### DEPARTMENT OF INTERNATIONAL AND EUROPEAN ECONOMIC STUDIES



ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

## **ÅN OVERVIEW OF INTEGRATED MARITIME OPTIMISATION APPROACHES**

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#### An overview of integrated maritime optimisation approaches

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#### Abstract

As the need for more environmentally friendly and energy-efficient operations becomes increasingly urgent, shipping — Shipping, despite being a carbon-efficient mode of transport — faces mounting pressure to adapt. The growing awareness of climate change and its impacts has led to a push for the decarbonisation of maritime transport, an industry responsible for approximately 3% of global greenhouse gas emissions. With international trade largely dependent on shipping, ensuring that maritime operations become more sustainable is essential for achieving broader global climate targets. This transition towards sustainability is especially crucial because of the sector's worldwide magnitude, which is growing in tandem with the surging shipping demand. The industry must fulfil these demands while substantially minimising its environmental impact... Alongside the increase in shipping demand, the transition to net-zero necessitates more environmental restrictions, which are expressed through policies (e.g., Emissions Trading Systems - ETS, etc.). Through a brief review of these new mandates, this paper provides a general overview of the main methods and simulation and optimisation models that have been proposed so far for analysing sustainable shipping scenarios, combining techno-economic and environmental parameters. These models combine techno-economic and environmental parameters to offer a comprehensive understanding of potential pathways for decarbonisation. Optimisation models considering technical shipping, fuels and costs, alternative fuels, transition rates, and various 'what-if' or policy scenarios, have been largely used to provide guidance to policymakers with respect to shipping decarbonisation. Herein, different case studies and scales are considered, in order to provide a more holistic picture of the technoeconomic and environmental optimisation modelling approaches in maritime

operations. Finally, different scenarios examined by these models are discussed, including different modelling cases related to the economic prices of various parameters, shipping demand, the stringency of environmental policies, and more. The findings of this research provide valuable insights for policymakers, shipping industry stakeholders, and researchers as they explore different models, and develop strategies to balance the need for increased shipping capacity with the imperative of environmental sustainability.

**Keywords:** Shipping; Sustainable maritime operations; Fleet Optimization; Environmental regulations; Techno-economic analysis; Modelling scenarios.

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