Sailing Towards Net Zero:

Unlocking India's e-fuel corridor potential

Ministry of
Ports, Shipping & Waterways
Government of India

INDIA MARITIME WEEK 2025

GREEN MARITIME DAY

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About

Rocky Mountain Institute (RMI) is an independent, nonpartisan nonprofit founded in 1982 that transforms global energy systems through market-driven solutions to secure a prosperous, resilient, clean energy future for all. In collaboration with businesses, policymakers, funders, communities, and other partners, RMI drives investment to scale clean energy solutions, reduce energy waste, and boost access to affordable clean energy in ways that enhance security, strengthen the economy, and improve people's livelihoods. RMI is active in over 50 countries.

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Executive Summary

The International Maritime Organization's (IMO's) ambitious climate goal of attaining net-zero emissions from international shipping by 2050 has set the right ambitions for global maritime sector decarbonisation. Green shipping corridors are becoming a critical tool for accelerating the adoption of zero- and near-zero emission fuels to achieve this goal.

India is positioned well to be a leader in this transition. Buoyed by abundant renewable energy resources and resulting low green hydrogen production costs, India can spearhead the market development for green hydrogen-derivative fuels. India's Ministry of Ports, Shipping and Waterways (MoPSW) is also leveraging its geography and prioritising the ports of Deendayal, Paradip, and V. O. Chidambaranar (VOC) as green hydrogen hubs, with VOC standing out as a strategic origination point for green shipping corridors due to its proximity to international routes along the Indian Ocean and routes between India's East and West ports of Paradip and Deendayal. Realising this potential will require the convergence of policy, port readiness, and pooling together of stakeholder interests.

Policy developments are supporting e-fuel[i] adoption: Policy momentum is driving green hydrogen and e-fuel adoption in maritime and industry decarbonisation.

India is advancing a strong policy framework, both at the national and regional levels, to reduce green hydrogen production costs and accelerate the uptake of e-fuels. The impact of these measures is already visible in the 2025 green ammonia auctions for feritiliser producers, which delivered competitive prices averaging around US$600 per ton. At the same time, international demand signals are reinforcing this momentum: the European Union's (EU) ambitious maritime and industrial decarbonisation targets are driving the uptake and import of hydrogen derivatives, while Singapore's hydrogen strategy and maritime decarbonisation goals are creating parallel demand in Asia. Complementing these regional drivers, the IMO's Net-Zero Framework, combining penalties for high-emission conventional fuels with incentives for the lowest-emission alternatives and mechanisms to trade overcompliance credits, provides a robust regulatory foundation for scaling green shipping corridors globally by 2030.

All these developments provide successful green corridor opportunities centred on India. This report assesses the prospect of such a green corridor between VOC Port and the ports of Rotterdam and Singapore.

Robust opportunity is emerging for green corridors: A green ammonia export corridor between VOC Port, Rotterdam, and Singapore can support approximately 11 million tonnes per year (Mt/y) of aggregated potential import demand volume in Rotterdam and Singapore by 2030. Across the same corridor, green methanol can account for over 7 Mt/y of aggregated potential demand volumes.

EU's decarbonisation policy and Singapore's national hydrogen strategy are key demand drivers for green hydrogen-derivative imports, creating an opportunity for green shipping corridors from India to EU ports like Rotterdam and the port of Singapore.

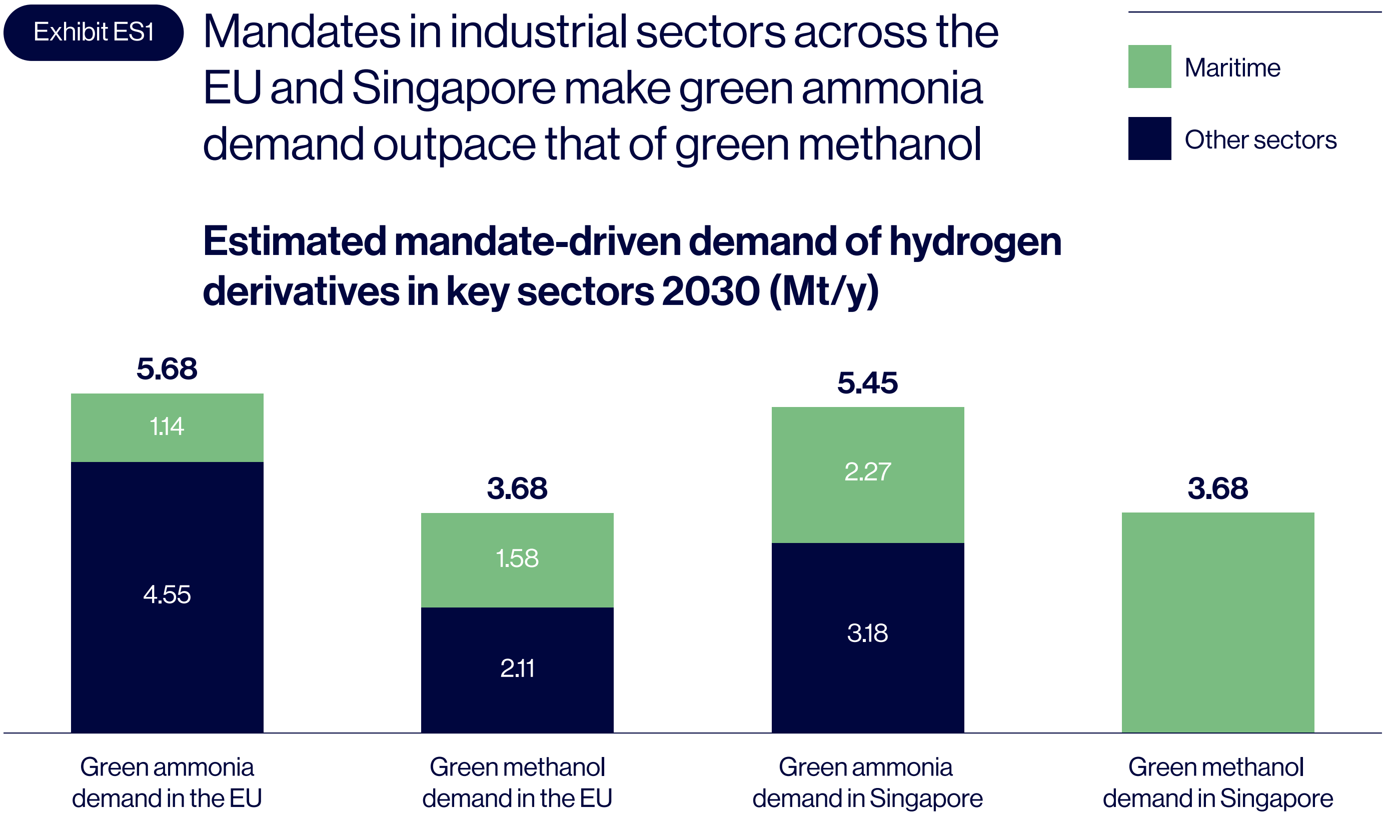
The combined green hydrogen demand for maritime and industrial decarbonisation in Singapore and the EU represents an estimated around 11 Mt/y of green ammonia and over 7 Mt/y of green methanol export potential by 2030 for corridors from India. These demand estimates include decarbonisation targets and mandates for key sectors such as aviation, refining, power, and fertiliser production. Exporting 11 Mt/y of ammonia from VOC Port to Rotterdam and Singapore will require 830 kilotonnes (Kt) of green ammonia per year to fuel a dedicated fleet, while exporting 7 Mt/y of methanol from VOC Port to Rotterdam and Singapore will require 310 Kt of green methanol fuel per year.

i E-fuels are synthetic fuels produced through electrolysis, which splits water molecules into hydrogen and oxygen using renewable electricity. Also known as electrofuels or Power-to-X fuels, they are a climate-neutral fuel that offer a pathway to decarbonise sectors where electrification is difficult, such as aviation and shipping, by leveraging current infrastructure. Green hydrogen produced through electrolysis is combined with CO_2 captured from various sources in a process known as synthesis. This results in a synthetic hydrocarbon fuel.

Exhibit ES1

Mandates in industrial sectors across the EU and Singapore make green ammonia demand outpace that of green methanol

Estimated mandate-driven demand of hydrogen derivatives in key sectors 2030 (Mt/y)



RMI Graphic. Source: European Hydrogen Observatory data, Eurostat, ANI, Ship and Bunker, S&P Global, EDB, GHIC, RMI analysis.

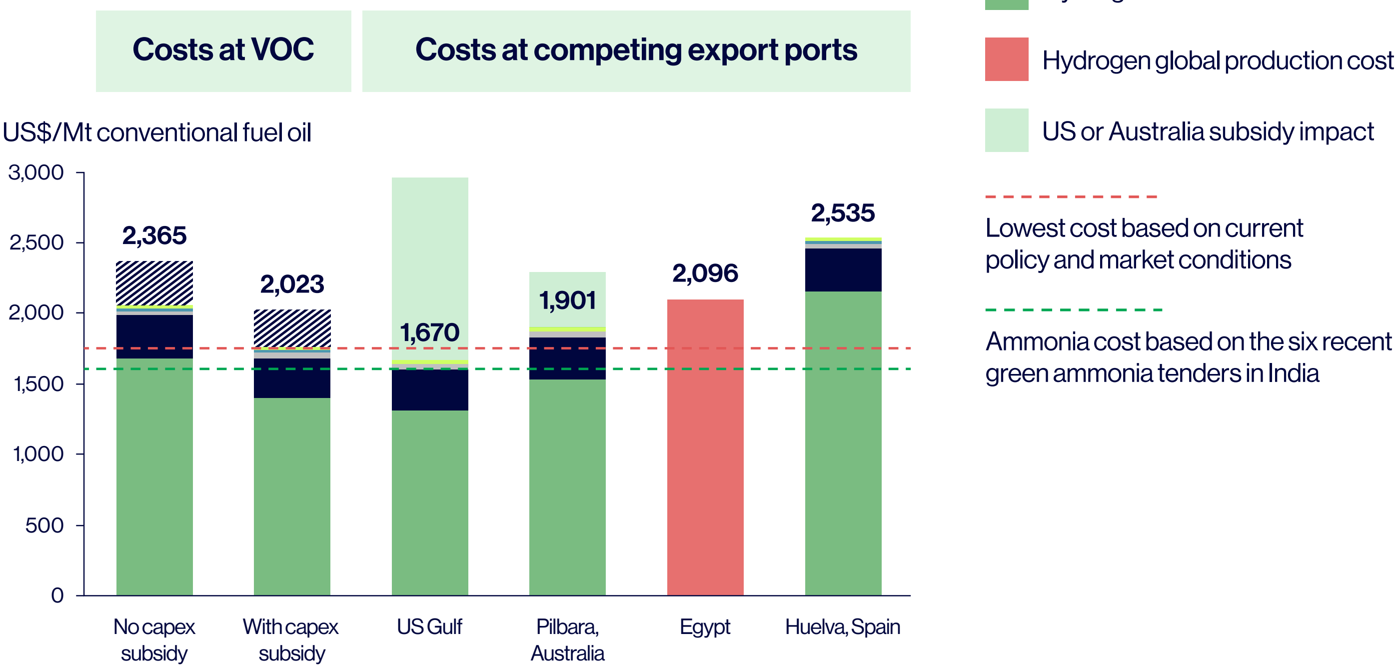
Production costs of India's e-fuels signal competitiveness: The current environment of conducive fiscal incentives for scaling a hydrogen-derivative market can enable India to deliver low-cost green ammonia and methanol to global bunker and industrial hubs like Rotterdam and Singapore.

The cost of e-fuel is typically three to four times more expensive than conventional fuel. However, VOC Port in Tamil Nadu benefits from relatively lower e-fuel prices due to stronger renewable resources and policy incentives in the state. There are capital expenditure subsidies in place through Tamil Nadu's Industrial Policy that have the potential to result in a 14% e-fuel cost reduction. In addition, policies that enable access to sustainable low-cost biogenic carbon sources would further improve Tamil Nadu's green methanol competitiveness.

Exhibit ES2

Production in the vicinity of VOC Port can be further made competitive for major e-fuel exporters with the introduction of subsidies

Green ammonia 2026 costs in Tamil Nadu benchmarked to various global green ammonia costs



RMI Graphic. Source: RMI analysis.

The VOC–Rotterdam corridor shows vessel total cost of ownership (TCO) rising from US$131 million (low sulphur fuel oil [LSFO]) to US$221 million (green ammonia, +69%), while VOC–Singapore increases from US$123 million to US$194 million (+58%). In both routes, fuel expenses dominate TCO, making them the key factor driving the higher cost of green fuels compared to conventional fuels.

IMO policy could bridge the cost gap between the use of e-fuel and conventional fuel, depending on the approach adopted for disbursing the zero and near-zero-fuel rewards that India's e-fuels could be eligible for. Under high IMO reward scenarios, using e-fuels for exporting green hydrogen derivatives can reduce the delivered cost of exported cargo by 1%–3% compared to shipping with conventional fuel vessels that will be subject to emission penalties.

Exhibit ES3

High IMO rewards lower delivered e-fuel costs via zero-emission-fuelled shipping

Shipping cost

Ammonia cargo cost

Provisional numbers

RMI Graphic. Source: RMI analysis.

Stakeholder commitment to e-fuel transition is positive: A robust hydrogen supply pipeline, e-fuel vessel readiness, and strategic offtake partners are aligning to create momentum for adoption of e-fuel corridors in India.

Given this prospect, multiple producers have announced green ammonia projects near VOC Port with an aggregated production capacity of about 4.5 Mt. The scale of production is significant enough to achieve economies of scale for port infrastructure and kickstart a local bunkering and export hub. For fuel offtake and export potential, global vessel owners that call at ports in India have dual fuel tankers on order that they can deploy on an India e-fuel export corridor if e-fuel prices are competitive and VOC Port is well prepared to handle e-fuel port calls. In addition, India has multiple chemical handling companies and traders with large-scale global operations, e-fuel transition commitments, and existing ammonia or methanol initiatives that stand out as potential offtakers or e-fuel exporters for India's e-fuel producers.

Port readiness to handle e-fuels is critical: VOC Port is well positioned for near-term green ammonia exports while advancing readiness for the ecosystem to handle and export green methanol to key global markets.

Prioritising the handling of ammonia fuel comes with risks, such as safety concerns and fewer global vessel orders for fuel offtake. However, VOC's ecosystem, including e-fuel production and handling experience, is aligned to near-term implementation of a green ammonia corridor. On the other hand, the ease of handling methanol and the high number of methanol vessel orders create incentives for the port to proactively support the development of the green methanol ecosystem by adopting incentives that attract methanol producers and infrastructure developers. Thus far, VOC Port has published a tender inviting proposals for establishing green methanol bunkering on a pilot scale, showcasing the port's commitment to developing the e-fuel market.

From the import viewpoint, both Singapore and Rotterdam are well-prepared to import and handle green ammonia and methanol from VOC Port. The ports are leaders in e-fuel bunkering infrastructure development with a combined planned storage capacity of over 3.5 Mt/y for methanol and over 5 Mt/y for ammonia. They have also supported bunkering pilots and demonstrations for ammonia and methanol fuels, putting them at the forefront of developing e-fuel handling safety regulations and guidelines. In addition, MPA Singapore has streamlined decision-making and strong national support for e-fuel transition that creates market certainty for corridors, while the Port of Rotterdam can offer access to Europe's broader maritime and industrial green hydrogen offtake markets. VOC Port can partner with either port for e-fuel exports, but given global competition, success will ultimately depend on VOC Port's ability to innovate and implement fast enough for first-mover advantage.

In conclusion, India has a unique opportunity to lead in green shipping corridors by leveraging cost competitiveness, strong policy momentum, and coordinated ecosystem investments. Ports such as VOC are well placed to emerge as e-fuel trade hubs as production costs decline, subsidies expand, and international frameworks like the IMO's Net Zero agenda help narrow cost gaps with conventional fuels. Realising this potential will require early alignment around a high-impact first-mover corridor, structured stakeholder collaboration, and formal consortium agreements that build trust and coordinate investments. With ports advancing readiness and international partners such as Singapore and Rotterdam prepared to import at scale, India can move decisively from vision to implementation — mobilising capital, securing long-term offtake, and cementing its role as a trusted global leader in maritime decarbonisation and the green e-fuel trade.

1 Introduction

The Maritime industry is the backbone of the global economy, transporting around 90% of international trade volumes and serving as a cornerstone for global fuel trade.[1] Consequently, international shipping is also a significant emitter of greenhouse gases, contributing nearly 3% of global CO_2 emissions and could rise to 10% of the global emissions by 2050 if unchecked.[2]

Recognising this problem, the International Maritime Organization (IMO) has set ambitious climate goals, including a commitment to achieve net-zero emissions from international shipping by 2050 as part of its 2023 IMO GHG Strategy.[3] The IMO has also agreed upon a Net-Zero Framework (to be formally adopted in 2026), putting in place both incentives and punitive measures designed to achieve its strategy.[4]

In addition to the regulatory efforts, the industry itself has been taking proactive steps. Cargo owners have come together to send clear demand signals around the procurement of green shipping for their products.[5] Shipowners and operators have ordered zero-emission vessels by the hundreds.[6] Ports have conducted pilots to showcase their ability to handle new alternative fuels in a safe manner.[7] Fuel producers have taken significant risks in investing in zero or near-zero fuel production without an existing liquid market. Both public and private sector entities are showing that the shipping sector can be a lighthouse for climate action. But more is needed.

Why green shipping corridors?

Within this context, green shipping corridors have emerged as a critical tool for accelerating decarbonisation by adopting zero- and near-zero (ZNZ) emission fuels. Green shipping corridors are defined as trade routes between two or more ports where public and private actions make zero-emission shipping viable by advancing technology, investment, and regulation.[8] Corridors serve as a tool for coordinating value chain investments and co-creating a shared business model that manages investment risk across the supply chain, thereby enabling early projects. By concentrating infrastructure development, vessel deployment, policy support, and other stakeholder initiatives and investments along specific routes, corridors help overcome the cost and scale barriers that currently limit the competitiveness of green fuels.

In particular, green shipping corridors can be a strategic opportunity when linked with the trade of hydrogen-derived fuels. Hydrogen-derived fuels such as ammonia and methanol are likely to be the most scalable zero and near-zero fuels for the maritime sector in the long run.[9] Hydrogen and hydrogen-derived fuels will also have a significant role beyond the maritime sector, and there is likely to be clear production cost differences based on geographical, demographic, and economic factors. A set of new energy flows are likely to emerge from low-cost production locations to high demand industrial centres. Ensuring that the transportation of these new energy flows occurs on a green shipping corridor is an easy way to catalyse the uptake of ammonia and methanol for shipping, create economies of scale for infrastructure, and reduce the carbon footprint of the commodity and the long-term compliance cost for vessel owners and operators.

Why India?

India has a strong maritime base with over 90% of its trade being seaborne. India is also well positioned to be one of the lowest cost production locations for green hydrogen due to several factors, including but not limited to low-cost renewables, supportive national and state-level subsidies, and an enabled grid. This is complemented by the strong national ambitions to be a global green hydrogen hub and to advance green shipping, with support from initiatives such as the National Green Hydrogen Mission and Harit Sagar guidelines.[10]

With these measures in place, Indian industry players have announced projects across the country targeting up to 12 Mt/y of green hydrogen and derivatives by 2030.[11] This scale creates the ability to launch e-fuel exports and bunkering for green corridor origination. India also stands out globally along with Oman and Saudi Arabia as one of the few exporters to have already taken final investment decisions on projects, making it viable to kickstart early corridor activities.[12]

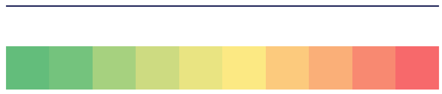
The country's geographic position along major international routes potentially allows it to serve as a strategic hub for e-fuel bunkering in the Indian Ocean, besides being well positioned as a producer and exporter of e-fuels. Considering India's green hydrogen production ambitions, and the clear strategic linkages between the export of green-hydrogen derivatives and green shipping corridors, this analysis focuses on the corridors likely to emerge as a result of the trade of hydrogen-derived fuels from India to early offtake markets.

The starting point of this analysis is based on a 2023 announcement by India's Ministry of Ports, Shipping and Waterways (MoPSW) that earmarked the ports of Deendayal, Paradip, and VOC as green hydrogen hubs, catalysing green hydrogen project announcements in the vicinity of these ports.[13] RMI's analysis of India's ports, shown in Exhibit 1 below, highlights that those three ports have an optimal mix of renewable energy potential, infrastructure development resources like land, regional policies, and stakeholder ambition to lead the development of e-fuel ecosystems and trade.

It is important to note that other ports in India also have several key factors that could support the development of an e-fuel ecosystem. Therefore, green shipping corridor opportunities in India have the potential to exceed the scope of this study, which focuses on the three ports prioritised by the MoPSW as starting points for developing the market.

Exhibit 1

Ports assessment matrix and scoring using indexed and weighted score for each variable



RMI Graphic. Source: RMI analysis.

Beyond their role in the energy transition, the ports of VOC, Deendayal, and Paradip are critical trade gateways, with Paradip and Deendayal ranking as the top two cargo handling ports in India by trade volume.[14] VOC Port stands out as a potential hub for green shipping corridors given its location on major Indian Ocean routes and its connectivity between India's eastern and western ports, including Paradip and Deendayal. Furthermore, VOC Port's goal of promoting green hydrogen production and establishing itself as a bunkering hub for e-fuels is well aligned with green shipping corridors.[15]

As a next step to understanding the potential of realising green corridors from VOC Port, we examine the economic and regulatory viability of high-potential routes such as the Green and Digital Shipping Corridors that have been agreed upon with The Netherlands and Singapore.[ii, 16]

Structure of the report

This report examines the corridor potential through several lenses to have a robust analysis framework. First, the report assesses e-fuel demand drivers at two likely destination ports, considering aspects such as international and domestic policy that are likely to impact trade volumes. Second, the report examines India's global competitiveness, assessing the costs of fuel production in India and their impacts on vessel operating costs. Finally, the report considers whether the required enabling ecosystems are available to effectively implement green shipping corridors. The report concludes with recommended next steps to move the corridor from theory to practice.

ii A Green and Digital Shipping Corridor combines the fuel transition and the data/digital transition to create structured, future-proof trade routes that accelerate shipping decarbonisation and efficiency. Activities usually include alternate fuel uptake, bunkering initiatives, port call optimisation, port-to-port data exchange, and more.

2 Global Policy Context

As part of shipping's energy transition, multiple barriers must be overcome, including the high-cost differential between fossil and alternative fuels, the lack of low-carbon bunkering and storage infrastructure, and the lack of clear demand signals for first movers. Overcoming these barriers will require private sector actions, but also a robust policy ecosystem at the international, national regional, and port levels.

Fortunately, a policy environment conducive to creating the right set of conditions for shipping decarbonisation and green corridors has started to emerge, both in India and globally, as seen in Exhibit 2. The section below highlights developments across the various applicable policy spheres, focusing primarily on policies that create demand for hydrogen or hydrogen-derived fuels, incentivise uptake for vessels, or lower the cost of green hydrogen production.

Exhibit 2

Implications of Indian and global policies across the green corridor value chain

	Demand	Vessels	Fuel production	Miscellaneous (ports/ regulators/financiers)
IMO	**GFI: Creates demand for e-fuel usage on vessels that increases over time**	**Surplus unit and ZNZ reward:** Reduces cost premium between e-fuels and conventional fuels for ship owners/operators		
India Federal		**Vessel capex subsidy:** 25% subsidy for vessels adopting green fuels; lowers first-mover vessel & turnaround risk at Indian ports	**T&D waivers:** Materially lowers opex for green hydrogen production **SIGHT electrolyser**: incentivises domestic electrolyser manufacturing and lowers capex for green hydrogen production	**Hydrogen-hub development funding:** Funding for green ammonia bunkering and fuelling facilities **Funding for maritime sector (2025):** ₹69,725 crore Shipbuilding Financial Assistance Scheme (SBFAS): ₹24,736 crore Maritime Development Fund (MDF): ₹25,000 crore Shipbuilding Development Scheme (SbDS): ₹19,989 crore
India State			**Tamil Nadu and Odisha capex subsidies:** Lower capex for green hydrogen production **Odisha electricity cost reduction:** Multiple electricity-based exemptions to lower cost of green hydrogen production	**Green hydrogen hub designation:** Official designation for VOC, Deendayal, and Paradip ports with active planning to operationalise bunkering and refuelling infrastructure by 2030
Singapore	**National hydrogen strategy** (2022): Enables ammonia (as a hydrogen carrier) for power generation via "pathfinder projects" **EMA–MPA ammonia power & bunkering** (Jurong): Tender for end-to-end ammonia import–storage–power generation and bunkering pilot	**Tonnage fee discounts:** Offering annual tonnage fee reductions for Singapore-flagged vessels operating on low-carbon fuels		**Port fee discounts:** Offering significant port fee reductions (up to 100%) for vessels using or operating on low-carbon fuels **Bunkering pilots:** Creating bunkering and safety standards for safe use of ammonia and methanol
Europe EU	**RED III directive:** Requires 42.5% of all hydrogen used by industry in 2030 to be RFNBO **FuelEU maritime:** Creates increasing demand for e-fuel usage on vessels operating in, to, and from the EU	**FuelEU maritime and EU ETS:** Reduces cost premium between e-fuels and conventional fuels for shipowners and operators		**Port fee incentives:** Offering port fee reductions for vessels operating on low-carbon fuels **Bunkering pilots:** Creating bunkering and safety standards for safe use of ammonia and methanol

RMI Graphic. Sources: RMI analysis, IMO, India Ministry of Ports, Shipping and Waterways, India Ministry of New and Renewable Energies, MPA Singapore, MTI Singapore, Port of Rotterdam, European Commission.

2.1 The IMO Net-Zero Framework

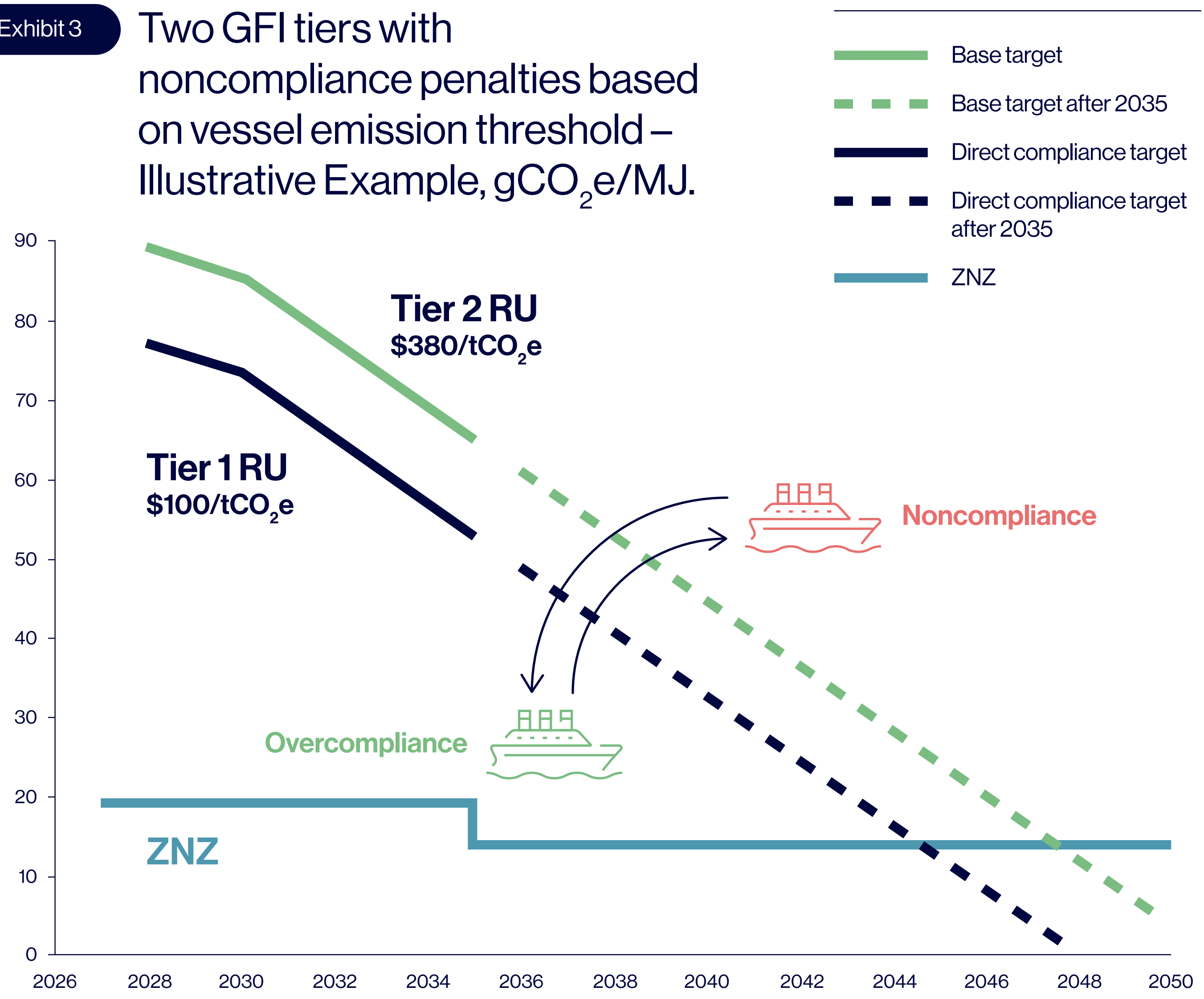
The most important policy development for the implementation of green corridors is the IMO's Net-Zero (ZNZ) Framework,[iii] which sets a mandatory emissions limit and an emissions pricing mechanism starting in 2028.

The framework is built on the concept of a two-tier emissions reduction mandate based on the fuel's greenhouse gas fuel intensity (GFI) as seen in Exhibit 3. Non-compliance with the reduction mandate can result in penalties of either US$100/ton CO_2e or US$380/ton CO_2e depending on which tier the non-compliance falls into. Additionally, a credit trading mechanism allows for a market-based mechanism to incentivise overcompliance. Finally, an additional subsidy for the utilisation of zero or near-zero fuels has been included in the framework to further incentivise the uptake of the long-term scalable solutions (e.g., green ammonia and methanol) that might not be as competitive in the market currently.

iii To be formally adopted in October 2025.

Exhibit 3

Two GFI tiers with noncompliance penalties based on vessel emission threshold – Illustrative Example, gCO_2e/MJ.



Note: Note: Z-factors (annual emission factors for each GFI tier) are established through 2035, with the IMO's Committee tasked to define Z-factors for the 2036–2040 period by January 1, 2032.The Z-factor for the Base Target in 2040 has already been set at 65%. The two-tier trajectories from 2025 to 2050 are based on a linear path. GFI based on a well-to-wake basis.
Source: IMO Draft revised MARPOL Annex VI, RMI analysis.

The framework affects green shipping corridors (especially those that are based on the export of green hydrogen derivatives) in two ways.

First, it creates greater demand for green hydrogen derivatives. While alternative fuels such as LNG and biofuels can be used to comply with the Net-Zero Framework in the short to medium term, the framework also creates enough optionality and incentives to make the use of hydrogen-derived fuels viable immediately. Additionally, compliance with the Net-Zero Framework in the medium to long term will almost certainly require the uptake of significant amounts of green hydrogen derivatives. This creates clear short-term and long-term demand for green-hydrogen derivatives in the maritime sector.

Second, it encourages the use of green hydrogen derivatives as fuel for green shipping corridors. Green ammonia and methanol are typically two to four times more expensive than conventional shipping fuel when considered on an energy basis. This has made it prohibitive to implement green shipping corridors due to the inability to create a business case. The incentive structure created by the Net-Zero Framework, however, can help green ammonia and methanol achieve (close to) cost parity with fuel oil, especially in low-cost production locations such as India.

In summary, the IMO's Net-Zero Framework creates both a demand pull for hydrogen-derived fuels from the maritime sector and a business case for the vessels to use the hydrogen-derived fuels immediately on the green shipping corridors that would transport the fuels.

2.2 Policy environment in India

India has launched multiple national initiatives that are aligned with green corridor creation at both the federal and state levels. At the federal level, the Ministry of New and Renewable Energies (MNRE) launched the National Green Hydrogen Mission in 2023 to establish green ammonia bunkering and refuelling facilities at all major ports by 2035, backed by a dedicated allocation of US$25 million for hydrogen hub development in 2024.[17]

The Indian government has also announced a mix of supply and demand-side incentives to stimulate adoption of alternate fuels. On the supply side, the government has introduced a 25-year waiver of interstate transmission charges for renewable electricity used in green hydrogen production, significantly reducing operating costs for producers. In addition, the government is currently supporting domestic electrolyser manufacturing through the MNRE's SIGHT financial incentives of ₹17,490 crore or over US$2 billion.[18] On the demand side, financial assistance schemes provide a 30% subsidy for India-made vessels adopting green fuels, reducing up-front risk for shipowners and encouraging investment in low-carbon technology.[19]

With a ₹69,725 crore (US$8 billion) comprehensive package recently approved to revitalize India's shipbuilding and maritime ecosystem, the government is signalling a bold investment leap that can transform India's ports into global infrastructure anchors.[20] Included is the Maritime Development Fund (MDF) to support India's Maritime sector with financial assistance pegged at ₹25,000 crore (US$2.82 billion), Shipbuilding Financial Assistance Scheme (SBFAS) worth ₹24,736 crore (US$2.79 billion), and the Shipbuilding Development Scheme (SbDS), with a budgetary outlay of ₹19,989 crore (US$2.25 billion).[21] The fund is aimed at directly benefiting financing for ship acquisition to boost Indian flagged ships' share in the global cargo volume up to 20% by 2047.[22] Established under the Sagarmala Programme, the Sagarmala Finance Corporation Limited became a non-banking financial company (NBFC) in 2025 to address financing gaps in maritime infrastructure, such as e-fuel bunkering, and to support sectoral growth aligned with the Maritime Amrit Kaal Vision 2047.[23]

Multiple states in India have also introduced green hydrogen policies to kickstart regional ecosystems. For example, Tamil Nadu and Odisha are offering capital subsidies, while Odisha also introduced multiple electricity-based exemptions that lower the cost of hydrogen production.[24] These initiatives can stimulate demand for e-fuels within India and advance development of international corridors for e-fuel trade.

Regionally, ports have emerged as key implementation centres for India's green hydrogen vision, with VOC, Deendayal, and Paradip ports designated as official green hydrogen hubs. These ports are actively planning to operationalize bunkering and refuelling infrastructure by 2030, positioning them as pivotal nodes for both domestic green shipping corridors and international e-fuel trade routes.

2.3 Policy environment in the EU

Through a combination of progressive supra-national regulations and targeted national measures, the EU is positioning itself as a key driver of demand for green hydrogen derivatives.[25]

EU's 2030 Renewable Energy Directive (RED III) requires renewable fuels of non-biological origin (RFNBOS) to account for 42.5% of all hydrogen use.[26] The ReFuelEU policy supporting the use of sustainable aviation fuels (SAFs) is also expected to drive demand for RFNBOs.[27] Despite these targets, green hydrogen production in the EU was only about 0.06 Mt/y in 2024, highlighting the wide gap between today's capacity and policy ambitions, which creates an opportunity for potential exporters such as India.[28]

In addition, the EU enacted the FuelEU Maritime regulation aiming for an 80% reduction in greenhouse gas emissions from shipping by 2050. [29] The regulation penalizes the continued use of high-emissions fuels such as conventional fuel oil, while rewarding the use of low-carbon fuels through the sale of overcompliance credits.[30] The policy also includes a fleet-wide emission pooling mechanism and RFNBO multipliers that offer shipping companies flexibility for compliance and encourage the uptake of hydrogen-derived fuels.[31]

Beyond FuelEU Maritime, the scope of the EU Emissions Trading System (ETS) was expanded to include maritime emissions from large vessels calling at EU ports, covering 100% of intra-EU voyages and 50% of international voyages.[32] ETS enforcement is phased over time, with shipping companies expected to reach full compliance and allowance payments by 2027.[33] Together, FuelEU Maritime and ETS create a strong regulatory push for shipping companies to adopt low-carbon fuels or risk paying escalating compliance costs.

At the national level, the Netherlands has established itself at the forefront of maritime decarbonisation, with the Port of Rotterdam serving as the anchor for the country's efforts.[34] Rotterdam has taken steps towards achieving the target by supporting demand aggregation as well as offering port fee reductions for vessels operating on low-carbon fuels. The port is also integrating international cooperation into its strategy, laying the foundation for a green and digital maritime corridor with Singapore and ports in India.[35]

The proactive regional initiatives and national ambitious goals highlight Rotterdam's commitment and suitability to handling e-fuels, especially as a gateway for Europe's broader energy transition.

2.4 Policy environment in Singapore

Singapore launched its National Hydrogen Strategy in October 2022, positioning hydrogen as a focal point of its energy transition and hydrogen derivatives like ammonia as vital carriers for imports.[36] The plan proposes that hydrogen supply up to 50% of the nation's power demand by 2050, making it a critical element of Singapore's long-term decarbonisation pathway. Recent tenders and plant announcements indicate that at least nine hydrogen-compatible power plants will be operational by 2030, with a combined capacity of 3.9 GW, showing clear intent to follow through on the proposal.

Singapore has taken ambitious steps on maritime decarbonisation, linked perhaps to its status as the world's largest bunkering hub. Singapore has already started implementing the regulatory and commercial frameworks required to integrate hydrogen derivatives into its bunkering mix.[37] Additionally, it finalised a methanol bunker licensing framework, enabling producers to apply for licenses for supplying methanol as a marine fuel.[38] In 2024, Singapore also selected two consortia (Keppel and Sembcorp-SLNG led) to support the development of ammonia-based bunkering solutions, signalling clear intent to diversify beyond methanol.[39]

To incentivise adoption, Singapore is offering significant (up to 100%) port fee discounts along with registration and annual tonnage fee reductions for Singapore-flagged ships that operate on low-carbon fuels.[40] These measures create immediate cost benefits for operators who transition.

3 Corridor Opportunity Sizing for VOC Port

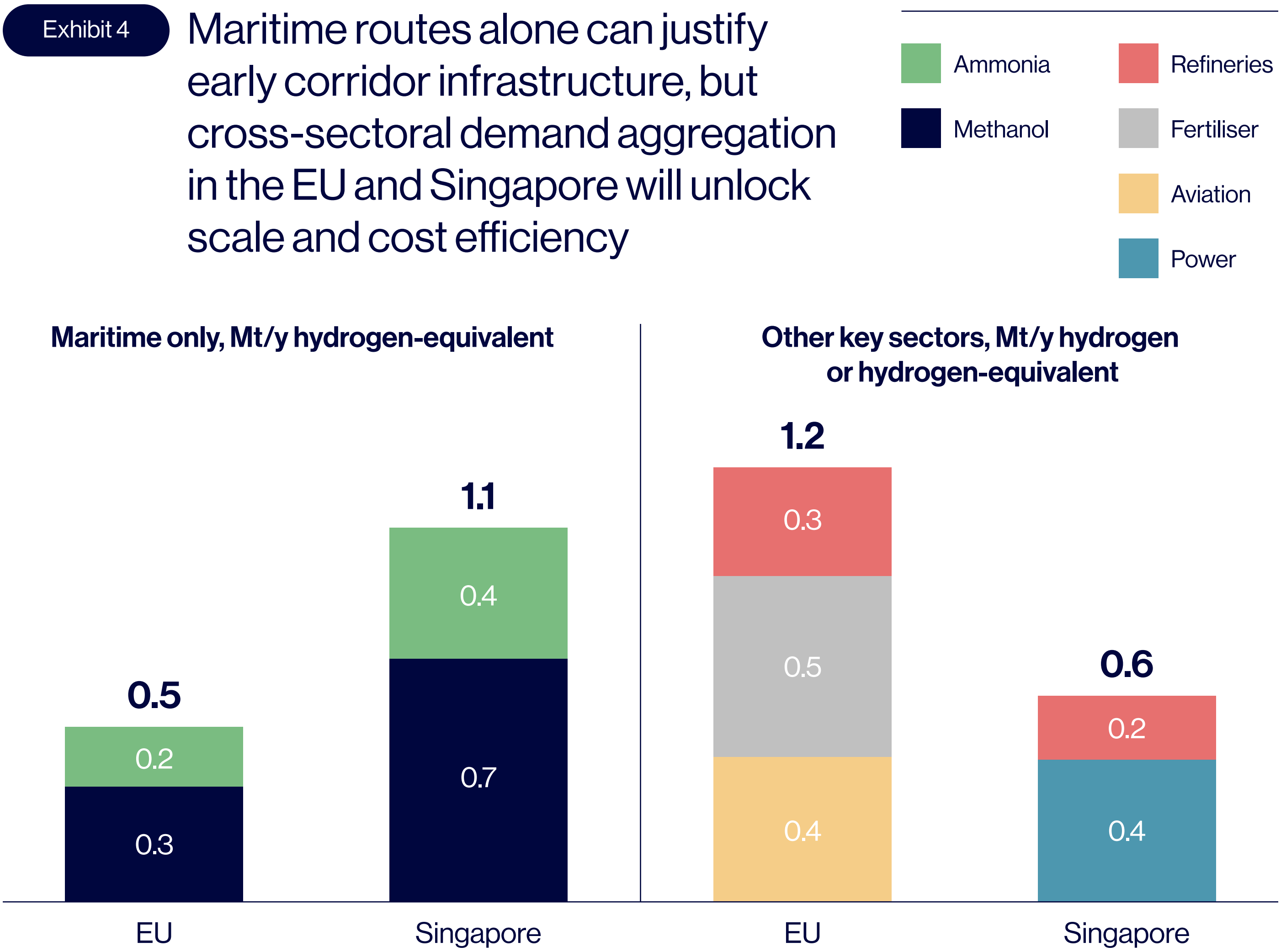
The conditions emerging in the global and Indian policy landscapes offer India a unique opportunity to capitalize on e -fuel trade by building strategic relationships across domestic and international markets. To create catalytic efforts, however, it is important to ensure significant volumes of demand. Without the requisite demand for hydrogen-derived fuels, both the threshold for achieving economies of scale at production and establishing enough traffic to ensure uptake of green ammonia or methanol by the vessels will not be met, making the creation of a green corridor unviable.

3.1 Green hydrogen derivative demand from Europe

The most significant policy drivers for hydrogen-derived fuel uptake in Europe are the RED III and ReFuelEU Mandates. RMI's analysis published in *The Case for Recalibrating Europe's Hydrogen Strategy* report indicates the mandates could drive an estimated 1.2 Mt/y of green hydrogen demand in industries such as fertiliser, aviation, and refining by 2030 (see Exhibit 4).[41] Demand from the refining and fertiliser sectors will be the anchor and can be met by green ammonia as a hydrogen carrier for transportation purposes and/or direct feedstock for nitrogen-based fertilisers, translating to 4.55 Mt/y of green ammonia demand by 2030.

Exhibit 4

Maritime routes alone can justify early corridor infrastructure, but cross-sectoral demand aggregation in the EU and Singapore will unlock scale and cost efficiency



RMI Graphic. Source: RMI, Ship and Bunker, Singapore Economic Development Board, International Solar Alliance, RMI analysis.

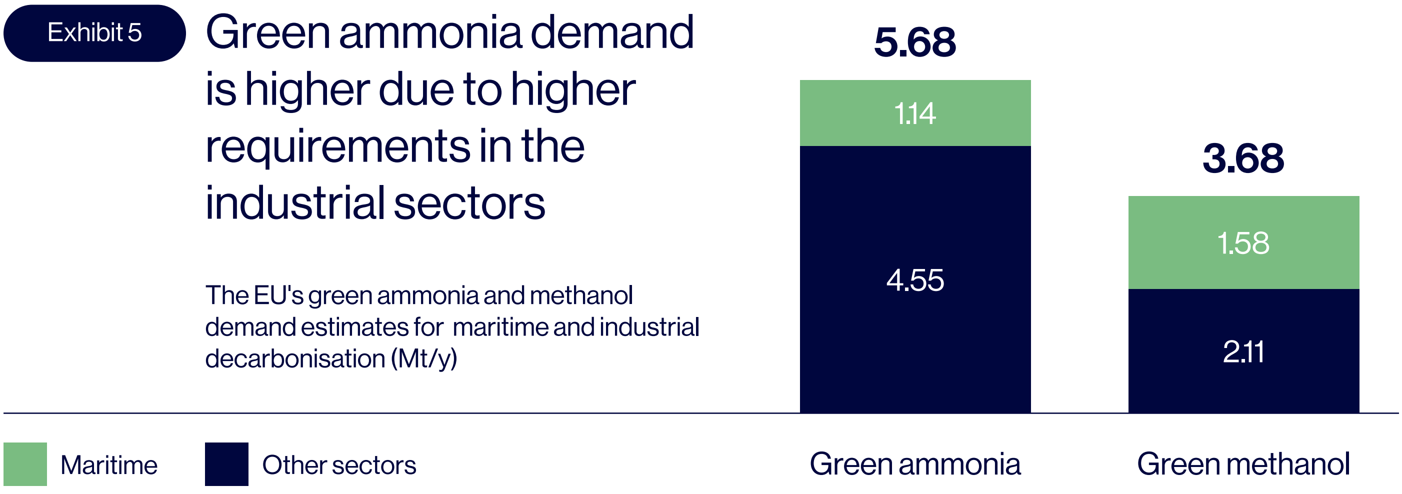
Although the aviation industry may not serve as a near-term demand centre for green hydrogen derivatives, green methanol could play a role in meeting this demand as the sector scales in the future. Realising this potential could translate into an additional 2.11 Mt/y of green methanol demand from the aviation sector by 2030. With aviation's ReFuelEU-driven demand anticipated to materialize slowly due to technology and regulatory huddles for SAF adoption at scale, green methanol volumes can serve multiple decarbonisation purposes in shipping, olefins, and other chemical processes as the SAF market matures.

The maritime sector could also be poised to adopt high volumes of e-fuels due to the IMO's Net Zero Framework. Europe consumed an estimated 25 Mt of conventional fuel oil in 2024 from major bunkering hubs such as Amsterdam–Rotterdam–Antwerp (ARA) and Gibraltar Strait (Gibraltar, Algeciras, and Ceuta).[42] RMI estimates that meeting 5% of the conventional fuel consumption through green hydrogen demand in the EU's major bunkering hubs would result in demand of 0.5 Mt/y by 2030.[iv, 43] Based on current vessel order books and observed market trends, the 0.5 Mt/y of green hydrogen demand would be projected to be split as 1.58 Mt/y of green methanol and 1.14 Mt/y of green ammonia.[v] Exhibit 5 below shows a summary of green ammonia and methanol demand estimates for EU's maritime and industrial decarbonisation.

Exhibit 5

Green ammonia demand is higher due to higher requirements in the industrial sectors

The EU's green ammonia and methanol demand estimates for maritime and industrial decarbonisation (Mt/y)



RMI Graphic. Source: RMI analysis.

3.2 Green hydrogen derivative demand from Singapore

Considering Singapore's National Hydrogen Strategy, Maritime Decarbonization blueprint, and proactive transition announcements from the energy industry, it is estimated that Singapore would require 1.7 Mt/y of green hydrogen by 2030 to satisfy demand in key sectors as seen in Exhibit 4 above.

E-fuel demand for the maritime sector encompasses most of Singapore's hydrogen demand since the port is currently the largest bunkering hub worldwide requiring an estimated 1 Mt/y of green hydrogen equivalent for bunkering by 2030.[vi] This is estimated from Singapore's current bunkering volume (54.48 Mt) and IMO's 2030 emissions reduction targets.[44] Based on current vessel order books and observed market trends, Singapore's hydrogen bunkering demand could represent an estimated 3.68 Mt/y and 2.27 Mt/y of green methanol and ammonia fuel respectively and still only be approximately 5% of maritime energy provided at the port.[vii]

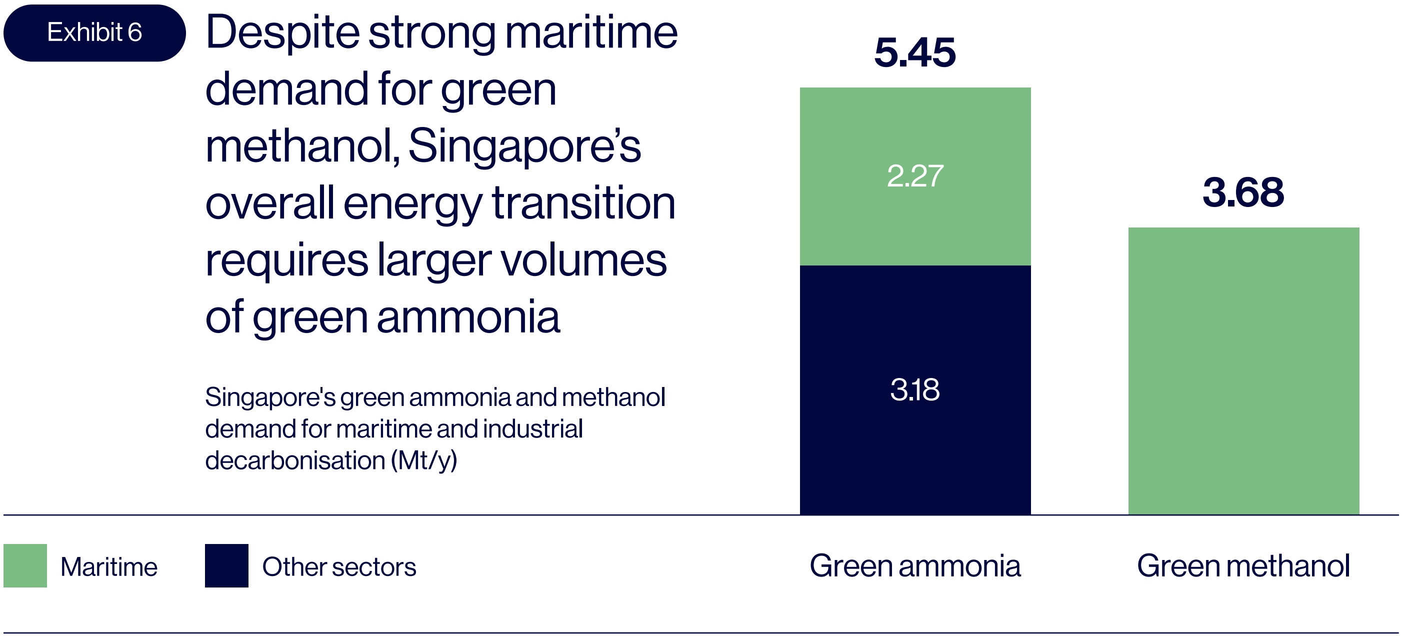
Furthermore, Singapore has been proactive with decarbonising its refining and power sectors. The nine or more hydrogen-compatible power plants that will be operational by 2030 will create an estimated 0.4 Mt/y of green hydrogen demand.[viii] Singapore also uses 0.7 Mt/y of grey hydrogen for its refining sector. [45] A 25% substitution of the grey hydrogen represents 0.2 Mt/y of green hydrogen demand that is assumed to require ammonia as a carrier, aggregating Singapore's estimated green ammonia demand for industrial decarbonisation to 3.18 Mt/y. Exhibit 6 shows a summary of green ammonia and methanol demand estimates for Singapore's maritime and industrial decarbonisation.

iv Considering IMO's 2030 fuel decarbonisation target, 5 % of the demand is expected to be fulfilled by low-carbon fuels such as green ammonia and methanol. The total also accounts for a 0.8% reduction due to ship efficiency measures.
v RMI analysis projects that approximately 65% of e-fuel demand will be met by green methanol, with the remaining share satisfied by green ammonia.
vi Considering IMO's 2030 fuel decarbonisation target, 5% of the demand is expected to be fulfilled by low-carbon fuels such as green ammonia and methanol. The total also accounts for a 0.8% reduction due to ship efficiency measures.
vii RMI analysis projects that approximately 65% of e-fuel demand will be met by green methanol, with the remaining share satisfied by green ammonia.
viii Assuming a 30% co-firing ratio as per announcements in Singapore.

Exhibit 6

Despite strong maritime demand for green methanol, Singapore's overall energy transition requires larger volumes of green ammonia

Singapore's green ammonia and methanol demand for maritime and industrial decarbonisation (Mt/y)



RMI Graphic. Source: RMI analysis.

By 2030, the total estimated hydrogen demand in the EU and Singapore is expected to reach the equivalent of 7 Mt/y of green methanol and 11 Mt/y of green ammonia that local production is unlikely to meet. This creates an opportunity for dedicated export corridors from ambitious producers like India.

It is important to note that the demand projections are intentionally not a product of bottom-up analysis in the initial pre-feasibility phase of the green corridor assessment. They are meant, rather, to indicate an order of magnitude to ensure that potential demand can meet the threshold to establish a green corridor. A more robust, bottom-up analysis is usually conducted during the feasibility phases of the corridor analysis.

Box 1

Sizing coastal corridors in India

India's coastal cargo traffic has increased significantly from 74 Mt in 2014–15 to 162 Mt in 2023–24, with a target of 230 Mt by 2030. With the Coastal Shipping Bill of 2024 that aims to promote sustainable transport, creating green shipping corridors can support decarbonisation for coastal trade routes. Since the scale and type of cargo transported determine the suitability of corridor efforts, we analysed vessel call data from financial year 2024–2025, provided by the MoPSW. This contributed to quantifying key business case information for corridor implementation such as current fuel consumption and equivalent e-fuel demand, the scale of e-fuel powered vessels required, and the emissions reduction potential of transitioning to e-fuels.

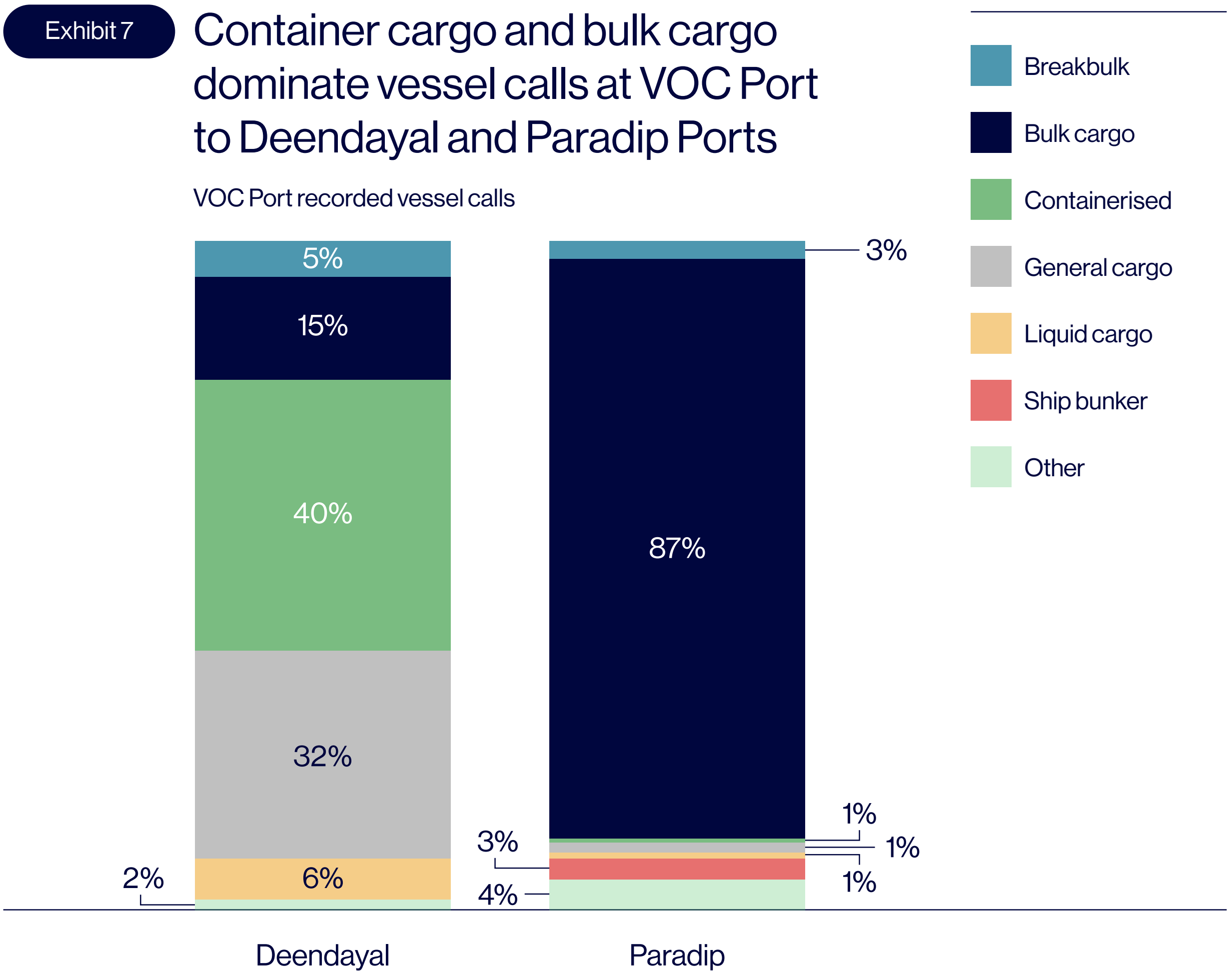
Vessel traffic around coastal corridors

VOC Port recorded over 2,500 vessel calls in financial year 2024–2025 with container vessels making up about 40% of vessel traffic between VOC and Deendayal Ports as shown in Exhibit 7 below. This amounts to approximately 92,200 TEU or 34,200 deadweight tonnage (DWT) between both legs of the Deendayal–VOC route. With container vessels accounting for over 50% of all alternate fuel vessel orders globally, the VOC–Deendayal container trade has strong decarbonisation potential through green shipping corridors.

Exhibit 7

Container cargo and bulk cargo dominate vessel calls at VOC Port to Deendayal and Paradip Ports

VOC Port recorded vessel calls



RMI graphic. Source: Port call data 2024–2025 from the MoPSW.

In contrast, bulk carriers from Paradip to VOC dominated vessel traffic between the two ports, representing 87% of calls during the same period. The dry bulk cargo between Paradip and VOC Ports consists primarily of coal destined for major power stations. Given that coal power generation accounts for the overwhelming share of life-cycle emissions, interventions targeting coal bulk carriers would deliver relatively negligible emissions reductions. Consequently, these vessels are considered out of scope for near-term decarbonisation efforts through green corridors, with container vessel decarbonisation as the higher emissions reduction opportunity between the ports.

Estimation of e-fuel requirement for coastal corridors

The estimated 92,200 TEU container vessel traffic between the ports of VOC and Deendayal requires about 9 kt of conventional shipping fuel (VLSFO) annually. Replacing conventional fuel with e-fuels can avoid 34 kt of CO_2 emissions on the route each year, helping reach India's shipping decarbonisation goals. As seen in Exhibit 8, decarbonising all container traffic along the route would require 20 kt of green ammonia or 19 kt of green methanol.

Exhibit 8

Overview of a coastal container green corridor between VOC and Deendayal Ports

~92,200 TEU
The total quantity of containers transported by vessels calling at VOC and Deendayal

~23 Annual trips

~9 Kilotonnes annual VLSFO burn for annual trips

~20 Kilotonnes of ammonia fuel equivalent

~19 Kilotonnes of methanol fuel equivalent

~34 Kilotonnes of avoided CO_2/year

RMI Graphic. Source: RMI analysis.

The VOC–Deendayal container corridor's 19–20 kt of fuel demand is insufficient to drive down the costs of infrastructure development that justify a standalone green corridor initiative. Barring a few exceptions, the recent SECI tenders also show a trend of higher uptake volumes to reduce production costs and denote standalone volumes of 19–20 kt as more expensive. Furthermore as seen in the *Oceans of Opportunity* Report, when throughput doubles, bunkering costs are halved, thus requiring over 300 kt of e-fuel throughput to achieve economy of scale in bunkering costs.

While coastal corridors such as the VOC–Deendayal container corridor provide early pilot opportunities, the larger demand potential of international corridors presents a pathway to achieving significant market and infrastructure cost reductions. As discussed in the following section, this positions VOC Port as both an e-fuel bunkering hub and an export hub.

By aggregating volumes through e-fuel corridors and regional bunkering hubs that consolidate demand across multiple routes, the VOC–Deendayal container corridor can advance towards full decarbonisation, while benefiting from the economies of scale that a large e-fuel ecosystem provides.

3.3 E-fuel demand required by the international corridors

In addition to establishing demand at the intended destinations, sizing the scale of India's coastal corridors and e-fuel export opportunities is also essential for determining where aggregation of fuel demand can unlock cost efficiencies and have the most emissions reduction impact. The following sections quantify the fuel demand required to decarbonise container vessels on the VOC–Deendayal route and the e-fuel exporting vessels on the VOC Port to Rotterdam and Singapore routes, highlighting the scale of India's opportunity to capture early momentum in national and global e-fuel adoption and trade.
To establish the e-fuel bunkering requirements for exporting approximately 7 Mt/y of green methanol and 11 Mt/y of green ammonia to meet projected EU and Singapore hydrogen demand by 2030, we assume that all volumes are supplied by India and routed through VOC Port. This assumption outlines the total addressable market for e-fuel corridor bunkering at VOC Port as a gateway for India's export potential.

Exporting 3.68 Mt/y of green methanol from VOC Port to Rotterdam and Singapore would require about 250 kt/y and 60 kt/y of methanol fuel respectively, driven by the significant difference in distance from VOC Port to the ports. The vast difference in fuel requirements and trade volumes plays an important role in highlighting fuel efficiency and emissions reduction potential during corridor selection. Exhibit 9 summarizes VOC Port's green methanol bunkering opportunity for Rotterdam and Singapore methanol export corridors.[ix]

ix Assuming chemical tanker vessel of 50,000 DWT. One chemical tanker vessel with an estimated fuel burn of 0.83 kt of VLSFO or 1.7 kt of methanol per trip. Assuming 3.77 tonnes of CO_2/tonne of VLSFO as well-to-wake.

Exhibit 9

Overview of VOC Port's green methanol export corridors to Rotterdam and Singapore

3.68 MMT
The total quantity of green methanol trade to **Rotterdam**

~74 Annual trips

~120 Kilotonnes annual VLSFO burn for fleet

~250 Kilotonnes annual methanol fuel needed for fleet of 15 vessels

~460 Kilotonnes of avoided CO_2/year

3.68 MMT
The total quantity of green methanol trade to **Singapore**

~74 Annual trips

~30 Kilotonnes annual VLSFO burn for fleet

~60 Kilotonnes annual methanol fuel needed for fleet of 6 vessels

~120 Kilotonnes of avoided CO_2/year

RMI graphic. Source: RMI analysis.

Exporting green ammonia from VOC Port shows a similar trend to methanol in route-length impact on fuel consumption. Supplying 5.68 Mt/y and 5.45 Mt/y to Rotterdam and Singapore, respectively, requires about 670 kt/y and 160 kt/y of ammonia fuel. Exhibit 10 summarizes VOC's green ammonia bunkering opportunity for Rotterdam and Singapore ammonia export corridors.[x]

x Assuming chemical tanker vessel of 30,000 DWT. One chemical tanker vessel with an estimated fuel burn of 0.2 kt of VLSFO or 0.44 kt of ammonia per trip. Assuming 3.77 tonnes of CO_2/tonne of VLSFO as well-to-wake.

Exhibit 10

Overview of VOC's green ammonia export corridors to Rotterdam and Singapore

Rotterdam		Singapore	
5.68 MMT	The total quantity of green ammonia trade to **Rotterdam**	**5.45 MMT**	The total quantity of green ammonia trade to **Singapore**
~189	Annual trips	**~181**	Annual trips
~300	Kilotonnes annual VLSFO burn for fleet	**~70**	Kilotonnes annual VLSFO burn for fleet
~670	Kilotonnes annual ammonia fuel needed for fleet of 40 vessels	**~160**	Kilotonnes annual ammonia fuel needed for fleet of 15 vessels
~1,150	Kilotonnes of avoided CO_2/year	**~280**	Kilotonnes of avoided CO_2/year

RMI graphic. Source: RMI analysis.

Collectively, exporting green ammonia and methanol to Rotterdam and Singapore requires approximately 830 kt of ammonia fuel and 310 kt of methanol fuel, establishing e-fuel export routes as cost-efficient corridors for infrastructure economies of scale and demonstrating maritime decarbonisation by 2030.[xi] However, this is contingent on VOC Port being able to capture a significant amount of the e-fuel market share, which will depend on cost competitiveness among other factors.

xi For more on the impact of bunkering volumes on last-mile costs see the Appendix.

4 Cost Competitiveness of India’s E-Fuels

While the opportunity sizing analysis underscores the scale of potential demand for e-fuels across India’s coastal and international export routes, realising the opportunities hinges on e-fuel cost competitiveness. High demand potential attracts stakeholder interest. However, the business case for final investment decisions for vessels, port infrastructure, and bunkering facilities is built on the willingness of end users to pay for competitively priced e-fuels. Assessing India’s cost competitiveness, based on production cost and total cost of ownership, is therefore critical in evaluating if corridors can progress beyond market interest to investable projects.

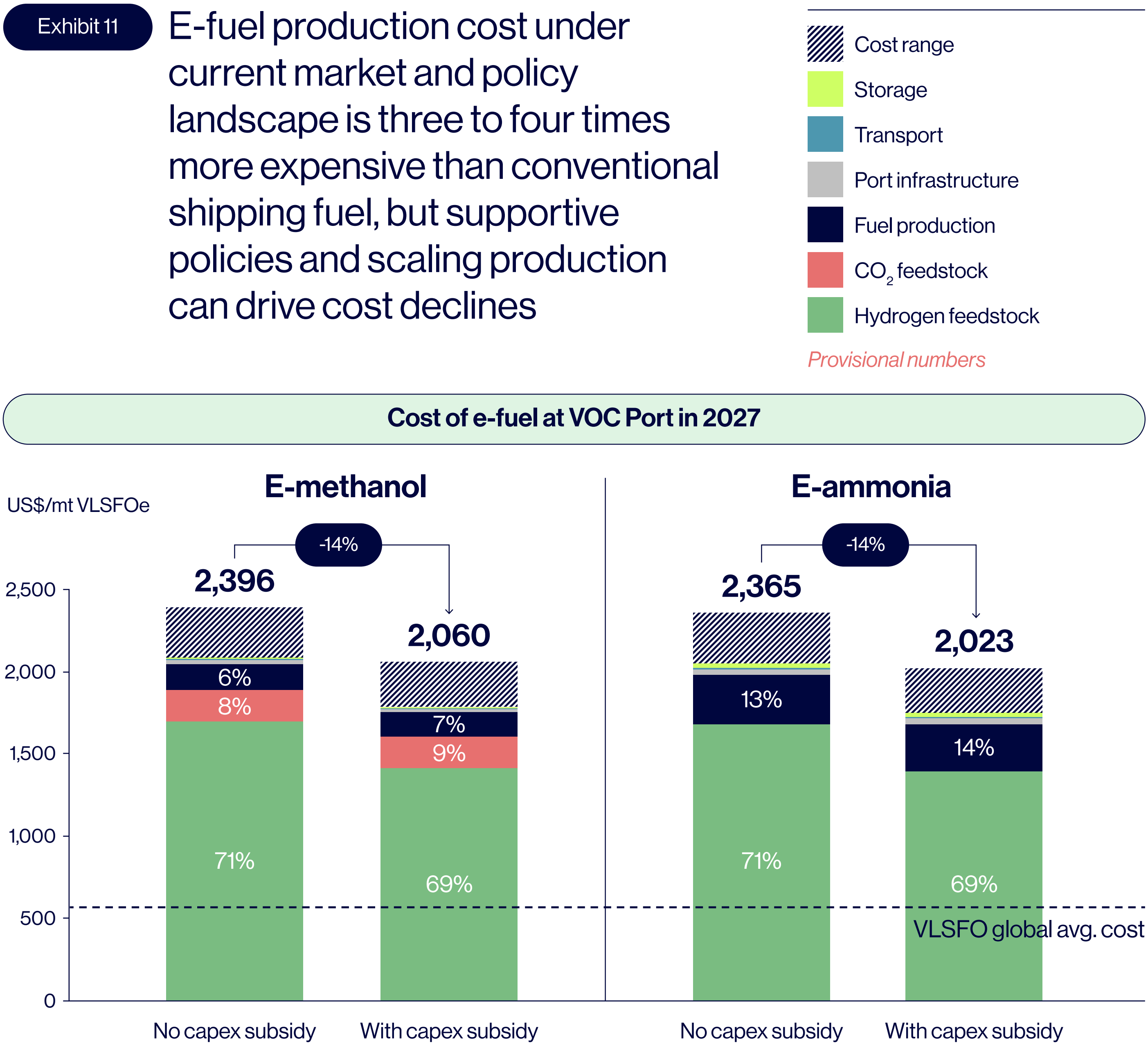
4.1 Cost of e-fuels at VOC Port

E-fuels are currently about three to four times more expensive than conventional maritime fuel. However, as production scales and supportive green hydrogen policies are adopted, costs are expected to decline. India has the fundamentals, such as abundant renewable resources and national and state incentives, to drive cost declines and be a leading affordable e-fuel producer. VOC Port is strategically positioned between frontrunner e-fuel global demand hubs, Rotterdam and Singapore, and can supply competitive e-fuels through green shipping corridors, especially if supported by policy incentives from the government and the IMO Net Zero Framework.

Exhibit 11 shows cost estimates for green methanol and green ammonia at VOC Port under current market and policy conditions.[xii] The subsidy scenarios assume a 25% subsidy for electrolyser and renewable energy capital costs, as outlined in Tamil Nadu's 2021 Industrial Policy.[46] Although Tamil Nadu does not yet have a specific green hydrogen policy, its industrial policy, which covers the manufacturing of renewable energy components and green hydrogen technology, can improve e-fuel competitiveness. E-fuel producers who utilise the state's industrial policy can already lower up-front capital costs and reduce e-fuel costs by about 14%.

Exhibit 11

E-fuel production cost under current market and policy landscape is three to four times more expensive than conventional shipping fuel, but supportive policies and scaling production can drive cost declines



RMI graphic. Source: RMI analysis.

xii See the Appendix for an overview of cost modelling assumptions.

In addition to Tamil Nadu's current capital expenditure subsidies from its Industrial Policy, India's targeted technological advancements in domestic electrolyser manufacturing and resulting learning curve effects can reduce hydrogen production costs. Though domestic manufacturing capacity is not likely to ramp up in time to meet the government's 2030 green hydrogen production goal of 5 Mt/y,[47] supplementing with imported low-cost electrolysers until domestic electrolyser manufacturing supply meets demand can keep green hydrogen production costs low.

India can also reduce capital expenses by lowering the cost of financing. One option for the government to lower financial risk and build investor confidence is through clear policy signals such as the MNRE's National Green Hydrogen Mission. India and Tamil Nadu can further build on policy signals as risk management options by utilising blended finance tools, such as guarantees, insurance mechanisms, and concessional loans.[48] Blended finance tools are applied globally to derisk high capital projects and lower the cost of capital.

To reduce operating expenses, Tamil Nadu can focus on lowering renewable energy costs. States such as Odisha have adopted electricity-based subsidies in addition to capital expenditure support, reducing production costs by up to 45%.[49] In the modelled e-fuel projects (see Exhibit 11), it is assumed that developers use the Central Transmission Utility of India (CTU) to source solar and wind from renewable-rich regions within Tamil Nadu. Under current MNRE guidelines, CTU charges are already waived. However, to further reduce operational expenditures for non-CTU-connected projects, Tamil Nadu could consider offering concessions on transmission-related charges, such as wheeling, transmission, and other fees. Such measures would directly lower the landed cost of power and improve the competitiveness of hydrogen production.

4.2 Competitiveness of VOC Port versus other e-fuel production regions

The next five years will be consequential in deciding who the leading global e-fuel producers and exporters are. VOC Port, as a first mover, can unlock strategic partnerships with leading importers, secure early market share, and attract international attention that drives investments for scale. First-mover success will largely depend on the cost competitiveness of the exported e-fuel.

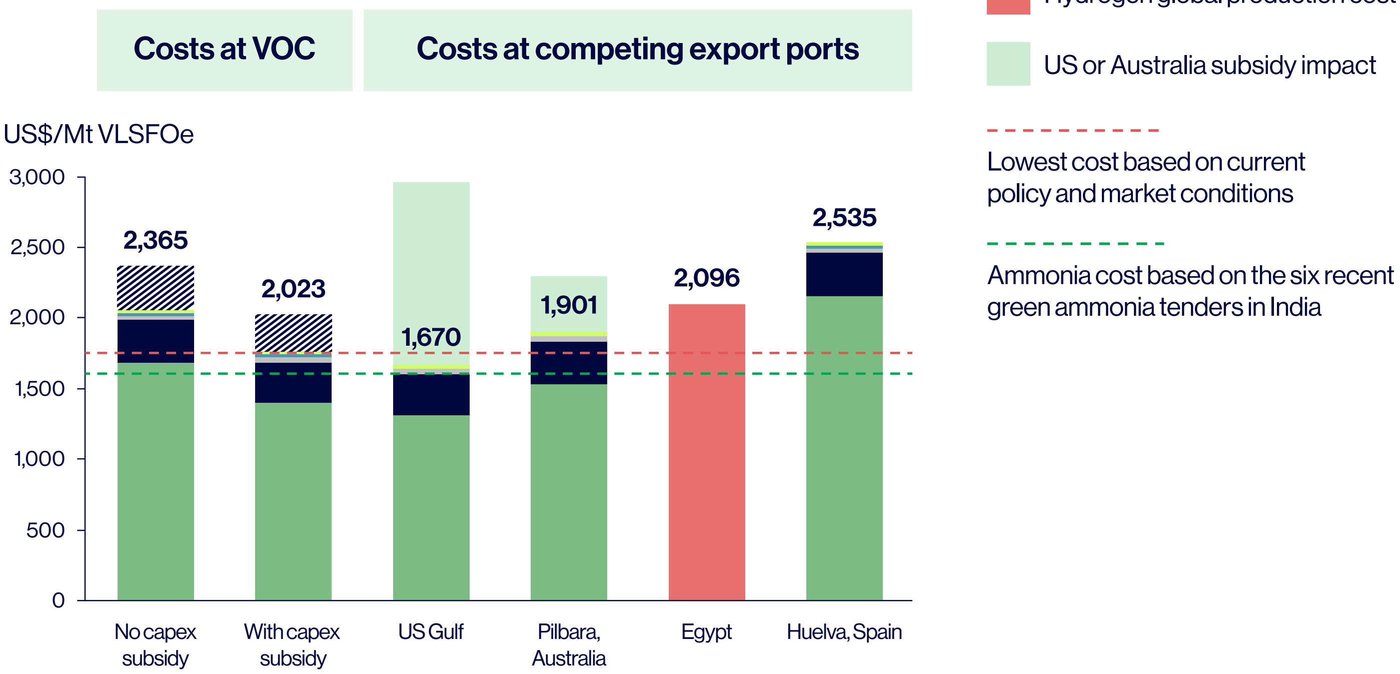
Ammonia

Compared to promising global green ammonia production regions, Tamil Nadu's costs are competitive when producers utilise capital expenditure subsidies and procure low-cost electrolysers. Without the incentives and low-cost electrolysers, there is a narrow margin between Tamil Nadu costs and other top-producing regions (Exhibit 12). Utilising the various capital expenditure and operational expenditure lowering tools discussed in the prior section, stacking incentives like tax credits, and strategic pricing guided by domestic and international offtake agreements are essential to ensuring successful global offtake.

Exhibit 12

A comprehensive incentive package, coupled with learning curve-driven cost reductions, is key for global competitiveness of Tamil Nadu's green ammonia

Green ammonia 2026 costs in Tamil Nadu benchmarked to various global green ammonia costs



RMI Graphic. Source: RMI analysis.

The US Gulf and Australia are especially competitive due to their tax credits from the US Inflation Reduction Act (IRA) and Australia's Hydrogen Production Tax Incentive. These tax credits are expected to reduce production costs by 18% (Australia HPTI) and 44% (US IRA). However, the US IRA will only be available for projects that begin construction before 2028. The declining cost of green ammonia is observed across India. The cost reduction potential of stacking incentives is demonstrated in India's recent green ammonia auctions conducted by the Solar Energy Corporation of India Limited (SECI) under the MNRE SIGHT scheme. The price results are some of the lowest green ammonia prices globally, as shown in Exhibit A8 with a green ammonia price ranging from US$572 to US$744 per tonne. Many of these projects received central and state subsidies. Additionally, SECI utilised the "reverse auction" mechanism, which incentivises companies to bid competitively. Producers in Tamil Nadu can use the results as a helpful price benchmark for their projects. Overall, the auction signals that India is committed to supporting low-cost green hydrogen production.

For producers with export ambitions, it's important to note that SECI auction prices may be more competitive than those targeted to global markets via green corridors. The green ammonia from the recent SECI auction is designated for the domestic fertiliser sector. Exported e-fuel will need to meet additional regulatory requirements and international certifications, which could increase production costs. In 2024, H2Global awarded Fertiglobe a winning bid to supply green ammonia to the Port of Rotterdam at a production cost of €1,000 (US$1,085 per tonne of ammonia).[50]

Although SECI auction results can serve as a useful reference for producers forming their pricing strategy, producers should reference global price benchmarks too. However, pricing data is currently limited with H2Global's auction being the first ever for green ammonia. Stakeholders should closely monitor the evolving market landscape in Europe and Singapore to compete with varying pricing and regulatory trends.

Methanol

Like green ammonia, green methanol produced by VOC Port is competitive with other leading production regions, assuming the use of capital expenditure subsidies and the procurement of low-cost electrolysers (see Exhibit 13). Green methanol projects can benefit from the same incentives discussed above in the ammonia section.

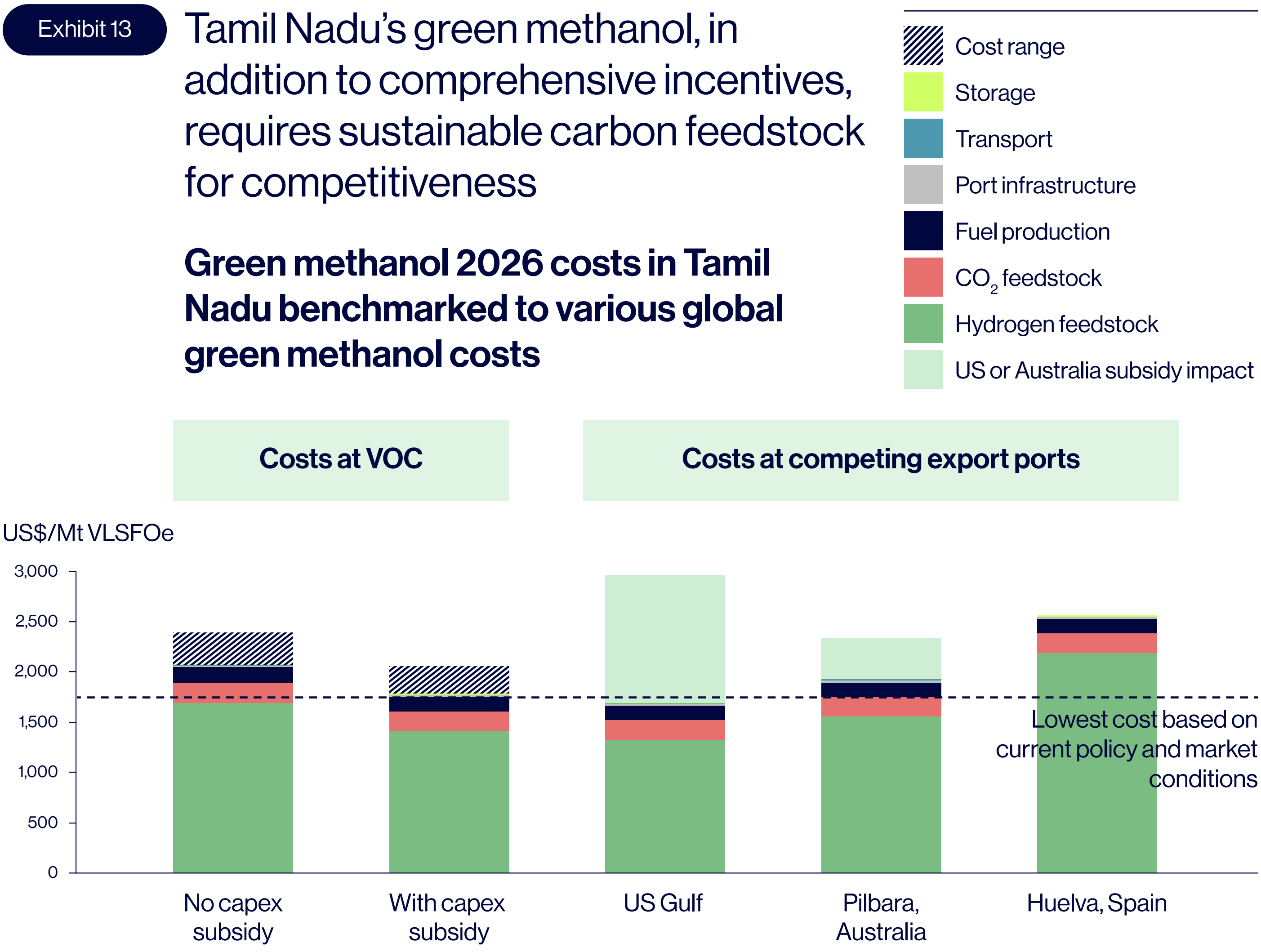
Generally, green methanol costs are slightly higher than green ammonia costs, driven by biogenic carbon feedstock, which can be scarce and costly to source and transport, creating a bottleneck in developing green methanol projects. However, producers that can access biogenic carbon have a competitive edge due to the high demand and low supply of sustainable green methanol globally.

Green methanol project competitiveness could benefit from policies that improve access to low-cost sustainable carbon sources. Sources of biogenic carbon include pulp and paper, bioethanol, and biomass power plants. However, logistical barriers can raise costs if these biogenic carbon sources are located far away from green methanol production plants. Therefore, Tamil Nadu and the government of India can improve carbon sourcing by incentivising carbon capture on bio-based plants and building out common user infrastructure to connect biogenic carbon sources to e-fuel production.

Exhibit 13

Tamil Nadu's green methanol, in addition to comprehensive incentives, requires sustainable carbon feedstock for competitiveness

Green methanol 2026 costs in Tamil Nadu benchmarked to various global green methanol costs



RMI Graphic. Source: RMI analysis.

4.3 Impact of shipping dynamics on delivered e-fuel prices at destination ports

In addition to the cost competitiveness of green ammonia and methanol production, the viability of green shipping and export corridors are also impacted by the competitiveness of e-fuel use on the vessel. The cost premium of e-fuels relative to conventional shipping fuels has historically posed a cost barrier for green corridors. This premium is primarily due to e-fuels being half as energy dense as fuel oil and costly to produce. The additional costs are further exacerbated by last-mile infrastructure costs and higher capital costs of dual-fuel vessels. With fuel accounting for up to 60% of a vessel's cost basis, the use of e-fuels can result in a 150% to 200% increase in the TCO over the lifetime of the vessel.

For the proposed corridors from VOC Port to Rotterdam or Singapore, the combination of low-cost e-fuel production and the application of the IMO's Net Zero Framework (as described in section 2.1) can materially close the gap when assessing the vessel's TCO.

As mentioned previously, the IMO's Net Zero Framework penalizes vessels that use high-emission fuels while incentivising low-emission fuels like green ammonia and methanol. To assess the implications, the analysis in this section outlines potential cost impacts under optimistic and conservative scenarios due to uncertainty associated with the exact renumeration that can be expected as a result of the incentives.[xiii]

It is important to note that while this analysis adopts ammonia as the focal fuel, using it as a case study to illustrate the techno-economics of international green shipping, this is only meant as a representative template for understanding the opportunities and challenges of operating international green corridors. While absolute cost figures may differ for fuels such as green methanol, due to varying technology costs and policy incentives, as well as the influence of frameworks like the IMO's Net Zero Framework, the overall trends and competitiveness dynamics are expected to follow a similar trajectory.

Exhibit 14 shows that despite the lifetime TCO of an ammonia vessel being 1.5 to 2 times higher than a conventional fuel vessel, high IMO rewards and surplus unit revenue can eliminate the cost premium. In the optimistic e-fuel incentive scenario, the TCO of an ammonia-powered vessel could be 28% (VOC–Rotterdam) or 16% (VOC–Singapore) lower than that of a conventional vessel. Even under limited e-fuel production incentives, IMO incentives more than halve the cost premium of an ammonia-powered vessel, reducing the premium from 42% to 17% (VOC–Rotterdam) and 40% to 19% (VOC–Singapore).

xiii While the Net Zero Framework sets the basic guidelines for the proposed policy, further guidelines still need to be developed to provide additional granularity and certainty for how the reward and incentive structure will function.

Exhibit 14

IMO policy could bridge the cost gap between conventional fuel (left) and e-fuel (right) vessel operation, depending on the disbursement approach

- Insurance, surveys, and spares
- Port and canal costs
- Labor costs
- Financing
- Dividend to equity
- Fuel cost

Total cost of ownership of an ammonia-powered vessel for a VOC–Rotterdam corridor
(NPV in Millions of USD)

Using LSFO as fuel | **Using ZEF as fuel**

IMO scenario with optimistic e-fuel incentives

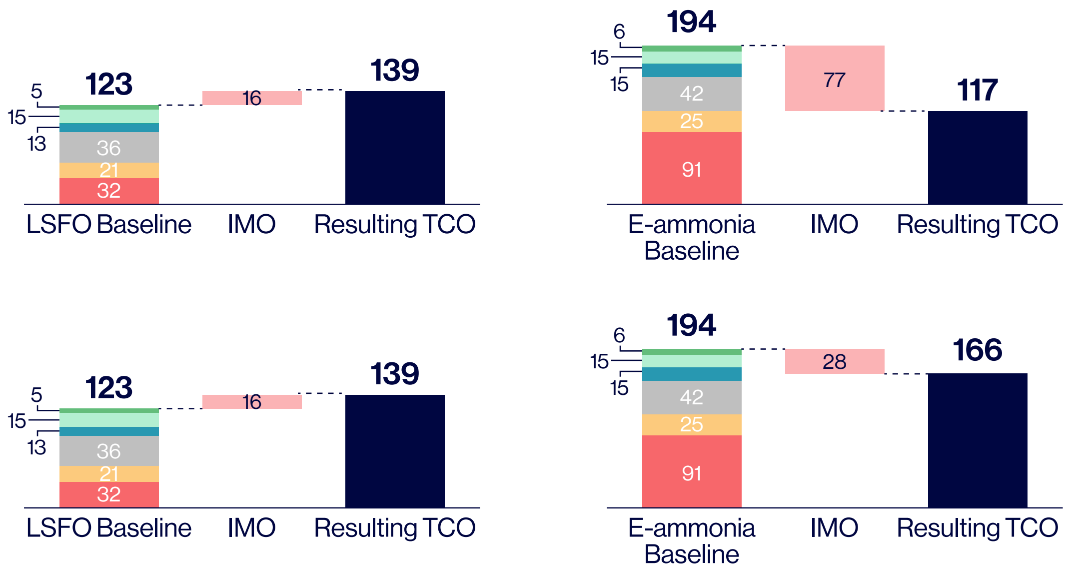
IMO scenario with conservative e-fuel incentives

Total cost of ownership of an ammonia-powered vessel for a VOC–Singapore corridor
(NPV in Millions of USD)

Using LSFO as fuel | **Using ZEF as fuel**

IMO scenario with optimistic e-fuel incentives

IMO scenario with conservative e-fuel incentives



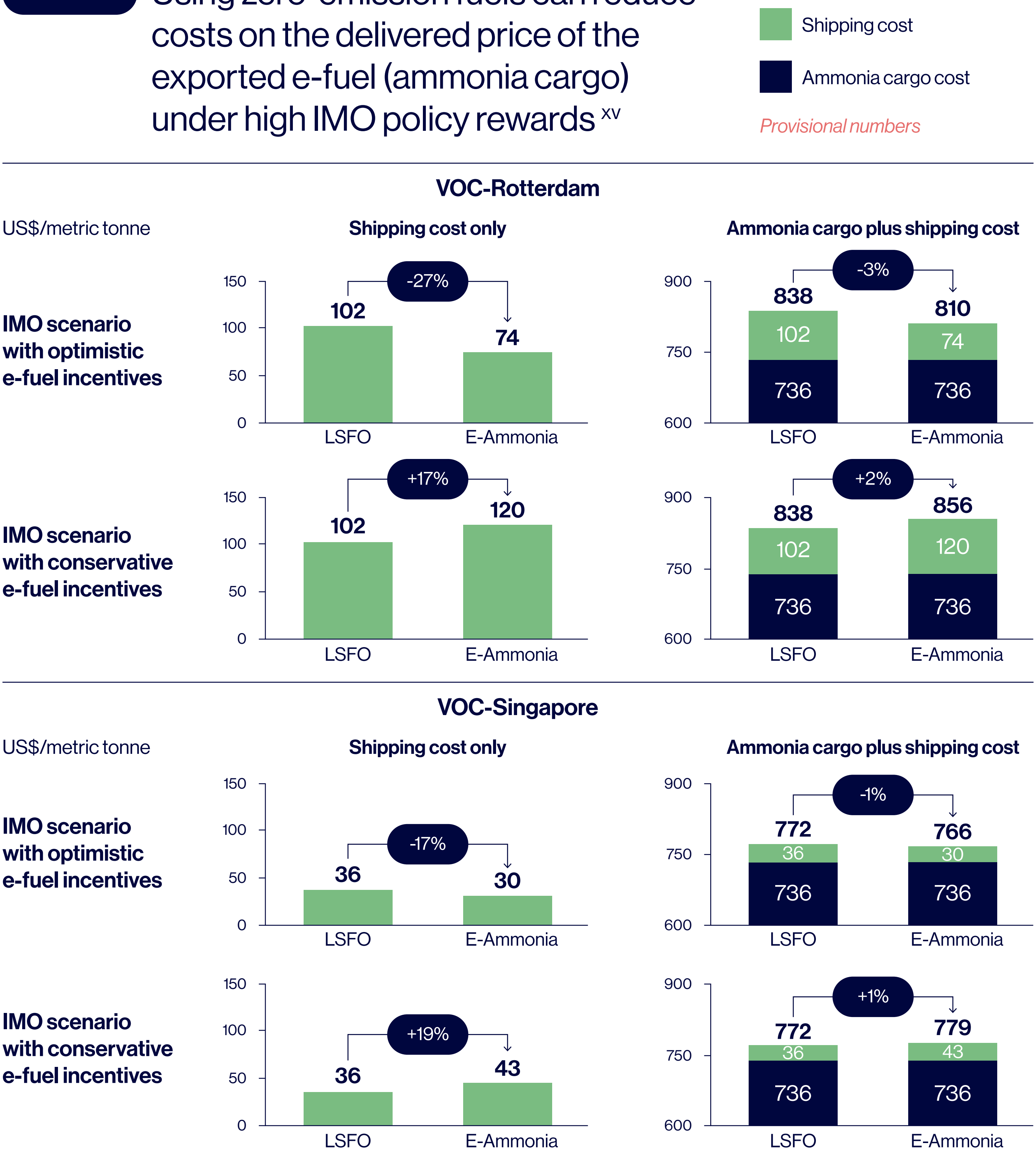
RMI Graphic. Source: RMI analysis.

xiv Only green ammonia modelled TCOs are shown, but similar trends with green methanol are expected.

Evaluating the impact on vessel TCO can provide insight into the costs that vessel owners may incur in green corridors. However, any cost changes that occur likely will be passed through to the cargo buyer, in this case the e-fuel offtaker. Therefore, evaluating pass-through costs on the e-fuel is critical. There is a nonmaterial cost difference between using LSFO or e-fuel under the IMO ZNZ framework. In the optimistic VOC– Rotterdam scenario, there is a 1%–3% decrease in delivered cost of green ammonia by using an ammonia-powered vessel instead of conventional fuel. In the conservative VOC–Rotterdam scenario, with a US$27 million or 17% lifetime cost premium for ammonia-powered vessels (see Exhibit 15), the delivered green ammonia cost only increases by 2%. Therefore, even in scenarios with lower IMO rewards, using lowest emission fuel for e-fuel export corridors is unlikely to affect e-fuel price competitiveness at import ports.

Exhibit 15

Using zero-emission fuels can reduce costs on the delivered price of the exported e-fuel (ammonia cargo) under high IMO policy rewards [xv]



RMI Graphic. Source: RMI analysis.

xv The shipping cost is the levelized price of shipping that the ship operator could set to attain the same estimated internal rate of return for LSFO and e-fuel operations.

While the IMO's Net Zero Framework can potentially help bridge a significant amount of the cost gap for international corridors, the government of India also aims to decarbonise the domestic maritime sector by leveraging coastal green shipping corridors. To comprehensively assess whether coastal corridors can succeed in India, it is essential to evaluate the impact of e-fuel prices on the TCO of vessels deployed on the corridor route, especially as the IMO's Net Zero Framework is unlikely to apply to vessels deployed on coastal corridors. This analysis is crucial for India's coastal corridors serving as pilots, to test economic viability and potentially attract the investments required to implement the corridor. Box 2 provides an outlook on the feasibility of operating a green methanol container vessel between VOC and Deendayal Ports, assuming economies of scale are achieved through integration with the international corridor.

Box 2

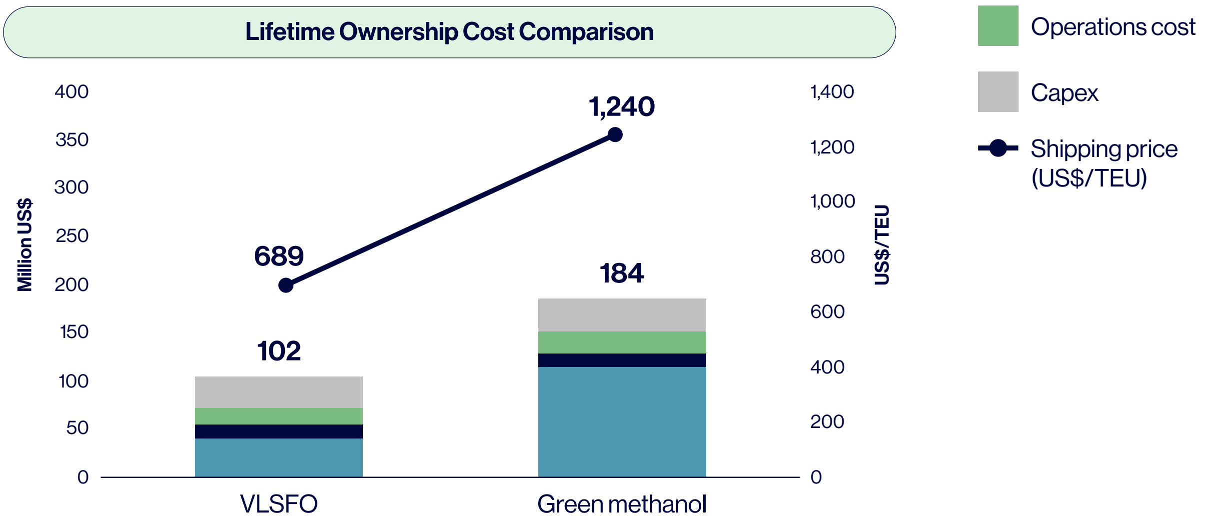
Techno-economic analysis for operating a container green shipping corridor between Deendayal and VOC Ports

At current container volumes, a green shipping corridor between Deendayal and VOC Ports would require approximately 19 kt/y of green methanol to fuel about 23 voyages annually. The scale of fuel demand is appropriate for a pilot-scale production plant that would likely have a high cost of production due to limited economy of scale of benefits. Integrating the corridor with an international route could increase throughput (estimated to be 16 times higher) and cut the delivered fuel cost by around 40% to about US$805 per tonne of green methanol. Higher throughput reduces unit production costs as well as last-mile costs (fuel storage, handling, and bunkering) from terminal to vessel by at least 80% through improved asset utilisation and shared infrastructure savings.

Even with the scale effects above, green methanol remains three times more expensive than conventional fuel oil (VLSFO). In addition, a methanol-fueled vessel's capital cost is approximately 11% higher than for a conventional fuel vessel. Based on all the above cost drivers, the lifetime TCO of a methanol-fueled container vessel on the Deendayal–VOC corridor route is about 80% higher (US$184 million) than a VLSFO baseline (US$102 million) (see Exhibit 16).

Exhibit 16

Lifetime cost comparison of a VLSFO and green-methanol vessel on the coastal corridor



Note: The analysis is performed for a container vessel with a capacity of 1,250 TEUs and an average utilisation rate of 45%. Since we model the Deendayal Port –VOC Port corridor as a container corridor, shipping prices are presented in US$/TEU. To convert to US$/tonne, multiply by 0.067.
RMI Graphic. Source: RMI analysis.

For a green-methanol vessel to operate commercially, the TCO and the resulting shipping price for cargo must achieve parity with conventional alternatives. Without a commercially viable business case, scaling beyond pilots will be challenging. Ports can consider three targeted measures to narrow the cost gap: (1) a vessel capital expenditure subsidy, (2) waivers or rebates on port-call charges, and (3) a viability-gap funding (VGF) mechanism for e-fuels. The analysis considers a "realistic" and "ambitious" scenario to reflect market and policy uncertainty and therefore illustrates a range of outcomes under different interventions (see Exhibit 17).

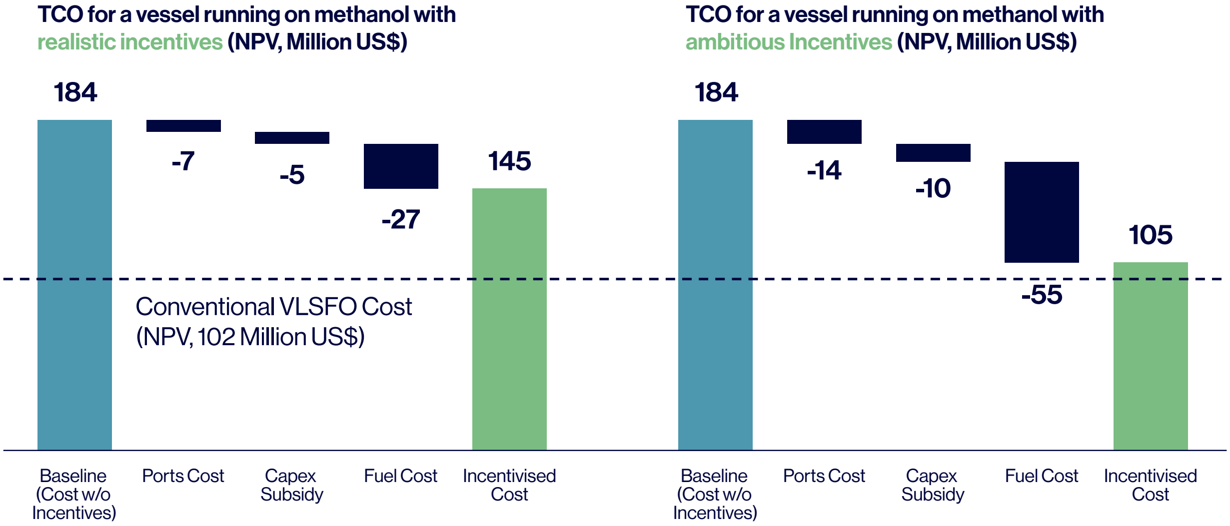
Exhibit 17 Scenario framework for measures to reduce the TCO of green-methanol vessels

Variable Name	% Subsidy/Discount (realistic)	% Subsidy/Discount (ambitious)
Vessel Capex Subsidy	15%	30%
Port Call Cost Waiver	50%	100%
Fuel Cost VGF	25%	50%

RMI Graphic. Source: RMI analysis.

In the realistic scenario, TCO is reduced by approximately 20% compared to 43% in the ambitious scenario, narrowing the cost gap toward near parity with a VLSFO-fueled vessel. Since fuel cost makes up the largest proportion of the green methane TCO stack, a fuel-cost VGF leads to the most significant cost reduction (see Exhibit 18).

Exhibit 18 TCO for a methanol-fueled vessel under realistic and ambitious incentive packages

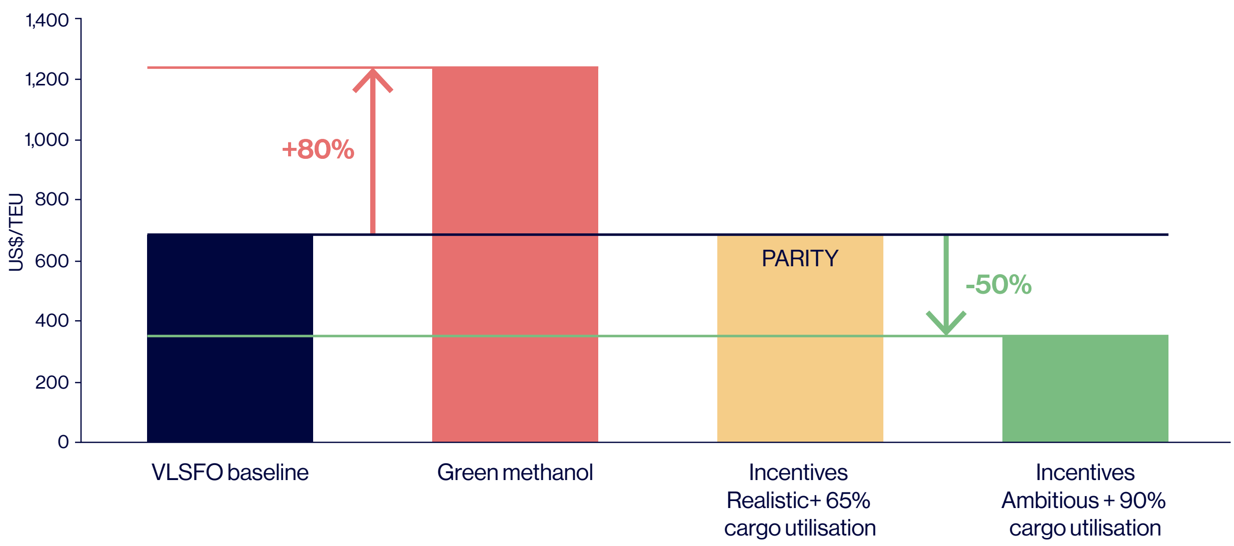


RMI Graphic. Source: RMi analysis.

Vessel operational costs are passed on to cargo owners through the shipping cost (US$/t of cargo). The shipping cost for a green methanol vessel is approximately 80% higher than the VLSFO baseline without interventions. In addition to incentives, increasing vessel utilisation with additional cargo can further reduce shipping costs .

While utilisation is a business-dependent variable, a supportive ecosystem can lift load factors. Under the realistic incentive scenario and ~65% utilisation, green methanol shipping cost achieves parity with VLSFO. Under the ambitious incentive scenario and ~95% utilisation, green methanol shipping cost is ~50% lower than the VLSFO baseline (see Exhibit 19).

Exhibit 19 Shipping price of VLSFO versus green methanol



RMI Graphic. Source: RMI analysis.

With the continued development and deployment of strategic regulatory and financial mechanisms in Tamil Nadu, there's strong potential for competitive e-fuel production. Additionally, the adoption of the IMO Net Zero Framework can reduce the cost premium associated with e-fuels, creating a far more compelling business case for the deployment of green shipping corridors and e-fuel export corridors. Finally, realising the policy and market levers could also create the opportunity for VOC Port to serve as a bunkering hub itself.

For the coastal corridors between VOC and Deendayal Ports, the volume of domestic trade limits the scalability of the corridor. To unlock greater efficiency and cost competitiveness, coastal corridors need stronger integration with international routes to bring scale and create a pathway for coastal corridors to become more economical in the long term.

5 State of Enabling Ecosystem for Corridor Implementation

Realising the potential of green shipping corridors depends as much on the supporting ecosystem as on trade volumes and fuel costs. Concretely, this means that ports must be equipped with the infrastructure to handle, store, and bunker e-fuels. At the same time, key value chain stakeholders must align on their project development ambition and timelines. Both aspects will be key to ensure that India's green corridors move from concept to reality and determine whether the country can establish itself as a leader in the global e-fuel transition.

4.1 Stakeholders leading adoption of e-fuel pathways

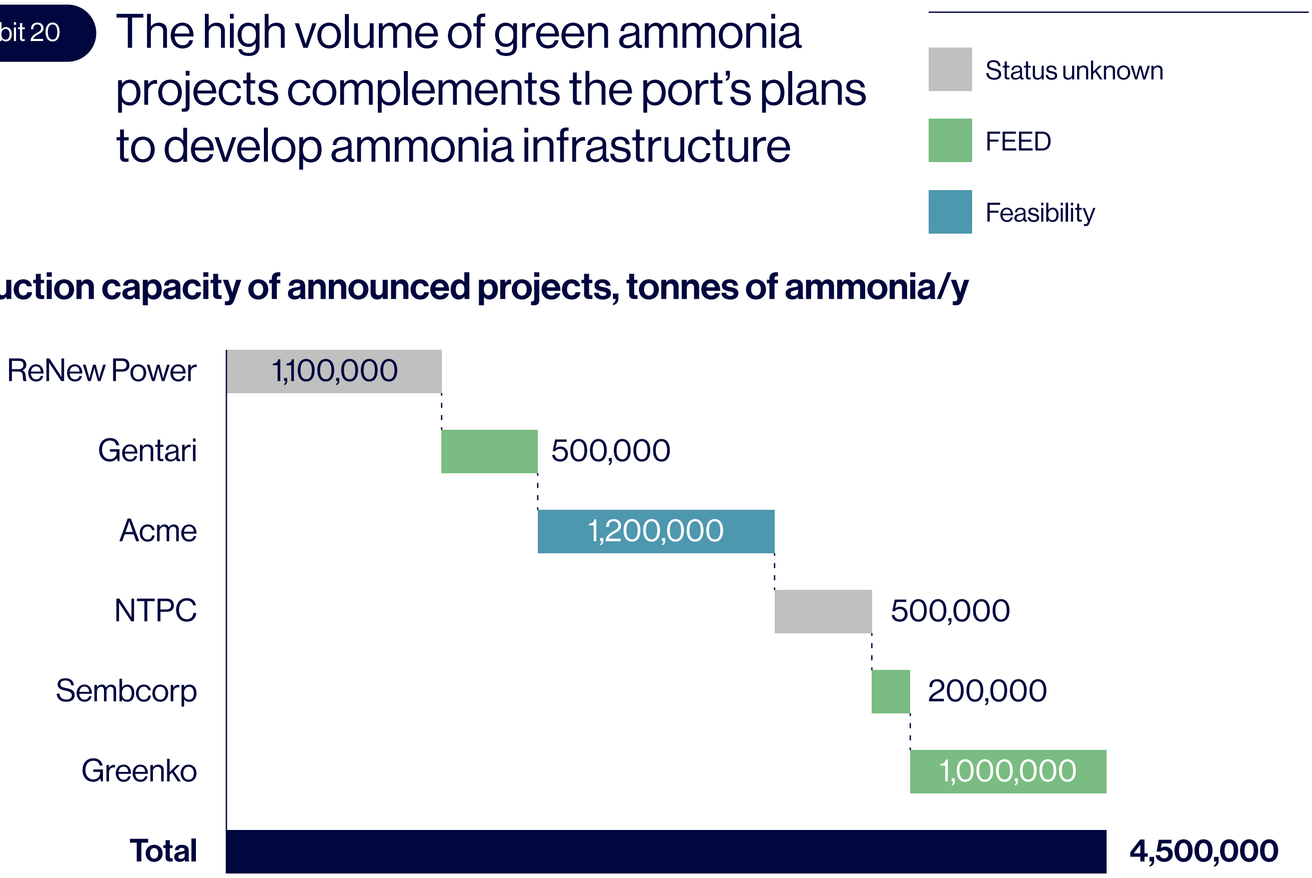
The successful emergence of e-fuel corridors in India depends on the alignment of multiple stakeholders across the value chain including fuel producers, vessel owners, and offtakers.

Fuel producers

Following VOC Port's announcement as a green hydrogen hub by the MNRE and MoPSW, there has been a rise in the announcement of green hydrogen projects in the port's vicinity, predominantly for green ammonia production. The high volume of green ammonia projects complements the port's plans to develop common-user ammonia infrastructure such as pipelines and dedicated berths for green ammonia exports.[51]

Exhibit 20 The high volume of green ammonia projects complements the port's plans to develop ammonia infrastructure

Production capacity of announced projects, tonnes of ammonia/y



RMI graphic. Source: Acme, Sembcorp, CTUIL.

Six producers have announced an estimated 4.5 Mt/y of green ammonia production capacity in the vicinity of the port (see Exhibit 20), providing sufficient supply to kickstart e-fuel bunkering and export to global offtakers. Most projects are relatively advanced in development with some in their front-end engineering and design phase. Producers have also been active in pursuing offtake deals providing strong indication that at least some of the projects can achieve final investment decisions. Advanced conversations include a 0.2 Mt/y MOU between Greenko and RWE for export to Europe,[52] and a heads-of-terms agreement was signed between Sembcorp, Sojitz Corp, Kyushu Electric Power Co., and NYK Line for green ammonia export to Japan.[53]

The announced 4.5 Mt/y of green ammonia is well positioned to satisfy bunkering needs for the Rotterdam and Singapore corridors (~0.8 Mt/y of green ammonia as fuel), although the total estimated ammonia demand for Singapore and the EU far exceeds the announced capacities. Based on the port authority's (VOCPA) insight into project development, ammonia production is expected to commence by 2028, positioning the port as a first mover to initiate e-fuel trade and accelerate green corridor creation. This kind of market signal can attract more investments and production capacity, potentially boosting trade volumes with high demand hubs like Singapore and the EU beyond 2030.

Vessel owners

The transition to green fuels is becoming an imperative for vessel owners worldwide as they respond to ambitious targets set by the IMO and policy measures across multiple geographies, such as port fee reductions for low-carbon fuels and carbon taxes. Many vessel owners have incorporated decarbonisation targets as a part of their long-term strategy, especially with IMO's Two-Tier GHG Fuel Intensity (GFI) system expected to take effect in 2028, rendering dependence on fossil fuels increasingly costly in the long run.[54]

As a part of their decarbonisation strategy, vessel owners are adopting green methanol- and green ammonia-powered vessels. Methanol-powered vessels are dominating order books with more than 400 methanol-powered vessels scheduled for delivery by 2030, primarily due to methanol's ease of handling.[55] Container vessels represent over 57% of these orders, while chemical tanker orders (which would be the most applicable for this green corridor) are also growing rapidly.[56] Twenty-nine chemical tankers are already operational with 30 more to be delivered in the next three years.[57] This rise comes with the projected rise in green methanol production, leading to the need for methanol tankers to decarbonise the global supply chain.

In comparison, momentum in ammonia-powered vessels has been slower due to a lack of commercially ready engines and vessels. There have been recent signs of acceleration in orders; while only 3 vessels are currently in operation, 39 are due for delivery within the next three years.[58] Gas tankers (the applicable vessel type for this corridor) lead the order books representing over 53% of the total vessel orders, driven by the projected rise in green ammonia trade in the near future.[59]

Regarding India's green corridor prospects, Exhibit 21 explores some of the most relevant vessel owners with dual-fuel ammonia and methanol vessels on order and previous calls at India's focus corridor ports of VOC, Deendayal, and Paradip (primarily carrying liquid cargo). The above criteria are adopted for spotlighting key vessel owners for India export corridors to ensure that the vessel owners have prior experience in handling international trade with India and methanol/ammonia vessels on order to kickstart the export corridors by 2030.

Exhibit 21 Vessel owners with an interest to upgrade to ammonia/methanol-powered fleets that have called at major Indian ports

Company	Vessel Orders	Capacities and Delivery Date	Decarbonisation Targets
Shipping Corporation of India	None but exploring to retrofit existing vessels to methanol by 2027		
Stolt-Nielsen	6 newbuilds that can be retrofitted to ammonia	26,000 DWT (2024)	Reduce Scope 1 carbon intensity by 50% (relative to 2008 levels) by 2030
	6 tankers that can be retrofitted to methanol	38,000 DWT (2026–2029)	
Trafigura	4 ammonia vessels	45,000 ccm (2028)	Reduce shipping fleet's carbon intensity by 25% by 2030
MOL	5 methanol vessels in operation	~50,000 DWT	Have 130 net-zero vessels by 2035
Euronav	2 methanol vessels	2026	Reduce Scope 1 carbon intensity by 40% (relative to 2008 levels) by 2030
	2 ammonia vessels	26,000 DWT (2028–2029) (partnership with MOL)	
	4 newbuilds with ammonia retrofits	26,000 DWT (2028–2029) (partnership with MOL)	
Hafnia	4 methanol vessels	49,800 DWT (2026)	Reduce Scope 1 carbon intensity by 40% (relative to 2008 levels) by 2028
Exmar	4 ammonia vessels	46,600 ccm (2026)	

RMI graphic. Source: CMB. TECH, Trafigura, Stolt-Nielsen, DNV, Hafnia, Offshore energy.

As seen in Exhibit 21, most vessel owners have decarbonisation targets for the near term that are in line with IMO's checkpoint of 40% reduction of international shipping carbon intensity by 2030, compared to 2008.[60]

Furthermore, vessel owners have been proactive in signing trade agreements to transport green ammonia. MOL signed an MoU to transport 400kt/y of green ammonia from India to Japan and ordered or chartered six tankers along with CMB.TECH.[61] MOL has also signed an MoU in 2024 with Idemitsu and HIF to develop an e-fuel supply chain.[62] Additional vessel owner market signals for e-fuel trade readiness include Euronav's recent partnership with CMB.TECH on an order of 10 ammonia tankers,[63] and Hafnia's collaboration with French energy company Total Energies on a time charter agreement for 4 methanol vessels.[64]

Together, these announcements demonstrate a clear shift in the shipping industry, with major owners moving from targets and announcements to tangible actions. Their investment in e-fuel vessels, coupled with e-fuel trade ambitions, underscores both confidence in the emerging supply chain and a readiness to operationalize green corridors in the near term.

Commodity traders as off takers

Commodity traders have long-standing experience in handling ammonia and methanol in India, owing to the country's large fertiliser and chemical industries.[65] With the emergence of green ammonia and methanol as an energy commodity, these traders have a first-mover opportunity to lead the e-fuel trade and utilise their prior experience in handling ammonia and methanol. Their operational know-how and logistical capabilities provide a strong foundation for accelerating e-fuel adoption.

Key global commodity traders that could lead successful implementation of India's export corridors are highlighted in Exhibit 22. The six major traders highlighted have each initiated projects or investments in ammonia or methanol, reflecting their intent to secure an early-mover advantage.

Exhibit 22 Key chemical traders globally with hydrogen derivatives-related activities

Company	Commodity	Global capacity	Hydrogen-related activities
Trafigura	Ammonia and methanol		• Completed ship to ship transfer of ammonia. • Will charter a methanol dual-fueled chemical bunker tanker to be used for its fuel delivery in Singapore.
Trammo	Ammonia	4 Mt/y (largest globally)	• Supplies most of India's ammonia and has multiple green ammonia agreements signed with Iberdrola, Allied Green Ammonia etc. • Trammo, OCI, and James Fisher Fendercare successfully conducted an ammonia bunkering pilot between two vessels at a terminal in the port of Rotterdam in 2025.
Mitsui & Co (related to MOL shipping)	Ammonia and methanol	2nd largest trader globally	• Invested in green methanol production and sales business in Denmark and acquired a Dutch chemical terminal operator. • Signed agreements for multiple low-carbon ammonia projects globally with JERA, TA'ZIZ, CF Industries etc.
Sabic	Methanol and ammonia		• Launched a certified low-carbon methanol to customers in 2024. • Sent low-carbon ammonia shipments to Japanese offtaker Fuji Oil Company and IFFCO in India in 2023. • Undergoing feasibility studies for its low-carbon ammonia plant in Saudi Arabia.
Fertiglobe	Ammonia	Largest seaborne exporter of urea and ammonia combined	• Won Germany's H2Global tender to deliver at least 259 kt of green ammonia.
Itochu	Ammonia		• Developing a 300 kt/y project in Deendayal Port to export to Singapore for bunkering and a 600 kt/y project in Egypt with ACWA Power. • Ordered a 5,000 cubic meter ammonia vessel as it aims for ship-to-ship ammonia bunkering.

RMI Graphic. Source: Trafigura, Trammo, Reuters, IHS Markit, Mysore ammonia, Sabic.

Most of the traders highlighted are engaging in low-carbon e-fuel projects globally as they diversify from commodity trading to active project development partnerships. Traders such as Trafigura and Trammo are also aiming to venture into e-fuel bunkering whereas Itochu, Trafigura, and Mitsui & Co (with its sister company MOL) aim to invest in ammonia or methanol-powered vessels to facilitate e-fuel trade.[66]

Several of these traders already maintain trade relationships in India. Trammo is India's largest supplier of ammonia while Sabic supplies over 80% of India's methanol.[67] Fertiglobe supplied green ammonia to SPIC via VOC Port in 2023 from Damietta port, Egypt, marking India's first shipment of green ammonia.[68] On the domestic front, Indian traders such as Mysore Ammonia are becoming increasingly active, securing distribution offtake with Avaada group for 100kt/y green ammonia.[69]

The examples above demonstrate that traders are no longer limiting themselves to traditional commodities but are actively positioning themselves across the emerging e-fuel value chain. By investing in production projects, securing offtake agreements, and ordering dual fuel vessels, chemical traders are signalling confidence in the long-term viability of green ammonia and methanol. Their established trade with India's fertiliser and chemical industries, combined with early examples of green shipments to Indian ports, highlight the strategic importance of India as both a consumer and exporter in the global green ammonia and methanol markets.

5.2 Port readiness to handle e-fuels

Implementing green shipping corridors requires collaboration across ecosystem players like fuel producers, vessel owners/operators, cargo owners, and port infrastructure owners/operators to make the necessary investments in timely alignment. Therefore, partnering with global ports that have strong stakeholder alignment is essential to ensuring the success of VOC Port's e-fuel export corridors. Additionally, building partnerships with ports that have experience in handling ammonia or methanol can accelerate VOC Port's operational readiness for e-fuels. This section outlines the key opportunities and challenges VOC Port faces in establishing e-fuel export corridors with the global leading bunker ports of Singapore and Rotterdam.

VOC Port could likely export green ammonia sooner than green methanol.

To be a frontrunner e-fuel export and bunkering hub in India, VOC Port requires a sufficient volume of e-fuel production to meet demand, infrastructure to move e-fuels from production sites to the vessels, appropriate training and guidelines to ensure safe handling of fuels, and at least one strategic partnership with an e-fuel import port.

The expected green ammonia production capacity in Tamil Nadu positions VOC Port as a potential global leader in green ammonia exports. To pursue the ammonia opportunity, the port should prioritise developing dedicated export and bunkering infrastructure. While there is currently no known existing or planned ammonia infrastructure, VOC Port signalled interest in the fuel by becoming the first Indian port to handle green ammonia imports in 2023.[70] The port's continued demonstration of commitment to the e-fuel market through similar first mover milestones are crucial for boosting investor confidence and unlocking long-term funding for infrastructure development.

Other first mover milestones that will signal VOC's readiness for ammonia exports include implementing an ammonia bunkering pilot. Though ammonia bunkering standards do not widely exist yet, best practices can be taken from demonstrations, such as the ammonia bunkering pilot in June 2025.[71] The port should also conduct safety and risk assessments and emergency response protocols given ammonia toxicity concerns before bunkering green ammonia. If the port proactively completes the appropriate safety studies and bunkering pilots while green ammonia production projects are under development, VOC Port can streamline green shipping corridor development and position itself as a global first mover in green ammonia exports by 2030.

Exhibit 23 VOC Port could likely export green ammonia sooner than green methanol

Overview on the VOC Port's readiness to export green ammonia or methanol

		Fuel sourcing within Tamil Nadu	Existing or planned infrastructure	Experience handling ammonia or methanol	Distance to green fuel import regions, nautical miles
Current conditions	Green Ammonia	Up to 3 Mt/y green ammonia production. Land scarcity may limit future fuel production expansion.	No known existing or planned green ammonia infrastructure.	Yes, first Indian port to handle green ammonia import. No known experience in handling green ammonia as a fuel.	Rotterdam: 6,511 Singapore: 1,845
	Green Methanol	No known green methanol projects planned.	No known existing green methanol infrastructure. VOCPA issued a tender inviting private players to establish pilot-scale green methanol bunkering and refuelling infrastructure.	No known experience in handling green methanol as a commodity or a fuel.	
Potential next steps to increase readiness		Coordinated land allocation for projects to manage infrastructure development costs (e.g., shared delivery pipeline or rail to port). Proactive demand signals (e.g., request for proposals to develop green methanol) needed to promote production.	Strategic prioritisation between ammonia and methanol fuel to champion development of production projects and port infrastructure since economy of scale has significant cost reduction potential for the e-fuel that the port champions.	Taking a lead role in conducting safety and risk assessments, establish safety and emergency response protocols, and perform bunkering and loading pilots.	Centralized location ideal for export to Rotterdam or Singapore. Singapore being closer reduces delivery transport costs and makes the port a prime kick-off market for early-mover corridors.

RMI Graphic. Sources: "Tough race for green H2 projects in India's Tamil Nadu," Argus Media, 2024; and India MoPSW, 2023.

In comparison, green methanol bunkering in Tamil Nadu is behind that of green ammonia, with no announced projects to date. If handling green methanol is a top near-term priority for VOC Port, the port can consider adopting incentives and market signals to attract methanol producers. For example, VOC Port can issue an expression of interest for establishing green methanol supply capacity at scale. The Maritime and Port Authority (MPA) of Singapore adopted a similar market signal approach in 2023 for developing its e-fuel supply chain.[72]

In 2025, VOC Port published a tender inviting proposals for establishing green methanol bunkering on a pilot scale.[73] This impactful first step communicates to stakeholders that VOC Port is willing to invest in methanol operations and develop supporting infrastructure. In parallel with building out infrastructure, VOC Port will need to conduct safety assessments, establish emergency response protocols, and perform bunkering and handling methanol pilots, similar to ammonia fuel requirements. However, this may be an easier process given methanol is less toxic, easier to handle due to its liquid state in ambient conditions, and has more established bunkering standards. Additionally, potential strategic partners like MPA Singapore have already established methanol bunkering guidelines, making VOC Port's adoption of methanol bunkering standards achievable at an accelerated pace if production volumes materialize.

While VOC Port has potential to export both green ammonia and methanol, each fuel requires capital-intensive dedicated infrastructure. Focusing on one fuel will enable the port to better coordinate common-user infrastructure, such as shared pipelines, tanks, and loading systems, reducing operational costs and supporting scalability. In addition, given the land constraints near VOC Port,[74] allocating space for production and port infrastructure for both fuels may not be feasible.

By strategically prioritising one green fuel before committing significant resources, the port can streamline green corridor development and send clear market signals to stakeholders and investors that attract capital. Through targeted investment, VOC Port can accelerate the deployment of e-fuel export corridors and establish itself as a first mover in the global e-fuel market.

The ports of Singapore and Rotterdam are prime markets for green fuel imports

Singapore and Rotterdam, the largest and second largest bunkering ports globally, are the current leaders in readiness to bunker e-fuels and are therefore prime markets for India's green ammonia and methanol exports. However, a few variations in national- and port-level approaches to preparing for e-fuels set the ports apart from each other in ammonia and methanol bunkering readiness.

Ammonia

Singapore could be a prime market for green ammonia imports due to the port's proactiveness and agility in establishing port infrastructure. MPA Singapore already has 10,000 cubic meters of ammonia storage in operation or development planning.[75] Additionally, the port authority issued a request for information in 2024 to establish benchmarks for ammonia delivery costs to the port,[76] demonstrating a competitive view of the e-fuel bunkering market. At the national level, Singapore's strong support for maritime decarbonisation and e-fuel investments are significant strategic advantages that limit policy risk for first-mover projects.

Strengthening VOC Port's ties with Singapore could be mutually beneficial because Singapore will need significant and affordable green ammonia imports to meet future e-fuel demand for its large bunker market under decarbonisation regulatory requirements. VOC Port could also leverage Singapore's leadership and expertise in ammonia handling and bunkering standards to help develop the port's capacity to handle high quantities of e-fuels.

Exhibit 24 Singapore and Rotterdam are prime markets for green ammonia imports as global leaders in championing safe ammonia fuel handling

Potential e-fuel importer ports and their readiness to handle green ammonia from Tamil Nadu

Port	Existing general trade with VOCPA?	Expected 2030 e-fuel import volume	Planned or existing ammonia import infrastructure?	IAPH port readiness for calling ammonia-fueled vessels?
Singapore	Yes	~0.4 Mt/y H_2e	At least 326 kt/y of existing storage, with ongoing discussions for expanding capacity	Port Readiness Level 6 (development): Proof of concept for calling green ammonia-powered vessels is being performed.
Rotterdam	No	~0.2 Mt/y H_2e includes demand from all major EU bunkering hubs)	EU Ammonia import hub with ~5 Mt 2030 handling target for hydrogen derivatives and planned ACE terminal with ammonia cracking	Port Readiness Level 5 (development): Framework designed for calling green ammonia-powered vessels.

Note: Annual storage for Singapore assumes the existing tank capacity of 6,800 Mt is filled up and emptied 60 times every year with 80% utilisation.
Source: RMI analysis, MPA Singapore, Oceans of Opportunity report, 2024.

On the other hand, Rotterdam's ACE terminal initiative, which will include an ammonia cracker and kickoff operation in 2026, shows that in the near term, Rotterdam could be a larger ammonia market than other industrial decarbonisation markets. As the second-largest global bunkering hub and gateway port to Northwest Europe's industrial hubs with ambitious decarbonisation goals, Rotterdam has high potential of becoming Europe's leading port in ammonia imports and bunkering.

However, the Netherlands is a part of the EU policy development process, which could result in bureaucratic delays. These delays could reduce near-term ammonia demand from EU industries beyond shipping whose emissions will be regulated globally by IMO mandates.

Methanol

Singapore's bunkering of 1.6 kt of methanol in 2024 showed that operations need scaling to meet the growing methanol bunker market.[77] Based on existing and planned infrastructure at the port, MPA Singapore can significantly increase methanol bunkering capacity to over 1 Mt per year. Thus far, MPA Singapore is a leader in the safe and efficient use of methanol for bunkering, and its "Technical Reference TR 129 for Methanol Bunkering," is the first national standard for methanol bunkering.

MPA Singapore's ability to jumpstart and expand methanol bunkering with infrastructure, standards, streamlined decision-making, and strong national support for maritime decarbonisation, positions the port as a key import partner for VOC Port's green methanol export ambitions. Partnering with MPA Singapore to develop a green methanol export corridor would give VOC Port access to a wide network of maritime offtakers and allow export operations to scale.

Alternatively, the Port of Rotterdam is the largest methanol hub in Northwestern Europe.[78] The port was the first to facilitate barge-to-ship bunkering of methanol and bunkered over 9 kt of bio-methanol in the first half of 2025.[79] With infrastructure to store over 2 Mt of methanol per year,[80] the port has capacity to expand methanol bunkering operations quickly. Similar to ammonia, imported green methanol at the Port of Rotterdam will likely serve maritime and other industrial sectors, with 100 kt of green methanol already transshipped annually.[81] Partnering with the Port of Rotterdam in a green methanol export corridor could unlock access to the growing maritime and industrial decarbonisation markets across Northwestern Europe.

Exhibit 25

Singapore and Rotterdam are both advanced in their preparation to import and handle green methanol fuel from VOC Port

Potential e-fuel importer ports and their readiness to handle green methanol from Tamil Nadu

Port	Existing general trade with VOCPA?	Expected 2030 e-fuel import volume	Planned or existing methanol import infrastructure?	IAPH port readiness for calling methanol-fueled vessels?
Singapore	Yes	~0.7 Mt/y H_2e	1.1 Mt/y of methanol storage	Port Readiness Level 7 (deployment): Project-based calls of green methanol-powered vessels.
Rotterdam	No	~0.3 Mt/y H_2e includes demand from all major EU bunkering hubs)	2.5 Mt/y of methanol storage	Port Readiness Level 8 (deployment): System-based calls of green methanol-powered vessels.

Note: Annual storage for Singapore assumes the existing tank capacity of 6,800 Mt is filled up and emptied 60 times every year with 80% utilisation.
IAPH = International Association of Ports and Harbors.
Source: RMI analysis, Methanol Institute Renewable Methanol Database of Methanol Ports, Oceans of Opportunity report, 2024.

Both Singapore and Rotterdam are well-prepared to import and handle green ammonia and methanol from VOC Port. The ports' leadership in e-fuel bunkering and growing decarbonisation demand makes them prime markets for e-fuel offtake. MPA Singapore benefits from streamlined decision-making and strong national support, while the Port of Rotterdam can offer access to Europe's broader maritime and industrial green offtake markets. VOC Port can successfully partner with either or both ports for e-fuel exports, but success will ultimately depend on VOC Port's ability to innovate and implement fast enough to capture significant e-fuel market share.

6 Conclusion and the Way Forward

India has an opportunity to catalyse green shipping corridors by combining cost competitiveness with coordinated ecosystem investments. Ports such as VOC are well positioned to emerge as hubs for e-fuel trade due to a confluence of international, national, and state-level policies creating demand-side pull and catalysing cost declines. Furthermore, the IMO's Net Zero Framework will further help narrow the cost gap with conventional fuels. **India has the ability to strategically advance maritime decarbonisation and advance its own green hydrogen goals through green corridors.**

The analysis conducted in this report provides the rationale for pursuing green shipping corridors from VOC Port to the ports of Rotterdam and Singapore. The next step to realising this opportunity is to create early alignment between key stakeholders. Bringing together a consortium of fuel producers, ports, shipping lines, bunkering companies/traders and regulators, and other high high-impact parts of the value chain allows for coordination in a sector that is traditionally disaggregated. By fostering trust and coordinating stakeholders, the fragmented interests can be evolved into a unified effort.

Building on the creation of a consortium as its foundation, technical, economic, and regulatory assessments should be undertaken to identify gaps and cross-cutting opportunities. The gap assessment and barrier identification will guide the consortium to the final step — the design of implementation roadmaps and risk mitigation strategies, with the end goal of achieving offtake agreements and final investment decisions.

India now stands at a pivotal juncture to transform its maritime sector and catalyse green hydrogen uptake through green corridors. Moving decisively from vision to implementation will require action-oriented steps that prioritise stakeholder engagement, gap/barrier assessment, and implementation roadmaps. By adopting this strategic, stakeholder-driven approach, India can leverage its geographic advantage, policy momentum, and cost competitiveness to position itself as a leader in global maritime decarbonisation and e-fuel trade.

Appendix: Methodology

Port assessment matrix

A port assessment matrix was created for major Indian ports to identify ideal origin points for green shipping corridors in India. Ports were assessed in three overarching categories: hydrogen and derivative production, storage, and domestic consumption; infrastructure and logistics; and policy and regulatory measures.

Exhibit A1 Categories and sub factors used for port assessment

Categories	Variables
Production, Storage, and Consumption	Green hydrogen production cost (2030)
	Green methanol production planned
	Green ammonia production planned
	Early production or pilot project
	Power connectivity flexible to support production (plans announced)
	State domestic green hydrogen demand (2025)
	Diversification of producers at the port
	Existing ammonia and methanol storage
Infrastructure and Logistics	State renewable potential
	Land availability and committed by ports
	Shipping frequency
	Proximity to selected international corridor
	Total cargo handled
	Pre-berthing detention time
	Port dredging depth
Policy and Regulatory	Central government's push for creating a hydrogen hub
	Investments announced
	State policy push to develop green hydrogen ecosystem
	Early port initiatives towards green ammonia/methanol storage
	Any considered or ongoing public-private or joint venture partnerships
	Ongoing port-to-port partnerships

RMI Graphic. Source: RMI analysis.

The factors were indexed according to their relative impact on ease of implementing green corridors. As seen in Exhibit A1, dark green corresponds to higher weighting, light green to medium weighting, and yellow to lower weighting. RMI aligned with value chain experts on appropriate weighting for the factors.

Core enablers such as the cost of green hydrogen production, proximity to major international shipping routes, and the central government's push to establish hydrogen hubs were given higher weighting, as they are critical to creating a conducive ecosystem. By contrast, factors such as the presence of pilot production plants or state-level domestic hydrogen demand were assigned lower weighting, reflecting their more limited role in shaping corridor viability at scale. Ports were subsequently assessed on these weighted factors and ranked based on their cumulative scores as seen in Exhibit A1.

Opportunity sizing for coastal corridors originating at VOC Port

The MoPSW provided vessel calls for FY 2024–2025 to support RMI's understanding of commodity flows and volumes at the ports of VOC, Deendayal, and Paradip. Analysing vessel calls provides insight into the type of vessels operating between the ports and their deadweight tonnages (DWT), which supports computation of commodity volumes by category but does not provide insight into the exact commodity handled between the ports.

The vessel calls used to analyse specific vessel traffic and total cargo capacities between the ports only included vessels whose last destination was either of the other two ports. The vessels' median DWT was used as a reference for further calculations such as estimating fuel consumption for container vessels on the Deendayal–VOC corridor route.

Opportunity sizing for international

Exhibit A2 shows the ammonia and methanol estimated demand by sector, as well as the corresponding hydrogen equivalent of the demand in the EU.

Exhibit A2

Ammonia, methanol, and its hydrogen-equivalent demand in the EU

	Ammonia (Mt/y)	Methanol (Mt/y)	Total H_2e (Mt/y)	Rationale
Refineries	1.7	0	0.3	Adopted from RMI's report *The Case for Recalibrating Europe's Hydrogen Strategy.*
Fertilisers	2.84	0	0.5	
Aviation	0	2.11	0.4	
Maritime	1.14	1.58	0.5	Estimated from current bunkering volumes at ARA and Gibraltar and scaled to 2030 (considering a -0.8% in efficiency and 5% IMO e-fuel target). Ammonia and methanol splits are based on current order book trends (65% methanol and 35% ammonia).
Steel	0	0	0	Adopted from RMI's report *The Case for Recalibrating Europe's Hydrogen Strategy.*

RMI Graphic. Source: RMI analysis.

Exhibit A3 shows the ammonia and methanol estimated demand by sector, as well as the corresponding hydrogen equivalent of the demand in Singapore.

Exhibit A3 Ammonia, methanol, and its hydrogen-equivalent demand in Singapore

	Ammonia (Mt/y)	**Methanol** (Mt/y)	**Total H_2e** (Mt/y)	**Rationale**
Maritime	1.86	3.23	0.92	Estimated from current bunkering volumes at Singapore and scaled to 2030 (considering a -0.8% in efficiency and 5% IMO e-fuel target). Ammonia and methanol splits are based on current order book trends (65% methanol and 35% ammonia).
Power	2.18	0	0.39	Recent tenders and plant announcements indicate that at least nine hydrogen-compatible power plants will be operational by 2030, with a combined capacity of 3.9 GW. Assuming a 30% co-firing rate as per Singapore market announcements.
Refineries	1.06		0.19	Assuming a 25% replacement of the 750 kt/y currently used by the refining sector in Singapore.

RMI Graphic. Source: RMI analysis.

Assumptions used to estimate e-fuel demand from the corridors

The variables shown in Exhibit A4 formed the basis for the fuel demand estimation for the coastal and international corridors.

Exhibit A4

Assumptions used for the fuel demand estimation for the coastal and international corridors

Variable	Unit	Value	Source
Transit time	days	16	Distance & Transit Time Calculator from SeaRates
Distance VOC–Deendayal	nm	1,236.2	Marine traffic
Total container cargo weight	DWT	965,653	RMI analysis
VOC–Deendayal (last destination)	DWT	758,845	Vessel calls
Deendayal–VOC (last destination)	DWT	206,809	Vessel calls
Median weight of a container carrier	DWT	34,769	RMI analysis
Median weight of a container carrier	TEU	~2,900	Evergreen Line
Fuel demand for each container vessel	kt/nm	0.000133	Fourth IMO Greenhouse Gas Study
Distance between VOC and Rotterdam	nm	13,598.2	Marine traffic
Transit time (VOC–Rotterdam)	days	76	Distance & Transit Time Calculator from SeaRates
Volume to Rotterdam	T	7,954,545	RMI analysis
Volume of methanol tanker	DWT	50,000	Industry experts
Volume of ammonia carrier	DWT	30,000	Industry experts
Distance between VOC and Singapore	nm	3,450.2	Marine traffic
Transit time (VOC–Singapore)	days	30	Distance & Transit Time Calculator from SeaRates
Volume to Singapore	T	5,454,545	RMI analysis
Fuel demand for 1 ammonia carrier	kt	0.000118	Fourth IMO Greenhouse Gas Study
Fuel demand for 1 methanol vessel	kt	0.000122	Fourth IMO Greenhouse Gas Study

Cost modelling assumptions

The variables shown in the Exhibit below were used in the green ammonia and methanol cost computations. Note that the costs below are for India scenarios with no subsidies applied. In the cost modelling scenarios with capital expenditure subsidies, a 25% reduction was applied to electrolyser uninstalled capital expenditures, and to solar, wind, and battery capital expenditures.

Exhibit A5

Assumptions used for cost modelling of the coastal and international corridors

Green Hydrogen Production

Fuel production location	VOC Port	
Solar location	Kamuthi	
Wind location	Kanyakumari	
	Optimistic	**Conservative**
Electrolyser efficiency	66%	64%
System energy requirement	50 kWh/kg	52 kWh/kg
Electrolyser uninstalled capex (stack + BOP)	US$495/kW	US$639/kW
Electrolyser stack overall	US$223/kW	US$ 288/kW
Electrolyser balance of plant overall	US$272/kW	US$ 351/kW
Electrolyser EPC	US$272/kW	US$324/kW
Solar single-axis tracking capex	US$560,241/kW	US$607,812/kW
Onshore wind capex	US$777,108/kW	US$913,491/kW
Solar O&M	US$3/kW-year	US$4/kW-year
Onshore wind O&M	US$32/kW-year	US$38/kW-year
Battery power capex	US$209,844/kW	US$209,844/kW
Battery energy capex	US$225,904/kWh	US$225,904/kWh
Battery opex	US$8/kWh-year	US$8/kWh-year

Financial Assumptions

Hydrogen cost of debt	%	9%
Hydrogen cost of equity	%	13%
Hydrogen debt to equity ratio	%	70%
Hydrogen weighted average cost of capital (WACC)	%	10%

Green Ammonia

Overall capex	US$600/Mt/metric tonne	RMI assumption based on Fasihi et al., "Global potential of green ammonia based on hybrid PV-wind power plants" (2021) and Nayak-Luke et al., "Techno-Economic Aspects of Production, Storage and Distribution of Ammonia" (2021)
Electricity consumption	719 kWh/year	Cesaro et al., "Ammonia to power: forecasting the levelized cost of electricity from green ammonia in large-scale power plants" (2020)
Opex	4% of capex	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)

Green Methanol

Default biogenic carbon cost assumption	55 US$/metric tonne carbon	RMI assumption
Fixed opex	4% of capex	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)
Electricity requirement	216 kWh per metric tonne methanol	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)

Storage at Production Site

	Ammonia	Methanol	
Capex	843–1,418 US$ per metric tonne ammonia	417–614 US$ per metric tonne methanol	RMI assumption based on HyDelta, "Technical analysis of hydrogen supply chains" (2022) and Nayak-Luke et al., "Techno-Economic Aspects of Production, Storage and Distribution of Ammonia" (2021)
Opex	3% of capex	0.60% capex	HyDelta, "Technical analysis of hydrogen supply chains" (2022);
Electricity requirement	37.8 kWh per metric tonne ammonia	None	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)
Tank utilisation	80%		Industry experts
Maximum frequency of tank usage	20 times/year		Industry experts

Transport Cost Assumptions

Via rail	US$0.095 per metric ammonia or methanol per km	Industry experts

New pipeline

Capex	US$857,000 per km	Nayak-Luke et al., "Techno-Economic Aspects of Production, Storage and Distribution of Ammonia" (2021)
Opex	US$500 per km per year	
Booster station capital expenditures	US$2,220,000	
Booster station electricity requirement	800 KW	

Assumptions behind oceangoing vessel costs

Laden energy consumption	363 MWh per day	Industry experts
Ballast energy consumption	323 MWh per day	Industry experts
Ship speed	15 knots	RMI assumption
Loading + unloading time	4 days	RMI assumption
Charter cost	US$23,000 per day	RMI assumption
Insurance cost	US$12,600/day	RMI assumption

Port Infrastructure

Portside storage

	Ammonia	Methanol	
Capex	US$1,156–1,418, per metric tonne ammonia	US$501–614 per metric tonne methanol	RMI assumption based on HyDelta, "Technical analysis of hydrogen supply chains" (2022) and Nayak-Luke et al., "Techno-Economic Aspects of Production, Storage and Distribution of Ammonia" (2021)
Opex	3% of capital expenditures	0.60% of capital expenditures	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)
Electricity requirement	37.8 kWh per metric tonne methanol	None	Lloyd's Register & UMAS "Fuel production cost estimates and assumptions" (2019)
Tank utilisation	80%		Industry experts

Bunker Vessel

Capex	US$25 million per bunker vessel	Industry experts
Bunkering crew & other operational costs	US$8,000 per day	Industry experts
Size	12,000 metric tonne ammonia/methanol	RMI assumption
Bunker vessel utilisation	60%	Industry experts

Conversions

Energy equivalency of ammonia to VLSFO	2.18 kg ammonia per kg VLSFO
Energy equivalency of methanol to VLSFO	2.06 kg methanol per kg VLSFO

RMI Graphic. Source: RMI analysis.

The variables shown in Exhibit A6 were used in modelling vessel total cost of ownership. Most of these assumptions were based on the 2020 IMO *Fourth Greenhouse Gas Study* and on the 2024 DNV report *Comprehensive Impact Assessment of the Basket of Candidate Mid-term GHG Reduction Measures – Task 2: Assessment of Impacts on the Fleet*.

Exhibit A6 Assumptions used for the total cost of ownership modelling for coastal and international corridors

Route Specs

Vessel type	-	Liquefied gas tanker (30k DWT)
Average speed	Knots	14.2

Cargo Specs

Cargo per vessel	tonne	30,000
Cargo value	US$/tonne	736
Cargo utilisation	%	50%

Opex

Crew members	#	24	
Crew wages	US$/year	929,611	
Technician wages	US$/year	110,668	
Management fees	US$/year	177,069	
Insurance	US$/year	132,802	
Special survey fees	US$/occurrence	973,878	
Intermediate survey fees	US$/occurrence	110,668	
Canal cost	US$/occurrence	-	
Spares	US$/year	154,935	

Capex

		VLSFO	Ammonia
Vessel capex	US$	50,200,000	58,900,000

Port Cost

Port call	US$/call	60,000

Financial Scenarios

Cost of debt	%	9%
Cost of equity	%	13%
Debt to equity ratio	%	70%
WACC	%	10%
Inflation rate	%	2%
Tax rate	%	0%

RMI Graphic. Source: RMI analysis.

The TCO modelling scenarios consider the impact of IMO's ZNZ reward framework. Many parameters were considered in the model, with the key assumptions outlined below.

In the optimistic e-fuel incentive scenarios, ZNZ rewards are considered independent of surplus unit revenue offsetting the cost premium with conventional fuel. In the conservative e-fuel incentive scenarios, ZNZ rewards are calculated considering the surplus unit revenue in offsetting the cost premium with conventional fuel. Additionally, sector-wide fuel uptake and its effect on surplus unit prices are considered in both scenarios. In the conservative e-fuel incentives scenario, high sector-wide e-fuel and blue fuel uptake with limited biofuel uptake is assumed. In the optimistic scenario, limited sector-wide e-fuel and blue fuel uptake with high biofuel uptake is assumed, justifying higher rewards for e-fuels.

Exhibit A7 IMO ZNZ reward assumptions used in TCO modelling

IMO ZNZ reward assumptions used in TCO modelling

Remedial unit price for above base compliance target	US$380/tonne CO_2e
Remedial unit price for between base and direct compliance target	US$100/tonne CO_2e
Well-to-wake emissions for green ammonia	5 gCO_2e/MJ
Well-to-wake emissions for LSFO	93 gCO_2e/MJ

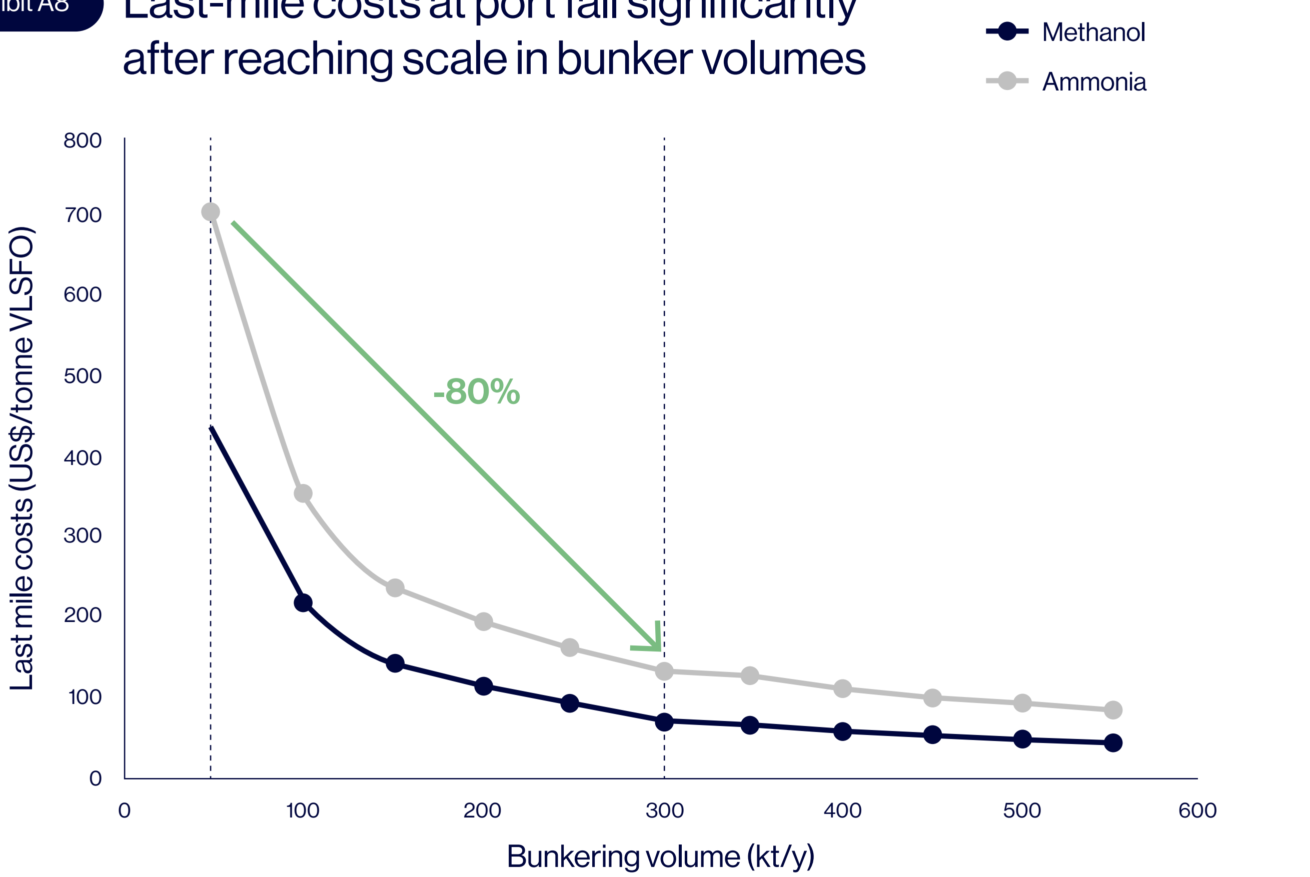
RMI Graphic. Source: IMO Draft revised MARPOL Annex VI, Maersk Mc-Kinney Møller Center for Zero Carbon Shipping.

Impact of bunkering volumes on last-mile costs

RMI's analysis described in the *Oceans of Opportunity* report illustrates that the impact of fuel throughput on last-mile infrastructure costs (fuel storage, transportation, and bunkering infrastructure) increases exponentially with scale. However, this effect diminishes as bunker volume increases beyond specific limits. For example, last-mile costs decline exponentially from about 700 US$ per tonne VLSFO equivalent at 50,000 tonnes of annual ammonia throughput to just over 100 US$ per tonne VLSFO equivalent at 300,000 tonnes of annual throughput.

Methanol infrastructure shows a similar trend in cost variations with scale. Clear thresholds emerge — around 200,000 tonnes per year for methanol and 300,000 tonnes per year for ammonia — beyond which additional fuel throughput has diminished impact on last-mile infrastructure costs.

Exhibit A8 Last-mile costs at port fall significantly after reaching scale in bunker volumes



RMI Graphic. Source: RMI analysis.

Exhibit A9

The SECI green ammonia auctions showcased India's affordable green ammonia production potential, with winning bids reflecting the most competitive green ammonia prices globally

	Name of Procurer	Location Of Procurer's Plant	Volume (Metric Tonnes)	Winner	Bid Price INR/Kg)	Bid Price (US$/ Tonnes)
1	Indian Farmers Fertiliser Cooperative Limited (IFFCO)	Kandla, Gujarat	100,000	ACME	54.73	629.08
2	Indian Farmers Fertiliser Cooperative Limited (IFFCO)	Paradip, Odisha	100,000	ACME	49.75	571.84
3	Madras Fertilizers Limited (MFL)	Manali, Tamil Nadu	4,000	Suryam International	50	574.71
4	Gujarat Narmada Valley Fertilizers & Chemicals Limited (GNFC)	Bharuch, Gujarat	50,000	Onix Renewable	52.5	603.45
5	Paradeep Phosphates Limited (PPL)	Paradeep, Odisha	75,000	ACME	55.75	640.80
6	Paradeep Phosphates Limited (PPL)	Zuarinagar, Goa	25,000	ACME	62.84	722.30
7	Indorama India Private Limited (IIPL)	Haldia, West Bengal	20,000	ACME	64.74	744.14
8	Mangalore Chemicals & Fertilizers Ltd. (MCFL)	Panambur, Karnataka	15,000	SCC Infrastructure	57.65	662.64
9	Coromandel International Limited (CIL)	Visakhapatnam, Andhra Pradesh	50,000	ACME	51.89	596.44
10	Coromandel International Limited (CIL)	Kakinada, Andhra Pradesh	85,000	Jackson Green	50.75	583.33
11	Krishana Phoschem Limited	Meghnagar, Madhya Pradesh	70,000	NTPC Renewable Energy	51.8	595.40
12	Madhya Bharat Agro Products Limited-II	Sagar, Madhya Pradesh	60,000	Oriana Power	52.25	600.57
13	Madhya Bharat Agro Products Limited-III	Dhule, Maharashtra	70,000	SCC Infrastructure	53.05	609.77

RMI Graphic. Source: "Result: Request for Selection of Green Ammonia Producers for Production and Supply of Green Ammonia in India through Cost Based Competitive Bidding under SIGHT Scheme (Mode-2A-Tranche-I), Solar Energy Corporation of India Ltd. (SECI), 2025, https://www.seci.co.in/uploads/news/1757001950_Website_result_for_GA_M2AT1.pdf

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