

Policy Fragmentation and Coordination Uncertainty in Indonesia's Bioethanol Industry Governance

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ABSTRACT

Objectives: This study examines how policy fragmentation and coordination uncertainty influence governance dynamics and managerial decision-making in Indonesia's fuel-grade bioethanol industry.

Methodology: The study adopts an exploratory qualitative approach using semi-structured interviews with bioethanol industry actors, policymakers, and renewable energy researchers. Data were analyzed using grounded theory through thematic analysis and iterative coding procedures.

Findings: The findings reveal that policy fragmentation produces multi-layered policy failure, including integration failure, orchestration failure, and enforceability failure, which together produce a pattern of fragmented policy governance. This condition generates coordination uncertainty that leads producers to adopt defensive managerial decisions such as delaying investment, underutilizing production capacity, and diverting to alternative markets. Weak knowledge governance further reinforces these coordination failures.

Conclusion: Strengthening cross-ministerial coordination, institutionalized policy learning, and knowledge-based governance mechanisms is essential to reduce uncertainty and improve business certainty in Indonesia's bioethanol industry within the context of green management and renewable energy transition.

Keywords: Policy Fragmentation; Coordination Uncertainty; Governance; Bioethanol Industry; Renewable Energy Transition.

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INTRODUCTION

The development of bioethanol has gained increasing legitimacy within the global energy transition since the adoption of the Paris Agreement (United Nations, 2015). In Indonesia, renewable energy development is articulated through the National Energy Policy and the National Energy Plan to strengthen energy security and diversification (GoI, 2015, 2017). These commitments are reinforced by Presidential Regulation No. 40 of 2023 on national sugar self-sufficiency and bioethanol development (GoI, 2023). However, bioethanol implementation remains fragmented across energy, industrial, and agricultural sectors. Operational regulations issued by the Ministry of Energy and Mineral Resources (MEMR, 2025) still face coordination challenges within the national energy system.

Although Indonesia has regulatory support and feedstock potential, bioethanol utilization remains limited, indicating a gap between policy design and cross-sector implementation. Previous studies suggest that multiple regulations do not automatically produce policy integration. Instead, weak coordination mechanisms and inter-ministerial incoherence may undermine policy credibility, increase planning uncertainty, and raise perceived investment risks in renewable energy sectors (Olbrich et al., 2024; Mathieu, 2023; Kivimaa, 2022). In this context, policy fragmentation and the dynamics of inter-actor coordination become critical factors shaping industry development.

Insights from Australia provide a useful reference for understanding governance challenges in renewable energy transitions. Effective renewable energy development depends on cross-sector coordination and institutional collaboration, while regulatory misalignment between federal and state authorities can create policy inconsistencies and coordination challenges (Griffiths et al., 2025; White et al., 2024).

Building upon these issues, this study investigates how policy fragmentation and inter-actor coordination dynamics influence governance patterns and managerial decision-making in Indonesia's bioethanol industry. Specifically, the study addresses the following research questions:

RQ1: How does policy fragmentation shape governance patterns and coordination mechanisms in Indonesia's fuel-grade bioethanol industry?

RQ2: How do inter-actor coordination dynamics influence managerial decision-making and business certainty in the bioethanol industry?

RQ3: How do policymakers interpret policy fragmentation and cross-ministerial coordination challenges in bioethanol development?

RQ4: Which governance mechanisms from Australia's renewable energy policies can be adapted to reduce policy fragmentation and coordination uncertainty in Indonesia?

Previous studies show that challenges in Indonesia's bioethanol development are largely structural and institutional rather than purely technical or economic. Policy conflicts, unclear incentive schemes, and weak institutional coordination have been identified as key barriers to achieving national blending targets (Wirawan et al., 2025; Rahman et al., 2021). Similar governance challenges are also observed in more mature biofuel sectors such as biodiesel, where implementation effectiveness depends on clear institutional roles and consistent policy instruments (Wirawan et al., 2024).

Unlike previous studies that primarily examine bioethanol development from technological, feedstock, or economic perspectives, this study focuses on governance fragmentation as the central explanatory mechanism shaping industry development. The study introduces the concept of coordination uncertainty as a governance-induced condition influencing managerial decision-making and business certainty. By linking policy fragmentation, coordination dynamics, and managerial responses, this research extends current

understanding of renewable energy governance beyond policy design toward the behavioral consequences experienced by industry actors.

This study contributes to the Green Management and Sustainability Management literature by demonstrating how governance quality and coordination mechanisms influence managerial behavior, investment decisions, and long-term industrial sustainability in renewable energy sectors. By integrating empirical findings from Indonesia with comparative insights from Australia, the study provides a broader understanding of how governance arrangements can either facilitate or constrain sustainable industry development in emerging economies.

The analysis focuses on governance structures, policy fragmentation, and inter-actor coordination from a management and institutional perspective. Technical aspects of production processes and detailed economic feasibility analyses are beyond the scope of this study. Instead, the research emphasizes how governance dynamics influence industrial stability and managerial decision-making in Indonesia's bioethanol sector.

From a Green Management perspective, this study explains how governance quality influences managerial responses to renewable energy investment and operational decisions. From a Sustainability Management perspective, the findings demonstrate that long-term industrial sustainability depends not only on technological readiness and economic incentives but also on coordinated governance arrangements capable of reducing uncertainty and supporting strategic decision-making.

LITERATURE REVIEW

Governance as the Core Analytical Framework

Governance theory conceptualizes public policy and industrial development as outcomes of interactions among networks of actors rather than as products of hierarchical state decision-making. The concept of governance without government highlights coordination among the state, market, and society (Rosenau, 1992; Rhodes, 1996). Contemporary governance approaches emphasize collaboration and adaptive institutional arrangements in complex policy environments (Krogh & Triantafillou, 2024; Sanchez-Soriano et al., 2024; Vigoda-Gadot & Mizrahi, 2024; Soininen et al., 2025).

In Indonesia's molasses-based fuel-grade bioethanol industry, governance provides an analytical framework for understanding cross-sector coordination, institutional relationships, and policy interactions shaping industry development. Governance quality also influences managerial decision-making, investment strategies, and risk perceptions in emerging green industries.

Policy Fragmentation as a Structural Condition

Policy fragmentation often emerges from sectoral differentiation, distributed institutional authority, and multi-level policy arrangements (Fleckenstein, 2024; Pimenta & Kamruzzaman, 2024). It reflects path dependency, dispersed policy ownership, and differing institutional priorities among policy actors (Cairney, 2025).

Fragmented responsibilities and weak coordination mechanisms can hinder cross-sector transformation even when policy frameworks formally exist (Davis et al., 2024; Normann et al., 2025). In Indonesia's bioethanol sector, misalignment among energy, agricultural, and industrial policies generates feedstock uncertainty, price volatility, and inconsistent blending implementation. Policy fragmentation therefore represents a structural governance condition shaping siloed policy implementation and weak coordination, increasing managerial uncertainty and weakening long-term investment incentives.

Coordination Failure in Multi-Actor Systems

Coordination failure theory explains situations in which actors fail to align expectations and actions in complex systems characterized by interdependence and uncertainty (Zyzak & Farsund, 2025). Within inter-organizational networks, coordination failure is often driven by fragmented authority structures, policy uncertainty, and asymmetric interests among actors (Krystallis et al., 2025). Under these conditions, weak coordination mechanisms can lead to delayed responses, defensive decision-making, and inefficient investment behavior (Machado, 2024; Xu et al., 2025). In the bioethanol industry, coordination failure may appear in weak upstream–downstream synchronization, inconsistent market signals, and unstable policy or contractual arrangements necessary for investment decisions. Consequently, coordination failure not only undermines policy implementation but also shapes managerial behavior, particularly in investment timing, production planning, and strategic responses to policy uncertainty.

Knowledge Governance as the Root of Systemic Failure

Knowledge governance theory explains how governance mechanisms shape the creation, sharing, and use of knowledge among actors and organizations (Foss et al., 2010). In public policy contexts, effective knowledge governance enables institutional learning and adaptive decision-making. Recent studies indicate that weak knowledge governance can become a major source of implementation failure in complex policy environments. Limited knowledge sharing, unclear learning mechanisms, and weak institutional trust can constrain collective learning and reinforce coordination problems among actors (Foster et al., 2024; Zhang et al., 2024; Jia et al., 2025). In Indonesia's bioethanol industry, such limitations are reflected in restricted data sharing, fragmented policy learning processes, and the absence of institutional mechanisms integrating knowledge across sectors.

Conceptual Framework Synthesis

Based on the literature, the bioethanol industry can be conceptualized as a governance ecosystem in which policy fragmentation forms the structural condition shaping actor interactions (Fleckenstein, 2024; Cairney, 2025). Fragmentation contributes to coordination failure among actors through misaligned expectations, policy uncertainty, and inconsistent investment signals (Zyzak & Farsund, 2025; Krystallis et al., 2025). These dynamics are further reinforced by weak knowledge governance, which constrains institutional learning and system adaptation (Foss et al., 2010; Zhang et al., 2024). Accordingly, knowledge governance functions as a key explanatory mechanism for how policy fragmentation and coordination failure persist over time within the bioethanol governance system.

Governance Lessons from Australia's Renewable Energy Transition

Research on Australia's renewable energy transition highlights the importance of governance capacity in coordinating policies across sectors and government levels. Weak integration between research support, market formation, and industrial development can undermine policy legitimacy and slow the development of bioenergy industries (Cox et al., 2021; Kallies, 2021). Policy discontinuities and fragmented institutional responsibilities have also been shown to generate coordination challenges in the energy transition (Flottmann, 2024). Effective renewable energy governance also depends on policy coherence and institutional reform shaped by power relations within governance systems (Dzebo et al., 2025).

At the same time, effective renewable energy governance requires policy coherence, public legitimacy, and institutional learning mechanisms capable of addressing long-term uncertainty (Churton & McCabe, 2024; Riedy, 2025). Studies further demonstrate that public

engagement and social legitimacy play important roles in supporting energy transition policies (Zander et al., 2024; Cotton et al., 2025). These experiences provide conceptual insights for designing governance mechanisms that may help reduce policy fragmentation and coordination uncertainty in Indonesia's bioethanol industry.

However, although research on renewable energy governance and policy fragmentation has expanded significantly, limited attention has been given to how fragmented governance environments influence managerial decision-making and investment behavior within bioenergy industries. Existing studies tend to focus on policy instruments, technological feasibility, or economic incentives separately, while the governance and coordination dynamics shaping industry responses remain insufficiently explored (Siddika et al., 2025; Dehghani & Shafiyi, 2025).

In Indonesia, research on bioethanol development has mainly focused on feedstock availability, production technology, and economic incentives. However, cross-country evidence shows that renewable energy development is strongly influenced by policy consistency, institutional coordination, and coherent policy mix design (Rastegar et al., 2024; Rajanikant et al., 2025). The managerial implications of fragmented governance—particularly how coordination uncertainty shapes risk perception, investment decisions, and business strategies—remain underexplored in the Indonesian bioethanol literature. While previous studies have examined policy fragmentation, renewable energy governance, and coordination challenges, limited attention has been given to how fragmented governance environments influence managerial decision-making and business behavior. Existing governance research primarily focuses on institutional arrangements and policy design, while the behavioral consequences of coordination failure for industry actors remain underexplored. Consequently, the theoretical relationship between governance fragmentation, coordination uncertainty, and managerial responses has not been adequately conceptualized within the renewable energy governance literature. Accordingly, this study develops a knowledge-based governance framework to analyze how policy fragmentation and coordination uncertainty influence managerial decision-making and business certainty in Indonesia's molasses-based fuel-grade bioethanol industry.

METHOD

This study adopts an exploratory qualitative approach to examine governance dynamics, policy fragmentation, and coordination mechanisms in Indonesia's molasses-based fuel-grade bioethanol industry. A qualitative design is appropriate because the research focuses on institutional processes and actor interactions that cannot be adequately captured through quantitative measurement (Radtke & Renn, 2024; Kaze et al., 2025).

The analysis employs grounded theory as the primary analytical strategy to generate conceptually grounded insights derived from empirical data through an iterative coding process (Corbin & Strauss, 2015). Grounded theory enables the study to identify patterns and relationships among governance structures, coordination dynamics, and knowledge integration mechanisms that shape the development of the bioethanol industry.

Data were collected through semi-structured interviews with nine purposively selected informants representing three stakeholder groups in bioethanol governance: industry actors, policymakers, and renewable energy researchers. Three industry informants were managerial-level practitioners from different bioethanol companies each with more than ten years of relevant experience. Three policymakers represented the Ministry of Energy and Mineral Resources, the Ministry of Industry, and the Coordinating Ministry for Economic Affairs. In addition, three renewable energy researchers from Australia provided comparative perspectives

on policy integration and knowledge governance. The number of informants was sufficient to capture diverse perspectives and reach theoretical saturation (Corbin & Strauss, 2015).

Data collection continued until theoretical saturation was achieved, where no substantially new themes, categories, or relationships emerged from subsequent interviews. Saturation became evident after the seventh interview and was confirmed through the final two interviews, which largely reinforced previously identified patterns.

Interviews were conducted individually using an interview guide designed to explore governance experiences, policy perceptions, and coordination dynamics among actors. All interviews were recorded and transcribed for analytical purposes. Data analysis was conducted iteratively by combining thematic analysis with grounded theory coding procedures. Thematic analysis was used to identify patterns and key issues emerging from the interview data. Subsequently, open coding, axial coding, and selective coding were applied to develop analytical categories, examine relationships among categories, and integrate them into a coherent conceptual explanation. Through this process, knowledge governance emerged as the core category explaining the persistence of policy fragmentation and coordination uncertainty in the bioethanol industry.

Research validity was strengthened through source triangulation across industry actors, policymakers, and academic experts, as well as systematic documentation of the analytical process. Interpretive validity was enhanced through iterative comparison of coding results across informant groups and continuous refinement of emerging categories during the coding process. The study followed qualitative research ethics principles, including informed consent and the protection of participants' confidentiality.

RESULTS AND DISCUSSION

This section presents the results of the grounded theory analysis organized around the four research questions.

RQ1: Policy Fragmentation and the Formation of Bioethanol Governance Patterns in Indonesia

The qualitative analysis shows that policy fragmentation in Indonesia's fuel-grade bioethanol industry manifests as multi-layered policy failure, producing fragmented governance patterns and weak coordination. Selective coding identified three interrelated categories: policy integration failure, policy orchestration failure, and policy enforceability failure.

Table 1. Grounded Theory Coding Summary for RQ1

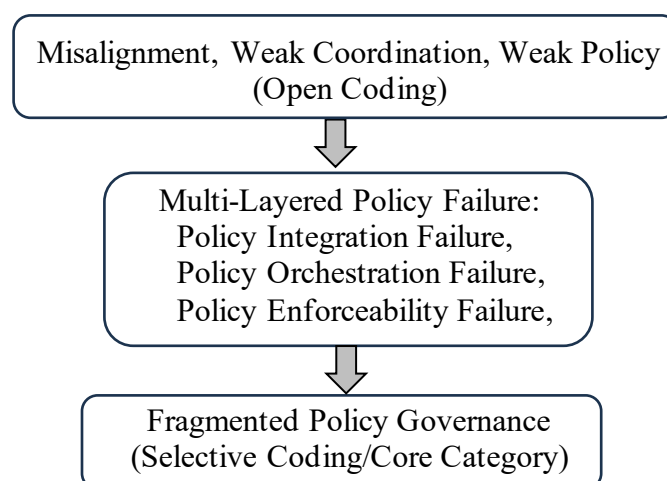
Empirical (In Vivo) Narrative	Open Coding	Axial Coding	Selective Coding
"Policies operate independently across ministries."	Policy misalignment	Policy Integration Failure	Fragmented Policy Governance
"No actor truly orchestrates the value chain from upstream to downstream."	Weak central coordination	Policy Orchestration Failure	Fragmented Policy Governance
"The regulations exist, but they are neither binding nor implemented."	Weak policy enforceability	Policy Enforceability Failure	Fragmented Policy Governance

First, policy integration failure is reflected in the lack of policy synchronization across ministries, causing energy, industrial, trade, and fiscal policies to operate in sectoral silos. The absence of an integrated policy framework results in regulations that are not operationally connected to industrial capacity, market readiness, or feedstock dynamics. Rather than

functioning as a coherent governance architecture, policies operate as a collection of stand-alone instruments.

Second, policy orchestration failure stems from the government's weak role as a policy orchestrator. The state has not effectively coordinated offtake arrangements, market formation mechanisms, pricing instruments, or upstream–downstream integration. Consequently, the fuel-grade bioethanol market fails to develop autonomously and remains dependent on ad hoc interventions, lacking medium- and long-term policy certainty.

Figure 1. Fragmented Policy Governance Model in Indonesia's Bioethanol Industry



Third, policy enforceability failure is characterized by weak enforcement capacity, unclear sanctions, and inconsistent policy direction. Regulations exist in name but lack binding force, leading to low compliance and ineffective implementation. This condition reinforces industry perceptions that policy frameworks do not provide business certainty and may even be counterproductive.

Fragmented policy governance emerges when policies fail to function effectively as binding, steering, and coordinating mechanisms for actor behavior within the bioethanol ecosystem. The findings for RQ1 indicate that this condition is not merely a problem of regulatory design but represents a structural and relational governance issue in Indonesia's bioethanol industry. Fragmentation operates through mutually reinforcing failures of policy integration, actor orchestration, and policy enforceability (Bessa & Gouveia, 2023), ultimately generating systemic coordination dysfunction.

Consistent with the literature on policy fragmentation and coordination failure, these findings confirm that public policies that are neither integrated nor orchestrated cannot align actors' expectations and actions (Zepa & Hoffmann, 2023). In the bioethanol context, this layered policy failure leads to market stagnation despite the availability of production capacity and feedstock potential. These governance failures also shape managerial expectations and investment behavior, reinforcing cautious investment strategies and delaying market development. Accordingly, RQ1 shows that fragmented policy governance in Indonesia's bioethanol industry stems from structural failures of policy integration, orchestration, and enforceability, which collectively weaken coordination and industrial sustainability.

RQ2: Inter-Actor Coordination and Managerial Decision-Making

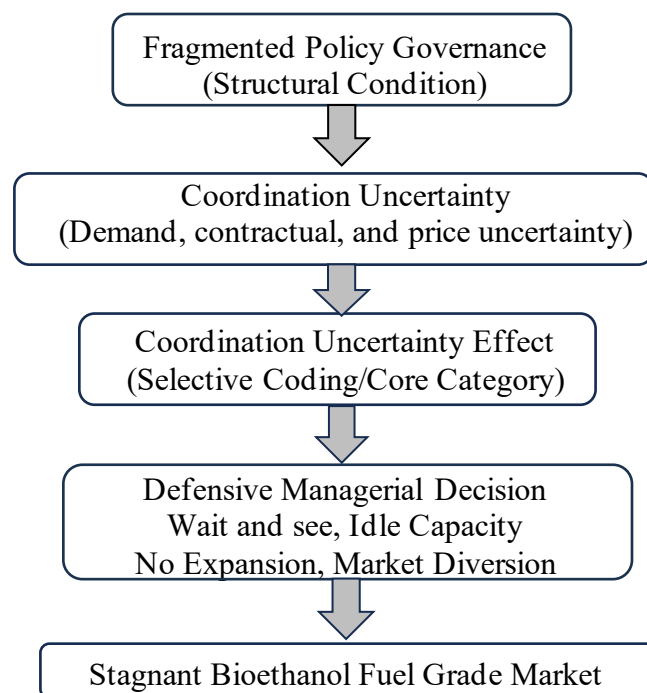
The analysis showed that fragmented governance and weak inter-actor coordination create coordination uncertainty that shapes managerial decisions of bioethanol producers.

Through selective coding, the study identifies the Coordination Uncertainty Effect as a core category that explains the link between fragmented governance and managerial behavior.

Table 2. Summary of the Grounded Theory Coding Process for Coordination Dynamics and Managerial Decision-Making (RQ2)

Empirical (In Vivo) Narrative	Open Coding	Axial Coding	Selective Coding
"We never know for sure when and how much volume will be absorbed."	Demand uncertainty	Uncertain Market Signal	Coordination Uncertainty Effect
"Without medium-term contracts, we do not dare to expand."	Lack of contractual certainty	Contractual Uncertainty	Coordination Uncertainty Effect
"It is safer to hold back production than to incur losses due to policy changes."	Defensive strategy	Defensive Managerial Response	Coordination Uncertainty Effect
"Capacity exists but is not activated."	Idle capacity	Investment Underutilization	Coordination Uncertainty Effect
"Fuel-grade ethanol is too risky; we shift to non-fuel markets."	Market diversion	Risk Avoidance Strategy	Coordination Uncertainty Effect

Figure 2. Coordination Uncertainty Effect Model in the Managerial Decision-Making of Bioethanol Producers



Unclear demand signals, the absence of contractual certainty, and the lack of coordinated market mechanisms prompt producers to adopt defensive decision-making. Dominant responses include wait-and-see strategies, postponement of capacity expansion, non-activation of existing production capacity, and diversion toward non-fuel-grade markets. Rather than reflecting stable market calculations, these decisions aim to minimize risk under coordination uncertainty, resulting in idle investments, underutilized production capacity, and weak long-term business certainty.

The findings for RQ2 underscore that coordination failure is not merely a macro-level institutional issue, but one that directly affects managerial rationality at the micro level. Under conditions of policy and coordination uncertainty, producers behave rationally by delaying decisions and avoiding risk, even when economic opportunities are available.

These findings are also consistent with the strategic management literature, which indicates that persistent policy and market uncertainty can alter managerial risk perceptions, discourage long-term investment commitments, and encourage defensive strategic behavior aimed at preserving organizational flexibility (Xu et al., 2025; Nyiwul et al., 2025).

These results are consistent with the coordination failure literature, which suggests that policy uncertainty weakens market signals and induces defensive behavior among actors (Nyiwul et al., 2025). In the context of Indonesia's bioethanol industry, weak coordination causes managerial decisions to be shaped not by coordinated market expectations, but by heightened perceptions of policy risk (Wirawan et al., 2025).

Accordingly, RQ2 demonstrates that inter-actor coordination uncertainty undermines business certainty and destabilizes managerial decision-making, preventing the fuel-grade bioethanol market from developing autonomously. The Coordination Uncertainty Effect category emerged through axial and selective coding processes, integrating producers' narratives on policy uncertainty and managerial responses.

This finding was reflected in the experiences of industry actors. As one producer explained, "When the market does not exist, and there is no certainty, it becomes difficult." This observation highlights how persistent uncertainty regarding market demand and policy implementation discourages investment expansion and reinforces cautious managerial responses within the bioethanol industry.

Although all informant groups acknowledged the existence of coordination challenges and policy fragmentation in Indonesia's bioethanol industry, they differed in the issues they emphasized. Industry informants primarily highlighted demand uncertainty, feedstock availability, investment risk, and business viability. In contrast, government informants focused on regulatory harmonization and inter-ministerial coordination, while academic informants emphasized governance integration, long-term policy consistency, and cross-sectoral knowledge coordination.

RQ3: Policymakers' Perspectives on Fragmentation and Coordination

The analysis for RQ3 indicates that policymakers interpret bioethanol policy fragmentation not as a lack of regulation but as a challenge of policy implementation and cross-ministerial coordination. Although formal regulations exist, policy execution remains sectoral and insufficiently orchestrated. Fragmentation is attributed to overlapping mandates among actors, the dual structure of coordinating ministries, and reliance on sector-specific legal authority. Consequently, coordination occurs through negotiation and caution rather than integrated orchestration, resulting in incremental implementation through non-PSO (Public Service Obligation) schemes and pilot projects rather than comprehensive policy integration.

This interpretation was reflected in policymakers' observations regarding the complexity of institutional coordination. One policymaker noted that "there are currently two coordinating ministries involved, and these coordinating ministries themselves need to be synchronized first." Another policymaker emphasized that "there are many challenges because multiple ministries are involved, each with its own interests, making collaboration a continuous challenge." These perspectives suggest that policymakers perceive fragmentation primarily as a coordination and alignment issue among institutions rather than as a lack of policy instruments.

The findings for RQ3 reveal a cognitive gap between policy design and industry experience (Ha & Kumar, 2021). From the policymakers' perspective, fragmentation is viewed as a manageable transitional phase. However, this gradual and defensive approach inadvertently reproduces coordination uncertainty and delays policy integration.

These results confirm that policy fragmentation is self-reinforcing, sustained by institutional structures and bureaucratic logics that prioritize sectoral authority. Accordingly, RQ3 demonstrates that bioethanol policy fragmentation is reproduced by structurally embedded cross-ministerial coordination uncertainty, even in the presence of formal regulatory frameworks.

RQ4: Lessons from Australia's Renewable Energy Governance

The analysis of renewable energy governance practices in Australia reveals institutional mechanisms that help reduce policy fragmentation and coordination uncertainty. The key mechanisms identified include clear federal–state role delineation, cross-ministerial coordination from the policy formulation stage, institutionalized public consultation, mandatory knowledge-sharing arrangements, and risk-sharing schemes between government and investors.

This governance approach was reflected in the observations of Australian informants. One researcher noted that "coordination occurs across ministries from the policy formulation stage, ensuring that policy decisions are not owned by a single ministry but developed collectively across sectors." This arrangement reduces fragmentation by aligning policy objectives, institutional responsibilities, and stakeholder expectations before implementation. The finding highlights the importance of orchestrated coordination as a mechanism for reducing uncertainty and supporting long-term renewable energy development.

Australia is used as a conceptual reference rather than a direct quantitative comparator. The findings of RQ4 generate governance design principles—namely orchestrated coordination, institutionalized learning, and knowledge-based governance—that can be translated into the Indonesian context.

The results of RQ4 further confirm that effective governance is not determined by policy centralization, but by the quality of orchestration and role clarity (Zepa & Hoffmann, 2023). In the Indonesian context, lessons from Australia are therefore relevant as institutional design principles to strengthen cross-sector coordination, reduce business uncertainty, and support the sustainable development of the bioethanol industry.

Synthesis of Findings Across Research Questions

Overall, the findings reveal a governance mechanism in which policy fragmentation generates coordination uncertainty that shapes managerial decision-making and contributes to stagnation in the fuel-grade bioethanol market. Fragmented governance weakens policy integration, orchestration, and enforceability, creating uncertain signals for industry actors and encouraging defensive managerial responses. Policymakers often interpret fragmentation as an implementation challenge rather than a structural governance issue, which inadvertently reproduces coordination uncertainty. Insights from Australia suggest that addressing these challenges requires stronger cross-actor orchestration, clearer institutional roles, and institutionalized policy learning and knowledge-sharing mechanisms.

CONCLUSION

This study shows that stagnation in Indonesia's fuel-grade bioethanol industry stems primarily from structural governance problems rather than technical or economic constraints.

Policy fragmentation generates failures of integration, orchestration, and enforceability that weaken coordination across actors. At the industry level, this condition translates into coordination uncertainty, leading producers to adopt defensive strategies such as postponing capacity expansion, diverting to alternative markets, and leaving installed production capacity inactive.

The findings identify coordination uncertainty as the key mechanism linking fragmented governance to market stagnation. Weak knowledge governance reinforces fragmentation through limited cross-ministerial learning and information sharing. By reconceptualizing policy fragmentation as multi-layered governance failure and identifying coordination uncertainty as a driver of managerial behavior, this study contributes to governance and renewable energy management literature. From a theoretical perspective, this study extends governance theory by demonstrating how policy fragmentation operates not only as a structural condition but also as a mechanism shaping managerial behavior through coordination uncertainty. The findings also contribute to coordination failure theory by showing that persistent uncertainty can emerge from fragmented governance arrangements, influencing investment decisions and organizational responses even in the presence of formal policy frameworks.

Insights from Australia suggest that strengthening the bioethanol industry requires clearer institutional roles, enforceable cross-ministerial orchestration, medium-term contractual certainty, and institutionalized policy learning to reduce coordination uncertainty and enhance business certainty. For strategic management, the findings suggest that long-term investment decisions in renewable energy industries depend not only on economic incentives but also on governance arrangements that reduce uncertainty and improve business certainty. For sustainability governance, the study highlights the importance of coordinated institutional mechanisms capable of aligning policy objectives, market expectations, and knowledge-sharing processes across sectors. Future research could examine how improved governance and coordination mechanisms can reduce policy uncertainty in emerging renewable energy industries.

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