RICARDO

EXECUTIVE SUMMARY

GREENING THE IRISH SEA
THE CENTRAL CORRIDOR

Maynooth University National University of Ireland Maynooth

Stena Line

Irish Ferries

EDF

Calafort Átha Cliath Dublin Port

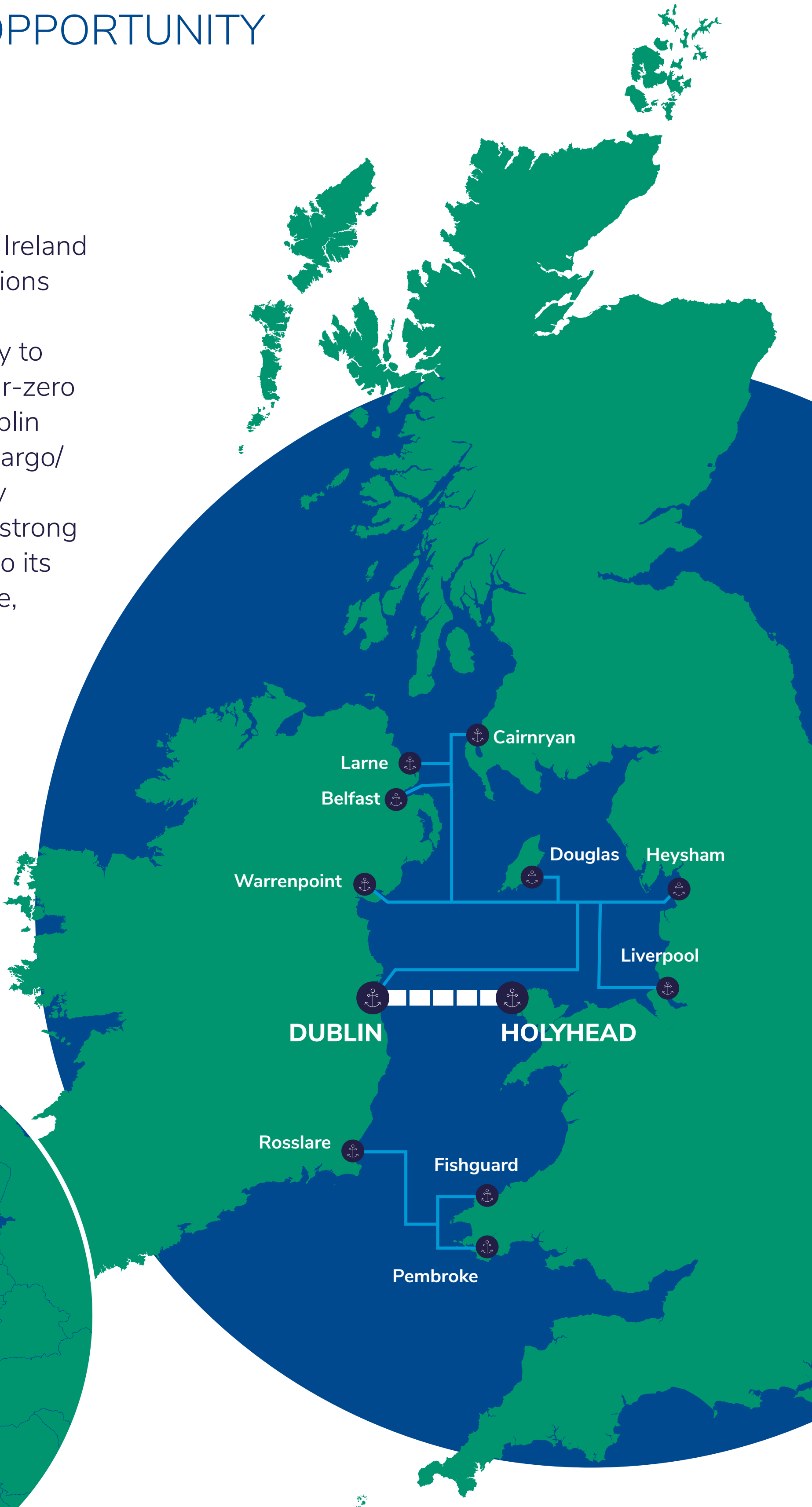
CONTENTS

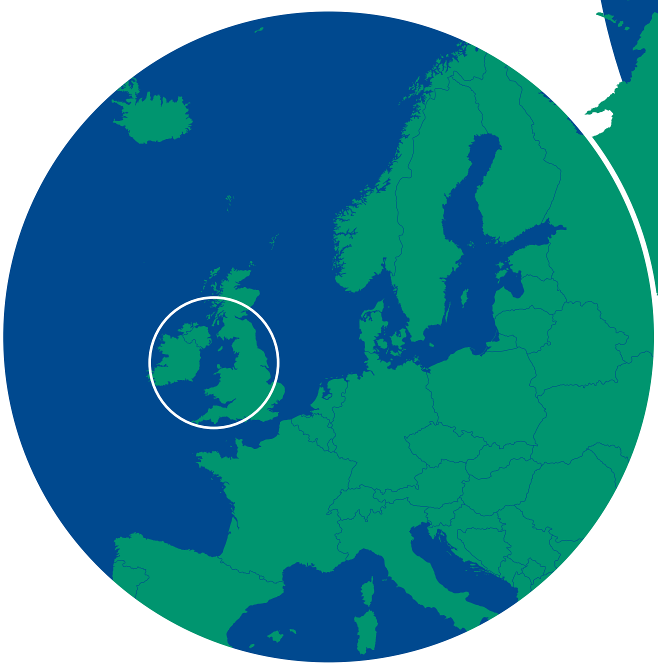
This project is part of the Clean Maritime Demonstration Competition: International Green Corridors Fund (CMDC5: IGCF). It is jointly funded by the UK Department for Transport (DfT) and the Marine Institute, Ireland. The funding is being delivered by Innovate UK and the Marine Institute, Ireland.

CMDC5: IGCF is part of the Department's UK Shipping Office for Reducing Emissions (UK SHORE) programme, a £206m initiative focused on developing the technology necessary to decarbonise the UK domestic maritime sector.

CONTEXT AND OPPORTUNITY

The maritime sector is under increasing pressure to decarbonise in line with international climate goals. The UK and Ireland have both committed to net-zero emissions and support the development of Green Shipping Corridors (GSCs) as a pathway to accelerate the adoption of zero and near-zero emission GHG fuels. The Holyhead–Dublin route, a high-frequency roll-on/roll-off cargo/passenger (RoPax) corridor operated by Stena Line and Irish Ferries, presents a strong candidate for early demonstration due to its strategic importance, high traffic volume, and relatively short distance.





PURPOSE AND GOALS

The primary aim of this project was to evaluate and demonstrate the viability of establishing a Green Shipping Corridor between the ports of Holyhead and Dublin using green methanol as a fuel supported by Onshore Power Supply (OPS) infrastructure.

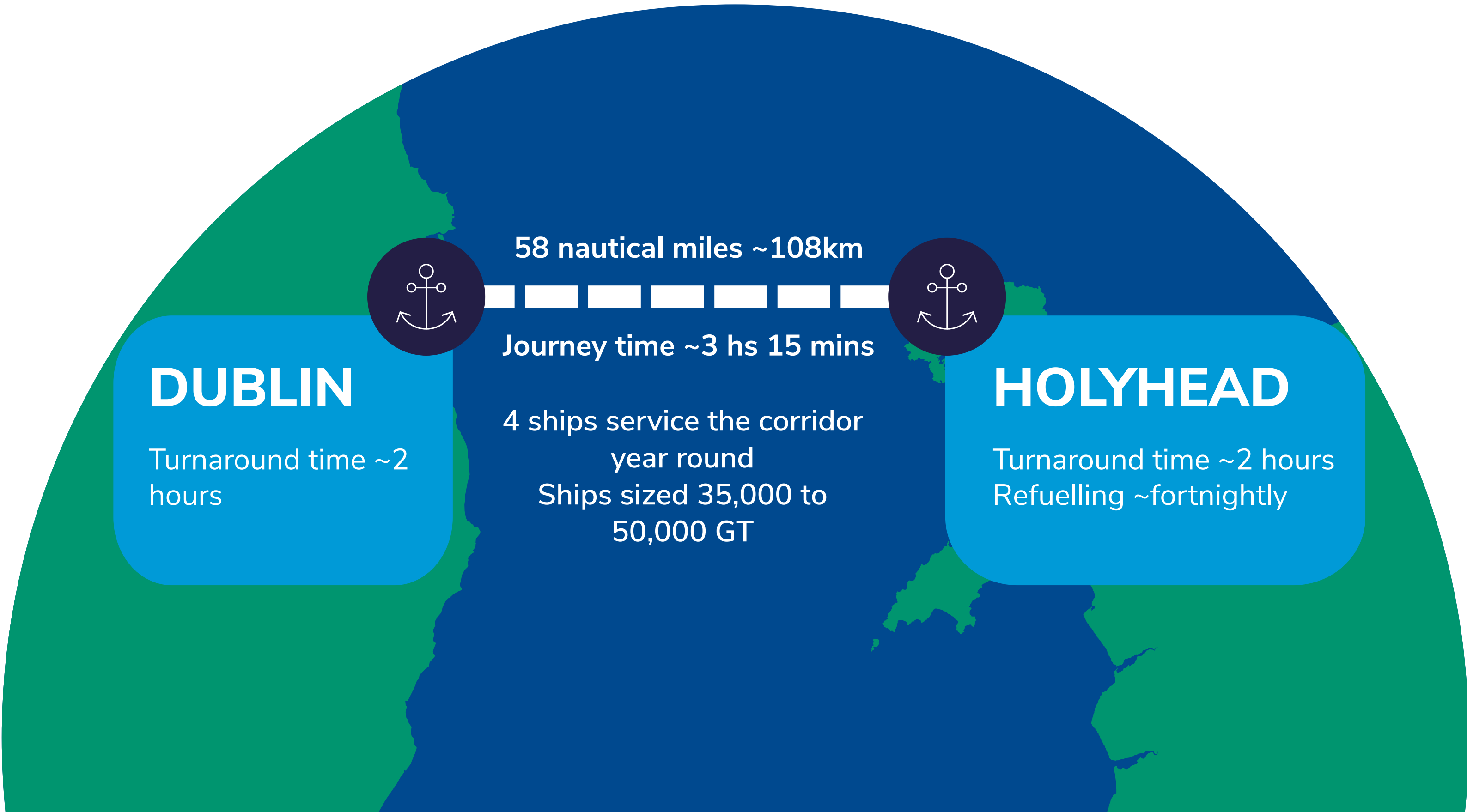
Although the study focused on methanol as the primary fuel pathway, a broader assessment of alternative fuels, including hydrogen, ammonia, and battery-electric, was also undertaken to establish the comparative benefits and constraints.

This initiative seeks to provide a practical, near-term decarbonisation pathway for RoPax services operating on this critical route.

To achieve this, the project sets out to identify vessel and port technologies that can be feasibly deployed within the next 10 years, assess the regulatory and safety landscape, and model the associated environmental and economic impacts.

The work also provides clarity on the financial and operational trade-offs associated with the transition to methanol-fuelled vessels and OPS infrastructure, and the enabling mechanisms, such as public-private investment strategies and regulatory pathways, that are necessary to deliver the corridor.

Ultimately, the findings are intended to inform future deployment and replication of similar corridors across Europe by demonstrating a replicable, scalable model for green short-sea shipping.



WHICH FUEL OPTIONS ARE MOST VIABLE FOR DECARBONISING THIS CORRIDOR?

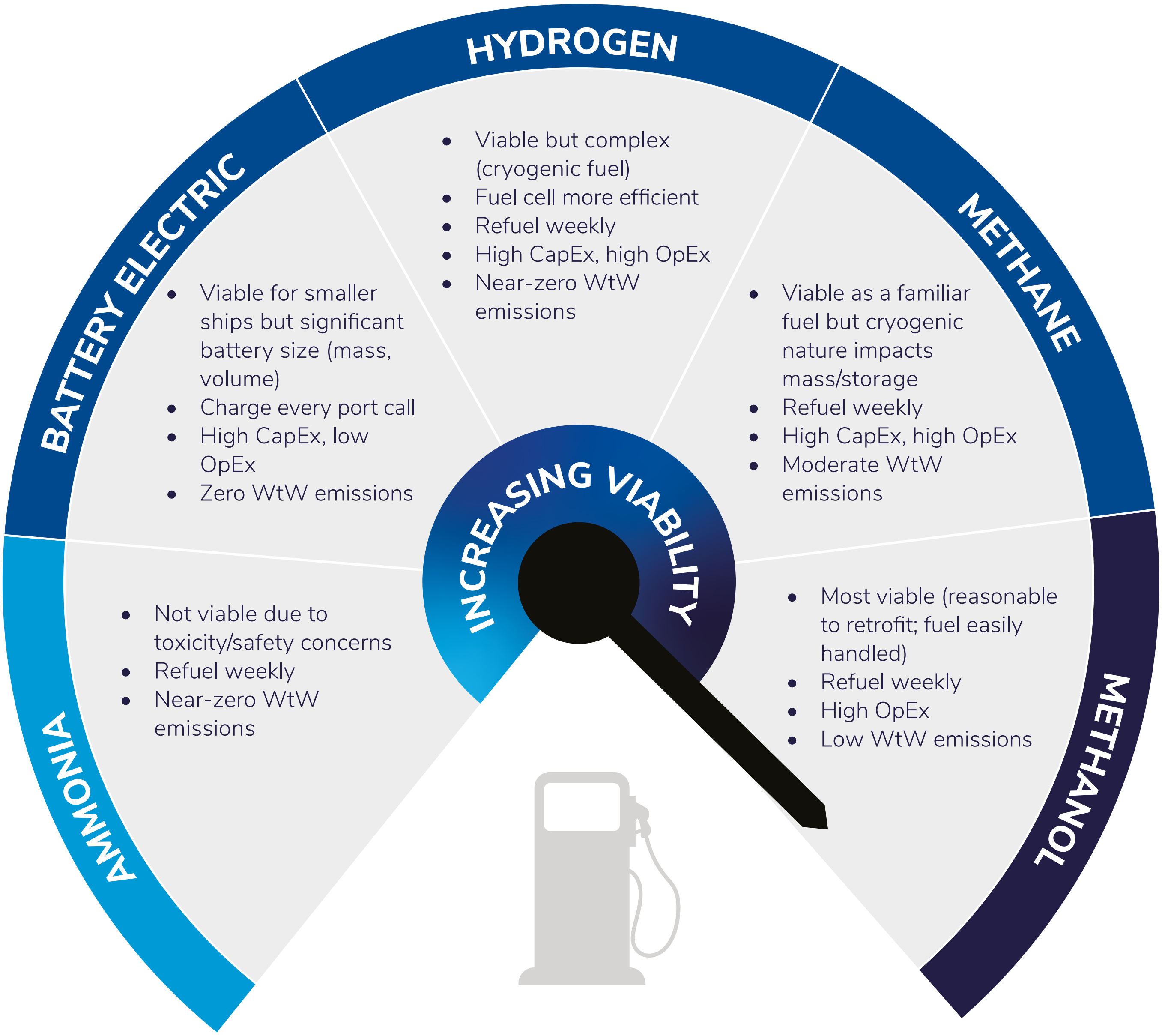
Methanol, with Marine Gas Oil as a pilot fuel, was identified as the most viable near-term fuel due to its compatibility with retrofits, manageable safety and handling properties, existing bunkering precedents, and technical feasibility across all vessels on this route.

While hydrogen and ammonia offer the potential for deep long-term decarbonisation under ideal production pathways, their lifecycle emissions depend heavily on how they are produced; some e-methanol or bio-methanol pathways may achieve comparable or even lower emissions.

Given that ammonia is hazardous, even at low concentrations, it remains unlikely to be adopted for passenger vessels in the near future despite its strong environmental performance and potentially relatively favourable pricing.

For the vessels currently operating on the route, retrofit of battery-electric solutions are infeasible due to the size and weight of batteries required. A battery-electric solution could be feasible for a new bespoke vessel designed specifically for this route, though this would reduce the operational flexibility currently offered by the existing fleet. Charge time may limit practicality for large, high-frequency RoPax operations.

VIABILITY OF FUEL OPTIONS



Biofuels such as HVO (Hydrotreated Vegetable Oil) and FAME (Fatty Acid Methyl Esters), though not explored in detail in this report, offer a drop-in solution that can deliver up to 60–90% well-to-wake GHG reductions compared to conventional Marine Gas Oil, depending on the feedstock and production pathway. They require minimal vessel modifications, making them suitable for near-term emission reductions. However, their long-term role is constrained by limited sustainable feedstock availability, risk of indirect land-use change emissions, and competition from other sectors such as aviation.

CAN HOLYHEAD AND DUBLIN SUPPORT 'ALTERNATIVE' FUEL AND SHORE POWER INFRASTRUCTURE?

Image: Dublin port

Both Dublin and Holyhead can accommodate methanol bunkering and OPS infrastructure with targeted port-side investment.

Detailed site layouts have been developed, including separation zones and safety access.

OPS implementation in Dublin is mandated to be installed from 2030 under the EU Alternative Fuel Infrastructure Regulation, and its use by vessels is mandated under Fuel EU Maritime. However, delivery of OPS in Dublin by 2030 will be contingent on the availability of sufficient grid capacity. Current indications suggest that the required power may not be available from the grid within this timeframe, which presents a significant risk to deployment.

Holyhead would need to follow on a voluntary basis in the absence of the UK Government introducing comparable requirements.

Infrastructure deployment would need to be closely coordinated with vessel retrofits to avoid operational disruption.

There is an operational preference for ship-to-ship bunkering to continue at Holyhead due to available space. This would avoid the need for onshore methanol storage exceeding Control of Major Accident Hazards Regulations thresholds (COMAH is the UK implementation of the EU Seveso Directive).

WHERE COULD THE FUEL FOR THIS CORRIDOR BE SOURCED FROM?

Green methanol would need to either be imported, or (dedicated) production set up for this corridor. Currently there is no methanol production in the UK or Ireland and limited planned green methanol production.

Annual methanol demand for the corridor is projected at ~150,000 tonnes (after accounting for the reduced fuel demand at berth due to the use of OPS).

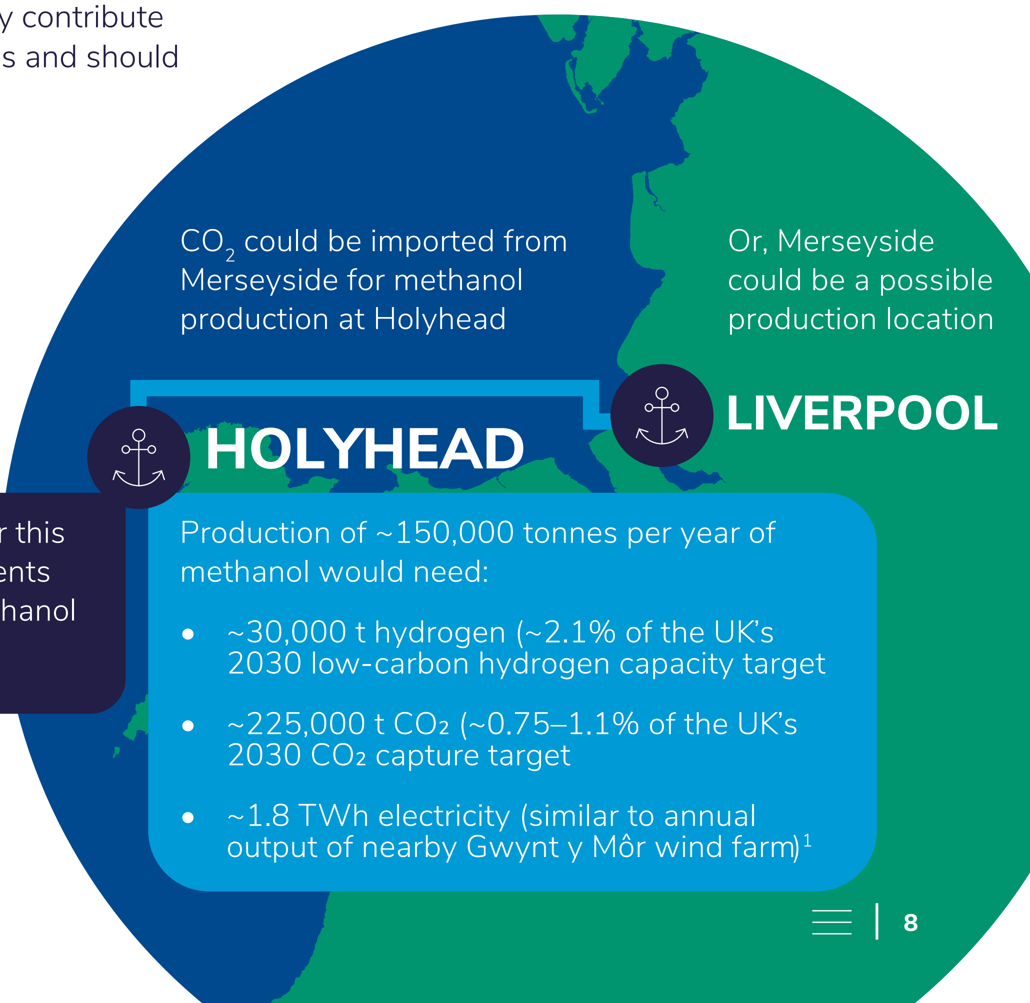
Imports

Short-term supply would likely be of bio-methanol and imported from the Netherlands, Scandinavia, or other emerging producers. A shortlist of 20 large-scale methanol supply projects within 3,000 km was identified as potential viable sources. However, transporting liquid fuel over this distance may contribute materially to upstream emissions and should be considered in future lifecycle assessments.

Local production

The operational preference is to continue refuelling at Holyhead. Future local production is also more feasible at the UK side, due to proximity with hydrogen production initiatives and land availability.

The annual demand for the corridor is about the scale of one dedicated medium to large-scale production facility. Renewable electricity would need to be dedicated for the production of green hydrogen and could conceivably be sought locally. For methanol production however, CO_2 sourcing remains a key constraint.



The demand for this corridor represents ~1/4 of UK methanol

Production of ~150,000 tonnes per year of methanol would need:

- ~30,000 t hydrogen (~2.1% of the UK's 2030 low-carbon hydrogen capacity target
- ~225,000 t CO_2 (~0.75–1.1% of the UK's 2030 CO_2 capture target
- ~1.8 TWh electricity (similar to annual output of nearby Gwynt y Môr wind farm)[1]

[1] Assuming point source CO_2 capture

WHAT ARE THE REQUIREMENTS FOR SAFE HANDLING AND USE OF THE SELECTED FUEL?

Methanol is currently regulated under the International Maritime Organization interim guidelines (MSC.1/Circ.1621) and will be formalised in the International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code) Part A-1.

Port-side methanol storage above 500 tonnes will trigger COMAH obligations, requiring site-specific risk assessments. This is avoided for ship-to-ship refuelling.

OPS must comply with EU AFIR and UK safety standards and at Holyhead should account for higher tidal range, which could complicate cable connection systems and installation.

Crew training aligned with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers Convention and IGF Code is essential, with defined pathways for basic, advanced, and vessel-specific roles.

Methanol's moderate flammability and toxicity require dedicated detection, ventilation, and emergency protocols.

WHAT IS THE POTENTIAL FOR EMISSION REDUCTION ACROSS THE GREEN SHIPPING CORRIDOR?

Green methanol-fuelled vessels deliver substantial WtW GHG reductions versus conventional marine fuels used on the corridor.

Emission savings range from 71%-80% based on *typical* bio- and e-methanol pathways.

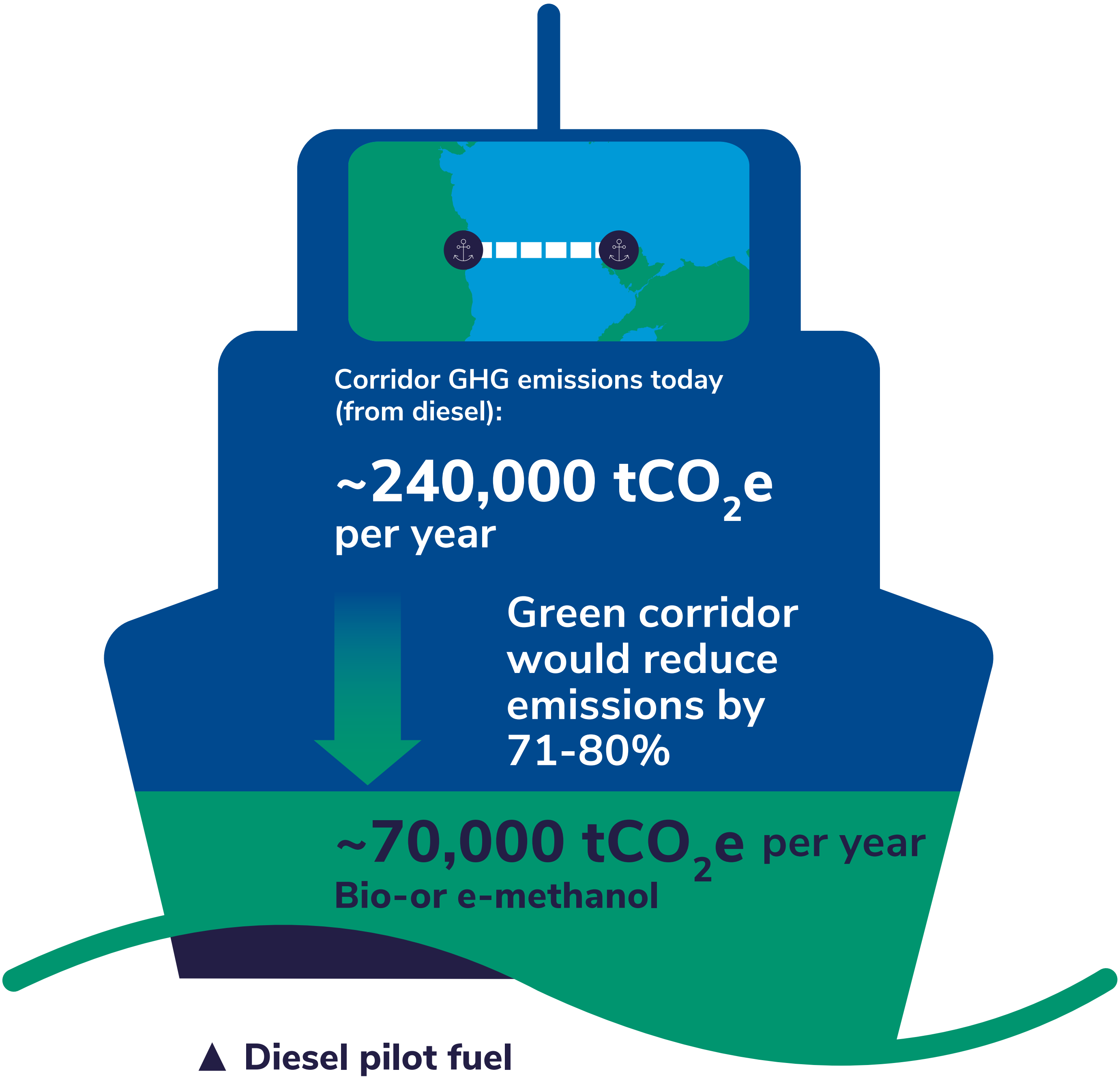
When considering a *broader range* of green methanol pathways, WtW emissions across a single round trip on the corridor could vary from –82 tCO_2e (best case) to +39 tCO_2e (worst case). This underscores the importance of careful sourcing and verification of input materials to ensure the intended environmental benefits are realised.

OPS enables an additional ~7,000 tCO_2e annual saving, around 10% of total corridor reductions, and supports compliance with FuelEU Maritime for vessels at berth. OPS infrastructure at Dublin must meet EU AFIR requirements, and while only 50% of voyage emissions are counted under FuelEU, OPS would also contribute to UK domestic emissions targets at Holyhead.

E-methanol and most bio-methanol pathways are compliant with FuelEU Maritime through to 2050. Beyond this, operators may need to adopt lower-carbon pilot fuels to maintain compliance.

E-methanol and most bio-methanol pathways are compliant with FuelEU Maritime up to 2049. Beyond 2050, operators may need to adopt even lower-carbon fuels or net-zero-compatible pilot fuels to ensure continued regulatory compliance[2]. It should be noted compliance doesn't equate to achieving net zero, although in nuanced circumstances some bio-methanol pathways from waste or residues could achieve carbon negative emissions.

[2] After the analytical work on this study had been concluded the IMO has proposed a new regulatory framework aimed at accelerating the transition to net zero by or around 2050. The emission intensity reduction targets defined in this framework are more stringent than those of FuelEU Maritime from 2029 onwards, it is expected the EU to review FuelEU Maritime targets in light of this. This study did not explore alignment to the IMO targets.



▲ **Diesel pilot fuel**

Shore power electricity rated zero emissions, saving ~7,000 tCO_2e/year

Dual fuel engine provides flexibility in methanol/ diesel ratio to allow fuel mix optimisation based on fuel cost

Any over-compliance with FuelEU in advance of its deadlines can be banked for later use, potentially extending compliance past 2050

Well-to-tank emissions from methanol vary depending on the pathway, so the benefit could be higher or lower than shown

IS IT ECONOMICALLY VIABLE TO OPERATE THIS GREEN SHIPPING CORRIDOR?

The economic case for the green corridor should be interpreted with caution. Assuming that biofuels are not available at commercial rates or in industrial quantities, whilst potentially viable long-term, methanol remains significantly more expensive than conventional marine fuels, with annual operating costs estimated at £83–125 million[3] compared to £34 million under fossil fuel use.

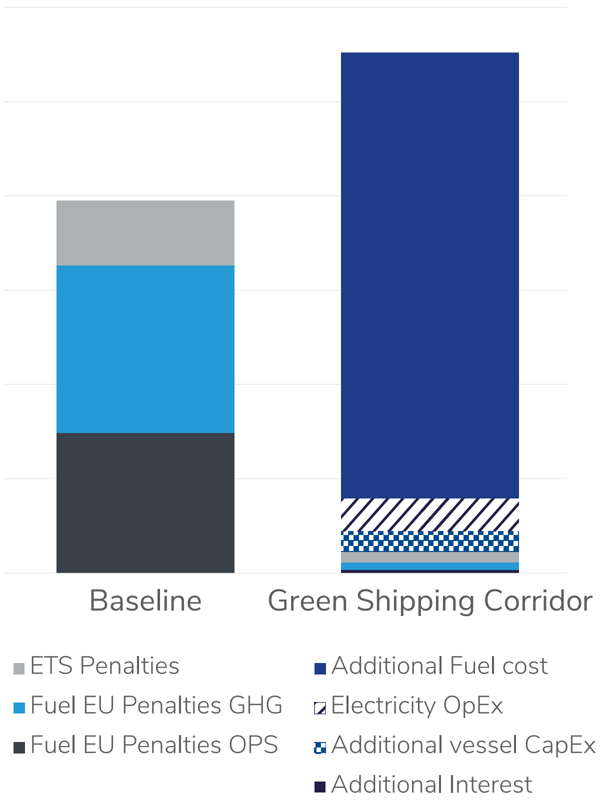
These figures are based on proxy estimates and long-term assumptions due to limited economic data available. Inputs such as fuel prices, carbon pricing, and policy instruments carry a high degree of uncertainty, meaning results should be considered as strictly indicative rather than definitive.

Methanol pricing is the single most influential factor in the corridor's economic feasibility. Prices are highly uncertain, ranging from ~£1,300/tonne (with subsidies) to £3,300/tonne (using CO_2 from direct air capture). If prices fall to ~£400/tonne, aligned with optimistic long-term projections, the cost gap with fossil fuels could narrow substantially. Without such cost reductions, investment decisions may be delayed or deprioritised.

OPS deployment offers a credible early action: it lowers fuel consumption, avoids carbon penalties, and cuts emissions without major operational changes. Innovative financing models, such as power purchase agreements, could help ports manage high upfront costs. The corridor also offers a first-mover compliance strategy as regulatory pressures increase. If carbon pricing or FuelEU penalties exceed current forecasts, fossil fuel operations may face a much higher cost burden. Uncertainty around future UK or IMO legislation could further raise compliance costs under the business-as-usual scenario.

Annualised cost comparison for the corridor (2030–2060)

While the GSC scenario shows higher costs due to investment in alternative fuels and infrastructure, penalties incurred in the baseline (e.g. ETS and FuelEU Maritime) are expected to increase over time, improving the long-term economic viability of the GSC.[4]



[3] Based on market data
[4] Some compliance costs exist in the GSC case as MGO was assumed as a pilot fuel - these could be avoided through the use of a sustainable alternative

CAN THIS GREEN CORRIDOR MODEL BE REPLICATED ELSEWHERE?

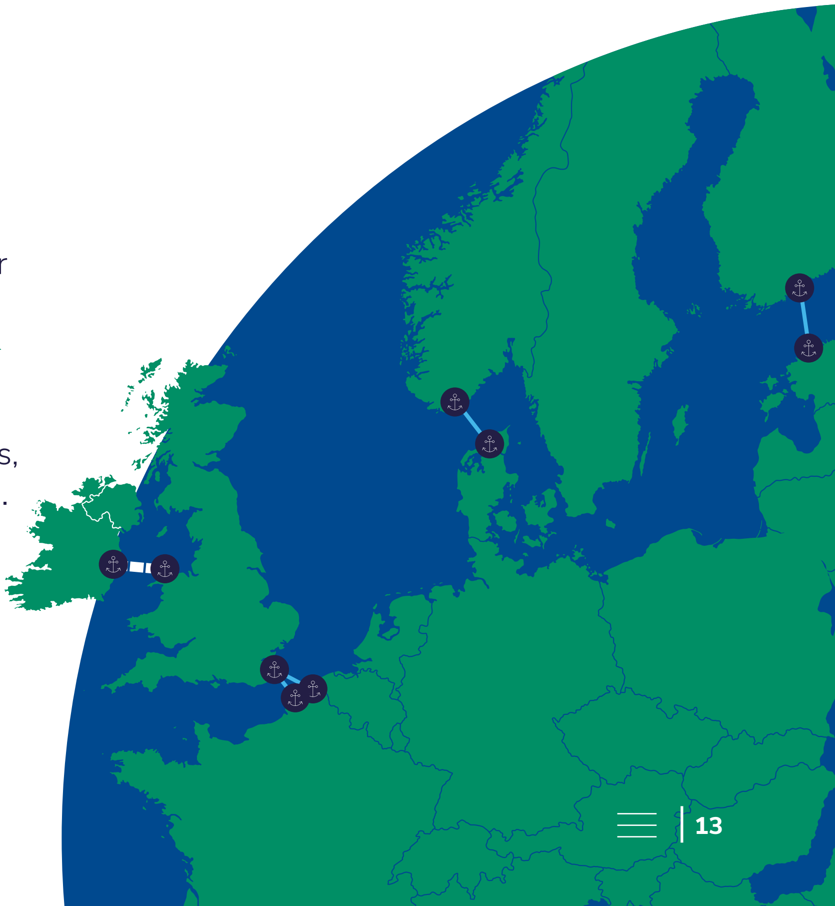
Image courtesy of Stena Line

The Holyhead–Dublin route is well-suited to serve as a demonstration project for green shipping corridors across Europe.

Replication potential is high for corridors with similar route lengths, vessel types, and port infrastructure such as Dover <-> Calais, Dover <-> Dunkirk, Helsinki -> Tallinn, Hirtshals <-> Kristiansand.

Key enabling conditions include policy alignment, coordinated infrastructure timelines, joint procurement, and streamlined permitting.

Lessons from this corridor can inform policy frameworks, port investment strategies, and green corridor funding models.



KEY TAKEAWAYS AND NEXT STEPS

The Holyhead–Dublin Green Shipping Corridor presents a realistic opportunity to decarbonise a high-frequency RoPax route using proven, scalable technologies. The analysis confirms that methanol-fuelled vessels supported by OPS infrastructure can deliver meaningful emissions reductions, meet emerging regulatory standards, and maintain operational reliability.

While the corridor would be more expensive to operate compared to conventional fuels, it offers a proactive approach to aligning with current regulatory measures. However, to make the investment in the corridor financially viable further work is needed to reduce the cost of methanol through targeted support across the supply chain and in tandem with policy support.

In this work, it was assumed that the vessels operating along the corridor would be retrofitted to operate on methanol. Given their age profiles, some vessels present a stronger case for retrofit investment, while others may be more suited to replacement or interim fuel-switching solutions. Broader fleet analysis suggests that a substantial portion of the European short-sea RoPax fleet (aged under 25 years) could be viable candidates for conversion – all vessels currently operating on the Holyhead-Dublin corridor fall below this guiding threshold.

Key enablers of success include the alignment of retrofit and infrastructure delivery timelines, early fuel procurement planning, clear regulatory pathways for bunkering and storage, and access to targeted public funding for green infrastructure and fuels. Without clear and aligned policy signals, particularly between the UK and EU, operators and ports may defer investment due to uncertainty around compliance pathways. Ensuring a level playing field across jurisdictions is essential to avoid competitive distortions and to build investor confidence.

Image courtesy of Irish Ferries

Implications for Vessel Operators:

- Retrofitting existing RoPax vessels for methanol is technically viable and operationally manageable (by temporarily utilising vessels within the wider fleet), with minimal disruption to layout and service schedules.
- Crew training requirements are clearly defined under the IGF Code, with pathways for basic, advanced, and vessel-specific roles.
- While methanol fuel is more expensive, regulatory compliance benefits and long-term cost stability offer a long-term fleet-wide compliance approach.
- OPS integration at both Dublin and Holyhead can be achieved without materially impacting turnaround times or service reliability.
- Fuel price sensitivity is a key driver of profitability. If e-methanol prices fall to levels considered "low-range" in the literature (e.g. ~£400/tonne post-2040), green operations could surpass BAU in long-term value. Engagement with potential local e-methanol producers is recommended to evaluate production potential and future costs projections.

Implications for Port Authorities:

Methanol bunkering and OPS infrastructure can be delivered with targeted capital investment. Methanol bunkering and OPS infrastructure can be delivered with targeted capital investment. In Holyhead, bunkering by barge is feasible and operationally preferred. In contrast, Dublin Port is constrained by limited river space, making barge bunkering highly challenging. Here, bunkering would need to be via truck at the quay wall, which is slower and less operationally efficient than barge transfer.

- Methanol's liquid state allows flexible delivery by road, rail, barge, or pipeline, avoiding the high cost and complexity associated with cryogenic LNG or hydrogen systems.
- Infrastructure investments enable ports to align with EU AFIR mandates (Dublin).
- OPS installation presents operational challenges, such as managing high tidal ranges, but these can be mitigated through technical design solutions.
- Early adoption of green shipping corridor infrastructure improves regulatory readiness and supports port ESG positioning but may temporarily increase costs relative to non-transitioning corridors.
- To avoid competitive distortion, coordinated policy measures, such as mirrored requirements on both sides of the corridor and targeted financial support, are needed to ensure early movers are not commercially disadvantaged.

RICARDO

FIND OUT MORE

For further information, or to explore partnership opportunities in developing Green Shipping Corridors, please contact:

Matthew Moss,
Green Shipping Corridor Lead
matthew.moss@ricardo.com

Discover how Ricardo supports ports, operators, and governments through our Maritime Services