AN INITIAL BASELINING STUDY TO

SUPPORT THE DEVELOPMENT OF THE LOS ANGELES/LONG BEACH TO SINGAPORE GREEN AND DIGITAL SHIPPING CORRIDOR

SUMMARY REPORT

ABS on behalf of C40 CITIES, THE PORT OF LOS ANGELES, Port of LONG BEACH THE GREEN PORT, MPA SINGAPORE

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1 INTRODUCTION

With its strategic location, the Port of Singapore is one of the busiest and leading container trans-shipment hubs, connecting Asian markets to more than 600 ports in over 120 countries around the world. On the other side of the Pacific Ocean, Port of Los Angeles and Port of Long Beach are the leading U.S. gateways for trans-Pacific trade in California. The trade route between Singapore and Los Angeles/ Long Beach play a significant role in cargo trade or supply chain globalization between Asia and North America. This trans-pacific route is a critical enabler of the strong economic relationship between Singapore and California. According to APEC (Asia Pacific Economic Corporation), bilateral trade reached $10.344 billion in 2022, establishing Singapore as California's 12th-largest trading partner. Additionally, California ranks as Singapore's second largest trading partner among all U.S states, representing 13.3% of the national trade in Singapore.

The Ports of Singapore, Los Angeles and Long Beach already play a significant role in maritime decarbonization:

- The Maritime and Port Authority of Singapore targets to reduce absolute emissions from port terminals by at least 60% from 2005 levels by 2030, and to achieve net zero by 2050. MPA also aims to reduce absolute emissions from the domestic harbour craft fleet by 15% from 2021 levels by 2030, and half the emissions from 2030-level by 2050. Singapore is developing various net-zero fuel pathways, including focusing on electrification and biofuels for domestic harbour crafts, and building up the value-chain for ammonia and methanol for international shipping.
- Both the Ports of LA and LB have signed green shipping corridors agreements with ports in Asia to deploy ships with full life cycle low or even zero carbon emission capabilities in this corridor. Since the announcement of ZEERO (Zero Emissions, Energy Resilient Operation) commitment, the Port of LB has invested $300 million in establishing a green fuel hub to cut carbon emissions by 91% since 2005.

These efforts underscore the ports' commitment to lead industry by being the first movers in maritime decarbonization.

In 2023, The Maritime and Port Authority of Singapore (MPA), Port of Los Angeles (POLA) and Port of Long Beach (POLB), with the support of C40 Cities, established a Green and Digital Shipping Corridor (GDSC) with the aim to accelerate decarbonization of the maritime industry and the development and deployment of digital technology solutions and enablers. The GDSC commissioned this study to investigate the baseline total corridor energy demand and forecast the share of near-zero and zero emission fuels consumed by vessels operating between Singapore and Los Angeles and Long Beach. The study further highlights the potential socio-economic impact of transitioning to zero and near-zero emission fuels and leveraging on digital solutions. Insights from this study will guide the planning and development of activities by the GDSC partners to advance their decarbonization objectives.

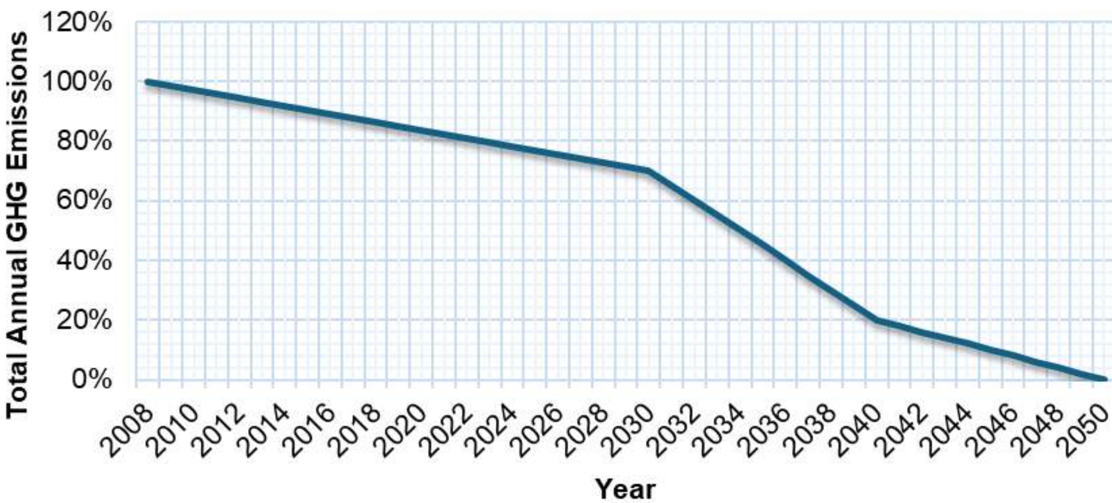


***Figure 1** Emission Trajectory for IMO GHG Strategy*

The Revised Strategy commits Member States to peak greenhouse gas (GHG) emissions from international shipping as soon as possible and reach net-zero by or around, i.e. close to 2050, taking into account different national circumstances whilst pursuing efforts to phase them out. The Revised Strategy further included targets to reduce GHG emissions from international shipping by at least 20%, striving for 30% by 2030, and by 70%, striving for 80%, by 2040

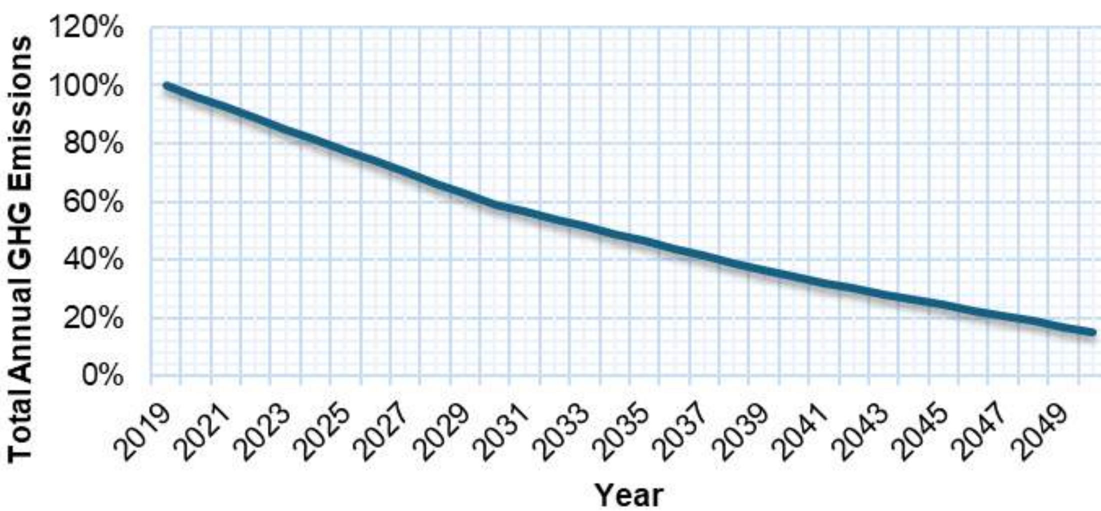


***Figure 2** Emission Trajectory for Paris 1.5-degree Scenario*

According to the Intergovernmental Panel on Climate Change (IPCC) [14], the target of total GHG emissions adhering to 1.5-degree Paris agreement is to be determined using 2019 as baseline year and is shown in Figure 32. According to this target, 41% emission reduction should be achieved by 2030 while 66% and 85% emission reduction should be achieved by 2040 and 2050 respectively.

The Approach:

- ✓ Estimate baseline energy demand from analysis of vessel traffic sailing between the three ports from Q1 2021 to Q3 2023.
- ✓ Techno-economic optimization for future fuel mix on the corridor through to 2050, considering decarbonization targets, fuel availability, production cost, and other constraints (see Figure 3).
- ✓ Assessment of the socio-economic opportunities and risk that should be considered in the corridor's development.

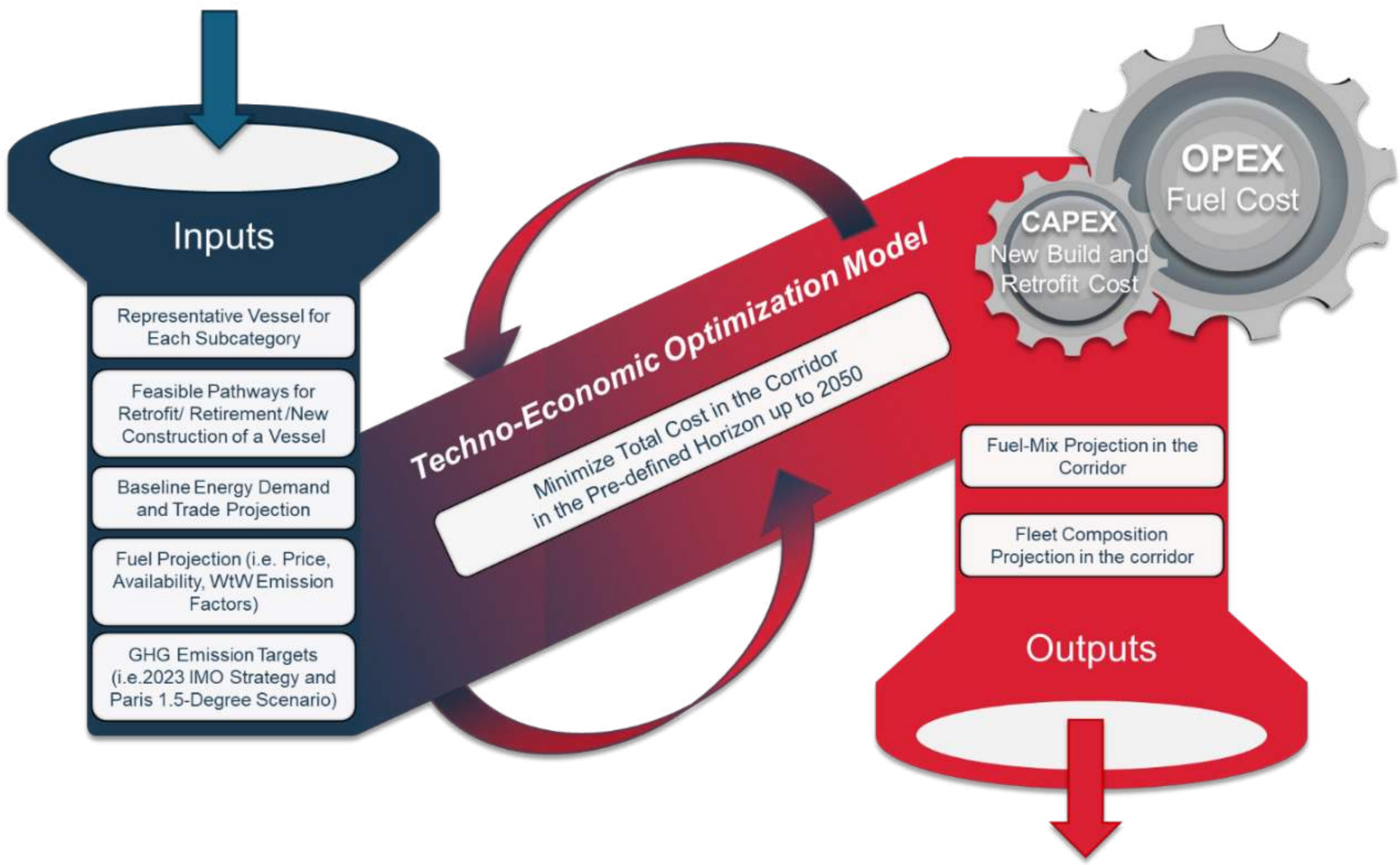


Figure 3 *Techno-economic Optimization for Fuel Mix in the Corridor*

2 VESSEL TRAFFIC OVERVIEW

Comprehensive analysis of AIS data has been conducted to characterize the vessel traffic operating on the corridor. For the Singapore (SG) to Los Angeles (LA) / Long Beach (LB) green corridor, voyages between the three ports are considered, excluding direct routes between LA and LB due to proximity. The corridor is defined as the direct and indirect voyages between Singapore and LA/LB in an east-west direction with voyage duration up to 120 days. For a larger population of vessels and abundance of historical data, this search was completed for an extended period ranging from Q1 2021 to Q3 2023 which is around 2.75 years of historical data. As global maritime traffic was disrupted due to COVID-19, data from the year 2020 was excluded from this study. Some vessel types such as tugs, passenger cruises, specialist vessels are not selected in the process as the number of occurrences were insignificant as compared to ocean going commercial vessels. A total of 642 unique vessels were identified making 1606 voyages over the period examined.

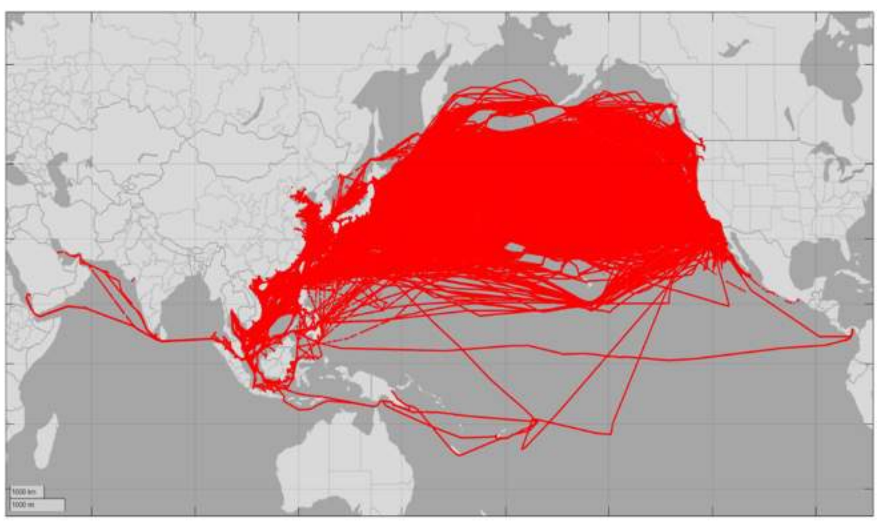


Figure 4 *Vessel Routes of all 642 vessels from Q1 2021 to Q3 2023*

It is estimated that while making 1606 voyages, the 642 vessels consumed ~3.9 million tons of oil eq. from Q1 2021 to Q3 2023 resulting in ~5.7 million tons of GHG emissions per year. It was found that the majority of voyages are indirect in nature and energy consumed by direct voyages accounts for just 2.5% of traffic. It was found that close to 98% of the corridor's energy demand is currently met with conventional fuels, with much of the remainder being met by LNG.

A total 80% of vessel traffic on the corridor is container traffic, 12% is petroleum products, 6% is RoRo vessels.

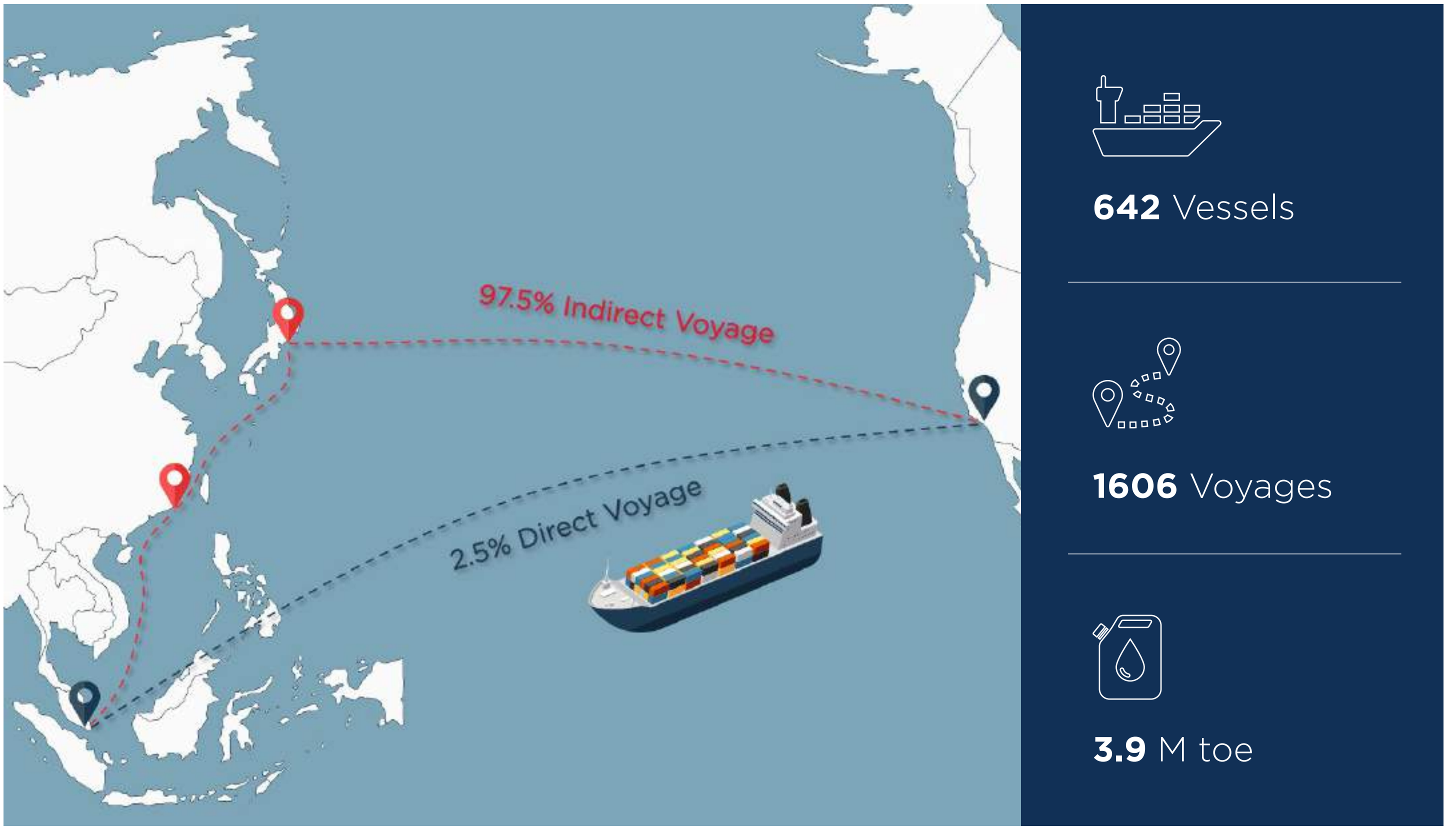


Figure 5 *Key Information of the Voyages in the Corridor from Q1 2021 to Q3 2023*

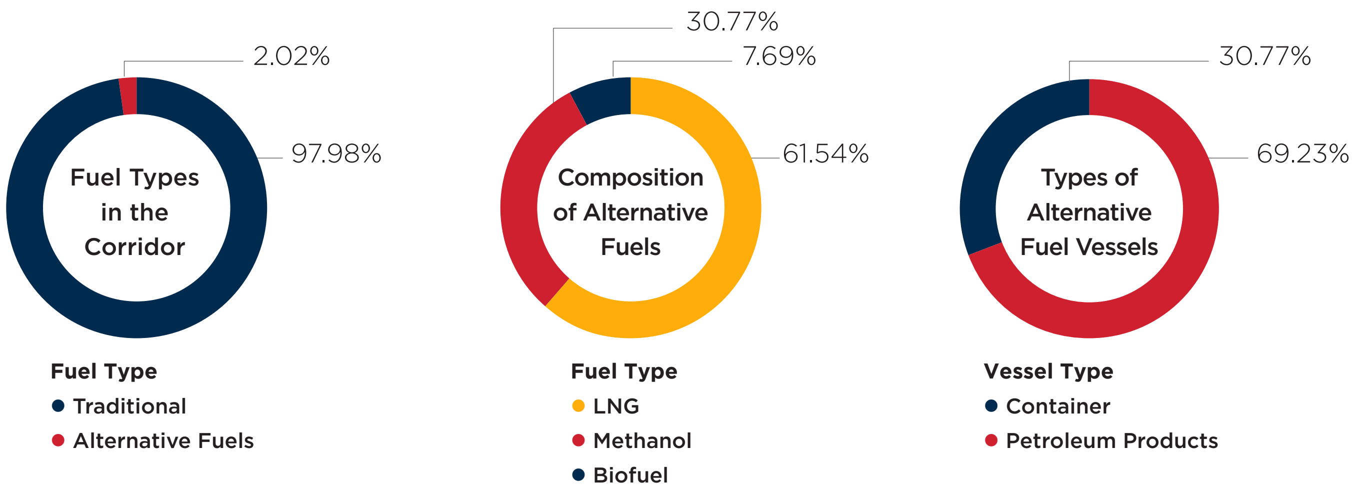


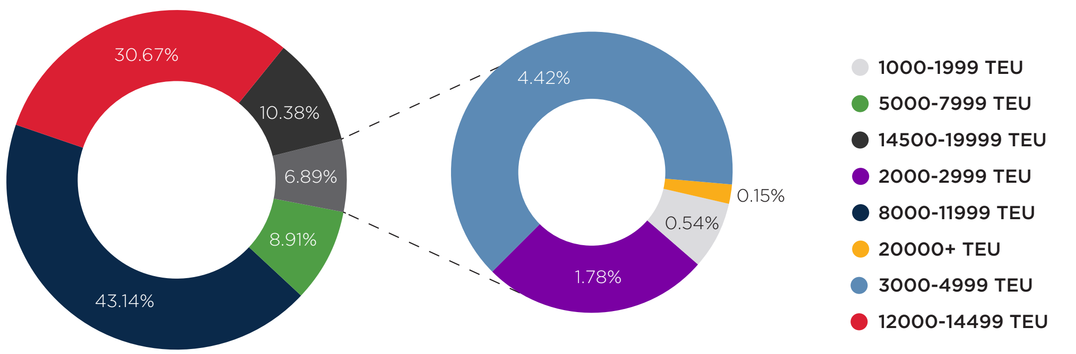
Figure 6 *Existing Fuel-Mix in the Corridor*

According to the latest ship order book, many newbuilding orders for containerships are dual-fuel engines, accounting for around 60%. The dual fuel order for RoRo is 35% and that of chemical tankers is 12%.

The majority of direct voyages between Singapore and California are by Petroleum and General Cargo vessels. Other segments typically make at least one interim port call between the two ends of the corridor. China emerges as the primary destination for intermediary port calls, particularly for handling containerships. On the other hand, Japan, South Korea, and Taiwan exhibit the highest share of port calls for petroleum products and Ro-Ro vessels.

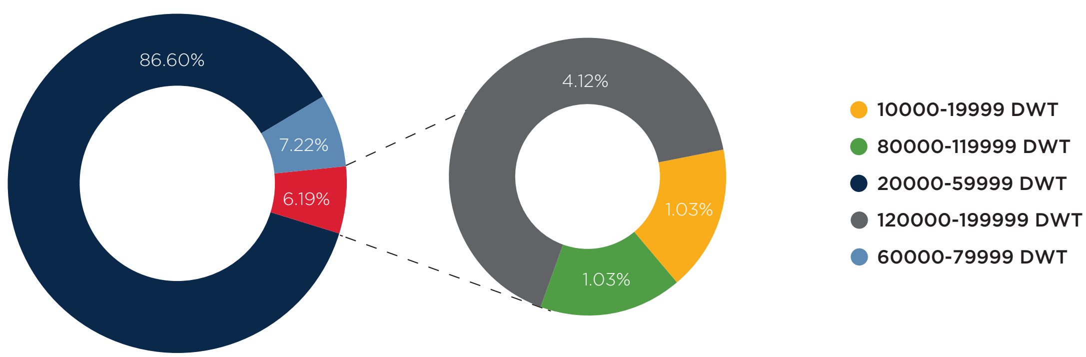
80.4%

1291
Container



12.1%

194
Petroleum Products



0.4%

7
Dry Bulk Cargo

1.2%

20
General Cargo

5.9%

94
Ro-Ro

Figure 7 *Voyages by each Vessel Category in the Corridor from Q1 2021 to Q3 2023*

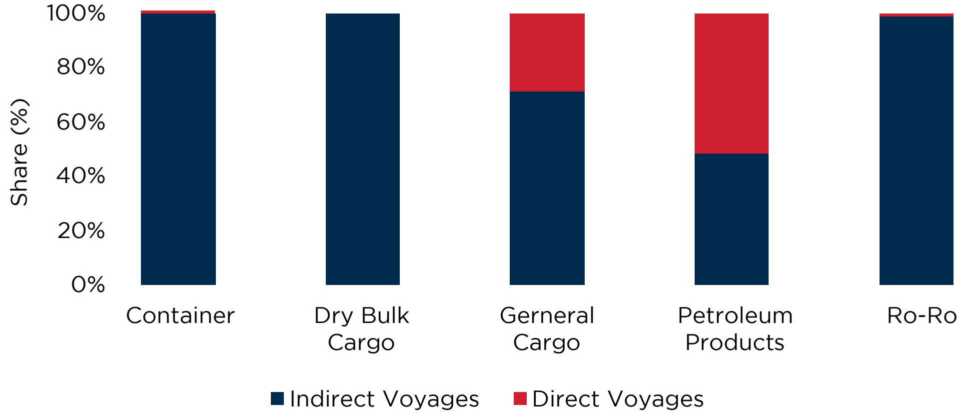


Figure 8 *Share of Direct and Indirect Voyages for Different Vessel Segments*

China emerges as the primary destination for intermediary port calls, particularly for handling containerships. Japan, South Korea, and Taiwan exhibit the highest share of port calls for petroleum products and Ro-Ro vessels. Understanding the location of intermediary port calls can help identify opportunities for broader collaboration in decarbonizing trans-pacific trade.

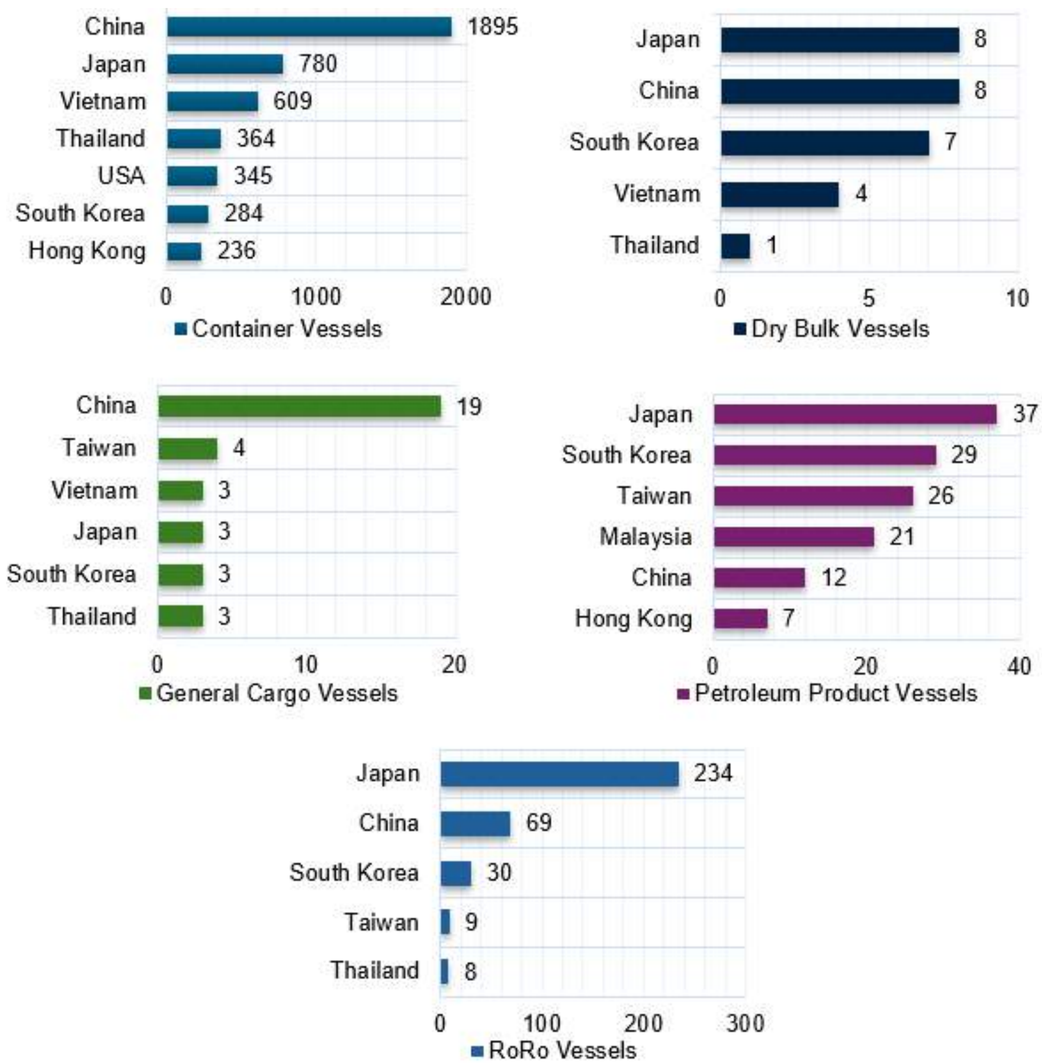


Figure 9 *Intermediate Port Calls by Countries from Q1 2021 to Q3 2023*

3 FUEL SUPPLY

Annual fuel mix projections spanning from 2024 to 2050 are explored under two emission trajectories, the 2023 IMO GHG strategy and the Paris 1.5-degree modeling scenarios:

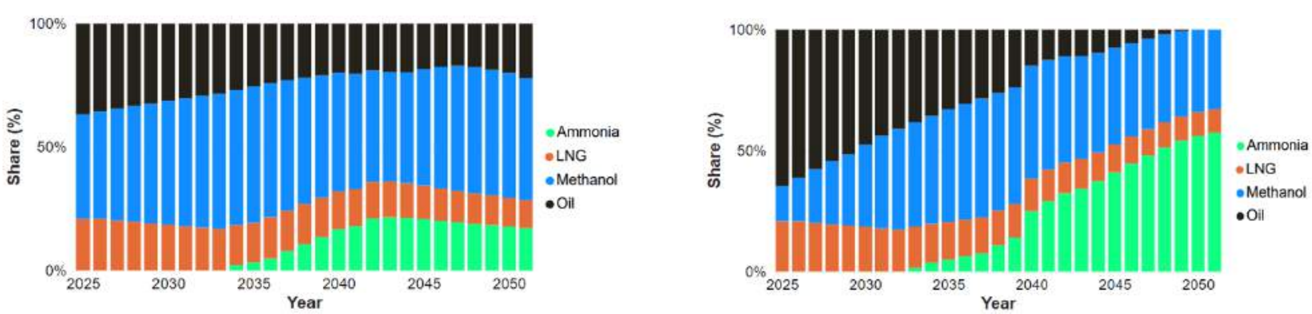


Figure 10 *YoY Fuel Share aligned to Paris 1.5-degree (left) and IMO Strategy (right)*

Oil

Demand for fossil fuel oils is projected to gradually decreases under the IMO strategy trajectory. However, for the Paris 1.5-degree scenario some demand of oil is observed towards 2050 as there is no net-zero constraint.

LNG

Demand for LNG is projected to remain relatively constant from 2025 through to 2050. The year-on-year demand from different LNG variants suggests that fossil-LNG will start to be replaced by bio-LNG from 2030, becoming dominant by the mid-2030s.

Methanol and Ammonia

Demand is present in both decarbonization scenarios. However, with the mandate of achieving net-zero for IMO strategy, demand of ammonia is higher than the Paris 1.5 deg scenario. On the other hand, demand for methanol is higher in the Paris 1.5 deg scenario as it is a cheaper option to meet less stringent emission targets.

It is anticipated that IMO’s 2030 target for 10% zero or near-zero energy sources will largely be met through the supply of low-carbon methanol, supplemented by a smaller amount of ammonia. The dynamics of the fuel market in the longer term remain uncertain. For example, safety challenges may present a barrier to widespread adoption of ammonia as a fuel. Additionally, constrained biogenic feedstock availability could result in limited availability of bio-derived versions of alternative fuels. These uncertainties and dynamics may influence the choice and availability of alternative fuels in the corridor. The offtake of methanol and ammonia (in Million Tons) is projected for both decarbonization scenarios subjected to different availability scenarios. The “base” scenario assumes fuels of all variants will be available across the corridor whereas the “Low Biomass” scenario assumes unavailability of bio-based alternatives. The “No Ammonia” scenario assumes that ammonia does not achieve widespread acceptance on the corridor.

- For the “Base” Scenario, 800,000 tonnes of methanol are needed per year by 2030 to adhere to IMO GHG strategy targets, with only a small amount of ammonia in the fuel mix. Meanwhile 2.1 million tonnes of methanol per year by 2030 is needed to adhere to the Paris 1.5 deg scenario.
- If biogenic feedstocks, are constrained, there is a greater reliance on ammonia to meet the decarbonization scenarios. By 2030, 1.1 million tonnes of ammonia would be required annually to meet the IMO strategy, whereas 700,000 tonnes would be necessary to comply with the Paris Agreement’s 1.5°C scenario.
- Where there is low ammonia acceptance, methanol is expected to have significant demand. By 2030, 800,000 tonnes of methanol would be needed to comply with IMO GHG strategy while 2.1 million tonnes would be needed for the Paris 1.5 deg scenario.

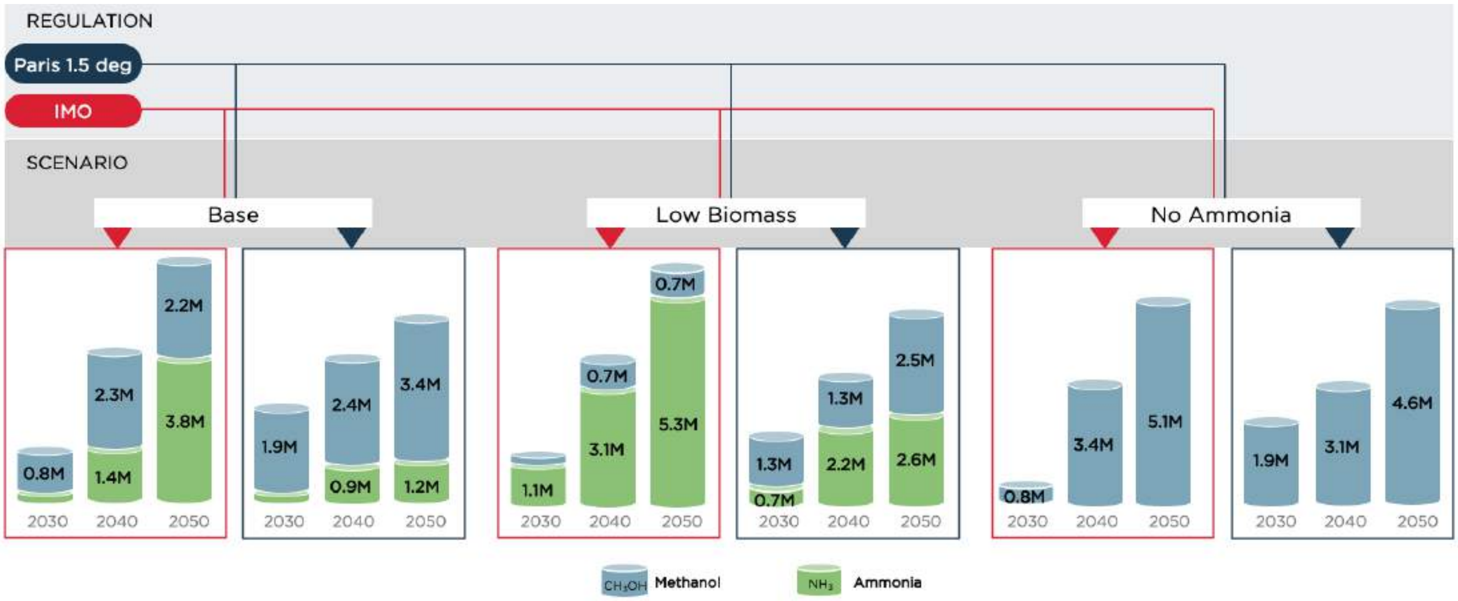


Figure 11 *Forecasted Demand of Methanol and Ammonia (in Tonnes) for IMO and Paris 1.5 Deg Emission Strategy considering various scenarios.*

4 SOCIO-ECONOMIC IMPACT

Ports remain a critical multimodal link for economic prosperity and global commerce. As the maritime industry works to decarbonize, it is essential that a transition is done in a just and equitable way. It is estimated that nearly 40% of Americans live within three miles of a port, and many of these are considered disadvantaged communities. Hence, targeting and reducing port and maritime emissions will be to the direct benefit of those neighboring communities which is aligned with the USA's Justice 40 initiative.

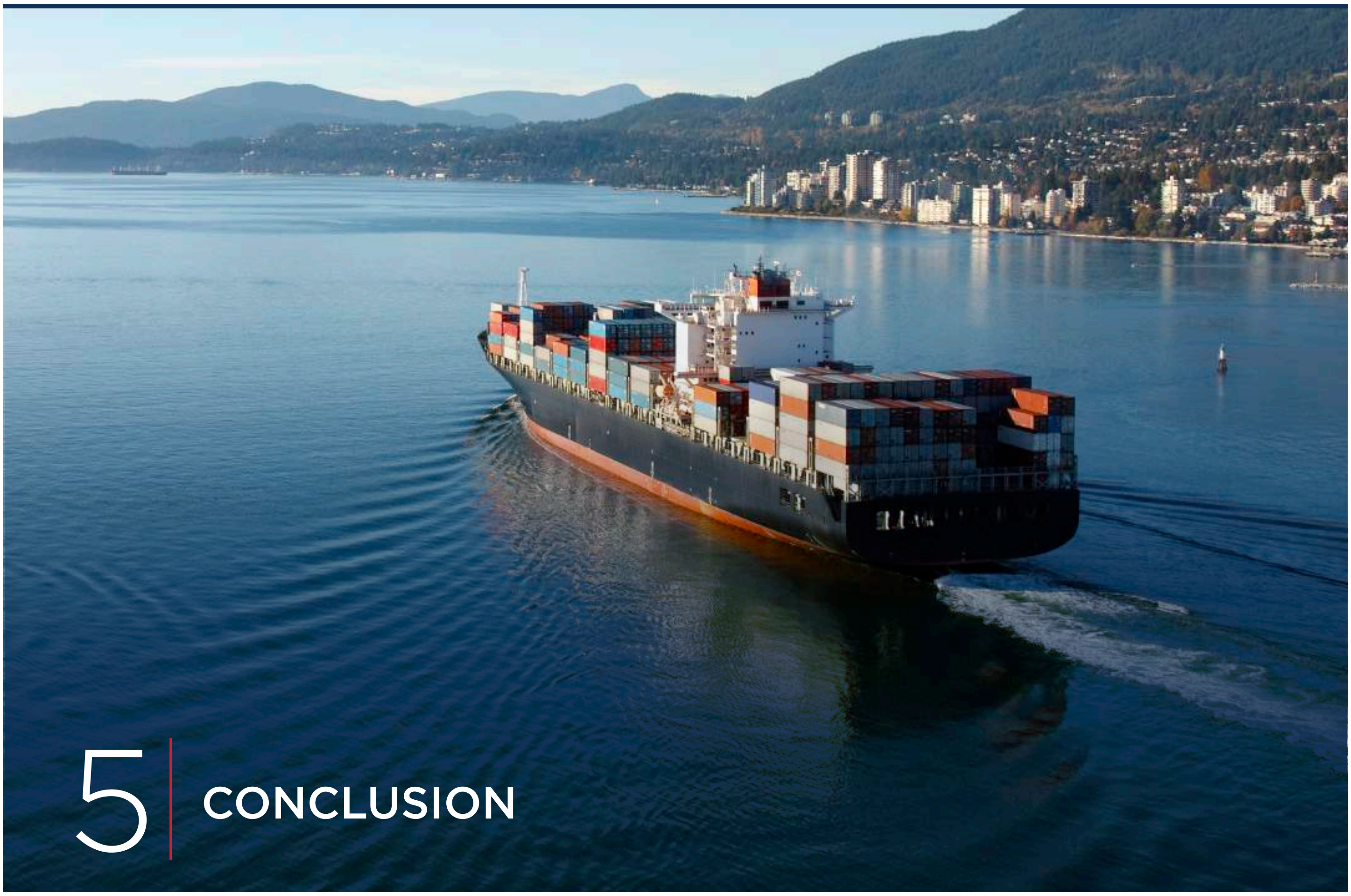
The IMO's vision for a "just and equitable" maritime energy transition points to the need for a deep understanding of not only the socio-economic opportunities associated with decarbonization decisions and investments, but also the risks to the workforce, individuals, local communities and economies.

New technologies come with new risks that need to be managed. Greener fuels will have different impacts to people and areas, for example, the toxicity concerns around use of ammonia, methanol's flammability, or hydrogen's explosive potential. At a national level, various opportunities that can arise from the GDSC include research and development, technology transfer, growth opportunities in new sectors, and greater national competitiveness.

Greener port and shipping operations can also help mitigate physical climate risks and reduce the risk of energy insecurity. Local opportunities can include increased employment, enhanced air quality and reduced health impacts, increased business opportunities in the maritime ecosystem, and improved access to clean energy.

At the **individual (worker) level**, the shift in energy patterns associated with decarbonization can create opportunities for up-skilling and reskilling existing workforce e.g. technical and safety training for new fuels.

Challenges for the Green Corridor Ports	Opportunities	Port-level Opportunities	Local / community-level opportunities	National / international-level opportunities
Developing new infrastructure or upgrading existing infrastructure to meet the technical, environmental, safety, etc. requirements of new fuels, e.g. green fuel bunkering and storage, RES integration, cold ironing, etc.	• Land use planning & smart growth & urban sustainability.	• Transportation congestion improvement • Environmental Sustainability • Port management	• New green economical /activities (income to local stakeholders, small investors, communities) • Green employment (Access to jobs, reduction of local unemployment) • Increased access to clean energy (lower cost) and energy security	• Robust national economy, competitiveness and GDP from alternative fuel supply chains and green electricity production. • Technology transfer and capacity building among countries. • Development of cross-border R&D ecosystems. • Systemic opportunities for National productivity through new green and decent jobs
Phasing out fossil fuel infrastructure	• Climate transition risks mitigation	• Stranded assets replacement or upgrade (risk mitigation) • Stranded human capital and just transition (reskill-upskill programs)	• Positive impact on improving air quality and related public health impacts.	• National & sectoral decarbonization targets
Futureproofing new/ existing infrastructure against climate impacts	• Resilient infrastructure development that addresses vulnerability to physical climate risks	• Retain competitiveness of the Green • Corridor ports	• Enhance climate impact resiliency of local communities	• Future proofing key national-level infrastructure (international transportation / commerce)



5 CONCLUSION

This baselining study for the Green and Digital Shipping Corridor between Singapore, Los Angeles and Long Beach has revealed useful insights into the traffic, trade, and future fuel mix development in the corridor, which will lay the foundation for stakeholder engagement goal setting, and planning implementation of the corridor.

With the containership and tanker segments being the main drivers for the establishment of a green corridor, it appears that, the majority of voyages along the corridor will include other intermediary port calls with the possibility of bunkering. For this reason, wider collaboration with such intermediary ports should be investigated for the development of sufficient alternative fuel capacity.

The study revealed that future fuel mix on the corridor is significantly influenced by the availability, price, and well-to-wake (WtW) emission factors of the fuels. The accurate long-term projection of prices and availability of alternative fuels poses substantial challenges. In any case, it is observed that both ammonia and methanol -based fuels will be crucial to achieving both short-term targets and long-term deep decarbonization of the shipping activity on the corridor, regardless of the decarbonization trajectory.