Assessing the feasibility of the South Africa-Europe iron ore green shipping corridor

Acknowledgements

About the South Africa-Europe iron ore green corridor

In 2023, a consortium consisting of Anglo American, CMB.TECH, Freeport Saldanha, VUKA Marine, and Engie (as well as former member Tata Steel) **was convened by the Global Maritime Forum** with the objective to explore and define a concept for developing a green shipping corridor on the South Africa-Europe iron ore trade route. After regular meetings in 2023 and 2024, the work to conduct a feasibility analysis kicked off at the end of 2024 and was completed in September 2025.

The South Africa-Europe iron ore green corridor initiative builds on previous work by the **P4G-Getting to Zero Coalition Partnership**, the **World Economic Forum** and the **World Bank**, all of which identified opportunities for South Africa to become a key player in the global energy transition and shipping's decarbonisation.

About this report

This report has been authored by the Global Maritime Forum and is based on a feasibility analysis conducted by the Rocky Mountain Institute (RMI) with input and validation from the consortium members. Stakeholders from South Africa's research, energy, and maritime fields have also been consulted. The Global Maritime Forum's project team would like to thank everyone who contributed.

Disclaimer

The views expressed in this report are the authors' alone. Various assumptions have been adopted to assess the feasibility of implementing the corridor and shall be used for this purpose only. The statements in the document do not represent guarantees of future operations. They are contingent upon known and unknown risks and uncertainties beyond the control of the Global Maritime Forum, RMI and the consortium members. Readers are cautioned not to place reliance on any forward-looking statements or graph-based projections.

GLOBAL MARITIME FORUM

About the Global Maritime Forum

The **Global Maritime Forum** is an international not-for-profit organisation committed to shaping the future of global seaborne trade. It works by bringing together visionary leaders and experts who, through collaboration and collective action, strive to increase sustainable long-term economic development and human well-being. Established in 2017, the Global Maritime Forum is funded through a combination of grants and partner contributions. It operates independently of any outside influence and does not support individual technologies or companies. Most of its roughly 50-person staff is based in the organisation's headquarters in Copenhagen, Denmark.

RMI

About RMI

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.

Executive summary

As countries and industries accelerate their efforts to reduce fossil fuel reliance, the adoption of alternative fuels and technologies is increasing. There is a broad consensus that renewable, electricity-based fuels (e-fuels), particularly those derived from hydrogen, will be crucial in achieving the maritime sector's target of net-zero emissions by 2050.

South Africa, with its abundant renewable energy resources and strategic location near major sea routes, has the opportunity to lead this transition and play a significant role in the global hydrogen economy.

Maritime trade is expected to be one of the first sectors to adopt hydrogen-derived fuels with a projected scale-up from the mid-2030s and onwards. Green shipping corridors, specific trade routes where the feasibility of zero-emission shipping is catalysed through public and private actions, can be an effective means of kick-starting this process. They provide early offtake opportunities for hydrogen-based production projects and spur essential infrastructure investments in support of the sector's energy transition.

This report examines the feasibility of establishing a green shipping corridor along the existing iron ore trade route between South Africa and Europe, using South African-produced green ammonia. The findings suggest that this route has the potential to deploy iron ore carriers powered by green ammonia from 2029 and achieve full decarbonisation by 2035 if certain prerequisites are met.

Key takeaways:

- Announced green ammonia projects in South Africa have the potential to competitively supply the corridor's fuel needs.
- While the corridor might bunker green ammonia in Rotterdam in its early years, Saldanha is well-positioned to become the long-term bunkering hub for the corridor.
- Global and regional regulations may help create a business case for this corridor, although uncertainties around the development of regulations remain.
- Additional action from private and public stakeholders is needed to launch the corridor by 2029 and reach full decarbonisation by 2035.

Key recommendations for private and public stakeholders:

- Create an enabling contracting environment to optimally and fairly allocate risks and rewards across the value chain.
- Engage with South African governmental bodies and industry stakeholders to raise awareness of the corridor and the need for an enabling policy environment.
- Mobilise funding and incentives for corridor infrastructure that will contribute to Saldanha's hydrogen hub and port development.

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Introduction

South Africa **is positioning itself as a key player** in the emerging green hydrogen economy, aiming to stimulate sustainable growth and contribute to industry-wide decarbonisation by leveraging its abundant renewable energy resources and proximity to major sea routes. Its hydrogen sector has the **potential to contribute to 3.6% of the country's gross domestic product** (GDP) by 2030, with shipping and steel well placed to become early offtakers of hydrogen and its derivatives.

Green shipping corridors, specific trade routes where the feasibility of zero-emission shipping is catalysed through public and private actions, could play a key role in enabling the early uptake of scalable zero-emission fuels (SZEF) such as green hydrogen and ammonia. Driven by voluntary action and forthcoming regulation, the primary role of green corridors is to support the shipping sector in reaching the **critical tipping point of at least 5%** adoption of SZEF by 2030, thereby unlocking the scaling of such fuels across the global fleet. For the sector to achieve this goal, targeted demonstrations and investments in vessels, bunkering, and fuel infrastructure that can support the uptake of SZEF need to happen this decade.

The Global Maritime Forum has convened a consortium of leading stakeholders from the mining, energy, and maritime sectors[1] to explore and define the feasibility of developing a green shipping corridor on the iron ore trade route between South Africa and Europe, specifically between the Port of Saldanha and the Port of Rotterdam.

The initiative, referred to as the **South Africa-EU iron ore green corridor** (hereafter "the corridor"), aims to support the production and uptake of green ammonia as a maritime fuel on the route, explore synergies with green hydrogen offtakers in other sectors like steel, and unlock sustainable development opportunities in South Africa. While **more than 70 green shipping corridors have been announced** since the launch of the Clydebank Declaration at COP26, this is one of the few initiatives that aims to develop a green shipping corridor between the Global South and the Global North.

A feasibility analysis examined the potential to deploy ammonia-powered iron ore carriers on the route by 2029 and reach full decarbonisation by 2035. This report presents the corridor's decarbonisation scenario, feasibility analysis outputs and the specific actions that are required to unlock the corridor opportunity in time.

1 Anglo American, CMB.TECH, Engie, Saldanha Bay, Vuka Marine

The South Africa-Europe iron ore green shipping corridor's decarbonisation scenario

The feasibility of the South Africa-Europe iron ore green corridor has been assessed against the target of deploying the first green ammonia-powered bulk carriers on the route by 2029 and reaching full decarbonisation by 2035. The assumption is that the vessels will run on green ammonia produced and bunkered in South Africa in the long term. In the initial years, while the necessary infrastructure and supply chains in South Africa are still being built out, vessels may bunker green ammonia produced elsewhere.

The target years were decided based on consortium input and their individual decarbonisation targets, as well as a high-level analysis of green ammonia production timelines and vessel orders. While there are other zero-emission fuel options, green ammonia was chosen as the corridor's fuel focus due to its zero-carbon potential, scalability, and South Africa's strong prospects for green hydrogen production. Consistent with the impact logic of green corridors, the underlying analysis assumes that vessels will run fully on green ammonia,[2] although this is likely to take a more phased approach in practice.

Taking the above target years and fuel focus into account, assessing the feasibility of the corridor first requires an understanding of projected iron ore trade flows between the two regions and what that will mean for future green ammonia demand.

Iron ore demand patterns and involved ports

Examining demand projections to 2035, three different scenarios for developing the iron ore trade between South Africa and Europe have been identified (see Figure 1). These are based on various trends and forecasts affecting the global and European steel landscape, such as price volatilities in raw materials, years of overcapacity, global competition, and rising carbon prices (see Appendix A).

In a business-as-usual (BAU) scenario, the South Africa-Europe iron ore trade is projected to continue with volumes similar to today's levels. However, South Africa also has an opportunity to meet the growing demand for high-grade iron ore[3] in Europe – a critical input material for green steel production. This is reflected in the high-demand scenario where trade significantly increases.

Finally, in a low-demand scenario, characterised by an increase in scrap-based steel production and a shift towards importing a more finished iron product[4] from South Africa, the iron ore demand levels decrease to mid-2010 levels.

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2 Assuming a 5% pilot fuel (LSGO) usage

3 Referred to as DR-grade iron ore

4 Referred to as hot briquetted iron (HBI) and constitutes an important production and high-value export opportunity for South Africa elaborated on in Appendix A and explored further in documents like the **Western Cape Green Hydrogen Strategy Roadmap**, p.12.

Scenario	European iron ore demand		South African exports to Europe		Share of European iron ore market in 2035
	Description	**Average Compound Annual Growth Rate (CAGR)**	**Description**	**Average CAGR**	
High	1.5C scenario	-1%	Starting with 2023 volumes and increasing to meet growing demand for DR-grade iron ore in Europe under 1.5C scenario	7%	27%
Medium	BAU scenario	-1%	Starting with 2023 volumes and following the annual growth rate for BAU scenario	-1%	12%
Low	Faster abatement scenario with 30% of Direct Reduced Iron (DRI)-based steel met by Hot Briquetted Iron (HBI) imports	-6%	Starting with 2023 volumes and following the annual growth rate for Faster Abatement scenario with HBI imports	-6%	12%

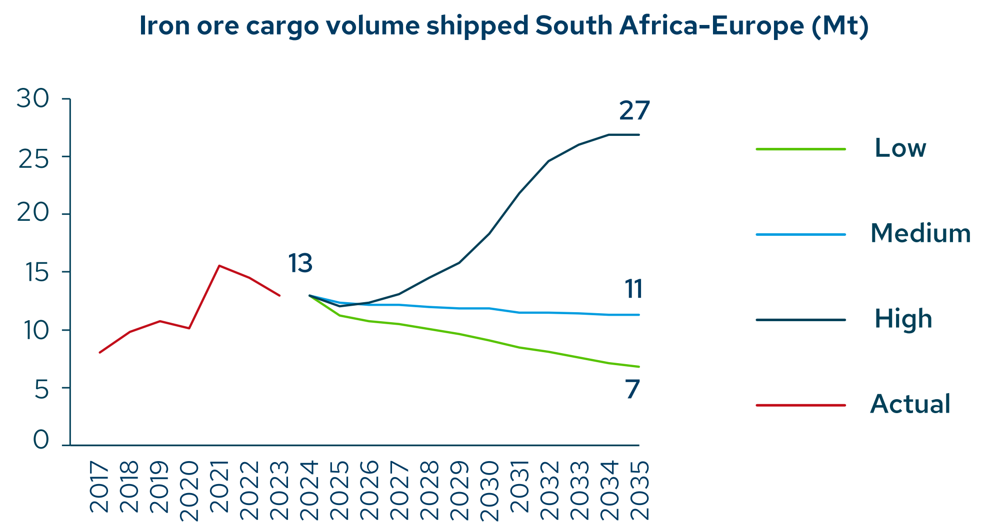


Figure 1: *Iron ore demand scenarios with projected market share in 2035 (above) and cargo volumes shipped (below). Sources: RMI analysis (2025) based on United Nations (UN) Comtrade for Harmonized System (HS) 2601 product trade (iron ores and concentrates); and Mission Possible Partnership (MPP) Steel Sector Transition Strategy (2022).*

In all three scenarios, the iron ore trade between South Africa and Europe is projected to continue to 2035 and beyond and will need servicing with vessels powered by SZEF driven by regional and global regulation as well as stakeholders' own decarbonisation targets.

The main ports on the South Africa-Europe iron ore route expected to accommodate this shift are Saldanha Bay and Port of Rotterdam. As of today, more than 90% of all iron ore exports from South Africa are shipped out of Saldanha Bay's Saldanha Terminal. Approximately 20% of this is shipped to Europe, with Rotterdam being the largest port of import.

Figure 2: *Port of Saldanha-Rotterdam as a leading corridor option for the South Africa-Europe iron ore green corridor*

Both Saldanha and Rotterdam are capable of handling the type of ammonia-powered iron ore bulk carriers currently represented in the global orderbook[5] and have announced plans or taken concrete steps towards developing SZEF port infrastructure and bunkering.[6] This makes Saldanha-Rotterdam the leading corridor option and the basis of this feasibility assessment.

The corridor's potential green ammonia demand

Based on the projected iron ore trade volumes through 2035, the maximum potential demand for green ammonia to fuel the iron ore vessels has been calculated to determine how much green ammonia is required to realise full decarbonisation by 2035.

Assuming a capacity of 210,000 tons of iron ore, burning ~2,740 tons of green ammonia per round trip and conducting six round trips per year,[7] this results in an annual green ammonia demand of:

5 210,000 deadweight tonnage (DWT) Newcastlemax bulk carriers make up the majority of the current ammonia-powered bulk carriers on order. Port of Rotterdam is one of few ports in Europe currently capable of handling these vessels.

6 Port of Rotterdam is developing ammonia safety frameworks and bunkering regulations to welcome the first ammonia powered ships in 2026 already, while Saldanha Bay is positioned to become a central green hydrogen hub in South Africa and supplier of green maritime fuels.

7 See fuel demand analysis assumptions in Appendix B

- 89,1 Kilo tonnes per annum (Ktpa) for ~six vessels transporting 6,8 Mega tonnes per annum (Mtpa) Deadweight tonnage (DWT) iron ore, in the low-demand scenario
- 147,5 Ktpa for ~9 vessels transporting 11,3 Mtpa DWT iron ore, in the medium-demand scenario
- 350,8 Ktpa for ~22 vessels transporting 26,9 Mtpa DWT iron ore, in the high-demand scenario

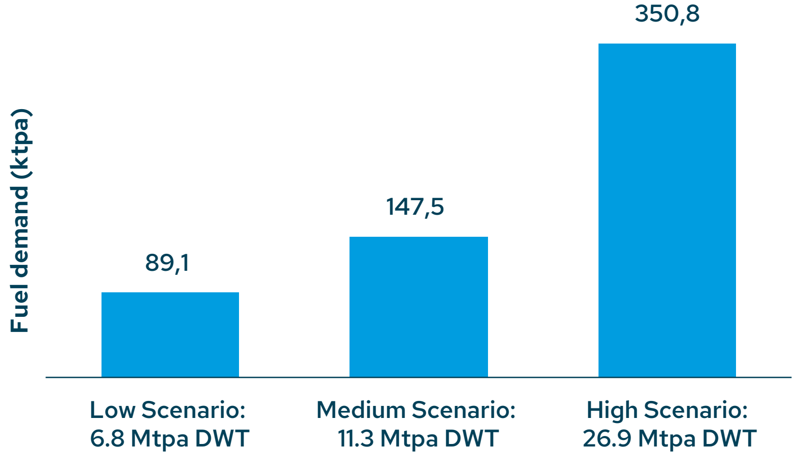


Figure 3: *Corridor's annual green ammonia demand based on 2035 iron ore demand scenarios. RMI analysis (2025).*

These volumes, when translated from ammonia to the required hydrogen feedstock, position the corridor as a meaningful offtaker relative to other industries in South Africa. In 2030, the corridor could represent a significant share of the shipping industry's green hydrogen demand, potentially exceeding demand from the cement, mining, and domestic iron sectors (see Figure 4). For hydrogen producers in South Africa seeking to secure sufficient offtake volumes to reach final investment decisions (FID) and initiate production projects this decade, the corridor could be an efficient target for demand stimulation and aggregation with other industries.

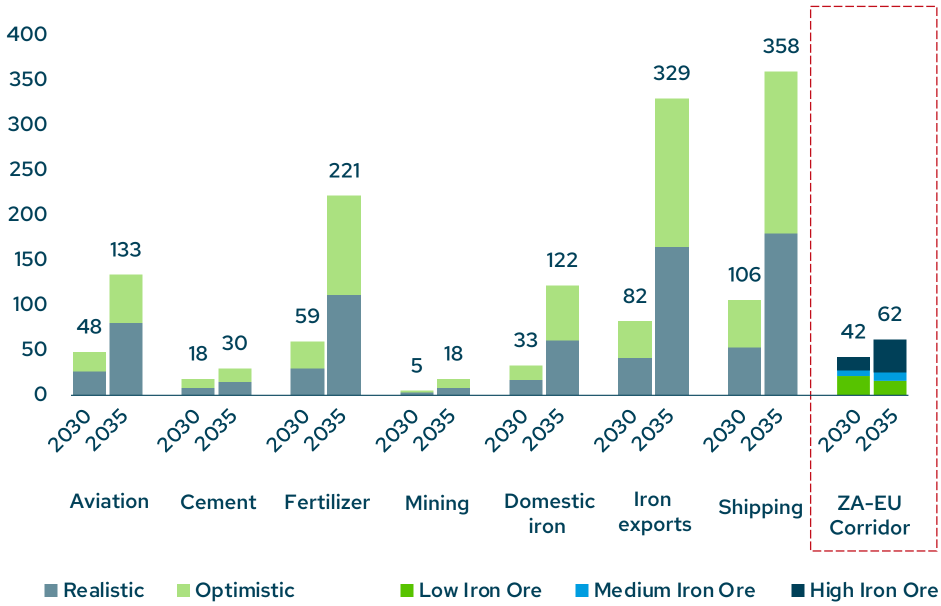


Figure 4: *Potential green hydrogen demand from key industrial sectors in South Africa (Ktpa) by 2030 and 2035. RMI analysis (2025).*

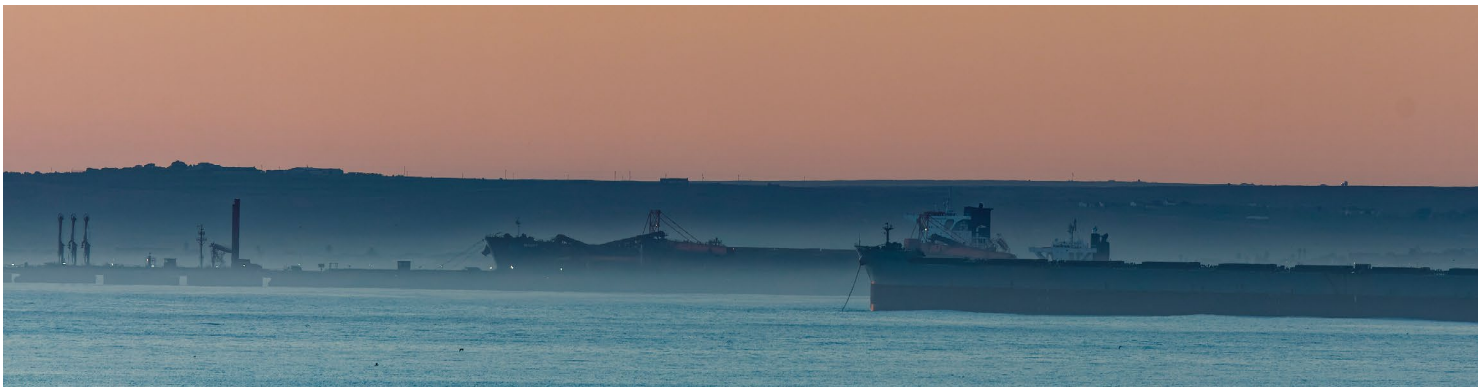
Assessing the corridor's feasibility

Taking the above iron ore and green ammonia demand scenarios into account, the following section tests whether the corridor can achieve its 2029 deployment and 2035 decarbonisation targets. The main factors include the availability of ammonia-powered vessels on the route and potential deployment strategies, an adequate green ammonia supply at a cost-competitive rate, port and bunkering infrastructure, and a robust business case for corridor operations.

Deploying ammonia-powered iron ore bulk carriers on the corridor

Iron ore bulk carriers currently represent a large share of ammonia-powered ships on order globally, with 15 set to hit the water by 2028 and more orders expected to be announced in the coming years.[8] While some of these vessels have been committed to other routes,[9] the number of ships on order suggests that up to 12 could be available to service the corridor during its initial deployment years. However, whether these vessels are deployed on this corridor or other iron ore trade routes[10] depends on where a viable business case exists.

Considering the fleet turnover on the route and assuming a viable business case, vessel deployment could occur in three ways (see Figure 5). Importantly, while the South Africa-Europe iron ore trade currently consists of tramp[11] vessels operating on the route, in the future, ammonia-powered vessels would likely be chartered to operate predominantly on this route, providing the necessary demand certainty until a commercially viable green ammonia market has been widely developed.



8 Clarkson's' World Fleet Register (accessed 12-08-25)

9 2 vessels on the Australia-Northeast Asia route and 1 vessel on the Australia-China route.

10 Examples include Australia-East Asia (China, Japan, Republic of Korea) and Brazil-China

11 Tramp shipping is a practice where ships are hired to make specific voyages, rather than a defined number of ships operating in a dedicated fashion on the route

	Strategy 1: Retirements only			Strategy 2: Early displacements			Strategy 3: Dedicated vessels		
Proposed strategies	Newbuilt ammonia-powered vessels replace trips from retired conventional vessels and from increased demand			Conventional vessels are displaced to other routes after a 12-year lifetime; newbuilt ammonia-powered vessels operate their trips and any increase in demand			Newbuilt ammonia-powered vessels are dedicated to the corridor following an S-curve: • 1 in 2029 • 4 in 2030 • 7 in 2031 • 12 in 2032 • 17 in 2032 • 20 in 2034 • 22 in 2035		
Demand scenario	Low	Medium	High	Low	Medium	High	Low	Medium	High
Green trips by 2035	25%	33%	53%	100%	70%	57%	100%	100%	100%

Figure 5: *Potential vessel deployment strategies .[12] RMI analysis (2025).*

The first vessel deployment strategy, where ammonia-powered vessels replace trips from retired conventional vessels, does not have the potential to decarbonise the corridor by 2035 under any demand scenario. The second and third strategies, however, both have the potential to match the capacity needed to fully decarbonise the corridor by 2035. The second strategy, based on early displacements, would only be enough to fully decarbonise the route in the low-demand scenario. Only the third strategy, based on adding dedicated vessels to the route, has the potential to decarbonise 100% of the yearly trips by 2035 under any demand scenario (see Figure 6). Specifically, starting with one vessel in 2029 and then adding three vessels per year would cover the entirety of iron ore demand in any scenario, with full route decarbonisation reached by 2031 and 2032 under the low and medium demand scenarios, respectively.

Figure 6: *Preferred vessel deployment strategy on the South Africa-Europe iron ore route (assuming a viable business case in place). RMI analysis (2025).*

12 See Appendix C for more details on the three deployment strategies

Involved stakeholders indicated their preference towards the third strategy, highlighting that the current tramp behaviour means that deploying ammonia-powered vessels is not necessarily conditional upon retiring or displacing conventional vessels. Ultimately, deployment will be driven by when and where there is a viable business case.

Supplying the corridor with green ammonia

For the corridor to successfully launch by 2029 and reach full decarbonisation by 2035, a sufficient supply of green ammonia will be essential, both in volume and at competitive costs. This section evaluates the potential of South Africa's regional production to fulfil the fuel demand needs of the corridor and to establish low-cost fuel sourcing options for bunkering at either end of the corridor.

The Southern African region's fuel production potential

The Southern African region, with its abundant solar and renewable energy resources, is well-positioned to become a producer of green ammonia. Green ammonia production projects announced or under development in the region have a combined capacity exceeding 700 ktpa (hydrogen equivalent) by 2035. These projects are in South Africa's Western and Northern Cape provinces and Namibia's Erongo region near the ports of Boegoebaai, Saldanha, and Walvis Bay. These projects are projected to have respective capacities of 285, 275, and 177 ktpa of ammonia by 2035 and are expected to meet the corridor's fuel demand by 2035 under all three demand scenarios (see Figure 7).

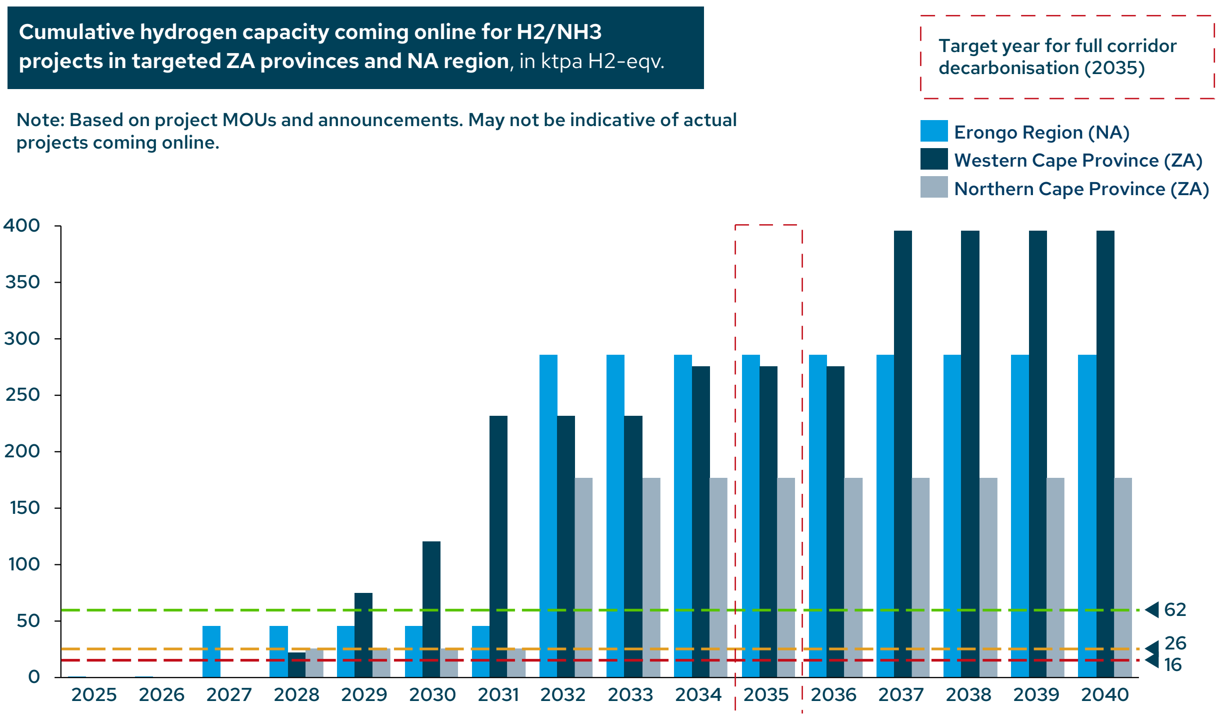


Figure 7: *Capacities of announced hydrogen production projects in the Southern African region compared with fuel demand on the corridor under different scenarios. RMI analysis (2025) with information extracted from IEA Hydrogen Projects Database (last retrieved March 2025).*

As of this publication, none of these projects has reached FID on their production plants, and there may be uncertainty as to whether the projects will be realised in time for the corridor's targeted launch year of 2029. This becomes even more relevant when considering the development timeline for ammonia production plants, which typically ranges from five to eight years from concept through to commercial operation.

Several challenges—some region-specific, others common across all fuel production projects—may delay progress. These include, but are not limited to, an uncertain policy landscape, permitting challenges, high capital costs, the slow pace of infrastructure development, and the absence of secured offtake agreements.

If bridging these challenges are prioritised in the next few years, it would send a strong market signal to fuel suppliers and buyers and increase the chances of having sufficient green ammonia projects come online in the region to support the development of the corridor. Demand aggregation with other offtakers may be required, as the corridor may not provide enough fuel demand on its own for these fuel production projects to secure FID.

Competitiveness of production and bunkering locations

In the initial years, iron ore bulk carriers operating on the South Africa-Europe green corridor would ideally have the option to bunker at either end of the route, in Saldanha or Rotterdam, depending on infrastructure and fuel availability as well as the total delivered cost of green ammonia.[13] To determine the most cost-effective combination for green ammonia production and bunkering, the total delivered cost of fuel at both locations is assessed and benchmarked against alternative regional and international supply locations.[14]

By 2029, a relatively modest volume of approximately 140 ktpa of green hydrogen-based fuel is **projected to flow through Saldanha Bay port**. Under this medium demand scenario, domestic production appears to be the lowest regional cost option for bunkering in Saldanha, at around $2,740/metric tons (mt), primarily due to minimal transport costs. At these demand levels, ammonia from the US state of Texas is one of the cheapest international sourcing options, at approximately $2,000/mt. This is primarily due to tax credits under the US Inflation Reduction Act (IRA) that substantially lower the fuel production costs.

Previous studies have shown that economies of scale for port bunkering are realised once green ammonia volumes exceed 200 ktpa. Therefore, the high-demand scenario of 350 ktpa green ammonia, 2.5 times the projected volumes for Saldanha, was modelled to test the cost implications and assess its impact on the regional competitiveness of Saldanha. Consistent with previous findings, the modelling showed that increasing the volumes lowers delivered costs, thus showcasing the potential of demand aggregation.

13 Total delivered costs aggregate fuel production, hydrogen feedstock, storage, transport, and port infrastructure costs.

14 See Appendix D for full list of regional and international sourcing options. Please note that estimated production costs are subject to a fast-developing market

In both the medium and high bunkering scenarios, Saldanha remains regionally competitive (see Figure 8).

In the high-volume scenario, all production locations surrounding Saldanha reduce their costs, but Saldanha remains the most competitive fuel sourcing choice in the region, while sourcing fuel from Texas remains one of the cheapest options globally.

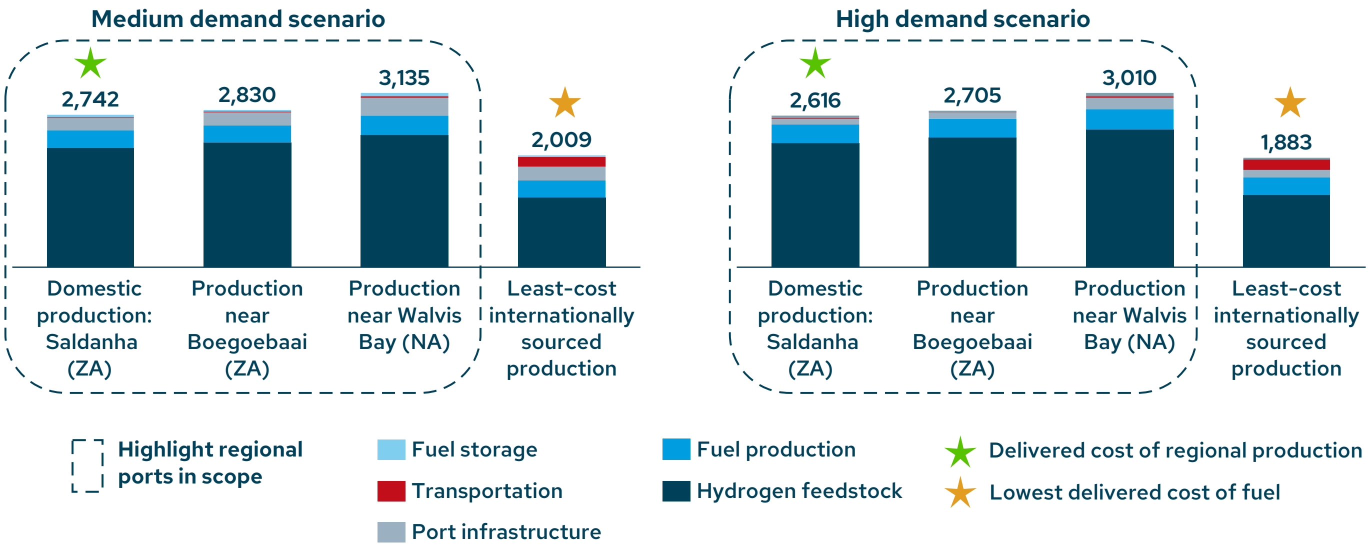


Figure 8: *Total delivered cost of green NH3 bunkered in Saldanha under medium and high demand scenarios in USD / metric ton very low sulphur fuel oil (VLSFO-equivalent). RMI analysis (2025).*

For Rotterdam as a bunkering location, internationally sourced fuel is a much cheaper option than domestically produced fuel. Under the high-demand scenario, bunkering in Rotterdam with domestically produced green ammonia has a total delivered cost of approximately $2,340/mt, while fuel internationally sourced from Texas emerges as the cheaper sourcing option, at a delivered cost of $1,820/mt. This cost differential is slightly smaller than that of Saldanha.

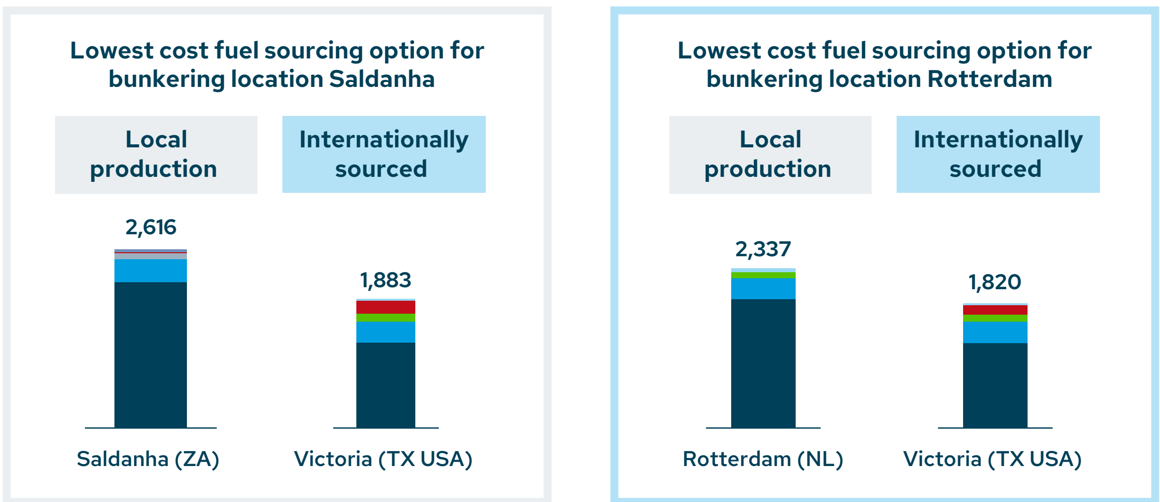


Figure 9: *Summary of lowest total delivered cost of green NH3 (high bunkering scenario) in USD / metric ton VLFSO-eq. RMI analysis (2025).*

Although local production in Rotterdam appears cheaper than Saldanha likely due to higher wind capacity and lower capital costs resulting in a lower levelised cost of electricity, green ammonia produced and bunkered in Saldanha can still compete in both medium- and high-volume scenarios. The difference in delivered costs ranges from $100 to $300/mt. Factors that may affect these cost differences include labour cost arbitrage between South Africa and Europe, and the limited availability of land in the Rotterdam area, which could make local production in Saldanha more attractive overall.

The above findings highlight Saldanha's growing potential as a viable production and bunkering location. While fuel sourced from Texas is significantly more cost-competitive in both locations, without the benefits of the IRA credits, which face uncertainty under the current US administration, the cost comparison becomes more balanced, further strengthening the case for producing and bunkering green ammonia in Saldanha. Importantly, if internationally sourced fuel remains cheaper in both bunkering locations, geopolitical or supply chain risks such as trade wars or delays in fuel imports may impact its attractiveness.

Assessing port readiness

Rotterdam already has a well-established bunkering infrastructure and is making important progress in its preparations for ammonia bunkering. It has conducted a successful ship-to-ship ammonia bunkering pilot, **elevating the Port's Readiness Level (PRL) score to seven**, and has already developed supportive policies and guidelines, such as the **PGS-12 code**, for ammonia-ready infrastructure.

Although the necessary port and bunkering infrastructure has not yet been established in Saldanha and safety guidelines and regulations are currently missing in South Africa, important progress is being made on both fronts. There are plans to develop the necessary bunkering infrastructure in Saldanha to supply SZEF to domestic and international shipping. This builds on ambitions laid out in the proposed Saldanha Green Hydrogen Hub under the West Coast Green Hydrogen Master Plan, as well as a forthcoming Transactional Maritime Feasibility Study at the Port of Saldanha. These initiatives resemble value chain collaborations that have taken place elsewhere, with an exemplary precedent being the Pilbara Ports Authority in Western Australia, which has developed a strategy for establishing a Clean Fuel Bunkering Hub, conducted an ammonia bunkering pilot in 2024 and signed a memorandum of understanding with NH3 Clean Energy and Oceania Marine Energy to develop ammonia bunkering operations in one of its ports by 2030.

Given the two options' similar cost profiles but different stages of progress, it is likely that the vessels deployed on the corridor could bunker in Rotterdam in the initial years while the stakeholders invest in Saldanha to enable it to become a long-term bunkering option by 2035.

The business case for early action on the corridor

Deploying ammonia-powered iron ore bulk carriers on the South Africa-Europe iron ore trade route requires switching to a more expensive, less energy-dense fuel and investing in new vessels and bunkering infrastructure. In the absence of policy support, switching from a conventional vessel to one powered by green ammonia today would double the cost of owning and operating the vessel over its lifetime (see Figure 10 for an illustrative example). This is primarily driven by higher fuel costs, which account for nearly 90% of the increase. Capital expenditures associated with the vessel purchase (including financing costs and equity dividends) are the second-largest driver, followed by other operating expenditures.

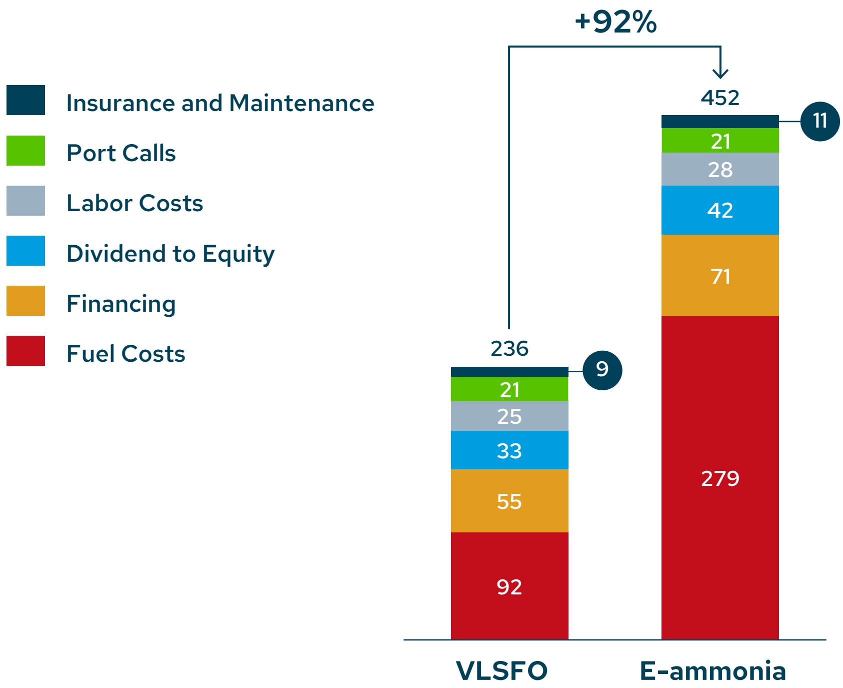


Figure 10: ***Total cost of ownership before considering regulation implications (Net Present Value (NPV), M$). RMI analysis (2025).***

Meanwhile, significant upfront investments are needed for the corridor's bunkering infrastructure. Depending on the configuration and location of these investments, costs in the tens of millions of dollars are anticipated. For example, the total cost of portside storage tanks[15] and a bunkering vessel for ship-to-ship bunkering is estimated to reach $68 million.[16]

In the absence of additional incentives, these costs negatively impact the business case for the corridor.

15 Assuming 2 tanks of 15,000 tonnes capacity

16 RMI analysis (2025)

Assessing the impact of EU regulations on the corridor business case

The South Africa-Europe corridor is subject to two sets of regulations: regional EU regulations and global International Maritime Organisation (IMO) regulations. Both have the potential to improve the business case for the corridor.

EU regulations include a greenhouse gas (GHG) fuel intensity requirement as part of **FuelEU Maritime**, which came into force in January 2025, and an emissions levy under the **Emissions Trading Scheme (EU ETS)**, expected to be fully phased in by 2026. These regulations apply to 50% of journeys entering or leaving the EU. Non-compliance with either incurs financial penalties. FuelEU offers flexible compliance mechanisms, including the option to trade over- and under-compliance between vessels.

The feasibility analysis modelled several scenarios to understand the possible impacts of the regulations on the corridor. The cost of maximum use of green ammonia has been compared to a business-as-usual (BAU) scenario of continued use of very low sulphur fuel oil (VLSFO), with compliance achieved by paying penalties. As shown in Figure 11, EU regulations help narrow this cost gap by 63%, strengthening the investment case for green ammonia-powered vessels.

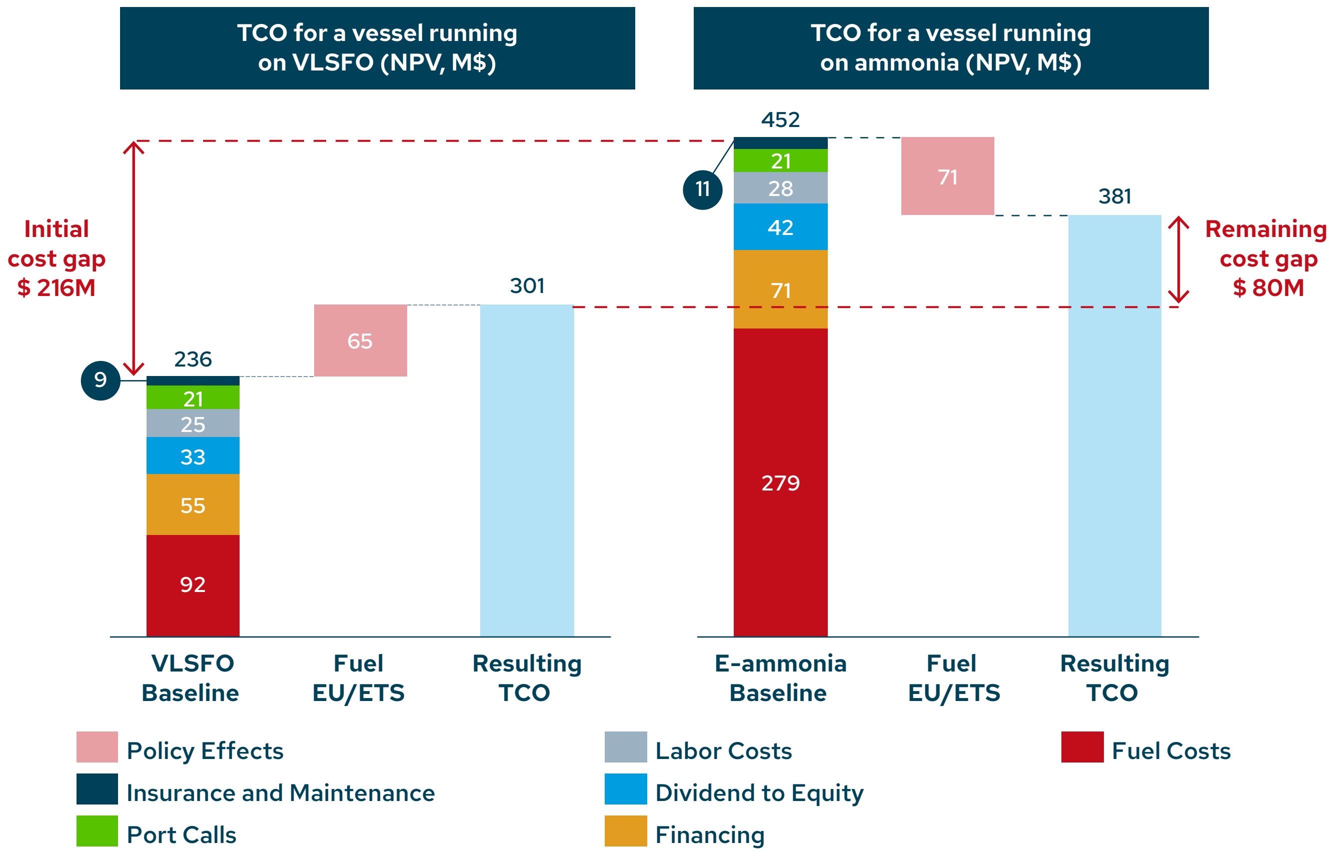


Figure 11: *Impact of FuelEU and ETS on total cost of ownership. RMI analysis (2025)*

Assessing the impact of IMO regulations on the corridor business case

The IMO's **Net-Zero Framework** (NZF) is designed to implement its 2023 IMO GHG Strategy, which stipulated the target of global net-zero GHG emissions by 2050, including interim emissions reduction targets for 2030 (at least 20%) and 2040 (at least 70%). The NZF was agreed in April 2025 and is now set to be revisited in 2026 following the decision in October 2025 to delay adoption. The regulation incorporates a two-tiered global fuel standard (GFS) and a credit trading mechanism to facilitate compliance. The GFS includes base and direct compliance targets for every year between 2028 and 2035, and a base target for 2040.[17] Similar to FuelEU Maritime, vessels can trade surpluses and deficits. Shipowners operating over-compliant vessels (i.e., emitting less than the direct compliance targets) can sell their surplus units (SU) to under-compliant ships (those emitting more than the base targets). The NZF also provides additional rewards for using ZNZ emission fuels[18] with the ability to potentially stack any SU generation to incentivise their early adoption.

In the short term, multiple fuels can be used to comply with the NZF, including biodiesel, methanol and (bio-) liquified natural gas, by mixing various ammonia (e.g., blue) and biodiesel blends, or by using green ammonia on portions of the route. This green corridor, however, targets the maximum use of green ammonia with adoption as early as possible.

When analysing how the NZF could benefit the corridor's business case, uncertainties remain about key parameters of the regulations, including the value of the generated SU, how the rewards will be disbursed, and how much the reward will be worth. As part of the analysis, a modelling exercise was conducted to illustrate the potential of the IMO measures to unlock a long-term business case for e-fuels. For the purposes of the modelling, it was assumed that the reward is designed to close the cost gap for the lowest-cost e-fuel. Three scenarios were then considered depending on the assumptions around the SU price, the trajectory for the ZNZ reward over time, and how the reward is calculated (whether the reward is offset by SU or not – see more in Appendix F).

17 See Appendix E for graph outlining the two GFI's tiers

18 ZNZs have a GHG Fuel Intensity (GFI) of no more than 19.0 gCO_2eq/MJ, which is 80% lower than the current average of 93.3 gCO_2eq/MJ (**The IMO Net-Zero Framework – FAQ**s. IMO(2025)).

Variable 1:
Surplus unit (SU) price

Context: In efficient markets, SU price will be set by the **abatement cost of the most expensive decarbonization option** that meets the demand, below the penalty.

Sector uncertainty: SU prices will vary **depending on price and emissions factors** which are modeled with high, medium and low e-fuel adoption scenarios.

Variable 2: Zero and Near-Zero (ZNZ) emission fuels reward trajectory

Context: ZNZ rewards aim at **compensating the cost gap between fossil fuels and the lowest cost e-fuel**.

Policy uncertainty: **As e-fuel production costs decrease over time, so will the e-fuel rewards.** Various downward trajectories might be deployed and are modeled with high, medium and low e-fuel adoption scenarios.

Variable 3:
ZNZ reward calculation

Context: ZNZ rewards **depend on SU prices, to achieve parity with Very Low Sulphur Fuel Oil (VLSFO)**.

Policy uncertainty: **ZNZ rewards are added on to the revenue received from selling SU** to fully bridge the cost gap **OR ZNZ rewards fully bridge the cost gap**, without being offset by SU (if IMO gets enough funding for e-fuel rewards).

IMO scenario in analysis	SU Price	ZNZ reward trajectory	ZNZ reward calculation
Highest IMO	High	High	Not offset by SU
Medium IMO	Medium	Medium	Not offset by SU
Lowest IMO	Low	Low	Offset by SU

Figure 12: *Three scenarios around key outstanding NZF parameters. RMI analysis (2025).*

Under the most favourable assumptions around these three variables (Highest IMO scenario in Figure 12), powering a Newcastlemax with green ammonia is almost 30% cheaper overall than using VLSFO, while the least favourable scenario (Lowest IMO scenario) leaves it at just under 30% more expensive.

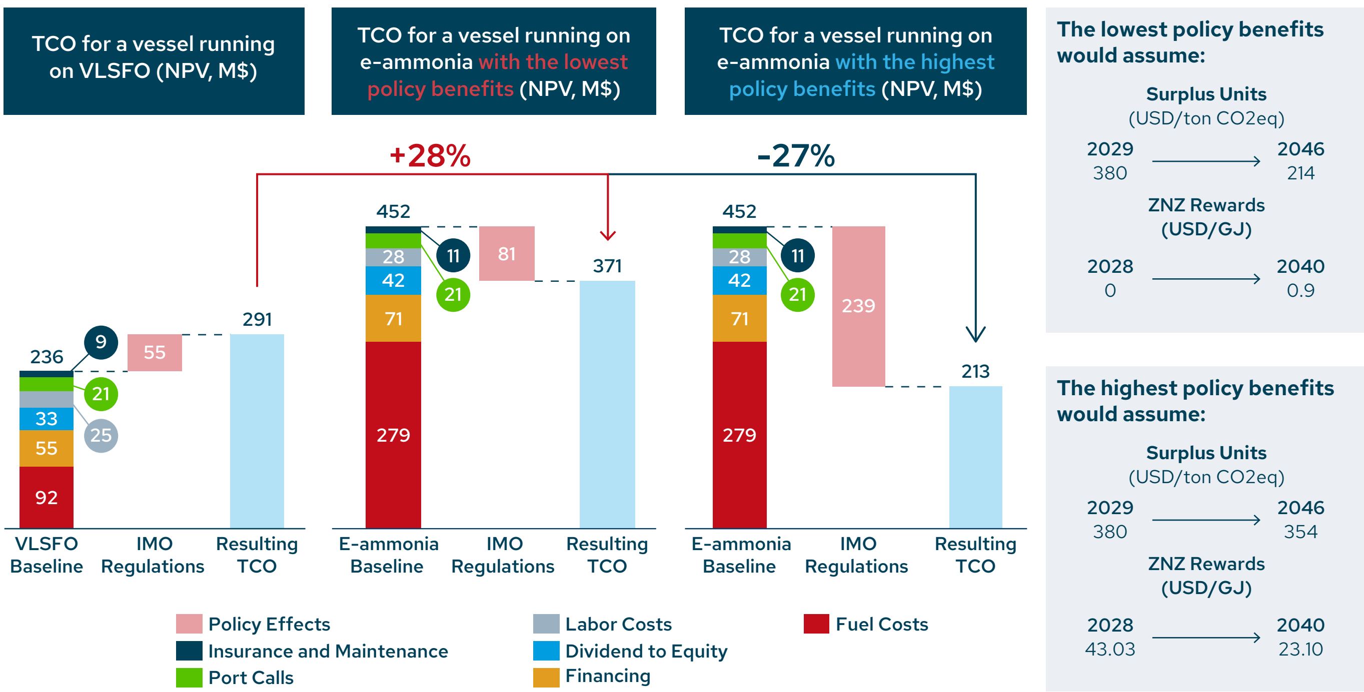


Figure 13: *The range of total cost of ownership gap impacts, depending on the assumptions. RMI analysis (2025).*

Under the medium scenario (right-side graph in Figure 14), green ammonia is expected to be around 10% cheaper than VLSFO. However, tweaking just one of the assumptions—from no surplus offset to surplus offset—makes ammonia just over 15% more expensive (middle graph in Figure 14).

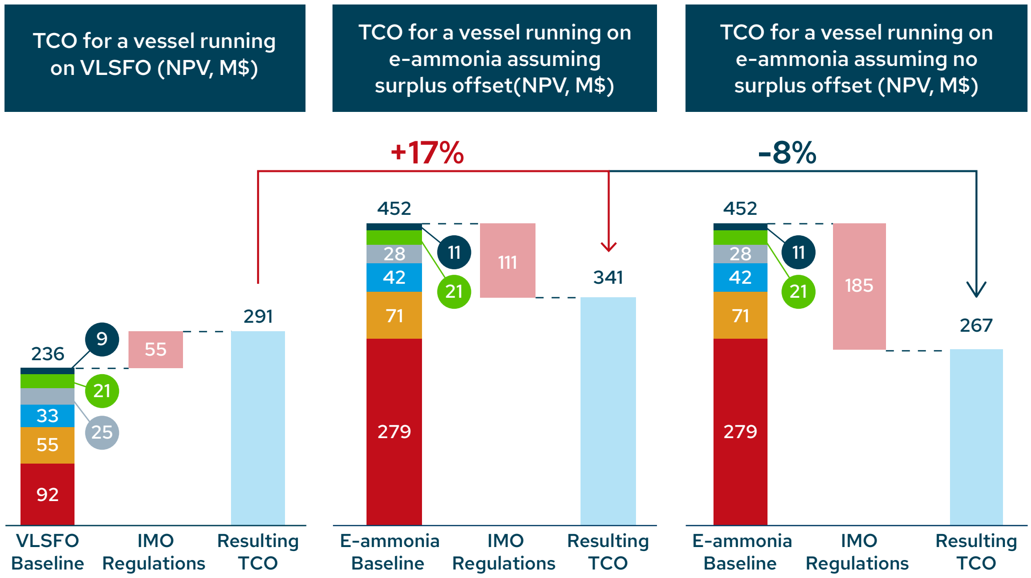


Figure 14: *Cost gap impacts with medium policy benefits assumptions (right side). RMI analysis (2025).*

For the end customer in the medium scenario, the delivered cost of iron ore transported on the route would translate to somewhere between 3% more expensive and 1% cheaper than VLSFO, assuming a surplus offset is considered and the costs are fully passed through (see Figure 15).

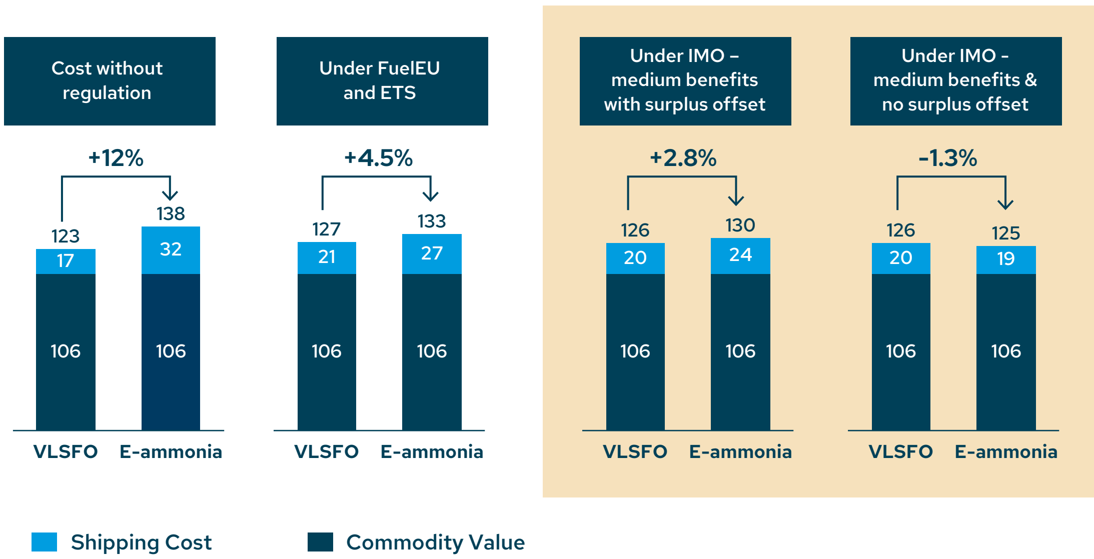


Figure 15: *Change in landed value of iron ore with EU and IMO regulations. RMI analysis (2025)*

Finally, should the EU regulations be continued alongside the NZF, this could make this route even more attractive for deploying ammonia-powered ships, as it potentially introduces a possibility for double application of penalties and allows for doubling the surplus unit generation and rewards from both regulations. This would strengthen the business case for the South Africa-Europe iron ore route and set it apart from other major iron ore routes, such as Australia-East Asia or Brazil-China.

The assessment proves that, if designed thoughtfully and implemented in a timely manner, regulatory measures could help narrow the total cost of ownership gap and strengthen the long-term business case for adopting green ammonia. However, in the corridor's 2029-2035 timeline, these regulatory frameworks are limited and, on their own, **unlikely to fully close the cost gap**. Furthermore, several uncertainties embedded in the timeline for the rollout of these regulations may hinder early investments. The corridor business case will therefore hinge on how these two mechanisms develop, and whether additional support mechanisms at the local or regional level are implemented.

Commercial barriers for implementation

While fuel costs will have the biggest impact on the corridor's business case, additional commercial barriers are expected to impact the feasibility of green ammonia uptake on the South Africa-Europe iron ore route. These are the result of the mismatch between commercial practices currently employed on the route and what is needed to enable new investments in green ammonia fuel production, bunkering infrastructure, and vessels.

Currently, iron ore is shipped on a tramp basis, and conventional fuel is purchased on the spot market or via short-term agreements (<one year). Meanwhile, green ammonia production projects require large-scale, long-term (over six years, preferably ten) offtake agreements to secure FID. This flexible approach to contracting is not compatible with the long-term demand certainty required to justify investments in the corridor.

In addition, the cost, risks and rewards associated with investing in the corridor would not be evenly distributed across the value chain under business-as-usual (BAU) contracting. For the corridor to successfully liftoff, new commercial arrangements and tools that address these barriers will be needed.[19]

19 See Appendix G for full list of barriers

Moving towards corridor implementation

With the results of the feasibility assessment as the starting point, a roadmap was developed in consultation with stakeholders to identify the major enablers for corridor implementation by 2029 (see Figure 17). A risk analysis was conducted, where milestones were assessed on a scale from 'on track' to 'high risk', reflecting the urgency of action required for each one.[20]

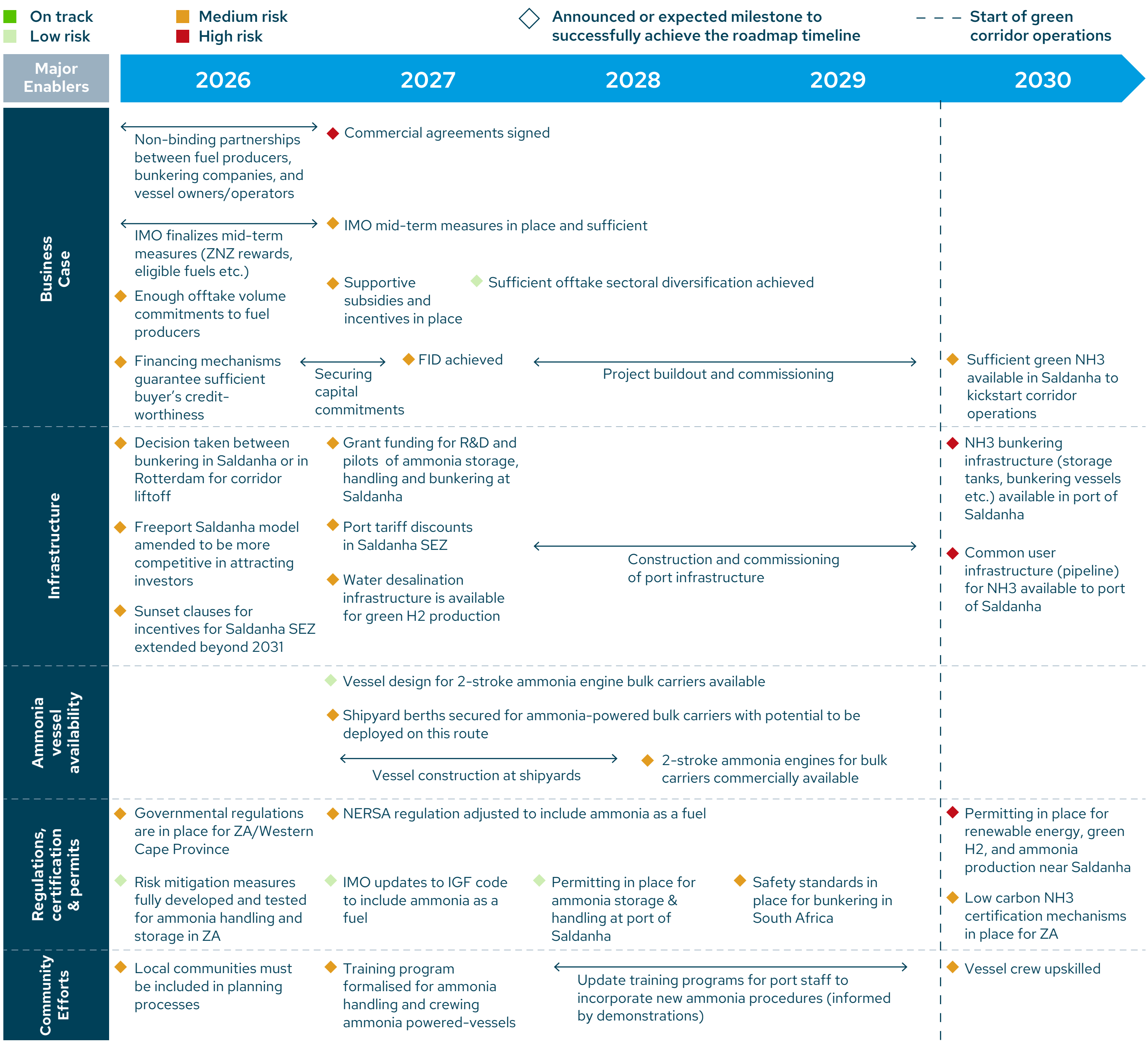


Figure 17: *Roadmap to 2029 deployment. RMI analysis (2025) based on existing analyses[21] and input from consortium members and external stakeholders within the research, energy and maritime fields*

20 See Appendix H for full risk register

21 Western Cape Green Hydrogen Strategy and Roadmap (2024); Green Hydrogen Investment Profiles South Africa Industrial Development (2025); Salgmann, Rico; Weidenhammer, Maximilian; Englert, Dominik. 2024. Creating a Green Marine Fuel Market in South Africa. World Bank (2024); SAMSA Bunkering Code of Practice (2024); DNV, IMO Safety Committee: MSC 109 (2024)

The areas of business models, infrastructure, and regulation all featured high-risk milestones. Key interdependencies included risk–reward sharing, infrastructure investment, global and national regulatory frameworks, certification, and permitting for ammonia handling. Based on these insights, several priority actions to enable corridor launch by 2029 and full decarbonisation by 2035 were identified at the private and public levels. These include:

- establishing strategic partnerships and new commercial arrangements;
- advancing an enabling regulatory landscape; and
- pursuing policy support and funding for infrastructure development.

Strategic partnerships and new commercial arrangements for green ammonia uptake and adoption

For the transition to ammonia-powered vessels to take off, innovative commercial arrangements are required that can facilitate the production and uptake of green ammonia and share costs, risks, and rewards among value chain members, including cargo end-users. Several innovative commercial arrangements and tools have been assessed based on their ease of implementation and ability to overcome barriers related to volume and duration of offtake agreements, buyer creditworthiness, and risk and reward sharing.[22]

There is a broad consensus among the consortium that cost, risk, and reward sharing on the vessel and cargo owner side could potentially be bridged through strategic partnerships and contractual arrangements. This could be through a medium to long-term charterparty with contractual clauses that ensure an even distribution of costs, risks, and rewards among the involved parties. However, the major challenge identified in the study lies in fuel production and bunkering, which require substantial upfront investments, sufficient offtake volumes, sector diversification, and enough time for production projects to get off the ground. Therefore, making joint investments in fuel production and bunkering infrastructure, investigating demand aggregation opportunities, and collaborating on relevant financing to enable these investments are priorities.

Two value chain configurations with the potential to address these challenges were shortlisted and evaluated (see Figure 18). In both configurations, costs, risks, and rewards are spread among parties along the value chain through either a vertical special purpose vehicle (SPV)[23] (Option 1) or through two distinct SPVs or contracting setups (Option 2) combined with a third-party matchmaker to aggregate fuel demand.

22 See Appendix I for full list

23 A separate legal entity created by an organisation usually established for a specific objective. It has its own legal status, assets and liabilities.

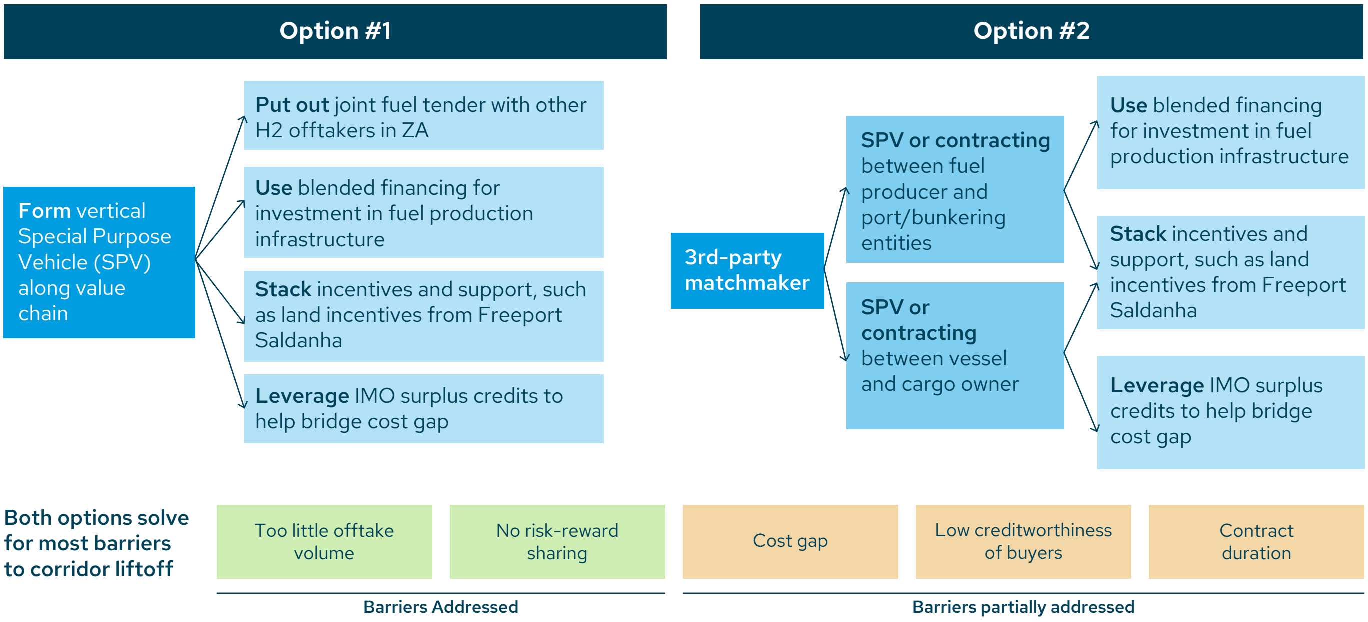


Figure 18: *Two potential pathways to corridor liftoff. RMI analysis (2025).*

The third-party matchmaker could be a government entity or port along the corridor. It would run requests for proposals and facilitate the purchase and sale of green ammonia to the corridor stakeholders, as well as to other South African offtakers, to help kickstart the market and maximise the utilisation of infrastructure. With visibility of the fuel volumes required and available, the matchmaker will be able to provide insights into the overall state of the market and help ensure that the corridor stakeholders secures the lowest-cost fuel through competitive bidding. The matchmaker's insights would also support accurate estimation of infrastructure requirements, thereby instilling confidence in both corridor operations and the wider green ammonia market.

Furthermore, the pace of progress between fuel producers and bunkering entities on one hand, and vessel and cargo owners on the other may differ, with the latter potentially ready to deploy ships before production and bunkering facilities are developed in Saldanha Bay. This, again, suggests the need for a phased approach, in which Rotterdam initially serves as the corridor's primary bunkering location while signalling commitment to and supporting the build-out of green ammonia bunkering in Saldanha Bay. Finally, establishing a SPV is legally complex, requires close coordination and alignment among the stakeholders involved, and is likely to involve long lead times, especially for a vertical SPV involving the full value chain. These complexities risk delaying corridor implementation and reinforce Option 2, where two separate contracting set ups are established, as the more likely scenario to be explored further by the consortium.

The collaborative split in contracting reflected in Option 2, with the vessel and cargo owner on one side, and the fuel and port/bunkering entities on the other, is also reflected in real world examples to date:

- Two ammonia dual-fuel Newcastlemax bulk carriers on order, expected to be chartered between BHP and COSCO for five years
- One ammonia dual-fuel Newcastlemax bulk carrier on order, expected to be chartered between Fortescue and CMB.TECH (duration unknown)

- Three ammonia dual-fuel Newcastlemax bulk carriers on order, expected to be chartered between MOL and CMB.TECH for 12 years
- Memorandum of understanding between Oceania, NH3 Energy Ltd, and Pilbara Ports Authority to deploy a bunker vessel at port by 2028 using locally sourced fuel
- Strategic partnership between Itochu, Clean Ammonia Bunker Shipping, and Maritime Port Authority of Singapore (MPA) to deploy an ammonia bunkering vessel by 2027

Advancing an enabling regulatory landscape

The timely development of green ammonia production, bunkering, and common-user transportation infrastructure in Saldanha is a significant challenge to the corridor and South Africa's long-term opportunity as a producer and supplier of green ammonia. Whilst South Africa has various initiatives working towards increasing hydrogen viability,[24] further action is needed to create an enabling environment for infrastructure development.

Key risks to corridor implementation include delayed or hindered permitting for renewable electricity and green ammonia production, a failure to navigate environmental and other governmental laws, and the need to develop certification mechanisms. While the South African government has introduced special permitting provisions and designated Renewable Energy Development Zones, streamlined permitting within Saldanha's Special Economic Zone (SEZ) and the development of green ammonia certification are critical for successful corridor liftoff. In addition, bunkering infrastructure—including storage, tanks, and vessels for ship-to-ship (STS) bunkering—is not yet available nor proven viable in Saldanha due to insufficient investments and a lack of demonstration projects. Importantly, common user infrastructure, including pipelines to move ammonia to the port, is either not yet operational or unreliable in service.

Some of these risks could potentially be mitigated by co-investing in bunkering infrastructure in exchange for preferential use rates and consulting stakeholders who can help ensure compliance with local and national regulation and streamline permitting. Stakeholderscould also form strategic partnerships with local authorities like Transnet National Port Authority (TNPA) on the identification and implementation of common user and bunkering infrastructure as well as partner with companies that have executed ammonia STS bunkering trials in other parts of the world. Engaging with national regulators[25] to highlight the necessity of streamlined permitting and certification mechanisms is also critical, as is building on existing partnerships like the one between Western Cape Energy Resilience Programme and South Africa's Eskom on renewable electricity permitting and green hydrogen development.

Finally, for bunkering in South Africa to take off, safety standards must be in place and ammonia must be recognised as a fuel as part of the National Energy Regulator of South Africa (NERSA) regulation. The availability of a

24 South Africa's creation of Special Economic Zones (SEZ), Hydrogen Society Roadmap, Hydrogen Valleys and the SA-H2 fund

25 Including, but not limited to, National Energy Regulator of South Africa (NERSA), Department of Mineral Resources & Energy (DMRE), Department of Trade, Industry and Competition (DTIC).

skilled workforce and community acceptance are also key considerations that can hinder corridor deployment, where local community engagement and upskilling are key to ensure equitable benefits and minimise opposition to infrastructure build out. Engaging local communities by, for instance, developing a community benefits plan [26] and employing local workers in corridor operations, are some mitigators to be explored. Here, support from and collaboration with South Africa's governmental bodies including South African Maritime Safety Authority (SAMSA), NERSA, Department of Transport (DOT) and South Africa's Just Energy Transition Investment Plan (JET IP) to define necessary safety regulatory frameworks and design a curriculum for hydrogen skills training is essential.

Pursuing policy support and funding for infrastructure development

For the corridor to be operational by 2029 and ensure the wider success of South Africa's green hydrogen economy, additional policy incentives targeting the cost gap, such as supply and demand-side subsidies (e.g., production tax credits and contracts for difference, are required. While the cost gap is a common issue across all green corridors and hydrogen-based fuel production projects, this issue is exacerbated in the Global South by **poor access to funding and the high cost of capital**.

Since this corridor connects South Africa with the European Union, bilateral policy action that leverages emerging collaborations between the two regions is a particularly promising avenue to improve the corridor's access to funding. The **EU Global Gateway Green Shipping Corridors** programme offers one such opportunity. The programme connects European ports with strategic global ports and supports countries transitioning to alternative fuels. While crucial details such as the scope and scale of funding are yet to be determined, Global Gateway intends to facilitate investments for the bunkering or production of green fuels in the partner countries. Another relevant programme is the European Hydrogen Bank, a supply-side incentive scheme for hydrogen-based fuels, which, among other things, aims to support the international production and import of hydrogen. H2Global, a double auction mechanism that offers combined demand and supply-side support, presents another avenue to close the 2029-2035 cost gap. It recently launched a shipping initiative to activate early demand within the sector.

As higher capital costs in South Africa is likely to increase infrastructure development costs in Saldanha and potentially price the country out of an early transition, support in reducing the financing costs is crucial. A blended financing vehicle, combining public or philanthropic development capital[27] with private capital to mobilise investments in green infrastructure, could be an attractive option for the corridor. Further opportunities lie in leveraging the country's SEZs. Freeport Saldanha offers a flexible structure designed to attract private investment but could improve its competitiveness further

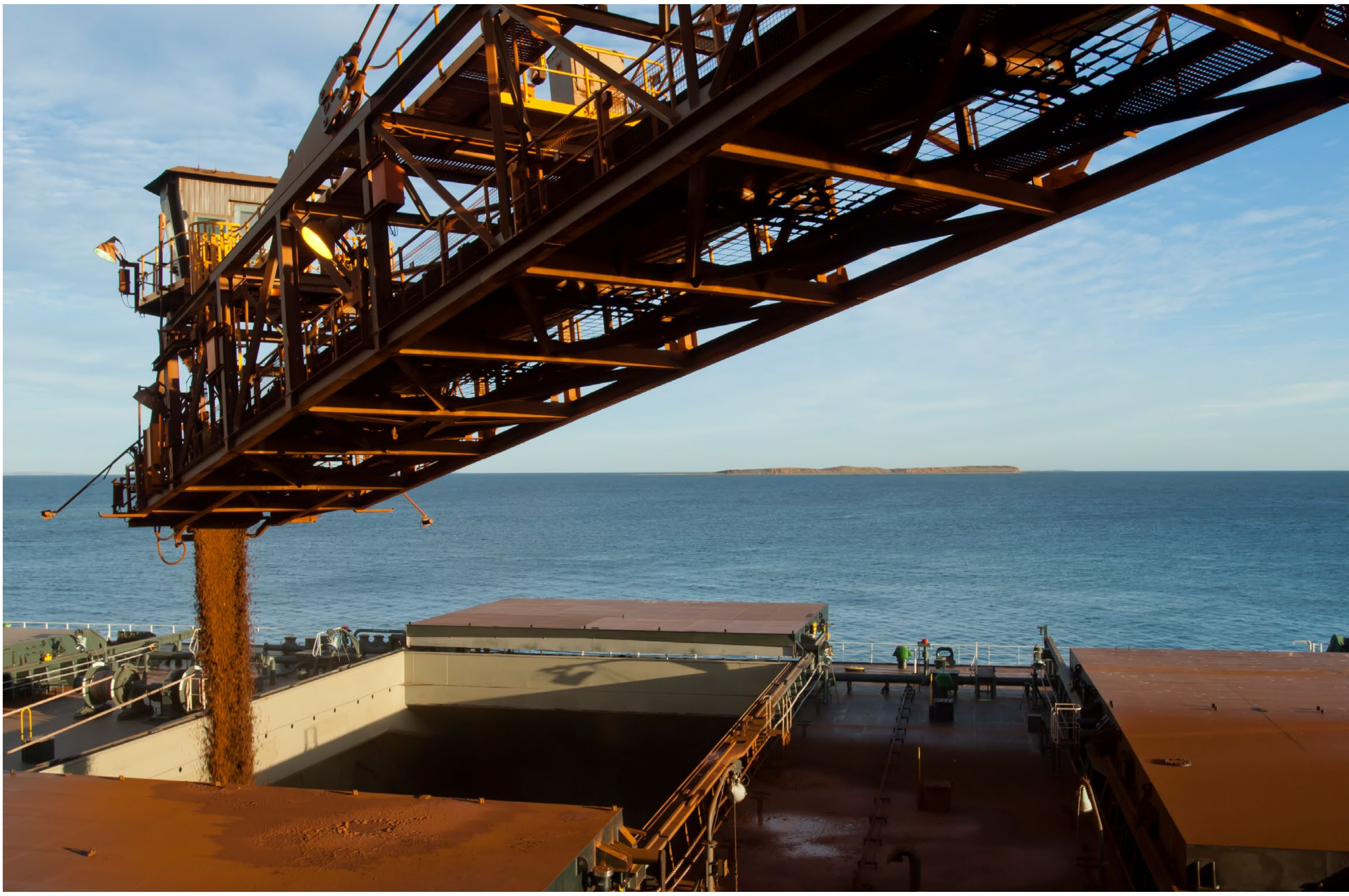
26 A written plan detailing how a developer or entity will provide tangible benefits to a host or surrounding community, often as a condition of receiving funding or approval for a project

27 Examples include SA-H2 Fund, SDG Namibia One Fund with funding from European Investment Bank, Development Bank of Southern Africa, EU bodies

through more favourable tax incentives and port tariff discounts to support the development of production and bunkering infrastructure. While signalling interest in utilising Saldanha's SEZ incentives for corridor implementation and operations is important, the incentives are currently set to expire in 2031.

Accessing these policy measures requires the corridor to reach a more mature development stage. As for the immediate next steps, early work towards harmonising the country's hydrogen certification framework with that of the EU can facilitate access to future EU funding. In parallel, raising awareness around how the corridor and shipping decarbonisation at large can support local, national, and regional governments in reaching their strategic objectives is key to laying the ground for future support. For South Africa, the co-benefits of the corridor would include accelerating the local hydrogen economy, contributing to local job creation, diversifying the economy, and futureproofing strategically located ports and key export commodities. Examples of progress already happening in this space that can be built upon is South Africa's commitment to develop a maritime decarbonisation action plan and its process of expanding its flagship status to reduce reliance on foreign flagged vessels and strengthen domestic supply chains.

Finally, engaging with policymakers at the IMO level on the importance of adopting and implementing the NZF and designing the remaining details in a way that supports a just and equitable transition is paramount. This includes advocating for channelling a portion of revenues into hydrogen-based fuel production projects in the Global South, which would further enhance South Africa's position as a competitive hub for hydrogen production and bunkering.



Final recommendations and next steps

The opportunity to decarbonise the South Africa-Europe iron ore green corridor is within reach. Private and public stakeholders should take the following key actions to make the corridor a reality by 2029 and enable the development of South African fuel production and bunkering:

- **Create an enabling contracting environment to optimally and fairly allocate risks and rewards across the value chain.** The members of the South Africa-Europe iron ore green corridor consortium are well-positioned to continue coordinating on a non-commercial basis while exploring viable commercial arrangements with stakeholders for the successful implementation of the corridor. This includes signalling intentions to, and sharing the feasibility findings with, steelmakers to bring in an end-use company, evaluating Port of Rotterdam's bunkering timelines and the corridor's opportunity to carry out a pilot in 2029, collaborating with South African stakeholders to advance fuel production and bunkering infrastructure investments in Saldanha, and exploring what opportunities there are to set up a third-party demand aggregator.

- **Engage with South African governmental bodies and industry stakeholders to raise awareness of the corridor and the need for an enabling policy environment.** This includes demonstrating how the corridor's development can benefit local and national strategic objectives in Saldanha and wider South Africa, advocating for an enabling regulatory environment for corridor operations (including, but not limited to, streamlined permitting, certification mechanisms, safety standards, upskilling, and community engagement) and partnering with local industry stakeholders that are interested in investing in or supporting the corridor's advancement.

- **Mobilise funding and incentives for corridor infrastructure that will contribute to Saldanha's hydrogen hub and port development.** This includes exploring relevant policy support, blended finance mechanisms, and other market-making mechanisms to stimulate the green ammonia market and uptake in the shipping sector.

Appendices

Appendix A. European iron ore demand projections and opportunities for South Africa

The European steel industry is in the midst of a transition which is expected to affect future iron ore trade between South Africa and Europe. Years of overcapacity, price volatilities in energy and raw materials, and global competition continue to impact the industry's profitability, with steel companies looking to adopt more cost-efficient production methods. Scrap-based steel production is growing with increased scrap availability (see figure A2), and rising carbon prices (see figure A4), to ensure a 1.5C aligned industry. This is also expected to incentivise a shift from coal-based Blast Furnace (BF) production to green hydrogen-based Direct Reduction of Iron (DRI) production (see figure A3). These developments are assumed to affect the types and volumes of traded iron ore on the South Africa-Europe route, where demand for high-grade iron ore (DR-grade) – a critical input material for DRI production – is expected to increase.

Three different demand scenarios have been put forward to reflect how these trends could impact iron ore demand in Europe out to 2035:

- **Business as usual (BAU):** Steel assets switch to lowest-cost technology at each major investment decision
- **1.5 aligned BAU:** Steel demand same as BAU, but with higher share of DRI-production, using high-quality (DR-grade) iron ore, instead of coal-based BF production
- **Faster abatement:** High rate of scrap-based recycling and material efficiencies.

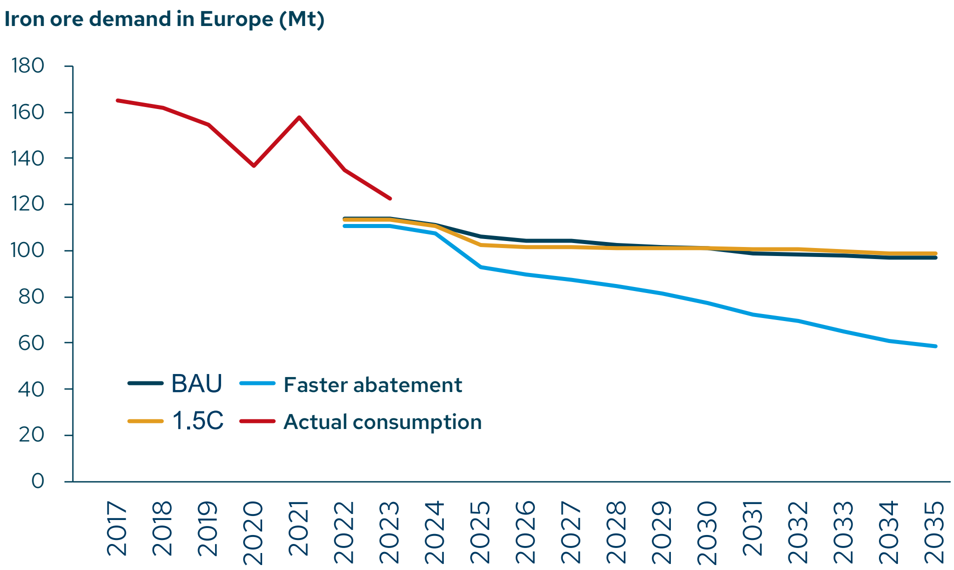


Figure A1: *Iron ore demand in Europe (Mt) according to the three demand scenarios. RMI analysis (2025) based on MPP Steel Transition Strategy (2022) and World Steel.*

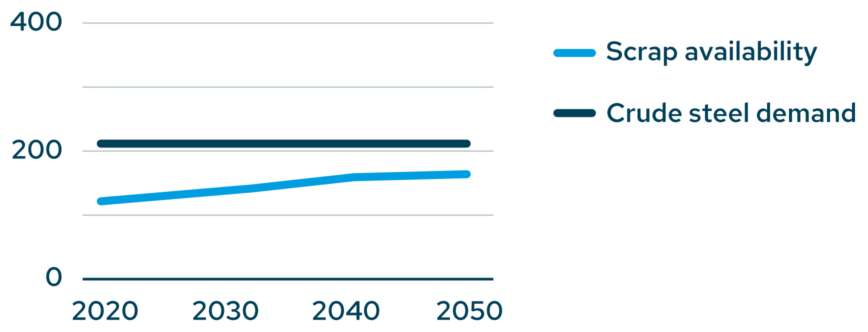


Figure A2: *BAU demand for crude steel and scrap availability in Europe (Mt) based on MPP Steel Transition Strategy (2022).*

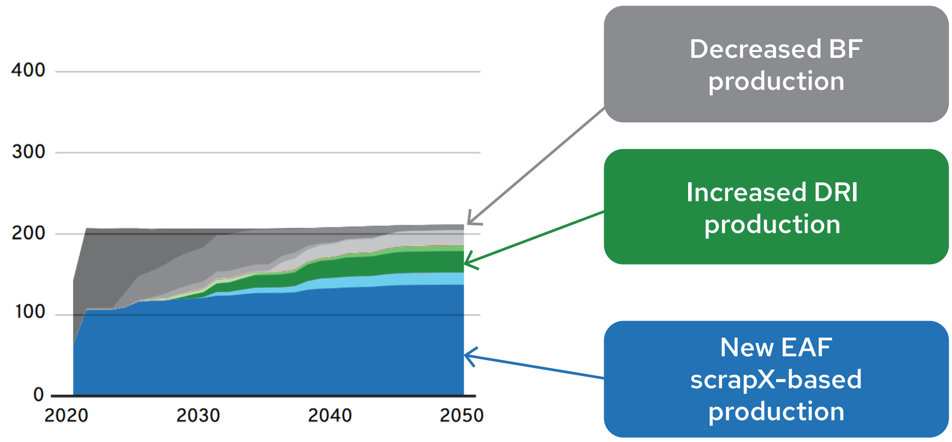


Figure A3*: Steel production by process in Europe with 1.5C aligned scenario (Mt) based on MPP Steel Transition Strategy (2022).*

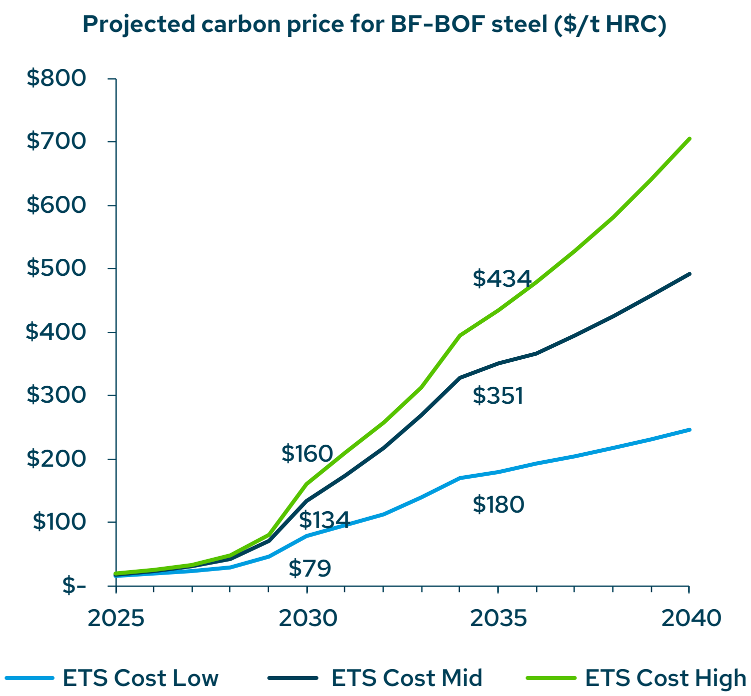


Figure A4: *RMI analysis (2025) based on carbon price projections from BloombergNEF and Enerdata.*

Despite the changing steel landscape, the South Africa-Europe iron ore trade is projected to continue out to 2035 and beyond (see graph A1), with future trade patterns depending on South Africa's ability to meet the growing demand for DR-grade iron ore and green hydrogen-based steel production. South Africa—home to DR-grade iron ore reserves, cost-competitive production prices and high renewable energy abundances—is well positioned to meet this opportunity through two key pathways:

1. Classified as a potential low-cost producer with comparable costs to competing exporters into Europe,[28] South Africa could capture market share for DR-grade pellets. To increase exports to Europe, South Africa can add new mining capacity or redirect exports from another region to European markets (e.g., as Chinese iron ore demand declines, exports can be diverted to Europe). To meet growing demand for DR-grade pellets in Europe, additional investments in beneficiation and pellet production facilities would be required.

2. South Africa could become a green iron supplier (hot briquetted iron), using domestically produced green hydrogen to produce and export a more finished iron product to Europe. The latter would ultimately decrease demand for iron ore in Europe, but could be offset by new green iron imports, enabling South Africa to produce and export a higher value commodity (reducing the impact of green ammonia fuel costs on the per tonne of green steel) while accelerating decarbonised steelmaking in Europe.

Appendix B. Route and bunkering specific assumptions

Iron Ore Demand Scenario Values	Route Assumptions	Fuel Assumptions

2035 iron ore scenarios
• Low: 6.8 Mtpa
• Medium: 11.3 Mtpa
• High: 26.9 Mtpa
	• Port of Saldanha to Rotterdam
	• 6166 nautical miles (one way)
	• Vessel type: 210 Newcastlemax
	• Vessel capacity: 210,000 DWT
	• Length: 53 days
	  ◦ Laden: 24 days
	  ◦ Port: 7 days
	  ◦ Ballast: 22 days
		Laden
		• Cruising speed: 11.5 knots
		• Laden fuel consumption: 61 mt/day NH3 (3 mt/day LSGO pilot fuel)
		Ballast
		• Cruising speed: 12.5 knots
		• Ballast fuel consumption: 58 mt/day NH3 (3 mt/day LSGO pilot fuel)

• Considers current and projected ZA-EU iron ore export market
• Analysis based on 2035 values:
  ◦ **High**: 1.5 degree C scenario
  ◦ **Med**: BAU scenario based on historical values
  ◦ **Low**: Faster abatement scenario + 30% new DRI steel from HBI imports
	• Existing route for iron ore trade from ZA to EU
	• Vessel type is the new technology frontier for the industry
	• Previous shipments used the capsize bulk carriers (~DWT of 180-182k) Assumes each vessel can do 6 roundtrip voyages per year (illustrative)
		• 2 x 3,000m^3 ammonia tanks per vessel
		• Newcastlemax vessels can do 2 roundtrip voyages before bunkering (est. ~25,000 nm)
		• Pilot fuel consumption would be (for 6.8, 11.3, and 26.9 Mtpa DWT scenarios, respectively): 4.5, 7.4, 17.7 ktpa lsgo

Figure B1: *Fuel demand analysis assumptions based off market research including consortium input. RMI analysis (2025)*

28 Canada, Brazil and Sweden

Iron Ore Demand Scenario Values

2035 iron ore scenarios

- Low: 6.8 Mtpa
- Medium: 11.3 Mtpa
- High: 26.9 Mtpa

- Considers current and projected ZA-EU iron ore export market
- Analysis based on 2035 values:
  - **High**: 1.5 degree C scenario
  - **Med**: BAU scenario based on historical values
  - **Low**: Faster abatement scenario + 30% new DRI steel from HBI imports

Route Assumptions

- Port of Saldanha to Rotterdam
- 6166 nautical miles (one way)
- Vessel type: New Baltic Standard Cape
- Vessel capacity: 182,000 DWT
- Length: 53 days
  - Laden: 24 days
  - Port: 7 days
  - Ballast: 22 days

- Existing route for iron ore trade from ZA to EU
- Vessel type is the standard for the industry

Fuel Assumptions

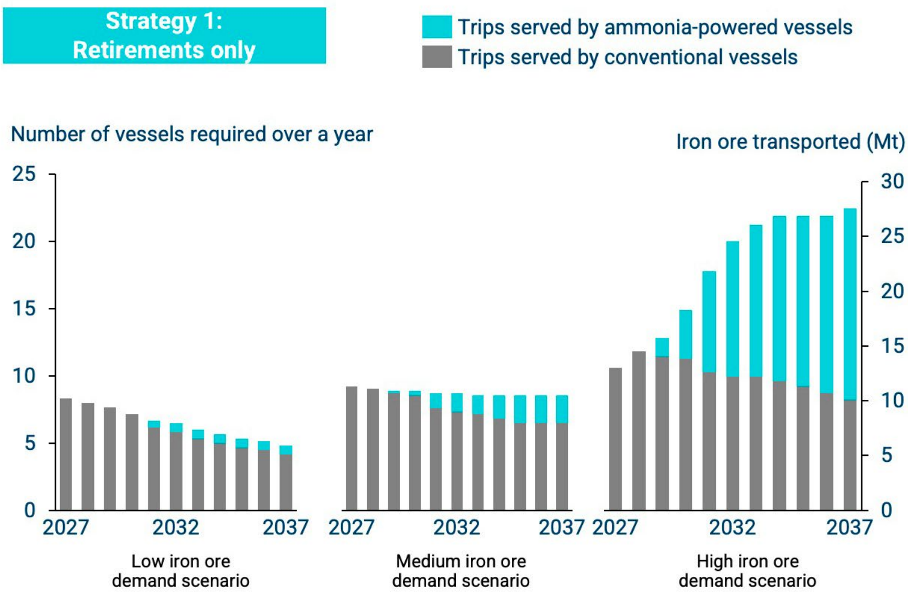
Laden
- Cruising speed: 11 knots
- Laden fuel consumption: 60.8 mt/day NH3-eq. (1.5 mt/day LSGO pilot fuel)

Ballast
- Cruising speed: 12 knots
- Ballast fuel consumption: 60.8 mt/day NH3-eq. (1.5 mt/day LSGO pilot fuel)

- Based on industry input on New Baltic Standard Cape Bulk Carriers
- Converts MFO fuel into NH3-equivalent for ammonia-powered vessels
- Pilot fuel consumption would be (for 6.8, 11.3, and 26.9 Mtpa DWT scenarios, respectively): 2.6, 4.3, 10.2 ktpa lsgo

***Figure B2:** Fuel demand analysis assumptions based off market research including consortium input (cont.). RMI analysis (2025)*

Appendix C. Vessel deployment strategies



When a vessel reaches the end of **its 20-year lifetime**, it has to be replaced.

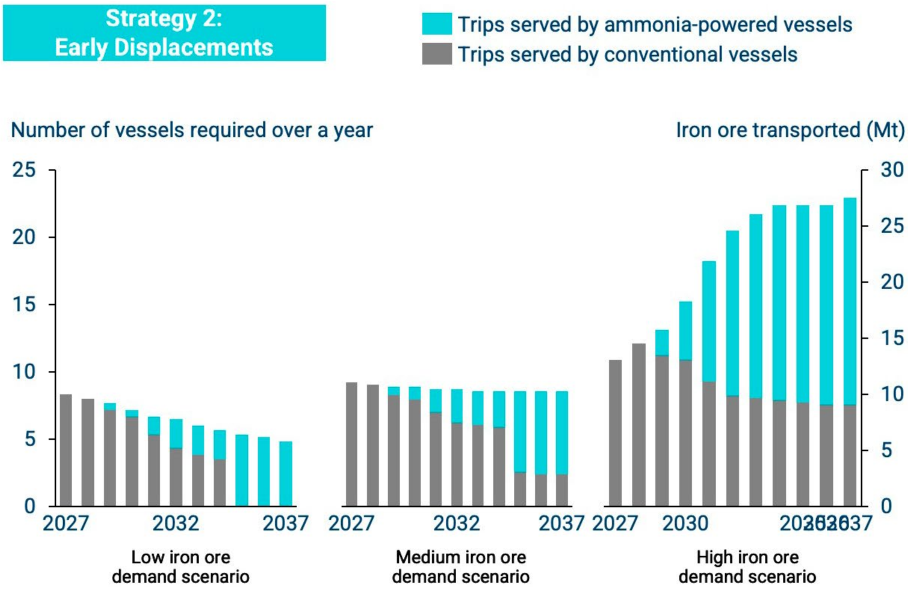
Ammonia-powered vessels are delivered **as soon as 2029**; they operate trips from retired vessels and from increased demand if green vessels supply permits.

Discussion

Under any scenario, **only replacing retired vessels would decarbonize no more than 15-55% of yearly trips by 2035:**

- Average age of vessel fleet is less than 10 years, limiting turnover
- Due to tramping behavior on the corridor, each retirement displaces only one trip, being less impactful than dedicating vessels to the corridor

***Figure C1:** Vessel deployment strategy 1. 'Retirements only'. Retirements alone would not be sufficient to decarbonise the corridor in the next 10 years under any iron ore demand scenario. RMI analysis (2025)*



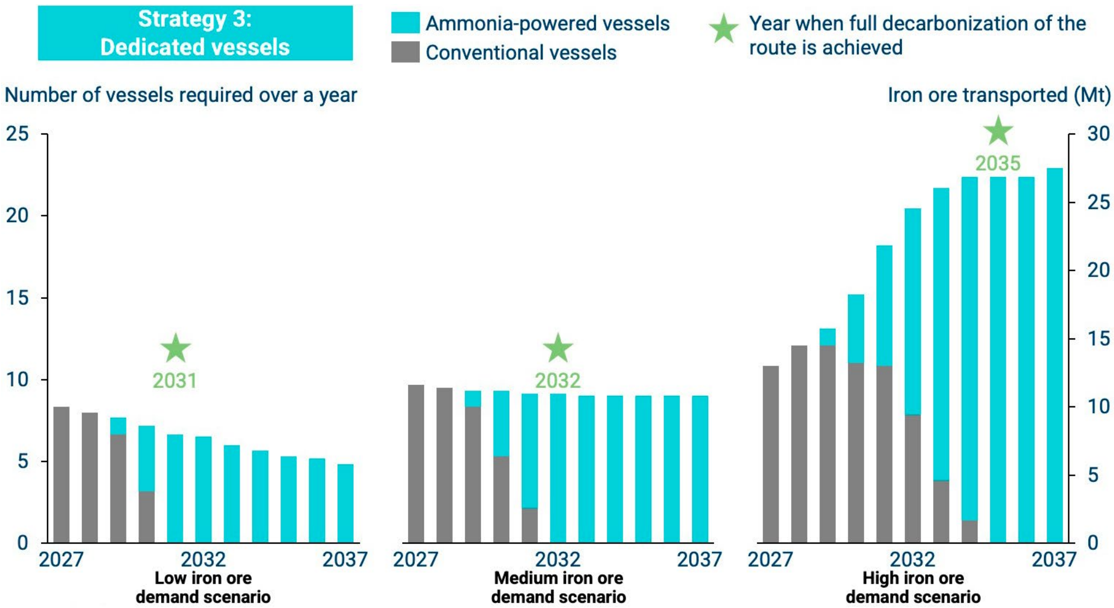
To accelerate the corridor's decarbonization, **vessels are displaced from the route earlier, after 12 years of operations.** They are assumed to be displaced to other routes where green ammonia is not available.

Discussion

Depending on the scenario, **early displacements would decarbonize 66-100% of yearly trips by 2035:**

- Early displacements would enable to replace most of current fleet by 2035
- That would be enough to decarbonize all trips in the low demand scenario
- In the high scenario, newbuilt conventional vessels have to be deployed to meet the increased demand

Figure C2: *Vessel deployment strategy 2. 'Early displacements'. Resorting to early displacements would decarbonise most of the corridor trips under any iron ore demand scenario. RMI analysis (2025)*



To accelerate further the corridor's decarbonization, newbuilt ammonia-powered vessels are **operating exclusively the corridor** (6 roundtrips per year)

Discussion

Under any scenario, **having vessels operating exclusively the corridor would decarbonize 100% of yearly trips by 2035**

Figure C3: *Vessel deployment strategy 3. ´Dedicated vessels´. Adding a dedicated fleet to the retirement strategy would decarbonise the corridor by 2035 under any demand scenario. RMI analysis (2025)*

Appendix D. Regional and international fuel sourcing locations for bunkering in Saldanha and Rotterdam respectively

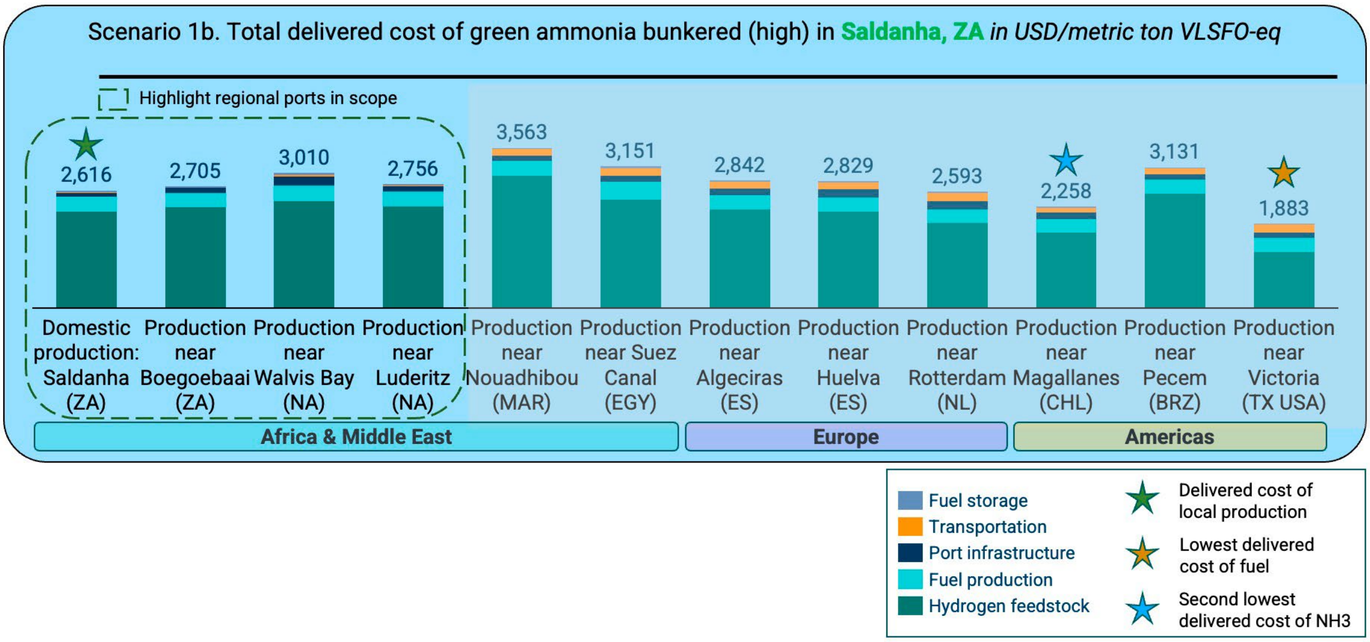


Figure D1: *Total delivered cost of green ammonia bunkered (high) in Saldanha, ZA. Delivered costs can be further reduced across all fuel production locations when increasing bunkering volumes due to scale. RMI analysis (2025)*

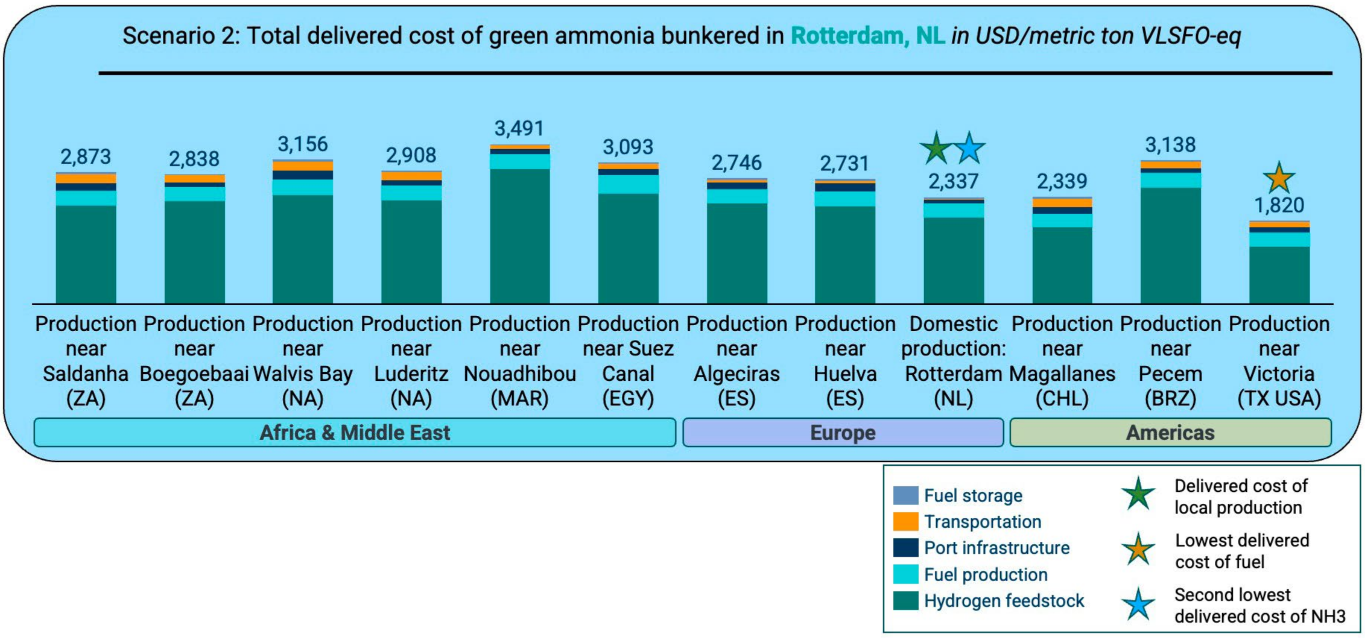
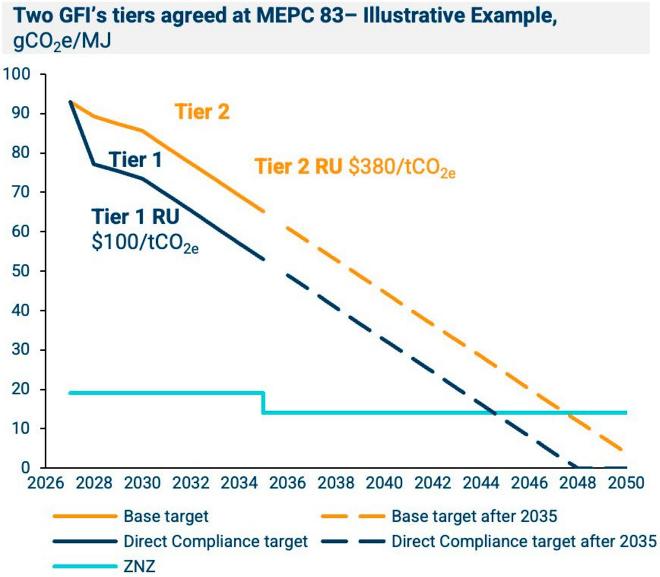


Figure D2: *Total delivered cost of green ammonia bunkered in Rotterdam, NL. Texas imports provide lowest cost option in Rotterdam, with domestic production being the next best option. RMI analysis (2025)*

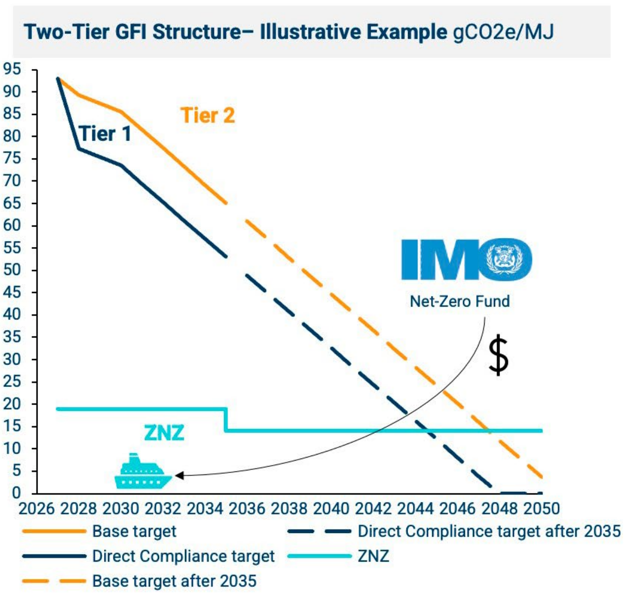
Appendix E: The global -tier fuel standard plus credit mechanisms



- Z-factors are established through 2035, with the Committee tasked to define Z-factors for the 2036–2040 period by January 1, 2032.
- The **Base Target** establishes a base for maximum allowable GHG intensity for fuels used onboard with a **large penalty for non-compliance.**
- The **Direct Compliance Target** establishes a secondary threshold for achieving compliance which has a **smaller penalty for non-compliance.**
- Ships operating **below direct compliance** level can generate credits called **Surplus Units (SUs).**
- The **ZNZ line** establishes a threshold for fuels that are aligned with the IMO's longer term objectives and sets a minimum **eligibility for additional reward** to encourage the uptake of these fuels in the short-term.

Note: 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.

Figure E1: *The two GFIs agreed at MEPC83 (illustrative example). The outcome of the MEPC 83 was a compromise: a two-tier fuel standard plus a credit trading mechanisms to facilitate compliance. The slide have been adapted from RMI, UCL, Race to Resilience, Race to Zero; MEPC 83-WP.11*



- The **ZNZ reward** is a compensation provided by the IMO Net-Zero Fund above and beyond any Surplus Unit generation.
- The reward is intended to **incentivize the early adoption of long-term, scalable zero-emission solutions** that are not yet cost-competitive.
- Funding for the reward is expected to come from revenue generated from noncompliant vessels purchasing **Tier 1** and **Tier 2** Remedial Units (RUs).

*Notes: **GFI**: Greenhouse Gas Fuel Intensity. **RU**: Remedial Units. **SU**: Surplus Units **ZNZ** fuels: Zero and Near-Zero-emission fuels. *Attained annual GFI is the average of all fuels used on board a ship in a given calendar year. The two-tier trajectories from 2025 to 2050 are based on a linear path. GFI based on a Well-to-Wake basis.*

Figure E2: *Two-tier GFI structure (illustrative example). The compromise proposal includes a reward for fuels that fall below the ZNZ threshold to incentivize uptake of long-term scalable fuels. The slide have been adapted from RMI, UCL, Race to Resilience, Race to Zero; MEPC 83-WP.11*

Appendix F: Policy uncertainty and assumptions around rewards and surplus units

The ZNZ reward aims at compensating for the **cost gap ($/MJ) between fossil fuels and the lowest cost e-fuels**
Its calculation method has not been finalized yet. 2 possible methods might be considered, following IMO negotiations *:

Illustrative purposes only; Not meant to reflect potential prices

1 **E-fuel rewards add on to the revenue received from selling SU to fully bridge the cost gap**
Then the e-fuel reward would depend on the SU price (see illustrative scenarios A to C slide 10) and would **bring the lowest cost e-fuel (be it e-ammonia, e-methanol, etc.) to parity with LSFO**

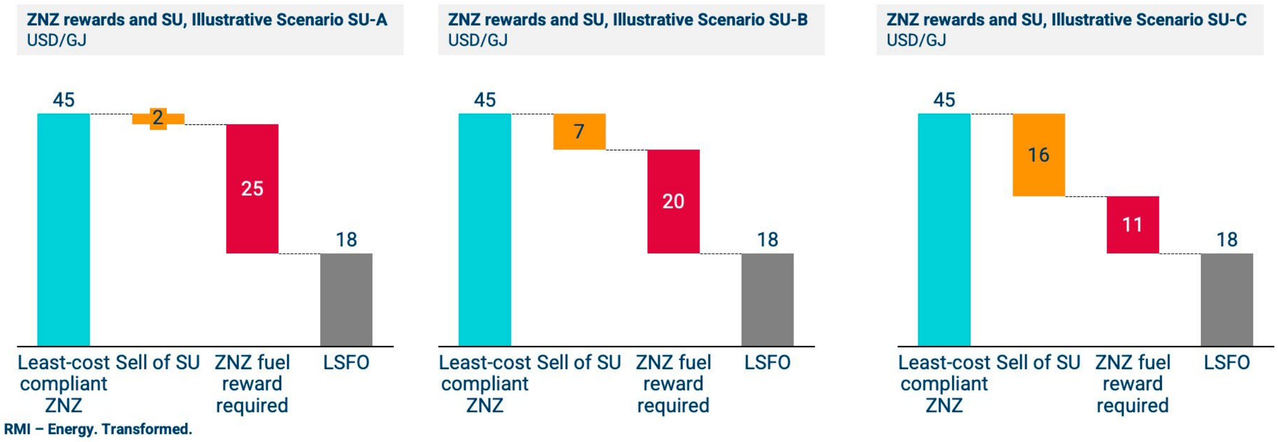


Figure F1: *Policy uncertainty: The exact rewards from the IMO regulations are still uncertain; they could be added to surplus units in 2 ways (1/2).*

The ZNZ reward aims at compensating for the **cost gap ($/MJ) between fossil fuels and the lowest cost e-fuel**
Its calculation method has not been finalized yet. 2 possible methods might be considered, following IMO negotiations *:

Illustrative purposes only; Not meant to reflect potential prices

2 **E-fuel rewards fully bridge the cost gap, without being offset by SU**
Then the e-fuel reward is fixed, and **higher than in the 1st calculation method** : SU revenue is an additional benefit that makes the lowest cost e-fuel cheaper than LSFO by as much as SU price available on the market

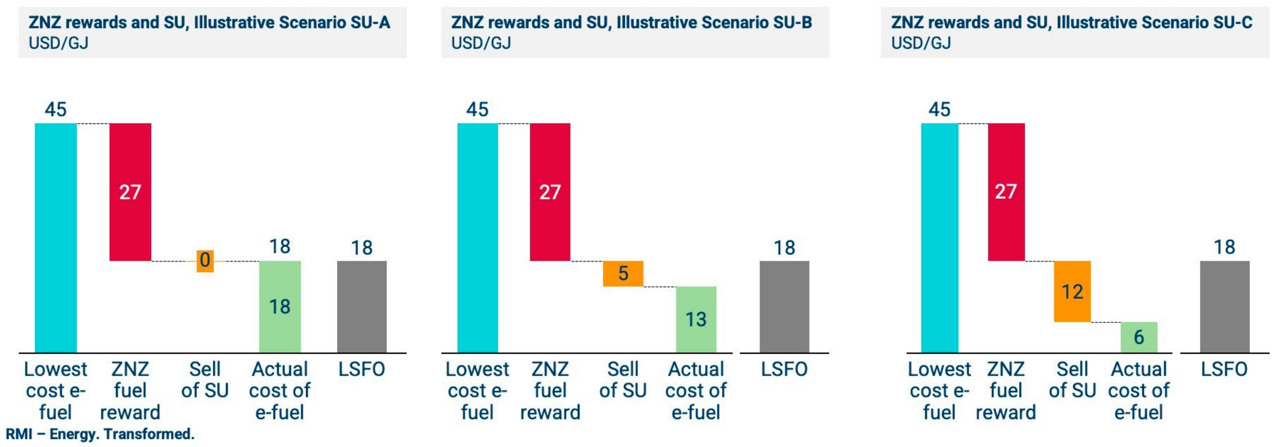


Figure F2: *Policy uncertainty: The exact rewards from the IMO regulations are still uncertain; they could be added to surplus units in 2 ways (2/2).*

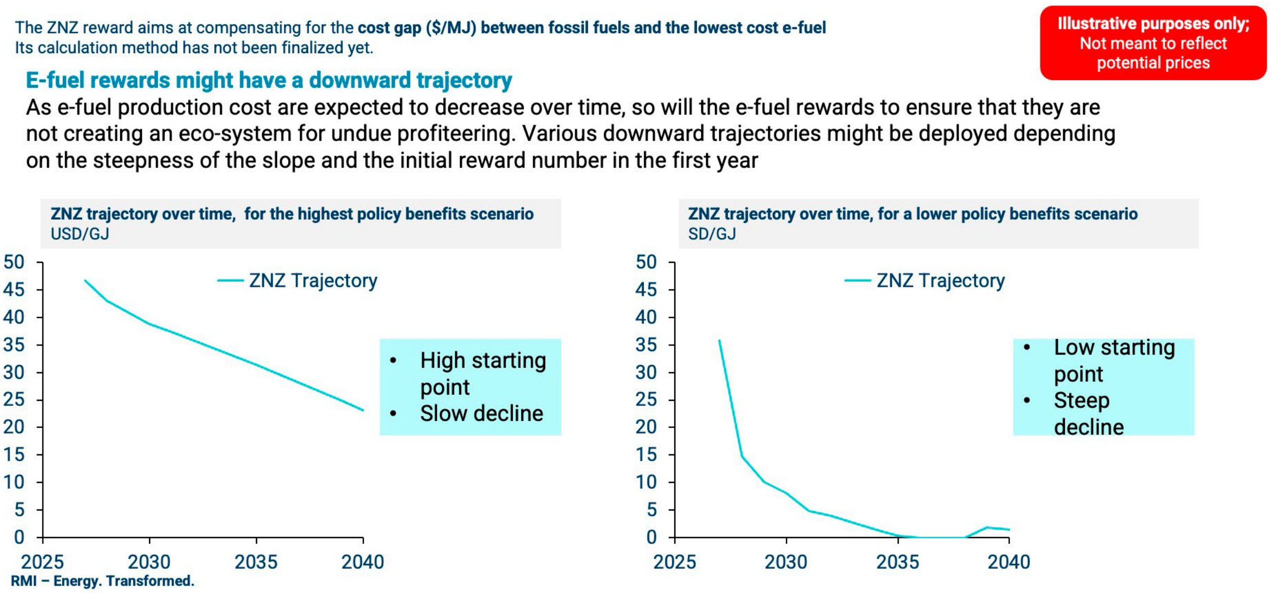


Figure F3: *Policy uncertainty: To reflect decreasing e-fuel production cost and resulting cost gap, the IMO is likely to implement declining rewards*

Appendix G: Key commercial barriers to corridor implementation

Most prominent barriers* to green ammonia uptake according to consortium members:

Cost gap: Insufficient willingness to pay among offtakers for a premium cost of zero-emissions fuel

Volume: Producers aim at building plants with large capacity to create economies of scale and to cover ~65% investment upfront by offtake; there is insufficient willingness to commit to high volumes among fuel buyers to avoid significant balance sheet commitments

Duration: Misaligned desired offtake contract length between producers and offtakers (e.g., 10 years vs. <1 year)

Low buyers' credit-worthiness: Offtakers need to be creditworthy in the eyes of project investors to provide reassurance they will fulfil their obligations; though very few shipowners possess an investment-grade credit rating

No risk/reward sharing: Corridor operations requires significant upfront investments which are not equitably distributed along the value chain; similarly, policy benefits (IMO rewards, etc.) are not distributed along the value chain under business-as-usual contracting

**Note: The barriers listed have been limited to those that may be solvable by novel business model configurations*

Figure G1: *Several barriers to contracting between fuel producers and buyers need to be addressed for corridor liftoff. RMI analysis (2025).*

Appendix H: Roadmap risk register and assessment

Key: On track | Low Risk | Medium Risk | High Risk

Enablers	No. (#)	Milestones	Associated Risk	Overall Risk Assessment	Mitigation Strategy	Stakeholders Involved
Business Models	1	Enough offtake volume commitments for fuel producers	Insufficient willingness to commit to high volumes among fuel buyers		Offtake agreement is signed by the consortium (SPV or similar multilateral contracting language) or a 3rd party matchmaker (like port demand aggregation)	Corridor Consortium Port of Saldanha as a 3rd party matchmaker Other offtake sectors (potentially)
	2	Sufficient offtake sectoral diversification achieved	Lack of diversification makes a project vulnerable to sector risk		Consortium works with other offtakers to bring in 1 to 2 other sectors for sectoral diversification	Corridor Consortium Other offtake sectors (potentially)
	3	Supportive subsidies and incentives in place	SEZ* program suffers from policy inconsistencies and limited private sector involvement		Consortium signals interest/ intent to build out infrastructure and use of ammonia with Saldanha SEZ and Western Cape gov't to push implementation of incentives	Corridor Consortium Western Cape Province Gov't InvestSA
	4	IMO mid-term measures in place and sufficient	IMO measures delayed/ legally contested		Write to IMO negotiators from their own country or industry interest groups to emphasize that IMO regulations should be more favorable to green corridors, and to advocate that JET fund granted to SA could be directed to this corridor	Corridor Consortium IMO
			Insufficient reward system		Consortium actively participates in IMO comment periods to share industry perspectives on reward system for green corridors	Corridor Consortium IMO
	5	Financing mechanisms guarantee sufficient buyer's credit-worthiness	Few ship operators are likely to meet stringent creditworthiness requirements		Consortium leans on creditworthiness of other parties included in contracting (such as cargo owner)	Corridor Consortium
	6	Commercial Agreements Signed	Complexity and high number of agreements between multiple parties required		Proactive legal counsel from the consortium's legal departments and learn from best practices from other green shipping corridors/ other industries (renewables, EPCM, etc.) with multilateral contracting	Corridor Consortium
			Uneven Risk Distribution		SPV or similar contracting structure formed to spread risk-reward among members. Consortium risk allocation framework created, where risk and investment is calculated on a member-level basis. Parties involved in green corridors tend to be progressive and first-movers, so might be more willing to take on more risk	Corridor Consortium
	7	FID achieved	Insufficient financing and minimum volume committed for fuel production project to take Final Investment Decision (FID)		Pre- and feasibility studies to derisk project for FID in addition to concessional financing. Financing through public-private partnerships (PPP) or blended finance vehicles in addition to government incentives (DMRE)	Corridor Consortium ZA Gov't Department of Mineral Resources and Energy (DMRE) Blended Finance Vehicle(s) (e.g., Development Bank of Southern Africa (DBSA))
	8	Sufficient green NH3 available in Saldanha/ Western Cape Province to kickstart operations	There is not enough green ammonia available as marine fuel for corridor at a competitive price		Consortium members create contingency plans for procuring cost-competitive ammonia, including alternative options along the ZA-EU corridor, such as Rotterdam, Namibia, or Spain	Corridor Consortium

Figure H1: *Risk register and assessment (1/4). RMI analysis (2025)*

Key: On track · Low Risk · Medium Risk · High Risk

Enablers	No. (#)	Milestones	Associated Risk	Overall Risk Assessment	Mitigation Strategy	Stakeholders Involved
Infrastructure	9	Freeport model* amended	The freeport lacks competitiveness to attract investors		ZA Department of Trade, Industry, and. Competition (DTIC) to implement the World Bank SEZ reform recommendations	Freeport Saldanha Western Cape gov't ZA Government (DTIC) InvestSA
	10	Port tariff discounts in Saldanha SEZ	The freeport lacks competitiveness to attract investors		Consortium signals interest/ intent to build out infrastructure and use of ammonia with Western Cape Province gov't to include port tariff discounts in SEZ	Corridor Consortium InvestSA ZA Department of Trade, Industry, and. Competition (DTIC) Western Cape Province Gov't
	11	Water desalination infrastructure is available for green H2 production	Costs are not managed to invest in desalination plant to support green hydrogen production		Strategic partnerships and governance with local authority, TNPA and the support of DoT and DMRE; SPV and transactional agreements need to be explored	Corridor Consortium Transnet National Ports Authority (TNPA)/Local Authorities ZA Dep't of Mineral Resource and Energy (DMRE)Department of Transport (DoT)
	12	Grant funding for R&D and pilots	Saldanha lags behind other ports to prove the feasibility of ammonia storage and bunkering at the port		Freeport Saldanha to work with CSIR to secure grant funding to implement necessary ammonia infrastructure	Council for Scientific and Industrial Research (CSIR) Freeport Saldanha
	13	Sunset clauses amended to beyond 2031	The different policy incentives provided to Saldanha for infrastructure investment expire too early to benefit corridor launch		Freeport Saldanha and TNPA to work bilaterally with the Western Cape Province Gov't to amend current expirations for policy incentives	Freeport Saldanha Transnet (TNPA) Western Cape Province Gov't
	14	Decision taken between bunkering in Saldanha or in Rotterdam for corridor liftoff	Infrastructure and safety standards in Saldanha will not be in place to enable fuel production and bunkering by 2029		Consortium could bunker in Rotterdam, that is planning on building ammonia bunkering infrastructure, has piloted ammonia bunkering, and implemented updated PGS-12 code on safe storage and handling of ammonia	Corridor Consortium Port of Rotterdam Local Bunkering Company
	15	NH3 bunkering infrastructure (storage tanks, bunkering vessels, etc.) available	Ship-to-ship (STS) bunkering infrastructure not available and/or viable in Saldanha due to weather patterns or insufficient investment		Consortium invests in local company to facilitate bunkering infrastructure in return for lower rate for use and ensure compliance with local/ national ZA laws; Consortium collaborates with TNPA on implementation; Utilize infrastructure financing	Corridor Consortium ZA Gov't Department of Mineral Resources and Energy (DMRE) Blended Finance Vehicle(s) (e.g., Development Bank of Southern Africa (DBSA))
	16	Common user infrastructure (CUI) (pipeline, etc.) to move ammonia to the port	CUI for moving ammonia from production facility to Freeport Saldanha is not ready-to-move or unreliable in service		Identify necessary CUI for corridor; Strategic partnerships and governance with local authority, TNPA and the support of CEF, SFF and DoT to build out necessary CUI infrastructure	Corridor Consortium

Figure H2: *Risk register and assessment (2/4) RMI analysis (2025)*

Key: On track Low Risk Medium Risk High Risk

Enablers	No. (#)	Milestones	Associated Risk	Overall Risk Assessment	Mitigation Strategy	Stakeholders Involved
Regulations, Certifications & Permits	17	IMO updates to IGF* code to include ammonia	IGF code excludes/ provides stipulations around ammonia as a fuel		Amendments to IGC code to use ammonia as fuel adopted in 2024, in effect 2026. Amendments to IGF code for ammonia expected start of 2027	IMO Marine Safety Committee (MSC)
	18	Safety standards in place for bunkering in ZA	Safety standards delayed for ammonia bunkering in ports in ZA		Learn from other global pilots for bunkering with ammonia at ports; Strategic partnership with Western Cape Province government, DMRE, and TNPA to ensure compliance with stringent safety standards	Corridor Consortium Transnet (TNPA) ZA Gov't Department of Mineral Resource and Energy (DMRE) Western Cape Province Gov't
	19	Governmental regulations are in place for ZA/Western Cape	Projects delayed by not correctly navigating environmental and other governmental laws		Partner with local companies to ensure compliance with local, province, and national regulations relating to environmental and other regulations. Reach out to local and national governments to emphasize what the corridor could bring for the SA economy (job creation etc.) for different industries, and that more advantageous regulations would make the ZA iron ore more competitive	Corridor Consortium Local Company
	20	NERSA regulation adjusted to include ammonia as a fuel	Ammonia is not considered as a fuel and cannot be used as such in ZA		Strategic partnership with the Government of South Africa and TNPA to amend NERSA regulations to include ammonia as fuel	Corridor Consortium Government of ZA Transnet (TNPA)
	21	Risk mitigation measures fully developed and tested	Safe handling and bunkering of ammonia not ready for commercial operations		Strategic partnership with DMRE, Western Cape Province government and TNPA to implement safety measures outlined in Province's Green Hydrogen Strategy and Roadmap	Corridor Consortium ZA Gov't Department of Mineral Resource and Energy (DMRE) Transnet (TNPA) Western Cape Province Gov't
	22	Permitting in place for ammonia storage & handling at Port of Saldanha	Permitting delayed for transport, storage, handling, and bunkering ammonia		Partner with local company to streamline permitting within the Saldanha SEZ; Freeport Saldanha as a Consortium Member to support streamlined permitting related to corridor operations	Corridor Consortium Freeport Saldanha Local Company
	23	Permitting in place for renewables and fuel production	Permitting for renewable electricity and fuel (green hydrogen and ammonia) delayed/hindered		Partner with local company to streamline permitting within the Saldanha SEZ; Freeport Saldanha as a Consortium Member to support streamlined permitting related to corridor operations	Corridor Consortium Eskom SA Local Company
	24	Low carbon NH3 certification in place	ZA certification not developed/recognized to verify emissions intensity of fuel in time		Government of South Africa to learn from other emerging economies building out green hydrogen/ammonia certifications in addition to harmonizing with requirements for IMO and/or EU certifications	Gov't of South Africa/ SAMSA IMO European Commission

Figure H3: *Risk register and assessment (3/4) RMI analysis (2025)*

Key: On track | Low Risk | Medium Risk | High Risk

Enablers	No. (#)	Milestones	Associated Risk	Overall Risk Assessment	Mitigation Strategy	Stakeholders Involved
Ammonia Vessel Availability	25	Vessel design for 2-stroke engine bulk carriers available	IGF code excludes/ provides stipulations around ammonia as a fuel	Low Risk	Signal intent/sign MOU to procure dual-engine 2-stroke vessel(s) and form strategic partnership with manufactures	Corridor Consortium Vessel Manufactures
	26	Shipyard berths secured	Safety standards delayed for ammonia bunkering in ports in ZA	Medium Risk	Signal intent/sign MOU for need of berth and form strategic partnership with shipyard	Corridor Consortium Shipyard
	27	2-stroke ammonia engines for bulk carriers commercially available	Projects delayed by not correctly navigating environmental and other governmental laws	Medium Risk	Signal intent/sign MOU to procure 2-stroke ammonia engine(s) and form strategic partnership with manufactures	Corridor Consortium Engine Manufactures
Community Efforts	28	Training program formalized for ammonia labor (i.e., handling and crewing ammonia powered-vessels)	Skills needed to safely handle/store ammonia in addition to crew an ammonia powered vessel not available in a timely fashion	Medium Risk	Identify types of necessary programs needed for green H2 economy; Design and launch a regional or national ZA hydrogen skills development initiative	Labour organizations Local communities ZA Gov't Department of Education Regional Province ZA Governments Council for Scientific and Industrial Research (CSIR) Technical Vocational Education and Training (TVET) colleges Just Energy Transition Investment Plan (JETIP) Office
	29	Local communities must be included in planning processes to ensure equitable benefits and minimize opposition	Local communities are reluctant to infrastructure buildout	Medium Risk	Employ local workers in corridor operations, engage in feedback often and incorporate it. Develop a community benefits plan for Saldanha	Labour organizations Local communities Corridor Consortium Council for Scientific and Industrial Research (CSIR) Western Cape Province Government Just Energy Transition Investment Plan (JETIP) Office
	30	Vessel crew upskilled	Not enough available ZA crew to ammonia vessel based on training and upskilling	Medium Risk	Consortium uses nationally/ regionally recognized training programs to hire labor with safe handling of hydrogen/ammonia credentials	Labour organizations Local communities Corridor Consortium Western Cape Province Government

Figure H4: *Risk register and assessment (4/4) RMI analysis (2025)*

Appendix I: Evaluation of business model suitability

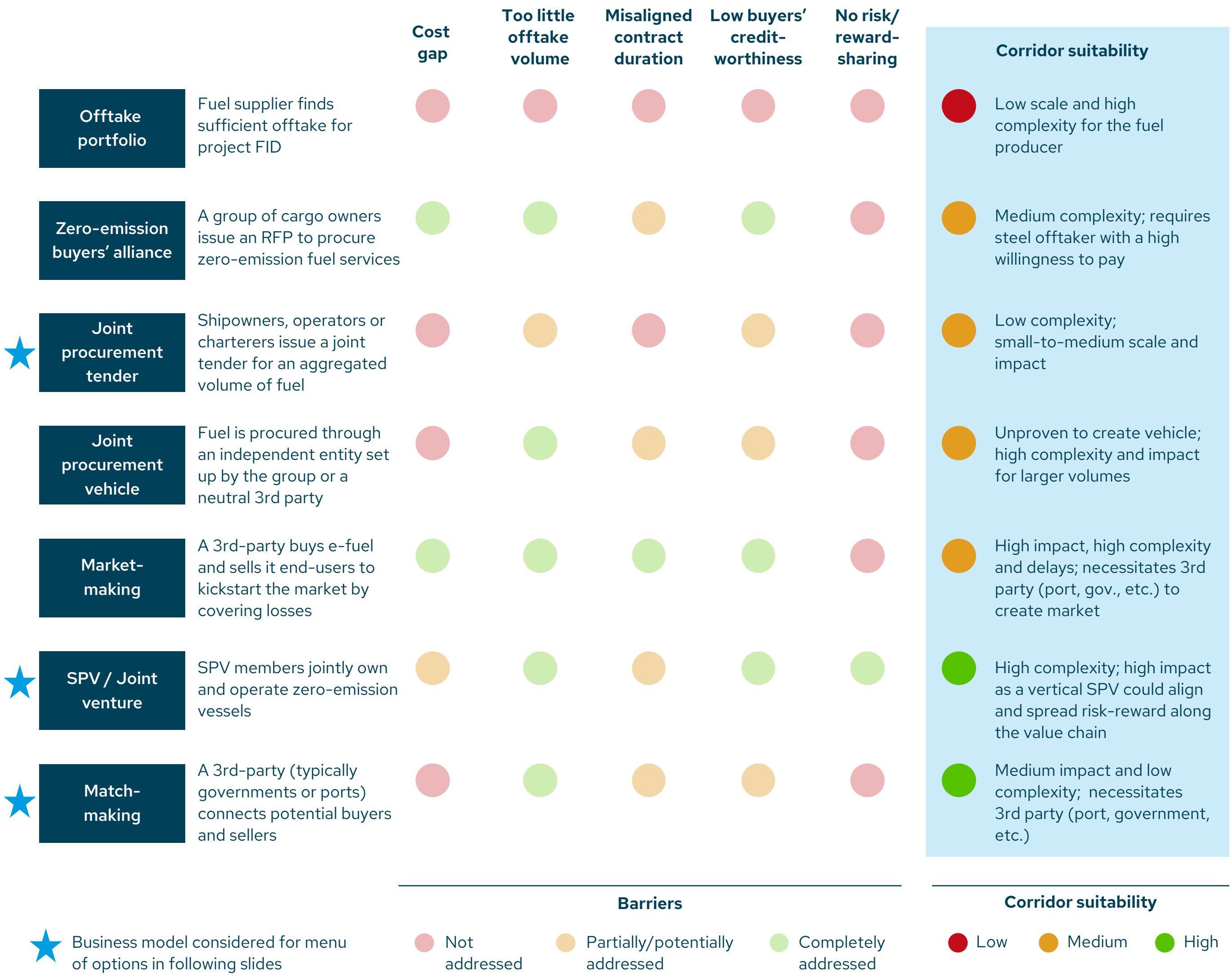


Figure I1: *Novel business models can address barriers; the consortium can draw on them to form the foundation for successful corridor implementation. RMI analysis (2025).*

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