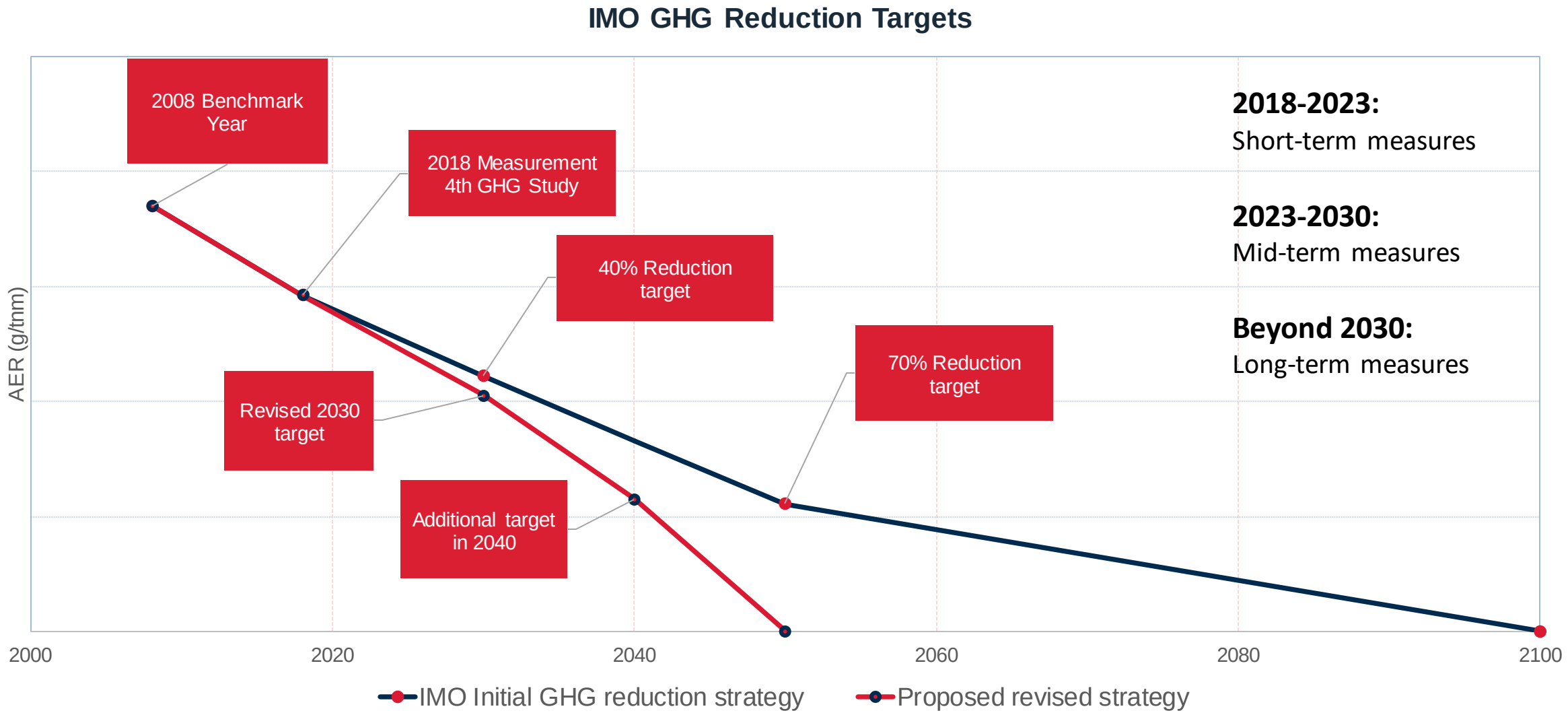
IMO Regulations: Impact on Ports
&
Green Shipping Corridors Overview

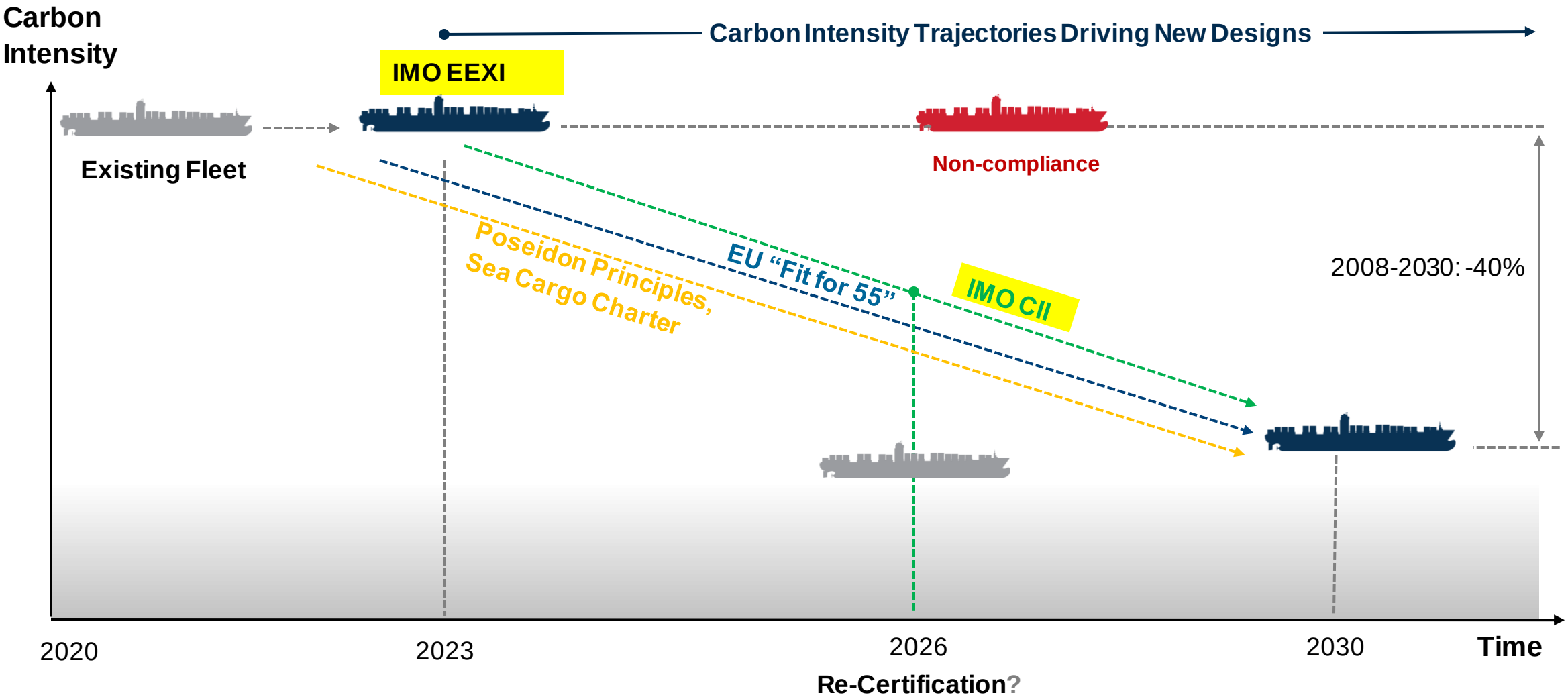
AAPA POWERS Summit & Expo

Stergios Stamopoulos, 24 January 2023

Revision of IMO GHG Initial Strategy

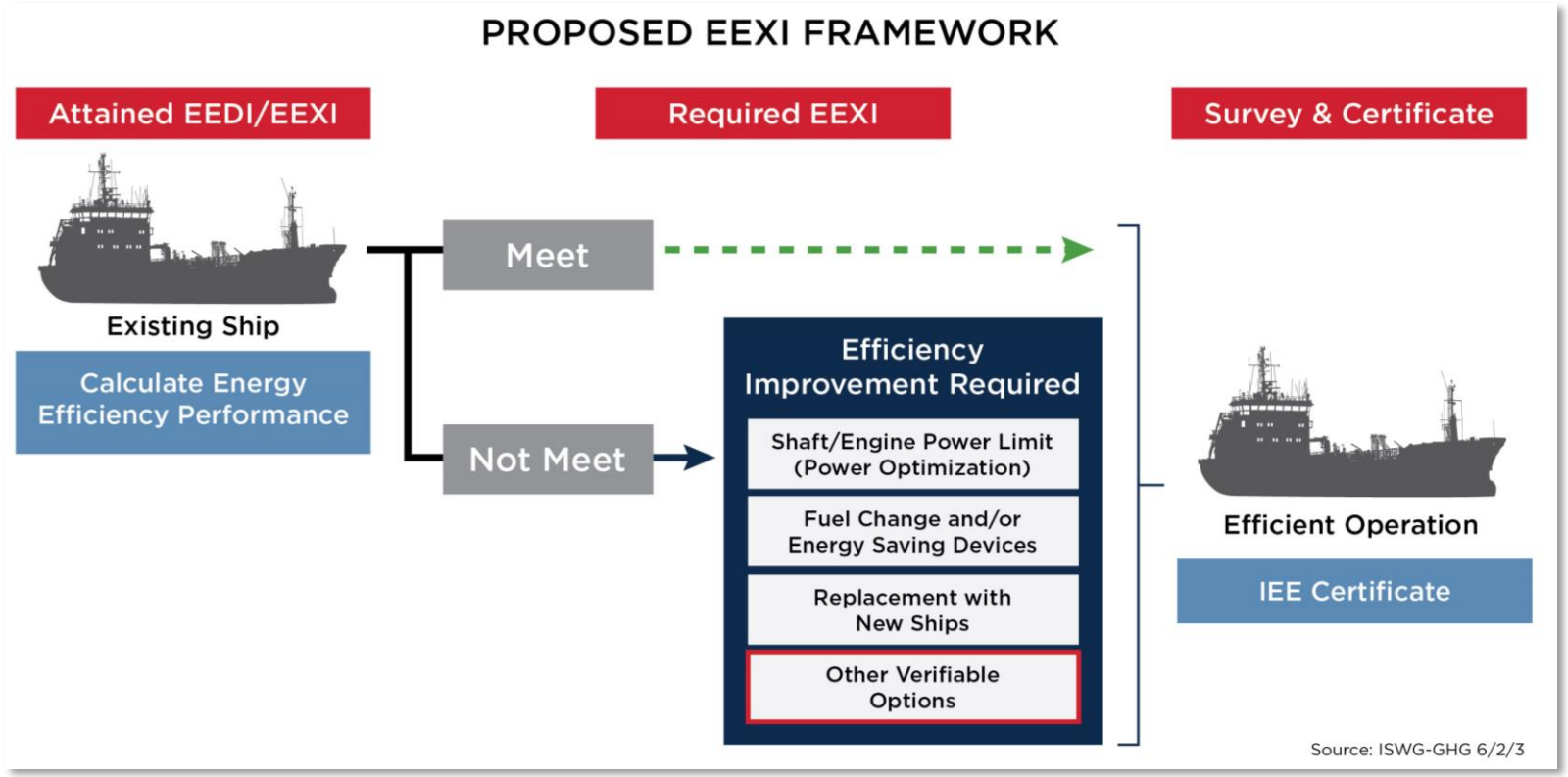


Emerging Landscape



Introduction to EEXI

- Required EEXI (Regulation 25)
  - *Energy Efficiency Design Index (EEDI)*
  - *Reference Line Reduction Factors (%)*
- Attained EEXI (Regulation 23)
  - *Calculation aligned with EEDI*



Introduction to CII

- For ships over 5,000 GT in line with IMO DCS for any propulsion type
- Exclusions and Corrections Factors (ice class, etc.) MEPC 78
- Required, Attained, Rating
- SEEMP CII Implementation Plan (now)
- Statement of Compliance (SOC) within five months of calendar year
- SEEMP CII Corrective Action Plan (future)

ATTAINED CII

$$CII = \frac{CO_2\ Emissions}{Transport\ Work} = \frac{Fuel\ Consumption \times Cf}{DWT \times Distance}$$

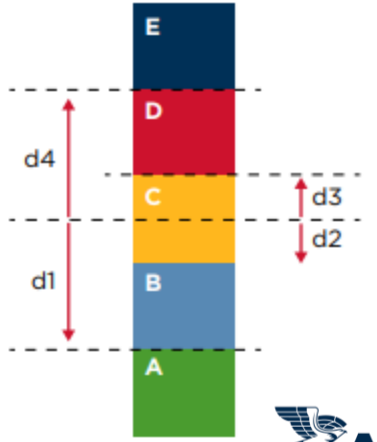
REQUIRED CII

$$CII_{ref} = a * Capacity^{c}$$

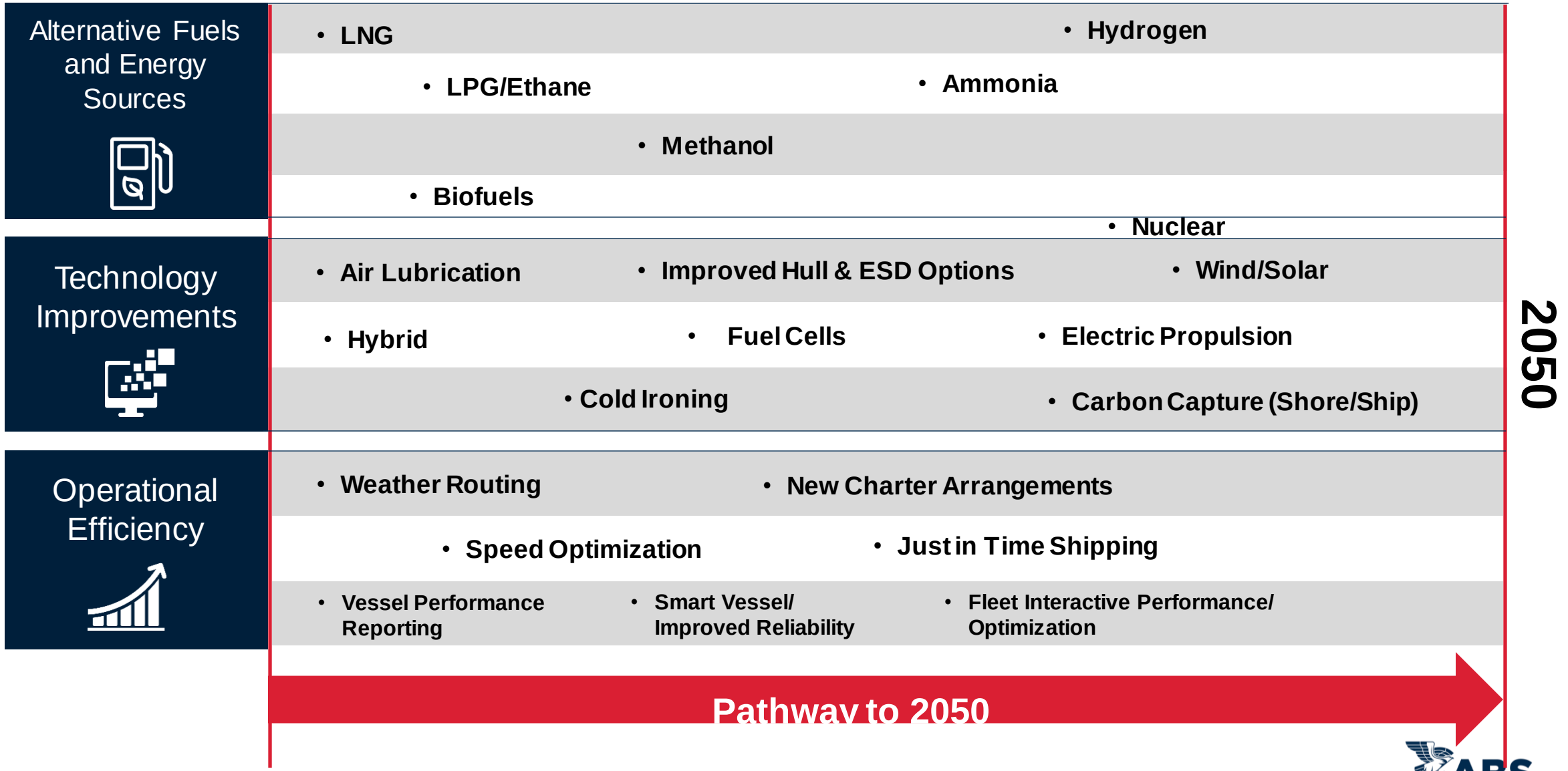
ANNUAL CII REDUCTION

$$CIIreq, year = CII_{ref}\left(1 - \frac{z}{100}\right)$$

CII RATING BOUNDARIES



Decarbonization Solutions



How do ports affect a vessel's CII rating?

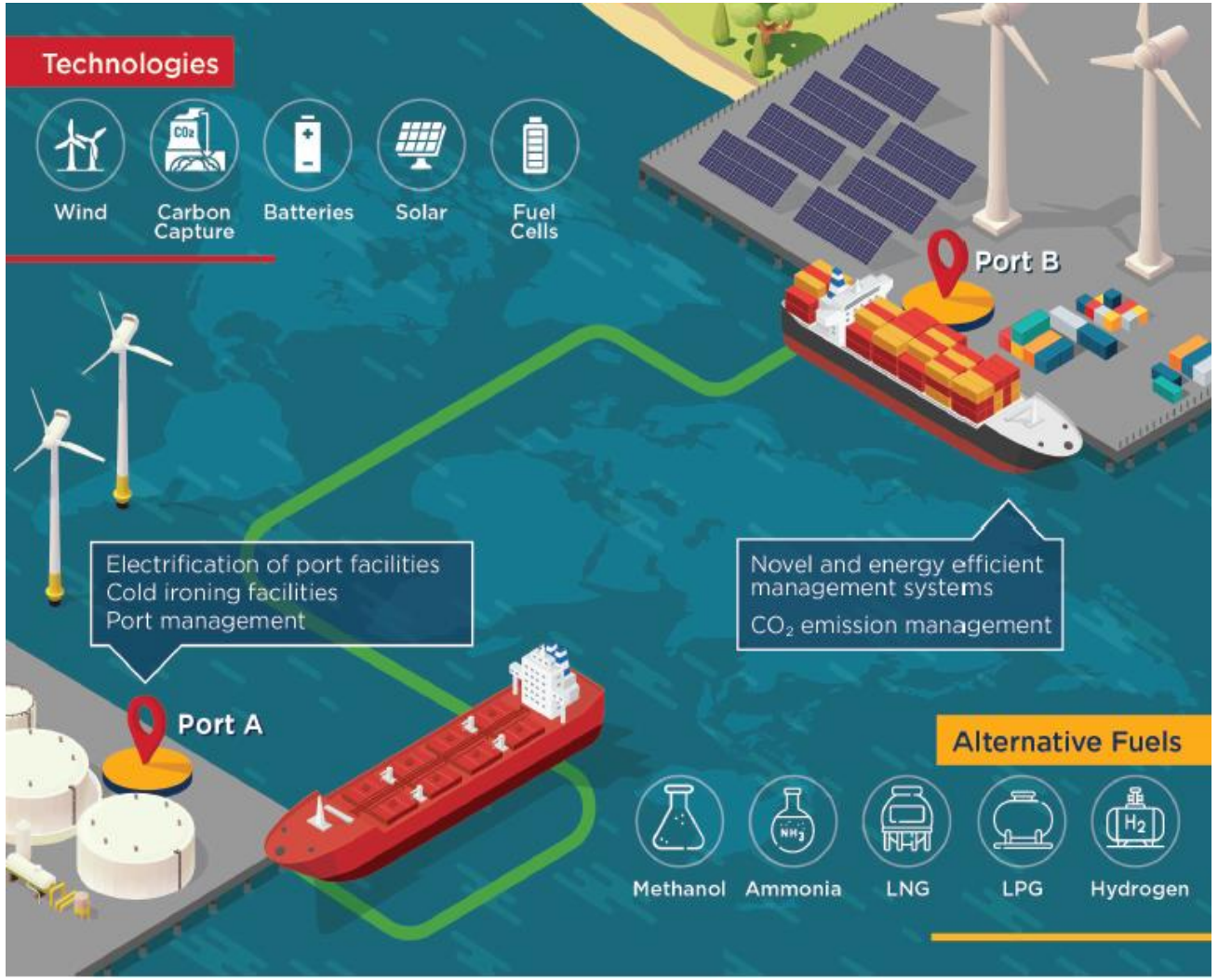
- CII is based on the transport work performed by a vessel. As a vessel sits in port, it does not perform transport work, and therefore the CII increases
- Example: a vessel is operating on a fixed charter from GoM to Singapore (~10 voyages/year). The vessel experiences an increase in port wait time of 2 days per voyage (20 extra days total) beyond expected/scheduled. This will cause a change in their CII rating 1 year earlier than expected.

	174k XDF on GOM to Singapore via Suez route @ 17 kts and 50/50 LNG/Diesel Fuel (MEPC 76 - 2% Phase 3)																	
Vessel	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Baseline	A	A	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	D
+1 Day per Voyage	A	A	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	D
+2 Days per Voyage	A	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	D	D
+3 Days per Voyage	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	C	D	D
+4 Days per Voyage	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	D	D	D

- The effect on CII shown in the example above is exacerbated for vessels with more frequent voyages/port stays
- Reducing emissions in port is therefore of utmost importance to most vessels

CII and Port Infrastructure

- How can ports assist vessel owners with CII?
  - Electrification
    - Cold ironing can reduce or completely eliminate in-port emissions
  - Increase fuel diversity
    - Switching to lower carbon fuels will enable vessels to operate longer under the CII regulation. Having wider access to these fuels will encourage adoption by vessel owners
  - Carbon capture
    - While not yet part of the regulation, it is likely to be incorporated in the near future.
    - Port based carbon capture can reduce in port emissions, while reception facilities for ships with onboard carbon capture systems will be needed



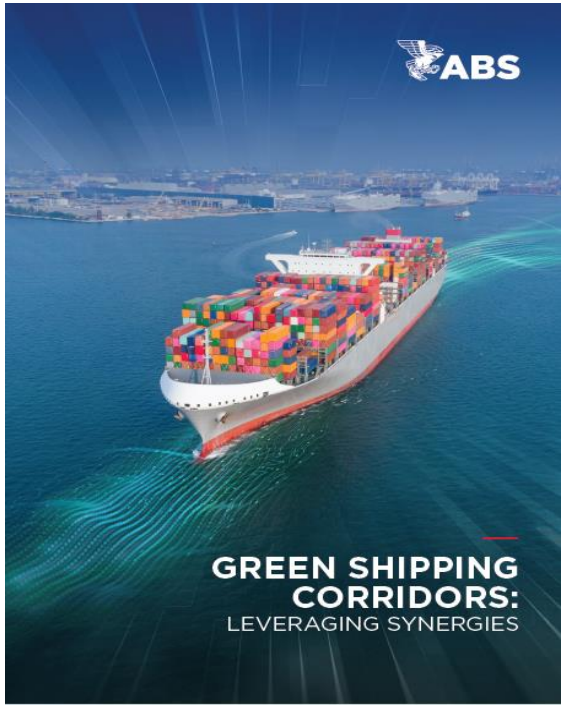
Green Shipping Corridors

Clydebank Declaration

- 24 signatories to the declaration at COP26
- Facilitates the establishment of partnerships along the value chain (ports, vessel operators, etc.) to accelerate decarbonization through 'Green Shipping Corridors'
- Looks to establish 6 green corridors by 2025, with more added by 2030
- Zero-emission maritime routes between 2 (or more) ports.

DOS Green Shipping Corridor Framework

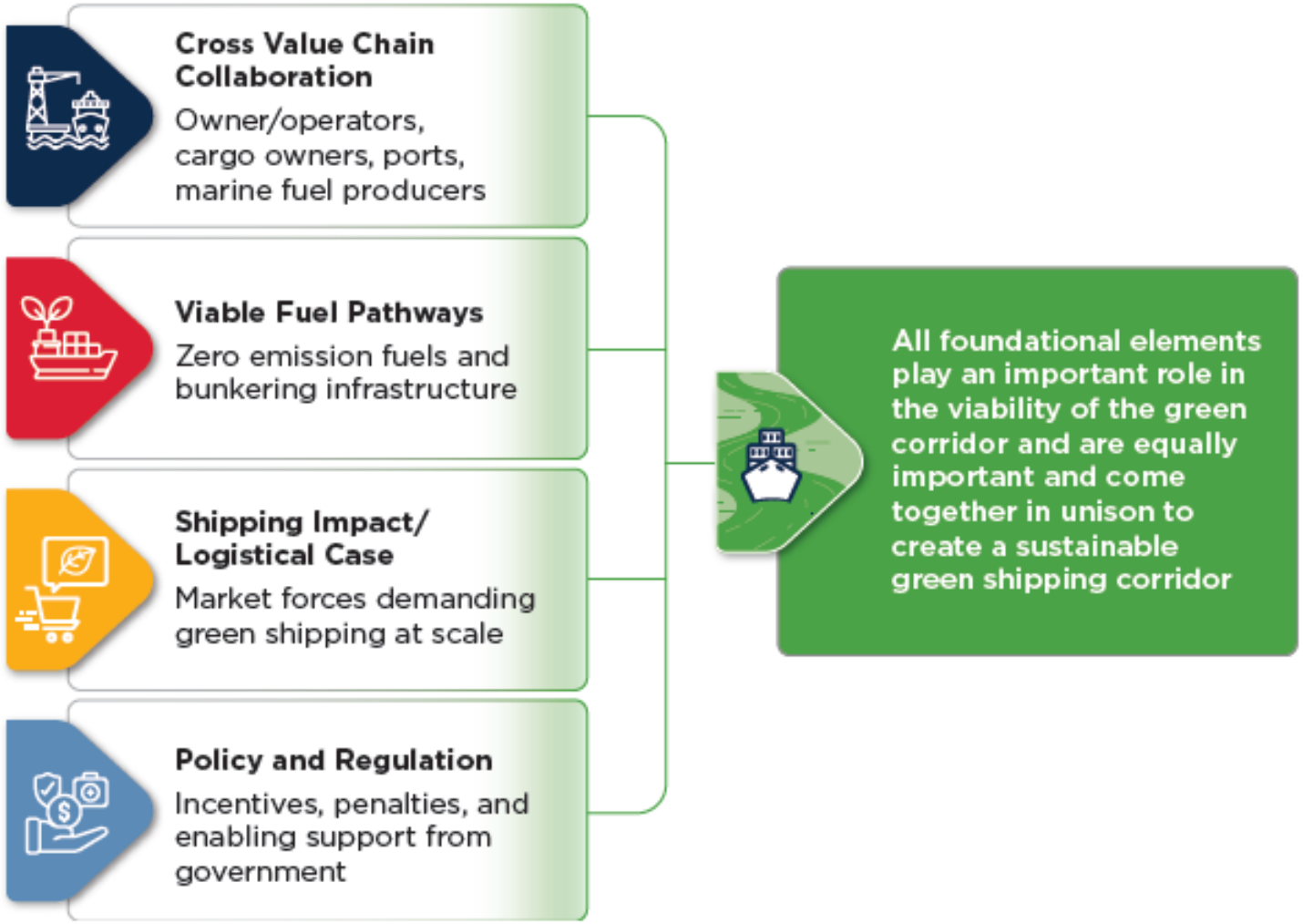
- The United States envisions green shipping corridors as maritime routes that showcase low- and zero-emission lifecycle fuels and technologies
- Ambition is to achieve zero GHG emissions across all aspects of the corridor in support of sector-wide decarbonization no later than 2050
- Ships using these corridors would use low-to-zero emission fuels



1. WHAT DOES "GREEN" MEANS?
2. HOW IS "CORRIDOR" DEFINED?
3. PORT-CENTRIC VS TECH-CENTRIC CORRIDOR

ABS

Foundational Elements of a Green Corridor



Element #1- Collaboration Across the Value Chain

- For a green corridor to succeed, each of the **members** of the value chain needs to **collaborate**, particularly at the intersection of their operational boundaries.
- Every member of the value chain will have different decision-making criteria which align with the needs of their business model.
- Each green corridor needs to undergo a **detailed pre-feasibility study** that addresses certain screening considerations

Value Chain Member	Description	Value Proposition (Why be a part of a Green Corridor?)	Decision-making Criteria
Vessel owners	The entity that has financial control of the vessel. This entity may also be the vessel operator	Vessel owners can get ahead of the curve in terms of investment in green technology deployment and testing of vessels. Being involved in a green corridor will allow for an "ecosystem" where the costs are spread across the various stakeholders interested in the implementation. In addition, green financing options make these investments attractive.	• Future Fleet Size Requirement • Total cost of ownership (TCO) of decarbonized options • Vessel Decarbonization pathway • Number of Newbuilds and retrofit vessels • Capital expenditures (CAPEX) requirements for converting existing vessels and new vessels and financing options
Vessel operators/ charterer	The entity that has operational control of the vessel. This entity may also be the vessel owner.	For vessel operators and charterers who have operational control, these investments will help them meet their net-zero goals and reduce their carbon footprint. In addition, will help them get ahead of the curve from an operational experience perspective.	• Understand downstream financial and non-financial impact of vessel fleet changes i.e., operating with new and retrofitted vessels and costs premiums related to alternative fuels • Identify commercial mechanisms that allow passing off some of the cost to the charterers or cargo owners • Forecast future demand for alternative fuels and ability to quickly obtain them
Cargo owners/ charterer	The entity that enlists the operator to transport their products.	Cargo owners aiming to reduce produce life cycle emissions can	• Cargo's sensitivity to shipping and transport cost
Ports	The entity that assists the vessel in loading and unloading cargo.		
Marine fuel producers	The entity that produces and supplies marine fuel		

What are the Important Questions Corridor Developers need to think about?	
Screening Considerations	What is the vision and objective of the green corridor? A well-defined end goal is a primary requirement, i.e., what are the corridor's key performance indicators (KPIs), which help understand metrics of interest to be tracked.
	What is the timeline for the formation of the green corridor?
	Is a regulatory framework in place at a country/province/port/city level to support a green corridor? If not, what advocacy needs to be done to create an enabling environment?
	What is the business case for these green corridors? What is the timeline for return on investment (ROI)
	What are the funding sources? How much governmental support is available? Green corridors are massive undertakings, and governmental support is paramount, particularly in the port and bunkering infrastructure-green corridor interface.
	Who are the members of the consortia? Ports, vessel owners/charterers, shipyards, alternate fuel producers, class societies, OEMs, regulatory and governmental bodies.
	What are the low/zero-emission fuel options and the potential for scalability for the green corridor?
	What are the trade routes, vessel segments, and cargo types that operate between ports which are part of the green corridor?

Element #2- Viable Fuel Pathways & Port Infrastructure

- An important decision-making criterion for a green corridor will be quantifying the energy demand for the corridor based on the evolution of the route, vessel utilization, vessel engine type and size.
- The producers in the consortium will need to calculate the alternative fuel demand based on the fuel characteristics.
- Decarbonization is economy wide and hence, the shipping industry will need to assess the availability of these fuels for the shipping industry.
- The green corridor consortium should help fuel producers by guaranteeing long-term demand to allow for capacity development and to corner the supply.
- The challenge that is presented when scaling alternative fuels is the need for requiring distinct bunkering infrastructure for different fuel types.

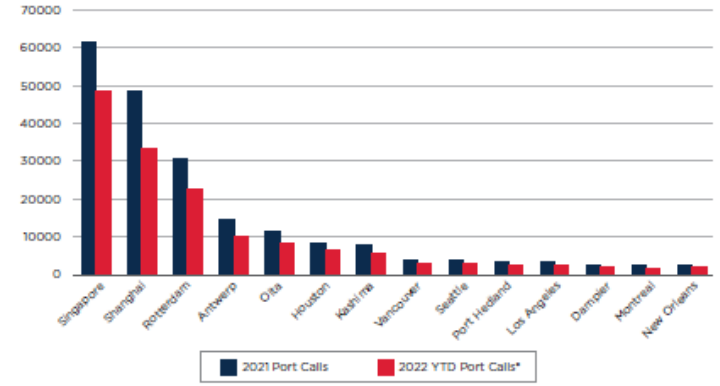
Figure 6: Overview of operational, under-construction and pending FID blue and green hydrogen projects worldwide.

Fuel	Production Pathway		Bunkering Infrastructure Status
	Strengths	Challenges	
Ammonia	• Cost of renewable NH_3 is expected to drop • Easier to store and transport • Low emission fuel with CCS production process	• Scaling up difficulties • High carbon emission in the production process • Inefficient combustion process	• Well-established worldwide distribution system, with many ships already capable of transporting ammonia • Extensive worldwide production • Green ammonia benefits from renewable H_2
Methanol	• No technical challenges in production scaling up • Commonly produced on an industrial scale • Can be used to produce many chemicals and products	• Large carbon footprint for black/brown pathways • High cost for renewable/ green pathway • Scaling up issues with green methanol • Feedstock selection for renewable methanol	• Easy to store, transport, and distribute by ship • Similar storage requirements to other common fuels • Low cost for bunkering facility modifications
Hydrogen	• Capable to be produced from renewable sources • No GHG emissions • Renewable H_2 is predicted to dominate	• High cost for H_2 production • Storage difficulties • High investment for shipping fuel application	• Infrastructure and bunkering for H_2 has not been developed • Benefit for ammonia value chain

Element #3- Shipping Impact and Logistical Case

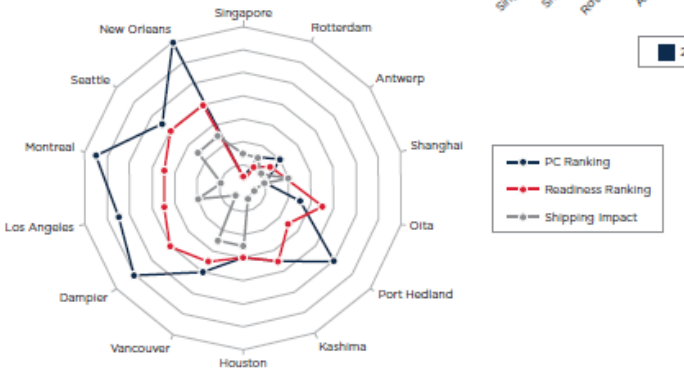
- An analysis of **port facility readiness** and **port calls** was conducted for some of the ports that have been included in the announced corridors.
- These are considered significant indicators from feasibility standpoint
- The two indicators to evaluate the trading or **shipping impacts** are the completion days and the ton-miles of each trip.
  - The completion days for one single trip are determined by the time interval between the port of destination date and the port of departure date.
  - The ton-mile is calculated by multiplying the cargoes in tons by the mileage in nautical miles, quantitatively showcasing the impact of freight or shipping activities.
- A preliminary rating of a list of port is presented in the report based on the 3 indicators considered

Port Facilities	Port Name
Onshore Power Supply	Singapore, Shanghai, Rotterdam, Antwerp, Houston, Seattle, Vancouver, Los Angeles, Montreal, New Orleans
Carbon Capture and Storage	Singapore, Shanghai, Rotterdam, Antwerp, Oita, Houston, Kashima, Port Hedland
LNG Bunkering Ready	Singapore, Shanghai, Rotterdam, Antwerp, Houston, Vancouver, Port Hedland, Dampier, Montreal, New Orleans
Ammonia Bunkering Ready	Singapore
Hydrogen Bunkering Ready	Singapore, Rotterdam, Antwerp, Los Angeles
Methanol Bunkering Ready	Singapore, Rotterdam
Biofuel Bunkering Ready	Singapore, Rotterdam, Antwerp
Windfarm Support	Shanghai



Source: Clarksons Research (https://www.clarksons.net)

Figure 8: Port Calls for the 14 Ports.



Source: Referred from Kpler database

Figure 12: Prioritization of Green Corridor Ports for Liquid Tankers.

Element #4- Policy and Regulations

- Policy and regulations are a **catalyst** for enabling these large initiatives that cover multiple stakeholders across different sectors of the economy.
- The report looked at different announced regulatory and policy support mechanisms which heavily invest in emissions reduction and sustainable development in the context of a shipping corridor.

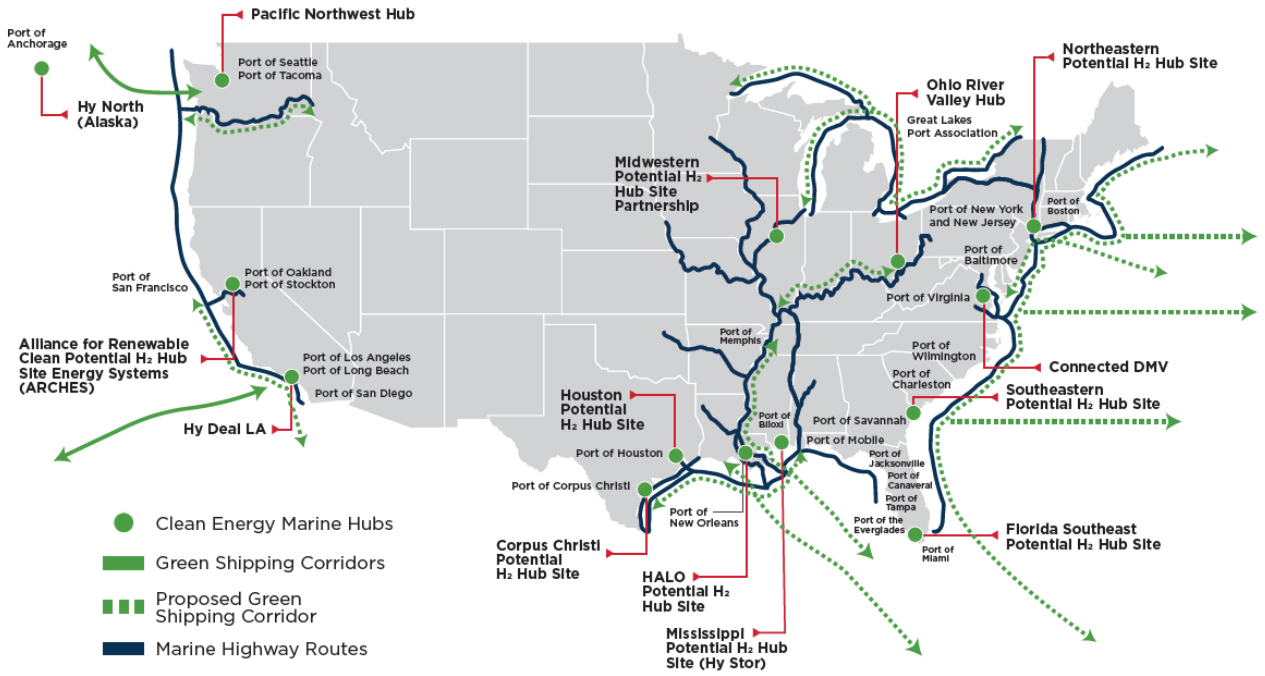
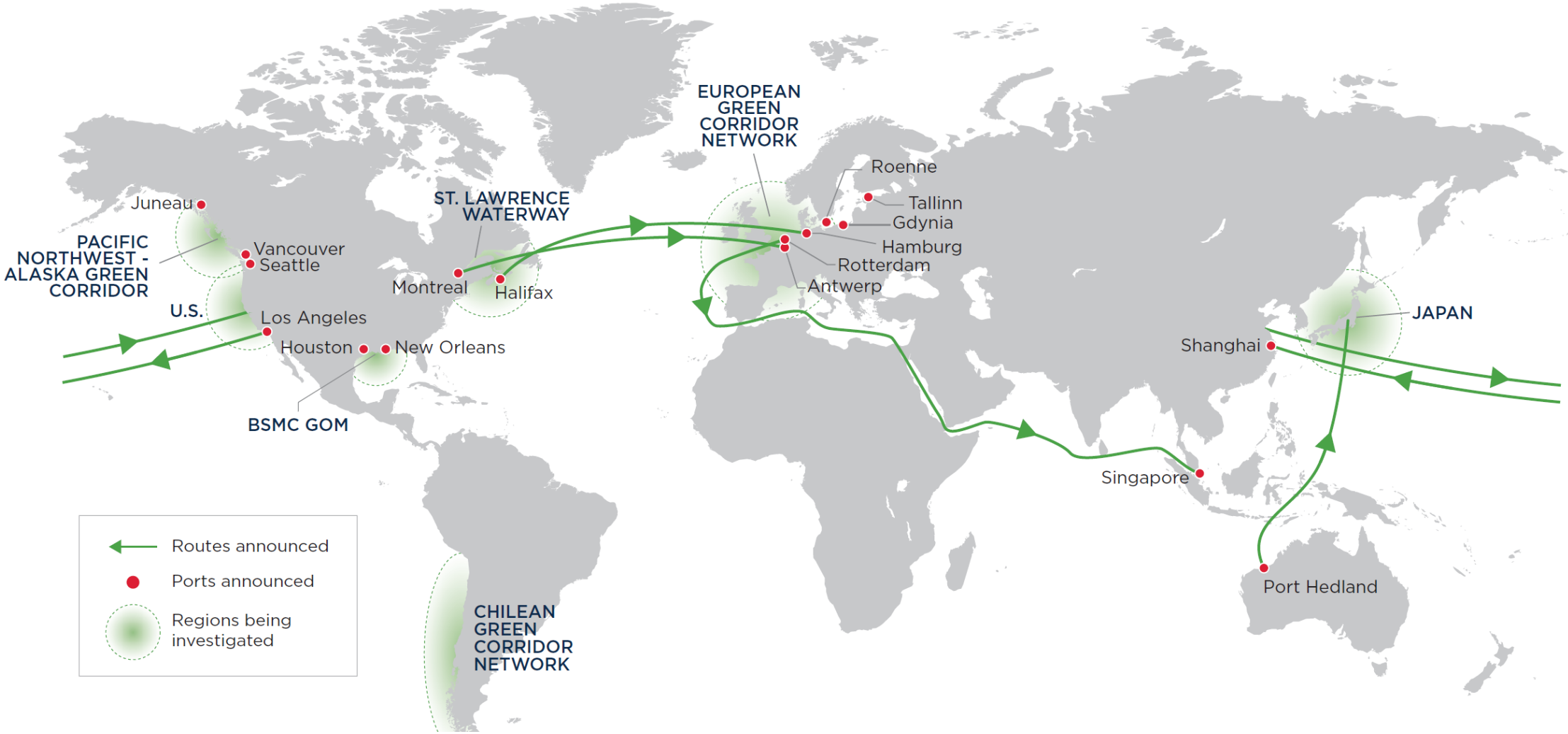


Figure 13: Connecting Hydrogen Hubs to Green Corridors.

Emission Scope, Boundaries and Metrics

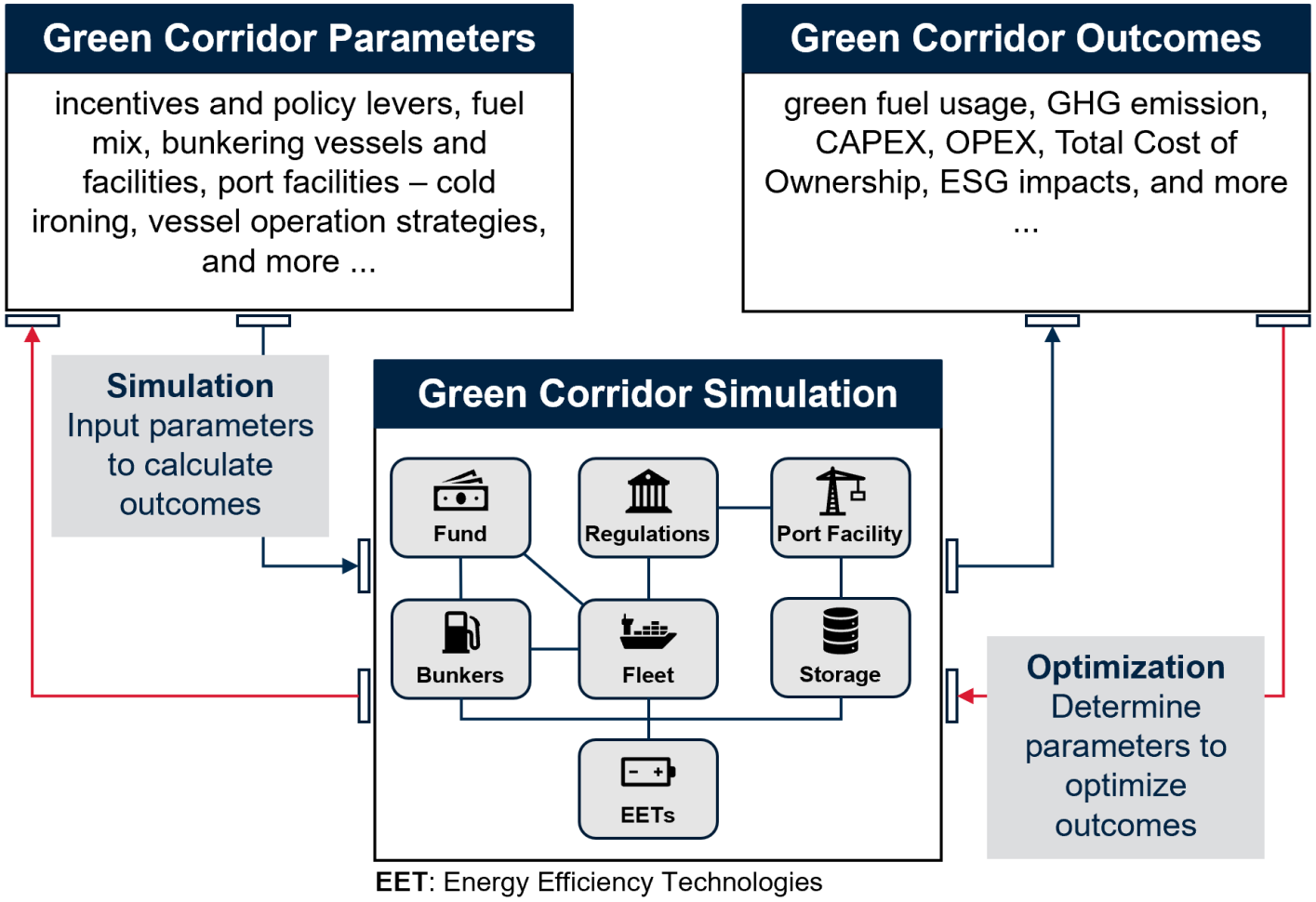
- A green corridor's success is a function of its greenhouse gas (GHG) emissions reduction potential, and for that to be a controlling metric, the **calculations need to be robust** and should follow commonly accepted standards such as ISO 14064-1, GHG protocol requirements and other maritime industry-specific methodologies.
- To improve the robustness of maritime emissions estimations, **life-cycle analysis (LCA)**, which is the estimation from well-to-tank (WTT) and tank-to-wake (TTW) of the fuel-related emissions should be followed.
- Each of the value chain stakeholders should clearly **demarcate their boundary and consistently calculate their baseline emissions**.
- To further improve confidence in the estimation, they may need to be **assured or certified by independent third parties**.

Currently Announced Green Shipping Corridors



ABS Green Shipping Corridor - Simulation Tool

- **How it will work**
  - Model the dynamic relationship between elements of a green corridor
  - **Simulation:** Stakeholders can assess the impact of various parameters on green corridor outcomes
  - **Optimization:** Adjust the parameters to achieve certain objectives



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