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# Regulatory Mediation as a Policy Lever in Renewable Energy Deployment: Evidence from the Jordanian Solar Sector

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**Abstract**

This study investigates the mediating role of regulatory obstacles in the relationship between four key implementation challenges—social, technical, financial, and market barriers—and the adoption of solar energy in Jordan. The research examines data from 195 specialists in the solar energy field employing structural equation modeling (SEM) with bootstrapping to explore both direct and indirect effects. The findings indicate that regulatory obstacles substantially affect the manner in which all four categories of barriers effect deployment, particularly regarding the correlation between market barriers and implementation results. These findings underscore the intricate role of institutions in energy transitions and emphasize the necessity for flexible regulatory frameworks that correspond with technological, financial, and social elements. The study offers theoretical insights and policy suggestions for regulators in emerging energy markets.

**Keywords:** Regulatory Barriers, Mediation, Solar Energy, Renewable Energy Policy, Jordan, Sem, Institutional Barriers, Deployment

## Introduction

The shift to renewable energy has emerged as a global necessity propelled by climate change apprehensions, energy security requirements, and technological advancements. In this context, solar energy has emerged as a prominent alternative due to its scalability, dicer asing costs, and abundance—especially in sun-rich nations like Jordan. Jordan has significantly advanced in the adoption of renewable energy, with solar energy initiatives gaining traction during the past decade. Jordan relies on imports for over 90% of its energy requirements, rendering it exceedingly susceptible to external disruptions (Al-kasasbeh, 2024). Despite Regulatory Reforms and Incentive Programs, the Pace of Deployment Continues to be restricted by a confluence of technical, financial, social, and market-related obstacles (Versteegen, 2021).

Although these barriers have been well examined in isolation (Abdulla et al., 2004; Teh, Adebanjo, & Kong, 2021), Insufficient attention has been devoted to their interaction with the regulatory environment. In numerous emerging economies, regulatory institutions fulfill a dual function: Facilitating Deployment with Supportive Policies While Concurrently Implementing Procedural or Bureaucratic Obstacles (Inês et al., 2020). In the Jordanian solar energy sector, regulatory frameworks frequently influence how businesses tackle and mitigate various challenges.

For instance, financial incentives may be there; however, if the approval process is overly sluggish or unpredictable, the advantage diminishes. Public awareness initiatives may enhance acceptance; yet, in the absence of effective authorization, implementation remains sluggish. Contemporary scholarship often regards regulatory barriers as singular constraints, neglecting their mediating role within the broader system of barriers (Chou, Ngo, & Tran, 2023; Kivimaa, Primmer, & Lukkarinen, 2020). This oversight limits the explanatory power of previous studies and hinders the development of more cohesive policy initiatives. Moreover, there is a lack of Empirical research at the firm level assesses how regulatory barriers affect the relationship between other barriers and deployment outcomes (Almarshad, Alwaely, AlKhawaldeh, Al Qaryouti, & Ahmad, 2024).

The purpose of this study is to investigate the role that regulatory obstacles play as a mediator in the interaction between social, technological, financial, and commercial issues and the adoption of solar energy in Jordan. Using structural equation modeling (SEM) with bootstrapping, the research investigates data from 195 solar energy specialists to investigate both direct and mediated interactions. Direct associations are investigated, the findings provide empirical evidence about how regulatory bottlenecks can either exacerbate the effects of other impediments or alleviate them. These findings have practical significance for all parties involved, including policymakers and academics.

## Literature Review

### *Policy Feedback Mediation Framework*

This study is based on stakeholder theory and policy feedback mediation frameworks, which highlight the influence of governance on organizational and market behavior. Stakeholder theory asserts that policy environments are dynamic and responsive to cultural, technological, and financial influences (Freeman, 2010). In the realm of renewable energy, governments and regulatory entities frequently serve as intermediaries among public interests, private investors, and technical realities. This intermediation role underpins what contemporary scholars name policy feedback mediation—a process in which policy acts not just as a restraint but also as a reactive factor that enhances or alleviates other obstacles (Alipour, Irannezhad, Stewart, & Sahin, 2022; Bhattarai, Maraseni, & Apan, 2022).

### *Regulatory Mediation in Renewable Energy*

Most current research considers regulatory constraints as an independent impediment to the implementation of renewable energy (Juszczyk, Juszczyk, Juszczyk, & Takala, 2022; Teh et al., 2021). This perspective fails to recognize the dynamic function of regulation in influencing the manifestation of other barriers. For instance, when technical issues like grid capacity or safety standards emerge, they may necessitate stricter interconnection regulations. Likewise, should public dissent to solar initiatives escalate, regulators may implement more stringent permitting procedures, Researchers have seldom conducted quantitative analyses of this regulatory feedback loop in firm-level solar energy settings, especially in emerging economies such as Jordan.

*Social Barriers and Regulatory Response*

Social obstacles, such as insufficient awareness, minimal community involvement, and NIMBY phenomena, are frequently identified as significant problems in the implementation of solar energy. Regulators may implement prudent or restrictive measures to prevent public dissent (Juszczyk et al., 2022). Stakeholder theory posits that this scenario arises when public opposition results in reactive regulation, a process wherein rules become increasingly rigorous due to diminished societal consensus (Heiskanen, Matschoss, Laakso, & Apajalahti, 2020). Consequently, social barriers may inadvertently augment regulatory complexity.

*Technical Barriers and Regulatory Constraints*

Technical constraints, like substandard grid infrastructure, insufficient storage capacity, and a lack of skilled personnel, frequently compel governments to implement cautious regulatory policies. Rules about connecting to the grid, limits on payment rates for energy fed into the system, or safety requirements might be necessary for technical reasons; however, they often end up being obstacles to progress in reality (Inês et al., 2020; Versteegen, 2021).
The interplay between these technical constraints and the ensuing regulation is inadequately examined in empirical research.

*Financial Barriers and Regulatory Rigidity*

Significant capital expenditures, restricted access to funding, and investor apprehension are frequently identified financial obstacles (Andrés-Cerezo & Fabra, 2023). Regulatory bodies may react by intensifying eligibility requirements for subsidies, imposing minimum investment levels, or centralizing licensing, so unintentionally elevating the entrance barrier. This tendency of financially induced regulatory reinforcement may worsen rather than mitigate project delays.

*Market Barriers and Regulatory Backlash*

Market-related difficulties, like restricted competition, ambiguous procurement procedures, and price volatility, may incite regulatory reaction. To mitigate perceived risks, authorities may establish auction quotas, restrict grid access, or mandate extensive documentation, so introducing additional bureaucratic layers (Teh et al., 2021). Market inefficiencies may provoke a regulatory overcorrection, particularly in politically sensitive contexts such as Jordan.

**Conceptual Framework**

The implementation of solar energy systems in Jordan is influenced by several upstream challenges, encompassing social, technical, financial, and market-related obstacles. Nonetheless, these barriers do not influence deployment in a linear or isolated manner. Instead, they affect the regulatory framework, which subsequently determines the manner in which deployment occurs on-site (Martiskainen & Kivimaa, 2018; Matschoss & Heiskanen, 2017).

This study conceptualizes regulatory barriers as a mediating construct that embodies the interpretation and institutionalization of public resistance, technical limitations, funding challenges, and market inefficiencies through rules, policies, and bureaucratic procedures. This approach is consistent with stakeholder theory and the logic of policy feedback mediation, which perceives regulations as responsive outcomes of systemic pressures (Chou et al., 2023; Freeman, 2010; Teh et al., 2021).

For example, extensive community opposition may result in more rigorous permitting; inadequate grid reliability may warrant limited interconnection; or insufficient financing options may compel regulators to centralize approvals and impose stricter eligibility criteria (Bhattarai et al., 2022; Kutan, Paramati, Ummalla, & Zakari, 2018). In each instance, the impact of the original barrier is mediated by regulatory mechanisms. The conceptual framework illustrated in Figure 1 delineates these relationships, with regulatory barriers mediating the impact of each upstream barrier category on solar energy deployment. The model is empirically evaluated by Structural Equation Modeling (SEM) with bootstrapping, concentrating solely on indirect effects. To elucidate these dynamics, this study introduces a regulatory mediation model (Figure 1).

The model asserts that regulatory barriers serve as a mediating variable between four independent kinds of barriers (social, technological, financial, and market) and the dependent construct,Implementation of renewable energy (Martiskainen & Kivimaa, 2018).

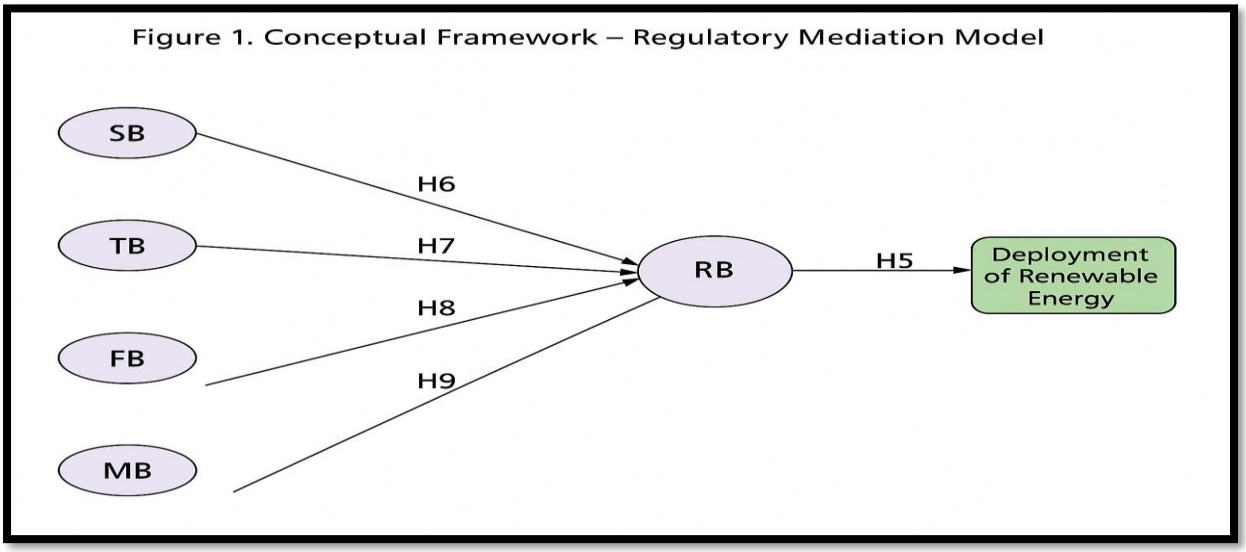


Figure 1. 1 Conceptual Framework – Regulatory Mediation Model.

## Methodology

*Research Design*

For the purpose of this study, a quantitative, cross-sectional design was utilized, and a structured questionnaire was sent out to experts working in solar energy enterprises located all throughout Jordan. The purpose of this study was to investigate the role that regulatory hurdles play as a mediator in the interaction between social, technical, financial, and market barriers and the deployment of solar energy. Structural Equation Modeling (SEM), which is best suited for assessing complicated, multi-path relationships including latent variables, was utilized in order to conduct the analysis of the hypothesized mediation model(Berman, Jones, Udry, & Health, 2020; Siedlecki, 2020).

*Sampling and Respondents*

The sample comprised 195 respondents working in small to mid-sized solar energy firms in Jordan. Most firms included between one and three engineers who simultaneously handled technical design, sales, procurement, and project management tasks. The use of such respondents was justified due to their comprehensive knowledge of both internal operational challenges and external regulatory interactions. The sampling approach was purposive, aiming to target individuals directly involved in implementation processes and decision-making(Kubiciel-Lodzińska, 2021; Raifman, DeVost, Digitale, Chen, & Morris, 2022). None of the pilot study respondents was included in the final dataset.

*Measurement of Constructs*

In order to measure all of the constructs, validated multi-item measures that were developed from earlier research were utilized, A likert scale with ten points, ranging from one (Strongly Disagree) to ten (Strongly Agree), was utilized to evaluate each of the constructs(Russo, Tomei, Serra, & Mello, 2021; South, Saffo, Vitek, Dunne, & Borkin, 2022). Table 1 contains the items that were utilized in this study, for measuring the latent variables. A Constructs and Example Measurement Items Summary is provided here.

Table 1. 1

*Appendix A1 contains the whole list of things that are the subject of measurement.*

| Construct | Item | Source |
|---|---|---|
| Social Barriers (SB) | The adoption of solar energy in Jordan is socially accepted. | Adapted from (Juszczyk et al., 2022) |
| Social Barriers (SB) | The solar energy projects in Jordan are socially supported. | Adapted from (Juszczyk et al., 2022) |
| Social Barriers (SB) | The social acceptance of solar energy in Jordan is increasing over time. | Adapted from (Juszczyk et al., 2022) |
| Social Barriers (SB) | The social acceptance of renewable energy projects is important to the success of solar energy companies in Jordan. | Adapted from (Juszczyk et al., 2022) |
| Social Barriers (SB) | There are no challenges related to social acceptance when implementing renewable energy projects in Jordan. | Adapted from (Heiskanen et al., 2020) |
| Social Barriers (SB) | We engage with local communities to ensure their acceptance and support for our renewable energy installations in Jordan. | Adapted from (Heiskanen et al., 2020) |
| Social Barriers (SB) | The level of public awareness and understanding of renewable energy in Jordan is high. | Adapted from (Heiskanen et al., 2020) |
| Technical Barriers (TB) | Maintaining proper standards is very important in ensuring that solar power projects are successful. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | Entrepreneurs are becoming innovative in the industry of solar energy. | Adapted from (Inês et al., 2020; Versteegen, 2021) |

| | | |
|---|---|---|
| Technical Barriers (TB) | Personnel skills and training institutes play a significant role in addressing technical challenges and barriers. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | Performance constraints and technology risks have significant effects in hindering the adoption of solar energy projects. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | Storage issues have critical implications in the implementation of solar power projects. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | It is important to have a good design so that solar power systems are easy to operate. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | Companies encounter some challenges or difficulties to connect to the national power grid for renewable energy projects in Jordan. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | It is important to have a reliable and efficient grid connection process for renewable energy projects in Jordan. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | The level of involvement of stakeholders in solar energy policies and regulations in Jordan is satisfactory. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | The land concession policies in Jordan are hindering the growth of renewable energy projects. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Technical Barriers (TB) | The infrastructure for grid integration between Renewable and conventional plants is inadequate. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Financial Barriers (FB) | The lack of financial institutions and suitable financing instruments hampers the growth of solar energy projects in Jordan. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | It is challenging to access capital with favourable interest rates for renewable energy projects. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | The high upfront capital costs function as a significant barrier for investors in renewable energy. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | It is challenging to find financial institutions that specifically support renewable energy projects. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | You frequently encounter customers who face difficulty in obtaining bank loans for solar energy projects due to a lack of steady income. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | You observed instances where customers have explored alternative financing options, such as crowd funding or collaborating with investors. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | JREEEF's role is effective in providing necessary funding for energy efficiency and renewable energy measures. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | JREEEF has contributed to the increased utilization of renewable energy and improved energy efficiency. | Adapted from (Andrés-Cerezo & Fabra, 2023) |
| Financial Barriers (FB) | Uncertain governmental policies in Jordan affect your confidence in investing in solar energy projects. | Adapted from (Andrés-Cerezo & Fabra, 2023) |

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| | | |
|---|---|---|
| Market Barriers (MB) | The ease of market entry results into negative consequences such as unethical practices or unfair competitions. | Adapted from (Teh et al., 2021) |
| Market Barriers (MB) | The current state of renewable energy technologies (RETs) is perceived as economically viable. | Adapted from (Teh et al., 2021) |
| Market Barriers (MB) | Cost reduction in RETs is necessary to improve economic viability. | Adapted from (Teh et al., 2021) |
| Market Barriers (MB) | The limitation of market size affects companies operating in renewable energy. | Adapted from (Teh et al., 2021) |
| Market Barriers (MB) | The high competition within the renewable energy industry in Jordan affects our company's operations. | Adapted from (Teh et al., 2021) |
| Market Barriers (MB) | Government policies and regulations in Jordan are effective in facilitating the growth of the renewable energy market. | Adapted from (Teh et al., 2021) |
| Regulatory Barriers (RB) | It is important to facilitate the process of obtaining the necessary licenses and permits from regulatory bodies. | Adapted from Al-(Inês et al., 2020; Versteegen, 2021) |
| Regulatory Barriers (RB) | Certain regulations impose significant costs on companies and negatively affect investment attractiveness. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Regulatory Barriers (RB) | Restrictions on the installation sites of renewable energy facilities can pose a barrier. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Regulatory Barriers (RB) | Frequent changes in government policies can create uncertainty and impact investor confidence. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Regulatory Barriers (RB) | Regional variations in electricity company requirements influence the development of renewable energy projects. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Regulatory Barriers (RB) | The multiplicity of approvals required acts as an impediment to the progress of solar energy. | Adapted from (Inês et al., 2020; Versteegen, 2021) |
| Deployment of Renewable Energy (DGY) | Regulatory barriers hinder solar energy companies in implementing PV systems. | Adapted from (Juszczyk et al., 2022) |
| Deployment of Renewable Energy (DGY) | Social barriers hinder solar energy companies in implementing PV systems. | Adapted from (Juszczyk et al., 2022) |
| Deployment of Renewable Energy (DGY) | Technical barriers hinder solar energy companies in implementing PV systems. | Adapted from (Juszczyk et al., 2022) |
| Deployment of Renewable Energy (DGY) | Market barriers hinder solar energy companies in implementing PV systems. | Adapted from (Heiskanen et al., 2020) |
| Deployment of Renewable Energy (DGY) | Financial barriers hinder solar energy companies in implementing PV systems. | Adapted from (Heiskanen et al., 2020) |

**Data Collection Procedures**
Throughout the course of a period of six weeks, the questionnaire was disseminated using a combination of in-person and electronic means. It was guaranteed that the respondents would remain anonymous and discreet(Z Awang, Afthanorhan, Lim, & Zainudin, 2023).

The questionnaire contained a brief introduction that provided an explanation of the goal of the study and requested participation from only those experts who were directly involved in the implementation of solar energy. An effective response rate of 84.8% was achieved by distributing 230 questionnaires, of which 195 were returned with all of their questions well answered.

**Data Analysis Techniques**
Both SPSS and AMOS were utilized in the process of data analysis. The reliability, validity, and goodness-of-fit of the measurement model were evaluated by the use of Confirmatory Factor Analysis (CFA) (P. Awang, 2018; Zainudin Awang, 2012). A subsequent analysis of the structural model was performed in order to test the expected mediation effects(P. Awang, 2015; Zainudin Awang, 2014; Z Awang et al., 2023). In particular, the bootstrapping methods that were applied with 2,000 resamples in order to investigate the significance of indirect routes concentrated on the mediating influence of regulatory barriers between each independent construct (SB, TB, FB, and MB) and the dependent construct (deployment). This was done in order to determine the relevance of indirect pathways. In order to ascertain whether or not indirect routes are pertinent, this was carried out. We examined the fit of the model by employing various indices, including RMSEA, CFI, TLI, and $\chi^2$/df (Z Awang et al., 2023).

Table 1. 2
*Appendix A1: Full Questionnaire Items by Construct*

| Construct | Item Code | Item Description | Source |
|---|---|---|---|
| Social Barriers (SB) | SB1 | Lack of public awareness regarding renewable energy | Juszczyk et al. (2022) |
| | SB2 | Resistance from local communities or NIMBY attitudes | Heiskanen et al. (2020) |
| | SB3 | Limited community engagement in solar initiatives | (Juszczyk et al., 2022) |
| Technical Barriers (TB) | TB1 | Inadequate grid infrastructure for solar integration | (Inês et al., 2020; Versteegen, 2021) |
| | TB2 | Lack of skilled technical professionals | (Inês et al., 2020; Versteegen, 2021) |
| | TB3 | Unstable electricity transmission systems | (Inês et al., 2020; Versteegen, 2021) |
| Financial Barriers (FB) | FB1 | High upfront capital costs for solar projects | (Andrés-Cerezo & Fabra, 2023) |
| | FB2 | Limited access to financing or loans | (Andrés-Cerezo & Fabra, 2023) |
| | FB3 | Unfavourable investment climate for renewables | (Andrés-Cerezo & Fabra, 2023) |
| Market Barriers (MB) | MB1 | Opaque or inefficient procurement procedures | (Teh et al., 2021) |

| | | | |
|---|---|---|---|
| | MB2 | Weak competition in the solar sector | (Teh et al., 2021) |
| | MB3 | Limited participation of private companies | (Teh et al., 2021) |
| Regulatory Barriers (RB) | RB1 | Delays in licensing and permitting procedures | (Heiskanen et al., 2020) |
| | RB2 | Unclear or inconsistent regulatory policies | (Inês et al., 2020; Versteegen, 2021) |
| | RB3 | Overly complex compliance requirements | (Inês et al., 2020; Versteegen, 2021) |
| Deployment of Renewable Energy (DGY) | DGY1 | Company's ability to implement solar PV systems | (Chou et al., 2023; Freeman, 2010; Teh et al., 2021) |
| | DGY2 | Company's progress in solar energy deployment | (Martiskainen & Kivimaa, 2018) |
| Construct | | Example Item | Source |
| Social Barriers (SB) | | The adoption of solar energy in Jordan is socially accepted. | (Juszczyk et al., 2022) |
| Technical Barriers (TB) | | Maintaining proper standards is important in ensuring success of solar projects. | (Inês et al., 2020; Versteegen, 2021) |
| Financial Barriers (FB) | | The lack of financial institutions hampers solar energy project growth. | (Teh et al., 2021) |
| Market Barriers (MB) | | The limitation of market size affects companies operating in renewable energy. | (Teh et al., 2021) |
| Regulatory Barriers (RB) | | It is important to facilitate the process of obtaining the necessary permits. | (Heiskanen et al., 2020) |
| Deployment of Renewable Energy (DGY) | | Regulatory barriers hinder our implementation of PV systems. | (Heiskanen et al., 2020) |

## Results

*Descriptive Statistics*

For providing a concise summary of the central tendencies and variability of each construct, descriptive analysis was carried out (Zainudin Awang, Afthanorhan, & Mamat, 2016; Dong, 2023; McCarthy et al., 2022). A likert scale with ten points was used to evaluate every item(Zainudin Awang et al., 2016). All of the barrier categories and the dependent variable are broken down into their respective mean and standard deviation values in Table1.3.

Table 1. 3
*Descriptive Statistics of Study Variables*

| Construct | Mean | Standard Deviation |
|---|---|---|
| Social Barriers | 6.78 | 2.01 |
| Technical Barriers | 6.32 | 2.14 |
| Financial Barriers | 6.14 | 2.33 |
| Market Barriers | 6.42 | 2.21 |
| Regulatory Barriers | 6.19 | 2.27 |
| Deployment of Renewable Energy | 6.58 | 2.17 |

*Confirmatory Factor Analysis (Cfa)*

CFA was conducted to validate the measurement model before structural modeling. The analysis confirmed that all constructs demonstrated good model fit, with factor loadings above the 0.6 threshold, and acceptable reliability and validity (Afthanorhan, Awang, & Aimran, 2020; Al Nohoud & Awang; Al Nohoud, Awang, & Khazaaleh, 2024; Austin-Egole, Iheriohanma, & Nwokorie, 2020; Zainudin Awang et al., 2016; Brown, 2015; Hox, 2021; Jöreskog et al., 2016; Thompson, 2004).

Table1.4
Summarizes the Model fit Indices; While Table1.5 Presents Factor Loadings and AVE/CR Values
Table 1. 4
*CFA Model Fit Indices*

| Fit Index | Recommended Threshold | Result |
|---|---|---|
| Chi-square/df | < 3.00 | 1.876 |
| GFI (Goodness-of-Fit) | > 0.90 | 0.927 |
| CFI (Comparative Fit Index) | > 0.90 | 0.953 |
| TLI (Tucker-Lewis Index) | > 0.90 | 0.945 |
| RMSEA (Root Mean Square Error of Approximation) | < 0.08 | 0.067 |

Table 1. 5
*Factor Loadings, AVE, and CR for All Constructs*

| Construct | AVE | CR | Cronbach's Alpha |
|---|---|---|---|
| Social Barriers (SB) | 0.611 | 0.903 | 0.894 |
| Technical Barriers (TB) | 0.584 | 0.915 | 0.907 |
| Financial Barriers (FB) | 0.616 | 0.925 | 0.918 |
| Market Barriers (MB) | 0.597 | 0.911 | 0.902 |
| Regulatory Barriers (RB) | 0.598 | 0.915 | 0.903 |
| Deployment of Renewable Energy (DGY) | 0.615 | 0.895 | 0.884 |

*Structural Equation Modeling (SEM)*
An examination of the structural model was carried out with the assistance of AMOS in order to evaluate the hypothesized connections that exist between the components. The analysis was carried out concurrently with the construction of the model it was being used to represent. The regulatory hurdles were found to have a substantial influence on the deployment of solar energy (DGY), in addition to the fact that each of the four independent factors (SB, TB, FB, and MB) had a considerable influence on the regulatory hurdles (RB). This was discovered in addition to the fact that each of the four independent variables had this influence (Zainudin Awang, 2012; Bagozzi & Yi, 1988). Table 1.6 summarizes the standardized path coefficients and significance levels.

Table 1. 6
*SEM Path Coefficients – Indirect Effects via Regulatory Barriers,*

| Path | Standardized Estimate (β) | p-value, *** P < 0.001 |
|---|---|---|
| Social Barriers → Regulatory Barriers | 0.238 | *** |
| Technical Barriers → Regulatory Barriers | 0.296 | *** |
| Financial Barriers → Regulatory Barriers | 0.211 | *** |
| Market Barriers → Regulatory Barriers | 0.201 | *** |
| Regulatory Barriers → Deployment of Solar Energy | 0.612 | *** |

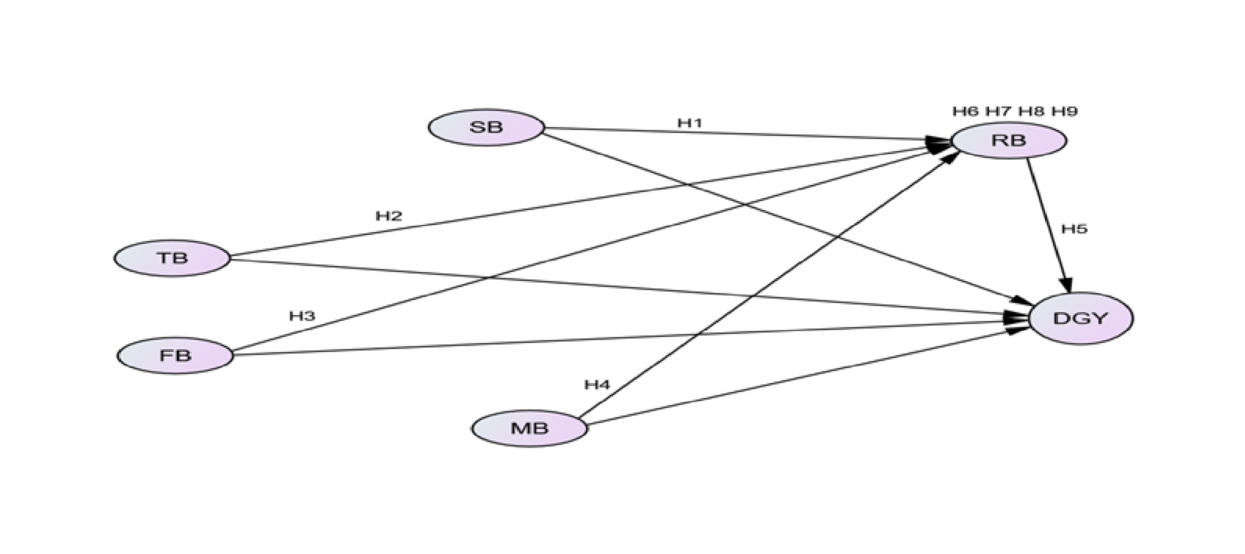


Figure 1. 2 SEM Mediation Path Model.

**Mediation Analysis**

Bootstrapping with 2,000 resamples was used to assess indirect effects. All four mediation pathways (SB → RB → DGY, TB → RB → DGY, FB → RB → DGY, MB → RB → DGY) were statistically significant, confirming the mediating role of regulatory barriers. Table 6 presents the mediation effect results including confidence intervals(Hair Jr et al., 2021; Huber, 2020).

Table 1. 7

*Bootstrapping Results for Indirect Effects via Regulatory Barriers*

| Indirect Path | Estimate | Boot SE | BootLLCI | BootULCI | Significance |
|---|---|---|---|---|---|
| Social Barriers → Regulatory Barriers → Deployment | 0.146 | 0.036 | 0.085 | 0.226 | Significant |
| Technical Barriers → Regulatory Barriers → Deployment | 0.181 | 0.042 | 0.109 | 0.266 | Significant |
| Financial Barriers → Regulatory Barriers → Deployment | 0.129 | 0.034 | 0.070 | 0.199 | Significant |
| Market Barriers → Regulatory Barriers → Deployment | 0.123 | 0.031 | 0.068 | 0.188 | Significant |

**Discussion and Implications**

*Discussion of Key Findings*

The results of this study offer empirical evidence for the mediating role of regulatory barriers in the deployment of solar energy systems in Jordan. The analysis confirmed that all four upstream challenges—social, technical, financial, and market barriers—exert significant indirect effects on deployment through regulatory channels.

These findings validate hypotheses H5 through H9 and reinforce the conceptualization of regulatory frameworks as policy reactions to broader systemic pressures. The significant path from social barriers to regulatory barriers (H6) suggests that a lack of public awareness, NIMBY sentiment, or weak societal engagement may compel authorities to implement more regulations that are restrictive This aligns with prior work by Almarshad et al. (2024) and

Andrés-Cerezo and Fabra (2023), which argue that negative public perceptions influence bureaucratic hesitance and risk-averse governance.

Similarly, the mediation effect of regulatory barriers in the technical pathway (H7) illustrates how infrastructure limitations, skill shortages, or grid instability can lead to conservative or protectionist regulatory responses. This supports the view that regulatory constraints often mirror underlying technological concerns, as highlighted by Al-kasasbeh (2024) and Versteegen (2021).Financial and market-related barriers also showed significant mediation effects via regulatory channels (H8 and H9). When capital is limited or procurement systems are inefficient, policymakers may respond with tighter eligibility criteria, slower approval cycles, or heightened documentation burdens—further impeding renewable energy growth (Juszczyk et al., 2022; Martiskainen & Kivimaa, 2018; Matschoss & Heiskanen, 2017).

*Theoretical Implications*

This study extends stakeholder theory and policy feedback frameworks by empirically modeling how regulatory bodies serve as conduits of influence. The findings suggest that regulatory barriers are not static or exogenous but are shaped by upstream societal, technological, and market conditions. This reinforces the notion that regulatory structures evolve in response to the institutional environment, echoing insights from Freeman (2010) and later work on adaptive governance(Freeman, 2010).

*Practical Implications*

The findings offer practical guidance for policymakers and private sector actors in Jordan's energy transition:

- Enhance public awareness campaigns to reduce social friction and preempt regulatory backlash.
- Invest in grid modernization and workforce training to prevent regulatory tightening in response to technical instability.
- Improve access to financing and streamline procurement processes, which would reduce the need for regulatory "safety nets" that often act as bottlenecks.
- Encourage inclusive policymaking, where stakeholder input can shape more facilitative regulations rather than reactive or restrictive ones.

By addressing the root causes of regulatory friction, Jordan can create a more enabling environment for solar energy deployment and attract higher levels of investment and innovation in the sector.

**Conclusion and Recommendations**

This study examined how social, technical, financial, and market-related barriers indirectly influence the deployment of solar energy in Jordan through the mediating role of regulatory barriers. Using Structural Equation Modeling (SEM) and bootstrapped mediation analysis, the research validated all five hypotheses (H5–H9), confirming that regulatory barriers serve as a significant conduit through which upstream challenges shape implementation outcomes. These findings contribute to the growing body of literature on institutional mediation in energy transitions. Rather than viewing regulatory barriers as static constraints, the study highlights their reactive nature—often reflecting societal resistance, technical uncertainties, funding challenges, or market inefficiencies.

This positioning aligns with stakeholder theory and policy feedback frameworks, offering a more dynamic and context-sensitive understanding of how regulation evolves in emerging energy sectors. From a policy standpoint, the results underscore the importance of addressing the foundational issues that give rise to regulatory bottlenecks. Efforts to streamline permitting, improve licensing transparency, or simplify compliance requirements will likely remain limited unless complemented by actions that reduce the perceived risks driving those regulatory responses. These may include:

- Strengthening community engagement and public awareness to build social support for solar projects;
- Enhancing technical capacity through training, infrastructure investment, and system design improvements;
- Improving financial accessibility via targeted lending mechanisms and risk-reduction instruments;
- Fostering a more efficient market environment by addressing procurement opacity and enhancing private-sector participation.

By tackling, these root causes, Jordan can create a more facilitative regulatory environment—one that encourages innovation, investment, and long-term sustainability in the renewable energy sector. Future research could extend this model by exploring cross-sectorial or longitudinal variations in regulatory behavior. Comparative studies between countries or within different segments of the energy industry could further validate the mediating role of institutional responses in diverse contexts. (Andrés-Cerezo & Fabra, 2023; Freeman, 2010; Inês et al., 2020; Kutan et al., 2018; Matschoss & Heiskanen, 2017; Teh et al., 2021).

The transition to renewable energy has become a global imperative driven by climate change concerns, energy security needs, and technological innovation. In this context, solar energy has emerged as a leading alternative due to its scalability, declining costs, and abundance—particularly in sun-rich countries such as Jordan.

Jordan has made notable strides in adopting renewable energy, with solar energy projects gaining momentum over the past decade. Jordan imports more than 90% of its energy needs, making it highly vulnerable to external shocks (Al-kasasbeh, 2024).

Despite regulatory reforms and incentive programs, the pace of deployment remains constrained by a combination of technical, financial, social, and market-related barriers (Heiskanen et al., 2020).While these barriers have been extensively studied in isolation (Juszczyk et al., 2022; Kutan et al., 2018; Teh et al., 2021), less attention has been paid to how they interact with the regulatory environment.

In many emerging economies, regulatory institutions play a dual role: enabling deployment through supportive policies while also introducing procedural or bureaucratic bottlenecks (Juszczyk et al., 2022). In the Jordanian solar energy sector, regulatory frameworks often mediate how other barriers are experienced and addressed by firms. For example, financial incentives may exist, but if the approval process is excessively slow or inconsistent, the benefit is diluted(Sandri, Hussein, & Alshyab, 2020).

Similarly, public awareness campaigns may boost acceptance, but without streamlined permitting, deployment still lags. Existing literature tends to treat regulatory barriers as an independent constraint, overlooking their mediating role in the broader barrier landscape(Andrés-Cerezo & Fabra, 2023; Martiskainen & Kivimaa, 2018).

This oversight limits the explanatory power of previous studies and hampers the development of more coherent policy interventions. Moreover, there is a lack of firm-level empirical research that quantifies how regulatory barriers influence the relationship between other barriers and deployment outcomes (Bhattarai et al., 2022; Matschoss & Heiskanen, 2017).
This study addresses these gaps by examining the mediating role of regulatory barriers in the relationship between social, technical, financial, and market barriers and the deployment of solar energy in Jordan. Using data from 195 solar energy professionals and analyzed through Structural Equation Modeling (SEM) with bootstrapping, the study examines both direct and mediated relationships.
The findings offer empirical evidence on how regulatory bottlenecks can amplify or dampen the effects of other barriers, thereby providing practical implications for policymakers and scholars alike.

**References**

Abdulla, F., Widyan, M., Al-Ghazawi, Z., Kiwan, S., Abu-Qdais, H., Hayajneh, M., . . . Al-Nimr, M. (2004). *Status of Jordan renewable energy sector: problems, needs and challenges.* Paper presented at the Proceedings of the Regional Collaboration Workshop on Energy Efficiency and Renewable Energy Technology.

Afthanorhan, A., Awang, Z., & Aimran, N. (2020). An extensive comparison of CB-SEM and PLS-SEM for reliability and validity. *International Journal of Data and Network Science, 4*(4), 357-364.

Al-kasasbeh, O. (2024). The Relationship between Business Intelligence and Sustainable Human Resources. *HISTORICAL: Journal of History and Social Sciences, 3*(3), 251-271.

Al Nohoud, O. M., & Awang, Z. The Mediating Role of Innovation in the Relationship between TQM Practices and Organizational Performance in Industrial SMEs in Jordan.

Al Nohoud, O. M., Awang, Z., & Khazaaleh, M. (2024). ASSESSING THE IMPACT OF TOTAL QUALITY MANAGEMENT PRACTICES ON ORGANIZATIONAL PERFORMANCE IN JORDANIAN SMALL AND MEDIUM INDUSTRIAL ENTERPRISES WITH INNOVATION AS A MEDIATOR: The use of total quality management practices aims to improve the organization's efficiency and competitiveness. Implementing TQM practices is fraught with challenges, especially in developing countries. It is important to improve the efficiency of organizations and workers as well as the quality of production. *journal of research administration, 6*(1).

Alipour, M., Irannezhad, E., Stewart, R. A., & Sahin, O. (2022). Exploring residential solar PV and battery energy storage adoption motivations and barriers in a mature PV market. *Renewable energy, 190*, 684-698.

Almarshad, M. N., Alwaely, S. A., AlKhawaldeh, B. Y. S., Al Qaryouti, M. Q. H., & Ahmad, A. Y. (2024). The mediating role of energy efficiency measures in enhancing organizational performance: Evidence from the manufacturing sector in Jordan. *International Journal of Energy Economics and Policy, 14*(4), 360-370.

Andrés-Cerezo, D., & Fabra, N. (2023). Storing power: Market structure matters. *The RAND Journal of Economics, 54*(1), 3-53.

Austin-Egole, I. S., Iheriohanma, E. B., & Nwokorie, C. (2020). Flexible working arrangements and organizational performance: An overview. *IOSR Journal of Humanities and Social Science (IOSR-JHSS), 25*(5), 50-59.

Awang, P. (2015). *SEM made simple: A gentle approach to learning Structural Equation Modeling*: MPWS Rich Publication, Bangi.

Awang, P. (2018). Pendekatan Mudah SEM (Structural Equation Modeling): MPWS Rich Resources.

Awang, Z. (2012). *Research methodology and data analysis second edition*: UiTM Press.

Awang, Z. (2014). *A handbook on SME: For Academicians and practitioners*: MPWS Rich Resources.

Awang, Z., Afthanorhan, A., & Mamat, M. (2016). The Likert scale analysis using parametric based Structural Equation Modeling (SEM). *Computational Methods in Social Sciences, 4*(1), 13.

Awang, Z., Afthanorhan, W., Lim, S., & Zainudin, N. (2023). SEM Made Simple 2.0 A Gentle Approach of Structural Equation Modelling. *Gong Badak: Penerbit Unisza*.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the academy of marketing science, 16*, 74-94.

Berman, P., Jones, J., Udry, J., & Health, N. L. S. o. A. (2020). Research design. *The SAGE Handbook of Political Science*, 437.

Bhattarai, U., Maraseni, T., & Apan, A. (2022). Assay of renewable energy transition: A systematic literature review. *Science of The Total Environment, 833*, 155159.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*: Guilford publications.

Chou, C.-H., Ngo, S. L., & Tran, P. P. (2023). Renewable energy integration for sustainable economic growth: Insights and challenges via bibliometric analysis. *Sustainability, 15*(20), 15030.

Dong, Y. (2023). Descriptive statistics and its applications. *Department of Mathematics, BostonUniversity, Boston, MA, 2215*.

Freeman, R. E. (2010). *Strategic management: A stakeholder approach*: Cambridge university press.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., Ray, S., . . . Sarstedt, M. (2021). Mediation analysis. *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*, 139-153.

Heiskanen, E., Matschoss, K., Laakso, S., & Apajalahti, E.-L. (2020). A critical review of energy behaviour change: The influence of context. *Energy and behaviour*, 391-417.

Hox, J. J. (2021). Confirmatory factor analysis. *The encyclopedia of research methods in criminology and criminal justice, 2*, 830-832.

Huber, M. (2020). Mediation analysis. *Handbook of labor, human resources and population economics*, 1-38.

Inês, C., Guilherme, P. L., Esther, M.-G., Swantje, G., Stephen, H., & Lars, H. (2020). Regulatory challenges and opportunities for collective renewable energy prosumers in the EU. *Energy Policy, 138*, 111212.

Jöreskog, K. G., Olsson, U. H., Y. Wallentin, F., Jöreskog, K. G., Olsson, U. H., & Wallentin, F. Y. (2016). Confirmatory factor analysis (CFA). *Multivariate analysis with LISREL*, 283-339.

Juszczyk, O., Juszczyk, J., Juszczyk, S., & Takala, J. (2022). Barriers for renewable energy technologies diffusion: Empirical evidence from Finland and Poland. *Energies, 15*(2), 527.

Kivimaa, P., Primmer, E., & Lukkarinen, J. (2020). Intermediating policy for transitions towards net-zero energy buildings. *Environmental Innovation and Societal Transitions, 36*, 418-432.

Kubiciel-Lodzińska, S. (2021). Snowball Sampling vs. Respondent Driven Sampling in Regional Research. Comparing the use of the Methods to Study Migrants Working in Elderly Care. *Studia Migracyjne-Przegląd Polonijny*(1), 149-180.

Kutan, A. M., Paramati, S. R., Ummalla, M., & Zakari, A. (2018). Financing renewable energy projects in major emerging market economies: Evidence in the perspective of sustainable economic development. *Emerging Markets Finance and Trade, 54*(8), 1761-1777.

Martiskainen, M., & Kivimaa, P. (2018). Creating innovative zero carbon homes in the United Kingdom—Intermediaries and champions in building projects. *Environmental Innovation and Societal Transitions, 26*, 15-31.

Matschoss, K., & Heiskanen, E. (2017). Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives. *Journal of cleaner production, 169*, 85-93.

McCarthy, R. V., McCarthy, M. M., Ceccucci, W., McCarthy, R. V., McCarthy, M. M., & Ceccucci, W. (2022). What do descriptive statistics tell us. *Applying predictive analytics: Finding value in data*, 55-85.

Raifman, S., DeVost, M. A., Digitale, J. C., Chen, Y.-H., & Morris, M. D. (2022). Respondent-driven sampling: a sampling method for hard-to-reach populations and beyond. *Current Epidemiology Reports, 9*(1), 38-47.

Russo, G. M., Tomei, P. A., Serra, B., & Mello, S. (2021). Differences in the use of 5-or 7-point likert scale: an application in food safety culture. *Organizational Cultures, 21*(2), 1.

Sandri, S., Hussein, H., & Alshyab, N. (2020). Sustainability of the energy sector in Jordan: Challenges and opportunities. *Sustainability, 12*(24), 10465.

Siedlecki, S. L. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist, 34*(1), 8-12.

South, L., Saffo, D., Vitek, O., Dunne, C., & Borkin, M. A. (2022). *Effective use of Likert scales in visualization evaluations: A systematic review.* Paper presented at the Computer Graphics Forum.

Teh, P.-L., Adebanjo, D., & Kong, D. L. (2021). Key enablers and barriers of solar paver technologies for the advancement of environmental sustainability. *Heliyon, 7*(10).

Thompson, B. (2004). Exploratory and confirmatory factor analysis: Understanding concepts and applications. *Washington, DC, 10694*(000), 3.

Versteegen, T. B. (2021). *Overcoming barriers to the transition to renewable energy sources: a study on the barriers to and support mechanisms for the implementation of PV solar plants in the Netherlands.*