The International Maritime Transport and Logistics (MARLOG 14) - ISSN 2974-3141
http://dx.doi.org/10.21622/MARLOG.2025.14.1.64
Artificial Intelligence Implementations Towards Shaping the Future of Digital World

SEANERGY PROJECT MASTER PLAN FOR PORT ENERGY TRANSITION

Anas S. Alamoush [1] Fabio BALLINI[2] and Monica Canepa [3]

Maritime Energy Management, World Maritime University, Malmö, Sweden, asa@wmu.se

Maritime Energy Management, World Maritime University, Malmö, Sweden, fb@wmu.se

Maritime Energy Management, World Maritime University, Malmö, Sweden, moc@wmu.se

ABSTRACT

The SEANERGY Master Plan (MP) for Port Energy Transition, developed under the Horizon Europe SEANERGY project (grant agreement number 101075710), represents the project's Deliverable D3.1. It provides a comprehensive framework for guiding European ports in adopting sustainable energy practices and achieving carbon neutrality. Ports are vital players in the global logistics network and are pivotal in advancing decarbonization and energy transition. This deliverable outlines a structured three-phase approach — High-Level Vision, MP Development, and Review and Implementation — to enable ports to transition to renewable energy while maintaining efficiency. By integrating stakeholder insights, innovative technologies, and policy alignment, the SEANERGY MP sets a new standard for sustainable port operations. This study charts a dynamic roadmap for aligning port operations with the EU's and international climate neutrality goals, ensuring that ports emerge as leaders in the green energy transition.

Keywords: SEANERGY, Port Energy Transition, Sustainability, Decarbonization, Master Plan

1. INTRODUCTION

Transitioning to renewable energy is critical to mitigating climate change, and ports are uniquely positioned to lead this effort (Alamoush, Ballini, and Ölçer 2024b; Alamoush 2024b, 2024a). As major energy consumers and emission contributors, ports face significant challenges, including the need for infrastructure adaptation, stakeholder alignment, and regulatory compliance (Alamoush et al. 2023). Different studies have emphasized the urgency of integrating sustainable practices into port operations (de Langen and Sornn-Friese 2019; Santos, Rodrigues, and Branco 2016; Gilman 2003; van den IJssel 2019; Denktas-Sakar and Karatas-Cetin 2012; Schipper, Vreugdenhil, and de Jong 2017).

Ports are critical for global trade but face significant environmental challenges, including high emissions and energy consumption (Alamoush, Ballini, and Ölçer 2024a; Alamoush, Ölçer, and Ballini 2022; Alamoush, Ballini, and Ölçer 2020). Many international and regional regulations and directives are pressing on ports to engage in the energy transition. For instance, the EU's directives, such as the European Green Deal and 'Fit for 55,' aim to reduce greenhouse gas emissions by 55% by 2030 and achieve climate neutrality by 2050. Key milestones include:

- 2025: Establishing alternative fuel and charging infrastructure.
- 2030: Introducing stricter limits on maritime emissions and incentivizing cleaner fuels.
- 2050: Transforming ports into fully climate-neutral hubs.

Studies addressed the energy transition from different perspectives, e.g., business models and governance (Ismail, Attia, and Alamoush 2024), determinants (Alamoush 2024a), measures

(Alamoush 2024b), stakeholders management (Alamoush, Ballini, and Ölçer 2024b), green shipping corridors, city port energy transition (Ramos and Yilmaz 2023) , actors in port energy transition (Bjerkan, Ryghaug, and Skjølsvold 2021), near-zero emission port planning (Sifakis and Tsoutsos 2021), review of energy efficiency measures (Iris and Lam 2019; Alamoush, Ballini, and Ölçer 2020; Sdoukopoulos et al. 2019), port energy management plan (Boile et al. 2016), the role of port authorities in energy management (Acciaro, Ghiara, and Cusano 2014), maritime energy transition and future fuels (Ramsay, Fridell, and Michan 2023). Nonetheless, most prior efforts prior efforts in port transition have been fragmented, focusing on isolated technologies or policies (Alamoush, Ballini, and Ölçer 2021; Alamoush et al. 2023). While progress is underway, the diverse operational scales and technological readiness of ports necessitate a flexible and comprehensive framework like a Master Plan (MP), which is the gap that this study fills.

This study reports the SEANERGY Master Plan (MP) to address the previous gap by providing a cohesive, scalable framework that aligns port operations with EU directives and integrates innovative technologies. Doing so contributes to the energy transition discussion. Also, it inspires port managers and policymakers to adopt a tailored MP that will help transit the port to cleaner energy operators and hubs.

1.1. The SEANERGY Project

The SEANERGY project, funded by the European Union's Horizon Europe program, aims to promote the sustainable transformation of European ports into green energy hubs. Coordinated by Magellan Circle, SEANERGY brings together 15 partners from diverse sectors, including academia (i.e., The World Maritime University), port authorities, and private enterprises, to develop practical solutions for port energy transition. The project, initiated in October 2022, spans 30 months and focuses on creating tools, frameworks, and training materials to support ports in adopting greener fuels and technologies. This MP, Deliverable D3.1, is a significant milestone in the SEANERGY project and builds upon previous work packages (WP1 and WP2), which included comprehensive literature reviews, stakeholder consultations, and regional workshops.

Key achievements of the SEANERGY project so far include:

- **Stakeholder Engagement**: Conduct seven European workshops to gather input from ports, policymakers, and industry experts.
- **Knowledge Development**: Producing a catalogue of technologies and practices for energy-efficient and sustainable port operations.
- **Digital Tools**: Developing an online prototype of the MP in multiple languages for broader accessibility.
- **Alignment**: Aligning ports with EU environmental objectives, such as climate neutrality by 2050.

Further details about the SEANERGY project can be found on its official website: SEANERGY Project Website. While this section introduces the topic, gap, and the Seanergy project, including the MP, section three is the methodology, section four reports the three phases of the MP, and section five is the conclusion.

2. Methodology

The SEANERGY MP was developed using a multi-faceted methodology:

- **Stakeholder Engagement**: Workshops with policymakers, port authorities, and industry representatives were conducted to gather insights and align priorities.

- **Baseline Assessments**: Employment of Life Cycle Assessments (LCA) and Environmental, Social, and Governance (ESG) metrics to understand existing energy consumption and environmental impacts.
- **Policy Integration**: An exercise was conducted to ensure alignment with EU directives such as the Renewable Energy Directive and the Alternative Fuels Infrastructure Regulation.
- **Phased Approach**: The MP was divided into three phases to ensure a systematic and adaptable process:
  - High-Level Vision: Establishing the foundation for the port energy transition.
  - MP Development: Translating the vision into actionable strategies.
- **Review and Implementation**: This element was proposed to ensure successful execution and continuous improvement.

3. PORT ENERGY TRANSITION MP

The Concept and Objectives of MP includes the following:

- **Customize Solutions**: Tailoring strategies to diverse port typologies and operational scopes.
- **Integrate Approaches**: Combining environmental, economic, and social considerations.
- **Foster Collaboration**: Engaging stakeholders through digital platforms and training modules.
- **Enable Continuous Improvement**: Using performance metrics and feedback loops to refine strategies.
- **Guide Clean Energy Adoption**: Providing actionable recommendations for achieving energy efficiency and emissions reduction.

The Port Energy Transition MP is the blueprint for transforming ports into green energy hubs, structured into three key phases, discussed in the following subsections.

3.1. Phase One: High-Level Vision

Phase One, the **High-Level Vision**, establishes the foundation for transitioning ports into sustainable energy hubs, aligning port strategies with EU climate goals, and addressing both short-term milestones (2025 and 2030) and long-term objectives (2050). This includes integrating the overarching goals of sustainability, energy efficiency, and carbon neutrality into the port's operational and governance frameworks. Overall, this phase defines the strategic direction, objectives, and initial frameworks necessary to guide ports through the subsequent stages of the MP **Development** and **Review**. **Key Components of the High-Level Vision** are as follows, while **Table 1** presents these components, their scope, and examples to illustrate their practical application:

3.1.1. Stakeholder Identification:

Scope: Identify and map all relevant stakeholders, including port authorities, local governments, investors, suppliers, and community representatives. Ensure their concerns and interests are addressed through inclusive strategies.

3.1.2. Governance Framework:

Scope: Establish roles, responsibilities, and decision-making processes to ensure accountability and transparency. Form a steering committee comprising representatives from key stakeholder groups.

3.1.3. Strategic Objectives:

Scope: Develop SMART (Specific, Measurable, Achievable, Relevant, Time-bound) objectives tailored to the port's unique characteristics, such as typology, location, and operational scale.

3.1.4. Communication and Engagement Strategy:

Scope: Facilitate stakeholder dialogue using workshops, online platforms, and regular communication channels. Foster transparency and maintain a feedback loop to integrate suggestions.

3.1.5. Responsibility Allocation:

Scope: Assign clear responsibilities to stakeholders to achieve specific objectives and establish accountability mechanisms to monitor progress.

3.1.6. Initiation Documentation:

Scope: Document all initiation activities, decisions, and plans to ensure transparency and provide a record for future reference.

Table 1: Steps and Examples for the High-Level Vision Phase, Source: Author

Step	Scope	Examples
Vision, mission, and boundaries	Define goals for sustainability, efficiency, and carbon neutrality, considering local and EU climate targets.	**Vision: "Transform Port X into a zero-emission energy hub by 2050." Mission: "Reduce carbon emissions by 50% by 2030 through renewable energy adoption."**
Stakeholder identification	Engage key stakeholders to ensure inclusivity and collaboration, considering their roles, interests, and influence. Use frameworks for prioritizing and mapping.	**Identifying primary stakeholders such as port operators, shipping companies, energy suppliers, local governments, and NGOs. Using stakeholder analysis frameworks to prioritize collaboration with primary stakeholders such as shipping companies, energy suppliers, and environmental NGOs**
Governance framework	Establish roles and responsibilities to oversee the transition, ensuring accountability and a clear decision-making process.	**Setting up a steering committee with representatives from port authorities, local councils, and renewable energy providers to manage the transition.**
Strategic objectives	Develop SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals tailored to port typologies and operational scales.	**Example SMART Goal: "Increase the share of renewable energy used in port operations to 40% by 2028."**
Communication and engagement strategy	Facilitate stakeholder dialogue through digital platforms and workshops, ensuring continuous feedback and dissemination of progress.	**Hosting quarterly workshops with stakeholders to review progress and adjust plans. Using online portals to share updates and collect feedback on the energy transition strategy.**
Responsibility allocation	Assign clear responsibilities and establish accountability mechanisms.	**Assigning energy efficiency targets to terminal operators and conducting biannual reviews to monitor performance.**
Initiation documentation	**Document all initiation activities, decisions, and plans for transparency and future audits.**	**Creating a detailed report of stakeholder roles, objectives, and the governance framework for reference.**

3.2. Phase 2: MP Development

The **MP Development** phase is a critical and comprehensive step within the SEANERGY project, transitioning the High-Level Vision into actionable, detailed strategies. It integrates a range of assessments, methodologies, and stakeholder inputs into a cohesive roadmap for sustainable transformation. This phase ensures that every aspect of the energy transition is tailored to the unique needs of each port while aligning with EU regulatory frameworks and global best practices. The following are the key elements of the MP development and Table 2 below present these elements, scope and examples.

3.2.1. Policy Compliance:

Scope: Reviewing and analyzing environmental regulations, maritime laws, and energy policies that affect port operations. Aligning strategies with overarching EU directives like the European Green Deal, Renewable Energy Directive (RED II), and local regulations to ensure compliance and long-term feasibility.

3.2.2. Baseline Identification:

Scope: Using Life Cycle Assessments (LCA) to evaluate the carbon footprint of current operations and Environmental, Social, and Governance (ESG) metrics to measure sustainability performance. Establishing a baseline helps identify gaps, prioritize interventions, and set a clear direction for improvement.

3.2.3. Target Setting:

Scope: Establishing SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals to drive realistic progress in emissions reduction, renewable energy use, and energy efficiency.

3.2.4. Methodological Framework Establishment:

Scope: Adopting structured project management frameworks, such as PDCA (Plan-Do-Check-Act), to ensure continuous improvement and adaptability. This framework provides a systematic approach to identifying issues, implementing solutions, and refining strategies.

3.2.5. Detailed Plan Development:

Scope: Creating a comprehensive action plan with milestones, timelines, and resource allocation mapped out using tools like GANTT charts. This ensures a clear and achievable roadmap for the transition.

3.2.6. Technology Integration:

Scope: Incorporating cutting-edge technologies, such as hydrogen fuel cells, battery storage systems, and digital energy management tools, to optimize operations and reduce emissions.

3.2.7. Stakeholder Alignment and Collaboration:

Scope: Facilitating inclusive planning processes by engaging a diverse group of stakeholders, from policymakers to industry experts. Stakeholder input ensures that strategies are practical and aligned with broader community objectives.

3.2.8. Capacity Building and Training Programs:

Scope: Equipping stakeholders with the knowledge and skills needed to manage and implement new technologies and processes effectively. This ensures that the workforce is prepared for the transition.

3.2.9. Financial Planning:

Scope: Developing a financial model to identify funding sources, assess investment needs, and explore cost-saving opportunities. This ensures the financial sustainability of the energy transition.

3.2.10. Risk Assessment and Mitigation:

Scope: Conducting a thorough risk assessment to identify potential challenges and uncertainties and devising robust strategies to mitigate them.

3.2.11. Technology and Innovation Exploration:

Scope: Continuously exploring and integrating emerging technologies and innovations that enhance sustainability and operational efficiency.

Table 2: *MP Key Elements Source: Author*

Element	*Scope*	*Examples*
Policy alignment	Ensure compliance with EU directives and maritime regulations.	**Reviewing the Alternative Fuels Infrastructure Regulation (AFIR) to ensure the installation of shore-side electricity systems by 2025. Aligning with the FuelEU Maritime initiative to adopt cleaner fuels for shipping activities.**
Baseline identification	Evaluate current energy use and environmental impacts through LCA and ESG tools.	**Conducting an LCA to determine that 60% of port energy consumption is derived from fossil fuels, highlighting opportunities for renewable energy integration. Using ESG metrics to identify that 40% of emissions originate from diesel-powered yard vehicles.**
Target setting	Establish SMART goals for renewable energy integration and emissions reduction.	**SMART Goal: "Achieve a 20% reduction in GHG emissions by 2027 through solar panel adoption." Establishing a goal to achieve 50% renewable energy integration by the same year.**
Methodological framework	Use frameworks like PDCA to ensure continuous improvement and adaptability.	**Applying PDCA to monitor the success of onshore power systems and adjust for scalability across terminals. Implementing a pilot project for hydrogen fuel integration and scaling based on review findings.**
Detailed plan development	Create a detailed roadmap with milestones and resource allocation.	**Using GANTT charts to map out timelines for infrastructure upgrades.**
Technology integration	Adopt innovations such as hydrogen fuel cells and digital monitoring tools for energy management.	**Piloting hydrogen-powered cranes in the port yard to replace diesel-powered equipment. Installing digital monitoring systems to track energy usage and emissions in real-time. Developing a timeline for transitioning to renewable energy across port operations by 2035. Allocating resources for infrastructure upgrades, such as retrofitting cranes for electric power.**

Stakeholder alignment	Engage stakeholders to align goals and ensure practical implementation.	**Collaborating with local governments and energy providers to set renewable energy targets. Hosting workshops with port authorities and local governments to align on energy goals. Collaborating with renewable energy providers to ensure a seamless transition to greener systems**
Capacity building and training	Equip stakeholders with the skills required for effective implementation.	**Hosting workshops for port operators on maintaining shore-side electricity systems. Organizing a training program for terminal operators to manage and maintain electric cranes. Conducting workshops on operating hydrogen fuel systems and other alternative technologies.**
Financial planning	Develop financial models to assess investment needs and funding sources.	**Securing EU grants through the Connecting Europe Facility (CEF) for alternative fuel infrastructure development. Partnering with private investors to fund solar energy installations across port facilities.**
Risk assessment and mitigation	Identify challenges and uncertainties and develop strategies for mitigation.	**Developing contingency plans to address delays in technology deployment, for example, creating contingency plans to address delays in deploying electric cranes. Mitigating risks related to stakeholder resistance through proactive engagement.**
Technology and innovation	**Explore emerging technologies that enhance efficiency and sustainability.**	**Testing autonomous electric yard vehicles for container handling. Exploring blockchain-based systems for energy efficiency tracking and reporting.**

3.3. Phase 3: Review and Implementation

The **Review Phase** assesses, refines, and enhances the implementation of the MP, ensuring alignment with envisioned goals and adaptability to evolving environmental, technological, and operational challenges. As the final phase of the SEANERGY MP, the Review phase emphasizes a comprehensive approach to evaluating the application and effectiveness of strategies. It includes diverse activities, from funding management and resource allocation to infrastructure adaptation, technology deployment, and continuous improvement mechanisms.

This phase is underpinned by robust monitoring systems, stakeholder engagement, and iterative refinement processes that promote a dynamic and responsive approach to energy transition. The following are the key component of the review and implementation, and Table 3 below presents these elements, scope and examples.

In order to organize the Full Paper, it is better to number the pages. Page numbers are not included in the printing box.

3.3.1. Resource Management and Funding Allocation:

Scope: Ensure financial resources are aligned with SEANERGY project goals. Implement financial controls and reporting mechanisms as outlined in WP3 to support transparency and economic viability.

3.3.2. Training Program Execution and Skill Enhancement:

Scope: Follow through on planned training modules and reskilling initiatives, leveraging the project's knowledge-sharing platforms and best practices.

3.3.3. Infrastructure Development and Site Adaptation:

Scope: Adapt port infrastructure to accommodate the technological and operational changes identified in the MP deliverables.

3.3.4. Progress Tracking and Performance Management:

Scope: Develop and implement a monitoring plan to track progress against MP targets. Incorporate real-time feedback systems for continuous improvement.

3.3.5. Governance Structure Implementation and Stakeholder Engagement:

Scope: Establish governance structures to define roles and decision-making processes, ensuring clear accountability and collaboration.

3.3.6. Technology Deployment and Integration:

Scope: Proceed with the adoption of chosen technologies, ensuring alignment with the project's technological catalogue and stakeholder recommendations.

3.3.7. Operational Changes Implementation:

Scope: Introduce and monitor operational changes to ensure alignment with sustainability goals outlined in the Grant Agreement.

3.3.8. Evaluation and Continuous Improvement:

Scope: Regularly assess implementation processes, draw insights from collected data, and refine strategies using feedback loop systems.

3.3.9. Reporting and Documentation:

Scope: Maintain detailed documentation of implementation activities, ensuring transparency, traceability, and compliance with WP3 requirements.

Table 3: *Review Phase Key Components, Source: Author*

Step	*Scope*	*Examples*
Resource Management and Funding Allocation	Align financial resources with project goals, ensuring transparency through financial controls and reporting mechanisms.	**Allocating EU CEF funds to support hydrogen fuelling stations and electric infrastructure.**
Training Program Execution and Skill Enhancement	Implement training modules and reskilling initiatives for stakeholders using project knowledge-sharing platforms.	**Organizing a workshop for operators to transition to electric yard cranes.**
Infrastructure Development and Site Adaptation	Adapt infrastructure to support technological and operational changes required for the transition.	**Retrofitting berths for shore-side electricity connections.**

Progress Tracking and Performance Management	Monitor implementation progress against targets, incorporating feedback systems for refinement.	**Using digital dashboards to track emissions reductions and optimize underperforming operations.**
Governance Structure Implementation and Stakeholder Engagement	Establish governance structures and engage stakeholders to ensure accountability and collaboration.	**Forming a steering committee with local government and private energy providers to oversee progress.**
Technology Deployment and Integration	Implement selected technologies, ensuring alignment with project recommendations and stakeholder needs.	**Deploying smart grids to manage and balance energy consumption across port operations.**
Operational Changes Implementation	Introduce and monitor operational changes to align with sustainability goals.	**Transitioning yard operations from diesel-powered to electric vehicles and monitoring energy usage.**
Evaluation and Continuous Improvement	Regularly assess implementation processes and refine strategies using data-driven feedback systems.	**Quarterly review meetings to evaluate emissions reductions and adjust interventions accordingly.**
Reporting and Documentation	**Maintain detailed records of implementation processes to ensure transparency and support audits.**	**Preparing biannual progress reports for stakeholders and auditors detailing energy transition achievements and challenges**

4. CONCLUSIONS

The SEANERGY MP serves as a transformative framework, guiding European ports in their transition toward sustainability and climate neutrality. It provides port managers with a structured roadmap to align operations with EU sustainability targets while balancing environmental goals with economic efficiency. By fostering innovation and collaboration among stakeholders, the MP empowers ports to adopt advanced technologies and integrate renewable energy solutions effectively.

Although the Seanergy project started presentation of the MP in different workshops and conferences and integrated it in the Project website targeting getting stakeholders feedback, future research should focus on validating the MP across diverse port typologies to ensure scalability, exploring AI-driven solutions and alternative fuels, and evolving the framework to incorporate new EU directives. As a cohesive and dynamic guide, the SEANERGY MP positions European ports to lead the global transition toward a sustainable and green future.

5. REFERENCES

1. Acciaro, Michele, Hilda Ghiara, and Maria Inés Cusano. 2014. "Energy Management in Seaports: A New Role for Port Authorities." *Energy Policy* 71: 4–12. https://doi.org/10.1016/j.enpol.2014.04.013.
2. Alamoush, Anas S. 2024a. "Harboring Change: Exploring the Multifaceted and Complex Determinants of Decarbonizing Ports." *Energy Research and Social Science* 118 (May): 103751. https://doi.org/10.1016/j.erss.2024.103751.
3. Alamoush, Anas S. "Trends in port decarbonisation research: are we reinventing the wheel?." *Current Opinion in Environmental Sustainability* 71 (2024): 101478. https://doi.org/10.1016/j.cosust.2024.101478.

4. Alamoush, Anas S., Fabio Ballini, and Aykut I. Ölçer. 2024a. "Investigating Determinants of Port Decarbonisation Implementation Using the Lens of Implementation Theory." *Transport Economics and Management* 2024. https://doi.org/https://doi.org/10.1016/j.team.2024.04.002.
5. Alamoush, Anas S., Fabio Ballini, and Aykut I. Ölçer. "Management of stakeholders engaged in port energy transition." *Energy Policy* 188 (2024): 114074. https://doi.org/10.1016/j.enpol.2024.114074.
6. Alamoush, Anas S., Fabio Ballini, and Aykut I Ölçer. 2020. "Ports' Technical and Operational Measures to Reduce Greenhouse Gas Emission and Improve Energy Efficiency: A Review." *Marine Pollution Bulletin* 160 (2020): 1–21. https://doi.org/10.1016/j.marpolbul.2020.111508.
7. Alamoush, Anas S., Fabio Ballini, and Aykut I. Ölçer. "Revisiting port sustainability as a foundation for the implementation of the United Nations Sustainable Development Goals (UN SDGs)." *Journal of Shipping and Trade* 6 (2021): 1-40. https://doi.org/10.1186/s41072-021-00101-6.
8. Alamoush, Anas S., Dimitrios Dalaklis, Fabio Ballini, and Aykut I Ölcer. 2023. "Consolidating Port Decarbonisation Implementation : Concept , Pathways , Barriers , Solutions , and Opportunities." *Sustainability* 15 (14185). https://doi.org/https://doi.org/10.3390/su151914185.
9. Alamoush, Anas S., Aykut I. Ölçer, and Fabio Ballini. 2022. "Ports' Role in Shipping Decarbonisation: A Common Port Incentive Scheme for Shipping Greenhouse Gas Emissions Reduction." *Cleaner Logistics and Supply Chain* 3 (December 2021): 100021. https://doi.org/10.1016/j.clscn.2021.100021.
10. Bjerkan, Kristin Ystmark, Marianne Ryghaug, and Tomas Moe Skjølsvold. 2021. "Actors in Energy Transitions. Transformative Potentials at the Intersection between Norwegian Port and Transport Systems." *Energy Research and Social Science* 72. https://doi.org/10.1016/j.erss.2020.101868.
11. Boile, Maria, Sotirios Theofanis, Eleftherios Sdoukopoulos, and Nikiforos Plytas. 2016. "Developing a Port Energy Management Plan Issues, Challenges, and Prospects." *Transportation Research Record*, no. 2549: 19–28. https://doi.org/10.3141/2549-03.
12. Denktas-Sakar, Gul, and Cimen Karatas-Cetin. 2012. "Port Sustainability and Stakeholder Management in Supply Chains: A Framework on Resource Dependence Theory." *Asian Journal of Shipping and Logistics* 28 (3): 301–19. https://doi.org/10.1016/j.ajsl.2013.01.002.
13. Gilman, Sidney. 2003. "Sustainability and National Policy in UK Port Development." *Maritime Policy & Management* 30 (4): 275–91. http://10.0.4.56/0308883032000145591.
14. IJssel, Daan van den. 2019. "Port Sustainability: A Terminal Comparison Approach: Benchmarking Sustainable Performance of Terminal Operators."
15. Iris, Çağatay, and Jasmine Siu Lee Lam. 2019. "A Review of Energy Efficiency in Ports: Operational Strategies, Technologies and Energy Management Systems." *Renewable and Sustainable Energy Reviews* 112 (September): 170–82. https://doi.org/10.1016/j.rser.2019.04.069.
16. Ismail, Ahmed M., Mahmoud M. Attia, and Anas S. Alamoush. 2024. "Comparative Analysis of Port Governance Models for Green Energy Transition." *The International Maritime Transport and Logistics Conference "MARLOG 13,"* no. 1: 394–403. https://marlog.aast.edu/files/marlog13-proceedings.v2.pdf.
17. Langen, Peter de, and Henrik Sornn-Friese. 2019. "Ports and the Circular Economy." In *Green Ports*, edited by Rickard Bergqvist and Jason Monios, 85–108. Elsevier Inc. https://doi.org/DOI: 10.1016/B978-0-12-814054-3.00010-4.
18. Ramos, Stephen J, and Umit Yilmaz. 2023. "Energy Transition and City–Port Symbiosis in Biomass Import–Export Regions." *Maritime Economics and Logistics* 25 (2): 406 – 428. https://doi.org/10.1057/s41278-022-00238-6.

19. Ramsay, William, Erik Fridell, and Mario Michan. 2023. "Maritime Energy Transition: Future Fuels and Future Emissions." *Journal of Marine Science and Application* 22 (4): 681–92. https://doi.org/10.1007/s11804-023-00369-z.
20. Santos, Solange, Lucia Lima Rodrigues, and Manuel Castelo Branco. 2016. "Online Sustainability Communication Practices of European Seaports." *Journal of Cleaner Production* 112 (4): 2935–42. https://doi.org/10.1016/j.jclepro.2015.10.011.
21. Schipper, C A, H Vreugdenhil, and M P C de Jong. 2017. "A Sustainability Assessment of Ports and Port-City Plans: Comparing Ambitions with Achievements." *Transportation Research Part D: Transport and Environment* 57 (December): 84–111. https://doi.org/10.1016/j.trd.2017.08.017.
22. Sdoukopoulos, Eleftherios, Maria Boile, Alkiviadis Tromaras, and Nikolaos Anastasiadis. 2019. "Energy Efficiency in European Ports: State-of-Practice and Insights on the Way Forward." *Sustainability (Switzerland)* 11 (18). https://doi.org/10.3390/su11184952.
23. Sifakis, Nikolaos, and Theocharis Tsoutsos. 2021. "Planning Zero-Emissions Ports through the Nearly Zero Energy Port Concept." *Journal of Cleaner Production* 286: 125448. https://doi.org/10.1016/j.jclepro.2020.125448.