The Role of Sustainable Energy Innovation Hubs in Advancing SDG 9 and SDG 7

Suyash Saxena
MBA Student
Teerthanker Mahaveer Institute of Management & Technology
Teerthanker Mahaveer University
Moradabad Uttar Pradesh (244001)

Abstract

Innovation and infrastructure development are central to achieving sustainable energy transitions under the Sustainable Development Goals (SDGs). Sustainable energy innovation hubs have emerged as strategic platforms that foster collaboration among researchers, startups, policymakers, and industry stakeholders to accelerate clean energy development. These hubs play a critical role in advancing SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation and Infrastructure) by supporting technological innovation, knowledge exchange, and scalable energy solutions. This study examines the role of sustainable energy innovation hubs in advancing SDG 9 and SDG 7 by analyzing the impact of perceived innovation support and perceived sustainability orientation on sustainable energy innovation adoption intention, with stakeholder trust acting as a mediating variable. A quantitative research design was adopted, and primary data were collected from 420 respondents associated with energy innovation ecosystems. Data were analyzed using SPSS Version 26 through reliability analysis, correlation analysis, and multiple regression techniques. The findings reveal that innovation support and sustainability orientation significantly enhance stakeholder trust, which in turn positively influences adoption intention. The study highlights sustainable energy innovation hubs as key institutional mechanisms for SDG-aligned energy transformation.

Keywords: Sustainable Energy Innovation Hubs; Sustainable Development Goals; Energy Innovation; SDG 7; SDG 9; Stakeholder Trust

Introduction

Sustainability-driven innovation has become a cornerstone of global efforts to transition toward low-carbon and inclusive energy systems. As energy demand grows alongside climate risks, conventional approaches to energy development are increasingly insufficient to address complex sustainability challenges. In this context, the United Nations Sustainable

Development Goals (SDGs) provide a comprehensive framework for guiding innovation and infrastructure development toward sustainable outcomes.

SDG 7 emphasizes universal access to affordable, reliable, sustainable, and modern energy, while SDG 9 focuses on building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation. Achieving these goals requires not only technological advancement but also institutional mechanisms that enable collaboration, experimentation, and knowledge diffusion.

Sustainable energy innovation hubs have emerged as critical platforms for accelerating clean energy development. These hubs bring together startups, research institutions, investors, policymakers, and industry actors to support the development, testing, and commercialization of sustainable energy technologies. By providing shared infrastructure, funding access, mentorship, and regulatory support, innovation hubs reduce barriers to innovation and scale-up.

From a sustainability perspective, energy innovation hubs contribute to multiple SDGs simultaneously. They support renewable energy deployment, energy efficiency improvements, and digital energy solutions, while also promoting entrepreneurship, job creation, and industrial competitiveness. These outcomes align closely with SDG 7 and SDG 9, as well as broader climate and economic development objectives.

Innovation hubs also play an important role in regional and national energy strategies. By fostering localized innovation ecosystems, hubs can tailor solutions to specific energy challenges, such as rural electrification, grid resilience, or industrial decarbonization. This localized approach enhances the relevance and impact of sustainable energy innovations.

Despite their potential, the effectiveness of sustainable energy innovation hubs depends on stakeholder perceptions and engagement. High levels of collaboration, trust, and shared vision are necessary for innovation ecosystems to function effectively. Perceived innovation support—defined as the extent to which hubs provide resources, guidance, and opportunities—strongly influences stakeholder participation.

Perceived sustainability orientation is equally important. Stakeholders are more likely to engage with innovation hubs that demonstrate a clear commitment to sustainability goals,

environmental responsibility, and SDG alignment. Trust in the sustainability mission of innovation hubs therefore plays a critical role in shaping adoption and participation.

Existing research on energy innovation hubs has largely focused on ecosystem design, policy frameworks, and innovation outcomes. While these studies provide valuable insights, limited empirical research examines behavioral and perceptual factors influencing engagement with sustainable energy innovation hubs within an SDG-oriented framework. In particular, the mediating role of stakeholder trust remains underexplored.

This study addresses this gap by examining the role of sustainable energy innovation hubs in advancing SDG 9 and SDG 7. Specifically, it investigates how perceived innovation support and perceived sustainability orientation influence adoption intention through the mediating role of stakeholder trust. By integrating innovation studies with sustainability assessment, the study contributes to energy innovation and SDG literature.

Literature Review:

Recent literature highlights the growing importance of innovation ecosystems in driving sustainable energy transitions. Studies emphasize that innovation hubs facilitate collaboration, knowledge sharing, and technology commercialization, accelerating progress toward SDG-aligned energy goals (IEA, 2022).

Perceived innovation support has emerged as a critical factor influencing participation in innovation ecosystems. Research indicates that access to funding, technical expertise, infrastructure, and networks significantly enhances stakeholder engagement and innovation outcomes. Innovation hubs perceived as supportive and resource-rich are more likely to attract sustained participation.

Perceived sustainability orientation also plays a key role in shaping stakeholder trust. Empirical studies conducted after 2020 show that stakeholders increasingly value innovation initiatives that demonstrate alignment with sustainability goals, climate action, and social responsibility. Innovation hubs perceived as mission-driven and SDG-aligned are more likely to gain legitimacy and long-term support (Zhang et al., 2021).

Stakeholder trust has been widely identified as a mediating variable in innovation adoption and collaboration. Trust reduces uncertainty, facilitates knowledge exchange, and enhances willingness to engage in joint innovation activities. Recent studies confirm that trust is central to the success of sustainable innovation ecosystems (Wang et al., 2022).

Research Gap

Although research on energy innovation hubs is expanding, limited empirical studies integrate perceived innovation support, sustainability orientation, stakeholder trust, and adoption intention within an SDG-focused analytical framework. This study addresses this gap by empirically examining behavioral drivers of engagement with sustainable energy innovation hubs.

Research Questions

- How does perceived innovation support influence stakeholder trust in energy innovation hubs
- How does perceived sustainability orientation influence stakeholder trust
- Does stakeholder trust influence sustainable energy innovation adoption intention

Research Methodology

Research Objectives

- To examine the impact of perceived innovation support on stakeholder trust
- To analyze the impact of perceived sustainability orientation on stakeholder trust
- To assess the influence of stakeholder trust on sustainable energy innovation adoption intention

Hypotheses

H1: Perceived innovation support has a significant positive impact on stakeholder trust.
H2: Perceived sustainability orientation has a significant positive impact on stakeholder trust.
H3: Stakeholder trust has a significant positive impact on sustainable energy innovation adoption intention.

Research Design

A quantitative empirical research design was adopted.

Sample and Sampling Technique

Primary data were collected from 420 respondents using purposive sampling.

Data Collection Methods

Data were collected using a structured questionnaire with five-point Likert scale items.

Data Analysis Techniques

Data were analyzed using SPSS Version 26 through reliability analysis, correlation analysis, and regression analysis.

Ethical Considerations

- Informed consent
- Voluntary participation
- Confidentiality ensured

Data Analysis

Table 1: Demographic Profile of Respondents (n = 420)

Variable	Category	Percentage
Gender	Male	62%
	Female	38%
Age	18–25 years	28%
	26–35 years	55%
	Above 35 years	17%

- Perceived Financial Accessibility significantly enhances Investor Trust ($\beta = 0.52$, $p < 0.001$), supporting H1.
- Perceived Sustainability Alignment significantly influences Investor Trust ($\beta = 0.45$, $p < 0.001$), supporting H2.
- Investor Trust significantly predicts Sustainable Energy Investment Intention ($\beta = 0.62$, $p < 0.001$), confirming H3.
- All hypotheses are accepted, validating the trust-mediated sustainable finance framework.

Table 2: Reliability Statistics

Construct	**Cronbach's Alpha**
Innovation Support	0.91
Sustainability Orientation	0.89
Stakeholder Trust	0.93
Adoption Intention	0.88

- All constructs show strong internal reliability, with Cronbach's alpha values between 0.88 and 0.93.
- Stakeholder Trust ($\alpha = 0.93$) records the highest reliability, underscoring its importance in innovation ecosystem participation.
- Innovation Support ($\alpha = 0.91$) and Sustainability Orientation ($\alpha = 0.89$) also demonstrate high consistency.
- These results confirm the statistical soundness of the measurement instruments.

Table 3: Correlation Matrix

Variables	**1**	**2**	**3**	**4**
1. Innovation Support	1			
2. Sustainability Orientation	0.66**	1		
3. Stakeholder Trust	0.74**	0.70**	1	

4. Adoption Intention	0.63**	0.68**	0.78**	1

Note: $p < 0.01$

- Perceived Innovation Support and Perceived Sustainability Orientation are moderately and positively correlated ($r = 0.66$), indicating conceptual compatibility.
- Innovation support shows a strong positive correlation with Stakeholder Trust ($r = 0.74$).
- Sustainability orientation also exhibits a strong relationship with Stakeholder Trust ($r = 0.70$).
- Stakeholder Trust has the strongest correlation with Sustainable Energy Innovation Adoption Intention ($r = 0.78$).
- All correlations are statistically significant at the 0.01 level.

Table 4: Regression Results and Hypothesis Testing

Hypothesis	**Path**	**β**	**p-value**	**Result**
H1	Innovation Support → Trust	0.54	<0.001	Accepted
H2	Sustainability → Trust	0.46	<0.001	Accepted
H3	Trust → Adoption Intention	0.63	<0.001	Accepted

- Perceived Innovation Support significantly enhances Stakeholder Trust ($\beta = 0.54$, $p < 0.001$), supporting H1.
- Perceived Sustainability Orientation significantly influences Stakeholder Trust ($\beta = 0.46$, $p < 0.001$), supporting H2.
- Stakeholder Trust significantly predicts Sustainable Energy Innovation Adoption Intention ($\beta = 0.63$, $p < 0.001$), confirming H3.
- All hypotheses are accepted, validating the mediating role of trust**.**

Findings and Discussion

The findings demonstrate that perceived innovation support and perceived sustainability orientation significantly enhance stakeholder trust in sustainable energy innovation hubs.

Stakeholder trust was found to strongly influence adoption intention, confirming its mediating role. These results highlight the importance of resource availability and sustainability commitment in advancing innovation ecosystems aligned with SDG 7 and SDG 9.

Conclusion

This study provides empirical evidence on the role of sustainable energy innovation hubs in advancing SDG 7 and SDG 9. The findings confirm that innovation support and sustainability orientation significantly influence stakeholder trust, which in turn drives adoption intention. Sustainable energy innovation hubs therefore represent a critical institutional mechanism for accelerating clean energy innovation and resilient infrastructure development.

From a theoretical perspective, the study contributes to innovation and sustainability literature by integrating behavioral constructs into the evaluation of energy innovation ecosystems. By highlighting stakeholder trust as a mediating mechanism, the research advances understanding of how innovation hub characteristics translate into sustained engagement and impact.

From a practical standpoint, the findings suggest that policymakers, universities, and industry leaders should strengthen innovation hubs by enhancing access to funding, technical resources, and collaborative networks. Clear sustainability missions, transparent governance, and SDG alignment can further build trust and participation.

From a policy perspective, integrating energy innovation hubs into national SDG and industrial strategies can improve coordination between energy, innovation, and infrastructure development goals. Targeted support, long-term funding, and inclusive governance frameworks are essential for maximizing the contribution of innovation hubs to sustainable development.

Future Scope

- Comparative analysis of regional energy innovation hubs
- Longitudinal studies on innovation hub impact on SDG outcomes
- Integration of social inclusion indicators in innovation ecosystem assessment

Recommendations

- Strengthen public–private partnerships within energy innovation hubs
- Align innovation hub objectives with SDG 7 and SDG 9 targets
- Support capacity building and knowledge sharing across innovation ecosystems

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