

ROK-US PCTC Green Corridor

Feasibility Summary Report

Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping



Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

Table of Contents

Executive Summary.....	1
Introduction.....	1
Alternative fuels supply chain.....	1
Strategically located project.....	1
Vessel decarbonization pathway	2
Cargo demand dynamics.....	2
Green Premium.....	2
Regulatory Feasibility	3
Cost Assessment.....	3
Incremental Cost Analysis	3
CO ₂ Abatement.....	4
Role of Public Funding	4
Summary.....	4

Disclaimer

Fonden Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping ("MMMCZCS") Methodology ("Methodology") has been used for this Feasibility Study. The Methodology is provided "as is" without warranty of any kind, express or implied, including but not limited to accuracy, completeness, merchantability, or fitness for a particular purpose. Any reliance on the Methodology is strictly at the user's own risk. While every reasonable effort has been made to ensure its accuracy and effectiveness, the Center makes no guarantees. It shall not be liable for any errors, omissions, or damages arising from its use. The Methodology should not be construed as strategic, investment, legal, or other advice. Users of the Methodology are encouraged to exercise their own judgment and seek professional advice as needed. Compliance with applicable laws, regulations, and standards, including, but not limited to, those related to safety, environmental protection, design requirements, and competition law, remains the sole responsibility of the user.



Executive Summary

The Republic of Korea (ROK)–United States (US) Pure Car and Truck Carrier (PCTC) Green Corridor Feasibility Study evaluates the potential for a zero near zero-emission maritime transport route between South Korea and the U.S. Pacific Northwest (See figure 1). The corridor would use green methanol as marine fuel, supporting The ROK's climate goals and the Clydebank Declaration.



Figure 1: Shipping Route

Ulsan Port is identified in this study as a strategic bunkering hub due to its chemical logistics infrastructure and proximity to the ROK's largest automotive export base. However, realizing this potential depends on securing a stable supply of green methanol—currently unavailable domestically and expected to be imported primarily from China.

The project is technically and regulatorily feasible, but further development and maturation is needed before Final Investment Decision. Regulatory challenges include the absence of finalized guidelines for ship-to-ship bunkering and simultaneous operations (SIMOPS) involving methanol-fueled vessels. Engagement with local authorities and adherence to IMO standards are essential to ensure safe and scalable implementation.

Economically, the corridor faces a \$900 million cost gap over 30 years, when comparing the as-is fossil-based activity with the future methanol-based activity. While the per-vehicle cost increase is modest (~\$70 per car), the analysis indicates that public funding of approximately \$200 million would be needed to catalyze private investment.

The corridor is projected to reduce CO₂ emissions by 1.84 million metric tons, supporting the ROK's role in sustainable shipping and offering a replicable model for future green corridors.

Introduction

The Republic of Korea and the United States have jointly explored the feasibility of establishing a green shipping corridor for PCTC vessels. This initiative supports the decarbonization of maritime

transport and aligns with both countries' climate commitments under the Clydebank Declaration.

The corridor connects major ports in the ROK (Ulsan, Masan) with those in the U.S. Pacific Northwest (Tacoma), using green methanol as an alternative marine fuel. The project aims to reduce greenhouse gas emissions from vehicle exports while fostering innovation and infrastructure development in clean shipping.

Alternative fuels supply chain

In the context of the Republic of Korea–United States PCTC Green Corridor, the availability of green methanol is a critical factor for enabling low-emission maritime transport. Unlike some regions with domestic production capacity, the ROK currently does not produce commercial-scale volumes of green methanol suitable for marine bunkering. The lack of control over fuel production poses a significant risk.

As a result, the project assumes reliance on imported green methanol. China is presently the only producer of green methanol at a scale and maturity level that allows for commercial export. Therefore, the feasibility study was conducted under the realistic assumption that green methanol would be sourced from China and transported to the ROK for use in bunkering operations.

This import-based supply model introduces several considerations that affect both cost and operational feasibility:

- **Logistics and transport costs** must be factored into the overall fuel pricing.
- **Supply stability** depends on long-term contracts and policy continuity in the exporting country.
- **Infrastructure readiness** in the ROK, particularly at Ulsan Port, is essential to receive, store, and distribute imported green methanol safely and efficiently.

While domestic production may become viable in the future, the current strategy focuses on building a robust alternative supply chain through regional partnerships (China, Australia and more). This approach ensures that the ROK participates in the early-stage deployment of green corridors while laying the groundwork for the future expansion of its own green fuel ecosystem.

Strategically located project

Ulsan Port is uniquely positioned to serve as a key node in the Republic of Korea–United States PCTC Green Corridor. As the ROK's largest industrial support port, Ulsan has long been a hub for chemical handling and petrochemical logistics, including methanol for non-maritime uses, as well as bunkering the first dual-fuelled container vessels. This existing infrastructure and the skill-set provide a solid foundation for scaling up green methanol bunkering operations, supporting maritime decarbonization.

The port's strategic relevance is further enhanced by its proximity to the ROK's most extensive automotive manufacturing facilities.



Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

Ulsan serves as a significant export base for finished vehicles, particularly to North America, making it a logical focal point for assessing alternative fuel bunkering in the context of the automotive sector's Scope 3 emissions reduction goals.

Additionally, Ulsan is closely linked to Busan Port, one of the world's busiest container terminals. Currently, conventional fuel oil used for bunkering in Busan and Ulsan is imported or locally refined in Ulsan for bunkering to vessels in the two ports. This existing supply chain underscores Ulsan's role as a de facto bunkering gateway for Busan and positions it to support future green fuel distribution across vessel types.

Recent developments further reinforce Ulsan's strategic importance. In 2023, Ulsan Port hosted the world's first green methanol bunkering operation for a container ship, marking a milestone in global maritime decarbonization. The port authority is actively collaborating with international partners—including Hamburg and Busan—on clean fuel logistics supporting Ulsan's emerging role as a regional hub for green shipping infrastructure.

Together, these factors make Ulsan not only technically capable but also economically and logistically well suited to support the ROK's green shipping ambitions.

Vessel decarbonization pathway

The ROK-US Green Corridor focuses on the decarbonization of PCTC vessels operating between Ulsan/Masan and Tacoma. Wallenius Wilhelmsen including EUKOR Car Carriers, Inc. and Wallenius Wilhelmsen Ocean AS (WALWIL) has ordered total 14 newbuilding PCTCs: 7 vessels will be equipped with methanol dual-fuel engines, while the other 7 will be fitted with LNG dual-fuel engines and ammonia-ready tanks. From the ROK, WALWIL plans to continuously load exported cars and high & heavy (H&H) cargo. The feasibility study was conducted based on the assumption that, out of the seven methanol dual-fuel PCTCs being delivered in the period of August 2026 to end of 2027, two vessels could be assigned to this corridor. These two vessels are expected to make a total of 15 voyages per year, with each vessel having a transport capacity of 9,300 Car Equivalent Units (CEU). ¹The cost calculations in this feasibility study are based on this operational scenario.

Cargo demand dynamics

WALWIL's service pattern is a mix of liner and tramp, meaning the number of voyages and vessel assignments may fluctuate based on cargo demand and contractual arrangements. The company regularly negotiates contracts with major shippers such as car manufacturers, which can affect cargo volumes from 2027 onward. While two vessels are assumed for feasibility

calculations, actual operations will depend on market conditions and contract developments.

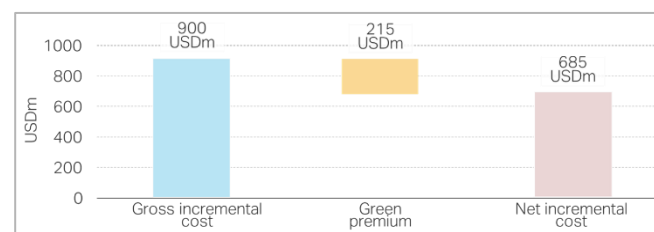
Green Premium

This study incorporates the effect of cost integration mechanisms into the incremental cost analysis and green premium calculations. WALWIL itself has published a framework, BAF2.0 (Bunker Adjustment Factor 2.0)^{2,3}, for integrating its cost of alternative fuels—including green methanol—into its freight rates. With this WALWIL seeks to enable cargo owners and stakeholders to anticipate and manage its green premium associated with advanced fuel adoption, thereby supporting its transition to zero-emission shipping.

By including cost integration mechanisms in our public assessment, the study illustrates how parts of the cost challenges of decarbonization may be addressed in practice. In this context, the study serves as an example that provides valuable insights for the South Korean maritime industry. Furthermore, the methodology and findings can be referenced in future studies to support policy development and broader understanding of green shipping solutions.

However, it is important to recognize that cost integration mechanisms alone are not sufficient to cover the full incremental cost of adopting green fuels. Not all cargo owners may agree to the principle of "mass-balancing" concept of utilizing low carbon fuels globally within the group fleet and application of cost integration mechanisms to their cargos. In practice, there would be additional costs beyond such mechanisms. In this study, it is assumed that participation in voluntary "book & claim" emission reduction programs and the payment of a green premium by cargo owners are possible mechanisms for addressing this. Without such mechanisms or governmental subsidies, shipping companies may face challenges absorbing the additional costs associated with alternative fuels.

In summary, the success of this green corridor depends on clear communication with cargo owners to support their understanding of the green premium, as this is considered an important possible mechanism for enabling both environmental progress and the economic viability of green shipping initiatives.



¹ <https://shippingtelegraph.com/shipyards-news/wallenius-wilhelmsen-newbuildings-get-dual-fuel-lng-and-methanol-engines/>

² <https://www.walleniuswilhelmsen.com/news/introducing-baf2-0-a-multi-fuel-baf-for-a-net-zero-future>

³ <https://www.marketscreener.com/quote/stock/WALLENIOUS-WILHELMSEN-ASA-6340571/news/Introducing-BAF2-0-a-multi-fuel-BAF-for-a-net-zero-future-48394669/>



Figure 2: Illustrative Green Premium

Regulatory Feasibility

The regulatory landscape in the ROK presents both opportunities and challenges for the implementation of green shipping corridors. The ROK has demonstrated a strong institutional commitment to maritime decarbonization through its 2050 Carbon Neutrality Strategy, the Eco-Friendly Ships Act, and its endorsement of the Clydebank Declaration. These frameworks provide a foundation for the adoption of alternative fuels such as green methanol in international shipping.

However, the operationalization of green methanol bunkering requires further regulatory development. Although Ulsan Port is technically capable of handling methanol due to its long-standing role as a chemical logistics hub, the absence of finalized guidelines for ship-to-ship and simultaneous operations (SIMOPS) involving methanol-fueled vessels remains a regulatory barrier. The Korean Register is actively developing procedures to ensure safe and compliant bunkering operations, including emergency shutdown systems and enhanced safety protocols.

Coordination with local authorities and emergency response agencies is crucial to ensure readiness for handling green methanol. Additionally, regulatory clarity around port dues, customs procedures, and fuel certification will be necessary to support commercial-scale bunkering operations.

On the international front, alignment with IMO regulations, notably the IGF Code and upcoming fuel standards, is critical. The ROK's proactive engagement with the International Maritime Organization and its participation in global initiatives such as the Zero-Emission Shipping Mission position it well to contribute and adapt to emerging regulatory frameworks.

In summary, while the ROK's regulatory environment is supportive of green shipping in principle, targeted updates and inter-agency coordination are required to enable the safe and efficient use of green methanol as a marine fuel.

Cost Assessment

The transition to zero-emission shipping presents a significant economic challenge, particularly in the preliminary stages of market development. The Republic of Korea–United States PCTC Green Corridor feasibility study revealed that while the long-term benefits of green shipping are substantial, the short-term cost gap between conventional and alternative fuels remains a significant barrier to implementation.

Incremental Cost Analysis

The study compared the lifetime costs of a conventional fossil-fueled corridor with those of a green corridor powered by green methanol. Over 30 years, the total cost of the green corridor is

estimated at \$1.6 billion, compared to \$700 million for the conventional corridor (See figure 3). This results in an incremental cost gap of \$900 million, or about \$225 per Car Equivalent Unit (CEU) transported.

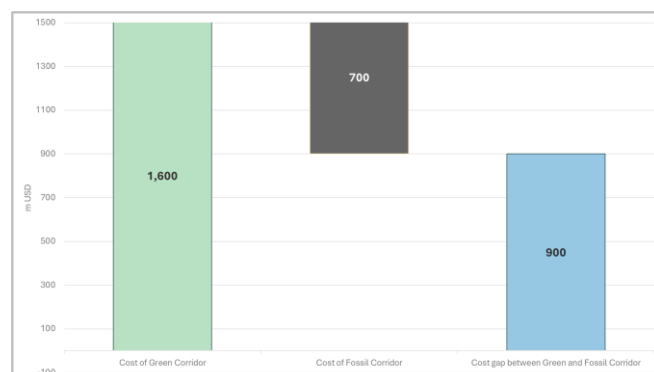


Figure 3: Cost gap between Green and Fossil Corridor

From this amount of \$900 million, an estimated USD 470 million reduction is anticipated due to the potential impact of the IMO Net Zero Framework (NZF), resulting in a net cost of approximately USD 430 million. This analysis assumed the existence of a hypothetical market which was willing to a premium for cargo to be transported on low carbon fuels. This, referred to as the green premium, provided a cost benefit to the corridor of 215m USD. Despite the inclusion of green premiums and other cost management benefits, the remains a residual cost gap of USD 200 million which will require additional support or innovative funding solution to fully bridge the cost gap (See figure 4).

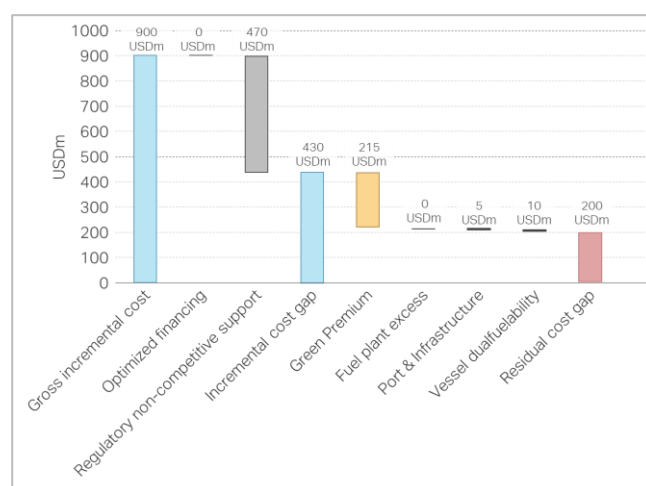


Figure 4: Incremental cost and Residual cost gap

When broken down by cargo type (sample):

- For a standard passenger car (1.4 CEUs), the additional fuel cost per vehicle is equivalent to below 0.5% of the vehicle's value, representing only a minor increase in the overall export cost.



- For a standard high-and-heavy vehicle (8.4 CEUs), the additional fuel cost corresponds to below 0.2% of the vehicle's value, remaining negligible in the context of the total unit value.

Passenger Car	Passenger Car	High & Heavy Vehicle	High & Heavy Vehicle
US\$27,000	US\$27,000	US\$550,000	US\$550,000
			
Cargo capacity: 1.4 CEUs	Cargo capacity: 1.4 CEUs	Cargo capacity: 8.4 CEUs	Cargo capacity: 8.4 CEUs
Fuel Cost: 222 \$/car	Fuel Cost: 579 \$/car	Fuel Cost: 2,251 \$/car	Fuel Cost: 3,175 \$/car
Simulation: 0.69 CO ₂ /car	Emission: 0.54 CO ₂ /car	Emission: 4.12 CO ₂ /car	Emission: 0.26 CO ₂ /car
Simulation Cost: 72 \$/CO ₂ /car	Simulation Cost: 156 \$/CO ₂ /car	Simulation Cost: 495 \$/CO ₂ /car	Simulation Cost: -936 \$/CO ₂ /car
Total Cost: 297 \$/car	Total Cost: 313 \$/car	Total Cost: 1,783 \$/car	Total Cost: 2,233 \$/car
Incremental cost ratio: 0.5 %/car	Incremental cost ratio: 0.5 %/car	Incremental cost ratio: 0.5 %/car	Incremental cost ratio: 0.08 %/car

Figure 5: Impact per transported vehicle (for illustration only)

These figures demonstrate that while the per-unit cost increase is relatively modest, the aggregate cost across the corridor is substantial, and, in this study, is not assumed to be fully absorbable by private stakeholders alone.

CO₂ Abatement

The Republic of Korea–United States PCTC Green Corridor is expected to deliver significant climate benefits by replacing conventional marine fuels with green methanol. Over the projected 30-year operational period, the corridor could reduce cumulative CO₂ emissions by approximately 1.84 million metric tons, representing a 90% reduction compared to Very Low Sulphur Fuel Oil (VLSFO).

The CO₂ abatement cost varies depending on fuel price and infrastructure maturity scenarios. According to this study, the estimated abatement cost is approximately \$600 per metric ton of CO₂ abated. While this figure reflects current market conditions for green fuels, it also underscores the importance of sustained investment in innovation, infrastructure, and regulatory support to lower costs over time.

By enabling low-emission vehicle exports and supporting Scope 3 reduction targets for the ROK's automotive industry, the corridor provides a tangible pathway toward sustainable logistics. It reinforces the ROK's position in advancing clean maritime transport.

Role of Public Funding

The study emphasizes that targeted, time-limited public support is essential to de-risk early investments and catalyze private capital. This support could take the form of:

- Direct subsidies for green fuel use
- Tax incentives for green shipping operations
- Infrastructure grants for bunkering and port upgrades

As a signatory to the Clydebank Declaration, South Korea has committed to incentives and support the establishment of green corridors.

As markets mature and economies of scale are achieved, the need for public funding is expected to diminish.

Summary

The Republic of Korea–United States PCTC Green Corridor Feasibility Study demonstrates the technical and regulatory viability of establishing a zero-emission maritime transport route between major ports in the ROK (Ulsan, Masan) and the U.S. Pacific Northwest (Tacoma). The corridor would utilize green methanol as an alternative marine fuel, supporting the ROK's climate commitments under the Clydebank Declaration.

A key challenge is the lack of domestic green methanol production, requiring imports—primarily from China. Based on the analysis, Ulsan Port, with its established green methanol handling infrastructure and proximity to the ROK's automotive manufacturing base, is well positioned to serve as the corridor's bunkering hub.

While regulatory frameworks such as the Carbon Neutrality Strategy and Eco-Friendly Ships Act support the initiative, further development of operational guidelines for green methanol bunkering is needed. Engagement with local authorities and adherence to IMO standards are essential for safe implementation.

Economically, the corridor presents a significant cost gap: over the next 30 years, green corridor operations are projected to cost \$1.6 billion, compared to \$700 million for conventional operations. Although the per-vehicle cost increase is modest, public funding of approximately \$200 million is, in this study, assumed to help bridge the gap and catalyze private investment.

The corridor is expected to reduce CO₂ emissions by 1.84 million metric tons over its lifetime, reinforcing the ROK's position in advancing sustainable shipping and providing a scalable model for future green corridors.



Abbreviation	Full term
ROK	Republic of Korea
US	United States
PCTC	Pure Car and Truck Carrier
CO ₂	Carbon Dioxide
IMO	International Maritime Organization
SIMOPS	Simultaneous Operations
CEU	Car Equivalent Unit
H&H	High and Heavy (cargo)
WALWIL	Wallenius Wilhelmsen (including EUKOR Car Carriers, Inc. and Wallenius Wilhelmsen Ocean AS)
LNG	Liquefied Natural Gas
NZF	Net Zero Framework (IMO)
VLSFO	Very Low Sulphur Fuel Oil
BAF	Bunker Adjustment Factor
BAF 2.0	Bunker Adjustment Factor 2.0 (WALWIL framework for green fuel cost integration)
IMO IGF Code	International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels
MMMCZCS	Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping
FID	Final Investment Decision
KR	Korean Register

