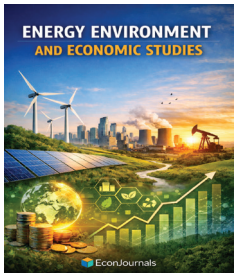

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Solar Energy Awareness and Government Support Perception: A Moderated Mediation Model of Solar Adoption Intention and Clean Energy Usage

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ABSTRACT

This paper will investigate the impact of solar energy awareness (SEA) on clean energy usage (CEU), and the mediating force of solar adoption intention (SAI) and the moderating impact of government support perception (GSP) in the mediated relationship through the theory of planned behavior (TPB). A structured questionnaire, convenience sampling technique were used to collect data on a sample of 318 household energy consumers in Jordan, and partial least squares structural equation modeling (PLS-SEM) was applied to test the hypothesized proposals. The results show that SEA is a considerable and positive influencer of SAI and CEU. Additionally, SAI was found to mediate the relationship between SEA and CEU indicating its critical role in converting awareness into real sustainable behavior. GSP further supported this mediated relationship, highlighting the significance of perceived policy and institutional support in strengthening the effectiveness of SEA. This paper offers a new approach to the relationship between personal consciousness and organizational encouragement in facilitating CEU, by combining SAI and GSP into the framework of TPB, which expands behavioral energy research. The results contribute to theoretical insights into the behavior of clean energy and provide policy implications that policymakers can use to speed up the use of solar energy in the developing economies.

Keywords: Solar Awareness, Government Support, Clean Energy, Adoption Intention
JEL Classifications: Q42, Q48, D91, Q41, Q56

1. INTRODUCTION

The energy transition in the world has been a major concern in tackling climate change, escalating fossil fuel reliance and escalating domestic energy expenses. Solar energy has become one of the fastest-developing and most available clean sources of energy among renewable options as the cost of installation is falling, technological advancements are increasing and policy incentives are provided. Recent reports on global energy outlooks have indicated that the increase in solar capacity has been so high in both developed and developing economies but the adoption of solar energy at household level is not uniform, especially in emerging markets where the awareness, finances, and institutional support of solar energy differ significantly (Yin et al., 2024; Ali et al., 2020). Solar energy is a viable option in those countries like Jordan, where the large amount of sunlight has been combined with increasing electricity demand and energy systems that rely on imports (Tanveer et al., 2021). Although there is an increasing supply, the change to solar uptake is not only a technological but mostly a behavioral and an institutional challenge. In this paper, four major constructs are being considered, namely SEA, SAI, CEU and GSP. SEA describes the knowledge people have about solar technology advantages, saving money and environmental influence.

Solar adoption intention reflects motivational preparedness to get solar systems installed or used (Waris et al., 2023). CEU is an indicator of real behavioral consequences including decreased

dependency on fossil-fueled electricity and more use of renewable energy. GSP reflects the faith of people in the effectiveness of policies, subsidies, incentives and encouragement of institutions towards renewable adoption (Vu et al., 2023). The choice of these variables is due to the existence of research in the past, which indicates that being aware of the need to change behavior does not guarantee a change unless coupled with an intention formation and facilitating institutional conditions (Ding et al., 2024; Chanda et al., 2026). The choice of the household energy sector in Jordan is very justified owing to the rising consumption of electricity, high dependency on imports and the high solar irradiation potential. Jordan imports more than 85% of its energy needs, making it vulnerable to global price fluctuations and supply disruptions (Huang and Cheng, 2023; Anjum and Subhan, 2025). Meanwhile, residential electricity demand is steadily growing with urbanization and population increase. The policies of renewable energy, net metering schemes, and solar subsidies have been introduced, but the rate of their adoption is still average, which implies that there is still a gap between the design of policies and their use by the population (Hussain et al., 2025; Irfan et al., 2021). This paradox renders Jordan a perfect empirical setting to study the determinants of adopting solar behaviorally and policy-based. Despite growing interest in renewable energy adoption, several important research gaps remain in the existing literature. Earlier studies have mainly examined SEA as a direct predictor of adoption behavior, but they often ignore the psychological pathway through which awareness translates into actual usage behavior (Alcaraz et al., 2025; Mustafa et al., 2023).

Research has frequently focused on economic incentives or cost benefits, while underestimating the role of behavioral intention as a key mechanism driving CEU (Hussain et al., 2025). Although government policies and subsidies are widely recognized, most studies treat government support as a direct influence, rather than exploring its role in strengthening or weakening behavioral relationships (Huang and Cheng, 2023). Limited attention has been given to moderating effects in energy behavior models, resulting in overly simplified linear frameworks that fail to capture real-world complexity (Waris et al., 2023). Existing research is largely concentrated in developed economies, with insufficient empirical evidence from developing countries such as Jordan, where energy dependency and policy structures differ significantly (Huang and Cheng, 2023; Jun et al., 2025). Prior studies rarely integrate CEU as an outcome variable, instead focusing only on adoption intention, creating a gap between intention and actual behavior (Kurniawan et al., 2025; Irfan et al., 2021). Lastly, fewer moderated mediation frameworks that integrate awareness, intention, behavior, and policy perception in one integrated framework are used (Vu et al., 2023; Yin et al., 2024). Such loopholes indicate that a more detailed and context-focused study is required.

The study is informed by the fact that the transition of awareness to actual energy behavior is an urgent issue that requires to be studied under different degrees of government support. Based on this, the primary objectives of the study are: (1) to determine the influence of SEA on SAI; (2) to determine the influence of SAI on CEU; (3) to determine the moderating influence of SAI; and (4) to determine the moderating influence of GSP in enhancing this relation. This study, in theory, adds value by generalizing the TPB by adding institutional support as a moderator and behavioral intention as a mediator. In practice, it offers information to policymakers in Jordan and other economies like this to develop specific awareness campaigns and reinforce subsidy systems. It is a unique study, as it incorporates psychological awareness, behavioral intention, and policy perception into one moderated mediation model, providing the more holistic explanation of renewable energy transition behavior. Finally, the study has a contribution to the academic literature and practical energy policy by filling the gap between the awareness and the real implementation of clean energy in a developing-country setting. Finally, there is limited application of moderated mediation frameworks that combine awareness, intention, behavior, and policy perception in a single integrated model (Vu et al., 2023; Yin et al., 2024). These gaps highlight the need for a more comprehensive and context-specific investigation.

This study is motivated by the urgent need to understand how awareness transforms into actual energy behavior under varying levels of government support. Accordingly, the main objectives of this research are: (1) to examine the effect of SEA on SAI; (2) to assess the impact of SAI on CEU; (3) to investigate the mediating role of SAI; and (4) to analyze the moderating role of GSP in strengthening this relationship. Theoretically, this study contributes by extending the TPB through incorporating institutional support as a moderating mechanism and behavioral intention as a mediating pathway. Practically, it provides insights for policymakers in Jordan and similar economies to design targeted awareness campaigns and strengthen subsidy frameworks. The study is unique in integrating psychological awareness, behavioral intention, and policy perception into a single moderated mediation model, offering a more holistic explanation of renewable energy transition behavior. Ultimately, this research contributes to both academic literature and practical energy policy by bridging the gap between awareness and actual CEU in a developing-country context.

2. THEORETICAL BACKGROUND

The paper is largely based on the TPB which offers a solid psychological model to explain how people make intentions and turn them into real actions (Ajzen, 1991). TPB is generally used in environmental and energy studies as it explains behavior based on cognitive evaluation processes and therefore, it is very appropriate in explaining the decisions to adopt solar energy. According to the theory, intention is what drives behavior and is influenced by attitudes, subjective norms and perceived behavioral control. SEA, in turn, is central to the development of positive attitudes in regard to clean energy, whereas GSP enhances the perceptions of behavioral control via the minimization of financial and institutional costs (Islam et al., 2026; Hussain et al., 2025). The TPB inclusion is explained by the fact that previous research always shows that the concept has the explanatory power in the context of renewable energy. As an example, Ali et al. (2020) and Tanveer et al. (2021) discovered that behavioral intention towards solar adoption is significantly enhanced by awareness. Equally, Irfan et al. (2021) asserted that intention is a robust predictor of actual energy-saving behavior which supports the assumption of TPB

that intention is the immediate predictor of behavior. Nevertheless, such studies tend to overlook external contextual influences like support of the government which can either augment or diminish the intention-behavior relationship. To overcome this shortcoming, this paper brings in GSP as a moderating variable to expand TPB beyond its conventional scope. This extension is in line with Irfan et al. (2021), who opined that policy incentives play crucial roles in behavioral change in adoption of renewable energy. Huang and Cheng (2023) also highlighted that the institutional trust and subsidy awareness enhance willingness of the citizens to invest in solar systems, especially in developing economies. Additionally, the mediation effect of SAI coincides with the main mechanism of TPB where the intention is the psychological mediator between cognition and behavior.

Research conducted by Chanda et al. (2026), Kumar and Nayak (2024) also proves the presence of intention between the awareness and the actual energy-related behavior. The majority of these studies, however, are restricted to linear mediation models and do not explain conditional effects, which the current study includes using a moderated mediation framework. The choice of TPB is also justified by its effective use in energy transition studies in various contexts. An example is Awais et al. (2022) who used TPB in the adoption of solar panels in China and observed a high predictive validity. Likewise, Yin et al. (2024) established that the behavioral attitudes are major factors affecting the decision to invest in renewable energy. In the original work of Ajzen (1991), external variables, like policy environment, could indirectly manipulate behavior by their impact on belief systems, which justifies the inclusion of GSP in the study. Moreover, the recent articles by Kumar and Nayak (2024), and Maqsoom et al. (2024) emphasize that the combination of behavioral factors and institutional support is a key to hastening the clean energy transitions in the developing economies. In Jordan, specifically, Waris et al. (2023) and Ding et al. (2024) note that despite the growing awareness, adoption is low because of the poor perception of efficacy of policies, which is another reason why GSP should have a moderating effect. In general, TPB offers a solid basis on which the psychological (awareness and intention) and contextual (government support) variables can be incorporated into a single model of explanations. This study introduces a mediator (solar adoption intention) and a moderator (GSP) to TPB to form a moderated mediation model that has a more realistic representation of the complexity of energy decisions in real-life. This integration is highly embraced by the previous empirical research findings and the gaps in the literature on renewable energy, especially in the context of developing countries where behavior and institutions play a significant role in influencing the process of clean energy transitions.

2.1. Solar Energy Awareness and Solar Adoption Intention

SEA is likely to play a considerable positive role on solar adoption intention because people with greater knowledge and perception of solar technologies would tend to form positive cognitive appraisal and behavioral preparedness to adoption. In the framework of the TPB, awareness is essential in behavioral intention formation as it influences the development of attitudes (Vu et al., 2023; Yin et al., 2024). When people know about the economic advantage, environmental benefit and long-term cost reduction of using solar power, their perception of the worth of adoption is more, thus improving the level of intention (Irfan et al., 2021). This relationship is always in line with empirical studies. Huang and Cheng (2023) discovered that renewable energy awareness among households is a significant factor in their intention to adopt renewable energy. On the same note, Jun et al. (2025) and Maqsoom et al. (2024) found that awareness is a major psychological motivation of solar technology acceptance. Awais et al. (2022) have also concluded that informed individuals have higher chances of showing willingness to invest in clean energy solutions. Wall et al. (2021) and Chanda et al. (2026) highlighted in their developing economies research that the lack of awareness is a significant obstacle to the transition towards renewable energy. Furthermore, Tanveer et al. (2021) emphasized that awareness campaigns are an excellent way to enhance citizens preparedness to adopt solar in Middle East settings. To reinforce this, Ali et al. (2020) and Tanveer et al. (2021) articles show that awareness is a pre-renewable energy diffusion determinant. Thus, SEA is not only informational but a cognitive stimulus reinforcing the intention formation, an essential prerequisite of solar adoption behavior.

H_1: SEA is positively related to SAI.

2.2. Solar Energy Awareness and Clean Energy Usage

SEA also have a considerable positive influence on CEU since the awareness will not only influence intention but will affect actual decisions in energy consumption. According to the lens of the TPB, behavioral results are frequently supported when people have a good level of knowledge and positive attitudes towards a particular behavior, which minimizes the uncertainty and enhances the perceived behavioral control (Hussain et al., 2025; Yin et al., 2024). In this regard, those who comprehend the environmental and economic advantages of solar power would have a higher chance of altering their real consumption habits to less polluting energy sources. Previous studies substantiate this direct behavioral relationship. An example is Tanveer et al. (2021) which discovered that environmental awareness is a significant factor in the minimization of the usage of non-renewable sources of energy. Likewise, Islam et al. (2026) indicated that informed households tend to indulge in energy saving and clean energy practices. Wall et al. (2021) highlighted that sustainable consumption behavior can be directly positively influenced through the use of awareness-based interventions without the need to involve complex motivational pathways. Yin et al. (2024) also affirmed the high correlation between energy literacy and real green behavior adoption. In the developing nations, Jun et al. (2025) and Anjum and Subhan (2025) emphasized that the fossil-based electricity consumption decreases significantly under awareness campaigns. Ding et al. (2024) also revealed that real energy usage patterns are enhanced by the enhanced awareness in the context of the Middle East. Macro-level evidence supporting the above assumptions is provided by Chanda et al. (2026) and Hussain et al. (2025): Awareness-based behavioral change is an important factor in enhancing the pace of clean energy transition. Thus, SEA is not solely a cognitive input but also a direct behavioral driver encouraging the use of clean energy in household energy choices in the real world.

H_2: SEA has a positive impact on CEU.

2.3. Solar Adoption Intention and Clean Energy Usage

SAI have a tremendous positive impact on CEU because intention is the direct psychological preparedness that morphs into real behavioral action. The TPB is an intention predictor, which implies that the stronger the behavioral intentions, the more likely that the desired action will be performed (Huang and Cheng, 2023). With respect to renewable energy, once people form a high intention to use solar systems, they tend to change their pattern of consumption of electricity towards cleaner ones and decrease the reliance on traditional energy sources. This mechanism is well-supported by the empirical literature. Vu et al. (2023) discovered that intention is a powerful predictor of renewable energy use at the household level. In the same way, Li et al. (2025) showed that behavioral intention was one of the key factors that dictate sustainable consumption practices. Mustafa et al. (2023) also asserted that people with increased adoption intention are more likely to participate in the environmentally responsible energy choices. Alcaraz et al. (2025) also found that there is a close behavioral correlation between intention and the use of green energy. In the case of the developing economy, Hussain et al. (2025) emphasized intention as an effective predictor of real energy-saving behavior in resource constraint environments. Jun et al. (2025) highlighted that intention is particularly significant in cases where adoption involves financial or infrastructural commitments. Chanda et al. (2026) also discovered the same in Middle Eastern households where strong intention had a notable effect of creating clean energy practices. On a macro-level, the reports by Wall et al. (2021) and Islam et al. (2026) affirm that behavioral intention is a determinant to adopt renewable energy in emerging markets. Therefore, solar adoption intention is a conclusive behavioural process that converts cognitive readiness into real CEU in residential energy systems.

H_3: SAI is positively related to CEU.

2.4. Mediating Role of Solar Adoption Intention

The relationship between SEA and CEU is likely to be mediated by SAI, which is how cognitive understanding can be applied to real behavioural results. In the context of the TPB, intention should be viewed as a key intervening variable that bridges the gap between the formation of beliefs and actual action, which means that awareness cannot do anything unless it transforms into a powerful behavioral intention (Liang et al., 2021; Kumar, 2026). Thus, those individuals will have more adoption intentions in case of higher SEA, and this will result in more CEU. This indirect route has been strongly backed up, through empirical studies. Ali et al. (2020) have shown that behavioral intention is a significant mediator between environmental awareness and sustainable energy behavior. Equally, Irfan et al. (2021) discovered that intention is a significant channel of transmission between the knowledge based factors and the green consumption outcomes. Irfan et al. (2021) have affirmed that the impact of awareness on energy behavior is mainly mediated by motivation intention formation. It was also found that intention mediates the impact of renewable energy awareness on the adoption behavior fully or partially (Hussain et al., 2025). Yin et al. (2024) emphasized that the more aware a person is, the more the intentions, which will lead to actual behavior change, develop. Ding et al. (2024) also highlighted the mediating role of intention in energy transition models especially in developing economies. Similar mediation effects were also observed by Vu et al. (2023) in Middle Eastern household energy situations. Macro evidence is supported by Yin et al. (2024) and Tanveer et al. (2021) and suggests that behavioral intention plays a very important role in the process of linking awareness to actual use of renewable energy. Therefore, SAI is a psychological process transforming awareness into practical clean energy consumption which supports its critical mediating role in the suggested model.

H_4: SAI mediates the relationship between SEA and CEU.

2.5. Moderating Role of Government Support Perception

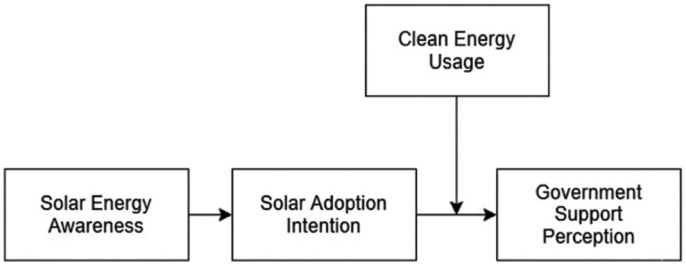
GSP is anticipative to have a positive moderating effect on the relationship between SAI and CEU, where the perceived government support is greater, the stronger the relationship between them. In the lens of TPB, external facilitating conditions may enhance the conversion of intention into actual behavior by alleviating the perceived barriers and enhancing the behavioral control (Awais et al., 2022; Waris et al., 2023). In the case of solar energy, despite the fact that people may have a good intention, their use of solar energy will rely on how favorable they consider the policy frameworks, subsidies and institutional facilitation. Such contextual reinforcement has been of importance in previous studies. Jun et al. (2025) established that behavioral intention has a greater effect on adoption of renewable energy when there are policy incentives. On the same note, Tanveer et al. (2021) observed that the perceived governmental encouragement increases the willingness to solar investment behavior to actual. Yin et al. (2024) highlighted the supportive institutional environments minimize implementation barriers hence enhancing the intention-behavior relation. Islam et al. (2026) also noted that support support mechanisms are important to reinforce sustainable consumption deliverables. As Vu et al. (2023) have shown, the state of financial and regulatory support is a great determinant of the intention to action. Irfan et al. (2021) also found out that the effectiveness of pro-environmental intentions is enhanced through government facilitation. Liang et al. (2021) recorded the same experience in the context of renewable energy adoption where the policy visibility increased behavioral performance. On a larger scale, reports by Anjum and Subhan (2025) and Huang and Cheng (2023) show that high levels of institutional support hastens the intention to actual use of clean energy in developing economies. Therefore, GSP is another important boundary condition, which enhances the behavioral conversion process of intention to CEU.

H_5: GSP positively moderates the relationship between SAI and CEU, such that the relationship is stronger when GSP is high compared to low.

2.6. Moderated Mediation Effect of Government Support Perception

It is anticipated that GSP would mediate the indirect impact of SEA on CEU via SAI, i.e. the stronger the relationship between them is when GSP is high. This is an exemplar of a conditional process model of the TPB, in which external facilitating conditions do not only have a direct impact on the behavior, but also reinforce the psychological channel between cognition and action (Ding et al., 2024; Anjum and Subhan, 2025). In this respect, although people may have a good level of awareness regarding solar energy, the

Figure 1: Research model



linking of this awareness to the real CEU proves more efficient in case of supportive institutional signals (Ali et al., 2020). This conditional mechanism has a solid empirical support in the literature. Chanda et al. (2026) have shown that policy support increases the indirect relationships strength of a renewable energy decision model. Jun et al. (2025) discovered that the more the government is perceived to facilitate, the more the awareness-intention-behavior pathway is reinforced in household energy transitions. Liang et al. (2021) have found out that institutional support enhances behavioral intention to mediate sustainable energy adoption. As Yin et al. (2024) pointed out, the external support systems contribute greatly to the overall explanatory quality of the mediation-based energy behavior models. Waris et al. (2023) also substantiated that policy and subsidy conditions mediate how behavioral pathways are strong in the context of green adoption. Irfan et al. (2021) also found the same moderated indirect effects that the government-related factors increased the translation of the awareness into real green behavior. Jabbour Al Maalouf et al. (2024) also agreed that institutional readiness enhances behavioral contribution of psychological drivers. Moreover, Anjum and Subhan (2025) and Vu et al. (2023) highlight that awareness, intention and favorable policy environments interplay to create a high dependency of renewable energy diffusion among developing economies. As such, GSP reinforces the overall mediated process, which renders the transformation of SEA to CEU by way of adoption intention as more effective when under favourable institutional circumstances.

H_6: GSP moderates the strength of the indirect effect of SEA on CEU through SAI, such that the mediated relationship is stronger under high GSP than under low GSP.

The relationship between variables and research hypotheses were visualized in Figure 1.

3. METHODOLOGY AND DATA

3.1. Sample and Procedure

The information was obtained at the households located in Amman and Irbid areas of Jordan. Residential energy consumption market in Jordan is a significant part of the study. Jordan offers one of the most relevant settings that the present study can be related to in the household energy sector. The role of households as the primary drivers of energy demand nationwide and their consumption trends determine the results of environmental sustainability and clean energy transition. In such a nation as Jordan where fossil fuels are mostly relied upon and at the same time where solar energy is abundant in irradiation potential, the necessity to encourage the use of solar energy is crucial. The people living in this sector are at the forefront of the solar adoption and CEU behaviors. The implications of studying households in this novel energy-dependent and policy-evolving context are quite useful both theoretically and practically to customize sustainability strategies that can meet both the environmental imperative and national energy security objectives. The sampling technique employed in this study to collect data was convenience sampling in the period between September 2024 and January 2025 (nonprobability sampling method). This approach was selected because it was challenging to reach geographically spread household respondents, as well as the different accessibility of respondents, and thus made random sampling less viable. The convenience sampling also enabled the researcher to access individuals who were easily accessible and were willing to respond and hence efficient data collection without imposing a survey burden. The method was realistic and that it was appropriate to derive insights of a general population that faced daily decisions in energy consumption.

There were 392 residents of households who originally expressed their consent to take part in the study by filling out the given questionnaire. A response rate of 91 resulted in 356 responses. After a rigorous screening process, incomplete or inconsistent answers were filtered out and only 331 fully filled surveys were obtained which was 84 percent of the entire study sample. This data is sufficient to assure reliability and strength of the analysis by data. Out of 331 participants who took part, 68% were male and the average age was 37 years. Most of the participants (79) had a bachelors degree and the average monthly household income level showed that their consumer base was middle-income, representing a diverse and representative consumer base in making decisions related to energy. Since the data collection process assumed a cross-sectional method, there was a risk of a possible problem of common method bias (CMB). The single-factor test created by Harman was implemented (Podsakoff et al., 2003) and indicated that a single factor explained 31.84% of the variance which was not below the acceptable level of 50. In order to evaluate the average variance inflation factor (AVIF), a collinearity test (Vu et al., 2023) was also performed. The findings revealed that all AVIF values, 1.52-3.08, were lower than the acceptable value of 3.3. The CMB results of this study show that CMB is not a major issue when it comes to validity of the results.

3.2. Measures

The analysis was based on the validated scales in the literature with the respondents rating their responses on a 5-point Likert scale with a range between 1 (strongly disagree) and 5 (strongly agree). Pilot study was conducted before a set of data collection to ensure internal consistency of the scales. Cronbach alpha values across all the scales were more than 0.70 which is the minimum recommended level, thus verifying consistency (Hair et al., 2019). SEA was assessed using a 12-item scale based on the existing literature on energy behaviors. Ali et al. (2020); Waris et al. (2023) that had high level of internal consistency of 0.941 Cronbach alpha value. A 5 item scale was created to measure the SAI with behavioral intention measures developed at Yin et al. (2024); Ding et al. (2024) and had a Cronbach alpha coefficient of 0.887. Anjum and Subhan (2025); Vu et al. (2023) adapted household

energy consumption studies into a 10-item scale, which identified clean energy usage, with a Cronbach's alpha of 0.913. GSP was tested through a 4-item scale developed based on the literature of policy support perception (Waris et al., 2023), with a Cronbach's alpha coefficient of 0.861.

4. DATA ANALYSIS AND RESULTS

4.1. Model Assessment

The SmartPLS-SEM was used to test the hypotheses (Jabbour Al Maalouf et al., 2024). The use of PLS-SEM, rather than CB-SEM, was determined by the tendency of the current research to use it as a common data analysis method, with most of the research papers being published only a few years ago (Tanveer et al., 2021). There are a number of reasons why PLS-SEM has been used in this study. Such an approach allows assessing the correlations between measured variables and their causes, as well as the interactions between these causes. PLS-SEM can be used to test intricate models, particularly those with mediation and moderation (Hussain et al., 2025). PLS-SEM is also more effective in estimating parameters that are not normally distributed, as compared to CB-SEM (Hair et al., 2019). Moreover, the variance-based method of SmartPLS has an easy-to-use graphical interface, which is more accessible than other programs, e.g. LISREL or AMOS. PLS-SEM has been successfully used in the recent research (Islam et al., 2026; Huang and Cheng, 2023).

4.2. Evaluation of Measurement Model

We have considered questionnaire item loadings based on suggestions provided by Hair et al. (2019) as presented in Table 1. According to the criteria proposed, the items whose loading was >0.70 were retained with a loading ranging between 0.715 and 0.892. To assess reliability, we used the Cronbach alpha and composite reliability (CR) and determined that both measures exceeded the 0.70 threshold, which indicates a strong reliability (Hair et al., 2019). Convergent validity was determined through average variance extracted (AVE), with the values ranging between 0.582 and 0.701, which is according to the standards provided by Fornell and Larcker (1981). Discriminant validity was assessed with the help of the Heterotrait Monotrait (HTMT) ratio, with the subsequent values of HTMT being <0.90, as required (Ding et al., 2024). We found that the model meets all the measurement standards that are relevant as illustrated in Tables 2 and 3.

4.3. Assessment of Structural Model

Table 4 provided the structural model that was tested based on the PLS-SEM guidelines suggested by Hair et al. (2019). The inner model test was conducted by looking at the main measures such as collinearity, coefficient of determination (R2), effect size (f2), predictive relevance (Q2), path coefficients (a) and their statistical significance. The variance inflation factor (VIF) was used to evaluate collinearity, and all of the results were between 1.702 and 2.97 (Table 1). These values are lower than the recommended value of 3.3, which means that there are no problems with multicollinearity. The R2 value has been determined to measure the explanatory power of the model and obtained a value of 0.679, which indicates a variance of 67.9% of CEU which is explained by SEA, SAI, and GSP. The effect sizes (f2) were also determined to be able to determine the effect of individual predictors on R2. According to guidelines by Chanda et al. (2026), where f2 values exceeding 0.02, 0.15 and 0.35 correspond to small, medium and large effects respectively, our model had both low and high effect ranges. The predictive relevance was checked with the help of Q2 values, and they are all >0, which indicates that the model has predictive ability (Hair et al., 2019). Finally, the strengths of the path relationships were also established by analyzing path coefficients (β) and t-values, which further proved the strengths of the model and its validity.

Table 1: Reliability results

Constructs	VIF	FL-range	CA	CR	AVE
SEA		0.792-0.835	0.938	0.954	0.612
SAI		0.764-0.861	0.887	0.918	0.689
CEU		0.715-0.845	0.914	0.928	0.582
GSP		0.803-0.892	0.861	0.905	0.701

Source: Authors own

Table 2: Descriptive and inter correlation

Constructs	1	2	3	4	Mean	SD
CEU	0.78				4.286	0.791
SEA	0.642**	0.81			4.037	0.768
SAI	0.661**	0.523**	0.76		4.215	0.642
GSP	0.673**	0.584**	0.419**	0.84	4.398	0.821

n=331; *=P<0.05; **=P<0.01. Square root of AVE is bold color. Source: Authors own

Table 3: Results of validity

Fornell–Larcker				
Constructs	1	2	3	4
SEA	0.814			
SAI	0.523	0.762		
GSP	0.566	0.479	0.835	
CEU	0.642	0.661	0.673	0.781
Heterotrait–Monotrait (HTMT)				
Constructs	SEA	SAI	GSP	CEU
SEA	—			
SAI	0.701	—		
GSP	0.592	0.479	—	
CEU	0.736	0.693	0.584	—

Source: Authors own

Table 4: Results of R^2, F^2, and Q^2

Constructs	R^2	Q^2
CEU	0.679	0.401
SAI	0.281	0.151
F-square		
Constructs	CEU	SAI	GSP
SEA	0.312		
SAI	0.347	—	—
GSP	0.114	0.368	-

Source: Authors own

4.4. Hypothesis Result

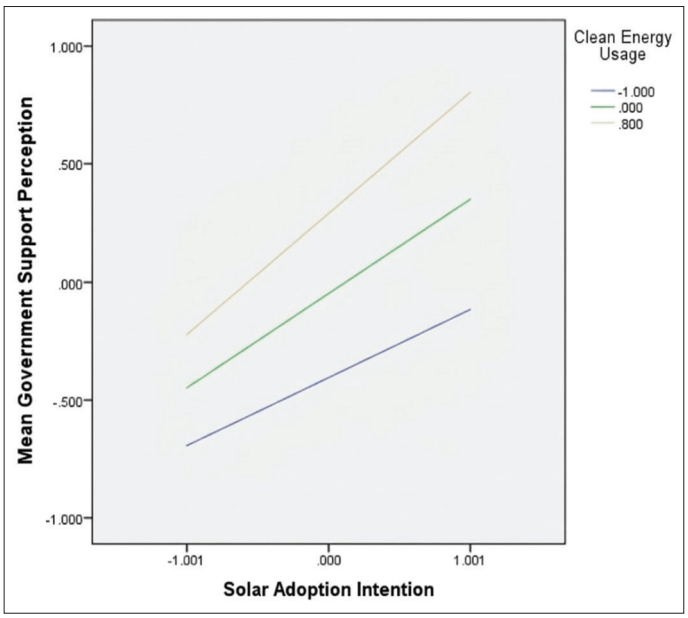
The statistics presented in Table 5 show that SEA positively and significantly influences both SAI (β = 0.472; t = 7.914) and CEU (β = 0.438; t = 8.136), which proves H_1 and H_2. The study's results show that SAI has a positive effect on CEU (β = 0.411; t = 5.842).

Table 5: Results of hypothesis

Hypothesis	Paths	β	SE	t-value	P-value
H_1	SEA→SAI	0.472	0.052	7.914	0.000
H_2	SEA→CEU	0.438	0.055	8.136	0.000
H_3	SAI→CEU	0.411	0.070	5.842	0.000
H_4	SEA→SAI→CEU	0.219	0.047	4.617	0.000
H_5	GSP×SAI→CEU	0.126	0.048	2.641	0.011
Moderated mediation (indirect effects)					
Values of moderator (government support perception)		**Conditional indirect effect**	**SE**	**LLCI**	**ULCI**
−SD		0.132	0.046	0.058	0.239
Mean		0.219	0.047	0.130	0.312
+SD		0.268	0.050	0.161	0.371

Source: Authors own

Figure 2: Moderated-mediation



Moreover, SAI mediates the association between SEA and CEU (β = 0.219; t = 4.617), which validates H_3 and H_4.

The results indicate that GSP plays an important role in mediating the association between SAI and CEU (β = 0.126; = 2.641), thus supporting H_5. Moreover, the findings also show that GSP also mediates the indirect impact of SEA on CEU via SAI with the mediated relationship strength ranging between SD −0.132 at low levels of GSP and SD +0.268 at high levels. Therefore, it provides support to H_6, as shown in Figure 2 and Table 5.

5. DISCUSSION

The conclusions of this paper are solid empirical data that SEA has a significant impact on SAI and CEU that awareness is a precursor to household renewable energy behavior. The relationship between SEA and SAI (H_1) is positive which implies that people being better informed on solar energy benefits, cost savings, and environmental impact tend to develop the willingness to adopt solar solutions. The discovery is in line with the findings of Ajzen (1991) and Vu et al. (2023) who noted that cognitive awareness reinforces behavioral intention development. It also aligns with Waris et al. (2023), and Ding et al. (2024) who found that awareness also has a powerful impact on renewable energy adoption Intentions. Likewise, Yin et al. (2024) and Jabbour Al Maalouf et al. (2024) verified that energy literacy is a key factor in the development of pro-environmental intentions. Nonetheless, certain previous research Ali et al. (2020) suggested that awareness will be ineffective without a support structure, which is partly covered in the current study in the form of GSP. The fact that SEA directly affects CEU (H_2) is an additional confirmation that awareness has an action, not only through intention, but can also directly affect the behavior. This finding is in line with Huang and Cheng (2023) and Sadiq et al. (2025) who discovered that behavioral change could be directly caused by environmental awareness. Similar results were also observed by Tanveer et al. (2021) and Awais et al. (2022): The focus on awareness campaigns considerably decreases the use of traditional energy sources. This finding however is different with that of Islam et al. (2026) who concluded that the effect of awareness is largely indirect and therefore it could be that contextual factors including household income, policy environment and energy accessibility could be the cause of this variation.

The affirmation of the positive correlation between SAI and CEU (H3) is the key assumption of TPB, which states that intention is the most significant predictor of actual behavior (Ajzen, 1991). Hussain et al. 2025; Chanda et al. (2026) and others all strongly support this finding since they all concluded that behavioral intention is strongly translated to sustainable energy practices. In the same manner, Alcaraz et al. (2025) emphasized that intention is a vital behavioral mediator in adopting renewable energy. Nevertheless, Anjum and Subhan (2025) observed that institutional support is necessary to translate intention to behavior, which is in line with moderating results of this study. The mediation analysis (H_4) supports the fact that SAI mediates the correlation between SEA and CEU partially. This implies that awareness has both direct and indirect effects on behavior by fashioning intention. This observation is in line with Irfan et al. (2021), and Ding et al. (2024), who found intention to be a pivotal mediating variable in energy behavior mode Yin et al. (2024); Mustafa et al. (2023) also endorsed this mental process indicating that awareness needs to be0. To intention to execute behavior. Tanveer et al. (2021) however, claimed that the strength of mediation is highly reliant on external policy factors which the study also supports by moderation effects.

The moderating effect of GSP (H_5) indicates that the correlation between SAI and CEU is stronger in case people believe that there is more support provided by the government. This observation is consistent with Li et al. (2025) who had underscored the role of policy incentives in enhancing behavior with regards to renewable energy. Likewise, Jun et al. (2025) discovered that perceived subsidies and institutional support play a crucial role in promoting solar adoption behavior in Middle East settings. Huang and Cheng (2023) also affirmed that positive policy environments reinforce behavioral implementation. Nevertheless, Mushtaq and Khattak (2026) proposed that in certain situations intention might be adequate and this implies that the moderating effect of policy is relative. Lastly, moderated mediation effect (H_6) shows that GSP enhances the indirect correlation between SEA and CEU via SAI. This shows that there is a conditional behavior mechanism, in which psychological and institutional elements intersect to influence energy choices. This finding is in line with Ajzen (1991) who recognized that extrinsic variables have an indirect effect on behavioral pathways via beliefs and perceptions of control. The same results were obtained by Vu et al. (2023); Ding et al. (2024), who focused on integrated behavioral models. This opinion is also supported by Yin et al. (2024), and Sadiq et al. (2025), who mention that awareness and policy support are the key factors of the renewable energy transition in the developing economies. According to Hussain et al. (2025) however, such moderated effects are usually more pronounced in the developing regions owing to the increased policy sensitivity, which is in line with the context of this study in Jordan. In general, the results have a high degree of confirmation that the behaviour of solar energy follows a multi-layered process, in which the awareness, intention and government support interact dynamically to dictate the results of clean energy usage.

5.1. Theoretical Contributions

This research has important theoretical implications as it expands the TPB into a more holistic moderated mediation model of explaining household clean energy behavior. First, it provides empirical support of TPB in that SEA is a major factor in both behavioral intention and reality CEU, which proves the cognitive basis of attitude formation that was postulated by Ajzen (1991). This paper shows that awareness has a direct and indirect impact on behavior, unlike the traditional TPB applications, which mainly consider intention as the ultimate predictor. Second, the study contributes to the field of the TPB by validating SAI as a key mediating factor, which supports the main assumption of the theory, that intention is the direct cause of behavior (Ali et al., 2020). Nonetheless, the model goes a step further to demonstrate that intention is not enough except when backed by external conditions. Third, the GSP moderator can be deeply integrated with TPB to bring in contextual institutional forces into prediction of behavior. This discusses one of the main shortcomings of classical TPB, which tends to under-value the effects of structure and policies. The results verify that the intention-behavior relationship is enhanced by perceived governmental support, which in turn incorporates environmental constraints in the behavioral control dimension of TPB. Lastly, the study also adds to the body of energy behavior studies by developing a moderated mediation TPB model where awareness = intention = behavior is conditional on policy perception. This stratified framework gives a more realistic explanation of adoption of renewable energy within the developing economies. On the whole, the research extends TPB beyond a linear behavioral explanation to a dynamic, context-based model that is more likely to elucidate clean energy transition behavior.

5.2. Practical Implications

The present study has some valuable practical implications to policymakers, energy planners and government institutions interested in increasing the pace of adoption of solar energy in Jordan and other developing economies. First, the results indicate that SEA is a pivotal point of enhancing the adoption intention and CEU. Thus, governments must focus on massive awareness efforts through media channels, schools and community initiatives to enhance the level of awareness among people on the benefits of solar, cost savings, and environmental impacts. Second, the importance of SAI is high, which implies that education is not enough but should be translated into behavioral readiness. The policy makers will then be called to come up with interventions which are proactive in converting awareness to intention i.e. demonstrations projects, subsidies and pilot domestic solar installations. Third, the GSP moderating role shows that the perceived policy credibility and accessibility have a significant effect on behavioral outcomes. This implies that even the people who are motivated can not embrace solar energy when they feel there is no strength or ambiguity by the government. Governments should thus make subsidy schemes, tax incentives and net metering policies transparent, visible, and available to the common man. Fourth, the high moderated mediation effect indicates that policy support does not only have a direct effect on behavior but also enhances the whole psychological process. This means that energy transition strategies need to incorporate both behavioral and institutional strategies. Lastly, these findings can help energy companies and individual investors to develop customer-oriented solar packages that will be consistent with government incentives. In general, the study provides a roadmap to the gap between awareness and real clean energy use by using coordinated policy, education, and market-based interventions.

6. CONCLUSION

The research finds that the adoption of solar energy in the home environment is a complex combination of psychological awareness, behavioral intention and institutional support mechanisms. The results clearly show that SEA is a core factor in the development of SAI and CEU that attests to its relevance as a cognitive factor in the transition to renewable energy. Moreover, SAI is recognized as one of the main mechanisms, which renders the awareness into real behavioral results, which is why it is central to the behavioral decision-making process. The research confirms too that GSP plays a critical role in enhancing the relationship between intention and CEU that policy credibility and institutional visibility are critical to successful behavioral change. More to the point, the moderated mediation findings indicate that the whole sequence of awareness to behavior is conditional on the perceived government support, and it is worthwhile to note that integrated psychological and policy-based approaches are very crucial.

Theoretically, the study builds on the TPB by adopting contextual moderation and mediation processes, which provides a more dynamic account of energy behavior. In practice, it emphasizes that effective clean energy transition needs to be supported by more than awareness campaigns, it should also be supported by powerful policy support mechanisms which solidify personal intentions. Conclusively, this research offers good evidences that sustainable energy transition can be achieved by a concerted approach which involves increasing the level of public awareness, reinforcement of behavioral intention and provision of effective government support mechanisms. The presented integrated model provides useful information to policy makers, researchers, and the energy stakeholders seeking to hasten the process of implementing clean and renewable energy systems in the emerging economies such as Jordan.

This study has a number of limitations that can be exploited in future studies in spite of its useful contributions. First, the study is cross-sectional, which restricts the potential to determine causal relationships between SEA, intention and CEU. The next generation of research ought to take the longitudinal or experimental approach to observing how behavior changes with a certain period. Second, the data were measured among households in selected areas of Jordan, which can possibly restrict the extrapolation of the results to other countries or rural-urban settings. This model needs to be replicated in other geographical and socio-economic contexts in future research to improve external validity. Third, the research is based on self-reported information, which can create a response bias or social desirability bias. The objective energy consumption data or smart meter records might be used in future studies to enhance the accuracy of the measurements. Fourth, this study incorporates GSP as a moderator but fails to capture other possible variables like the income level, the variations in electricity prices, and the availability of technology. The variables need to be included in future studies in order to come up with a more detailed model. Fifth, the study focuses only on TPB-based mechanisms. Further studies may incorporate more theories like Technology Acceptance Model (TAM), Institutional Theory or Value-Belief-Norm Theory to offer multi-theoretical approach. Lastly, future studies may be developed to compare developing and developed countries to learn the contextual disparities in the adoption of solar energy. All in all, a solution to these weaknesses will enhance the theoretical rigidity and practical usefulness in research on renewable energy in the future.

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