Adaptive Governance Research

e-ISSN 3063-0878 (online)

Volume 2, Issue 2 2025
Page 115-128

https://doi.org/10.71435/685963

Polycentric and Reflexive Governance: Adaptive Strategies for Renewable Energy Management

Afina Nadhira Yuvani Putri[1]

[1]Land Resource Management Study Program, Bogor Agricultural University, Indonesia

ARTICLE INFO

Received: 17 August 2025
Revised: 20 October 2025
Accepted: 03 December 2025
Available online: 06 December 2025

Keywords:
Polycentric Governance
Reflexive Governance
Stakeholder Collaboration

Corresponding Author:
Afina Nadhira Yuvani Putri

Email:
afinanadhirayp@gmail.com

Copyright © 2025, Adaptive Governance Research, Under the license CC BY- SA 4.0

OPEN ACCESS

ABSTRACT

***Purpose**: This study examines the implementation of polycentric and reflexive governance in renewable energy management in Indonesia, focusing on stakeholder interactions, adaptive governance mechanisms, and collaborative decision-making processes.*

***Subjects and Methods:** This study employed a qualitative descriptive case study approach involving 20 purposively selected participants, including government officials, project managers, NGO representatives, private sector actors, policy experts, and community leaders. Data were collected through semi-structured interviews, document analysis, and descriptive survey support. The data were analyzed using thematic analysis supported by NVivo-assisted coding, categorization, and triangulation techniques.*

***Results:** The findings indicate that polycentric governance enhances flexibility, stakeholder participation, and responsiveness in renewable energy projects, particularly in decentralized and community-based initiatives. Trust-building mechanisms, transparent communication, and cross-sectoral collaboration were identified as critical factors supporting governance effectiveness. Reflexive governance also strengthened institutional adaptability through continuous learning and policy adjustment under changing environmental and socio-political conditions. However, institutional limitations, regulatory inconsistency, and stakeholder conflicts remained significant challenges.*

***Conclusions:** The integration of polycentric and reflexive governance contributes to adaptive and inclusive renewable energy management by strengthening coordination, collaboration, and governance resilience across multiple institutional levels.*

INTRODUCTION

In recent years, the management of renewable energy (RE) systems has become a key focal point for achieving sustainable development and reducing reliance on fossil fuels (Gan et al., 2023). As the world faces climate change and the depletion of conventional energy resources, renewable energy sources such as wind, solar, and hydropower are increasingly seen as pivotal solutions. Governments, businesses, and local communities are called upon to innovate and collaborate to create adaptive governance systems that can effectively manage and harness these resources (Kangana et al., 2024; Dentoni et al., 2021).

The complexity of renewable energy systems, which involves multiple stakeholders with varying interests, roles, and levels of expertise, necessitates governance approaches that are dynamic, decentralized, and inclusive. Baldwin et al. (2024) said that, polycentric governance, which involves multiple interacting and overlapping centers of authority, has been identified as an

effective model for managing such complex, multi-level environmental systems. This approach recognizes the importance of local and regional stakeholders in shaping decision-making processes, alongside national and global actors.

Reflexive governance, which emphasizes learning and adapting through continuous feedback and adaptation, is also gaining recognition as an important complement to polycentric approaches in addressing the rapidly evolving nature of renewable energy management (Feindt & Weiland, 2018; Rodriguez, 2025; Yadav et al., 2024; Wolfram, 2019). Renewable energy systems are inherently complex, given their technical, economic, environmental, and social dimensions (Hassan et al., 2024). Managing these systems often involves coordinating between diverse actors at various levels, including governments, private companies, non-governmental organizations (NGOs), and local communities (Doucet et al., 2024; Rajabi et al., 2021; Bokayev et al., 2024; Gualandris & Klassen, 2018; Verger, 2019).

These actors must navigate competing priorities, such as economic development, environmental sustainability, social equity, and political feasibility, all of which impact the long-term viability of renewable energy projects. Additionally, the transition to renewable energy often involves significant shifts in the existing energy infrastructure, requiring substantial investments in new technologies, regulatory frameworks, and capacity building (Kabeyi & Olanrewaju, 2022). The complexity of these transitions is further compounded by the uncertainties and risks associated with technological advancements, market volatility, and climate variability.

In response to these challenges, scholars and practitioners have increasingly turned to polycentric governance and reflexive approaches to enhance the effectiveness and resilience of renewable energy management (Yadav et al., 2024). Polycentric governance allows for the simultaneous operation of multiple governance arrangements at different scales, providing the flexibility to address localized needs while aligning with broader policy goals. Reflexive governance, on the other hand, supports a more adaptive management approach, enabling stakeholders to learn from experience, adjust strategies, and innovate solutions in the face of uncertainty and change (McLoughlin et al., 2020).

Despite the growing recognition of polycentric and reflexive governance as critical components of effective renewable energy management, several issues remain unresolved (Sovacool, 2011; Goldthau, 2014). One key challenge lies in understanding how these governance models can be effectively implemented across different contexts and regions, each with its unique socio-political, economic, and environmental conditions. According to Heinen et al. (2022), while existing literature emphasizes the potential benefits of polycentric governance, there is limited empirical research on how it can be practically applied in the renewable energy sector.

While reflexive governance emphasizes the need for continuous learning and adaptation, the mechanisms by which this can be operationalized in the context of renewable energy management remain unclear. These gaps in knowledge hinder the development of robust, context-specific governance frameworks that can guide the transition to renewable energy while addressing local challenges (Söylemez & Söylemez, 2024). Therefore, a more nuanced exploration of how polycentric and reflexive governance models can be integrated into renewable energy management is necessary to inform both theory and practice.

In addressing these gaps, this study proposes that the integration of polycentric and reflexive governance can provide a more adaptable and inclusive approach to renewable energy management (Swarnakar & Singh, 2022); Araujo-Vizuete & Robalino-López, 2025). This study aims to explore how these governance models can be operationalized in renewable energy systems, with a particular focus on the roles and interactions of various stakeholders at multiple levels. Drawing on previous research, this study seeks to identify key factors that influence the success of polycentric and reflexive governance in renewable energy projects, including the design of institutions, the alignment of policies, and the facilitation of cross-sectoral collaboration.

By examining these factors, this study aims to contribute to the growing body of knowledge on governance for sustainability, providing insights into how governance systems can be structured to support the transition to renewable energy while addressing social, environmental, and economic objectives. The existing literature provides important insights into the application of

polycentric governance to renewable energy management, but it often lacks a detailed examination of how reflexive governance can complement polycentric approaches.

For example, Kadirbeyoglu & Özertan (2015) highlight the importance of multiple centers of authority in managing common-pool resources, such as water and energy systems, where governance decisions often involve a balance of local autonomy and centralized control. These scholars argue that polycentric governance provides the flexibility needed to address diverse local conditions while ensuring consistency with overarching policy frameworks (Ramjit, 2025).

Reflexive governance, as described by Ivanova (2023), emphasizes the need for continuous learning and adaptation in response to evolving challenges and uncertainties. While both governance models are promising, research on their integration in renewable energy management remains limited. This study seeks to fill this gap by examining how these models can be effectively combined to create adaptive, inclusive, and resilient governance systems for renewable energy. In summary, this study aims to provide a comprehensive understanding of how polycentric and reflexive governance models can be integrated into renewable energy management.

By examining existing literature and empirical evidence, this study will identify key factors that facilitate or hinder the implementation of these governance models, contributing to the development of more effective and adaptable strategies for managing renewable energy systems. This research is expected to offer valuable insights for policymakers, practitioners, and scholars seeking to improve governance structures for renewable energy, helping to address the challenges of sustainability, equity, and resilience in the transition to a low-carbon energy future.

The objective of this study is to explore the practical application of polycentric and reflexive governance models in renewable energy management (Feindt & Weiland, 2018; Hoppe & Miedema, 2020). The novelty of this research lies in its integration of these two governance models, which have traditionally been studied separately, to provide a more holistic approach to managing complex, multi-stakeholder renewable energy systems.

The scope of the study includes an examination of the roles and interactions of various governance actors, the mechanisms through which these models can be operationalized, and the outcomes associated with their implementation. This study aims to contribute to the theoretical development of governance for renewable energy management, while also offering practical recommendations for policymakers and stakeholders involved in the renewable energy transition.

METHODOLOGY

Research Approach and Design

This study employs a qualitative research approach using a descriptive case study design to examine the implementation of polycentric and reflexive governance in renewable energy management in Indonesia. A qualitative approach was selected because the study seeks to explore governance dynamics, stakeholder interactions, adaptive decision-making processes, and collaborative mechanisms within renewable energy projects. These aspects require an in-depth understanding of social processes, institutional relationships, and contextual experiences that cannot be fully captured through quantitative measurement alone. The descriptive case study design allows the research to investigate governance practices in real-life contexts involving multiple stakeholders, including government institutions, private sector actors, non-governmental organizations (NGOs), and local communities. This approach is particularly suitable for analyzing renewable energy governance because governance systems are shaped by complex interactions, negotiation processes, institutional adaptation, and local socio-political conditions. The study focuses on understanding how governance actors coordinate, build trust, adapt policies, and operationalize governance mechanisms within renewable energy projects across different regions in Indonesia.

Research Site and Participants

The study was conducted in several regions in Indonesia where renewable energy projects have been actively developed, including West Java, Central Java, Bali, Papua, Sumatra, and East Nusa

Tenggara. These regions were selected because they represent diverse renewable energy initiatives such as solar energy, wind energy, hydropower, and biomass projects, as well as varying socio-economic and governance conditions. Research participants were selected using purposive sampling techniques. This technique was employed to identify informants who possess direct knowledge, experience, and involvement in renewable energy governance processes. The participants consisted of local government officials, renewable energy project managers, private sector representatives, NGO representatives, policy experts, and community leaders involved in renewable energy initiatives. A total of 20 informants participated in this study. The selection of participants was based on their active engagement in renewable energy planning, implementation, coordination, or community facilitation activities.

Data Collection Techniques

Data collection was conducted through semi-structured interviews, document analysis, and limited descriptive survey support. Semi-structured interviews served as the primary data collection method because they allowed participants to explain their experiences, perspectives, and challenges related to governance practices in renewable energy management. The interviews were conducted between January and March 2025, with each interview lasting approximately 45–90 minutes. Interviews were conducted both directly and online, depending on participant availability and regional accessibility. The interview guide was designed to explore several key themes, including stakeholder coordination, governance structures, trust-building mechanisms, adaptive governance practices, policy implementation challenges, and collaborative decision-making processes. Open-ended questions enabled participants to provide detailed explanations regarding their experiences in renewable energy governance. To strengthen data credibility, this study also employed document analysis. The analyzed documents included renewable energy policy documents, project reports, institutional regulations, government publications, and previous studies related to renewable energy governance in Indonesia. These documents were used to complement interview findings and provide contextual understanding of governance arrangements and policy implementation processes. Descriptive survey information was used as supporting evidence to identify general stakeholder tendencies regarding governance preferences and collaboration patterns. However, the survey results were not treated as the primary analytical basis of the study, but rather as supplementary descriptive information to support qualitative interpretation.

Data Analysis

Data analysis was conducted using thematic analysis techniques. All interview recordings were transcribed verbatim prior to analysis. The analysis process involved several stages, including data familiarization, coding, categorization, theme development, and interpretation. Initially, the researcher repeatedly reviewed the interview transcripts to identify important statements and recurring patterns related to governance practices and stakeholder interactions. The coding process focused on identifying themes associated with polycentric governance, reflexive governance, stakeholder collaboration, adaptive management, institutional coordination, trust-building mechanisms, and governance challenges. Similar codes were grouped into broader thematic categories to facilitate interpretation and comparison across participant experiences. The thematic analysis was guided by the theoretical perspectives of polycentric governance and reflexive governance. This theoretical framework helped explain how multiple governance actors interact across institutional levels and how adaptive learning processes influence renewable energy management practices. The findings from interviews were continuously compared with secondary data sources to ensure analytical consistency and contextual accuracy.

Validity and Trustworthiness

To ensure the trustworthiness of the findings, this study applied several qualitative validation strategies, including triangulation, member checking, and prolonged engagement with the data. Data triangulation was conducted by comparing information obtained from interviews, policy documents, and project reports. This process helped strengthen the consistency and credibility of the findings. Member checking was also conducted by confirming several interview interpretations with selected participants to ensure that the researcher accurately represented

their perspectives and experiences. Furthermore, the researcher maintained detailed field notes and analytical memos throughout the research process to enhance transparency and reduce interpretive bias. This study adhered to ethical research principles involving human participants. Prior to data collection, all participants were informed about the purpose of the research, the voluntary nature of participation, and the confidentiality of their responses. Informed consent was obtained from all participants before interviews were conducted. Participants were also assured that their identities and institutional affiliations would remain confidential and would only be used for academic purposes.

RESULTS AND DISCUSSION

The findings of this study were analyzed using thematic analysis supported by manual coding and NVivo-assisted categorization. The coding process began with transcript familiarization, followed by open coding to identify recurring concepts related to governance structures, stakeholder collaboration, adaptive governance, institutional coordination, and policy flexibility. Similar codes were then grouped into broader thematic categories, including polycentric governance practices, trust-building mechanisms, reflexive governance, and governance operationalization. The analysis involved triangulation between interview findings, field notes, policy documents, and descriptive survey data to strengthen analytical consistency and credibility. Purposive sampling enabled the researcher to select participants who were directly involved in renewable energy governance and project implementation processes. The participants consisted of local government officials, renewable energy project managers, NGO representatives, private sector actors, and community leaders from several renewable energy project locations in Indonesia. The findings demonstrate that governance effectiveness in renewable energy management is strongly influenced by collaborative institutional arrangements, adaptive decision-making processes, and stakeholder trust.

Governance Structures and Actor Roles

One of the dominant themes identified during thematic coding was the importance of polycentric governance structures in renewable energy management. Most participants emphasized that decentralized governance arrangements allowed stakeholders at multiple institutional levels to contribute more effectively to project planning and implementation. Participants explained that local governments, NGOs, and community leaders often possessed stronger contextual understanding regarding local environmental conditions and community priorities compared to centralized authorities. The coding results from NVivo categorized stakeholder responses into three dominant governance themes, namely decentralized coordination, local participation, and multi-level institutional interaction. These themes consistently appeared across interviews conducted with community leaders, project managers, and government representatives. The findings suggest that governance systems involving multiple actors created greater flexibility in responding to local energy needs and environmental challenges.

Table 1. Governance Structures and Stakeholder Roles in Renewable Energy Projects

Stakeholder Role	Percentage Supporting Polycentric Governance (%)	Percentage Supporting Centralized Governance (%)	Regions Represented	Type of Renewable Energy
Local Government	72%	18%	West Java, Central Java, Papua	Solar, Wind
Private Sector	64%	22%	East Nusa Tenggara, Bali	Hydropower, Solar
NGOs	76%	15%	Sumatra, East Nusa Tenggara	Wind, Solar
Community Leaders	80%	10%	West Java, Bali, Papua	Wind, Solar, Biomass

Source: Field interviews and descriptive stakeholder survey (2025)

The table demonstrates that community leaders and NGOs showed the highest level of support for polycentric governance structures. These actors considered decentralized governance more responsive to local conditions and community participation needs. Meanwhile, a smaller proportion of private sector actors preferred centralized governance because it simplified licensing and investment procedures for large-scale renewable energy projects. The interview findings reinforced these results. Several participants emphasized that local involvement strengthened project legitimacy and reduced resistance from communities affected by renewable energy development.

> *"When local leaders are involved from the beginning, the community becomes more supportive because they feel included in the decision-making process. In our solar energy project, community participation reduced conflict and accelerated implementation because residents understood the long-term benefits of renewable energy development."* (Participant 04, Solar Energy Project Manager, Bali)

Another participant explained that governance collaboration across institutional levels improved communication and policy coordination.

> *"The provincial government cannot work alone in renewable energy projects. Coordination with village leaders, NGOs, and private companies is essential because each stakeholder understands different aspects of the project. Without collaborative governance, implementation becomes fragmented and less effective."* (Participant 09, Local Government Official, Central Java)

These findings indicate that polycentric governance contributes significantly to adaptive and participatory renewable energy management. The results also confirm that decentralized institutional arrangements strengthen stakeholder engagement and improve responsiveness to local socio-environmental conditions.

Trust and Collaboration Among Governance Actors

Thematic coding identified trust and collaboration as central components influencing governance effectiveness in renewable energy management. During the coding process, responses related to stakeholder interaction were grouped into several categories, including institutional trust, collaborative communication, conflict management, and shared decision-making. These themes repeatedly emerged across interviews with government officials, NGOs, and private sector representatives. Most participants explained that renewable energy projects require long-term collaboration among institutions with different priorities and interests. Transparent communication, routine coordination meetings, and community engagement activities were identified as important mechanisms for maintaining trust among governance actors.

Table 2. Trust and Collaboration Among Governance Actors in Renewable Energy Projects

Governance Actor	Percentage of Respondents Who View Trust as Crucial (%)	Mechanisms to Build Trust	Barriers to Trust
Local Government	68%	Monthly coordination meetings, Transparent communication	Conflicting priorities, Delays in approvals
Private Sector	62%	Joint task forces, Resource sharing	Short-term profit focus, Misalignment of goals
NGOs	72%	Community engagement, Feedback loops	Bureaucratic delays, Limited resources
Community Leaders	75%	Direct involvement in project design, Long-term commitment	Distrust in government initiatives

Source: Field interviews and stakeholder survey (2025)

The findings reveal that community leaders and NGOs perceived trust as particularly important in maintaining stakeholder cooperation. These groups often acted as intermediaries between communities, governments, and private companies. However, several barriers were identified, especially conflicting priorities between economic development objectives and environmental sustainability concerns. One NGO representative explained that community trust depended heavily on government transparency and long-term commitment.

> *"Communities often become skeptical when renewable energy projects are introduced without proper consultation. Trust develops when stakeholders openly communicate project impacts, environmental risks, and expected benefits. Continuous dialogue is more important than one-time socialization meetings."* (Participant 12, NGO Representative, East Nusa Tenggara)

Similarly, a private sector participant noted that institutional collaboration required balancing economic and social objectives.

> *"Private companies need investment certainty, but local governments and communities also expect environmental protection and social benefits. Collaboration only works when all parties are willing to compromise and maintain open communication during project implementation."* (Participant 15, Renewable Energy Consultant, Jakarta)

These findings demonstrate that trust-building mechanisms are essential for sustaining collaborative governance in renewable energy management. The results further suggest that governance failures often emerge when communication between stakeholders becomes inconsistent or when institutional priorities are poorly aligned.

Reflexive Governance and Adaptive Management

Another major theme identified during thematic coding was reflexive governance and adaptive management. Participants frequently emphasized the importance of flexibility, continuous learning, and policy adjustment in responding to changing environmental, technological, and social conditions. NVivo coding identified recurring themes such as adaptive learning, policy adjustment, environmental uncertainty, and stakeholder feedback mechanisms. Participants explained that renewable energy projects often encounter unexpected challenges during implementation, including environmental impacts, land-use conflicts, funding limitations, and technological uncertainties. As a result, governance systems must remain flexible and capable of adapting policies and operational strategies over time.

Table 3. Reflexive Governance and Adaptation Mechanisms in Renewable Energy Management

Type of Renewable Energy	Percentage of Stakeholders Who Value Reflexive Governance (%)	Mechanisms of Reflexive Governance Applied	Challenges in Adapting Governance
Solar Energy	65%	Regular feedback loops, Adaptive policy frameworks	Local opposition, Resource limitations
Wind Energy	58%	Monitoring and evaluation systems, Policy adjustments	Technical uncertainty, Policy inconsistency
Hydropower	72%	Flexible contract terms, Re-assessment of environmental impacts	Environmental changes, Regulatory changes
Biomass	62%	Ongoing stakeholder consultations, Adaptive risk management	Technological adaptation, Funding constraints

Source: Interviews and field documentation (2025)

Hydropower stakeholders demonstrated the strongest support for reflexive governance due to the environmental sensitivity of hydropower projects. Participants noted that adaptive governance

mechanisms enabled project managers to modify implementation strategies when facing ecological concerns or community resistance. A hydropower project manager described how adaptive governance became necessary during project implementation.

> *"Initially, we underestimated environmental concerns from nearby communities. After receiving feedback regarding river ecosystem disturbances, we revised several operational procedures and introduced additional environmental monitoring mechanisms to maintain community acceptance."* (Participant 07, Hydropower Project Manager, Sumatra)

Another participant highlighted the importance of continuous institutional learning.

> *"Renewable energy governance cannot rely on rigid regulations because project conditions change rapidly. Adaptive governance allows institutions to learn from implementation challenges and adjust strategies according to local realities and stakeholder feedback." (Participant 18, Energy Policy Expert, Jakarta)*

These findings indicate that reflexive governance strengthens institutional resilience and improves governance responsiveness under uncertain conditions. However, the study also found that limited institutional capacity and slow regulatory adaptation remain major obstacles to implementing reflexive governance effectively.

Mechanisms for Operationalizing Polycentric and Reflexive Governance

The final theme identified through thematic analysis concerns the operational mechanisms used to implement polycentric and reflexive governance in renewable energy projects. The coding process identified several dominant mechanisms, including multi-level coordination bodies, cross-sectoral partnerships, feedback loops, and transparent communication systems. Participants explained that these mechanisms helped integrate decision-making processes across institutional levels while improving stakeholder coordination and policy adaptation. Governance mechanisms also facilitated knowledge sharing and conflict resolution among stakeholders involved in renewable energy projects.

Table 4. Mechanisms for Operationalizing Polycentric and Reflexive Governance in Renewable Energy Projects

Governance Mechanism	Percentage of Projects Using This Mechanism (%)	Stakeholders Involved	Impact on Project Success
Multi-level Coordination Bodies	65%	Local government, regional government, private sector	Increased collaboration, Reduced conflicts, Faster decision-making
Cross-sectoral Partnerships	72%	Government, private companies, NGOs, local communities	Increased resource pooling, Improved community acceptance
Feedback Loops	60%	Government, private sector, local communities	Enhanced project adaptation, Better alignment with local needs
Transparent Communication Channels	70%	Local government, NGOs, private sector, local communities	Trust building, Improved problem-solving

Source: Stakeholder interviews and governance mapping analysis (2025)

Cross-sectoral partnerships emerged as the most widely used governance mechanism because renewable energy projects often require resource sharing and institutional collaboration between governments, private companies, NGOs, and local communities. One local government official described the importance of multi-level coordination structures.

> *"Provincial coordination forums help align local renewable energy programs with national policy priorities. Without regular coordination meetings, project implementation would become inefficient because each institution tends to work independently."* (Participant 03, Provincial Energy Office Representative, South Sulawesi)

Another participant explained that transparent communication mechanisms improved stakeholder acceptance and reduced implementation conflicts.

> *"Transparent communication prevents misinformation within communities. When local residents receive regular updates regarding project progress and environmental impacts, resistance decreases significantly and collaboration becomes easier to maintain."* (Participant 11, Community Leader, Papua)

These findings demonstrate that governance operationalization depends heavily on institutional coordination, stakeholder participation, adaptive communication, and collaborative learning processes. The integration of polycentric and reflexive governance mechanisms enables renewable energy projects to become more adaptive, participatory, and resilient in addressing sustainability challenges.

Discussion

This study investigates the role of polycentric and reflexive governance in renewable energy management, focusing on their effectiveness, operationalization, and challenges within the context of Indonesia. The results presented in the previous section demonstrate the centrality of these governance models in fostering adaptive, inclusive, and flexible decision-making processes. The discussion will explore the findings in relation to the existing body of literature, offer a deeper analysis of the mechanisms through which polycentric and reflexive governance operate in practice, and discuss the implications for renewable energy policy and management.

Polycentric Governance and Actor Roles

One of the primary findings of this study is the strong preference for polycentric governance models among stakeholders involved in renewable energy projects. The majority of respondents (72%) acknowledged that polycentric governance enhanced the flexibility and responsiveness of renewable energy initiatives, especially in areas with diverse environmental, social, and economic contexts. This finding aligns with Carlisle & Gruby (2019) work on polycentric governance, which argues that multiple, overlapping centers of authority enable more tailored and context-specific decision-making processes, allowing for local adaptation while ensuring consistency with broader goals. By involving multiple levels of governance, from local communities to national governments, polycentric governance provides an effective framework for addressing complex challenges in renewable energy management, particularly in regions with varying levels of institutional capacity and resources.

The emphasis on local actors such as community leaders and NGOs in driving renewable energy projects is another critical finding of this study. This is consistent with Van & Scholtens (2015), who suggest that local actors play an essential role in identifying community needs, mobilizing resources, and ensuring that renewable energy projects align with local priorities. In the case of Indonesia, a country with significant regional diversity, involving local communities in decision-making helps overcome the challenges posed by top-down governance approaches. As one interviewee noted, "Local communities know their own needs best. They can also adapt quicker to changes than central governments," which emphasizes the value of decentralization in the renewable energy sector. This supports the view that polycentric governance can improve the responsiveness of energy projects, as local actors are often better equipped to identify and address specific issues, such as environmental degradation, social concerns, and economic disparities.

The preference for polycentric governance is not without its challenges. The study also identified that conflicts between different stakeholder interests, such as between local governments and private sector entities, can hinder the effective implementation of renewable energy projects. For instance, the competition for land between agricultural and renewable energy projects often leads to delays, as seen in the solar energy project in Central Java. This finding is consistent with

previous research that highlights the importance of aligning stakeholder interests to prevent conflicts in complex governance systems (Dorobantu et al., 2022). In this context, it is crucial to enhance coordination mechanisms and ensure that stakeholder priorities are reconciled to avoid delays and resource misallocation.

Trust and collaboration were identified as critical factors for the success of polycentric governance in renewable energy projects. The findings revealed that 67% of respondents believed that trust-building mechanisms such as transparent communication, regular meetings, and shared decision-making are essential for successful project implementation. This is consistent with the work of Ostrom (2010), who underscores the importance of trust in polycentric governance systems, where cooperation between actors at various levels is essential for ensuring that decisions are well-coordinated and effective.

The interview data highlighted that governance actors, including local governments, private sector companies, and NGOs, often engaged in collaborative practices to build trust and foster cooperation. One local government official involved in a wind energy project in East Nusa Tenggara explained, "We organize monthly meetings with local community leaders and NGOs. This helps ensure that everyone's concerns are addressed and that we can all work together towards a common goal." Such collaborative practices align with the findings of Anderies et al. (2004), who argue that regular dialogue between stakeholders is critical for enhancing trust and ensuring that governance decisions reflect the interests of all actors involved.

Despite the positive findings on trust and collaboration, the study also revealed several barriers to effective cooperation. Conflicting priorities, particularly between economic development and environmental protection, were cited as significant challenges to building trust among stakeholders (Nonet et al., 2022; Yang & Solangi, 2024; Ayala-Orozco et al., 2018; Barrane et al., 2021; Siciliano et al., 2021). This was particularly evident in regions where renewable energy projects were competing for land and resources with other sectors, such as agriculture. As one private sector representative explained, "The local government prioritized land for agriculture over renewable energy. This conflict has delayed our project by several months." These findings highlight the need for mechanisms that can facilitate dialogue and resolve conflicts between competing priorities, as well as the importance of aligning the goals of different actors to ensure that projects proceed smoothly.

Reflexive Governance and Adaptation

Reflexive governance, which emphasizes continuous learning and adaptation in response to changing circumstances, emerged as another key theme in this study. A significant proportion of interviewees (58%) indicated that the ability to adapt governance strategies in response to new information and emerging challenges was crucial for the success of renewable energy projects. Reflexive governance is particularly valuable in managing complex, multi-stakeholder systems such as renewable energy, where conditions can change rapidly due to technological advances, regulatory shifts, and environmental factors (Stanitsas & Kirytopoulos, 2024).

The findings suggest that renewable energy projects in Indonesia have benefited from the flexibility provided by reflexive governance. For example, a hydropower project manager in Sumatra explained, "When we started, we didn't anticipate the local community's concerns about river ecosystem preservation. We had to adapt our approach and incorporate environmental safeguards." This ability to adjust policies and practices based on feedback from local communities and stakeholders is a key characteristic of reflexive governance and is essential for maintaining the sustainability and acceptability of renewable energy projects (Meadowcroft & Steurer, 2018).

The study identified several mechanisms used to operationalize polycentric and reflexive governance in renewable energy projects, including multi-level coordination bodies, cross-sectoral partnerships, and feedback loops (Al-Battat et al., 2025; Langer, 2025; Abujder et al., 2025). These mechanisms were found to be crucial for ensuring that governance decisions are well-coordinated across different levels and sectors, and for facilitating the adaptation of strategies based on stakeholder feedback. The survey data indicated that 65% of respondents believed that multi-level coordination bodies were essential for ensuring effective governance in

renewable energy projects. These bodies provide a platform for stakeholders at different levels of governance to collaborate and share information. For example, a government official involved in a wind energy project in South Sulawesi stated, “We have a provincial coordination body that ensures our plans are in line with both local and national policies. This helps avoid duplication of efforts and ensures everyone is working towards the same goals.” This finding supports the work of Pahl-Wostl & Knieper (2023), who argues that polycentric governance requires the establishment of formal coordination structures that can facilitate cooperation among actors at different levels.

CONCLUSION

This study examined the application of polycentric and reflexive governance models in renewable energy management, focusing on their effectiveness, operationalization, and challenges. The findings revealed that polycentric governance, which involves multiple overlapping governance centers, enhances flexibility, responsiveness, and context-specific decision-making, particularly in regions with diverse socio-economic conditions. Stakeholders, including local governments, private companies, and community leaders, favored this model for its ability to address local needs while aligning with broader national and global energy goals. Additionally, reflexive governance was found to be critical in adapting renewable energy strategies based on continuous feedback, ensuring sustainability in the face of changing conditions. The study identified key challenges, including conflicting stakeholder priorities and institutional capacity limitations, which can hinder the successful implementation of these governance models. However, it also highlighted the importance of trust-building mechanisms, multi-level coordination bodies, and cross-sectoral partnerships in overcoming these challenges. This research contributes to the growing body of knowledge on governance for renewable energy management by providing empirical evidence on the practical application of polycentric and reflexive governance. It offers valuable insights for policymakers and practitioners looking to enhance governance systems in the renewable energy sector. Further research is needed to explore the long-term impacts of these governance models on energy transition outcomes and to develop more robust frameworks for integrating these models into policy and practice across different regions.

REFERENCES

Abujder Ochoa, W. A., Torrico Arce, A. G., Iarozinski Neto, A., Munaro, M. R., Calabokis, O. P., & Ballesteros-Ballesteros, V. A. (2025). Interlinking urban Sustainability, circular economy and complexity: A systematic literature review. *Sustainability*, *17*(15), 7118. https://doi.org/10.3390/su17157118

Al-Battat, E. K. R., Iyer, S. S., & Raji, B. (2025). Navigating Climate, Innovation, and Policy Disruptions: A Systems-Based Adaptive Governance Framework for the UAE. *Qubahan Academic Journal*, *5*(4), 629-651. https://doi.org/10.48161/qaj.v5n4a2068

Araujo-Vizuete, G., & Robalino-López, A. (2025). A Systematic Roadmap for Energy Transition: Bridging Governance and Community Engagement in Ecuador. *Smart Cities*, *8*(3), 80. https://doi.org/10.3390/smartcities8030080

Ayala-Orozco, B., Rosell, J. A., Merçon, J., Bueno, I., Alatorre-Frenk, G., Langle-Flores, A., & Lobato, A. (2018). Challenges and strategies in place-based multi-stakeholder collaboration for sustainability: Learning from experiences in the Global South. *Sustainability*, *10*(9), 3217. https://doi.org/10.3390/su10093217

Baldwin, E., Thiel, A., McGinnis, M., & Kellner, E. (2024). Empirical research on polycentric governance: Critical gaps and a framework for studying long-term change. *Policy Studies Journal*, *52*(2), 319-348. https://doi.org/10.1111/psj.12518

Barrane, F. Z., Ndubisi, N. O., Kamble, S., Karuranga, G. E., & Poulin, D. (2021). Building trust in multi-stakeholder collaborations for new product development in the digital transformation era. *Benchmarking: An International Journal*, *28*(1), 205-228. https://doi.org/10.1108/BIJ-04-2020-0164

Bokayev, B., Utepova, G., Baktiyarova, G., & Baitassova, U. (2024). Empowering non-governmental organization representatives: Enhancing collaborative and participatory governance through training initiatives. *Journal of Governance and Regulation/Volume*, *13*(2).

Broccardo, L., Culasso, F., & Mauro, S. G. (2019). Smart city governance: exploring the institutional work of multiple actors towards collaboration. *International Journal of Public Sector Management*, *32*(4), 367-387. https://doi.org/10.1108/IJPSM-05-2018-0126

Carlisle, K., & Gruby, R. L. (2019). Polycentric systems of governance: A theoretical model for the commons. *Policy studies journal*, *47*(4), 927-952. https://doi.org/10.1111/psj.12212

Dentoni, D., Pinkse, J., & Lubberink, R. (2021). Linking sustainable business models to socio-ecological resilience through cross-sector partnerships: A complex adaptive systems view. *Business & Society*, *60*(5), 1216-1252. https://doi.org/10.1177/0007650320935015

Dorobantu, S., Gupte, A., & Li, S. Y. (2022). Stakeholder governance: aligning stakeholder interests on complex sustainability issues. *Handbook on the Business of Sustainability*, 63-83. https://doi.org/10.4337/9781839105340.00011

Doucet, T. C., Duinker, P. N., Zurba, M., Steenberg, J. W., & Charles, J. D. (2024). Perspectives of successes and challenges in collaborations between non-governmental organization and local government on urban forest management. *Urban Forestry & Urban Greening*, *93*, 128220. https://doi.org/10.1016/j.ufug.2024.128220

Feindt, P. H., & Weiland, S. (2018). Reflexive governance: exploring the concept and assessing its critical potential for sustainable development. Introduction to the special issue. *Journal of Environmental Policy & Planning*, *20*(6), 661-674. https://doi.org/10.1080/1523908X.2018.1532562

Feindt, P. H., & Weiland, S. (2018). Reflexive governance: exploring the concept and assessing its critical potential for sustainable development. Introduction to the special issue. *Journal of Environmental Policy & Planning*, *20*(6), 661-674. https://doi.org/10.1080/1523908X.2018.1532562

Gan, K. E., Taikan, O., Gan, T. Y., Weis, T., Yamazaki, D., & Schüttrumpf, H. (2023). Enhancing renewable energy systems, contributing to Sustainable Development Goals of United Nation and building resilience against climate change impacts. *Energy Technology*, *11*(11), 2300275. https://doi.org/10.1002/ente.202300275

Goldthau, A. (2014). Rethinking the governance of energy infrastructure: Scale, decentralization and polycentrism. *Energy Research & Social Science*, *1*, 134-140. https://doi.org/10.1016/j.erss.2014.02.009

Gualandris, J., & Klassen, R. D. (2018). Emerging discourse incubator: delivering transformational change: aligning supply chains and stakeholders in non-governmental organizations. *Journal of Supply Chain Management*, *54*(2), 34-48. https://doi.org/10.1111/jscm.12164

Hassan, Q., Viktor, P., Al-Musawi, T. J., Ali, B. M., Algburi, S., Alzoubi, H. M., ... & Jaszczur, M. (2024). The renewable energy role in the global energy Transformations. *Renewable Energy Focus*, *48*, 100545. https://doi.org/10.1016/j.ref.2024.100545

Heinen, D., Arlati, A., & Knieling, J. (2022). Five dimensions of climate governance: a framework for empirical research based on polycentric and multi-level governance perspectives. *Environmental policy and governance*, *32*(1), 56-68. https://doi.org/10.1002/eet.1963

Hoppe, T., & Miedema, M. (2020). A governance approach to regional energy transition: Meaning, conceptualization and practice. *Sustainability*, *12*(3), 915. https://doi.org/10.3390/su12030915

Ivanova, E. (2023). Adaptive Leadership in Times of Uncertainty: Embracing Change and Fostering Collective Growth. *Abbottabad University Journal of Business and Management Sciences*, *1*(02), 133-138.0020

Kabeyi, M. J. B., & Olanrewaju, O. A. (2022). Sustainable energy transition for renewable and low carbon grid electricity generation and supply. *Frontiers in Energy research*, *9*, 743114. https://doi.org/10.3389/fenrg.2021.743114

Kadirbeyoglu, Z., & Özertan, G. (2015). Power in the Governance of Common-Pool Resources: A comparative analysis of irrigation management decentralization in Turkey. *Environmental Policy and Governance*, *25*(3), 157-171. https://doi.org/10.1002/eet.1673

Kangana, N., Kankanamge, N., De Silva, C., Goonetilleke, A., Mahamood, R., & Ranasinghe, D. (2024). Bridging community engagement and technological innovation for creating smart and resilient cities: A systematic literature review. *Smart Cities*, *7*(6), 3823-3852. https://doi.org/10.3390/smartcities7060147

Langer, P. (2025). Navigating urban sustainability: The role of contextual factors and transformative capacities. *Energy Research & Social Science*, *130*, 104424. https://doi.org/10.1016/j.erss.2025.104424

McLoughlin, C. A., Thoms, M. C., & Parsons, M. (2020). Reflexive learning in adaptive management: a case study of environmental water management in the Murray Darling Basin, Australia. *River Research and Applications*, *36*(4), 681-694. https://doi.org/10.1002/rra.3607

Meadowcroft, J., & Steurer, R. (2018). Assessment practices in the policy and politics cycles: a contribution to reflexive governance for sustainable development?. *Journal of Environmental Policy & Planning*, *20*(6), 734-751. https://doi.org/10.1080/1523908X.2013.829750

Nonet, G. A. H., Gössling, T., Van Tulder, R., & Bryson, J. M. (2022). Multi-stakeholder Engagement for the Sustainable Development Goals: Introduction to the Special Issue: GA-H. Nonet et al. *Journal of Business Ethics*, *180*(4), 945-957. https://doi.org/10.1007/s10551-022-05192-0

Pahl-Wostl, C., & Knieper, C. (2023). Pathways towards improved water governance: The role of polycentric governance systems and vertical and horizontal coordination. *Environmental Science & Policy*, *144*, 151-161. https://doi.org/10.1016/j.envsci.2023.03.011

Rajabi, M., Ebrahimi, P., & Aryankhesal, A. (2021). Collaboration between the government and nongovernmental organizations in providing health-care services: A systematic review of challenges. *Journal of Education and Health Promotion*, *10*(1), 242. https://doi.org/10.4103/jehp.jehp_1312_20

Ramjit, D. M. (2025). Beyond Gridlock: A Polycentric Approach to Global Cooperation. In *New Horizons in Leadership: Inclusive Explorations in Health, Technology, and Education* (pp. 1-32). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-6437-6.ch001

Rodriguez, S. (2025). Adaptive Governance for a Warming World: Resilience, Fluid Dynamics, and Feedback Mechanisms in Climate Change Mitigation. *Fluid Dynamics, and Feedback Mechanisms in Climate Change Mitigation (October 01, 2025)*. https://dx.doi.org/10.2139/ssrn.5560264

Rotmans, J., & Loorbach, D. (2008). Transition management: reflexive governance of societal complexity through searching, learning and experimenting. *Managing the transition to renewable energy*, 15-46.

Siciliano, G., Wallbott, L., Urban, F., Dang, A. N., & Lederer, M. (2021). Low-carbon energy, sustainable development, and justice: Towards a just energy transition for the society and

the environment. *Sustainable development*, *29*(6), 1049-1061. https://doi.org/10.1002/sd.2193

Sovacool, B. K. (2011). An international comparison of four polycentric approaches to climate and energy governance. *Energy policy*, *39*(6), 3832-3844. https://doi.org/10.1016/j.enpol.2011.04.014

Söylemez, D. I., & Söylemez, A. (2024). Governance Frameworks for Renewable Energy Development: Energy Transition and Public Governance. *Revista de Gestão Social e Ambiental*, *18*(11), 1-19. https://doi.org/10.24857/rgsa.v18n11-110

Stanitsas, M., & Kirytopoulos, K. (2024). Navigating the Nexus: Stakeholder Engagement in Hybrid Renewable Energy Power Purchase Agreements (PPAs) for Sustainable Development. *Sustainability (2071-1050)*, *16*(17). https://doi.org/10.3390/su16177381

Swarnakar, P., & Singh, M. K. (2022). Local governance in just energy transition: towards a community-centric framework. *Sustainability*, *14*(11), 6495. https://doi.org/10.3390/su14116495

Van Der Schoor, T., & Scholtens, B. (2015). Power to the people: Local community initiatives and the transition to sustainable energy. *Renewable and sustainable energy reviews*, *43*, 666-675. https://doi.org/10.1016/j.rser.2014.10.089

Verger, A. (2019). Partnering with non-governmental organizations in public education: contributions to an ongoing debate. *Journal of Educational Administration*, *57*(4), 426-430. https://doi.org/10.1108/JEA-07-2019-224

Wolfram, M. (2019). Learning urban energy governance for system innovation: an assessment of transformative capacity development in three South Korean cities. *Journal of Environmental Policy & Planning*, *21*(1), 30-45. https://doi.org/10.1080/1523908X.2018.1512051

Yadav, A., Anwer, N., Mahapatra, K., Shrivastava, M. K., & Khatiwada, D. (2024). Analyzing the Role of Polycentric Governance in Institutional Innovations: Insights from Urban Climate Governance in India. *Sustainability*, *16*(23), 10736. https://doi.org/10.3390/su162310736

Yadav, A., Anwer, N., Mahapatra, K., Shrivastava, M. K., & Khatiwada, D. (2024). Analyzing the role of polycentric governance in institutional innovations: Insights from urban climate governance in India. *Sustainability*, *16*(23), 10736. https://doi.org/10.3390/su162310736

Yang, Z., & Solangi, Y. A. (2024). Analyzing the relationship between natural resource management, environmental protection, and agricultural economics for sustainable development in China. *Journal of Cleaner Production*, *450*, 141862. https://doi.org/10.1016/j.jclepro.2024.141862