

Polycentric and Reflexive Governance: Adaptive Strategies for Renewable Energy Management

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ABSTRACT

Purpose: This study aims to explore how polycentric and reflexive governance models can be implemented in renewable energy management, focusing on the roles and interactions of stakeholders at multiple levels.

Subjects and Methods: A mixed-methods research design was employed, combining quantitative surveys and qualitative semi-structured interviews. The survey gathered data from stakeholders involved in renewable energy projects in Indonesia, while interviews provided deeper insights. Descriptive statistics and thematic analysis were used to analyze the data.

Results: The study found strong support for polycentric governance, with 72% of respondents agreeing it enhances flexibility and responsiveness in projects. Local actors, including community leaders and NGOs, played a key role in project success. Trust and collaboration were crucial, with 67% of respondents highlighting the importance of transparent communication. Reflexive governance, emphasizing learning and adaptation, was vital, with 58% of stakeholders emphasizing its importance. Multi-level coordination and cross-sectoral partnerships were identified as effective mechanisms.

Conclusions: Polycentric and reflexive governance models are essential for managing renewable energy systems, particularly in diverse socio-economic contexts. While challenges such as conflicting priorities remain, the study emphasizes the need for trust-building and adaptive governance mechanisms to improve the effectiveness of renewable energy projects.

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. 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.

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.

Similarly, 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-Vizueté & 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 (Rijke et al., 2012; . 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

This study adopts a mixed-methods research design, integrating both qualitative and quantitative approaches to examine the effectiveness of polycentric and reflexive governance models in renewable energy management. By combining these methods, this study seeks to provide a comprehensive understanding of the mechanisms through which these governance models can be operationalized in the renewable energy sector. The methodology is structured around three main components: research design, data collection, and data analysis. Each of these components is detailed below, with a focus on the rationale for their selection, the specific techniques employed, and their relevance to the research objectives.

Research Design

The research design for this study is based on a sequential explanatory mixed-methods approach. This design allows for a comprehensive exploration of polycentric and reflexive governance in renewable energy management, starting with quantitative data collection followed by qualitative analysis. The quantitative phase aims to gather empirical data on the roles and interactions of governance actors in renewable energy systems, while the qualitative phase seeks to provide deeper insights into the experiences and perspectives of stakeholders involved in renewable energy projects. This design is particularly well-suited to address the study's research questions, as it allows for a systematic analysis of both the broad patterns of governance behavior (quantitative) and the nuanced, context-specific dynamics that influence governance decisions (qualitative). The use of a mixed-methods approach also aligns with the study's theoretical framework, which draws on both polycentric governance and reflexive governance theories. Polycentric governance emphasizes the importance of multiple, overlapping centers of decision-making authority, which can lead to more adaptive and resilient management systems (Carlisle & Gruby, 2019). Reflexive governance, on the other hand, focuses on learning and adaptation through ongoing feedback loops, which are essential for managing complex systems such as renewable energy (Rotmans & Loorbach, 2008). Together, these two governance models provide

a comprehensive lens for analyzing the management of renewable energy systems, which involves multiple actors at various levels of governance.

Data Collection

Data collection for this study involves both primary and secondary data sources. Primary data is gathered through surveys and semi-structured interviews with stakeholders involved in renewable energy projects across various regions. These stakeholders include government officials, energy sector representatives, community leaders, and experts in renewable energy policy. The survey instrument is designed to capture quantitative data on the perceptions of stakeholders regarding the effectiveness of polycentric and reflexive governance models in renewable energy management. The survey includes questions on the roles and interactions of different governance actors, the perceived effectiveness of decision-making processes, and the level of trust and collaboration among stakeholders. It also includes questions on the barriers to implementing polycentric and reflexive governance and the mechanisms through which these models can be operationalized. In addition to the surveys, semi-structured interviews are conducted with a subset of survey participants to gain deeper insights into the practical challenges and successes of implementing polycentric and reflexive governance in renewable energy projects.

These interviews provide an opportunity to explore the specific experiences and perspectives of key stakeholders, allowing for a more detailed understanding of the factors that influence governance decisions in the renewable energy sector. The interviews are conducted using an interview guide, which includes open-ended questions designed to encourage participants to share their experiences, challenges, and suggestions for improving governance in renewable energy management. Secondary data is also used to complement the primary data collection. This includes a review of relevant literature on polycentric and reflexive governance, as well as policy documents, reports, and case studies from renewable energy projects. These secondary sources provide context for the primary data and help to triangulate the findings from the surveys and interviews. The literature review focuses on identifying best practices and lessons learned from previous studies on governance in renewable energy management, particularly those that have explored the application of polycentric and reflexive governance models.

Data Analysis

The data analysis process is conducted in two phases: quantitative analysis and qualitative analysis. In the first phase, quantitative data from the surveys is analyzed using descriptive statistics, including frequency distributions, measures of central tendency (mean, median, mode), and measures of variability (standard deviation). This analysis provides an overview of the patterns and trends in stakeholder perceptions of polycentric and reflexive governance in renewable energy projects. It also helps to identify any significant differences in perceptions based on factors such as the role of the stakeholder (e.g., government official, energy sector representative, community leader), the region in which the project is located, and the type of renewable energy project (e.g., solar, wind, hydropower). The quantitative data is also subjected to inferential statistical analysis to examine the relationships between different variables. For example, regression analysis is used to determine the impact of factors such as stakeholder trust, level of collaboration, and the presence of formal governance structures on the perceived effectiveness of polycentric and reflexive governance models. This analysis helps to identify the key factors that influence the success of governance models in renewable energy management and provides insights into the mechanisms through which these models can be effectively implemented.

In the second phase, qualitative data from the semi-structured interviews is analyzed using thematic analysis. The interviews are transcribed verbatim and coded using a systematic approach to identify recurring themes and patterns. The coding process involves reading through the interview transcripts multiple times, highlighting key phrases and ideas, and grouping similar responses into categories. This analysis is guided by the theoretical framework of polycentric and reflexive governance, with particular attention given to the ways in which stakeholders perceive and experience the governance models in practice. Thematic analysis allows for the identification of the key challenges and opportunities associated with polycentric and reflexive governance in

renewable energy projects, as well as the strategies that stakeholders use to overcome these challenges. The findings from the qualitative analysis are integrated with the results from the quantitative analysis to provide a comprehensive understanding of how polycentric and reflexive governance can be operationalized in renewable energy management. This integration allows for a more nuanced interpretation of the data, as it combines the broad patterns identified in the survey data with the in-depth insights gained from the interviews.

Validity and Reliability

To ensure the validity and reliability of the data, several steps are taken throughout the research process. First, the survey instrument is pre-tested with a small group of stakeholders to ensure that the questions are clear, relevant, and valid. Any ambiguities or issues identified during the pre-testing phase are addressed before the full survey is distributed. Second, the semi-structured interviews are conducted by a trained researcher who is familiar with the research objectives and the interview guide. This ensures consistency and reduces the potential for interviewer bias. Third, the data analysis process is carried out using established techniques for both quantitative and qualitative analysis, ensuring that the results are reliable and robust. Finally, the findings from the primary data are triangulated with secondary data from the literature review, helping to validate the results and provide additional context.

Ethical Considerations

Ethical considerations are a key aspect of this study. Informed consent is obtained from all survey and interview participants, ensuring that they are fully aware of the purpose of the study, the data collection process, and their rights as participants. Participants are assured that their responses will remain confidential and that their participation is voluntary. The study also adheres to ethical guidelines for research involving human subjects, ensuring that all participants are treated with respect and that their privacy is protected throughout the research process.

RESULTS AND DISCUSSION

The results of this study provide a comprehensive analysis of the application of polycentric and reflexive governance models in renewable energy management. Through surveys and semi-structured interviews with stakeholders in the renewable energy sector, this section presents the findings regarding the effectiveness of these governance models, the roles of various actors, trust-building mechanisms, adaptive strategies, and the operationalization of governance models in renewable energy projects.

Governance Structures and Actor Roles

One of the central findings of this study is the strong support for polycentric governance structures in renewable energy projects. Polycentric governance involves multiple levels of governance interacting simultaneously, and stakeholders generally view this as an effective model for managing renewable energy systems. In the survey, a significant proportion of respondents (72%) indicated that polycentric governance models improved the flexibility and responsiveness of renewable energy projects, particularly in rural and community-based energy initiatives. Local actors such as community leaders and NGOs were often found to play a key role in project initiation, while national and regional actors provided the necessary policy frameworks and technical expertise. A smaller proportion (18%) expressed support for centralized governance, noting that centralized systems were more efficient for large-scale renewable energy projects that require streamlined decision-making. However, the majority preferred a decentralized approach to address local needs and circumstances. The following table summarizes the perceptions of governance structures based on the survey responses:

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
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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: Survey data collected from renewable energy stakeholders across Indonesia (2025).

The qualitative interviews reinforced these findings, emphasizing the importance of local actors in ensuring the success of renewable energy projects. Respondents often mentioned that the inclusion of community representatives in decision-making led to better alignment of projects with local needs. For example, a solar energy project manager in Bali stated, "By involving local leaders early, we ensured that the community was on board and knew exactly how the project would benefit them."

Trust and Collaboration Among Governance Actors

Trust and collaboration among stakeholders were identified as critical elements for the success of polycentric governance in renewable energy projects. Approximately 67% of respondents indicated that the success of renewable energy projects was highly dependent on trust between different governance actors, particularly between local governments, private companies, and NGOs. Trust-building mechanisms, such as transparent communication, regular meetings, and shared decision-making, were found to enhance cooperation and mitigate conflicts. The following table illustrates the mechanisms used to build trust and the barriers faced by stakeholders in renewable energy projects:

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: Interviews with local government officials, private sector representatives, and community leaders (2025).

These findings highlight the challenges stakeholders face in building and maintaining trust. While most stakeholders agreed that trust was essential for successful collaboration, the data also revealed that conflicts between differing priorities such as economic growth versus environmental sustainability often posed significant barriers. For instance, government officials and private sector representatives frequently cited concerns over balancing long-term sustainability goals with short-term economic incentives.

Reflexive Governance and Adaptation

Reflexive governance, characterized by continuous learning and adaptation, was found to be a key factor in the success of renewable energy projects, especially in the face of uncertainties and

changes. In total, 58% of respondents emphasized the importance of being able to adapt governance structures and strategies in response to new information, unforeseen challenges, or changes in the external environment. Reflexive governance was most beneficial in projects that involved multiple, interdependent stakeholders with varying goals, as it allowed for ongoing dialogue and adjustments based on stakeholder feedback. A majority of interviewees (62%) noted that governance systems that allowed for adaptive management were particularly effective in managing projects under changing conditions. For example, a project manager involved in a geothermal energy project in Papua stated, "We had to adjust our policies multiple times as we received feedback from local communities and encountered unexpected environmental challenges." The table below summarizes the findings on reflexive governance and the role of adaptation in renewable energy management.

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: Data from interviews and surveys (2025).

The findings suggest that reflexive governance mechanisms are particularly effective when governance actors engage in continuous learning and make real-time adjustments. However, there are several barriers to implementing reflexive governance, such as insufficient resources to adapt policies and the slow pace of regulatory changes. These barriers underscore the need for greater institutional support for reflexive governance processes, particularly in resource-constrained contexts.

Mechanisms for Operationalizing Polycentric and Reflexive Governance

The study also sought to identify specific mechanisms that were used to operationalize polycentric and reflexive governance in renewable energy projects. Multi-level coordination bodies, cross-sectoral partnerships, and feedback loops were the most commonly cited mechanisms by stakeholders involved in renewable energy projects. These mechanisms were found to enhance cooperation between different levels of governance and facilitate the adaptation of strategies based on stakeholder feedback. The table below shows the use of these mechanisms and their impact on the success of 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: Survey and interviews with project managers and stakeholders from renewable energy projects (2025).

These mechanisms played a critical role in ensuring the success of renewable energy projects. Multi-level coordination bodies, for instance, helped ensure that decisions made at the local level were consistent with national policies, while feedback loops allowed for adjustments to be made as new challenges emerged. Transparent communication was also essential in building trust among stakeholders, which in turn facilitated collaboration.

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.

However, 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 Among Governance Actors

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. 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).

However, while reflexive governance is seen as an effective tool for managing renewable energy projects, the study also identified several challenges to its implementation. A key barrier is the slow pace of policy changes and regulatory adjustments, which can hinder the ability of governance systems to respond quickly to new challenges. For example, the delay in approving regulations for wind energy projects in certain regions of Indonesia has slowed the development of this renewable energy source. This highlights the need for more responsive and flexible

regulatory frameworks that can keep pace with the rapid changes occurring in the renewable energy sector.

Mechanisms for Operationalizing Polycentric and Reflexive Governance

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. 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.

Cross-sectoral partnerships were also identified as key to the success of renewable energy projects. A majority of respondents (72%) reported that partnerships between government, private companies, NGOs, and local communities helped pool resources and expertise, making it easier to address the complex challenges associated with renewable energy projects. These partnerships also enabled the sharing of risks, which was particularly important in high-investment areas like hydropower and solar energy projects. A private sector representative involved in a solar energy initiative in Bali explained, “We rely on the local government to provide access to land and permits, while the community helps us with local knowledge and support. It’s a partnership that works well.” Finally, feedback loops used to continuously monitor and evaluate the progress of renewable energy projects were identified as essential for reflexive governance. The study found that 60% of respondents reported using feedback mechanisms to adjust policies and strategies in response to changing conditions. This ongoing learning process allowed governance actors to remain flexible and responsive, ensuring that renewable energy projects could adapt to new challenges and opportunities as they arose.

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.

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