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Bridging Seas Sustainably: Adopting Norway's Green Maritime Innovations in Greece

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Abstract

The transition to sustainable maritime transport is imperative for Greece's coastal ferry sector, which faces environmental, economic, and operational challenges. Drawing insights from Norway's pioneering experience in adopting electric and hybrid ferries, this study proposes a strategic roadmap for Greece to modernize its aging fleet. Norway's success stems from robust government policies, extensive infrastructure development, and public–private partnerships. Greece's fragmented ferry sector must address key issues such as seasonality, network complexity, and a lack of environmental incentives. The proposed roadmap emphasizes feasibility studies, pilot projects, and the establishment of charging infrastructure to facilitate the transition. Two pilot initiatives are highlighted: a hybrid vessel retrofit for the Perama–Salamina route and a fully electric vessel for the Chios-Oinousses route. These initiatives aim to demonstrate scalable solutions that reduce greenhouse gas emissions while ensuring economic viability. This research underscores the importance of strategic collaboration, regulatory frameworks, and targeted investments in achieving Greece's maritime decarbonization goals. By leveraging lessons from Norway's success, Greece can develop a sustainable, resilient, and efficient coastal shipping network that aligns with broader climate objectives and social cohesion goals.

Keywords

coastal ferry sector; decarbonization; electric ferries; environmental regulations; green shipping; hybrid vessels; sustainable maritime transport

1. Introduction

The Greek coastal shipping serves as the backbone of connectivity between mainland Greece and the islands, playing a crucial role in both passenger and freight transport (Lekakou et al., 2018). It consists of a complex network, providing services not only from mainland Greece to the islands but also between islands and between parts of the mainland. Greece's islands have a total coastline of 7,700 km. In total, the country's 9,837 islands, islets, rocky islets, and uninhabited islands cover 18.8% of the land area (24,739.4 square km). The remaining islands rely exclusively on coastal shipping for their needs. Therefore, coastal shipping is vital for the national and social cohesion of the country (Lekakou, 2007).

The network of companies operating in coastal shipping comprises 79 businesses, of which 49 serve short distances, while 30 focus on long-distance routes. Only three of these are classified as major companies. Most companies are small, adhering to a traditional management model where shipowners make decisions regarding investments and fleet management. Despite the market's potential, its fragmentation, aging fleet, high borrowing costs, and lack of transparency limit investment opportunities (Gavalas et al., 2024).

The coastal shipping system includes 153 passenger ships, with an average age of almost 30 years, most of which have a capacity of up to 1,000 Gross Tonnage. In the summer of 2024, 153 coastal shipping vessels belonging to long-distance companies served 115 islands daily, either connecting them to the mainland or linking islands with one another (XRTC Business Consultants, 2025). Out of 153 ships in the Greek coastal fleet, 45 vessels (29%) are 40 years old or older, highlighting the need for fleet renewal. Notably, over 40% of these 257 ships were built in Greece, supporting the Greek shipbuilding industry. However, these are primarily short-distance ferries serving inter-island routes. In the category of large ships, there is a gradual decline in the number of vessels operated by major, publicly listed companies (Gavalas et al., 2024).

The Greek coastal shipping system comprises 278 routes, divided into three main categories: 88 main routes covering distances between 50 and 257 nautical miles, 91 medium-distance routes ranging from 20 to 50 nautical miles, and 99 short-distance ferry routes of up to 20 nautical miles (XRTC Business Consultants, 2024). At the European level, there is a particularly large number of short-distance ferry routes. Half of these routes are located in Scandinavia, while the rest are found predominantly in countries with many islands, such as Greece, Denmark, and Croatia. In total, there are 222 ferry routes in Europe shorter than 16 km (8.6 nautical miles). Based on the share of these very short-distance ferry routes, Greece ranks second in Europe, after Norway, accounting for 9% of all such routes (Papaioannou, 2018). Of these 98 short-distance routes, for the purposes of this study, routes up to 10 nautical miles were selected, numbering 44 in total. Among them, two routes stand out as particularly suitable candidates for early electrification: the Chios–Oinousses route, which is 10 nautical miles long and currently served by a combination of low-frequency and dedicated daily services, and the Salamina–Perama shuttle. Both routes combine short distances with regular demand and manageable crossing times, making them promising options for pilot implementation. In this article, however, the Salamina–Perama route is selected as the main case study for detailed technical, regulatory, and stakeholder analysis, while the Chios–Oinousses connection is retained as an additional reference candidate for future pilot projects.

In 2024, short-distance routes transported approximately 19.5 million passengers and 4.0 million vehicles. In 2023, the corresponding figures for the entire year were almost 18.8 million passengers and 3.8 million vehicles (XRTC Business Consultants, 2025). Regarding ferry traffic (part of the short-distance routes), the most heavily used route remains Perama (Salamina)–Paloukia, with annual traffic exceeding 6.7 million passengers and 3.7 million vehicles in 2023, and having recorded over 7.6 million passengers and 4.0 million vehicles in 2024 (Hellenic Statistical Authority, 2024). Other important routes include Rio–Antirrio and Corfu–Igoumenitsa. On the Chios–Oinousses route, which is one of the two lines the authors have set as a case study, 17,252 passengers disembarked at the port of Oinousses in 2024, according to data from the Hellenic Statistical Authority (ELSTAT, 2024). Overall, ferry lines account for a significant volume of both passenger and vehicle traffic, as also illustrated in the Supplementary File under the category "Other," which refers to ferry lines beyond the 14 specifically listed in the Supplementary File. These traffic data reveal the geographical dispersion and extensive reach of the network (Papaioannou et al., 2022).

The coastal shipping market exhibits strong seasonality. During the summer, driven by increased tourist demand, routes to the Cyclades, Dodecanese, and Crete take center stage. In contrast, during the winter months, activity is limited, with emphasis on the transportation of essential goods. Excluding fuels and other commodities serving as production inputs (including liquid and dry bulk cargo), the share of goods delivered to the islands by truck (predominantly via ferry) reached 86% in 2022 (Foundation for Economic and Industrial Research [IOBE], 2025).

Greek coastal shipping significantly contributes to the Greek economy. According to data from IOBE, its total contribution to GDP in 2023 amounted to €11.8 billion, representing 5.4% of GDP. This contribution mainly stems from transport activities, the broader impacts of tourism, production on islands, and effects on foreign trade. Additionally, coastal shipping directly and indirectly employs 318,000 workers, accounting for 6.9% of total jobs in the country for 2023 (IOBE, 2025). These achievements highlight the vital role of coastal shipping in supporting island communities, tourism development, and overall economic activity in Greece.

Transitioning to a sustainable coastal shipping model is both a challenge and an opportunity. The adoption of electric and hybrid ships, combined with the upgrading of port infrastructure, is essential to reduce environmental impacts and achieve SDGs (Gavalas et al., 2024). Furthermore, initiatives such as those recently announced by the minister of maritime affairs for launching projects for the green transition of coastal shipping, fleet renewal for subsidized ferry routes with "green" ships through public–private partnerships, and the creation of a master plan for port infrastructure mark a new era of modernization and foster a positive climate for investments (Ministry of Maritime Affairs and Insular Policy, 2024a, 2024b).

The objective of this article is to develop a realistic roadmap for the electrification and hybridization of Greek coastal shipping, with emphasis on short-distance ferry routes and lessons from Norway's green maritime transport. The contribution of the study lies in integrating technical, industrial, regulatory, and stakeholder perspectives into a coherent framework for the transition to electric and hybrid vessels. The analysis is guided by three working hypotheses: first, that short-distance routes are suitable for early adoption of electric and hybrid vessels; second, that a coherent regulatory and financial framework is required for large-scale uptake; and third, that structured stakeholder consultation can enhance feasibility and social acceptance. The remainder of the article is structured as follows: Section 2 presents the methodology and case study design, Sections 3–6 provide the analysis and integrated roadmap, and Section 7 concludes.

2. Methodology and Case Study Design: Salamina–Perama Ferry Route

The Salamina–Perama ferry route is a vital maritime connection between the island of Salamina and the mainland port of Perama, near Piraeus. This short sea route is characterized by high-frequency operations, with departures every 15 to 30 minutes, 24 hours a day, facilitating both passenger and vehicle transport (ELSTAT, 2023). The fleet serving this route primarily consists of double-ended roll-on/roll-off passenger ferries. These vessels are designed for short-distance crossings, allowing for quick loading and unloading of vehicles and passengers. Quantitative traffic and fleet data for this short-sea route (e.g., frequency of sailings, passenger and vehicle volumes, and vessel characteristics) are combined with a review of technical literature, policy and legislative documents, international experience from Norway, and a structured stakeholder consultation. These sources are used jointly to assess the feasibility, challenges, and opportunities of introducing electric and hybrid vessels on the Perama–Paloukia line.

Analytically, the study combines descriptive statistics, qualitative content analysis of stakeholder consultation outputs, and comparative policy analysis between Greece and Norway, structured around a quadruple helix framework (academia–industry–government–civil society). The stakeholder consultation on 27 March 2025 at Salamis Town Hall is treated as a focused exploratory exercise; its findings are indicative rather than statistically representative, and the single-route case study limits the generalizability of results to similar short-distance ferry services.

The ferry services on the Salamina–Perama route are operated by multiple private companies, often family-owned, reflecting the decentralized nature of Greece's coastal shipping industry (Gavalas et al., 2024; Lekakou, 2007). One prominent operator is Tsokos Lines, a company based in Eretria. Founded in 2004, Tsokos Lines has developed a fleet of modern double-ended ferries, many of which have been constructed in Greek shipyards, including those in Perama and Amaliapolis (XRTC Business Consultants, 2024). Their vessels, such as the Protoporos X, Protoporos XI, and Protoporos XIII, have been deployed on various short sea routes, including the Salamina–Perama line. Another operator is Agios Fanourios Ferries, which owns and operates vessels like the M/F Elena A. The presence of multiple operators on this route indicates a competitive environment, with each company managing its own fleet and operations (Papaioannou et al., 2022).

The Salamina–Perama ferry route is characterized by its high-frequency service, with ferries departing every 15 minutes during peak hours. This frequent schedule necessitates a robust and reliable fleet to meet the transportation demands of both residents and visitors. The short crossing time of approximately 15 minutes allows for efficient turnaround and continuous service throughout the day. The Salamina–Perama ferry route is served by a fleet of double-ended roll-on/roll-off passenger ferries operated by various private companies, including Tsokos Lines and Agios Fanourios Ferries. The decentralized ownership structure and high-frequency operations underscore the route's importance in regional transportation and its role in facilitating the movement of people and vehicles between Salamina and the mainland (Gavalas et al., 2024; IOBE, 2021).

The Salamina–Perama ferry route serves as a critical maritime corridor, facilitating the movement of passengers and vehicles between the island of Salamina and the mainland port of Perama. This short sea route is characterized by high-frequency operations, accommodating both daily commuters and commercial transport needs (Gavalas et al., 2024; Papaioannou, 2018). Operational data indicates that ferry services commence at 05:30 and continue until 24:00, with departures occurring every 15 minutes between 05:30 and 22:00. From 22:00 to 00:00, services operate every 20 minutes, while from 00:00 to 05:30, ferries depart every 30 minutes, ensuring 24-hour connectivity between the two ports. This intensive schedule reflects the route's significance in regional transportation, catering to a substantial volume of daily traffic (ELSTAT, 2023).

The Perama–Paloukia ferry line has the highest traffic of any sea route in Greece. This line has the largest ferry traffic in Greece and ranks seventh among all the ports of the EU (based on the 2022 passenger traffic data). According to Eurostat, in 2022, about 7.1 million passengers and 3.7 million vehicles were transported on the Perama–Paloukia line (Hellenic Competition Commission, 2024).

The high-frequency service necessitates a robust and reliable fleet to meet the transportation demands of both residents and visitors. The short crossing time of approximately 15 minutes allows for efficient turnaround and continuous service throughout the day. This operational profile underscores the route's importance in regional transportation and its role in facilitating the movement of people and vehicles between Salamina and the mainland (IOBE, 2021; Papaioannou et al., 2022).

3. Background of the Shipbuilding Industry in Greece

Greece's rejuvenated shipbuilding sector is poised for a renaissance, bolstered by the consolidation of shipbuilding facilities in Syros and Elefsina, alongside the resumption of operations at the Skaramangas shipyard and heightened activity in Chalkida. Since ONEX Shipyards and Technologies, based in New York, took charge in 2019, Neorion Shipyard in Syros and Elefsis Shipyard have successfully repaired over 500 vessels for both Greek and international owners ("ONEX Elefsis Shipyard," 2023). With additional contributions from various ship repair and building operations, Greece is now recognized as a vital player in the annual output of European shipyards, which totals around €43 billion and exceeds that of competing Asian yards in terms of combined civil and naval orders (Hellenic Marine Equipment Manufacturers & Exporters, 2024).

Through a series of strategic alliances and significant investments, Greek shipyard operators, along with governmental support, aim to demonstrate their long-term commitment to an industry that currently represents about 1% of the national GDP (IOBE, 2021). The revival of this sector is set to bolster the economy and enhance national security. Collaborative projects are underway, including naval endeavors as the Greek government engages with the US on the joint design and co-production of the latest Constellation frigates (U.S. Embassy & Consulate in Greece, 2023). Increased shipyard operations will further empower Greek maritime equipment manufacturers, significantly contributing to Europe's commanding 50% market share in this sector (Hellenic Marine Equipment Manufacturers & Exporters, 2024).

Skaramangas Shipyards plans to maximize its substantial existing infrastructure, which includes the largest drydocks in the Mediterranean, capable of accommodating very large crude carriers, liquefied natural gas (LNG) carriers, and aircraft carriers. Skaramangas has been upgrading its facilities and enhancing fire safety systems while bringing back online a sizeable tank that has been dormant for roughly 20 years (Glass, 2024).

Across the board, Greek shipyards are investing to enhance their competitiveness and appeal, particularly to domestic shipowners who currently account for 80% of ship repair and new construction activities in Greece (XRTC Business Consultants, 2024). ONEX has outlined a business plan that allocates $550 million towards shipyard enhancements, targeting an increase in repair operations to reach 300 vessels annually (U.S. Embassy & Consulate in Greece, 2023). ONEX's vision includes transforming the shipyards into a comprehensive support hub for commercial shipping, energy transitions, defense initiatives, and industrial solutions, thus enhancing Greece's economic and geopolitical standing in the region.

Concurrently, Chalkis Shipyard is investing in photovoltaic systems for energy needs, both for the shipyard and vessels docked at its facilities, while also developing infrastructure for building specialized vessels up to 100 meters long. The goal is to expand capabilities to handle about 240 vessels per year, accommodate larger ships, and construct smaller vessels using innovative technology (Ministry of Environment and Energy, 2024).

Moreover, both private and institutional investors are recognizing the potential of Greece's geographic advantages, maritime legacy, and the commitment of the domestic shipping community, alongside governmental support, to invest in the industry. The recent acquisition of Skaramangas by shipowner George Prokopiou and the $125 million loan from the US International Development Finance Corporation for Elefsis Shipyards underscore the strong investor interest in the Greek shipbuilding landscape (U.S. Embassy & Consulate in Greece, 2023).

As maritime technologies continue to evolve, Greek shipyards have the chance to embrace and integrate innovations in AI, green energy, and automation, which promise operational efficiencies and enhanced productivity, thus strengthening their order books (Cadmatic, 2024; Gavalas et al., 2022). Chalkis Shipyards is already leveraging new technologies and implementing digitalization in programs related to repair design, new constructions, and customer relations management (CRM) systems. The yard is investing in 3D modeling and relevant equipment, while actively pursuing new AI integration to optimize operations and streamline tasks (Cadmatic, 2024). Skaramangas is focusing on emission-reduction technologies and scrubber installations, while also seeking collaborative opportunities for developing new ship designs utilizing the next generation of green fuels (Glass, 2024).

3.1. Importance of Electric and Hybrid Ships in Current Maritime Trends

In contrast to industries like road transport and aviation, the maritime sector utilizes fuels that are less refined or processed. The main fuel powering marine diesel engines in this sector is heavy fuel oil, which has a high viscosity and contains significant amounts of sulfur. This results in the production of harmful SOx emissions upon combustion. The shipping industry also utilizes other fuels with lower viscosity and reduced sulfur content, such as marine gas oil and marine diesel oil, with marine gas oil typically employed for smaller vessels (Hsieh & Felby, 2017).

There is potential for alternative fuels to achieve lower or even zero net emissions for vessel propulsion. Currently, the adoption of alternative fuels like LNG and hydrogen is on the rise. Additionally, alternative fuels can be used as "drop-in" options (like biodiesel), though their application in shipping is still largely experimental. Notably, Japan is undertaking four pilot projects, in line with its *Roadmap to Zero Emission from International Shipping* report. This report indicates that the pilot initiatives will follow two potential emission reduction pathways: the use of LNG, contingent upon its transition to carbon-recycled methane; and the implementation of hydrogen or ammonia as fuels (Jaques, 2020).

Clarksons research indicates that over 60% of the new ship orders made in 2022 were for vessels that utilize alternative fuels. The rise of green technologies and alternative fuel propulsion is significantly influencing ship design, particularly emphasizing the growing importance of electrical design. The increasing emphasis on alternative fuels has led to a substantial rise in the adoption of hybrid and electrified systems. This shift complicates ship designs, particularly when it comes to electrical systems, which play a crucial role in the overall design process. Consequently, electrical design must be approached in an integrated manner rather than as a separate component. To enhance project efficiency and ensure successful outcomes, it is essential that electrical design is incorporated into the wider ship design project from the outset, utilizing appropriately tailored tools (Cadmatic, 2024; Clarksons, 2024).

3.2. Overview of Electric/Hybrid Ship Technology

Energy storage options for providing power to zero-carbon electric propulsion include: batteries, flywheels, and supercapacitors. Electric motors, which are relatively economical, can drive propulsion systems. However, when considering the costs associated with batteries and their installation in ships, this option can become quite costly (International Transport Forum, 2018). A study by Lloyd's Register and UMAS (2018) evaluated electric vessels against alternative fuels like hydrogen, ammonia, and biofuels across various scenarios, concluding that electric vessels tend to be the least economically viable technology. Hybrid marine engines present an appealing solution as they can operate on diesel, LNG, or hydrogen, incorporating a fuel cell, batteries, or an electric motor (Newman, 2019). This hybrid approach can yield fuel savings of 10–40% and offer payback periods as short as one year. Furthermore, hybrid propulsion allows for design flexibility to meet both financial and environmental requirements of operators (Royal Academy of Engineering, 2013).

Electricity is generated by the movement of electrons through a conductive medium, commonly referred to as a circuit. A battery consists of three main components: the anode (–), the cathode (+), and an electrolyte. The cathode and anode represent the positive and negative terminals of a typical battery and are connected to an electrical circuit. Chemical reactions occurring within the battery lead to an accumulation of electrons at the anode, creating a voltage difference between the anode and cathode. The electrons, which are in a state of imbalance, seek to stabilize themselves. However, they do so in a specific manner, as electrons repel each other and tend to move towards areas with fewer electrons.

In the case of a battery, the only route available for the electrons is towards the cathode. The electrolyte acts as an insulator, preventing direct electron flow from the anode to the cathode within the battery. When the circuit is completed by connecting a wire between the cathode and anode, the electrons can travel through this wire, illuminating a light bulb in the process. This illustrates how electrical potential drives electron movement within the circuit. It is worth noting that the electrochemical reactions occurring in the battery alter the materials at the anode and cathode, ultimately limiting their ability to continue generating electrons. This leads to a finite power supply in the battery (Australian Academy of Science, n.d.).

When recharging a battery (a process applicable only to rechargeable batteries), an external power source, such as solar panels, is used to reverse the flow of electrons. This reversal allows the electrochemical processes to occur in the opposite direction, restoring the anode and cathode to their initial configurations, thus enabling them to generate power once more. Chemical reactions vary depending on the specific electrodes and electrolytes used. Nonetheless, the fundamental concept involves the movement of electrons through the circuit and the interaction of ions with the electrolyte. As a battery produces energy, the substances within it progressively transform into different compounds. This transformation leads to a diminished capacity for power generation, resulting in a decrease in voltage until the battery is depleted. In essence, when a battery can no longer generate positive ions due to the exhaustion of its chemicals, it cannot produce electrons for the external circuit either (Skundin & Kulova, 2024).

During the discharge process, the anode undergoes an oxidation reaction, releasing electrons to the negative terminal and ions into the electrolyte. Simultaneously, the cathode at the positive terminal receives these electrons, thereby completing the circuit necessary for electron flow. The role of the electrolyte is to allow the chemicals from both the anode and cathode to come into contact, enabling the equalization of chemical potential between the two terminals and transforming stored chemical energy into usable electrical energy.

There is a wide range of batteries available in various sizes, shapes, voltages, and capacities. While they can be constructed with different types of electrolytes and electrodes, batteries primarily fall into two categories: primary and secondary. Primary batteries are single-use disposables that cannot be recharged. Their electrochemical reactions are irreversible, meaning that once the reaction is depleted, the battery is no longer functional. Primary cells can be arranged in series to obtain the desired voltage; however, connecting them in parallel is not advisable, as one cell may attempt to charge another. On the other hand, secondary batteries, also known as storage batteries, can be recharged numerous times. Recharging reverses the internal chemical process, allowing the battery to restore its electrical supply simply by directing current in the opposite direction of its normal flow. This ability to recharge is not present in primary batteries (Skundin & Kulova, 2024).

In marine applications, batteries are utilized to power electrical systems, including wireless very high frequency devices, and they are charged via the engine, generator, or battery charger connected to the primary power source. All-electric vessels rely solely on batteries for power, eliminating the need for internal combustion engines. Secondary cells can be arranged in series, parallel, or a combination of both to achieve the required voltage and capacity. The main requirement is that each cell should have similar voltage, capacity, and chemical composition.

Lithium-ion batteries represent a transformative technology poised to significantly impact numerous industries, including consumer electronics, energy, oil and gas, and transportation, particularly in maritime contexts. The use of electric and hybrid ships equipped with substantial Lithium-ion battery storage and advanced power management systems can lead to reductions in fuel consumption and emissions. Additionally, these battery solutions may enhance maintenance efficiency and boost ship performance, reliability, adaptability, and safety during critical scenarios. Remarkably, a maritime battery can be several hundred times the size of a standard electric vehicle battery. However, the high energy density and demanding charging and operational conditions present new challenges for safety, integration, and longevity. To prevent accidents and other incidents that could pose serious safety risks and financial repercussions (and potentially impede technological advancement), it is crucial to ensure that battery-related systems are thoroughly verified and validated in accordance with established best practices (Det Norske Veritas–Germanischer Lloyd [DNV GL], 2016).

4. Legislative Review and Feasibility of Tech Adoption in Greek Shipping

The transition to electric vessels is a critical component of Greece's maritime decarbonization strategy. As global shipping regulations become increasingly stringent, the need for sustainable and low-emission maritime transport solutions has grown (DNV GL, n.d.). Electrification of vessels offers a viable alternative to traditional fossil fuel-powered ships, significantly reducing greenhouse gas (GHG) emissions and improving air quality in port areas (Buhaug et al., 2009). This report examines the existing legislative framework in Greece regarding the construction and operation of electric vessels, identifies regulatory gaps, and suggests improvements by drawing on best practices from Norway.

Internationally, the regulatory framework for electric vessels is influenced by policies such as the International Maritime Organization (IMO) updated GHG Emissions Strategy, which aims to achieve net-zero GHG emissions from international shipping by or around 2050, in line with global climate goals (IMO, 2023). To monitor progress, the IMO has set intermediate targets for reducing GHG emissions from shipping. By 2030, the goal is to reduce total annual GHG emissions by at least 20%, with a more ambitious target of 30%, compared to 2008 levels. By 2040, the IMO seeks to cut total annual emissions by at least 70%, striving for 80%, relative to 2008 levels (IMO, n.d.). These milestones are integral to the IMO's comprehensive strategy to decarbonize the shipping industry and align with global climate objectives.

In addition, the EU's push for greener maritime transport is complemented by investments in renewable energy production, particularly wind and solar power, which can further enhance the viability of electric vessels and contribute to the overall sustainability of the sector. Through these initiatives, the EU seeks to modernize the maritime industry, reduce its dependency on fossil fuels, and drive innovation in maritime electrification (European Climate, Infrastructure and Environment Executive Agency [CINEA], 2025).

Greece, as a leading maritime nation, has begun aligning its policies with these international directives. The country's National Energy and Climate Plan emphasizes the importance of reducing emissions from maritime transport and investing in alternative fuel infrastructure (Hellenic Ministry of Environment and Energy, 2019). However, despite these efforts, significant challenges remain in implementing a robust regulatory framework that facilitates the widespread adoption of electric vessels (Ministry of Maritime Affairs and Insular Policy, 2024b).

A review of previous studies on the adoption of electric vessels highlights both opportunities and barriers; challenges such as high initial investment costs and the lack of charging infrastructure hinder widespread adoption (Remoundos et al., 2025). Additionally, successful case studies from countries like Norway demonstrate that strong governmental incentives and well-developed shore-side electricity (SSE) infrastructure are key enablers for the transition to electric maritime transport (Lindstad et al., 2016).

This article aims to provide a comprehensive analysis of Greece's current legislative framework regarding electric vessels, identify gaps in existing policies, and propose potential regulatory measures. Furthermore, it will examine Norway's best practices to extract valuable lessons applicable to the Greek context. The development of electric vessels in Greece is governed by a combination of national laws, EU regulations, and international conventions. This section provides an overview of the key legislative instruments that define the regulatory landscape for building and operating electric vessels in Greece. It also highlights relevant funding mechanisms and policy initiatives that support the transition to maritime electrification (Ministry of Environment and Energy, 2024).

Greece has enacted a range of legislative measures to regulate shipbuilding and maritime operations. However, there is currently no specific reference to electric vessels within the existing legal framework (Ministry of Maritime Affairs and Insular Policy, 2024a). Despite the country's strong maritime industry, the regulations do not yet address the unique requirements of electric vessels, leaving them to comply with broader, traditional maritime laws and EU regulations related to alternative energy-powered vessels.

However, electric recreational vessels falling under the scope of Directive 2013/53/EU must comply with the relevant harmonized standards, such as (a) small craft–electric propulsion system, (b) electrical installations in ships–Part 507: pleasure craft, and (c) small craft–electrical systems—alternating and direct current installations (Cadmatic, 2024).

4.1. EU Legislative Framework and Funding Mechanisms

The EU has taken a leading role in steering the maritime sector toward greener horizons, much like a captain charting a course through turbulent waters toward a sustainable future. Through comprehensive legislative action, especially under the Fit for 55 initiative introduced in 2021, the EU aims to reduce net GHG by at least 55% by 2030 compared to 1990 levels (European Commission, 2021a). This initiative is a central part of the EU Green Deal and acts as the ship's rudder—guiding the maritime industry toward decarbonization. It includes key measures such as revising the Energy Taxation Directive to favor low-carbon fuels and incorporating maritime transport into the EU emissions trading system, effectively making carbon emissions a financial liability and incentivizing cleaner alternatives (European Commission, 2023).

In tandem with these policy shifts, the EU has also introduced financial mechanisms to support the electrification of maritime transport. Think of these as the wind in the sails—grants and financial tools are provided to help expand the use of electric and hybrid propulsion systems across the sector (CINEA, 2025). As a member of the EU, Greece is bound by these maritime decarbonization rules and plays a role in implementing them at the national level (Ministry of Maritime Affairs and Insular Policy, 2024a).

Several key legislative instruments underpin the EU's approach. These include the amended EU Emissions Trading System Directive, which now covers shipping emissions (European Commission, 2023); the Alternative Fuels Infrastructure Regulation, which supports the development of facilities like electric charging stations at ports (European Commission, 2023); and the revised Energy Taxation Directive, designed to promote the use of electricity and other low-carbon fuels (European Commission, 2021a). Additionally, the Renewable Energy Directive has been updated to encourage renewable energy use in maritime settings, while the Carbon Border Adjustment Mechanism ensures imported goods are taxed based on their carbon footprint, indirectly nudging the shipping industry toward cleaner technologies (European Environment Agency, 2025).

Taken together, these EU instruments define an increasingly stringent decarbonization pathway for maritime transport, but their effectiveness in Greece is constrained by several context-specific factors. Fragmented port governance and uneven grid capacity across the islands slow down the deployment of SSE and fast-charging infrastructure. Limited access to long-term, affordable finance for small ferry operators weakens the investment signal created by EU climate targets, while administrative complexity and legal uncertainty around state-aid rules may delay the absorption of available funds. As a result, the regulatory "push" from Brussels does not automatically translate into a credible, bankable framework for electrifying short-distance ferry services in Greece (European Commission, 2023; Ministry of Maritime Affairs and Insular Policy, 2024b).

To help navigate this transformative journey, Greece can draw from several funding reservoirs. The Recovery Fund, Greece 2.0—part of the EU's broader Recovery and Resilience Facility—acts like a lifeboat for economic and green recovery post-Covid-19 (Ministry of Maritime Affairs and Insular Policy, 2024b). The Greek Green Transition Fund provides domestic financial support for sustainable maritime technologies, including battery-powered vessels (Ministry of Environment and Energy, 2024). Meanwhile, the EU Innovation Fund offers additional support for the development of zero-emission maritime solutions, akin to providing blueprints and materials for building the next generation of eco-friendly ships (CINEA, 2025).

4.2. Challenges and Legislative Gaps in Greece's Maritime Electrification Framework

Despite the existence of a relatively robust regulatory structure, several critical challenges persist in Greece's efforts to support maritime electrification. One major issue is the limited SSE infrastructure in Greek ports, which hampers the effective operation of electric vessels. Many ports still lack the necessary facilities, making it difficult to support electric ship operations (Maersk Mc-Kinney Møller Center for Zero Carbon Shipping, 2024; Remoundos et al., 2025). Compounding this is the complexity and fragmentation of the regulatory pathways for certifying electric vessels, leading to delays and uncertainty (DNV GL, 2025).

Furthermore, although funding mechanisms such as national and EU-level grants are available, smaller shipowners and operators often struggle to access this financial support (CINEA, 2025; Ministry of Environment and Energy, 2024). Technological barriers also pose a challenge, particularly due to the lack of standardized battery technologies and charging systems, which complicates large-scale adoption and interoperability (Bureau Veritas, 2025; DNV GL, n.d.).

In terms of legislative alignment, Greece has made strides to incorporate EU and international maritime regulations. However, significant gaps remain that hinder the broader adoption of electric vessels and the expansion of SSE infrastructure. These gaps include inconsistencies in regulation, inadequate infrastructure planning, limited certification clarity, insufficient financial incentives, and a lack of interoperability standards (European Commission, 2023; Ministry of Maritime Affairs and Insular Policy, 2024a).

One of the most pressing issues is the absence of a comprehensive national strategy dedicated to electric vessels. While Greece has integrated relevant EU directives into national law, it lacks a centralized framework—unlike frontrunners such as Norway—that outlines specific targets, incentives, and regulatory measures for maritime electrification (Norwegian Government, n.d.-a). This has resulted in fragmented policy implementation and poor coordination among government bodies, port authorities, and private stakeholders (Gavalas et al., 2024; Lekakou, 2007).

Another critical gap is the underdeveloped SSE infrastructure. Despite requirements outlined in Regulation (EU) 2023/1804, Greece has not yet devised a nationwide plan to fulfill its obligations (European Commission, 2023). The country faces several obstacles in this area, including a limited number of SSE-equipped ports, the high costs associated with installing the infrastructure, and a lack of standardized charging protocols, which leads to compatibility issues for electric vessels docking at various ports (Cadmatic, 2024; DNV GL, n.d.).

Certification and licensing processes also suffer from ambiguity. The current national framework does not clearly address the unique requirements of electric and hybrid propulsion systems. This leads to unclear compliance guidelines for shipowners, delays in vessel approvals, and inconsistencies between national and EU certification standards, all of which discourage innovation and investment (DNV GL, 2016).

Financial limitations represent another major barrier. Although programs like the Greek Green Transition Fund and the EU Innovation Fund provide some level of support, there is a lack of targeted financial instruments specifically for electric vessels (CINEA, 2025; Ministry of Environment and Energy, 2024). Missing elements include direct subsidies, tax incentives, and low-interest financing tailored to support the construction, retrofitting, and operation of battery-electric ships. Without these, electric shipping remains less competitive compared to conventional fuel-powered alternatives (Clarksons, 2024; DNV GL, n.d.).

Regulatory misalignment with European best practices further compounds these challenges. Greece has yet to adopt emissions-based port fee incentives, binding electrification requirements for new vessels, or strong enforcement mechanisms for existing EU directives—all of which are common in leading maritime nations like Norway (Tradewinds, n.d.; Norwegian Ministry of Climate and Environment, 2021).

Interoperability and technological standardization also pose a significant challenge. The lack of harmonized charging interfaces across ports, variations in battery technology, and limited integration of renewable energy into SSE grids all contribute to inefficiencies and limit the sustainability impact of electrification efforts (Bureau Veritas, 2025; European Commission, 2021b).

Addressing these legislative and infrastructural gaps is essential for Greece to accelerate its transition to maritime electrification. Developing a unified National Electric Vessel Strategy, expanding SSE infrastructure, and introducing well-targeted financial incentives will be vital steps. Moreover, aligning Greek regulations with European best practices and creating standardized certification and safety procedures will strengthen the country's position in the emerging low-emissions maritime sector (Gavalas et al., 2024; XRTC Business Consultants, 2024).

To address these issues, Greece is now moving toward a more structured regulatory approach. A key development is the upcoming Presidential Decree on Safe Electricity Supply, Safe Electric Charging, Testing, and Certification of Electric and Hybrid Ships. This decree, currently submitted to the European Commission's Technical Regulation Information System under Directive (EU) 2015/1535, is expected to provide a legal foundation for maritime electrification (Ministry of Maritime Affairs and Insular Policy, 2024a).

The draft decree covers multiple aspects essential to the regulation of electric and hybrid vessels. It introduces clear definitions for electric and hybrid ships, specifying that electric ships are entirely powered by zero-emission technologies, while hybrid ships use electric power in ports. It also broadens the scope of infrastructure by recognizing both onshore and offshore (floating) electricity supply installations. The decree mandates the inclusion of battery management systems for safety, defines specifications for electricity supply and charging infrastructure in line with EU Regulation 2023/1804, and outlines certification processes under the Hellenic Register of Shipping and other recognized bodies (ISO, 2018).

In addition to certification and infrastructure regulations, the decree sets out fire safety measures, requiring emergency power systems and specialized protocols for battery management. It also aligns national technical standards with those from international bodies such as IMO, the International Electrotechnical Commission, and ISO, ensuring consistency with global best practices (IMO, 2023; ISO, 2017).

5. Best Practices from Norway in Maritime Electrification

Norway is internationally acknowledged as a frontrunner in the adoption and regulation of electric and hybrid vessels. The country's progress in maritime electrification has been driven by a combination of proactive policies, strong financial incentives, and extensive infrastructure development. These efforts have enabled Norway to lead the global shift toward greener shipping practices (DNV GL, n.d.; Norwegian Government, n.d.-a). The following best practices from Norway can offer valuable guidance to Greece as it works to enhance its own regulatory framework for electric vessel adoption (Ministry of Maritime Affairs and Insular Policy, 2024b).

A cornerstone of Norway's success lies in its robust governmental support and strategic policy framework. The Norwegian National Transport Plan outlines ambitious targets for reducing maritime GHG emissions, including the requirement that all new fjord ferries be zero-emission by 2030 (Norwegian Government, n.d.-a). Complementing this is the Green Shipping Program, a collaborative initiative between public and private sectors designed to promote low and zero-emission shipping through regulatory and financial incentives (DNV GL, n.d.). Notably, Norway also enforces zero-emission requirements for publicly funded ferry services, mandating the use of electric or hydrogen-powered vessels—an approach that has significantly stimulated demand for green maritime technologies (Hessevik, 2022).

Norway's legislative framework provides further support through targeted laws and regulations. The Climate Action Plan 2021–2030 sets binding emission reduction targets for domestic shipping, ensuring compliance with international climate agreements (Norwegian Ministry of Climate and Environment, 2021). The Maritime Electric Infrastructure Act mandates the development of SSE infrastructure for high-traffic ports (Norwegian Government, n.d.-a), while the Alternative Fuel Act establishes safety and operational standards for vessels using alternative energy sources (Climate and Clean Air Coalition, n.d.). Additionally, Norway has implemented a progressive carbon taxation scheme for shipping, incentivizing cleaner operations (Norwegian Government, n.d.-b). Training and certification requirements for crews operating electric and hybrid vessels ensure that the workforce is prepared to manage these advanced technologies safely and efficiently (Norwegian Maritime Authority, 2022).

Financial support has played a pivotal role in accelerating Norway's green transition. Through the EVOVA Fund, the government covers up to 50% of the additional costs associated with adopting electric or hybrid propulsion (Tradewinds, n.d.). The NOx Fund (n.d.) offers further subsidies for emission-reducing maritime projects. Moreover, shipowners benefit from low-interest loans and tax exemptions when investing in clean technologies, making the financial case for electrification significantly stronger (Norwegian Government, n.d.-b).

Norway has also developed one of Europe's most advanced SSE networks. Major ports, including Oslo, Bergen, and Trondheim, are equipped with extensive cold ironing facilities, enabling ships to plug into the electric grid while docked and thereby reduce emissions (Port of Oslo, 2023). The country has standardized its charging systems to ensure interoperability between different ports and vessels (DNV GL, n.d.). Crucially, much of the SSE infrastructure is powered by renewable hydropower, making it a genuinely zero-emission solution.

In terms of fleet electrification, Norway has led the way with pioneering vessels that demonstrate the viability and benefits of electric shipping. The Ampere, launched in 2015, was the world's first all-electric ferry, setting a global precedent (Nordregio, 2016). This was followed by the Future of the Fjords, an all-electric passenger ship designed for eco-friendly tourism (Norwegian Ministry of Climate and Environment, 2018), and the Yara Birkeland, the first autonomous and fully electric container ship, showcasing the potential for zero-emission cargo transport (Skredderberget, n.d.).

The effectiveness of these Norwegian policies cannot be explained by their formal design alone, but also by the enabling conditions under which they were implemented. Abundant low-cost renewable electricity, a long-standing tradition of public procurement for ferry services, and a dense maritime cluster of shipyards, technology providers, and operators created a favorable environment for early adoption of electric and hybrid vessels, supported by systematic experimentation with battery-electric solutions (Bureau Veritas, 2025). Strong coordination between national authorities, regional counties, and state-owned financial institutions, combined with dedicated research and innovation funding, further reduced transaction costs and investment risks and nurtured a vibrant ecosystem of innovation (Research Council of Norway, n.d.). These structural features significantly amplified the impact of support schemes that, in isolation, might have been less transformative.

There are several clear lessons that Greece can draw from Norway's experience. These include implementing binding zero-emission requirements for public ferry operations to drive market demand (Ministry of Maritime Affairs and Insular Policy, 2024a), introducing comprehensive financial incentives such as grants, low-interest loans, and tax benefits to support green transitions (Ministry of Environment and Energy, 2024), and investing in standardized and renewable-powered SSE infrastructure.

From a transferability perspective, only selected elements of the Norwegian model can be directly transplanted to Greece. Norway's cold climate, fjord geography, and highly centralized transport governance differ markedly from Greece's milder climate, fragmented archipelagic network, and more decentralized institutional setting. Moreover, Norway's predominantly renewable energy mix and strong fiscal capacity allow for higher levels of public support than those currently feasible in Greece. This implies that Greek policy makers need to adapt, rather than copy, Norwegian solutions by prioritizing routes with favorable demand profiles, sequencing infrastructure investments, and designing support schemes that reflect domestic fiscal and administrative constraints, particularly where EU innovation and deployment programs are already present (Gavalas et al., 2024).

6. Stakeholder Consultation Report: Electric Vessels on the Salamina–Perama Line

6.1. Action and Implementation

The consultation brought together participants representing the four helices of the quadruple helix framework. Participants were selected through purposive sampling, based on their direct involvement in the Perama–Paloukia ferry line or in closely related domains (coastal shipping operations, port management, local and national administration, business associations, and environmental or community organizations). The aim was not statistical representativeness, but to capture a balanced set of informed perspectives from actors who are in a position to influence or be affected by the transition to electric vessels. The workshop combined a short plenary introduction with moderated group discussion and a working lunch to support relationship-building and further dialogue.

The primary goal of the consultation was to identify and analyse the key challenges, potential solutions, and stakeholder perspectives regarding the implementation of electric vessels on the Perama–Paloukia ferry line. The session included two structured rounds of discussion and voting. The authors adopted a quadruple helix approach to stakeholder engagement, integrating perspectives from academia, industry, government, and civil society. This inclusive framework ensured that diverse viewpoints were considered in the planning and decision-making processes related to the introduction of electric vessels on the Perama–Paloukia ferry line. The primary goal of the consultation was to identify and analyze the main challenges, enabling factors, and priority actions for the electrification of the Perama–Paloukia ferry line, using the quadruple helix framework as a structured lens. In this context, the framework was operationalized by explicitly distinguishing the roles of academia, industry, government, and civil society, and by inviting each helix to articulate both its own interests and its expectations from the others. The consultation design encouraged cross-helix interaction through open discussion, joint problem-framing, and co-creation of potential solutions, rather than separate siloed interventions, reflecting recent applications of quadruple helix approaches in sustainable transportation and regional innovation policy (Gavalas et al., 2024). During the consultation, stakeholders from each helix contributed the following insights:

- Academia: Provided research-based perspectives on the feasibility and implications of electrifying the ferry line.
- Industry: Shared practical considerations regarding the implementation of electric vessels, including technological and infrastructural requirements.
- Government: Discussed policy frameworks, regulatory considerations, and potential support mechanisms to facilitate the transition.
- Civil Society: Expressed concerns and expectations related to environmental impact, service reliability, and community benefits.

The integration of these diverse perspectives, combined with the two structured rounds of discussion and voting, helped to clarify the main trade-offs that need to be managed in the transition. As reflected in the identified challenges and proposed solutions, stakeholders recognize tensions between minimizing costs and travel times, ensuring system stability and reliability, and delivering broader environmental and community benefits. The ranked lists of challenges and solutions, together with the voting results, therefore capture both areas of broad convergence, such as the importance of incentives, a clear regulatory framework, targeted training, and issues that require further negotiation, including potential fare increases and uncertainties around business models and investment planning.

Although a full quantitative cost–benefit model is beyond the scope of this article, an indicative assessment suggests that the proposed electrification of the Perama–Paloukia ferry line can generate net socio-economic benefits under plausible assumptions. On the cost side, higher upfront capital expenditure for vessels and charging infrastructure is partially offset by lower operating costs, reduced exposure to volatile fuel prices, and the monetized value of emission reductions. The overall outcome is highly sensitive to the relative evolution of electricity and marine fuel prices, vessel utilization rates, battery lifetime, and the availability of investment subsidies or tax incentives. These parameters determine payback periods and can either accelerate or delay investment decisions by operators.

Stakeholders have the potential to either accelerate or delay the energy transition, depending on how effectively they are engaged. Poor management of stakeholder relationships can lead to project delays, increased costs, social tensions, and even implementation failures. On the other hand, including local communities in the planning and decision-making processes enhances the legitimacy and social acceptance of energy initiatives, fostering smoother execution and long-term success.

The application of the quadruple helix model in this consultation exemplifies a commitment to inclusive and collaborative decision-making. By actively involving stakeholders from academia, industry, government, and civil society, the authors have laid a robust foundation for the successful introduction of electric vessels on the Perama–Paloukia line.

6.2. Preliminary Phase: Stakeholder Perspectives

In the initial phase, participants shared a range of views regarding the transition to electric vessels on the route. The Norwegian representatives reaffirmed their commitment to supporting the study with technical expertise, recognizing the strategic potential of the Perama–Paloukia line. They emphasized that, with the existing technological capabilities, implementation is feasible, provided there is a well-structured framework in place. Reference was made to international examples where the emphasis was not only on shipbuilding, but also on system-wide planning.

Participants raised questions about how proposed measures would be implemented in practice and stressed the need for a clear strategic roadmap and institutional support. The importance of integrating sustainable energy solutions into the maritime ecosystem was highlighted. Infrastructure challenges, particularly concerning shipbuilding and port capacity, were seen as critical bottlenecks.

There was a strong sense of optimism about the future of electric shipping and technological advancements, but participants also stressed the importance of investment in charging infrastructure and adequate energy supply. Concerns were expressed about the cost of transition, with warnings that, without appropriate funding, the project could negatively impact island connectivity. Calls were made for local manufacturing of batteries to reduce reliance on external suppliers.

Additional views underscored the need for close integration between vessels and land-based infrastructure, the development of expertise and training, and the establishment of efficient systems for propulsion, loading, and vessel management. Participants also highlighted the symbolic and strategic importance of the study in positioning the region at the forefront of sustainable maritime innovation.

6.2.1. Round 1: Challenges in Introducing Electric Vessels

Eighteen key challenges to the implementation of electric vessels were identified during the first round of discussions:

1. Inadequate charging infrastructure;
2. Limited availability of suitable charging stations;
3. Absence of a clear regulatory framework;
4. High battery replacement and upgrade costs;
5. Lack of training and information for crew and operators;
6. Public hesitancy due to reliability concerns;
7. Potential fare increases linked to transition costs;
8. Spatial constraints for installing port-side infrastructure;
9. Absence of proven business models;
10. Insufficient policy support for sector development;
11. Lack of relevant data and monitoring systems;
12. Absence of a comprehensive subsidy scheme;
13. Uncertainty regarding the transition plan;
14. Lack of a pilot project;
15. Incomplete investment planning;
16. Legal and legislative ambiguities;
17. Market instability;
18. Lack of a systems-based approach.

Based on an individual voting exercise in which each of the 14 participants was invited to select up to three challenges they considered most critical, the percentages reported below represent the share of participants who voted for each challenge and therefore indicate relative salience rather than statistically representative frequencies. The resulting ranking, with financial and regulatory barriers appearing at the top, suggests that stakeholders view enabling government incentives and a clear legal framework as preconditions for investment, while the presence of training needs and potential fare increases among the leading concerns highlights worries about implementation capacity and the distributional effects of the transition:

1. Lack of government incentives and subsidies (78.6%);
2. Absence of a clear regulatory framework (28.6%);
3. Lack of information and training for staff (28.6%);
4. Potential fare increases due to transition costs (28.6%);
5. Unclear legislative framework (28.6%).

6.2.2. Round 2: Proposed Solutions to Key Challenges

In the second round, participants explored and prioritised 20 possible solutions in response to the top five challenges:

1. Introduction of tax incentives and subsidies for electric vessel adoption;
2. Development of financial instruments and funding programmes at national and EU levels;
3. Provision of subsidised financing for shipowners investing in electrification;
4. Establishment of cooperative funding mechanisms;
5. Creation of clear procedures for licensing and operational approval of electric ships;
6. Development of dedicated training and certification programmes;
7. Design of subsidised business models to offset initial costs;
8. Formulation of a cohesive national strategy;
9. Strategic infrastructure planning;
10. Expansion of cooperative financing schemes;
11. Creation of energy markets tailored to maritime transport;
12. Introduction of regulatory mandates;
13. Development of collaborative pilot projects;
14. Ship scrapping incentive schemes;
15. Public–private partnership initiatives;
16. Investor guarantees;
17. Feasibility permits with a specific duration;
18. Integration into national innovation funds;
19. Participation of national energy providers;
20. Adoption of a "green transport equivalent" mechanism.

Following the vote by 16 participants, the five most preferred solutions were:

1. Development of financial instruments and support programmes via national and EU funds (75%);
2. Formulation of a national strategy for electric maritime transport (56.3%);
3. Introduction of tax incentives and subsidies (37.5%);
4. Subsidised financing options for shipowners (37.5%);
5. Cooperative financing schemes (37.5%).

7. Conclusions

The transition to electric and hybrid vessels in Greek coastal shipping represents both a significant challenge and a transformative opportunity for the country's maritime sector. This study has systematically explored the technical, economic, regulatory, and infrastructural aspects of this transition, drawing valuable lessons from Norway's successful electrification model. The findings emphasize the urgent need for Greece to modernize its aging ferry fleet, expand shore-side charging infrastructure, and establish supportive policy frameworks to accelerate decarbonization efforts.

Key insights from the research highlight several critical areas. Regarding technical feasibility and fleet renewal, Greece's coastal shipping network, which is characterized by an aging fleet and high operational demands, necessitates targeted investments in electric and hybrid propulsion systems. Short-distance routes, such as Salamina–Perama and Chios–Oinousses, are particularly suitable for pilot electrification projects owing to their high frequency and manageable energy requirements. On the regulatory and policy front, while Greece has begun aligning with EU decarbonization directives, notable gaps remain in national legislation, certification standards, and financial incentives. The upcoming presidential decree on electric and hybrid ships is a positive development, however, further policy coherence (similar to Norway's binding zero-emission mandates and carbon taxation) is essential.

Infrastructural and investment considerations reveal that the absence of standardized charging infrastructure at Greek ports is a major barrier. Strategic investments, supported by EU funds such as the Recovery and Resilience Facility and the Green Transition Fund, alongside public-private partnerships, must prioritize port electrification and renewable energy integration. Stakeholder collaboration, as evidenced through the quadruple helix consultation, demonstrated a strong consensus on the necessity for financial incentives, training programs, and a comprehensive national strategy for maritime electrification. Stakeholders underscored the importance of subsidies, tax breaks, and cooperative financing mechanisms to enable shipowners to adopt cleaner technologies.

Lessons from Norway's experience highlight the effectiveness of a holistic approach that combines strict emissions regulations, state-backed funding (e.g., ENOVA, NOx Fund, etc.), and collaboration between industry and academia. Building on the preceding analysis and stakeholder consultation results, this article proposes a phased roadmap for maritime electrification in Greece. In the short term, priorities are pilot electric ferry projects on high-traffic routes such as Perama–Paloukia and Chios–Oinousses, deployment of standardized shore-side charging infrastructure at key ports, and targeted subsidies to support retrofits and newbuilds. The subsequent phase focuses on extending electrification to additional short-distance routes, increasing the share of renewable electricity in port operations, and progressively tightening national emissions and performance standards. Over the longer term, progress should be tracked through a limited set of indicators, including the share of short-distance traffic served by electric or hybrid vessels, installed shore power capacity, and reductions in well-to-wake GHG, in line with IMO and EU decarbonization targets.

This shift toward sustainable coastal shipping is not only an environmental necessity but also an economic opportunity, strengthening Greece's shipbuilding industry, enhancing energy security, and positioning the country as a Mediterranean leader in green maritime transport. By leveraging EU funding, fostering cross-sector collaboration, and adopting proven international best practices, Greece can transform its coastal shipping sector into a model of innovation and sustainability for the wider region. Future research should focus on advancements in battery technology, lifecycle cost analyses of electric ferries, and the socio-economic impacts of maritime decarbonization on island communities. Additionally, ongoing stakeholder engagement will be vital to refining policies and ensuring equitable implementation of these initiatives.

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Conflict of Interests

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Data Availability

Data is available upon request.

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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