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The Impact of Islamic Trade Agreements on Solar Panel Manufacturing: Mediating Role of Tariff Reduction Policies

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Abstract

This study examines the impact of Islamic Trade Agreements (ITA) on the solar panel manufacturing sector (SPMP) in South Asia, emphasizing the mediating role of Tariff Reduction Policies (TRPs). Using a quantitative research design, data were collected from 421 industry stakeholders, and analyzed through Structural Equation Modeling (SEM). Findings reveal that ITAs significantly enhance solar panel manufacturing performance, both directly and indirectly through TRPs, which effectively reduce trade barriers and encourage cross-border industrial collaboration. The results highlight the critical role of policy coherence and Islamic economic frameworks in accelerating renewable energy manufacturing. The study offers practical insights for policymakers and industry leaders to design trade and tariff policies that foster sustainable industrial and environmental growth across the region.

Keywords: *Tariff reduction policies, South Asia, solar panel manufacturing, Islamic trade agreements, manufacturing industry*

A. Intruduction

The construction of solar energy systems is increasingly gaining attention in developing economies seeking to balance industrial growth with environmental sustainability. Solar energy has emerged as a cornerstone of sustainable development and climate change mitigation, reflecting a global imperative to diversify energy sources and reduce carbon footprints. Concurrently, ITA have become instrumental in promoting economic integration among Muslim countries, offering frameworks that align with Islamic principles of fairness, shared growth, and equitable development. Empirical evidence suggests that tariff concession schemes under these agreements can stimulate local production and encourage the creation of value-added goods (Aldabousi, 2022). Prior studies indicate that investment and trade objectives are largely achievable through such agreements by removing barriers to intra-regional trade (Awad et al., 2024). Moreover, Aldabousi et al (2025) emphasize that these

agreements can create competitive advantages for the manufacturing sector by reducing import and export costs. Countries such as Pakistan, Bangladesh, and Malaysia illustrate the potential of leveraging Islamic trade agreements to advance renewable energy industries. Notably, over 30% of the global Muslim population resides in South Asia, a region with an estimated 20% of the world's solar energy potential (Zhao et al., 2023). Despite these opportunities, the solar manufacturing sector faces persistent infrastructural and regulatory challenges. Nazil (2025) highlights that inconsistent tariff policies and weak enforcement mechanisms undermine the potential of trade agreements, resulting in an estimated 10–12% annual loss in manufacturing growth. Similarly, Khan et al (2023) note that fragmented policies and non-coordinated tariff reductions hinder cross-border industrial cooperation. While studies underscore the role of trade benefits mediated through tariff reductions (Aldabousi, 2022), there is a notable gap in understanding how these policies specifically affect solar panel manufacturing in South Asia..

Structural barriers such as bureaucratic bottlenecks and limited technology transfer further constrain the realization of trade agreement advantages (Hajdukiewiez & Pera, 2020). Consequently, the interplay between Islamic trade agreements and tariff policies warrants deeper examination to identify key drivers of green industrial development in this strategically important region. While the potential benefits of Islamic trade agreements are acknowledged, scholarly work assessing their real impact on green industries, including solar panel production, remains sparse, particularly in South Asia. Aldabousi et al (2025) and Mahmoud et al (2025) observe that South Asian nations are progressing toward trade liberalization; however, the effects of tariff changes on renewable manufacturing are complex. These economies face regulatory silos, policy inconsistencies, and infrastructural deficiencies that limit the effective utilization of trade agreements (Awad et al., 2024). Although theoretically, Islamic trade agreements are designed to support solar panel manufacturing by reducing trade barriers, practical implementation in South Asia has fallen short. Ongoing issues such as tariff discrepancies, regulatory fragmentation, and inadequate infrastructure continue to erode the effectiveness of these agreements (Aldabousi, 2022). While market liberalization policies tied to tariff reductions are recognized as key cost drivers and access enhancers, there remains a critical policy gap in understanding how these measures mediate the relationship between Islamic trade agreements and solar manufacturing growth (Lanzetta et al., 2021). Addressing this gap is essential to comprehensively understand the effects of Islamic trade agreements on South Asia's solar panel industry. The significance of this research lies in its focus on South Asia, home to a substantial proportion of the world's Muslim population and holding untapped potential for renewable energy expansion. Despite ongoing solar energy projects in Pakistan, Bangladesh, and Malaysia, these countries face challenges in global competitiveness and access to international markets (Khan et al., 2023). This study aims to inform trade policy design for Muslim policymakers, offering strategies to enhance green industrialization and foster innovation and production at the firm level. By doing so, it contributes to global sustainability objectives and the growing demand for clean energy technologies. This paper makes three major contributions. First, it empirically broadens the understanding of ITA by examining the mediating role of TRPs on solar infrastructure trade within Islamic frameworks. Second, it addresses a literature gap by focusing specifically on South Asia. Third, it provides policy recommendations grounded in the unique cultural and economic context of Islamic countries regarding trade cooperation. The findings are reinforced by a sample of 421 stakeholders from the solar power industry, enhancing the reliability of the results. Adopting a quantitative approach, this study utilizes SEM to analyze survey data from

industry officials, trade specialists, and government personnel. This methodology enables a systematic assessment of the complex interdependencies among the various components, providing nuanced insights into the mediating role of tariff policies in trade agreements. Data collection covered a representative sample from South Asia's manufacturing sector, following established empirical methodologies in international trade and industrial studies (Al Murfie et al., 2023).

1. Theoretical Background

The basis of this study is anchored in two complementary theories: Trade Theory, particularly the New Trade Theory (NTT) and Policy Network Theory (PNT). Together, these theories formulate a sufficient explanation for understanding the impact of ITA, through TRPs, on the solar panel manufacturing industry in South Asia. As earlier noted, New Trade Theory (NTT) argues that trade policies like tariff lowering allow countries to specialize and achieve economies of scale, innovation, and greater market access (Karim et al., 2022). Unlike classical trade models that focus on comparative advantage, NTT includes the existence of imperfect competition as well as proactive subsidization by the state to enhance industry's competitiveness. More recently, Ali et al (2022) have shown NTT's relevance by proving that tariff reduction policies within regional trade agreements lower costs and increase production in economically-sensitive industries like high-tech manufacturing and renewable energy equipment. The adoption of ITA provides international markets for wider penetration and their unbundled access results in harnessing scale economies, enhanced efficiency, and innovation for the firms within the solar panel manufacturing industry (Hussain, 2022). This supports results from other studies that investigate trade agreements and identify that tariff reductions mediate their positive impacts by enabling cheaper imports of raw materials and components critical for assembling and producing solar panels (Awad & Mahmoud, 2024). PNT adds to NTT with analyses on institutional actors and governance systems within a particular policy outcome. PNT argues that the implementation of trade agreements are dependent on the interaction among nations, industrial constituents, and regulatory (Nagi, 2024). Some scholars from South Asia provide a perspective on effectiveness with Al Kadash et al (2023) focusing on the questions of coherence in policies and engagement of stakeholders within a tariff-cut policy framework. For instance, other approaches Aldabousi (2025) showed that countries which rely on strong institutional networks to guide polices are more able to achieve comprehensive institutional reforms towards trade leading to more efficient tariff processes and improved industrial development. Moreover, Hussain (2023), along with Nagi & Nigam (2023), argue that ITA function effectively when integrated within a supportive policy framework that Guarantee Achieve transparency, ensure adherence, and establish mechanisms for conflict resolution, all of which influence the manufacturing sector's performance. All these theories, taken together, create the conceptual model of this study which depicts ITA as the independent variable impacting solar panel manufacturing (dependent variable) with the mediation of tariff policies in place through the aforementioned policies). NTT elucidates the justification for liberalizing trade and the logic of competitive benefits of it, while PNT sheds light on governance and institutional aspects that are just as important in garnering these economic advantages.

2. Islamic Trade Agreements and solar panel manufacturing

ITA have a positive impact on the development and technological growth of the solar panel manufacturing industry by incorporating Shariah-compliant finance, facilitating ethical trade, and regionally coordinating sustainability efforts. ITA blend Islamic principles deeply rooted in Shariah which allows for ethical business, risk-

sharing, and long-term financing (Zhang et al., 2022; Awad et al., 2025; Fathallah & Nagi, 2022). These agreements further bolster green industrialization by eliminating interest-based restrictions and expanding on alternatives to financing like mudarabah and murabaha Yahia Shams Eldin et al (2025) that finance capital-intensive projects in the renewable energy sector. Research indicates that freemium trade zones, when coupled with clean ecological objectives, accomplish the greatest reduction in costs of production, improvement in cross border technology supply, boost in innovation capabilities at the domestic level (Kumar et al., 2025; Abdulrahim et al., 2024; Arif et al., 2022). Also, the Islamic ethical mandate of khalifah (stewardship) maslahah (public interest) works in synergistic way with the sustainable concern mandating the member states to encourage the development of solar panels in wider sustainable development plan (Hussain et al., 2022). Altogether, it constitutes a strong institutional and ethical framework which just notifies green investment, but also creates an environment conducive to the localization of solar technology, export readiness, and regional self-reliance.

H1: ITA have a positive effect on the SPMP.

3. Islamic Trade Agreements and Tariff Reduction Policies

ITA are deeply rooted in Shariah such as the principles of adl (justice), ta'awun (mutual cooperation), maslahah (public interest), usury riba, and gharar (uncertainty). Together, these support equitable, honest and transparent economic transactions (Zhang, 2023). These principles are also helpful in providing reasons for reducing tariff barriers on goods that are socially important, such as, technologies related to renewable energy (Saad et al., 2025). Empirical studies confirm the existence of preferential tariff policies that promote the transfer of green technologies and industrial diversification within and between Islamic economic zones and trade blocs, especially those of the OIC (Arif et al., 2022; Al-sherman & Aldabousi, 2024; Sun et al., 2022). Evidence suggests that ITA contain clauses that smooth the alignment of technical standards and streamline Customs procedures in addition to lowering import taxes on key sectors to enhance regional integration and competitiveness (Khan et al., 2022; Yu et al., 2022; Awad, 2024). Moreover, the ethical responsibility of environmental protection (khalifah) and Islamic finance is counterbalancing logic that reinforces the policy rationale to lower barriers to clean technology access through TRPs (Li et al., 2021). Therefore, these agreements serve not only as instruments for commerce, but also as tools for moral and economic change through which member states strive to achieve sustainable development objectives using equitable trade policies.

H2: ITA significantly impact on on the Adoption of TRPs.

4. Tariff Reduction Policies And The Manufacturing Of Solar Panels

As () notes, TRPs cut the cost of importing critical inputs like photovoltaic cells, semiconductors, and specialized equipment, amplifying solar manufacturing potential. With lower trade barriers, manufacturers optimize production costs, achieve economies of scale, and price competitiveness at domestic and international stages (Adams & Kaffo Fotio, 2024). There is empirical evidence that suggests that manufacturers are able to integrate into global value chains, given that the unsupported advanced technologies and practices from partners abroad are available to them after adopting TRPs (Hussain et al., 2023). In addition to this, reduced tariffs foster an environment that encourages investment by demonstrating support for free trade and low regulatory risk, thus, attracting foreign direct investment (FDI) designated for renewable energy manufacturing (Awad & Aldabousi, 2024). This boost in capital helps with the infrastructural spending, increasing the available productive capacity, and improving

the skills of the workforce (Ghonim et al., 2025). To summarize, the solar panel manufacturing industry, along with the growth in its technological capabilities and competitiveness with other industries, stand to benefit with strategized policies for the reduction of tariffs, overcoming the manufacturing challenges for sustainable energy transitions."

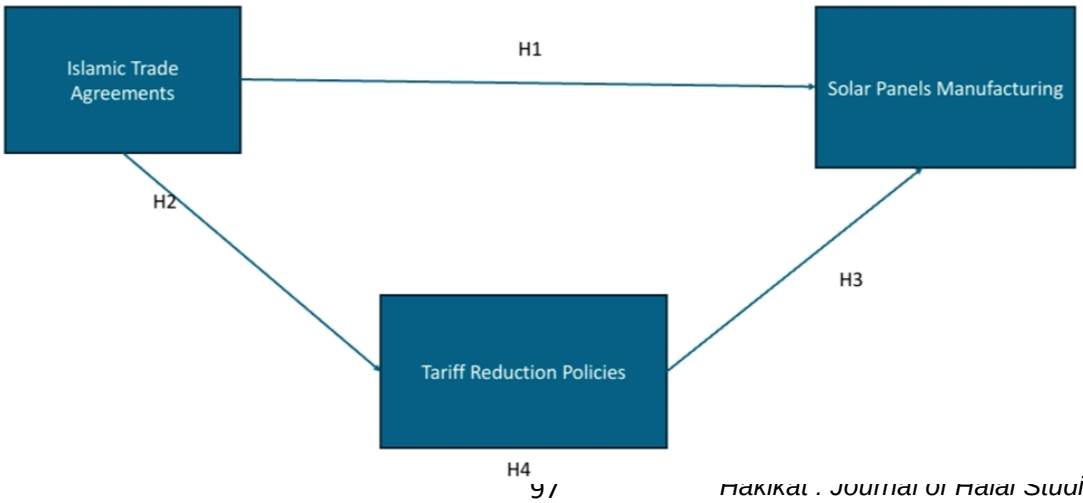
H3: TRPs have a significant influence on the SPMP.

5. The Mediating Role of Tariff Reduction Policies

The ITA that are based on the principles of justice (adl), mutual cooperation (ta'awun), and public welfare (maslahah) seek to set up systems that facilitate fair and ethical trade. These alliances automatically encourage policies aimed at the reduction of tariffs by eradicating lopsided economic barriers such as riba (usury) and gharar (excessive speculation) and establishing a smooth and unimpeded trade system that is in consonance with Islamic economic law (Nagi, 2024; Mahbub et al., 2022; Almeer et al., 2024). For such alliances, tariff reduction is not just an option but is also a hallmark of Islamic ethics intended for constructive socio-economic and environmental (khalifah) stewardship (Mahmoud et al., 2025). In this regard, the role of tariff reduction policies as a mediator is crucial. The ITA formulate the institutional and social framework that justifies and prioritizes tariff cuts for economic and sustainability driven sectors, specifically for solar panel manufacturing (Nagi & Nigam, 2023). These policies assist in lowering the cost of production and increase market entry for manufacturers within member states by reducing tariffs on raw materials, components, and finished solar products, which allows scaling of operations and enhances competitiveness (Yusuf et al., 2025). Additionally, the tariff cuts endorsed through ITA help achieve greater regional integration and uniform standards, simplified customs and borders which altogether improve supply chain efficiencies and foster FDI in solar manufacturing (Rehman et al., 2023; Aldabousi, 2022; Hussain, 2023). This mediation effect facilitates the Islamic frameworks on trade and Industry by transforming ethical and collaborative commerce values into concrete economic value and competitive benefits for the solar sector. As suggested, tariff reduction strategies are the major driver that allow for the ITA to meaningfully implement principles and commitments designed to renew panel manufacturing in the Islamic world toward sustainable industrial development, innovation, and growth. Absent that mediating pathway, the ability of ITA to encourage renewable energy manufacturing would otherwise be seriously hampered by ongoing fiscal and non-fiscal constraints.

H4: TRP mediate the positive relationship between ITA and SPMP.

Figure 1. Conceptual Framework



B. Materials and Methods

1. Research Sample

The primary focus group for this research was composed of experienced industry professionals and executives from the solar panel manufacturing sector in major South Asian regions such as Pakistan, Bangladesh, India, Sri Lanka, and the Maldives. These countries were selected due to their increasing emphasis on renewable energy infrastructure, growing engagement with Islamic economics, and their strategic role in the green industrialization of the Global South. Using purposive sampling, 570 questionnaires were sent to target managers, trade policy analysts, and operations specialists involved in solar production, policy implementation, and industrial logistics. Out of the collected responses, 421 were found to be valid after thorough checks for completeness and consistency, resulting in a 73.8% response rate. Data was collected over a three-month period between January and March 2025. Participants represented a diverse institutional and geographical background, ranging from private sector manufacturers to semi-public renewable energy firms, and spanning key cities such as Dhaka, Karachi, Lahore, Islamabad, Colombo, New Delhi, Mumbai, and Bengaluru. This coverage captures both primary economic hubs and secondary industrial areas, enhancing the external validity and generalizability of the study's findings within the South Asian context. While purposive sampling is a non-probability technique and may introduce some selection bias, its use is justified in this study due to the specialized nature of the target population. The research focuses on professionals with specific expertise in solar panel production, policy, and logistics—groups that are not uniformly distributed across the population. By combining purposive selection with expert judgment in identifying participants across multiple countries and institutional types, the study ensures inclusion of diverse perspectives while maintaining relevance to the research objectives. Additionally, rigorous data validation and a substantial sample size mitigate potential bias, supporting reliable and meaningful insights from the collected responses

. 2. Research Methods and Tools

This work explores three primary constructs: ITA, TRP, and SPMP. In this research, each variable was operationalized through multi-item measurement instruments derived from existing ITA and TRP studies, as well as other industrial performance literature. All items were measured on a 5-Likert scale, 1 denoting strong disagreement and 5 strong agreement.

- Islamic Trade Agreements (ITA): A 6-item scale was constructed from a trade-promotion agreement between Islamic nations and other cooperatives, including Islamic Economic Cooperation, provided by Arif et al (2022) and Li et al (2021). Example: "The Islamic trade agreements have enhanced our access to regional markets."
- Tariff Reduction Policies (TRP): The variable was calculated through an 8-item scale based on policies defined by Nagi & Nigam (2023) and Yusuf et al (2025), which monitored clarity, applicability, and direct savings of proposed policies. Example: "Our spending on imported parts has lowered because tariff eliminations have consistently been applied."
- Solar Panel Manufacturing Performance (SPMP): Performance was measured through an adapted 9-item instrument from Khan et al (2023) and Ali et al (2022) focusing on production and operational metrics, including efficiency of production, technology integration, and smooth supply chain operations.

Example: “Trade facilitation measures have led to an increase in solar panel production.”

All context and content related items underwent vetting for contextual fit and relevance of meaning. The items were translated and cross-checked into the local languages (Urdu, Bengali, Hindi) and English by three PhD researchers in industrial economics and policy studies. The validity of the content and the scaling for the given study were reviewed by the experts from renewable energy think tanks and national trade bodies. Control variables captured the demographics of the respondents: age, gender, job title, years of experience in trade-related positions, and organizational affiliation as private, public, or multilateral. Responses were given in ordinal scales to enable further statistical analysis.

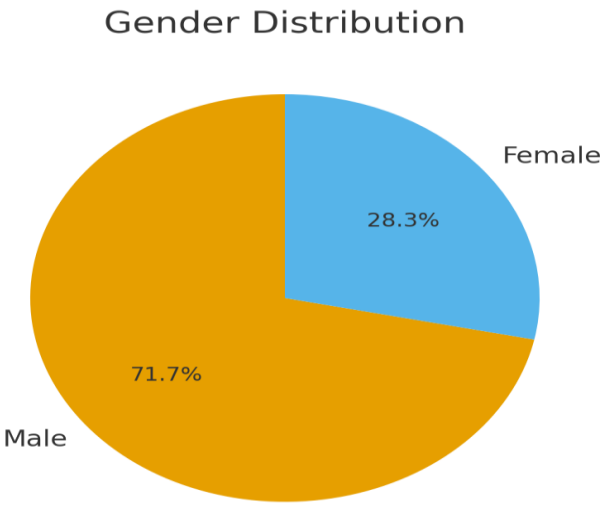
3. Data Analysis

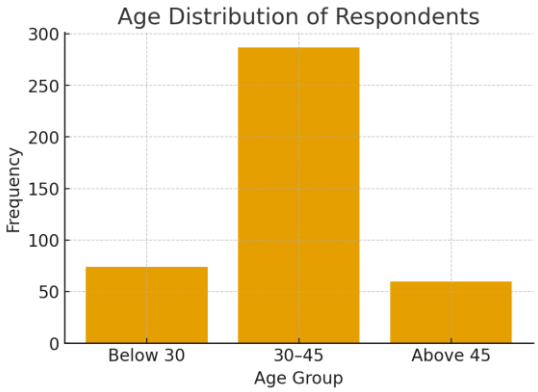
Quantitative data was analyzed on structural equation modeling (SEM) and mediation analysis with the help of SPSS 26.0 and SmartPLS 4.0. A number of analyses were carried out which included: Reliability Analysis (Cronbach’s alpha, Composite Reliability), Convergent and Discriminant Validity (using AVE and Fornell-Larcker criteria), Exploratory and Confirmatory Factor Analyses (CFA), (EFA), Direct, Indirect, and Total Effects mediative estimation, clear model fit indices for proposed conceptual models, and other essential checks for model robustness. Bootstrapping (5000 samples) was done to assess the significance of the mediating effect of TRP on ITA and SPMP.

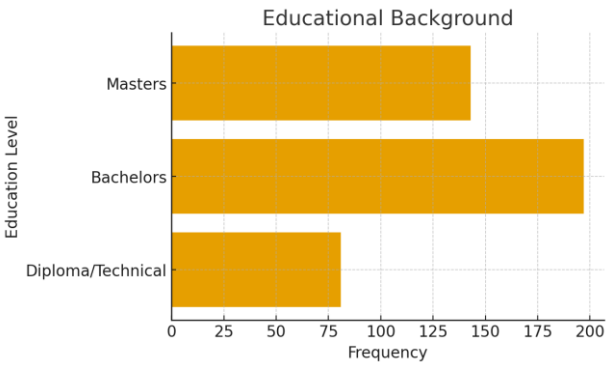
5. Sample Descriptive analysis

From the 421 valid responses received from solar panel manufacturing firms throughout South Asia, 302 (71.7%) were males and 119 (28.3%) were females, thereby yielding a gender ratio of approximately 5:2. This demographic disparity corresponds to South Asia’s enduring employment trends within the manufacturing and renewable energy sectors that show a persistent masculine dominance. By age groups, the largest proportion of respondents, 287 (68.2%), was in the 30-45 age bracket which indicates that most respondents are in their peak professional years. There were 74 respondents (17.6%) below 30, and 60 respondents (14.2%) over 45. This suggests that there is a broader pool of mid career professionals sustaining operational and strategic activities in the sector. With regard to the level of education attained, 197 respondents (46.8%) had a bachelor’s degree, 143 (34%) had a master’s degree or higher, and 81 (19.2%) had diploma or lower technical qualifications. That shows a considerably high level of educational qualifications, which may be attributed to the advanced solar technology systems and international trade policies with their sophisticated regulatory frameworks. Analysis of the data gathered from the renewable energy and manufacturing sectors indicates that 165 respondents (39.2%) had an employment duration of 5–10 years, 131 respondents (31.1%) had 2–5 years, and 82 respondents (19.5%) had less than 2 years. Only a small fraction—43 participants (10.2%)—had over 10 years of experience. This data on experience seems to align with the age data and indicates that there is a workforce with considerable experience and insight into industry trends and trade dynamics. All respondents were employed in active positions, including but not limited to, supply chain and industrial management, export control, and implementation of renewable energy systems with national manufacturers or regional subsidiaries under Islamic trade cooperation.

Table 1. Demographic Profile







6. Common Method Bias

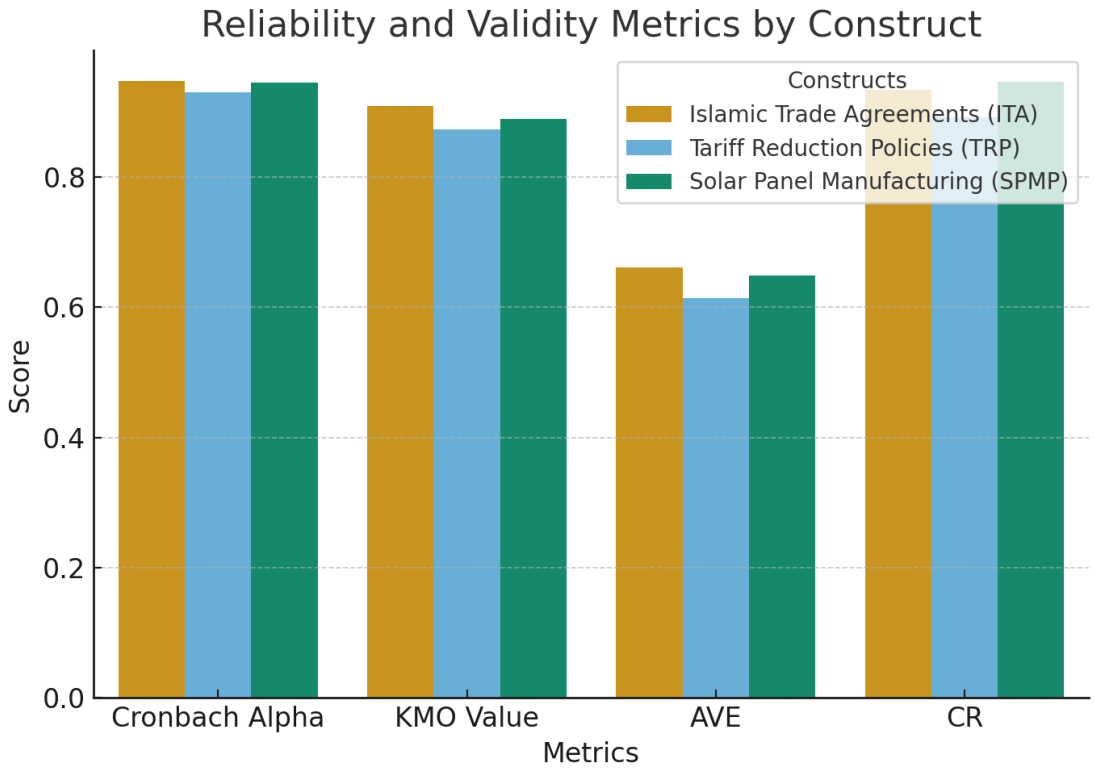
Considering that this study was based on a self-administered questionnaire, common method bias (CMB) was an issue to consider. For this purpose, Harman's single factor test was performed using exploratory factor analysis in SPSS 26.0. All the items of the ITA, TRP, and SPMP constructs were entered into the analysis. They found the first unrotated factor contributed 29.834% of the total variance which is less than the 40% threshold suggested by Podsakoff et al. (2003). This suggests that CMB is not a serious issue for this study and that the relationships among measured variables are not, in fact, significantly distorted owing to bias in the measurement process.

7. Reliability and Validity Test

In order to test the reliability and validity of the measurement instruments applicable to this study, SPSS 26.0 and SPSSAU were utilized. The constructs tested included ITA, TRP, SPMP. Each construct was assessed utilizing multi-item scales that

had already been tested, and customized to fit the South Asian context within industry. The reliability and validity results are incorporated in Figure 2. ITA following results were achieved; Cronbach's alpha value was 0.948 which is excellent internal consistency. The KMO value 0.910 ($p < 0.001$) meaning that indeed the sample was fit for factor analysis. AVE was at 0.661 while Composite Reliability was 0.934 which means there was a strong convergent validity and composite reliability. TRP yielded a Cronbach's alpha of 0.931 which fairly represents a high level of reliability. The KMO was 0.873 ($p < 0.001$) and so was the AVE and CR with the values of 0.614 and 0.892 respectively indicating acceptable convergent validity and internal structure. SPMP achieved for this construct, Cronbach's alpha was 0.945 which indicates very high internal consistency of the items. Supports sample adequacy was met with the KMO score of 0.889 ($p < 0.001$). The AVE of the construct was 0.649 and the CR was 0.926. These results indicate that all constructs used in this study demonstrate adequate reliability and construct validity and are therefore appropriate for further analysis including SEM and mediation modeling.

Figure 2. Reliability and Validity Results

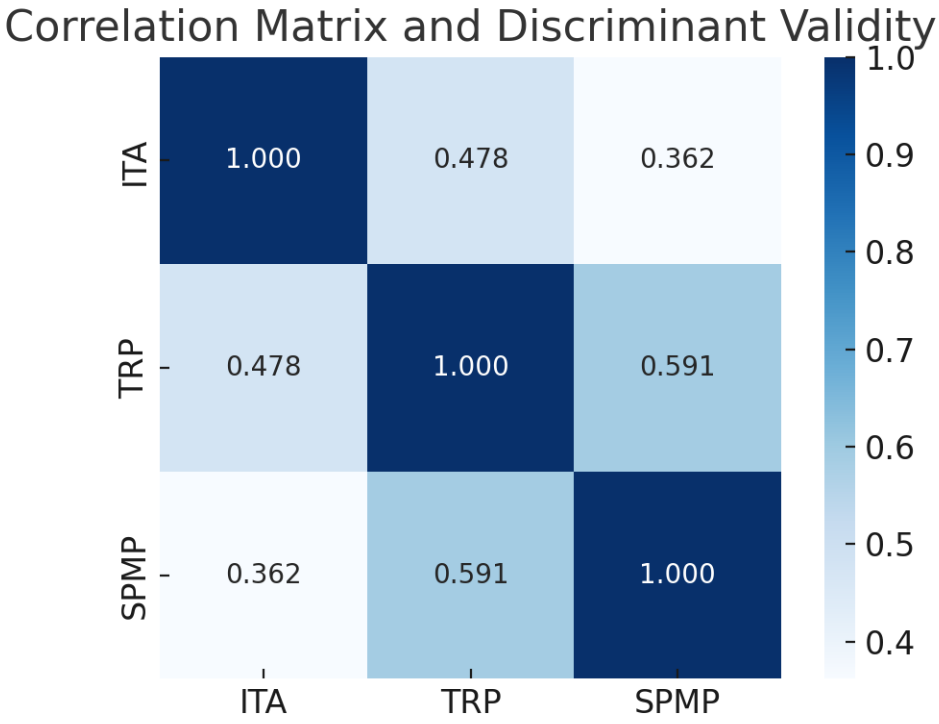


8. Construct Validity and Correlation Analysis

Survey instruments used for the study's primary data collection were adopted from previous studies with properly documented and accepted metrics which resulted in a high content validity. The scales were modified to fit the context of the South Asian region within the solar energy industry and were subject to a pre-test for relevance. Both types of validity were evaluated using EFA and CFA of exploratory and confirmatory factor analysis as part of the construction validation process. The EFA KMO results for ITA, TRP, and SPMP indicated that all three had KMO scores over .7. Moreover, Bartlett's test of sphericity was significant with $p < .001$ indicating that the

data could reliably undergo factor analysis. In the principal component extraction with varimax rotation, all factor loadings were above .5 on their respective constructs and below .4 on others which confirms there were no cross-loading issues and suggests that all items may be retained. CFA results validated AVE values of converged validity ranging from 0.614 to 0.661 which strengthened CFA results while remaining above the .5 threshold. Furthermore, composite reliability (CR) values between .892 and .934 further proved that internal consistency was confirmed because those values exceeded the minimum criterion of .7. In order to check for validity, the correlation coefficients among constructs for each variable was compared to the square root of the AVE. As can be seen in Figure 3, the square roots of AVE (diagonal entries) exceed the inter-construct correlations (off-diagonal entries) which satisfies Fornell-Larcker criteria for validity. These outcomes confirm that the measurement scales used in this study are indeed valid and reliable, enabling more sophisticated statistical techniques like mediation analysis.

Figure 3. Correlation Matrix and Discriminant Validity



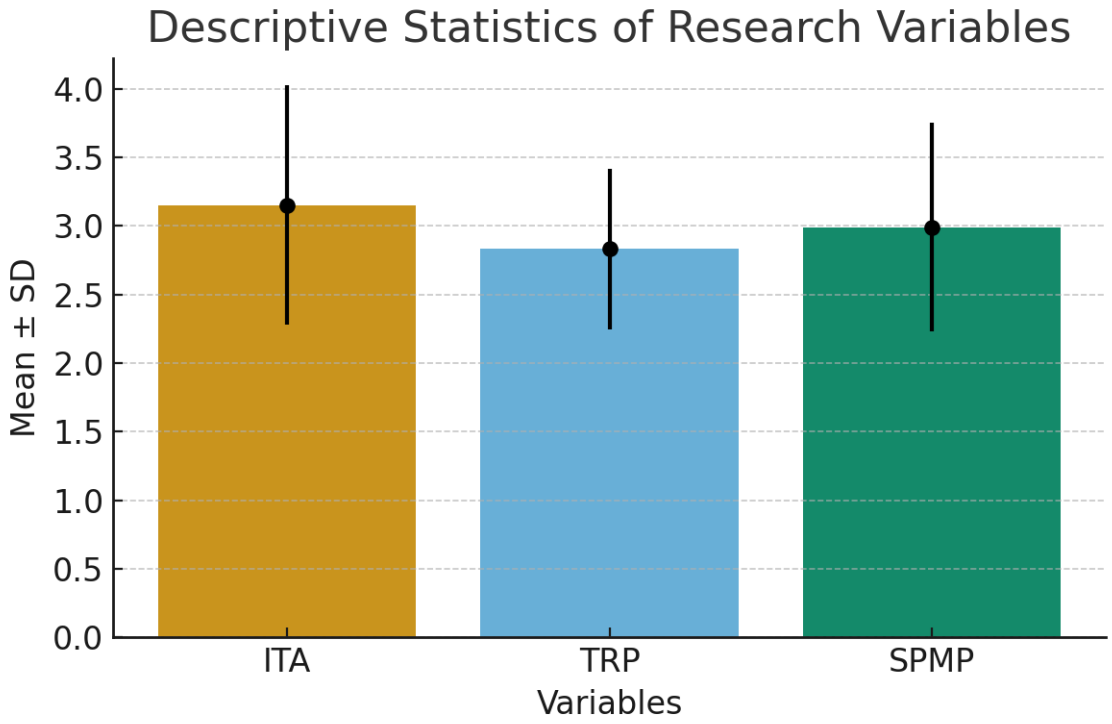
Note: Diagonal values in bold represent the square root of AVE; off-diagonal values are Pearson correlation coefficients.***p < 0.001

9. Descriptive Statistical analysis and model preparation

Core constructs of this research, ITA, TRP and SPMP were descriptively analyzed in the following Figure 4. Their means ranged from 2.833 to 3.154 and standard deviations from 0.587 to 0.871, which indicates that responses remarkably vary to some extent. As previously discussed in Table 3, inter-variable correlations among ITA, TRP, SPMP yield significant positve relationships, confirming these relations are aligned with the underlying theoretical framework while also proving the preliminary empirical evidence proposed for the mediating influence of TRP on trade

agreements versus manufacturing performance. In order to perform hypothesis testing, all variables were mean-centered to control multicollinearity arising from the regression models. This process allows an easier interpretation of interactions and mediation effects in SEM within later stages of analysis. The following analytic stage is multi-layered hierarchical regression focused on SEM, allowing evaluation of both direct and indirect influences as well as overall alignment with the research model.

Figure 4. Descriptive Statistics of research variables



10. Main effects and mediation effects testing

Main effects testing

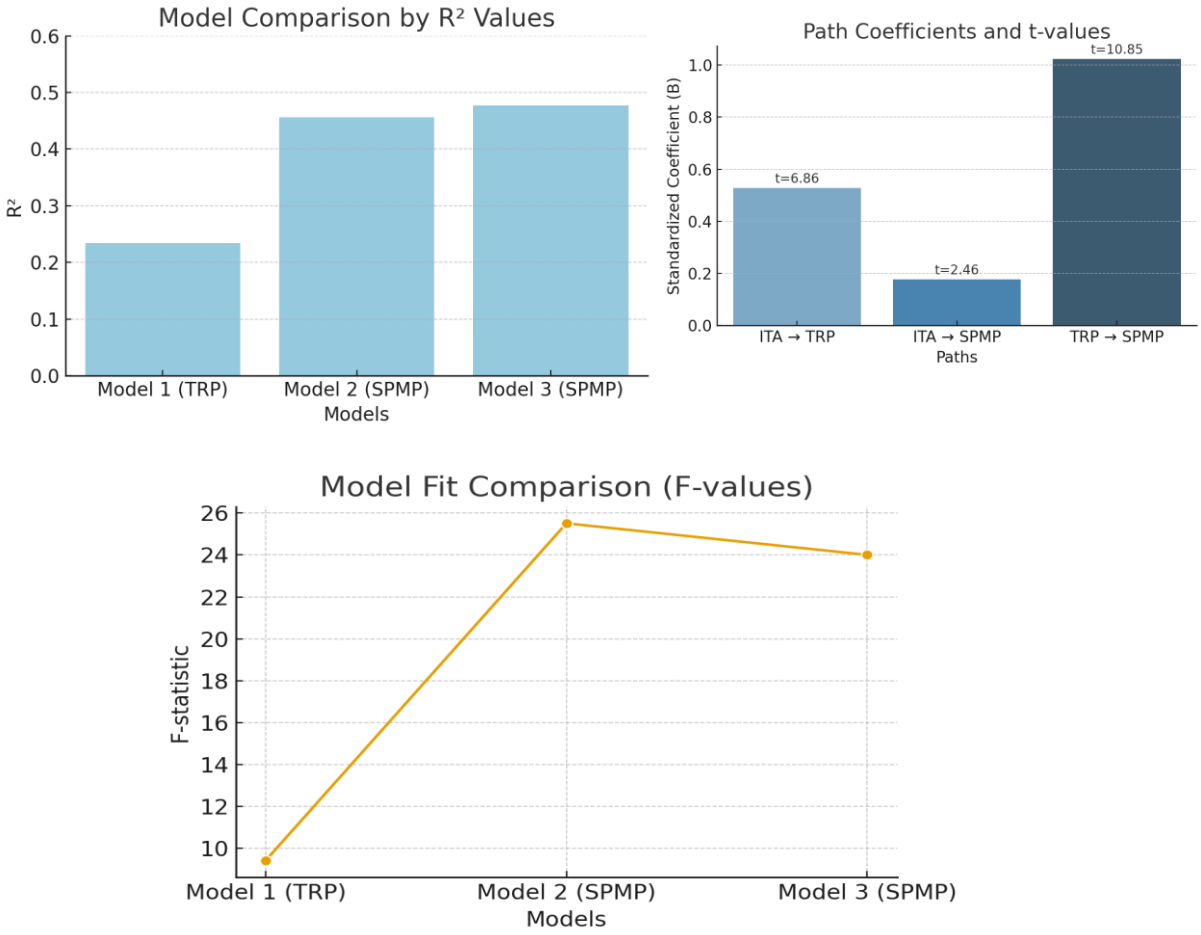
For Models 1 and 2, ITA were set in the first model as the independent variable and both TRP and SPMP as dependent variables. In Model 3, however, TRP was the independent variable, and SPMP was the dependent variable. The regression results shown in Table 5 were calculated after controlling for demographic factors, i.e., GDP ratio of the country concerning their imports or exports. All models had positive and significant variables ITA and TRP as per the regression results. Likewise, all cases VIF under 2 suggests no multicollinearity problems. These results confirm Hypotheses H1, H2 and H3 which suggests the primary link is trade agreements impact tariff policy which drives manufacturing performance.

Mediation Effects Testing

In order to test the mediation hypothesis (H4), SPMP was chosen as dependent, while ITA and TRP were added as independent and mediating variables, respectively, for Model 3. To estimate indirect effects, bootstrapping was applied with 5,000 samples. Results indicate that TRP has significant mediation effect, as the regression coefficient for TRP was $\beta = 1.023$, $p<0.001$ with the 95% bootstrap

confidence interval not containing zero. The direct effect of ITA on SPMP decreased from 0.528 to 0.177 when TRP was incorporated. The confidence interval suggesting a direct effect did include zero indicates a case of full mediation. It was found that the total effect of ITA on SPMP was 0.528, out of which the indirect (mediated) effect was 0.351, almost double the direct effect. These findings robustly support the mediation hypothesis proposed in H4.

Figure 5. Results of Main Effects and Mediation Effects Testing



Note: *p < 0.05; **p < 0.01; ***p < 0.001. Bootstrap CI in brackets. VIF < 2 for all predictors.

C. Discussion

This research underlines the significance of ITA with regard SPMP in South Asian regions, employing the mediation effect of TRP. The results indicate that ITAs exert a direct positive impact on SPMP and a significant indirect impact through TRP, confirming the full mediation hypothesis. These findings illustrate the effect of institutional economic collaboration on industrial development in emerging economies that aim for a sustainable energy transition. The direct relationship ITAs have with

TRAs strengthens the claim sought by Islamic economies on accelerating favorable trade policy changes in line with Khan et al (2022) and Obeidat et al (2024) who argued Shariah compliant inter-state pacts considerably reduce tariff restrictions on energy and its related services. Besides, the positive relationship connecting TRPs and SPMP aligns with the findings by Awad et al (2024) where lowered trade restrictions are known to enhance the inflow of technologies and the volume of manufactured goods in renewable energy sources. Moreover, the findings by Almeer et al (2024) and Nagi (2024) about facilitators of regulation being covert determinants of success for international economic initiatives ties with the overarching TRP mediation effect on ITA and SPMP. Saad et al (2025), in the context of trade liberalization impacts on green tech deployment, also reported facilitators confirming the mechanism uncovered in this study. In addition, other researchers from the region, Hussain (2022) and Awad et al (2024), reflect on the trade relations uncovered in this study noting how South-South cooperation based on religion and culture enhances trade-boosted industrial performance through lower structural trade costs, with solar panels being the most pronounced example where chains of command serve to maximize efficiency and reduce costs. The work of Yahia Shams Eldin et al (2025) and Mahmoud et al (2025), adding an international angle, contend that international trade treaties of a moral and religious nature like those of OIC cease member states commence considerable long-term investment, and technological advancement within the energy industry. Arif et al (2022) and Awad & Aldabousi (2024) corroborate, albeit through the context of Islamic preferential tariff schemes, that such frameworks have the potential to stimulate regional industrial development. To summarize, this research provides additional evidence that underlines the relationship between trade policy, trade deals with religious undertones, and the sustainable performance of industries. By illustrating the mediating effects of lower tariffs, this work enhances understanding of the processes through which the benefits of industrial capitalistic development relative to another south Asian economy's solar manufacturing industry infrastructure is achieved.

Theoretical Implications

This research adds significant theoretical value to the international trade policy and inter-subject relations of Islamic economy integration systems; to the Islamic development and international sustainable cooperation frameworks; to the interdisciplinary studies on renewable energy, and to industrial relations sociology. First, the work expands an existing theory on the impact of ITAs on industrial performance within the South Asian context, more precisely, on SPMP. This study proposes a new concept by adding TRP as a mediator, which provides an understanding of the gaps between institutional trade agreements and their effect on manufacturing output. This finding strengthens and deepens the institutional and regional trade integration theories regarding the soft, but strong, effects of trade liberalization based on religious and ethics norms. Second, the study has subsequently developed the discourse on sustainable industrialization within the emerging market context by framing SPMP as a product of economic diplomacy and policy tools aligned with religion. Existing literature has predominantly approached International Relations from a Eurocentric paradigm. This study is considered a contribution to developing a

culturally informed Islamic economic paradigm by providing evidence about the role of Islamic economic instruments in shaping cleaner energy futures. Third, the study advances the mediation theory in the trade-performance relationship by confirming the complete mediating role of TRP. It shows that the effectiveness of ITAs does not operate directly or in a straightforward manner, but rather through major policy channels like the system of tariffs. This increases the explication power of SEM in international trade and inter-industry relations.

Practical Implications

In terms of practicality, the research offers clear recommendations to South Asian policymakers, trade deal negotiators, and proponents of clean energy. This emphasizes that public authorities and intergovernmental trade organizations must create ITA with defined clauses on tariff eliminations for renewables. This can enhance the industrial capacity building in the solar sector which is essential for meeting the sustainability targets not only at the national level but also internationally, including goals under the United Nations Sustainable Development Goals (SDGs). Also, Energy ministries and export-import departments should use the ITAs, under the active strategy framework, as means for attracting FDI in solar manufacturing centers. The mediating role of TRP suggests that the unlocking of tariffs on solar technology and primary components imports will greatly improve cost, efficiency, and innovation in manufacturing. From an industrial perspective, the research calls out the need for manufacturers and suppliers in the solar panel value chain to rethink their operational level strategy in view of changing trade policy business environment and their efforts to edge forward will make a difference. They need to take a proactive approach in participating in policy conversations and negotiations regarding ITAs and tariff settings, which have the potential of drastically altering costs related to inputs, as well as opportunities for market access and supply chain streamlined access to resources. At last, the regional trade bodies and economic cooperation forums, particularly among the OIC member states, may utilize the findings to formulate more focused and detailed trade strategies at a specific sector level. This not only improves the significance of the ITAs, but also strengthens intra-Islamic economic cooperation through concrete growth in the developing industries, especially in renewable energy.

Limitations

This study has balanced its contribution with some limitations. To begin with, the research focused on a single subsector: solar panel manufacturing in a specific region of South Asia. While this comes with certain benefits, it diminishes the applicability of the results across other sectors of renewable energy or different geographic areas. Subsequent research should focus on other areas of renewable energy such as wind, hydro, or bioenergy within the Islamic context to offer a more comprehensive understanding. Also, the study followed a cross-sectional design, which restricts the ability to make causal inferences over time. Trade agreements, tariff policies, and industrial performance are sufficiently dynamic to justify the need for longitudinal studies that capture the impact of ITAs along with tariff reduction on sectoral growth over time. Moreover, the research drew on self-reported data obtained

through structured surveys, which poses a risk of social desirability or response bias. Even though the constructs met the reliability and validity thresholds after undergoing rigorous statistical testing, the study could be strengthened with objective measures of performance or policy outcomes like trade figures, tariff levels, and FDI values. Lastly, the mediating impact of TRP on other policies was examined in isolation. Trust in institutions, the quality of regulations, and even the facilitation of technology transfer, among other potentially influential mediators, were not included, which could further enrich the understanding of the effect of ITAs on industrial performance. Lastly, the heterodox Islamic economics principles embedded within South Asian trade agreements could also be influenced by the region's distinct cultural, political, and institutional contexts. This context-specific characteristic may limit the use of the results in regions that are politically diverse and do not have a Muslim majority.

Directions for Future Study

Following the current findings, future studies can focus on a few promising areas. First, comparative studies involving cross multiple OIC (Organization of Islamic Cooperation) member countries can understanding the varying impacts of ITAs in differing socio economic and political environments. Such comparative work could show whether the mediating effect of TRP is context specific or universally consistent. Second, longitudinal studies focusing on the influence of ITAs and TRP on industrial performance overtime would strengthen the basis for causal reasoning and evaluation of policy effectiveness. Panel data could also enhance examination of temporal policy shifts, economic reforms, and industrial activity post-agreement, within a multi-faceted framework. Third, more scholars should strive to add other mediating and moderating variables to broaden the understanding framework. Innovation potency, institutional quality, market freedom, and religious legitimacy of agreements may all provide deeper explanatory power and revealing intricate pathways. Fourth, future studies could pursue case studies alongside quantitative analysis to provide unstructured ITA and TRP context interpretation document analysis or interviews policies. This approach would provide a contextual explanation of ITAs and TRPs in action. Finally, broadening the scope to include sustainability science, political economy, and transnational governance may provide interdisciplinary approaches that enhance the scholarship on the Islamic cooperation in green industrialization.

D. Conclusion

The present study analyzes the impact of ITAs on the operational performance of the solar panel manufacturing industry in South Asia, focusing on the mediating effect of TRP. The results confirm that ITAs positively enhance industrial performance, and this effect is strengthened by TRP, highlighting the role of Islamic economic principles in facilitating trade, reducing costs, and promoting growth in renewable energy sectors. This research shows that ethically guided trade agreements, when actively implemented through policies such as TRP, can significantly advance sustainable industrialization in the Global South. This study relies on purposive sampling and cross-sectional data, which may limit generalizability and capture only a snapshot in time. Future research could use broader sampling methods, longitudinal

data, or explore other regions and industries. Qualitative studies may also provide deeper insights into how Islamic economic principles influence industrial practices.

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