

No.012 October 2026

How Regulatory Uncertainty Shapes Maritime Green Technology Adoption

Stronger environmental regulations are widely seen as essential for maritime decarbonisation. In this research we show that the relationship between regulation and green technology adoption is more complex and can have unintended consequences. Regulatory stringency can lead to slower technology adoption and there can be uneven impacts on profitability within the sector.

This research explored how owners of competing container vessels can make investment and pricing decisions when future regulations and their stringency are uncertain. Modelling, based on game theory that analyses how actors make decisions, compared two container vessels in two time periods – one where technology adoption occurs and a second where regulation may occur. The overview of the model's decision-making sequence is provided in the figure below.

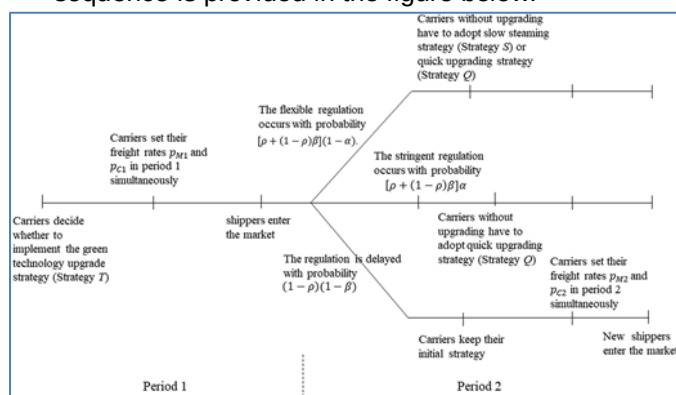


Figure. Decision making sequence of the model

Key findings are as follows:

- More stringent regulation does not always encourage investment, conditions depending, firms may delay technology adoption.
- Regulatory uncertainty can create a “wait-and-see” effect especially among competing firms
- Impacts are not evenly distributed across the sector as some firms are in a better position to respond to regulatory change.
- Uncertainty can contribute to market concentration. Larger or better-resourced firms may benefit disproportionately, potentially crowding out smaller firms.

POLICY IMPLICATIONS

To support effective maritime decarbonisation, policymakers at Department for Transport should consider the following:

- **Clear and credible policy signals.** Publish long-term regulatory roadmaps and implementation timelines. Minimise unnecessary policy reversals or abrupt changes in targets.
- **Encourage early adoption.** Consider targeted incentives and support mechanisms for first movers. Reduce uncertainty around future compliance requirements.
- **Monitor market impacts.** Assess how regulations affect different types and sizes of operator. Consider measures to avoid accelerating market concentration or disadvantaging smaller firms.
- **Role of market dynamics.** Technology adoption decisions and regulatory expectations influence one another. Policy frameworks should account for how sector behaviour may change in response to uncertainty.

RESEARCH PUBLICATIONS

Zheng, W., Song, D.P., Jiang, Z.Z., An, S.M. 'The paradox of stringent environmental policies: the feedback between regulatory uncertainty and green technology adoption in competitive shipping', *Asia Pac. J. Mark. Logist.*, 2026, <https://doi.org/10.1108/APJML-09-2025-1854>

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The [UK National Clean Maritime Research Hub](#) is funded by the Department for Transport and EPSRC with pioneering research aims to accelerate the decarbonisation and elimination of air pollution from maritime activity in ports and at sea. This Policy Bulletin is based on independent research and the views expressed are those of the authors and should not be taken to represent the views of the Department for Transport or the UK Government.