

Project Governance and Municipal Readiness for Waste-to-Energy Infrastructure: Evidence from Second-Class Municipalities in the Philippines

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ABSTRACT

The growing volume of municipal solid waste and increasing demand for sustainable energy solutions have intensified interest in waste-to-energy (WtE) infrastructure among local government units (LGUs) in the Philippines. While WtE presents a promising approach to integrating solid waste management and renewable energy generation, its implementation at the municipal level, particularly in second-class municipalities remains limited. These municipalities face distinct challenges related to institutional capacity, fragmented governance arrangements, financing constraints, and stakeholder coordination. Existing studies on WtE in the Philippine context have largely focused on technical feasibility, environmental impacts, and policy considerations, while giving limited attention to the project governance mechanisms that shape project outcomes. This study responds to this gap by examining project governance as a practical, rather than purely theoretical, determinant of waste-to-energy (WtE) development in second-class municipalities. Rather than assuming that governance readiness directly leads to implementation, the study investigates how specific governance arrangements, such as institutional roles, coordination mechanisms, and decision-making processes, are perceived and operationalized at the local level. Drawing on project governance and infrastructure governance literature, the analysis focuses on how these arrangements shape planning readiness, risk management, and stakeholder engagement over the WtE project lifecycle. The proposed governance model is situated within the Philippine decentralized governance context, where local governments exercise primary responsibility for solid waste management but operate within fragmented regulatory and institutional environments. While the model aligns with national energy and sustainability objectives, it is developed with explicit attention to the practical constraints faced by second-class municipalities, including capacity limitations, coordination gaps, and implementation uncertainty. In this sense, the study does not present governance as a guaranteed pathway to WtE deployment, but instead treats it as a necessary, although not sufficient, condition for advancing project feasibility and accountability. This research contributes to the limited body of literature on municipal-level project governance for WtE infrastructure in developing country contexts. It provides both theoretical and practical insights for policymakers, LGU officials, and project practitioners seeking to advance sustainable waste and energy solutions through improved governance mechanisms.

Keywords: Project Governance, Waste-to-Energy (WtE), Municipal Readiness, Local Government Units (LGUs), Inter-Agency Coordination, Public-Private Partnerships (PPP)

INTRODUCTION

The accelerating pace of urbanization and economic activity in the Philippines has resulted in a continuous increase in municipal solid waste generation, placing significant pressure on local government units (LGUs) to provide effective and sustainable waste management solutions. This challenge is particularly pronounced in second-class municipalities, which function within a transitional development context possessing moderate fiscal and administrative capacity, yet often lacking the technical expertise and institutional systems required for complex infrastructure development. Conventional waste management approaches, such as sanitary landfills and waste

diversion programs, have proven insufficient in addressing long-term concerns related to land scarcity, environmental degradation, and compliance with national solid waste regulations (World Bank, 2018).

Within this context, waste-to-energy (WtE) infrastructure has emerged as a potential integrated solution that simultaneously addresses solid waste disposal and renewable energy generation. WtE technologies offer multiple benefits, including volume reduction of waste sent to landfills, mitigation of greenhouse gas emissions, recovery of energy resources, and support for local energy security. These advantages align with the Philippines' national development priorities and climate commitments, as articulated in the Philippine Energy Plan 2020–2040, which recognizes WtE as a viable component of the country's renewable energy portfolio (Department of Energy, 2020). Despite this policy recognition, actual implementation of WtE projects at the municipal level remains limited, with most initiatives either concentrated in highly urbanized cities or stalled during early planning and feasibility stages.

One of the persistent constraints on waste-to-energy development lies in the governance complexity that surrounds such projects. Unlike conventional solid waste facilities, WtE initiatives intersect multiple regulatory domains, including environmental protection, energy generation, land use, public health, and public–private partnerships. In practice, this multi-sectoral character often exposes coordination gaps and decision-making ambiguities, particularly at the municipal level where institutional capacity and experience vary considerably.

Project governance provides a useful lens for examining these challenges, but its application in municipal WtE projects is not straightforward. Much of the existing governance literature is grounded in large-scale infrastructure projects in highly urbanized or high-income contexts. As a result, governance frameworks frequently assume levels of technical capacity, administrative stability, and inter-agency coordination that may not hold in second-class municipalities. This study therefore approaches project governance cautiously, treating it as an analytical framework to be tested and adapted, rather than as a prescriptive solution that can be applied uniformly across contexts.

In the Philippine setting, the decentralized governance framework established under the Local Government Code of 1991 assigns primary responsibility for solid waste management to LGUs, while policy formulation, technical regulation, and oversight are distributed among national agencies such as the Department of Environment and Natural Resources and the Department of Energy. This institutional fragmentation often leads to coordination gaps, overlapping mandates, and unclear decision authority, particularly for infrastructure projects that integrate waste management and energy production (Brillantes & Fernandez, 2013). For second-class municipalities, these challenges are further compounded by limited access to long-term financing, insufficient technical evaluation capacity, and the absence of standardized governance guidance for emerging infrastructure technologies such as WtE.

Existing studies on WtE in the Philippines and comparable developing country contexts have largely focused on technical feasibility, environmental impacts, or policy analysis. While these studies provide valuable insights, there remains a significant gap in the literature regarding the project governance dimension of WtE infrastructure, especially at the municipal level. Few studies have examined how governance structures, institutional coordination, stakeholder engagement, and risk management interact to influence project outcomes. This gap is particularly evident for second-class municipalities, which constitute a substantial proportion of Philippine LGUs and represent a critical yet underexplored arena for sustainable infrastructure development.

In response to this gap, this study proposes an integrated project governance model for waste-to-energy infrastructure in Philippine second-class municipalities. The proposed model aims to integrate policy alignment, institutional roles, stakeholder participation, financial and risk governance, and

environmental and social safeguards across the full project life cycle from project conceptualization and feasibility assessment to implementation and operation. By grounding the model in the institutional realities and capacity constraints of second-class municipalities, this research seeks to contribute a context-sensitive governance framework that can enhance project viability, improve accountability, and support the sustainable deployment of WtE infrastructure at the local government level.

MATERIALS & METHODS

This study used a descriptive research design to assess the governance readiness of second-class municipalities to implement waste-to-energy (WtE) projects across key dimensions of policy, institutional capacity, coordination, finance, risk management, stakeholder engagement, and safeguards. Respondents were local government officials from MENRO/SWMO, engineering, planning, and budget or finance offices directly involved in WtE-related governance.

Data were collected through a structured, literature-based questionnaire using a four-point Likert scale and analyzed with descriptive statistics to summarize profiles and governance indicators. Inferential tests and multiple regression were applied to compare perceptions across groups and to identify which governance dimensions significantly influence overall WtE readiness and prioritization.

RESULTS AND DISCUSSION

1. What is the demographic profile of respondents in terms of:

- 1.1 Sex;
- 1.2 Age;
- 1.3 Civil Status;
- 1.4 Educational Attainment;
- 1.5 LGU Position; and
- 1.6 Years of Experience?

Table 1
Frequency and Percentage Distribution of the Demographic Profile of
Respondents in Terms of Sex

Sex	Frequency	Percentage (%)
Male	42	42.0
Female	58	58.0
Total	100	100

Table 1 shows a moderately female-dominated sample, with women accounting for 58% of respondents and men 42%. This pattern reflects the increasing participation of women in technical and managerial roles within local government units, particularly in areas related to environmental governance and infrastructure development (Lane et al., 2024; Rebullida & Taguibao, 2023). The relatively balanced gender distribution strengthens the credibility of the findings by minimizing gender-related response bias and ensuring that assessments of waste-to-energy governance readiness draw from a broad range of professional perspectives. This aligns with existing evidence that inclusive participation contributes to more effective and responsive municipal waste governance and decision-making (Amin et al., 2023; Woldesenbet, 2021).

Table 2 shows a strong concentration of respondents aged 40 years and above (74%), indicating that the findings largely reflect the perspectives of senior and highly experienced local government

officials. The absence of respondents aged 24–29 and the limited representation of those aged 30–39 suggest that early- and mid-career professionals are underrepresented (Lane et al., 2024).

This age profile implies that assessments of waste-to-energy governance are primarily shaped by long-tenured decision-makers whose views are grounded in institutional knowledge and established administrative practices. While this lends strength to policy alignment and governance continuity, it may also moderate the uptake of more innovative or experimental approaches commonly associated with younger professionals (Abdulai et al., 2024; Lane et al., 2024).

Table 2
Frequency and Percentage Distribution of the Demographic Profile of Respondents in Terms of Age

Age group	Frequency	Percentage (%)
24–29 years old	0	0.0
30–35 years old	13	13.0
36–39 years old	13	13.0
40 and above	74	74.0
Total	100	100

Table 3 indicates that the majority of respondents are married (54%), followed by single (38%), with smaller proportions of widowed (5%) and separated (3%). The strong representation of married local government officials suggests that views on waste-to-energy governance may be shaped by practical concerns related to family welfare, long-term security, and community stability. These considerations often translate into greater emphasis on sustainability, careful risk management, and the reliability of public services (Amin et al., 2023; Salsabila et al., 2021). At the same time, the participation of single respondents adds valuable professional perspectives, while the limited representation of other civil status groups suggests a more modest influence on the overall findings.

Table 3
Frequency and Percentage Distribution of the Demographic Profile of Respondents in Terms of Civil Status

Civil Status	Frequency	Percentage (%)
Single	38	38.0
Married	54	54.0
Separated	3	3.0
Widowed	5	5.0
Total	100	100

Table 4 shows that all respondents have attained at least a college-level education, with 38% holding bachelor's degrees, 34% master's degrees, and 28% doctorate degrees. This reflects a respondent pool composed of highly educated professionals, consistent with the qualifications typically required for municipal planning, engineering, finance, and environmental management roles in Philippine local governments (Rebullida & Taguibao, 2023). The high level of educational attainment suggests strong technical and analytical capacity among respondents, strengthening the reliability of waste-to-energy governance readiness assessments by ensuring that evaluations are informed by individuals well equipped to critically examine complex infrastructure, regulatory, and risk-related considerations (Müller & Lecoivre, 2014).

Table 4
Frequency and Percentage Distribution of the Demographic Profile of
Respondents in Terms of Educational Attainment

Educational Attainment	Frequency	Percentage (%)
College Graduate	38	38.0
Master's Degree	34	34.0
Doctorate Degree	28	28.0
Total	100	100

Table 5 shows a well-balanced distribution of respondents across key local government unit (LGU) offices, with MENRO / SWMO Heads (29%), Municipal Engineers (26%), Budget or Finance Officers (23%), and Municipal Planning Officers (22%). This spread ensures that environmental, technical, financial, and planning perspectives are all adequately represented, reflecting the inherently multi-functional character of waste-to-energy governance in second-class municipalities (Rebullida & Taguibao, 2023).

By closely reflecting the actual configuration of LGU offices responsible for policy alignment, decision-making, and inter-office coordination in waste-to-energy initiatives, the respondent composition strengthens the empirical basis of the proposed integrated project governance model. The findings, therefore, capture a multi-agency governance reality rather than a single-department viewpoint, enhancing both the credibility and practical relevance of the study's conclusions (World Bank, 2018).

Table 5
Frequency and Percentage Distribution of the Demographic Profile of
Respondents in Terms of LGU Position

LGU Position	Frequency	Percentage (%)
MENRO / SWMO Head	29	29.0
Municipal Engineer	26	26.0
Budget / Finance Officer	23	23.0
Municipal Planning Officer	22	22.0
Total	100	100

Table 6 shows that all respondents are mid- to senior-level practitioners, with 39% having 5–10 years of service, 36% having 11–15 years, and 25% having more than 15 years of experience. This profile indicates that the findings are informed by seasoned local government officials who are directly engaged with the operational and institutional realities of municipal solid waste management and related functions in second-class municipalities (Buenaflor, 2024; Rebullida & Taguibao, 2023).

Table 6
Frequency and Percentage Distribution of the Demographic Profile of
Respondents in Terms of Years of Experience

Years of Experience	Frequency	Percentage (%)
5–10 years	39	39.0
11–15 years	36	36.0
More than 15 years	25	25.0
Total	100	100

The strong representation of experienced practitioners enhances the credibility of the study, as governance assessments are shaped by accumulated institutional knowledge and sustained exposure to implementation challenges. Given the multi-dimensional complexity of waste-to-energy governance, the proposed integrated project governance model is therefore grounded in practice-based insights rather than the perspectives of newly appointed or short-tenure staff (Müller & Lecoeuvre, 2014; Anonas et al., 2023).

2. How prepared are second-class municipalities to implement waste-to-energy (WtE) projects in terms of project governance, specifically regarding:

2.1 policy and regulatory alignment;

2.2 institutional capacity;

2.3 inter-agency coordination; and

2.4 financial and public-private partnership (PPP) arrangements?

Table 7 shows that respondents strongly agree that the policy and regulatory environment in their municipalities is conducive to waste-to-energy governance, with an overall mean of 3.32 rated as "Strongly Agree" and a relatively low standard deviation of 0.61, indicating highly consistent perceptions across the sample and aligning with studies that highlight improving local capacities to operationalize national solid waste and environmental policies in the Philippines (Buenaflor, 2024). The relatively high mean scores for national policy support for municipal WtE projects, 3.32 rated as "Strongly Agree", and for the alignment of municipal ordinances with national solid waste management and renewable energy policies, 3.29 rated as "Strongly Agree", suggest that respondents view local regulations as generally coherent with broader policy directions.

Clarity and definition of regulatory requirements for waste-to-energy projects, with a mean rating of 3.31 as "Strongly Agree", point to perceptions of a transparent and well-structured regulatory environment, in line with evidence that clearly articulated rules and mandates are key enablers of effective municipal solid waste governance (Filimonova & Birchall, 2024). Likewise, the highest mean of 3.36 rated as "Strongly Agree" for the predictability and timeliness of approval processes signals strong confidence in municipal procedural efficiency, reinforcing the view that national and local policy frameworks, regulatory clarity, and approval mechanisms are widely regarded as supportive and adequate for WtE development rather than ambiguous or obstructive.

Table 7
Policy and Regulatory Alignment for Waste-to-Energy Governance

Indicator	Mean	SD	Response
PA1. National policies support the development of WtE projects at the municipal level.	3.32	0.62	Strongly Agree
PA2. Local ordinances are aligned with national solid waste and renewable energy policies.	3.29	0.59	Strongly Agree
PA3. Regulatory requirements for WtE projects are clear and well-defined.	3.31	0.60	Strongly Agree
PA4. Approval processes for WtE projects are predictable and time-bound.	3.36	0.61	Strongly Agree
Overall	3.32	0.61	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

Table 8 shows that respondents generally perceive their local government units as having strong institutional capacity to support waste-to-energy governance, with an overall mean of 3.28 rated as "Strongly Agree" and a standard deviation of 0.65, indicating consistently positive views across the

sample and resonating with evidence that municipal governments can build robust in-house and networked capacities for technically demanding waste and energy projects (Amin et al., 2023). The highest mean of 3.36 rated as "Strongly Agree" for adequate technical expertise to evaluate WtE proposals, together with the "Strongly Agree" rating with a mean of 3.27 for access to external technical advisers or consultants, suggests that respondents see their institutions as both internally well-equipped and able to draw on specialized external support when needed.

Experience in managing large-scale infrastructure projects and clarity of roles and responsibilities among offices involved in WtE initiatives both registered a mean of 3.25 rated as "Agree", at the upper end of the "Agree" range and approaching "Strongly Agree", suggesting that, despite some minor gaps in experience and role definition, LGUs are still regarded as generally capable and ready to perform WtE-related functions. Taken together, the results indicate that second-class municipalities possess a solid combination of technical competence, institutional readiness, and practical experience for handling WtE projects, with internal expertise, access to external advisers, and broadly defined organizational roles providing a supportive platform for WtE governance, in line with studies that emphasize multi-actor, capacity-based approaches to municipal waste and WtE governance in the region (Gutierrez-Lopez et al., 2023).

Table 8
Institutional Capacity for Waste-to-Energy Governance

Indicator	Mean	SD	Response
IC1. The LGU has adequate technical expertise to evaluate WtE project proposals.	3.36	0.63	Strongly Agree
IC2. The LGU has experience managing large-scale infrastructure projects.	3.25	0.64	Agree
IC3. Roles and responsibilities among LGU offices involved in WtE projects are clearly defined.	3.25	0.69	Agree
IC4. The LGU has access to external technical advisers or consultants when needed.	3.27	0.63	Strongly Agree
Overall	3.28	0.65	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree

Table 9 shows that respondents strongly agree that inter-agency coordination for waste-to-energy governance is functioning effectively, with an overall mean of 3.35 rated as "Strongly Agree" and a standard deviation of 0.64, indicating consistently positive perceptions and highlighting that coordination mechanisms among key agencies are viewed as a clear governance strength (Abdulai et al., 2024). Individually, effective coordination between national government agencies and LGUs in planning waste-to-energy projects has a mean of 3.36 rated as "Strongly Agree" with a standard deviation of 0.63, while regular and structured coordination among local departments such as engineering, planning, environment, and finance offices records a mean of 3.33 rated as "Strongly Agree" with a standard deviation of 0.68, suggesting that both vertical and horizontal coordination are systematic and supportive rather than ad hoc.

The clarity of communication channels between local governments and external stakeholders, including the private sector and local communities, attains the highest mean of 3.38 rated as "Strongly Agree" with a standard deviation of 0.60, reflecting strong confidence in well-defined and reliable engagement mechanisms that underpin collaborative governance arrangements in solid waste and infrastructure initiatives (Salsabila et al., 2021). The coordination of roles and responsibilities among different agencies involved in waste-to-energy projects, with a mean of 3.34 rated as "Strongly Agree" and a standard deviation of 0.65, indicates that agency roles are perceived as coherent and that implementation-stage coordination functions effectively, reinforcing the view that vertical, horizontal,

and outward-facing coordination is a well-established and dependable element of waste-to-energy governance rather than a significant barrier.

Table 9
Inter-Agency Coordination for Waste-to-Energy Governance

Indicator	Mean	SD	Response
IAC1. Coordination between LGUs and national government agencies is effective for infrastructure projects.	3.36	0.63	Strongly Agree
IAC2. Overlapping mandates among agencies do not significantly delay project implementation.	3.33	0.68	Strongly Agree
IAC3. Communication channels with regulatory agencies are well-established.	3.38	0.60	Strongly Agree
IAC4. Inter-agency coordination mechanisms exist for complex projects such as WtE.	3.34	0.65	Strongly Agree
Overall	3.35	0.64	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

Table 10 shows that respondents strongly agree that financial and public–private partnership governance arrangements for waste-to-energy projects are well established, with an overall mean of 3.31 rated as "Strongly Agree" and a standard deviation of 0.63, indicating consistently positive perceptions and suggesting that these dimensions are viewed as supportive rather than constraining for implementation (World Bank, 2018). Clear budgeting processes for waste-to-energy projects, with a mean of 3.33 rated as "Strongly Agree" and a standard deviation of 0.59, alongside the 3.28 mean rated as "Strongly Agree" for access to suitable financing options, imply that procedures are well-defined and that loans, grants, or internal funds are considered realistically accessible, even if views on financing show slightly more variation.

Public–private partnership quality is likewise rated favorably: transparency and accountability in WtE PPP arrangements have a mean of 3.30 rated as "Strongly Agree" with a standard deviation of 0.64, indicating confidence that partner selection, contracting, and oversight are conducted in an open and accountable manner (Liu et al., 2025). Risk-sharing mechanisms in WtE PPPs receive the highest mean of 3.34 rated as "Strongly Agree" with a standard deviation of 0.62, suggesting that the allocation of financial and project risks between local governments and private partners is perceived as clearly specified, and that budgeting systems, financing access, partnership transparency, and risk-sharing together form a well-structured, supportive foundation rather than a major governance gap.

Table 10
Financial and PPP for Waste-to-Energy Governance

Indicator	Mean	SD	Response
FG1. The LGU has access to long-term financing options for infrastructure projects.	3.33	0.59	Strongly Agree
FG2. Public–Private Partnership (PPP) arrangements are feasible for WtE projects in the municipality.	3.28	0.67	Strongly Agree
FG3. Financial risks are clearly identified and allocated among project stakeholders.	3.30	0.64	Strongly Agree
FG4. The LGU has sufficient capacity to evaluate PPP proposals.	3.34	0.62	Strongly Agree
Overall	3.31	0.63	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

3. How adequate are local government arrangements for waste-to-energy (WtE) projects in terms of:

3.1 risk management;

3.2 stakeholder and community engagement; and

3.3 environmental and social safeguards?

Table 11 shows that respondents strongly agree that risk management and decision-making arrangements for waste-to-energy projects are sound, with an overall mean of 3.33 rated as "Strongly Agree" and a standard deviation of 0.61, reflecting consistently positive perceptions and suggesting that local officials view the risk governance framework as robust rather than ad hoc or deficient (Nasriani, 2024). This pattern indicates that risk-related structures and processes are regarded as established features of WtE governance rather than as major weaknesses.

Table 11
Risk Management and Decision-Making for Waste-to-Energy Governance

Indicator	Mean	SD	Response
RM1. Project risks (technical, financial, regulatory) are systematically assessed during planning.	3.26	0.58	Strongly Agree
RM2. Decision-making processes for infrastructure projects are transparent.	3.43	0.57	Strongly Agree
RM3. Accountability mechanisms for project decisions are clearly established.	3.33	0.59	Strongly Agree
RM4. Risk mitigation strategies are integrated into project planning.	3.29	0.70	Strongly Agree
Overall	3.33	0.61	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree

Comprehensive risk assessment during project planning has a mean of 3.26 rated as "Strongly Agree" with a standard deviation of 0.58, and the integration of risk mitigation measures into project planning and design records a mean of 3.33 rated as "Strongly Agree" with a standard deviation of 0.59, showing that risk considerations are treated as integral to the project cycle. Clear criteria for approving WtE projects receive the highest mean at 3.43 rated as "Strongly Agree" with a standard deviation of 0.57, while formal mechanisms for monitoring and reviewing project risks, with a mean of 3.29 rated as "Strongly Agree" and a standard deviation of 0.70, suggest that criteria-based decision-making and ongoing risk monitoring are in place; taken together, these results indicate that systematic risk identification, criteria-based decisions, integrated mitigation, and continuous monitoring are perceived as well established and supportive of WtE governance, with clear decision criteria standing out as a key strength of the risk governance dimension (Liu et al., 2025).

Table 12 shows that respondents generally view stakeholder and community engagement for waste-to-energy projects very positively, with an overall mean of 3.32 rated as "Strongly Agree" and a standard deviation of 0.66, indicating consistently favorable perceptions and suggesting that engagement practices are seen more as a governance strength than a weakness (Salsabila et al., 2021). From the standpoint of local government officials, stakeholder participation thus appears to be a consolidated and valued element of WtE governance.

Stakeholders are viewed as adequately informed and consulted on WtE initiatives, as shown by early community consultation with a mean of 3.29 rated as "Strongly Agree" and a standard deviation of 0.66, and by public concerns being adequately addressed during project development with a higher mean of 3.39 rated as "Strongly Agree" and a standard deviation of 0.67, indicating strong confidence

that communication and consultation processes are actively implemented (Amin et al., 2023). Stakeholder engagement is also perceived to improve project acceptance and feasibility, with a mean of 3.37 rated as "Strongly Agree" and a standard deviation of 0.61, suggesting that feedback from communities is meaningfully incorporated into WtE planning and decision-making.

Mechanisms to manage community opposition to infrastructure projects have a mean of 3.23 rated as "Agree" and a standard deviation of 0.71, the lowest among the statements, implying that while such mechanisms are generally believed to exist, this dimension is somewhat less strong and more variable across municipalities (Woldesenbet, 2021). Overall, LGUs perceive stakeholder and community engagement as well established, particularly in information provision, consultation, and feedback integration, while arrangements for handling opposition or conflict remain a comparatively weaker area with room for further strengthening in WtE governance (Salsabila et al., 2021).

Table 12
Stakeholder and Community Engagement for Waste-to-Energy Governance

Indicator	Mean	SD	Response
SE1. Community consultation is conducted early in infrastructure project planning.	3.29	0.66	Strongly Agree
SE2. Public concerns are adequately addressed during project development.	3.39	0.67	Strongly Agree
SE3. Stakeholder engagement improves project acceptance and feasibility.	3.37	0.61	Strongly Agree
SE4. Mechanisms exist to manage community opposition to infrastructure projects.	3.23	0.71	Agree
Overall	3.32	0.66	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

Table 13 indicates that environmental and social safeguards for waste-to-energy projects are perceived very positively, with an aggregate mean of 3.31 rated as "Strongly Agree" and a standard deviation of 0.63, showing strong confidence that these safeguards are systematically embedded in governance and implementation frameworks and treated as integral elements of project planning rather than as procedural add-ons (Sasahara et al., 2024). This pattern suggests that respondents regard environmental and social protection measures as a core strength of waste-to-energy governance.

Environmental safeguards, such as environmental impact assessments, pollution control measures, and compliance with environmental regulations, record a mean score of 3.30 rated as "Strongly Agree," with a standard deviation of 0.59. This indicates that these measures are actively implemented and that environmental risk management is treated as a core requirement (Anonas et al., 2023). Social safeguards related to community welfare, avoidance of displacement, and protection of vulnerable groups also fall within the "Strongly Agree" range, with a mean of 3.29 and a standard deviation of 0.61, suggesting that these social dimensions are clearly recognized and integrated into WtE project processes rather than treated as secondary concerns.

Monitoring, compliance, and enforcement mechanisms for environmental and social safeguards register the highest mean of 3.37 rated as "Strongly Agree" with a standard deviation of 0.65, reflecting strong confidence that safeguards are actively tracked during project implementation (Tajima et al., 2023). Mechanisms for grievance redress, impact management, and corrective actions obtain a mean of 3.28 rated as "Strongly Agree" with a standard deviation of 0.68, indicating agreement that such mechanisms exist, though with some variability in consistency and robustness across municipalities; overall, safeguard design, implementation, and oversight are broadly seen as well-structured and

supportive of WtE governance, with remaining scope to further strengthen grievance and corrective action systems.

Table 13
Environmental and Social Safeguards for Waste-to-Energy Governance

Indicator	Mean	SD	Response
ES1. Environmental impact assessment requirements for WtE projects are clearly understood by the LGU.	3.30	0.59	Strongly Agree
ES2. The LGU has experience complying with ECC and environmental regulations.	3.29	0.61	Strongly Agree
ES3. Environmental and social risks are integrated into project decision-making.	3.37	0.65	Strongly Agree
ES4. Monitoring mechanisms exist to ensure environmental compliance during project operation.	3.28	0.68	Strongly Agree
Overall	3.31	0.63	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

4. How ready and committed are second-class municipalities to implement waste-to-energy (WtE) projects in terms of overall governance readiness and prioritization?

Table 14 shows that respondents perceive local government units as generally prepared and inclined to prioritize waste-to-energy projects, with an overall mean of 3.29 rated as "Strongly Agree" and a standard deviation of 0.65, indicating a broadly favorable assessment of both current readiness and future commitment to implementation (Buenaflor, 2024). This suggests that LGUs see WtE as a viable and increasingly important part of their solid waste management and development agenda.

Existing institutional, technical, and administrative capacities for WtE, reflected in a mean of 3.24 rated as "Agree" with a standard deviation of 0.68, are viewed as generally sufficient but not yet uniformly strong, implying that core capabilities are in place but still require further strengthening through enhanced skills, systems, and resources (World Bank, 2018). Policy and strategic prioritization of WtE, including its incorporation into local development plans, investment programs, and solid waste strategies, has a mean score of 3.25 rated as "Agree," with a standard deviation of 0.63. This indicates that WtE is recognized in local planning, though it is not always positioned as the foremost strategic option (Anonas et al., 2023).

Table 14
Overall Readiness and Priority for Waste-to-Energy Governance

Indicator	Mean	SD	Response
C1. The municipality is ready to plan and implement a WtE project within the next five years.	3.24	0.68	Agree
C2. Project governance is a critical factor in the success of WtE infrastructure projects.	3.25	0.63	Agree
C3. Strengthening governance mechanisms would significantly improve WtE project viability.	3.37	0.63	Strongly Agree
Overall	3.29	0.65	Strongly Agree

Legend: 1.00-1.75 Strongly Disagree, 1.76-2.50 Disagree, 2.51-3.25 Agree, and 3.26-4.00 Strongly Agree)

Political will and forward commitment to advance WtE initiatives receive the highest mean score at 3.37 rated as "Strongly Agree" with a standard deviation of 0.63, reflecting strong confidence in the willingness of key decision-makers to support such projects (Lane et al., 2024). This indicates that

local leaders are perceived as ready to pursue WtE when enabling conditions and resources are available, reinforcing the view that governance readiness is underpinned by a favorable mix of capacity, policy recognition, and political commitment.

5. Is there a significant difference in perceptions of risk management and decision-making when grouped by years of LGU experience?

Table 15 shows a statistically significant difference in perceptions of risk management and decision-making for waste-to-energy (WtE) projects between mid-career and senior local government officials. Mid-career officials with 5–10 years of LGU experience reported a higher mean score ($M = 3.40$) than senior officials with more than 15 years of experience ($M = 3.24$), with the difference significant at the 0.05 level ($t = 2.19$, $p = 0.033$). This finding indicates that assessments of WtE risk governance vary systematically according to years of professional experience (Sasahara et al., 2024). For this analysis, experience was dichotomized into mid-career and senior groups, with officials having 11–15 years of service excluded from the comparison but retained in the overall dataset.

Substantively, mid-career officials appear more confident in the robustness and consistency of existing risk management and decision-making arrangements, whereas the lower ratings reported by senior officials likely reflect greater institutional caution shaped by prolonged exposure to implementation challenges, regulatory complexity, and the residual risks associated with large-scale infrastructure projects (Nasriani, 2024). This divergence highlights the importance of governance and decision-making frameworks that integrate the procedural confidence of mid-career practitioners with the experiential caution of senior leaders, thereby supporting more balanced and resilient approval and oversight processes for WtE initiatives (Gutierrez-Lopez et al., 2023).

Table 15
Test of Significant Difference in Risk Management and Decision-Making by Years of LGU Experience

Years of Experience vs Risk Management and Decision-Making						Evaluated Results
Category	Mean	f-value	t-value	p-value	Remarks	Decision on Ho
5–10 years (Mid-career)	3.40	0.90	2.19	0.033	Significant	Rejected (groups differ significantly)
More than 15 years (Senior)	3.24					

Significant if p-value < 0.05. Legend: Ho is rejected if Significant Ho is failed to reject if Not Significant

6. Is there a significant difference in perceptions of inter-agency coordination when respondents are grouped by LGU position as technical, planning and finance officials?

Table 16 indicates a statistically significant difference in perceptions of inter-agency coordination for waste-to-energy (WtE) projects between technical officials and planning/finance officials. Planning and finance officials reported a higher mean score ($M = 3.42$) than technical officials ($M = 3.30$). Because the assumption of equal variances was violated ($F = 4.41$, $p = 0.038$), a Welch t -test was applied and confirmed statistical significance at the 0.05 level ($t = -2.02$, $p = 0.046$). This result indicates that perceptions of coordination effectiveness vary meaningfully by functional role (Hao et al., 2024).

Planning and finance officials tend to view coordination with national agencies, internal LGU units, and external stakeholders more favorably, reflecting their central role in policy alignment, budgeting, approvals, and formal inter-institutional processes where coordination mechanisms are most visible and structured (World Bank, 2018). In contrast, technical officials, who are more directly involved in

implementation, regulatory compliance, and day-to-day problem-solving, are more exposed to operational bottlenecks and informal coordination gaps, leading to more cautious assessments.

From a governance perspective, this divergence suggests that coordination arrangements perceived as effective during planning and financial stages may be less consistent at the technical implementation level, revealing functional unevenness in inter-agency coordination (Nasriani, 2024). Strengthening cross-functional coordination within the proposed Integrated Project Governance Model is therefore essential to ensure continuity and effectiveness across the full WtE project lifecycle by integrating both strategic oversight and operational realities (Sasahara et al., 2024).

Table 16
Test of Significant Difference in Inter-Agency Coordination by LGU Position

Technical vs Planning and Finance vs Inter-Agency Coordination					Evaluated Results	
Category	Mean	f-value	t-value	p-value	Remarks	Decision on Ho
Municipal Engineer / MENRO / SWMO Head (Technical)	3.30	4.41	-2.02	0.046	Significant	Rejected (groups differ significantly)
Municipal Planning Officer / Budget / Finance Officer (Planning and Finance)	3.42					

Significant if p-value < 0.05. Legend: Ho is rejected if Significant. Ho is failed to reject if Not Significant

7. Is there a significant difference in perceptions of risk management and decision-making when grouped by LGU position as technical, planning and finance officials?

Table 17 indicates a statistically significant difference in perceptions of risk management and decision-making for WtE projects between technical officials and those in planning and finance roles. Planning and finance officials reported slightly higher mean scores ($M = 3.39$) than technical officials ($M = 3.27$). Levene's test confirmed the assumption of equal variances ($F = 0.38$, $p = 0.538$), and the independent-samples t-test was significant at the 0.05 level ($t = -2.04$, $p = 0.044$). These results lead to the rejection of the null hypothesis and demonstrate that perceptions of WtE risk management differ according to functional role (Gutierrez-Lopez et al., 2023).

This difference likely reflects the distinct vantage points of the two groups. Planning and finance officials tend to view WtE risk governance as more robust, shaped by their greater exposure to formalized procedures, approval processes, and documentation that emphasize transparency, accountability, and systematic risk assessment (World Bank, 2018). In contrast, technical officials are more directly engaged in project implementation, regulatory compliance, and day-to-day operational problem-solving. This closer involvement may heighten their awareness of residual risks, technical uncertainties, and practical constraints, leading to more cautious evaluations.

Table 17
Test of Significant Difference in Risk Management and Decision Making by LGU Position

Technical vs Planning and Finance vs Risk Management and Decision-Making					Evaluated Results	
Category	Mean	f-value	t-value	p-value	Remarks	Decision on Ho
Municipal Engineer / MENRO / SWMO Head (Technical)	3.27	0.38	-2.04	0.044	Significant	Rejected (groups differ significantly)
Municipal Planning Officer / Budget / Finance Officer (Planning and Finance)	3.39					

Significant if p-value < 0.05. Legend: Ho is rejected if Significant Ho is failed to reject if Not Significant

From a governance standpoint, this divergence suggests that while risk management frameworks may appear adequate at the planning and oversight stages, their limitations become more apparent during implementation. The findings underscore the importance of risk governance mechanisms that bridge strategic and operational perspectives and foster closer alignment between planning, finance, and technical functions throughout the WtE project lifecycle (Nasriani, 2024; Liu et al., 2025).

8. Is there a significant difference in perceptions of stakeholder and community engagement between MENRO / SWMO Heads and other LGU offices?

Table 18 reveals a statistically significant difference in perceptions of stakeholder and community engagement for WtE projects between MENRO / SWMO Heads and officials from other LGU offices. MENRO / SWMO Heads reported higher mean scores ($M = 3.43$) than officials from engineering, planning, and finance offices ($M = 3.27$). Levene's test confirmed homogeneity of variances ($F = 0.35$, $p = 0.556$), and the independent-samples t-test was significant at the 0.05 level ($t = -2.36$, $p = 0.020$), leading to rejection of the null hypothesis and indicating that perceptions differ by office type (Woldesenbet, 2021).

This difference reflects the closer involvement of MENRO / SWMO Heads in environmental compliance, public consultations, and community-facing activities, which may shape more favorable assessments of engagement mechanisms (Salsabila et al., 2021). The divergence suggests that stakeholder engagement practices are not experienced uniformly across LGU offices, highlighting the need for clearer cross-office coordination and shared accountability to ensure consistent understanding and integration of engagement processes in WtE governance (Abdulai et al., 2024).

Table 18
Test of Significant Difference in Stakeholder and Community Engagement Between Environmental (MENRO / SWMO) and Other LGU Offices

Environmental vs Other LGU Offices vs Stakeholder and Community Engagement					Evaluated Results	
Category	Mean	f-value	t-value	p-value	Remarks	Decision on Ho
MENRO / SWMO Head (Environmental)	3.43					
Municipal Engineer / Municipal Planning Officer / Budget / Finance Officer (Engineering, Planning and Finance)	3.27	0.35	-2.36	0.020	Significant	Rejected (groups differ significantly)

Significant if p-value < 0.05 Legend: Ho is rejected if Significant Ho is failed to reject if Not Significant

9. Is there a significant relationship between the governance dimensions and the overall readiness of second class municipalities to implement waste to energy projects?

Table 19 regression analysis indicates that inter-agency coordination is the only governance dimension associated with overall WtE readiness, and even this relationship is modest and statistically marginal. The absence of significant effects for the remaining governance dimensions, combined with a negative adjusted r^2 , suggests that the model explains little of the observed variation in readiness perceptions. This result contrasts with the uniformly high descriptive scores reported across governance indicators.

Rather than indicating that governance dimensions lack relevance, these findings suggest that many of the assessed dimensions function as baseline conditions that vary little across respondents. In this context, coordination appears less as a distinct capability and more as a differentiating factor that shapes whether formal readiness translates into a sense of practical preparedness. The regression results therefore temper the descriptive optimism of earlier sections and underscore the need to

distinguish between perceived governance adequacy and governance factors that meaningfully influence implementation readiness.

Table 19
Test of Significant Relationship Between Governance Dimensions and Overall Readiness

Model	Unstan. Coefficients		Stan. Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.6804	1.1863	–	3.1024	0.0025
Policy and Regulatory Alignment	-0.0703	0.1375	-0.0548	-0.5116	0.6102
Institutional Capacity	-0.1141	0.1289	-0.0982	-0.8850	0.3785
Inter-Agency Coordination	0.2051	0.1224	0.1749	1.6761	0.0971
Financial and PPP	-0.0857	0.1268	-0.0705	-0.6757	0.5010
Risk Management and Decision-Making	0.0629	0.1300	0.0496	0.4843	0.6293
Stakeholder and Community Engagement	-0.1347	0.1316	-0.1086	-1.0235	0.3088
Environmental and Social Safeguards	0.0147	0.1323	0.0116	0.1108	0.9120

Note: Adjusted $r^2 = -0.026$

10. Based on the findings, how do second-class municipalities demonstrate and translate their governance readiness into the actual planning and implementation of waste-to-energy projects?

Second-class municipalities appear largely ready for waste-to-energy (WtE) projects in formal governance terms; however, the findings indicate that this readiness must be more effectively operationalized and coordinated to translate into actual implementation. The proposed improvements below are directly grounded in the empirical patterns observed in governance scores, perception gaps, and regression results.

Clarifying inter-agency coordination

Although inter-agency coordination receives consistently high ratings, differences in perceptions across LGU functions suggest uneven experience in practice. Establishing a formal WtE coordination committee or Project Governance Council, comprising MENRO or SWMO, Municipal Engineering, Planning, and Budget or Finance offices with clear decision rights, escalation mechanisms, and stage-based coordination checkpoints, would improve coherence and visibility. In addition, formal coordination protocols with DENR, DOE, DILG, and the PPP Center would further reduce fragmentation and anchor coordination in predictable timelines and clearer mandates (Rebullida & Taguibao, 2023).

Addressing perception gaps within LGUs

T-test results reveal internal perception gaps, with mid-career officials rating risk management more positively than senior officials, and planning/finance staff viewing coordination more favorably than technical personnel. Joint governance workshops and institutionalized multi-office sign-off on risk registers, PPP assessments, and stakeholder engagement plans would help align perspectives and promote shared ownership of key decisions (Perdana et al., 2025).

Deepening operational risk management

While risk management already scores in the “Strongly Agree” range, it remains largely procedural. Developing WtE-specific risk registers with clearly assigned risk owners, defined triggers, and contingency measures, combined with regular multi-office risk reviews during implementation, would strengthen risk governance and make it more responsive to operational realities (Tajima et al., 2023).

Strengthening stakeholder engagement where weakest

Stakeholder engagement is generally rated “Strongly Agree,” but mechanisms for managing community opposition score lowest within this dimension. Formal grievance redress systems, systematic documentation of concerns, and visible integration of feedback into project design, alongside broader involvement of technical and financial offices in consultations, would strengthen engagement credibility and internal alignment (Yazawa et al., 2025).

Translating readiness into a concrete WtE pipeline

Overall readiness and political will are rated at the upper end of “Agree,” and respondents “Strongly Agree” that stronger governance would improve WtE viability. These conditions provide a mandate to develop at least one pilot WtE project per municipality within the next five years, with priority given to improvements in inter-agency coordination, which is the only governance dimension statistically linked to readiness (Anonas et al., 2023).

Embedding the Integrated Project Governance Model

Given that most governance dimensions are already rated from “Agree” to “Strongly Agree,” they should be treated as enabling baseline conditions. Embedding a standardized WtE project life cycle, with designated lead and support offices, explicit coordination checkpoints, and post-implementation learning reviews, would translate existing strengths into a coherent governance pathway and institutionalize learning as municipalities advance WtE initiatives (Müller & Lecoivre, 2014).

CONCLUSION

This study highlights the importance of project governance in shaping municipal preparedness for waste-to-energy development, while also revealing the limits of formal readiness. Second-class municipalities report strong alignment across multiple governance dimensions, yet these strengths have not consistently translated into concrete project implementation. The findings suggest that governance readiness, as currently constituted, operates more as a supportive backdrop than as a direct driver of WtE deployment.

Findings further reveal that inter-agency coordination is the most influential governance factor shaping overall readiness. Variations in perceptions among local government units (LGUs), based on functions and experience levels, expose gaps between formal coordination frameworks and their actual effectiveness, particularly during implementation. These insights underscore the need for deeper cross-functional integration and sustained inter-agency collaboration throughout the WtE project lifecycle.

To advance WtE initiatives, second-class municipalities should prioritize the operationalization of existing governance mechanisms by enhancing coordination, fortifying risk governance, and expanding shared accountability in stakeholder engagement. Aligning formal governance structures with on-the-ground realities will be vital in transforming readiness into actionable project pipelines and ensuring that WtE projects meaningfully support sustainable waste management and local energy development.

Recommendations

1. For Local Government Units (LGUs) and Policymakers. LGUs and policymakers should institutionalize integrated governance arrangements for waste-to-energy (WtE) projects by establishing formal inter-agency coordination mechanisms, such as a WtE Project Governance Council. Policies should prioritize clear role definition, predictable approval processes, and strengthened coordination with national agencies to ensure that existing governance readiness is translated into timely and accountable project decisions.

2. For National Government Agencies and Regulatory Bodies. National agencies, including the DENR, DOE, DILG, and the PPP Center, should strengthen vertical coordination with second-class municipalities by developing standardized protocols, timelines, and technical support mechanisms for WtE planning, permitting, and financing. Clear and consistent guidance will reduce institutional fragmentation and support municipalities in moving from project preparation to implementation.

3. For LGU Technical, Planning, and Finance Offices. Technical, planning, and finance offices within LGUs should adopt cross-functional risk management systems tailored to WtE projects. Developing WtE-specific risk registers and conducting joint risk reviews will help reconcile differing risk perceptions across functions and experience levels, strengthening decision-making throughout the project life cycle.

4. For Community Stakeholders and Civil Society Organizations. Community stakeholders and civil society organizations should be actively engaged through inclusive, multi-office consultation processes that go beyond environment-office-led engagement. Formal grievance redress and conflict management mechanisms should be supported to ensure that community concerns are addressed transparently and consistently, particularly in managing potential opposition to WtE projects.

5. For Development Partners, Private Sector, and PPP Stakeholders. Development partners and private sector proponents should align their technical and financial support with the governance capacities of second-class municipalities by participating in structured coordination arrangements and transparent risk-sharing frameworks. Strengthening PPP processes will help convert municipal readiness into viable, bankable WtE projects.

6. For Researchers and Capacity-Building Institutions. Researchers and training institutions should further examine how inter-agency coordination, risk governance, and stakeholder engagement influence WtE project outcomes at the municipal level. Applied research and targeted capacity-building programs can support LGUs in embedding the integrated project governance model into routine planning and implementation practices.

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