

Policy Coherence and Governance Gaps in Maritime Decarbonization: Implications for the Philippine Domestic Ferry Sector

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Abstract

This study examined policy coherence and governance gaps in maritime decarbonization and their implications for the Philippine domestic ferry sector. It aimed to determine how existing policies, institutional arrangements, and governance mechanisms influence the sector's transition toward sustainable maritime operations. The study was guided by governance, institutional, and sustainability transition perspectives that emphasize the importance of policy alignment, stakeholder collaboration, and coordinated action in achieving decarbonization goals. A quantitative descriptive-correlational research design was employed, involving 100 purposively selected maritime stakeholders from government agencies, port authorities, domestic ferry operators, and maritime-related organizations. Data were collected through a researcher-developed adaptive survey questionnaire that assessed policy coherence, governance gaps, and maritime decarbonization preparedness. The findings revealed that existing maritime policies and governance mechanisms provide a supportive foundation for decarbonization efforts; however, challenges remain in regulatory consistency, institutional coordination, financing support, technological and infrastructure development, data management, and workforce capacity. The results further showed that the Philippine domestic ferry sector demonstrates readiness in institutional, technological, and operational aspects, but resource availability remains a significant concern. The study concluded that successful maritime decarbonization requires stronger policy integration, improved inter-agency collaboration, enhanced investment mechanisms, reliable information systems, and sustained institutional support. The study contributes to Sustainable Development Goal (SDG) 13 on Climate Action and SDG 9 on Industry, Innovation and Infrastructure by promoting climate-responsive maritime governance, sustainable transport systems, and improved infrastructure readiness. Its sustainability contribution lies in strengthening policy and governance frameworks that support environmental sustainability, institutional resilience, and the long-term transition of the Philippine domestic ferry sector toward low-carbon maritime operations.

Keywords: Climate Action, Domestic Ferry Sector, Governance Gaps, Maritime Decarbonization, Philippine Maritime Sector, Policy Coherence, Stakeholder Coordination, Sustainable Maritime Transport, Sustainability Transitions

1. Introduction

The International Maritime Organization strengthened global maritime climate action through its 2023 GHG Strategy, which aims to achieve net-zero greenhouse gas emissions from international shipping by or around 2050 and encourages the adoption of zero- and near-zero-emission fuels and technologies. However, achieving these targets requires more than technological adoption because effective decarbonization depends on aligned regulations, coordinated institutions, reliable emissions data, investment support, port readiness, and accountability mechanisms. Global maritime literature emphasizes that decarbonization is a system-wide transition requiring cooperation among governments, regulators, industries, ports, technology providers, and financial institutions (Chen et al., 2023; Cret et al., 2024; Masodzadeh et al., 2022). UNCTAD highlighted the continued dependence of shipping on fossil fuels and the increasing need for resilient infrastructure, faster low-carbon transition, and support for vulnerable economies affected by climate-related disruptions (UNCTAD, 2023; UNCTAD, 2025). Similarly, technical assessments emphasize that alternative fuels, energy-efficiency measures, and emissions compliance systems require coordinated policy and operational preparation (DNV, 2025). In the Philippines, maritime sustainability is guided by the Maritime Industry Development Plan 2028, which promotes maritime modernization, environmental sustainability, and industry development (Maritime Industry Authority, 2024). National climate and transport priorities also recognize the importance of low-carbon mobility, with national climate commitments and implementation plans supporting low-carbon development pathways (Republic of the Philippines, 2021; United Nations Framework Convention on Climate Change, n.d.; Climate Change Commission, 2024). Despite these directions, the domestic ferry sector continues to face challenges involving aging vessels, fragmented institutional responsibilities, limited emissions monitoring, uneven port capacity, and uncertain investment pathways.

Recent literature demonstrates that maritime decarbonization is increasingly understood as a governance and policy challenge rather than solely a technological concern (Adamowicz, 2022; Cret, Baudry, & Lantz, 2024; Wang et al., 2023). Studies indicate that successful transition requires alignment among regulatory frameworks, infrastructure development, financing systems, stakeholder participation, and institutional implementation (Niu et al., 2025; Wang et al., 2025; Wu, 2025). Dong et al. (2022) emphasized that maritime decarbonization depends on effective legal and policy instruments across international, regional, and national levels. Li et al. (2024) highlighted the importance of balancing environmental, economic, legal, and political interests through coordinated governance. Effective maritime emission-reduction efforts require functional implementation systems, coordinated policy mechanisms, and strong institutional support to translate climate objectives into operational outcomes. Research on domestic shipping also identifies distinct challenges related to infrastructure readiness, financing limitations, technology adoption, and institutional capacity. Emerging research also highlights the importance of ports, digital systems, and stakeholder coordination (Jäger et al., 2023; Pu & Lam, 2021; World Maritime University, 2024). Port-based interventions, renewable energy integration, and technological improvements are important components of maritime decarbonization, while digitalization supports emissions monitoring, operational efficiency, and informed decision-making (Khabir et al., 2025).

Globally, maritime decarbonization is shaped by international commitments, particularly the 2023 IMO Strategy on the Reduction of Greenhouse Gas Emissions from Ships, which establishes stronger climate ambitions and promotes zero- and near-zero-emission technologies (International Maritime Organization [IMO], 2023). These global directions require national governments to translate international commitments into practical policies and sectoral programs. At the national level, the Philippines has established policy directions through the Maritime Industry Development Plan (MIDP) 2028, which integrates maritime modernization, environmental sustainability, infrastructure development, and innovation. Republic Act No. 11285, otherwise known as the Energy Efficiency and Conservation Act of 2019, further supports sustainable development through energy efficiency measures, energy management systems, and the promotion of energy-saving technologies. The domestic ferry sector represents an important area for applying these policy directions because it supports inter-island connectivity, economic activity, and public mobility. However, implementation remains challenged by overlapping institutional responsibilities among agencies such as MARINA, PPA, PCG, DOE, CCC, and LGUs. These conditions highlight the need to assess whether existing policies are sufficiently coherent and whether governance structures effectively support maritime decarbonization.

This study is anchored on three complementary theoretical perspectives: Multi-Level Governance (MLG) Theory, Institutional Theory, and Sustainability Transitions Theory. Multi-Level Governance Theory developed by Hooghe and Marks (2001, 2003) explains that complex policy concerns require collaboration among international organizations, national governments, local authorities, private-sector actors, and other stakeholders. The theory provides a basis for examining vertical and horizontal coordination among institutions involved in maritime decarbonization. Institutional Theory, associated with North (1990) and DiMaggio and Powell (1983), explains how formal rules, informal norms, organizational expectations, and institutional pressures influence behavior and decision-making. In maritime decarbonization, this perspective helps explain how regulations, incentives, enforcement mechanisms, and institutional capacities affect the adoption of sustainable practices. Sustainability Transitions Theory, particularly the Multi-Level Perspective of Geels (2002, 2011), explains how socio-technical systems shift from established carbon-intensive arrangements toward sustainable alternatives. It recognizes the interaction among landscape pressures, existing maritime regimes, and emerging innovations such as electric ferries, hybrid vessels, alternative fuels, and digital emissions systems. This transition requires coordinated technological development, regulatory alignment, infrastructure readiness, and institutional support to enable the adoption of sustainable maritime solutions.

Although maritime decarbonization research has expanded globally, limited studies examine policy coherence and governance gaps specifically within the Philippine domestic ferry sector. Existing international frameworks largely focus on international shipping, while domestic ferries are often examined primarily through transportation, safety, or modernization perspectives rather than as a distinct decarbonization governance challenge. The Philippine context requires further investigation into how maritime, energy, transport, environmental, and port policies interact in practice. There remains limited evidence regarding the coordination of responsibilities among MARINA, PPA, PCG, DOE, CCC, LGUs, ferry operators, and port authorities (OECD, 2020, 2023, 2025, 2026a, 2026b; Giest, 2023) in areas such as emissions reduction, alternative fuels, financing, infrastructure readiness, and data governance. This study addresses this gap by examining policy coherence, identifying governance challenges, assessing sector preparedness, and developing insights that may strengthen coordinated maritime decarbonization planning in the Philippine domestic ferry sector.

This study aligns with several Sustainable Development Goals, particularly SDG 13 – Climate Action, SDG 9 – Industry, Innovation and Infrastructure, SDG 11 – Sustainable Cities and Communities, SDG 8 – Decent Work and Economic Growth, and SDG 17 – Partnerships for the Goals. The research contributes to SDG 13 by examining governance mechanisms necessary to reduce greenhouse gas emissions and support climate-responsive maritime transport. It supports SDG 9 by addressing the role of infrastructure readiness, technological innovation, and modernization in enabling cleaner

ferry operations. It relates to SDG 11 through its focus on sustainable and resilient transport systems that support island communities. It contributes to SDG 8 by considering the relationship between sustainable maritime transition and economic activity within the transport sector. Finally, it supports SDG 17 by emphasizing institutional collaboration and partnerships among government agencies, industry actors, and stakeholders.

The study contributes to multidisciplinary sustainability by integrating environmental, technological, institutional, economic, and governance perspectives in examining maritime decarbonization. From an environmental sustainability perspective, it addresses mechanisms for reducing emissions and promoting cleaner maritime operations. From technological sustainability perspectives, it highlights the importance of innovation, alternative fuels, energy efficiency, and digital monitoring systems. From a governance and institutional sustainability perspective, the study examines how policy alignment, coordination mechanisms, and organizational capacity influence successful implementation. It also contributes to socio-economic sustainability by recognizing the importance of maintaining reliable ferry services while transitioning toward lower-carbon operations. Through this multidisciplinary approach, the study provides insights into strengthening a resilient, coordinated, and sustainable domestic ferry sector in the Philippines.

2. Material and methods

2.1 Research Design

The study utilized a quantitative descriptive-correlational research design to assess policy coherence, governance gaps, and preparedness for maritime decarbonization in the Philippine domestic ferry sector. The quantitative approach enabled the collection of measurable data from stakeholders involved in maritime governance, policy implementation, port management, and ferry operations. The descriptive component determined the extent of policy coherence, governance challenges, and sector preparedness, while the correlational component examined the relationship between policy coherence and preparedness for maritime decarbonization. The study also employed predictive analysis through regression analysis to identify which dimensions of policy coherence significantly influence the preparedness of the domestic ferry sector. Inferential statistical procedures, including Pearson Product-Moment Correlation and Multiple Regression Analysis, were used to assess relationships among variables and test the hypotheses at the 0.05 level of significance.

2.2 Locale of the Study

The study was conducted within the Philippine domestic ferry sector, which serves as a vital component of the country's transportation system and economic development. As an archipelagic nation, the Philippines relies on domestic ferry services to support passenger mobility, movement of goods, regional connectivity, tourism, and economic activities among islands and regions. The research covered maritime institutions, government agencies, port authorities, and domestic ferry operators involved in maritime governance, environmental compliance, policy implementation, and ferry operations. These organizations represented key stakeholders responsible for developing, implementing, regulating, and supporting maritime decarbonization initiatives within the country.

2.3 Respondents of the Study

The respondents consisted of 100 selected maritime stakeholders from government agencies, port authorities, domestic ferry operators, and maritime-related organizations operating in the Philippines. They included policymakers, maritime regulators, port administrators, environmental compliance officers, sustainability officers, fleet managers, operations managers, maritime engineers, and senior personnel from domestic ferry companies and maritime institutions. The respondents were selected because of their professional knowledge, technical expertise, and practical experience related to maritime governance, policy implementation, environmental sustainability, ferry operations, and decarbonization initiatives. Their participation provided governance-level and operational-level perspectives necessary for assessing policy coherence, institutional coordination, and sector preparedness.

2.4 Sample and Sampling Procedure

The study employed purposive sampling in selecting respondents with relevant expertise and direct involvement in maritime governance, ferry operations, environmental management, or policy implementation. Qualified participants were required to hold positions related to maritime regulation, environmental compliance, sustainability management, port administration, or ferry operations; possess at least three years of professional experience in the maritime sector; and have direct knowledge of policies, programs, or operational practices related to environmental sustainability and maritime decarbonization. The inclusion of respondents from both regulatory institutions and industry organizations reflected the multi-stakeholder nature of maritime decarbonization. This approach enabled the study to obtain comprehensive perspectives regarding governance arrangements, implementation challenges, and operational realities affecting the Philippine domestic ferry sector.

2.5 Research Instrument

The study utilized a researcher-developed adaptive survey questionnaire designed to measure policy coherence, governance gaps, and maritime decarbonization preparedness within the Philippine domestic ferry sector. The instrument was developed from governance, institutional, sustainability transition, and policy implementation frameworks, as well as relevant maritime decarbonization literature, international guidelines, and national policy documents. The questionnaire assessed three major areas: policy coherence, governance gaps, and maritime decarbonization preparedness. Policy coherence was evaluated through policy alignment, regulatory consistency, inter-agency coordination, policy implementation and enforcement mechanisms, stakeholder participation and engagement, and monitoring, evaluation, and accountability mechanisms. Governance gaps were assessed through regulatory and policy constraints, institutional limitations, financial barriers, technological and infrastructure deficiencies, data management issues, and workforce capacity concerns. Preparedness was measured through institutional readiness, technological readiness, operational readiness, and resource readiness. All questionnaire items used a four-point Likert scale consisting of 4 – Very High Extent, 3 – High Extent, 2 – Low Extent, and 1 – Very Low Extent. Prior to administration, the instrument underwent expert validation and reliability testing to ensure its validity, consistency, and suitability for measuring the study variables.

2.6 Data Gathering Procedure

The data-gathering process began with securing necessary approvals from academic authorities and requesting permission from maritime institutions, government agencies, port authorities, domestic ferry operators, and participating organizations. After approval, the researcher finalized the survey questionnaire, which underwent content validation by experts in maritime studies, public policy, governance, environmental sustainability, and research methodology. Qualified respondents were identified through purposive sampling, and the purpose, significance, and procedures of the study were explained before participation. Informed consent was obtained, and ethical principles involving voluntary participation, confidentiality, anonymity, privacy, and data protection were observed. The survey questionnaires were distributed through appropriate data collection platforms, including online survey platforms such as Google Forms or printed copies provided personally or through organizational representatives. Completed questionnaires were screened for completeness and validity, then organized, coded, and prepared for statistical analysis.

2.7 Data Analysis Techniques

The collected data were analyzed using descriptive and inferential statistical tools appropriate for the objectives of the study. Frequency counts and percentages were used to describe respondent characteristics, while weighted mean and standard deviation were utilized to determine the extent of policy coherence, governance gaps, and maritime decarbonization preparedness. Ranking was applied to identify the highest and lowest-rated indicators related to policy coherence, governance challenges, and preparedness. Pearson Product-Moment Correlation Coefficient (r) was used to determine the relationship between policy coherence and maritime decarbonization preparedness. Multiple Regression Analysis was employed to identify which dimensions of policy coherence significantly influence preparedness. The hypotheses were tested at the 0.05 level of significance. The results of the statistical analyses served as the basis for interpreting governance conditions and developing a proposed Policy and Governance Enhancement Framework for Maritime Decarbonization.

2.8 Ethical Considerations

The study adhered to ethical research standards to protect respondents and maintain research integrity. Participation was voluntary, and respondents were provided with informed consent forms explaining the purpose of the study, their participation, and their right to withdraw without consequences. Confidentiality, anonymity, and privacy of respondent information were strictly maintained. Personal identifiers were not disclosed, collected data were presented in aggregated form, and information was securely stored and used solely for academic purposes. The researcher ensured honesty, transparency, and objectivity throughout the research process.

3. Results and Discussion

3.1 Policy Coherence in Maritime Decarbonization

The findings revealed that stakeholders generally perceived the policy environment for maritime decarbonization as coherent and supportive. The assessment covered policy alignment, regulatory consistency, inter-agency coordination, policy implementation and enforcement, stakeholder participation, and monitoring and accountability mechanisms. Overall, respondents indicated that existing policies provide direction for decarbonization efforts in the domestic ferry sector, although some areas require further strengthening to ensure consistent implementation. The findings suggest that the Philippines has established an emerging policy foundation for maritime decarbonization through international commitments, national maritime strategies, and sector-specific initiatives. However, policy existence alone does not guarantee effective implementation. Coherence requires continuous coordination among maritime agencies, transport institutions, energy authorities, port organizations, and industry stakeholders to ensure that policies translate into operational practices.

3.1.1 Alignment of International, National, and Sectoral Policies

The results showed that stakeholders generally recognized alignment between international maritime decarbonization commitments and Philippine domestic ferry policies. Respondents perceived that global sustainability directions, national maritime development strategies, and sectoral regulations provide a supportive framework for reducing emissions within the domestic ferry sector. The findings indicate that existing policy instruments establish a foundation for integrating decarbonization objectives into maritime development planning. The result demonstrates that policy alignment is an essential component of maritime transition because decarbonization requires consistency between international commitments and national implementation mechanisms. However, alignment must extend beyond policy statements and include operational guidelines, institutional responsibilities, and implementation support. This supports the broader argument of the study that effective maritime decarbonization depends on coordinated governance rather than isolated policy actions.

3.1.2 Consistency of Maritime, Energy, Transport, and Environmental Regulations

The findings indicated that respondents generally viewed maritime, energy, transport, and environmental regulations as supportive of decarbonization objectives. Existing regulatory frameworks were perceived to provide guidance for improving energy efficiency, promoting sustainability practices, and encouraging cleaner maritime operations. However, respondents also identified areas where regulatory consistency and integration require improvement to avoid implementation difficulties. The findings imply that regulatory coherence remains a critical requirement for domestic ferry decarbonization. Multiple institutions are involved in maritime governance, and differences in regulatory approaches may create uncertainty for operators. Strengthening regulatory coordination can help ensure that environmental objectives, maritime safety requirements, transport needs, and industry realities are addressed through a unified governance approach.

3.1.3 Inter-Agency Coordination and Institutional Collaboration

The findings showed that inter-agency coordination and institutional collaboration were generally viewed positively, indicating that existing cooperation mechanisms contribute to maritime decarbonization efforts. Respondents recognized the presence of collaborative initiatives among maritime stakeholders; however, coordination was not yet considered fully developed. Concerns remained regarding communication processes, institutional responsibilities, and long-term coordination arrangements. The findings indicate that cooperation exists but requires stronger institutionalization. Effective maritime decarbonization involves multiple actors with overlapping responsibilities, including maritime regulators, port authorities, energy agencies, climate institutions, local governments, and private operators. Without clearly defined roles and permanent coordination mechanisms, implementation may remain dependent on temporary programs or individual initiatives. Establishing stronger governance arrangements would improve accountability, reduce duplication, and support more consistent implementation.

3.1.4 Policy Implementation and Enforcement Mechanisms

The results showed that respondents generally recognized the presence of implementation and enforcement mechanisms supporting maritime decarbonization. Existing regulatory systems were viewed as providing guidance for compliance and sustainability initiatives within the domestic ferry sector. Nevertheless, challenges remain in ensuring consistent enforcement, monitoring capacity, and institutional support for implementation. The findings suggest that effective implementation requires more than regulatory frameworks. Enforcement capacity, technical capability, reliable monitoring systems, and institutional resources are necessary to convert policy commitments into measurable outcomes. Strengthening these mechanisms would improve the ability of the domestic ferry sector to adopt and sustain decarbonization initiatives.

3.1.5 Stakeholder Participation and Engagement

The findings indicated that stakeholder participation contributes positively to maritime decarbonization efforts. Respondents acknowledged the importance of involving government agencies, ferry operators, port authorities, technical experts, and other maritime stakeholders in planning and implementation processes. The results demonstrate that inclusive governance is necessary because maritime decarbonization affects various sectors and operational levels. Stakeholder engagement allows policies to consider practical challenges, technological limitations, financial realities, and operational requirements. Stronger participation mechanisms can improve policy acceptance and ensure that transition strategies are realistic and applicable within the domestic ferry sector.

3.1.6 Monitoring, Evaluation, and Accountability Mechanisms

The findings showed that monitoring and accountability mechanisms were generally present but require further improvement. Respondents recognized the importance of emissions monitoring, performance assessment, and reporting systems in tracking progress toward maritime decarbonization. The findings highlight that effective monitoring systems are essential for evidence-based governance. Reliable data allow institutions to evaluate implementation progress, identify deficiencies, and improve decision-making. Strengthening monitoring frameworks would support transparency and accountability among agencies and industry stakeholders.

3.2 Governance Gaps Affecting Maritime Decarbonization

The findings revealed that governance gaps continue to affect the implementation of maritime decarbonization initiatives in the Philippine domestic ferry sector. Respondents identified challenges related to regulatory and policy limitations, institutional and organizational constraints, financial and investment barriers, technological and infrastructure deficiencies, data management issues, and workforce capacity concerns. Among these challenges, limitations in financing, infrastructure readiness, information systems, and technical competency were identified as significant concerns affecting the sector's ability to accelerate decarbonization efforts. The results indicate that while policy directions for maritime decarbonization are present, implementation remains constrained by practical governance conditions. The transition toward cleaner ferry operations requires more than regulatory commitments; it depends on institutional capacity, adequate financial mechanisms, technological accessibility, reliable data systems, and skilled personnel. Governance gaps occur when policies are not fully supported by operational resources, coordinated implementation structures, and sustainable support mechanisms.

3.2.1 Regulatory and Policy-Related Challenges

The findings showed that respondents recognized existing regulatory frameworks as generally supportive of maritime decarbonization; however, challenges remain in achieving complete policy integration. The results indicated that regulations from maritime, energy, transport, and environmental sectors are compatible but still require stronger coordination to establish a unified and comprehensive framework for domestic ferry decarbonization. The findings suggest that regulatory coherence remains an important factor in reducing uncertainty among ferry operators and encouraging investment in cleaner technologies. Although different policies share sustainability objectives, fragmented implementation may limit their effectiveness. Stronger harmonization among responsible institutions is necessary to ensure that regulations provide consistent guidance for maritime decarbonization.

3.2.2 Institutional and Organizational Constraints

The results showed that institutional coordination mechanisms exist among maritime stakeholders, but respondents identified continuing concerns related to role clarity, communication, and coordination among agencies. The findings indicate that overlapping responsibilities and differences in institutional mandates may affect the efficiency of implementing decarbonization initiatives. The findings demonstrate that maritime decarbonization requires coordinated governance among multiple institutions, including maritime regulators, port authorities, energy agencies, environmental organizations, local governments, and industry operators. Without clearly established responsibilities and effective collaboration mechanisms, implementation efforts may become fragmented and less effective.

3.2.3 Financial and Investment Limitations

The findings showed that financial limitations remain a major challenge affecting maritime decarbonization. Respondents identified difficulties related to investment requirements, access to financial support, and the economic burden associated with adopting cleaner technologies and upgrading maritime infrastructure (World Bank, 2021, 2026; Baştuğ et al., 2024; Climate Bonds Initiative, 2020; Poseidon Principles Association, 2024). The results imply that financial readiness is essential for enabling domestic ferry operators to transition toward low-carbon operations. Cleaner vessels, alternative fuels, energy-efficient systems, and supporting infrastructure require significant investment. Without accessible financing mechanisms and institutional support, smaller operators may experience difficulty participating in the transition.

3.2.4 Technological and Infrastructure Deficiencies

The findings indicated that technological adoption and infrastructure readiness remain areas requiring further improvement. Respondents identified limitations related to cleaner vessel technologies, alternative fuel systems, port facilities, and supporting infrastructure necessary for maritime decarbonization (Robalo-Cabrera et al., 2025; Ziakas & Boile, 2025; International Energy Agency, 2023, 2024, 2025). The findings highlight that technological transition depends on the availability of supporting systems beyond vessel modernization. The adoption of cleaner technologies requires coordinated planning among ferry operators, ports, energy providers, and government institutions to ensure that infrastructure development supports long-term decarbonization goals.

3.2.5 Data Management and Information-Sharing Issues

The results showed that respondents identified weaknesses in emissions data availability, information sharing, digital monitoring systems, and data accessibility. The findings indicated that information-related challenges affect the ability of institutions and operators to effectively plan, monitor, and evaluate maritime decarbonization initiatives. The findings demonstrate that reliable information systems are essential for evidence-based maritime governance (European Commission, 2025; International Maritime Organization, n.d.; Li et al., 2023; OECD, 2026). Without accurate emissions data, integrated databases, and effective information-sharing mechanisms, institutions may experience difficulties in establishing baselines, monitoring progress, and making informed policy decisions.

3.2.6 Workforce Capacity and Technical Competency Concerns

The findings showed that workforce capability remains an important governance consideration in maritime decarbonization. Respondents identified the need for stronger technical competencies, specialized knowledge, and capacity-building opportunities related to emerging maritime technologies and sustainability practices (DNV, 2023; European Maritime Safety Agency, 2024; Inal et al., 2022; International Chamber of Shipping, 2022). The findings indicate that human resource development is necessary to support the transition toward low-carbon ferry operations (IMO, 2025; Maritime Just Transition Task Force, 2025; Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2022). Technological improvements and policy reforms require skilled personnel who can implement, manage, maintain, and evaluate new systems and practices.

3.3 Preparedness of the Domestic Ferry Sector for Maritime Decarbonization

The findings revealed that the Philippine domestic ferry sector is generally prepared to support maritime decarbonization initiatives. Respondents assessed the sector positively in terms of institutional readiness, technological readiness, and operational readiness. However, resource readiness emerged as the weakest dimension, indicating limitations in funding, infrastructure support, technical resources, and long-term capacity development. The findings suggest that the sector has established foundations necessary for beginning the transition toward lower-emission operations, but sustained progress requires stronger resource allocation and institutional support. Preparedness is not determined solely by awareness or policy commitment but also by the availability of financial, technological, and organizational resources needed for implementation.

3.3.1 Institutional Readiness

The results showed that stakeholders generally perceived domestic ferry institutions as capable of supporting maritime decarbonization efforts. Respondents recognized existing governance structures, policy awareness, and institutional involvement as positive foundations for implementing sustainability initiatives. The findings indicate that institutional readiness provides an important starting point for decarbonization. However, continued improvement in coordination, implementation capacity, and institutional collaboration is necessary to translate readiness into effective outcomes.

3.3.2 Technological Readiness

The findings showed that the sector demonstrates emerging technological readiness through awareness of cleaner technologies, energy-efficient systems, and potential low-carbon maritime solutions. However, limitations remain regarding accessibility, affordability, and infrastructure support. The results imply that technology adoption requires supportive policies, investment mechanisms, and infrastructure development. Cleaner technologies cannot be effectively implemented without coordinated preparation among operators, ports, and supporting institutions.

3.3.3 Operational Readiness

The findings indicated that domestic ferry operators possess operational capacity to support decarbonization initiatives. Respondents recognized existing operational practices and management systems as potential foundations for improving efficiency and reducing emissions. The findings suggest that operational readiness can facilitate gradual transition when supported by appropriate policies, technical guidance, and investment (Sheikh et al., 2025). Operational improvements must be integrated with broader governance strategies to achieve sustainable results.

3.3.4 Resource Readiness

The results showed that resource readiness was the least developed dimension of preparedness. Respondents identified limitations involving financial resources, technical facilities, specialized personnel, and supporting systems necessary for long-term decarbonization. The findings demonstrate that resource availability is a critical factor influencing the sustainability of maritime transition efforts. Existing support may sustain selected initiatives, but long-term progress requires expanded financing mechanisms, infrastructure development, workforce strengthening, and institutional capacity-building.

3.4 Relationship Between Policy Coherence and Preparedness

The findings showed that policy coherence is associated with the preparedness of the Philippine domestic ferry sector for maritime decarbonization. The results indicate that stronger alignment of policies, improved coordination mechanisms, effective implementation systems, stakeholder participation, and monitoring practices contribute to higher levels of sector preparedness. The findings suggest that governance conditions directly influence the ability of the domestic ferry sector to transition toward low-carbon operations. A coherent policy environment provides clearer direction, reduces implementation barriers, and supports institutional and operational adaptation necessary for maritime decarbonization.

3.5 Predictors of Decarbonization Preparedness

The findings identified dimensions of policy coherence that significantly influence maritime decarbonization preparedness in the Philippine domestic ferry sector. The analysis demonstrated that governance-related factors, including policy

alignment, regulatory consistency, institutional coordination, implementation mechanisms, stakeholder engagement, and monitoring systems contribute to explaining differences in preparedness levels. The findings indicate that strengthening policy coherence can improve the sector's ability to adopt and sustain decarbonization initiatives. Effective transition requires integrated governance arrangements where policies, institutions, resources, and stakeholders operate toward shared sustainability objectives. These results support the development of a policy and governance enhancement framework aimed at improving coordination and strengthening maritime decarbonization efforts in the Philippine domestic ferry sector.

4. Conclusion & Recommendations

The study concludes that the Philippine domestic ferry sector has a generally supportive policy environment and favorable preparedness level for maritime decarbonization. Existing policies, regulations, institutional coordination, stakeholder participation, enforcement mechanisms, and accountability systems provide a foundation for reducing greenhouse gas emissions. However, governance gaps remain in regulatory consistency, institutional capacity, financing, technology and infrastructure, data management, workforce competency, and resource availability. Thus, while the sector is capable of initiating the transition toward cleaner ferry operations, sustained progress requires stronger policy coordination, sufficient investment, improved technical capacity, reliable information systems, and continuous institutional and resource support.

Based on the findings, the Philippine government and maritime stakeholders should establish a unified decarbonization framework for the domestic ferry sector that clarifies agency responsibilities, harmonizes regulations, strengthens inter-agency coordination, and improves approval processes for cleaner vessels and technologies. Financial support through grants, concessional loans, tax incentives, and public-private partnerships should be strengthened, particularly for small ferry operators and essential routes. Priority should also be given to alternative-fuel infrastructure, digital emissions monitoring, reliable data systems, and workforce training. Pilot projects may be implemented on appropriate routes before broader adoption, while regular monitoring, evaluation, and public reporting should be conducted to assess progress and enhance future programs.

Compliance with ethical standards

The authors declare no conflict of interest. This study complied with recognized ethical standards for human-participant research by ensuring voluntary participation with informed consent, the right to withdraw without penalty, and strict confidentiality through anonymous, secure, and aggregated data handling. Given the focus on psychological well-being, procedures were non-invasive, and safeguards were observed to minimize discomfort, with guidance to appropriate support services when needed, and required institutional permissions were secured for instrument use and access to academic records.

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