

## การวิเคราะห์ช่องว่างเชิงสถาบันในการประยุกต์ใช้กลไกการเงินแบบผสมผสาน เพื่อส่งเสริมการลงทุนของภาคเอกชนในโครงการโรงไฟฟ้าชีวมวลในประเทศไทย

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### บทคัดย่อ

การศึกษานี้มุ่งวิเคราะห์ปัจจัยเชิงสถาบันที่เกี่ยวข้องกับการใช้กลไกการเงินแบบผสมผสาน เพื่อส่งเสริมการลงทุนของภาคเอกชนในโครงการโรงไฟฟ้าชีวมวลชุมชนในประเทศไทย โดยมีวัตถุประสงค์เพื่อระบุปัจจัยเชิงสถาบันที่เป็นตัวสนับสนุนและช่องว่างเชิงสถาบันที่ส่งผลกระทบต่อความพร้อมของประเทศไทยในการนำกลไกการเงินแบบผสมผสานมาใช้ โดยใช้กรอบการวิเคราะห์และการพัฒนาสถาบันเป็นแนวทางในการศึกษา งานวิจัยนี้ใช้ระเบียบวิธีเชิงคุณภาพ โดยอาศัยข้อมูลทฤษฎีภูมิและการสัมภาษณ์เชิงลึกกับผู้ให้ข้อมูลหลักจำนวน 13 ราย จากหน่วยงานภาครัฐ ผู้ประกอบการภาคเอกชน และองค์กรระหว่างประเทศ ผลการวิจัยพบว่า ประเทศไทยมีระบบสถาบันพื้นฐานที่สนับสนุนการลงทุนในภาคพลังงานชีวมวลในระดับหนึ่งผ่านเครื่องมือสำคัญ เช่น อัตราการรับซื้อไฟฟ้าแบบ Feed-in Tariff (FiT) การร่วมลงทุนระหว่างภาครัฐและเอกชน และ สิทธิประโยชน์จากคณะกรรมการส่งเสริมการลงทุน ซึ่งช่วยสร้างเสถียรภาพด้านนโยบายและความเชื่อมั่นของนักลงทุน รวมถึงการมีหน่วยงาน แนวนโยบายและกฎหมาย อย่างไรก็ตาม การศึกษายังพบว่ามีช่องว่างเชิงสถาบันหลายประการที่เป็นอุปสรรคต่อการนำกลไกการเงินผสมผสานมาใช้ในเชิงระบบ ได้แก่ ช่องว่างด้านองค์ความรู้ นโยบายที่สนับสนุน ข้อจำกัดของเครื่องมือทางการเงินเพื่อลดความเสี่ยง และการขาดผู้มีส่วนเกี่ยวข้อง การวิจัยชี้ให้เห็นว่า หากประเทศไทยต้องการขยายศักยภาพของกลไกการเงินผสมผสานและดึงดูดการลงทุนจากภาคเอกชนในโครงการโรงไฟฟ้าชีวมวลชุมชน ประเทศไทยควรเน้นการเสริมสร้าง กลไกการประสานงานระหว่างสถาบัน การพัฒนาเครื่องมือทางการเงินเชิงนวัตกรรม การปรับให้เกิดความสอดคล้องทางนโยบายและ การเสริมสร้างศักยภาพของผู้มีส่วนเกี่ยวข้อง เพื่อสนับสนุนการเปลี่ยนผ่านของประเทศไทยไปสู่ระบบพลังงานที่มีคาร์บอนต่ำและครอบคลุมอย่างยั่งยืน

**คำสำคัญ:** กลไกการเงินแบบผสมผสาน / การเงินเพื่อการเปลี่ยนแปลงสภาพภูมิอากาศ / โครงการโรงไฟฟ้าชีวมวลชุมชนในประเทศไทย / การลงทุนของภาคเอกชน / กรอบการวิเคราะห์และการพัฒนาสถาบัน

## Unlocking blended finance to mobilize private sector investment in biomass power plant projects: An analysis of institutional gaps in Thailand

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### Abstract

This study investigates institutional factors in the adoption of blended finance as a mechanism to promote private sector investment in community biomass power plant projects in Thailand. The research aims to identify institutional enablers and gaps that affect Thailand's readiness to implement blended finance mechanisms, guided by the Institutional Analysis and Development (IAD) framework. The research employed a qualitative approach, drawing on secondary data and semi-structured in-depth interviews with 13 key stakeholders from government agencies, private developers, and international organizations.

The findings reveal that Thailand has established a foundational institutional system supporting biomass power sector investment through the presence of responsible agencies, policy orientations, and legal frameworks, as well as instruments such as the Feed-in Tariff (FiT), Public-Private Partnership (PPP) framework, and Board of Investment (BOI) incentives, which contribute to policy stability and investor confidence. However, the study also identifies several institutional gaps that hinder the systematic adoption of blended finance. These include knowledge gaps, support policy, limited de-risking financial instruments, and the absence of actors and a central coordination platform to integrate financial, regulatory, and policy efforts across agencies. The research highlights that to scale up blended finance and attract greater private investment in community biomass power, Thailand must strengthen institutional coordination, enhance financial innovation, policy alignment, and capacity building. The findings are expected to inform policy-related recommendations that bridge institutional, regulatory, and financial gaps and contribute to Thailand's transition toward a low-carbon and inclusive energy system.

**Keywords:** Blended Finance Mechanism/ Climate Finance/ Community Biomass Power Projects in Thailand/ Private Sector Investment/ Institutional Analysis and Development (IAD) Framework

## 1. Introduction

To achieve Thailand's renewable energy goals, an estimated THB 779 billion (USD 22 billion) is needed [1]. However, raising sufficient investment to meet the demand is particularly challenging. Therefore, promoting investment in renewable energy must be done effectively to enhance private-sector participation in financing and reduce investment risks, especially for small-scale community-based projects [2]. Various studies have proposed that the blended finance mechanism represents a high-potential tool for bridging financing gaps in green investment. The goal of blended finance is to mobilize or leverage development finance from other actors to green activities or projects that are risky and less attractive to the private sector [3]. Despite the potential of blended finance, the application of blended finance in Asia, including Thailand, remains limited. A blended finance mechanism has not been widely adopted in Thailand. To fully reach the potential that blended finance offers, it requires institutional components that vary depending on the specific context [4]. Among various renewable energy options in Thailand, community biomass power plant projects represent a particularly relevant case for examining the institutional conditions for blended finance adoption. As such, this research aims to address these gaps by applying the Institutional Analysis and Development (IAD) framework developed by Elinor Ostrom, using community biomass power plant projects as an initial case to examine the institutional dynamics and stakeholder interactions influencing the adoption of blended finance in Thailand.

## 2. Objectives

The purpose of this research is to study the blended finance mechanism supporting community biomass power plant projects in Thailand. Three specific objectives are as follows:

1. To examine the current institutional factors, such as policy, regulatory, and financial instruments that support the community biomass power plant projects' investment and blended finance mechanism in Thailand.
2. To analyze and identify the institutional gaps in Thailand for implementing a blended finance mechanism that promotes private sector investment in community biomass power plant projects.
3. To provide policy-relevant recommendations to support the implementation of blended finance in community biomass power plant projects.

## 3. Conceptual Framework

The Institutional Analysis and Development (IAD) framework is a conceptual framework with strengths in helping to understand complex problems involving institutional rules, multiple stakeholders, and governance processes [5]. To apply such a framework, there are four core components in IAD: exogenous variables, action arena, patterns of interaction, and outcomes (see Figure 1). For Elinor Ostrom (1999), an institution is defined as a form of law, rule, policy, or strategy that creates the incentive of behavior and the interaction between actors. Institutions can be both formal, such as law and policy, or they may emerge informally as norms, standard operating practices, or habits. Evidence across the energy, waste, and natural resource sectors

demonstrates that IAD helps identify both enabling conditions and institutional barriers affecting policy performance and private sector participation.

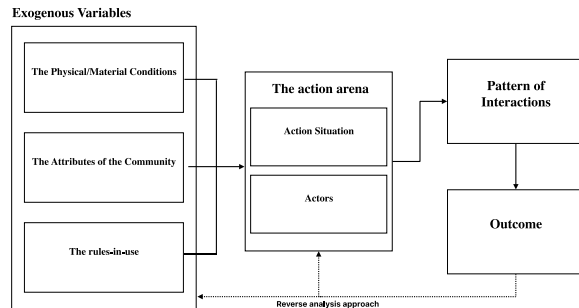


Figure 1. The institutional analysis and development framework [6]

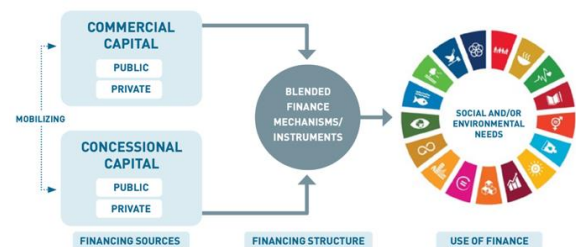


Figure 2. Blended finance mechanism [7]

In this research, blended finance refers to the practice of strategic development finance of mobilizing additional private finance for investment by combining public, development, or philanthropic capital with private funds for supporting social and environmental projects that are considered high risks and unviable for investment (see Figure 2). In simple terms, blended finance refers to the use of both concessional and commercial capital in a single investment structure [8]. The institutional analysis framework helps the researcher identify the misalignments and gaps between formal structures (regulations) and informal practices (norms and beliefs) that may hinder effective outcomes. Therefore, the application of the IAD framework in this research is highly appropriate.

#### 4. Methodology

The study employs a qualitative approach to identify the institutional gaps, using data collected from in-depth interviews and desk research. One key component of the IAD framework is the action arena, which comprises actors and the actions needed to achieve the outcome. Stakeholder analysis is an important step to take in order to understand the action arena component. Based on the literature review, three sectors are mentioned as key actors: 1. Public Sector and Government Agencies: Government actors provide the regulatory and policy foundation essential for enabling blended finance. 2. Private Sector: The private sector is central to the success of blended finance. Interviews focus on renewable energy firms, investors, and industry associations to reflect market needs and investment readiness. 3. International Development Institutions: International organizations contribute global experience, technical support, and best practices. To identify suitable interviewees, this research conducted a stakeholder influence-interest matrix analysis and consulted with experts in the area of renewable energy policy, finance, or related fields, to develop a potential interviewees list. Only high and medium levels of organizations will be interviewed in this study.

Interview questions were developed to address the research objectives. Participants were asked both general and sector-specific questions tailored to their roles. Guided by the IAD Framework (see Figure 3). For

data analysis, primary interview data were analyzed using Framework Analysis. The analysis applied a deductive coding scheme based on the four IAD components (see Figure 4)—exogenous variables, action arena, patterns of interaction, and outcomes—combined with descriptive coding to summarize key ideas and capture emerging concepts [9]. All transcripts were transcribed verbatim, anonymized, and systematically coded in an Excel-based matrix. Secondary data from academic literature, policy documents, and case studies were analyzed using deductive content analysis following [10]. The analysis involved selecting key statements related to institutional factors, policies, enablers, barriers, and financial mechanisms relevant to blended finance, then categorizing them under the same IAD components used for primary data. The synthesized findings were subsequently integrated with interview results to provide contextual background and complementary insights.

Participants Sector	Example of Interview Questions
Public Sector	<ol style="list-style-type: none"> <li>1. In your opinion, are there any policies and national plans that specific include the use of blended finance for community-based biomass power plant projects?</li> <li>2. In your view, are there any laws or mechanisms in Thailand that allow funding from public sources, private investors, and international development organizations to be combined within a single project?</li> <li>3. In your view, are there any existing laws, policies, or mechanisms in Thailand that allow the government or international development organizations to use public funds or development finance to help reduce investment risks for the private sector in community biomass power plant projects?</li> </ol>
Private Sector	<ol style="list-style-type: none"> <li>1. Based on your experience, what factors are the greatest obstacles to private sector to investment in community biomass energy projects?</li> <li>2. Based on your experience, have you been involved in any projects where funding was mobilized from multiple sectors within a single project?</li> <li>3. In your opinion, how ready is Thailand currently in the following aspects to implement blended finance mechanisms to attract private sector investment in high-risk projects such as community biomass power plants?</li> </ol>
International Development Institution	<ol style="list-style-type: none"> <li>1. Based on your experience, are international development organizations currently able to participate in co-investment or support for energy projects such as community biomass power plants in Thailand?</li> <li>2. In your opinion, how effective and appropriate of Thailand's existing financial support mechanisms such as concessional loans, capital subsidies, or tax incentives in attract private investment and reduce risks for community-scale projects like biomass power plants?</li> <li>3. From your perspective, if Thailand aims to effectively use blended finance mechanisms to promote private sector investment in community biomass power plant projects, which institutional issues do you think require the most development?</li> </ol>

Figure 3. Example of in-depth interview questions

Participant's ID	Transcript	IAD	Research Question	Descriptive code
G1	"The electricity business in Thailand has become a liberalized market that can continue without additional support, and blended finance might not be necessary for community biomass projects."	Attributes of community	RQ2	Commercialization of the energy sector Blended finance not suitable for community biomass
G2	Currently, there are end-point incentive mechanisms that do not rely on direct subsidies or financial grants, such as the Feed-in Tariff (FIT) scheme, which guarantees a fixed electricity price to encourage renewable energy investment.	Rule-in-use	RQ1	Revenue Support FIT
G8	Thailand currently lacks a central coordinating body or core agency responsible for designing and facilitating blended financial mechanisms. There is still uncertainty regarding which organization should take this role.	Actor	RQ2	Absence of a central coordinating and design agency

Figure 4. Example of the coding table

## 5. Results and Discussion

### Participants Profile

In this study, 13 participants were interviewed. In total, 9 participants are from the public sector, representing policymakers and planners, regulators, state enterprises, and investment promotion—two participants from the private sector, representing to both renewable energy developers and private sector associations. Two participants are financing and energy experts from an international development institution. To ensure confidentiality, the participant's name and organization will be coded into ID: G1-G9, P1-P2, and I1 and I2, following stakeholder groups (see Table 1). These codes are consistently used throughout the findings and analysis.

Table 1. The table of participant's profile

ID	Roles/ Position	Organization Function
G1	Director of Division	Renewable energy policy, implementation, promotion, and technology research.
G2	Head of Division	Power plant planning and feasibility under PDP.
G3	Director of Division	Licensing and regulation of renewable energy projects.
G4	Senior Officer	Overseeing public-private joint investment projects and state enterprise investment.
G5	Senior Officer	Oversees electricity procurement and electricity system based on energy related policies.
G6	Director of Division	Regulates and supervises capital market fundraising to ensure compliance, transparency, and investor protection.
G7	Director of Division	Formulates energy policies and plans to ensure secure and sustainable energy supply, providing strategic guidelines for private sector implementation.
G8	Director of Division	Promotes and develops renewable energy policies by supporting projects and encouraging private sector participation in clean energy initiatives.
G9	Director of Division	Promotes private sector investment through tax and non-tax incentives to encourage investment and facilitate business operations.
P1	Chairperson	Renewable energy private sector group and policy advocacy
P2	Committee	An industry association representing private power producers that supports policies and promotes sustainable development of the power sector.
I1	Expert	Climate Finance and Renewable energy Expert
I2	Financial Expert	Climate Finance and Blended finance experts

**Data Analysis for Research Question 1:** This section addresses RQ1 by analyzing stakeholder perspectives and literature through the Institutional Analysis and Development (IAD) framework, focusing on three dimensions: Attributes of the Community, Rules-in-Use, and the Action Arena (see Figure 5).

- Attributes of the Community (Exogenous Variables):** Thailand's private sector demonstrates motivation to invest in community biomass power plant projects due to established market structures, feedstock availability, and commercial feasibility. Stakeholders expressed confidence in renewable energy investment, driven by global ESG trends, sustainability goals, and the opportunity to enhance corporate reputation and competitiveness. Interviewees (G3, G4) emphasized that the private sector is "adequately prepared," particularly for biomass projects that utilize existing agricultural resources. Private stakeholders also viewed blended finance as a promising mechanism for addressing financial constraints and de-risking investments, especially for SMEs. From the government's perspective, Thailand acknowledges the need to support private sector investment in renewable energy. The readiness to support community biomass power plants appears in three areas: policy, with targets for biomass energy in the AEDP and PDP, financial

instruments, and institutional arrangements, involving agencies such as EPPO, DEDE, EGAT, and ERC, responsible for policy formulation, licensing, supervision, and monitoring.

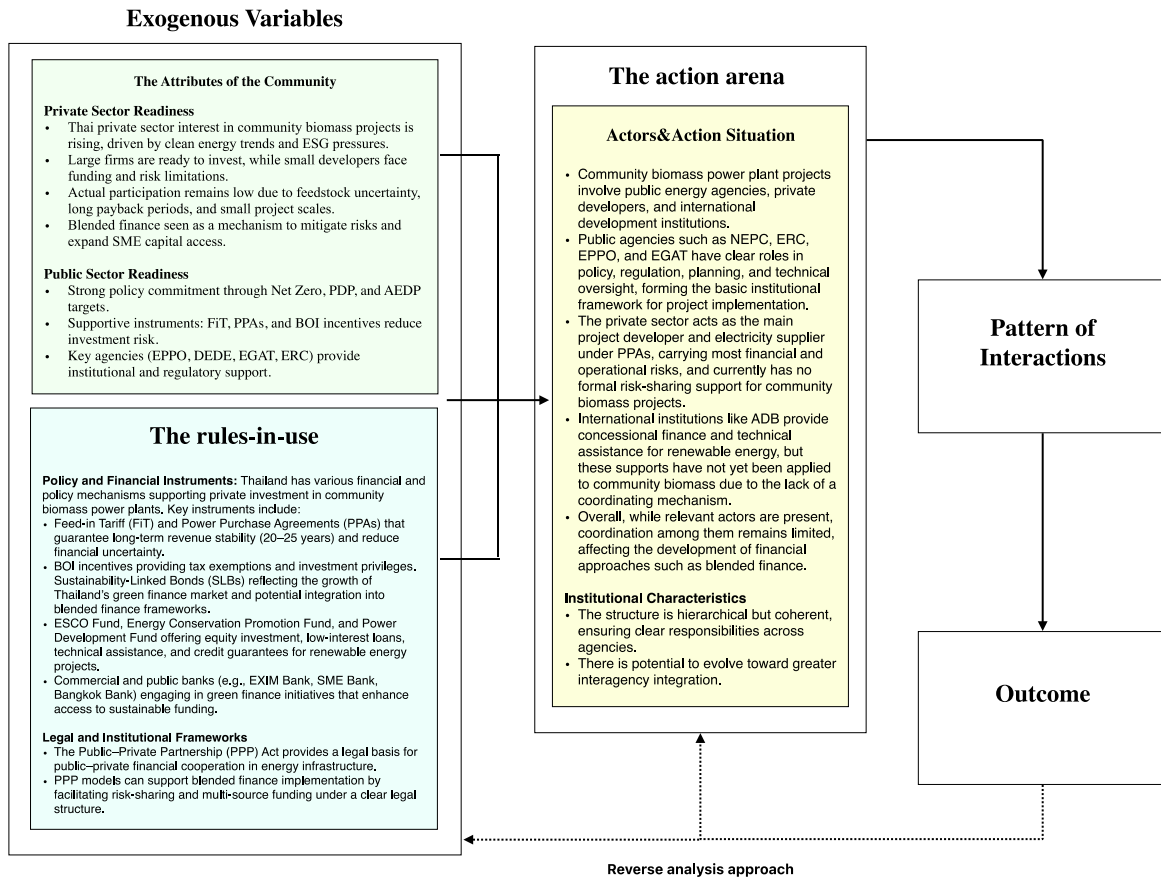


Figure 5. Integrated analysis of the Institutional enabler to adopt the blended finance mechanism

- **Rules-in-Use (Exogenous Variables):** Thailand’s renewable energy policy framework provides essential financial and regulatory support through instruments such as the Feed-in Tariff (FIT) and Power Purchase Agreements (PPAs), both of which enhance investor confidence by guaranteeing stable revenue streams. As interviewee G5 noted, “The FIT has made Thailand's renewable energy market more commercial and encouraged greater private sector participation.” Additional support mechanisms include BOI tax incentives, exemptions on machinery imports, and low-interest loans from state energy funds (G1, G9). While these tools are implemented on a project-by-project basis rather than through an integrated system, they form a foundational structure for future blended finance applications. The Public-Private Partnership Act (2019) also provides a legal foundation for cooperation between public and private sectors, potentially adaptable to small-scale community energy projects.
- **Action Arena:** The Thai energy governance structure involves multiple agencies—NEPC, ERC, EPPO, and EGAT—responsible for policymaking, regulation, and system operations. Interviewees described the sector as “systematic and well-regulated” (G4), yet coordination remains vertical and fragmented. The private

sector continues to serve as the principal investor and risk-bearer under the PPA framework, while international financial institutions such as the Asian Development Bank (ADB) contribute concessional loans and technical support but lack integration at the community level.

**Integrated Analysis:** Thailand exhibits emerging institutional readiness for blended finance, supported by motivated private actors, established financial mechanisms, and clear regulatory structures. However, limited cross-sectoral coordination and fragmented implementation constrain the full operationalization of blended finance for community biomass power plant projects.

**Data Analysis for Research Question 2:** This section addresses RQ2 by analyzing stakeholder perspectives through the Institutional Analysis and Development (IAD) framework. The findings reveal how institutional gaps within Thailand's energy and financial systems hinder the adoption of blended finance for community biomass power plant projects (see Figure 6).

- **Physical Conditions (Exogenous Variables):** Community biomass power projects in Thailand face structural challenges rooted in small project sizes, unstable feedstock supply, and high investment costs. Interviewees (G1–G3) noted that plants under 3 MW are exempt from heavy regulation but “cannot achieve real economies of scale.” Feedstock availability was consistently cited as the greatest risk, as “no guarantee the fuel will last through the loan period,” while transportation costs account for 40–60 percent of total expenses (G1, G4, G5, P1). Several respondents (G5, G7) also emphasized high capital requirements—averaging 40–70 million THB per MW—which result in long payback periods and low investor confidence. These conditions limit project bankability and the capacity to attract financing, particularly from commercial banks.
- **Attributes of the Community (Exogenous Variables):** Significant gaps in knowledge and perception of blended finance exist across both public and private stakeholders. Many interviewees admitted limited understanding, with some stating that it was “the first-time hearing about blended finance” (G3, P2) or misinterpreting it as a government subsidy (G6, G8). This lack of understanding contributes to the perception that such a mechanism is unnecessary. Officials often believe existing schemes—especially the FiT—are sufficient, arguing that “electricity projects are commercial and do not need special financial support” (G1, G5). While international experts (I1) recognized the potential of blended finance for small developers, domestic stakeholders viewed it as incompatible with Thailand's current market context.
- **Rules-in-Use (Exogenous Variables):** The findings reveal three interconnected institutional gaps that hinder the adoption of blended finance in Thailand's community biomass sector. First, there is no national policy or legal framework to guide blended finance, reflected in a clarity rating of 1/5, with agencies noting that “Thailand has no policy supporting blended finance” (G1–G9). Second, institutional fragmentation persists, as energy and financial agencies operate in isolation, with “each agency working on different missions” (G4), resulting in the absence of a central coordinating body or integrated platform for financial

and policy alignment. Third, project selection and monitoring mechanisms are underdeveloped: the lowest-price bidding system is “not suitable for biomass” (P1), criteria remain unclear, and oversight is weak, leading respondents to rate system readiness at 2/5. Collectively, these gaps indicate that Thailand’s institutional environment is not yet equipped to operationalize blended finance effectively. Building on these institutional gaps, the analysis also identifies critical weaknesses in Thailand’s de-risking and financial support mechanisms. The FIT and bidding system fails to address core biomass risks—developers noted it “does not cover feedstock cost or supply uncertainty” and often forces bids below actual cost. At the same time, Thailand lacks risk-sharing tools such as credit guarantees or first-loss mechanisms, leaving investors to shoulder all risks while existing funds provide only limited, non-systematic support.

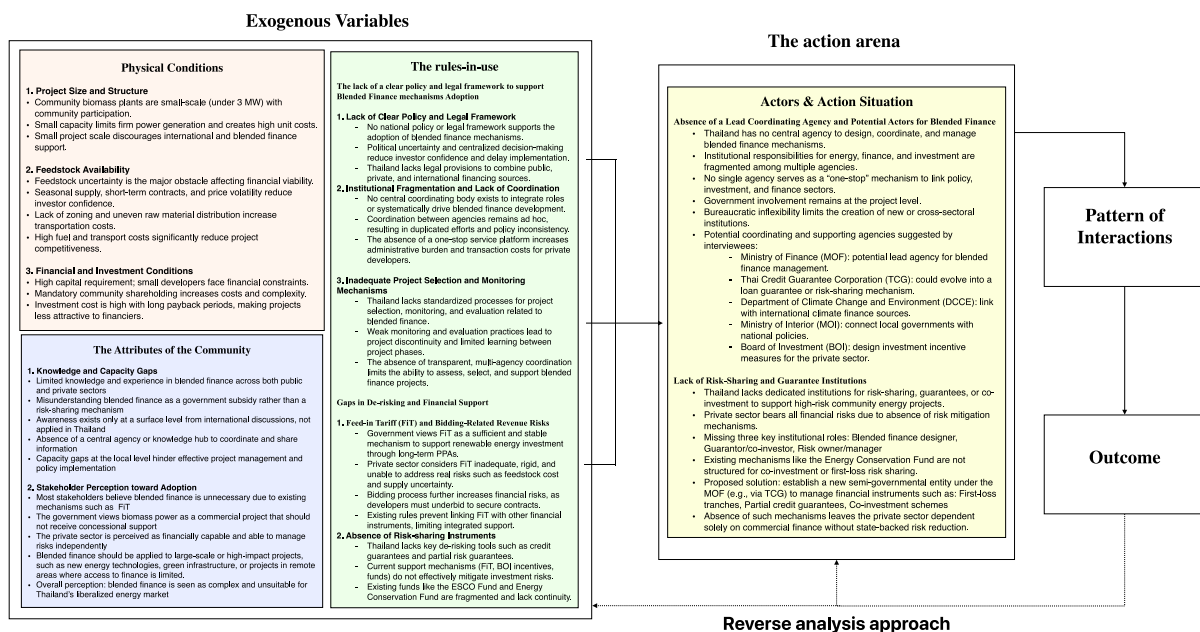


Figure 6. Integrated analysis of Institutional gaps in adopting blended finance

- **Action Arena:** The analysis highlights two major actor-related gaps that hinder the adoption of blended finance in Thailand’s community biomass sector. First, there is no lead coordinating agency with a mandate to design or manage blended finance; stakeholders repeatedly noted that “no single agency can coordinate the mechanism” (G1–G9), forcing project developers to coordinate across multiple bodies without a one-stop platform (P1). Although several entities—such as the Ministry of Finance, TCG, DCCE, and BOI—were mentioned as possible future coordinators, none currently hold the authority or tools required. Second, Thailand lacks risk-sharing and guarantee institutions, with respondents confirming that “there is no risk guarantee or co-investment agency” (G5, G7, G8). Existing funds cannot provide first-loss capital or partial guarantees, leaving developers fully exposed to investment risk. These structural gaps demonstrate that Thailand’s action arena does not yet include the actors necessary to operationalize blended finance.

**Integrated Analysis:** The IAD analysis identifies four interlinked institutional dimensions—physical conditions, community attributes, rules-in-use, and actors—that collectively constrain Thailand’s ability to operationalize blended finance. Structural limitations, knowledge gaps, policy fragmentation, and the absence of risk-sharing institutions leave the system conceptually aware but institutionally unprepared. Consequently, Thailand’s blended finance ecosystem remains fragmented and lacks the operational mechanisms required for effective and sustainable implementation in the community biomass power sector.

## 6. Conclusion

This study examined how institutional factors influence the adoption of blended finance mechanisms for private investment in Thailand’s community biomass power projects, using the Institutional Analysis and Development (IAD) framework. Findings show emerging institutional readiness—through FiT, BOI incentives, and motivated private developers—but also critical gaps: limited knowledge, fragmented coordination, lack of policy clarity, and absence of risk-sharing tools. To advance blended finance implementation, Thailand must strengthen institutional capacity, establish policy and institutional integration, and develop financial risk-sharing mechanisms. Creating a National Blended Finance Coordination Center under government authority with support from international partners would provide a foundation for systematic, cross-sector collaboration. In summary, Thailand’s progress toward adopting blended finance remains conceptual rather than operational. Bridging institutional gaps through coherent policy alignment, actor collaboration, and risk-sharing instruments is essential to mobilize private capital and accelerate Thailand’s transition toward a low-carbon, Net Zero future.

## 7. Recommendation

The study identifies four institutional gaps hindering the adoption of blended finance in community biomass power projects in Thailand: limited knowledge, fragmented policy coordination, inadequate financial risk-sharing tools, and unclear stakeholder roles. Strengthening institutional capacity requires targeted training, inter-agency learning platforms, and a national knowledge hub. Policy fragmentation should be addressed through a national coordination working group, clear blended-finance guidelines, and transparent project-selection and monitoring systems. Financial support should combine existing incentives with de-risking instruments such as guarantees, concessional loans, and technical-assistance funds. Finally, Thailand should designate a lead coordinating body to integrate policy, funding, and project information, while positioning the private sector as a co-designer and risk-sharing partner in financing structures.

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