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Research Article

The Role of Filipino Early Career Ocean Professionals (ECOPs): Challenges and Opportunities in the Philippine Domestic Shipping Decarbonization

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ABSTRACT

The global shipping sector faces strong decarbonization targets, requiring major emission cuts by 2030, 2040, and net zero by 2050. In the Philippines, domestic shipping is vital for connectivity, making this challenge urgent. This study explored Filipino ECOPs' roles, awareness, challenges, and opportunities in advancing maritime decarbonization policies and practices.

A mixed-methods design was employed, combining survey responses from ECOPs, semi-structured interviews with participants, and document analysis of national and international maritime policies. Quantitative analysis assessed awareness and readiness levels, while qualitative insights revealed systemic challenges and enabling conditions.

The findings revealed that ECOPs demonstrate moderate to high awareness of environmental aspects of decarbonization (68.6%), yet significant gaps persist in regulatory knowledge, economic understanding, and technical applications (48%). Opportunities for ECOPs' engagement were rated as "moderate potential" (WM = 3.22), with enabling factors deemed "sufficient" (WM = 2.85). Respondents recognized ECOPs' capacity to drive technological adoption and policy innovation, though barriers, including restricted access to decision-making, inadequate training, and limited mentorship, pose "major challenges" (WM = 3.15). Policy analysis affirmed national alignment but underscored weak mechanisms for meaningful ECOP participation.

ECOP integration is vital to strengthening the Philippines' maritime decarbonization agenda. Strategic measures such as advisory councils, capacity-building programs, and curriculum reforms are recommended to empower ECOPs for of sustainable shipping transitions in archipelagic contexts.

Keywords: *Maritime decarbonization, Domestic shipping, Early Career Ocean Professionals (ECOPs), Sustainable shipping, Policy integration, Capacity building, Philippines*

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Background

The world's oceans are facing increasing pressures as maritime transport, which carries over 90% of global trade, is required to reduce its contribution to climate change. The International Maritime Organization has set ambitious targets for reducing greenhouse gas emissions from shipping, aiming for 20% reduction by 2030, 70% by 2040, and net zero by 2050. These global commitments have significant implications for regions such as Southeast Asia, where nations rely heavily on shipping for trade and connectivity, but also face acute risks from climate change impacts.

For the Philippines, domestic shipping is the lifeline that connects communities and sustains economic and social development. This sector is now under increasing scrutiny to adopt sustainable practices while maintaining its essential role in national growth. Meeting decarbonization targets poses not only technological and regulatory challenges, but also requires active involvement of the maritime workforce. Early Career Ocean Professionals (ECOPs) represent a key group in this transition, as they bring fresh perspectives, adaptability, and long-term engagement potential. However, their capacity to meaningfully contribute depends on opportunities for training, mentorship, and policy integration. While studies have examined technical and regulatory aspects of shipping decarbonization, limited research exists on the role of ECOPs in domestic shipping, particularly in archipelagic nations such as the Philippines.

This article reports on a study that examines the role of Filipino ECOPs in domestic shipping decarbonization, focusing on their awareness, challenges, and opportunities for greater participation in shaping sustainable maritime practices.

Methods

Research Design

The study adopted a mixed-methods design to comprehensively assess the role of ECOPs in maritime decarbonization. This approach combined quantitative survey analysis with qualitative interviews and document review to capture both breadth and depth of perspectives.

Participants and Sampling

Using *Raosoft* calculator, survey respondents included 383 Filipino ECOPs working in various maritime sectors. A purposive sampling technique was applied to target participants since specific criteria needs to be met such as having relevant knowledge and involvement in shipping operations, training, or policy. Participants from government agencies, industry organizations, and academic institutions were selected for semi-structured interviews to provide institutional perspectives. Convenience sampling was also employed since the participants availability and willingness to answer open ended questions were also considered.

Survey Instrument

A structured questionnaire was developed and validated to measure awareness, knowledge, opportunities, and barriers related to shipping decarbonization. Items covered environmental, regulatory, and technical dimensions, using Likert-scale measures to quantify responses. Pilot testing ensured clarity and reliability prior to full deployment.

Interviews

Semi-structured interviews were conducted with participants to gather qualitative insights. Open-ended questions explored perceptions of ECOP roles, policy integration, and capacity-building needs. Interviews were transcribed, coded, and thematically analyzed to identify recurring patterns and insights.

Document Analysis

Relevant policy documents and frameworks were reviewed, including national decarbonization roadmaps, international maritime regulations, and institutional competency guidelines. Documents were classified according to relevance and systematically examined to assess alignment with ECOP participation and workforce development.

Data Analysis

Quantitative survey data were analyzed using descriptive and inferential statistics to assess awareness levels and identify gaps.

Qualitative data from interviews and documents were analyzed thematically to contextualize findings and triangulate results across multiple sources.

Results and Discussions

Awareness of ECOPs on Maritime Decarbonization

The findings in Table 1 demonstrate that Filipino ECOPs exhibit an overall high level of awareness (68.6%), reflecting a strong foundation in the environmental dimensions of maritime decarbonization. The highest awareness levels were observed in areas directly tied to international frameworks and technical solutions, such as understanding maritime decarbonization (82.2%), identifying energy efficiency measures (79.1%), and recognizing electric and hybrid vessel technologies (78.9%). These results suggest that ECOPs are most informed about globally promoted concepts that are emphasized in both training curricula and international policy discourse.

However, a clear contradiction emerges when comparing technical-environmental awareness with knowledge of economic and policy mechanisms. Despite their strong grasp of technological and environmental indicators, awareness of carbon pricing mechanisms was notably low (48.0%), underscoring a significant gap in understanding the economic instruments that are central to international decarbonization frameworks. This imbalance suggests that while ECOPs are prepared to engage with the technical and environmental dimensions of decarbonization, they may be less equipped to participate in regulatory and policy-driven decision-making processes.

Another important insight is that while ECOPs demonstrated strong knowledge of green shipping technologies (71.0%) and environmental impact assessments (71.3%), their lower awareness of the Philippines' specific 2030 greenhouse gas reduction commitment (60.3%) indicates a disconnect between international discourse and localized policy frameworks. This finding reinforces the need for capacity-building efforts that not only transfer global knowledge but also contextualize it within national policy commitments and governance mechanisms.

Overall, the results affirm that ECOPs possess the technical-environmental literacy required to contribute to decarbonization initiatives but face critical knowledge gaps in policy fluency and economic instruments. Addressing these gaps through targeted training, mentorship, and policy engagement is essential to fully harness their potential as partners in achieving the Philippines' maritime decarbonization goals.

Table 1. Level of Awareness Among ECOPs Regarding Maritime Decarbonization

Indicators	Correct		Interpretation
	n	%	
1. Which of the following best describes maritime decarbonization?	315	82.2	Very High
2. What is the Philippines' commitment for greenhouse gas emission reduction by 2030?	231	60.3	High
3. According to the International Maritime Organization (IMO), what is the target year for achieving net-zero greenhouse gas emissions from international shipping?	260	67.9	High
4. Which of the following is considered an alternative marine fuel for decarbonization?	223	58.2	High
5. Environmental impact assessment of domestic shipping operations typically evaluates:	273	71.3	High
6. Which of the following are energy efficiency measures for vessels?	303	79.1	Very High
7. Electric and hybrid vessel technologies are most suitable for:	302	78.9	Very High

Indicators	Correct		Interpretation
	n	%	
8. Port-based decarbonization initiatives typically include:	263	68.7	High
9. Carbon pricing mechanisms in shipping work by:	184	48.0	Low
10. Current developments in green shipping technologies include:	272	71.0	High
Average	263	68.6	High

Note. Percentages are based on total number of respondents (*N*) = 383

Knowledge and Skills Essential for ECOPs to Effectively Support Decarbonization – Thematic Analysis

Structured interviews with five participants were analyzed using Braun and Clarke's (2006) six-phase thematic analysis, which provided a systematic framework for identifying patterns within the qualitative data. The analysis generated several themes reflecting the essential knowledge and skills required by Early Career Ocean Professionals (ECOPs) to meaningfully contribute to maritime decarbonization.

Foundational Technical Knowledge

Participants consistently highlighted the need for ECOPs to strengthen their technical expertise in alternative fuels, energy efficiency technologies, digital monitoring systems, and environmental assessments. While many ECOPs possess theoretical familiarity, gaps remain in operational mastery, particularly in handling emerging fuels such as ammonia and hydrogen. Participants emphasized that compliance with safety and regulatory standards requires not only awareness but also practical competence in applying these technologies.

Policy Literacy

Another critical theme was the lack of policy and regulatory literacy. Respondents noted that ECOPs often struggle to interpret maritime environmental regulations and connect them with technical practices. Without policy fluency, technical competence risks becoming disconnected from compliance requirements. Strengthening regulatory knowledge is essential for aligning technical skills with evolving international and national decarbonization frameworks.

Management Skills

Weaknesses in project management, leadership, and organizational competencies were also reported. Participants pointed out difficulties in scheduling, planning, and timeline management. These limitations hinder ECOPs' ability to oversee complex sustainability projects. The findings underscore the need for deliberate capacity-building initiatives focused on managerial and leadership development.

Communication and Cross-Cultural Competence

Communication emerged as another recurring challenge. Many ECOPs were described as hesitant to present ideas to senior officials or external agencies and struggled with data presentation. Given the international and multicultural nature of maritime work, the development of strong communication and intercultural competence is critical to ensuring ECOPs can actively participate in decision-making processes and collaborations.

Digital Proficiency Gap

Although ECOPs are generally proficient in basic digital tools, participants observed gaps in sector-specific digital systems and maritime software. This deficiency may limit their ability to engage with advanced monitoring and environmental data analytics systems essential to decarbonization. Integrating maritime-specific digital training into educational programs is therefore crucial.

Knowledge and Skills Requirements – Document Analysis

The document analysis drew upon five key sources: the 10-Year Maritime Industry Development Plan (MIDP) 2021, the IMO 2023 GHG Strategy, the ECOP Policy Brief 2023, the

Philippine Development Plan (PDP) 2023–2028, and the Philippine NDC Implementation Plan 2023–2030. Using the SOP2 framework, the analysis identified convergences and divergences in the treatment of knowledge and skills relevant to maritime decarbonization and ECOP integration.

Convergence on Foundational Competencies

Across all five documents, consistent emphasis was placed on policy and regulatory literacy, environmental knowledge, leadership competencies, and lifelong training systems. The IMO 2023 GHG Strategy highlighted compliance with MARPOL Annex VI, EEXI, and CII, while the MIDP underscored environmental protection standards and international convention enforcement. Similarly, the PDP linked climate action to workforce skill development, and the NDC Implementation Plan stressed MRV literacy and GHG inventory management. Collectively, these documents affirm the necessity of integrating regulatory fluency with technical and environmental competencies.

Technical Knowledge and Skills

Technical competencies emerged strongly in the MIDP, IMO strategy, and NDC Plan, though framed differently. The MIDP focused on inspection, pollution control, and alternative fuel handling; the IMO prioritized zero- and near-zero GHG fuels and life-cycle assessments; and the NDC Plan highlighted renewable energy and transport decarbonization. In contrast, the PDP addressed technical skills broadly within labor frameworks, while the ECOP Policy Brief emphasized advocacy and ecosystem protection over technical detail.

Digital and MRV Competencies

Digital literacy and MRV skills were highlighted in the IMO strategy, MIDP, PDP, and NDC Plan. These documents stressed ICT applications, emissions tracking, and integration of digital competencies into education and training. The ECOP Policy Brief, however, did not explicitly reference MRV or digital tools, focusing instead on advocacy and youth participation—indicating a gap between advocacy frameworks and technical-regulatory requirements.

Divergent Perspectives on ECOP Roles

The ECOP Policy Brief was the only document to explicitly define ECOPs, framing them as governance partners and advocates. In contrast, national and international frameworks tended to subsume ECOPs within the general workforce, focusing primarily on technical compliance and training. This divergence highlights a structural disconnect between how ECOPs envision their roles and how policy frameworks currently integrate them.

Capacity Gaps and Development Needs

All five documents acknowledged gaps impeding decarbonization readiness. The MIDP cited weak fuel-handling capacity, the IMO emphasized outdated training standards, the PDP noted implementation gaps in climate action tools, and the NDC Plan identified shortages in MRV specialists. Meanwhile, the ECOP Policy Brief highlighted non-technical deficits such as lack of mentorship, limited recognition in governance, and inadequate funding support.

Education and Training Frameworks

Education and training emerged as a universal theme. The IMO and MIDP pointed to future revisions of training standards, the PDP emphasized labor market alignment, and the NDC Plan called for upskilling in renewable energy and emissions monitoring. The ECOP Policy Brief stressed advocacy training and intergenerational mentorship. Together, these documents suggest a dual imperative: technical mastery of decarbonization technologies must be paired with governance literacy and advocacy capacity.

Opportunities and Enablers Supporting ECOPs' Contribution to Maritime Decarbonization Efforts

Opportunity Areas

Table 2 presents the weighted mean scores for the identified opportunity areas. The highest-rated opportunity was the advancement of research and development on alternative fuels (WM = 3.70, SD = 0.458), reflecting strong consensus that ECOPs can meaningfully contribute to innovation in green ammonia, hydrogen, methanol, and biofuels. Conversely,

infrastructure development for sustainability scored lowest (WM = 2.60, SD = 0.799), indicating only moderate potential, largely due to systemic and financial barriers in scaling port and energy infrastructure.

On average, the composite score across all indicators was WM = 3.22 (SD = 0.597), interpreted as moderate potential. This suggests that while ECOPs recognize multiple entry points for contributing to decarbonization, their effectiveness is contingent on the development of enabling systems and long-term investment.

The findings are consistent with broader industry evidence that technological innovation in fuels is advancing rapidly, whereas infrastructure development continues to lag. This gap underscores the importance of aligning R&D momentum with parallel efforts in infrastructure, policy, and financing to fully unlock ECOPs' potential in advancing maritime decarbonization.

Table 2. Opportunities Area Supporting ECOPs' Contribution to Maritime Decarbonization Efforts

Indicators	*WM*	*SD*	Interpretation
1. Technology adoption in shipping	3.20	0.748	Moderate Potential
2. Environmental policy development	3.40	0.491	High Potential
3. Environmental policy review	3.31	0.461	High Potential
4. Sustainability training programs	3.29	0.455	High Potential
5. Capacity building programs	3.19	0.602	Moderate Potential
6. Research and development of alternative fuels	3.70	0.458	High Potential
7. Digital solutions for emission monitoring	2.90	0.303	Moderate Potential
8. Digital solutions for emission reporting	3.29	0.455	High Potential
9. Green port operations	3.30	0.781	High Potential
10. Infrastructure development for sustainability	2.60	0.799	Moderate Potential
11. Industry-academia collaboration on sustainability projects	3.30	0.457	High Potential
12. International maritime environmental initiatives	3.30	0.457	High Potential
13. Participant engagement activities	3.40	0.490	High Potential
14. Public awareness campaigns	2.90	0.296	Moderate Potential
Composite *WM*	3.22	0.597	Moderate Potential

Note. 3.25–4.00 (High Potential); 2.50–3.24 (Moderate Potential); 1.75–2.49 (Limited Potential); 1.00–1.74 (No Potential)

Enablers

Table 3 presents the weighted mean scores for the enablers supporting ECOPs. Analysis shows that the indicator no. 7 received the highest weighted mean (*WM* = 3.19, *SD* = .744), indicating that the respondents agree that policy advocacy platforms are sufficient as an enabler for maritime decarbonization. On the other hand, the indicators no. 1 and 10 received the lowest weighted mean (*WM* = 2.58, *SD* = 1.017, 1.019), indicating that the respondents only agree that government support and educational institution partnerships are sufficient as enablers.

Overall, the results indicate that the respondents generally perceive a "sufficient" enabler supporting ECOPs' contribution to maritime decarbonization efforts (*WM* = 2.85, *SD* = .850). This goes with findings that also point to the importance of stakeholder engagement and policy advocacy as important parts in making maritime decarbonization strategies more effective, since these areas are often where different actors such as government, industry, and research groups can meet, share ideas, and push for stronger action. It also shows that without continuous involvement of participants and without active platforms for policy advocacy, many of the strategies for decarbonization may remain slow to implement or may not reach the expected outcomes (Mallouppas, 2021).

Table 3. Enablers Supporting ECOPs' Contribution to Maritime Decarbonization Efforts

Indicators	*WM*	*SD*	Interpretation
1. Government support	2.58	1.017	Sufficient
2. Industry mentorship programs	2.69	1.007	Sufficient
3. Access to advanced technology and tools	2.89	0.700	Sufficient
4. Professional development opportunities	2.79	0.749	Sufficient
5. International collaboration platforms	2.79	0.749	Sufficient
6. Research and development partnerships	3.09	0.541	Sufficient
7. Policy advocacy platforms	3.19	0.744	Sufficient
8. Innovation accelerators	2.89	0.712	Sufficient
9. Cross-sector networking opportunities	2.98	0.898	Sufficient
10. Educational institution partnerships	2.58	1.019	Sufficient
Composite *WM*	2.85	0.850	Sufficient

Note. 3.25–4.00 (Highly Sufficient); 2.50–3.24 (Sufficient); 1.75–2.49 (Somewhat Sufficient); 1.00–1.74 (Insufficient)

Thematic Analysis

Braun and Clarke's (2006) six-phase thematic analysis were still employed to systematically analyze the structured interview responses of participants.

Technology-Led Opportunity Space for ECOPs

Participants consistently located ECOPs' strongest immediate opportunities in digital solutions for emission monitoring (MRV), alternative-fuel R&D, and related infrastructure. Illustrative remarks included: "Big chance in policy writing and compliance check, also in monitoring ships emission" (Participant 1, MARINA); "Good opportunity in energy efficiency and alternative fuel research" (Participant 2, DOE Policy); and "R&D projects are main chance, like testing biofuels and emission reduction" (Participant 3, DOE Research). Ports likewise see roles in environmental monitoring: "They can join in environmental monitoring at ports, carbon check, waste system" (Participant 4, PPA).

These observations mirror international evidence that digitalization enables decarbonization and unlocks energy-efficiency gains (UNCTAD, 2023), while zero-carbon fuels (ammonia, methanol, hydrogen) create new R&D and infrastructure roles and opportunities, including for developing countries (World Bank, 2021). Skills roadmaps emphasize urgent upskilling for green and digital operations (DNV, 2023).

Policy and Governance Engagement as a High-Value Contribution Path

Participantsdescribed concrete, near-term roles in policy development and review, compliance work, and stakeholder engagement: "One group of ECOPs help draft compliance manual for domestic ships" (Participant 1); "We had ECOP interns help in drafting energy transition roadmap" (Participant 2); "Opportunity is in policy review, compliance audits, and stakeholder consult" (Participant 5, DOTr). Global guidance supports this direction that the IMO's strengthened GHG strategy and the broader decarbonization agenda require system-wide collaboration and swift regulatory measures, opening room for practitioner input and implementation support (UNCTAD, 2023).

Capacity-Building and Education Pathways (Training, PD Design, Awareness)

Respondents pointed to training-centric opportunities and enablers: "We give training sessions and workshops" (Participant 1); "We offer policy seminar and staff development" (Participant 2); "Provide field training at ports, not only classroom" (Participant 4). They also flagged PD design and scholarships: "Funding support and training scholarships will help a lot" (Participant 2). The literature supports that seafarer and shore-side workforces need rapid upskilling for fuels expected this decade and for digital systems (DNV & SMF, 2023; DNV, 2023).

Innovation, Pilots, and Cross-Sector Collaboration

ECOPs can add value through applied research, pilot studies, and corridor-style collaborations: "One ECOP team worked on a pilot study for methanol fuel test" (Participant 3); "Work with DOE, DENR, ECOPs can be in project teams" (Participant 4). Green shipping corridors specifically promote multi-actor pilots that de-risk novel fuels/tech and accelerate scale-up (Getting to Zero Coalition/Global Maritime Forum, 2021; Mission Innovation, 2023.)

Enabler Sufficiency vs. Gaps—Partnerships Strong; Government Support, Mentorship, and Advanced Tech Access Weak

The respondents judged educational partnerships, networking, and professional development as generally present, but emphasized critical deficits in government support, industry mentorship, and access to advanced technology: "Mentorship is informal only" (Participant 1); "Mentorship weak, senior don't have time always" (Participant 3); "Government must give direction and budget for skill development" (Participant 5); and "Access to advanced technology" rated lowest in Table 3.8. Global assessments echo these constraints that the transition demands large-scale training reform (with STCW modernization under review) and investment in new fuels and landside infrastructure, particularly challenging for the Global South (Reuters, 2024; UNCTAD, 2023; World Bank, 2021).

Institutionalizing Inter-Agency Collaboration and ECOP Representation

Finally, participants asked for formal seats for ECOPs in inter-agency work: "Collab thru inter-agency task force, but ECOP seldom included" (Participant 1); "Joint policy drafting… but ECOP not always invited" (Participant 2); "Inter-agency group must include ECOP representation" (Participant 5). International studies argue that structured, multi-stakeholder governance (e.g., corridor coalitions) accelerates adoption and creates pathways for early-career talent to contribute visibly and continuously (Global Maritime Forum, 2021; UNCTAD, 2023).

Challenges and Barriers Faced by ECOPs in Decarbonization

Table 4 present the challenges and barriers ecops faced in engaging with decarbonization efforts. Analysis shows that the indicators no. 6, 7, 8, 9, and 10 were rated as critical barriers, indicating that the respondents strongly agree that resistance to change from established industry practices (WM = 3.61, SD = .489), limited access to relevant technology and tools (WM = 3.30, SD = .460), unclear career pathways in maritime sustainability (WM = 3.40, SD = .491), insufficient networking opportunities (WM = 3.80, SD = .403), and language barriers in international forums (WM = 3.29, SD = .455) are considered as critical barriers in their engagement with decarbonization.

On the other hand, the indicators no. 1, 2, 3, 4, 5, 11, and 12 were rated as major challenges, indicating that the respondents only agree that limited access to decision-making positions (WM = 2.79, SD = .749), insufficient funding for professional development (WM = 2.68, SD = 1.273), lack of mentorship and guidance (WM = 3.08, SD = .947), limited recognition of ECOP capabilities by senior professionals (WM = 2.50, SD = 1.114), inadequate educational preparation for sustainability challenges (WM = 3.10, SD = 1.384), cultural barriers to innovation and change (WM = 3.10, SD = .306), and limited research and development opportunities (WM = 3.20, SD = .397) are major challenges in their engagement with decarbonization.

Overall, the results indicate that the respondents generally perceive the barriers faced by ECOPs as "major challenge" in engaging with decarbonization efforts (WM = 3.15, SD = .869). This goes with literature that shows policy gaps, weak institutional support, and limited integration of ECOPs in decision-making are repeated and big barriers in shipping decarbonization, and it also points out that without stronger policies and more support, these barriers will continue to slow down the progress of the sector toward meeting decarbonization targets (Masodzadeh et al., 2022).

Table 4. Challenges And Barriers ECOPs Faced in Engaging with Decarbonization Efforts

Indicators	*WM*	*SD*	Interpretation
1. Limited access to decision-making positions	2.79	0.749	Majority Challenge
2. Insufficient funding for professional development	2.68	1.273	Majority Challenge
3. Lack of mentorship and guidance	3.08	0.947	Majority Challenge
4. Limited recognition of ECOP capabilities by senior professionals	2.50	1.114	Majority Challenge
5. Inadequate educational preparation for sustainability challenges	3.08	1.384	Majority Challenge
6. Resistance to change from established industry practices	3.61	0.489	Critical Barrier
7. Limited access to relevant technology and tools	3.30	0.460	Critical Barrier
8. Unclear career pathways in maritime sustainability	3.40	0.491	Critical Barrier
9. Insufficient networking opportunities	3.80	0.403	Critical Barrier
10. Language barriers in international forums	3.29	0.455	Critical Barrier
11. Cultural barriers to innovation and change	3.10	0.306	Majority Challenge
12. Limited research and development opportunities	3.20	0.397	Majority Challenge
Composite *WM*	3.15	0.869	Majority Challenge

Note. 3.25–4.00 (Critical Barrier); 2.50–3.24 (Major Challenge); 1.75–2.49 (Minor Challenge); 1.00–1.74 (Not a Challenge)

Integration of ECOP Perspectives in National Maritime Decarbonization Strategies

The synthesis of SOP 1 to SOP 4 into SOP 5 highlights that the integration of Filipino Early Career Ocean Professionals (ECOPs) into maritime decarbonization requires a multi-dimensional strategy (Table 7). Findings reveal that while ECOPs demonstrate high awareness and theoretical knowledge, they continue to face persistent gaps in practical training, limited policy participation, and barriers such as insufficient mentorship and restricted access to advanced technology. At the same time, opportunities exist in technology adoption, policy development, and innovation, if these are formalized and supported by strong institutional mechanisms.

The integration strategies therefore emphasize upgrading technical competencies through applied training, embedding ECOPs into national and inter-agency policy structures, addressing barriers through mentorship and funding, and positioning government as the central enabler of systematic support. Collectively, these measures ensure that ECOPs are not only workforce participants but also active policy contributors and innovation leaders in the Philippines' domestic shipping decarbonization agenda.

Global evidence strengthens these findings. The IMO and Maritime Just Transition Task Force estimate that by 2030, around 450,000 seafarers will require additional training, with the number rising to 800,000 by the mid-2030s, primarily in handling ammonia, hydrogen, and methanol fuels—areas not currently covered by STCW standards (Reuters, 2024; Lloyd's Register, 2024). This mirrors the skills gaps identified in SOP 2 of this study, where ECOPs were found strong in theory but weak in practical application.

National frameworks also affirm the urgency of green skills integration. The Philippine Development Plan 2023–2028 calls for embedding lifelong learning and green competencies within curricula, technical training, and labor market systems (NEDA, 2023). Similarly, the NDC Implementation Plan 2023–2030 stresses the importance of MRV system knowledge, project-level technical capacity, and reskilling programs for workers displaced by just transition measures (CCC & DENR, 2023).

Taken together, these documents align with ECOP-driven calls for governance inclusion, as highlighted in the ECOP Policy Brief 2023, which frames ECOPs not just as technical implementers but as policy advocates and intergenerational partners in ocean governance

(European Marine Board & UN ECOP Programme, 2023). Thus, integration strategies must combine technical mastery (fuel handling, MRV, compliance) with governance and advocacy capacities, ensuring that ECOPs evolve as both decarbonization specialists and policy influencers in the Philippine maritime sector.

Table 5. Integration Framework

SOP Source	Key Findings / Issues	Integration Strategy
SOP 1: Awareness	ECOPs aware of decarbonization concepts but limited understanding of complex mechanisms (e.g., carbon pricing, market-based measures).	Develop advanced awareness programs that go beyond basics, covering IMO GHG targets, carbon pricing, and environmental impact assessment; integrate modules in curricula and seminars.
SOP 2: Knowledge & Skills	Strong theoretical knowledge of alternative fuels and digital systems but weak in practical application; education too theoretical.	Establish simulation-based training centers, shipboard immersion, and practical modules on hydrogen, ammonia, and methanol fuel handling, plus MRV systems; align curricula with IMO competency frameworks.
SOP 3: Opportunities & Enablers	ECOPs have potential in tech adoption, policy review, training, and innovation, but participation remains informal and underutilized.	Create formal roles for ECOPs in inter-agency policy drafting, R&D consortia, and compliance audits; institutionalize ECOP representation in green shipping corridor initiatives and national task forces.
SOP 4: Challenges & Barriers	Barriers include lack of mentorship, weak access to advanced technology, insufficient funding, and exclusion from decision-making.	Implement structured mentorship programs, allocate government funding for ECOP capacity-building, provide access to modern tools and laboratories, and create ECOP networking/exchange platforms.
Cross-Cutting Finding (All SOPs)	Government seen as the primary enabler but current support fragmented and inconsistent.	Government to update STCW framework to include sustainability competencies, integrate ECOP development into PDP and NDC strategies, establish public–private partnerships for ECOP-led projects, and ensure stable funding mechanisms for training and R&D.

Conclusion

This study explored the role of Filipino (ECOPs) in the decarbonization of Philippine domestic shipping through survey data, stakeholder interviews, and document analysis. ECOPs show strong awareness of decarbonization goals, alternative fuels, and efficiency measures. However, significant limitations persist in advanced policy literacy, such as carbon pricing mechanisms, and in the practical application of emerging technologies. While ECOPs show motivation and potential to support sustainable transitions, their contributions are constrained by theory–practice gaps, inadequate mentorship, limited access to decision-making processes, and insufficient institutional support. Participants acknowledged their promise in technology adoption, environmental policy development, and research, yet their involvement remains largely informal, short-term, and underfunded.

To address these challenges, it is recommended that maritime institutions, government agencies, and industry participants strengthen ECOP engagement through a dual approach that combines technical mastery with governance integration. Expanding awareness campaigns and embedding decarbonization literacy into higher education curricula will ensure a broader and more comprehensive

understanding of complex mechanisms such as emissions trading and market-based measures. Bridging theory and practice through simulation-based training, shipboard immersion, and exposure to digital monitoring systems will enhance practical readiness. Equally important is the development of communication, leadership, and cross-cultural competencies through structured mentorship and soft-skill training programs.

Institutionalizing ECOP participation in policy-making bodies, advisory councils, and inter-agency platforms is essential to ensure sustained involvement and recognition. Government agencies such as MARINA, DOE, and PPA must update competency frameworks like STCW to reflect decarbonization skills, while embedding ECOP development explicitly in national strategies such as the Philippine Development Plan (PDP) and the Nationally Determined Contributions (NDC). Public–private partnerships should be leveraged to provide access to laboratories, simulators, and funding support, while international collaborations will expand ECOP exposure to best practices worldwide.

In sum, the integration of ECOPs into the decarbonization agenda requires systemic reforms that combine education, training, policy inclusion, and mentorship. Strengthening both technical and governance capacities will allow ECOPs to emerge not only as implementers of sustainable shipping practices but also as policy shapers and innovators in the maritime transition toward a low-carbon future.

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