisions. Contrarily, when the adopters of RETs were asked to provide their actual payback periods, RESPONDENTS stated the period to be between 3-4 years; therefore a disconnection exists between perception and reality. This highlights the need for awareness training, financial literacy, and demonstration of success through model RET projects.

SMEs also face challenges in obtaining loans because of high-interest rates and the requirement for collateral which limits their ability to obtain loans. This finding is consistent with findings throughout the world that indicate that small businesses, particularly in developing countries, are constrained in their ability to secure financing and thereby limit green technology adoption due to lack of access to funding. SME studies in Punjab, referenced in the introduction, also exhibited financing gaps which affect small and micro-sized businesses disproportionately. Therefore, economic barriers creating challenges for SMEs in Peshawar also mirror local infrastructural gaps and systemic constraints to financing that are prevalent throughout the financial systems in Pakistan.

4.2 Socioeconomic Barriers and Behavioral Influences

The study concluded that Awareness, familiarity with Solar Technology and sociocultural norms were positively associated/attributed to adoption with approximately 68% (over two-thirds) of SMEs having limited knowledge about Solar Technology (specifically performance, maintenance and pay back cycles). This aligns with international findings that lack of technical knowledge hinders decentralized energy transitions among small businesses.

There is also evidence of misconceptions particularly the belief that dusty climates render solar systems ineffective or that maintenance is excessively technical

These findings mirror behavioral constraints found in different types of green innovation models (i.e. risk aversion, information asymmetry and distrust towards new technologies) which inhibited the ability to adopt these technologies.

Another critical finding from this research was Social Influence, particularly in the Family-owned SME segment, whereby many of the respondents indicated they would have adopted RETs earlier had they seen their competitors or

neighbouring businesses adopt them beforehand. This supports TPB Theory, whereby Social Norms shape environmentally related behaviors (decision-making).

In Pakistan's Collectivist Business Culture, peer practices and community perceptions have a significant impact on Technology Decision-making by SMEs.

The study also indicated that female-led SMEs and women entrepreneurs experienced higher levels of exclusion/access to training/technical assistance than their male counterparts. This finding aligns with the broader structural barriers within Pakistan's SME ecosystem where women entrepreneurs lack Equity in Access to Financial and Technical Resources. Although Women-led SMEs accounted for less than 10% of the sample, their Very Limited Participation in the Adoption of RETs indicates that Gender Dynamics need to be incorporated into Policy Planning.

4.3 Technological Perceptions and the Role of TAM

The Technology Acceptance Model (TAM) helps us understand how people see the benefit and ease of using technology when using RET. In this study, we find that perceived usefulness has the highest positive impact, with approximately 74 percent of SMEs believing that RET's reduce their reliance on unpredictable grid electricity. The results of the regression analysis also show that perceived usefulness ($\beta = 0.38$) is a significant predictor of intentions to adopt RETs. Perceived complexity had a negative impact on adoption intention ($\beta = –0.22$), suggesting that SMEs perceive RETs to be difficult to use or understand. Interview responses show that SMEs reported significant confusion surrounding the terminology associated with RET's, the quality of the components used, as well as the credibility of the installers. Therefore, SMEs need to have access to information that is easy for them to understand, a standardized process for obtaining installed RET certification and support post installation. Thus, while this finding suggests that SMEs value the usefulness aspect of RETs, it is a prime example of a TAM-related issue: Individuals will perceive a benefit to the technology they are considering, yet they may not be willing to adopt the technology if it appears too complex or risky to them. In order to close this gap and reduce the negative perception of RETs due to perceived complexity, organizations need to implement systems that increase trust between technology providers and SMEs, and provide easily accessible sources of knowledge.

4.4 Policy and Institutional Challenges

The findings show that regulatory delays especially in net-metering approvals discourage adoption. Respondents described the process as slow, bureaucratic, and not SME-friendly. Delays of several months reduce the attractiveness of investments by increasing uncertainty and operational burden.

While Pakistan’s Alternative and Renewable Energy Policy (2019) supports net-metering and independent power production, the implementation process remains fragmented, with inconsistent procedures across provinces. KPK’s policy framework, though ambitious with a 5,000 MW solar capacity target, lacks SME-specific interventions, which is why adoption remains under 5% in Peshawar.

The study also found that institutional roles remain unclear.Although PEDO, SMEDA, and local chambers of commerce have a mandate to support the establishment of SMEs, weak coordination between the three bodies has resulted in a lack of structured training and blended financing options available to SMEs despite the strong demand for these options.

The conclusions found in this research study support the general findings within the broader literature indicating the need for clearly defined policies, streamlined regulation, and targeted assistance to support the energy transition in developing economies. The disconnection between national policies and local implementation has led to slow rates of adoption.

4.5 Economic Benefits Experienced by Adopters

A key contribution of this study is documenting the substantial benefits experienced by SMEs who have already adopted RETs. Adopters reported:

- 32% reduction in monthly electricity expenditure
- Increased business hours during load-shedding
- Higher productivity levels
- Improved operational stability

These benefits validate the economic rationale for RETs and align with SDPI’s findings forecasting that Pakistan could reduce national productivity losses by PKR 100–200 billion through decentralized renewable systems.

These findings show that the implementation of RETs is good for the environment as well as being a smart economic strategy for SMEs in areas where energy is not secured (like Peshawar). The information can assist policymakers with creating incentive plans that define projected operational savings and benefits.

4.6 Alignment With Theoretical Models

The study's results support both TAM and TPB:

Perceived usefulness → strongly predicts adoption intention

Perceived ease of use → moderate but significant influence

Social influence → important behavioral determinant

Behavioral control (access to resources) → dominant factor affecting actual adoption

In conclusion, the factors that affect a small-to-medium-sized enterprises' (SMEs) adoption of renewable energy technology (RET) are economic ability, access to information, and social and cultural influences. This work confirms that integrating the Technology Acceptance Model (TAM) with the Theory of Planned Behaviour (TPB) is valid for the study of green technology adoption.

4.7 Contribution to Existing Literature:

The purpose of this study is to advance the understanding of the adoption of renewable energy in Pakistan by providing the first large-scale, comprehensive analysis of renewable energy adoption in Peshawar, a previously understudied area of Pakistan with substantial renewable energy potential. Additionally, this research examines the interaction between economic barriers and socio-behavioural barriers that affect renewable energy adoption, moving beyond simply analyzing costs. Finally, this study presents a mixed-method data source that demonstrates the collective effect of consumer perceptions, misconceptions, and institutional barriers on consumer adoption outcomes.

Finally, this study provides new empirical evidence on the benefits realized by consumers who have already adopted renewable energy, which will help guide future financial decision-making with respect to the adoption of renewable energy technologies.

The results are consistent with the results found in the studies conducted in Abbottabad, Punjab, and various cities throughout South Asia that are experiencing similar energy shortages.

4.8 Implications for Policy and Practice:

The research indicates several important implications for both policy and practice:

Developing financial products, including micro-financing, subsidized loans and equipment leasing options for small and medium enterprises (SMEs), provides necessary financial support for the development of renewable energy technologies in Pakistan.

Training and education programs also have the potential to significantly reduce the barriers to consumer acceptance and use of renewable energy technologies, while improving their overall comfort level with these technologies.

While certifications of installers can build consumer trust and promote quality installations, net-metering reforms should be established to increase the efficiency of the approval process.

Finally, in developing policies that facilitate the adoption of renewable energy technologies by small and medium-sized businesses, policymakers must place a priority on making renewable energy technologies accessible, affordable, and reliable.

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