OPPORTUNITIES AND CHALLENGES IN DEVELOPING PORT INFRASTRUCTURE FOR ZERO EMISSIONS SHIPPING

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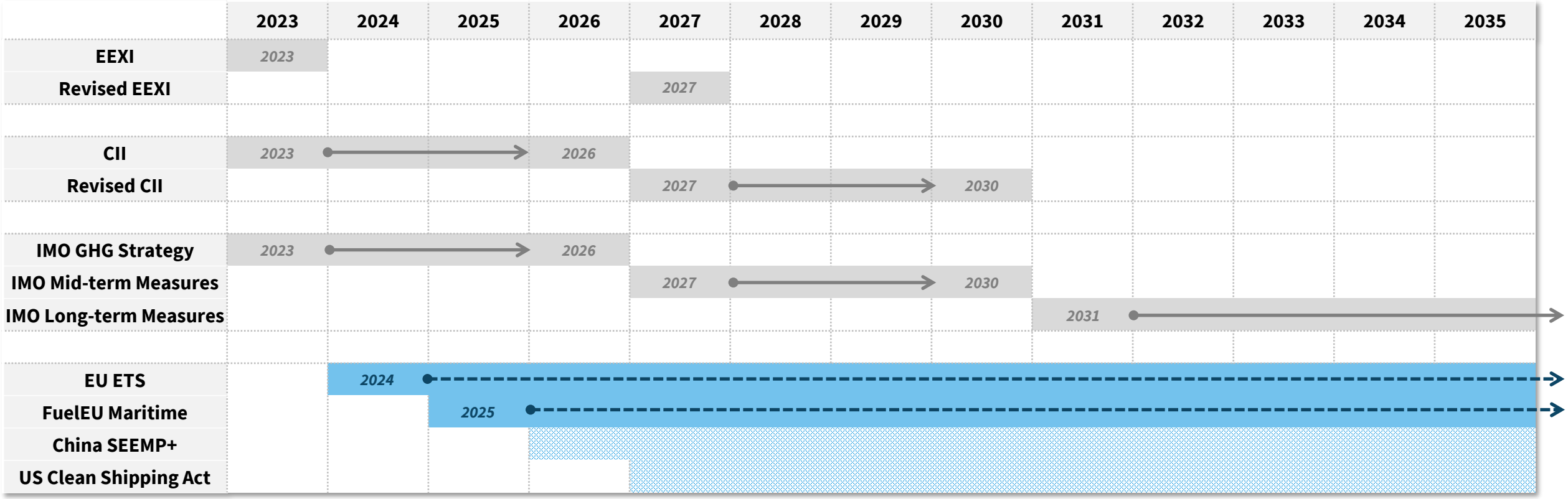
Maritime Regulatory Landscape

A raft of stringent environmental regulations is being rolled out, but we face a possible fragmented regulatory landscape



IMO Measures

- **Short-term GHG reduction measures (2018-2023):** targeting the energy efficiency and carbon intensity of international shipping
- **Medium-term GHG reduction measures (2024-2030):** targeting direct GHG emission reduction and uptake of “clean” fuels across international shipping
- **Long-term GHG reduction measures (after 2030):** to be developed as part of the 2028 review of the IMO GHG Strategy

Maritime Regulatory Landscape

Although measures are designed to help decarbonise the sector, there is still a lot of uncertainty over practicalities

Adopted at MEPC 80th session (July 2023) and subject to 5 yearly review.

Next review and update in 2028.

2023 IMO GHG Strategy

Basket of measures:

Combination of an economic and a technical element.

- **Technical Element**
  - Synergy with CII
  - Goal Based Marine Fuel Standard
    - LCA Guidelines
- **Economic Element** (GHG price mechanism)
  - Levy or Cap & Trade (ETS)
  - Feebate Mechanism (fee + rebate)

The economic and technical element is under development/discussion.

(Adoption: 2025 / EIF: 2027)

MEDIUM-TERM GHG REDUCTION MEASURES	
Technical Element	*A goal-based marine fuel standard that regulates the phased reduction of the GHG intensity of marine fuels*
Economic Element	*A maritime GHG emissions pricing mechanism*

WHAT IS A FEEBATE MECHANISM?

A feebate system is a levy-based system that uses all or part of the revenues raised through the levy/fund/contribution to offer rebates to first movers and reward vessels that are built for and will utilise alternative "clean" marine fuels.

What is the Solution to Shipping's Decarbonisation Journey?

A multifaceted approach that looks at the market holistically is needed

Alternative Fuels

Carbon Intensity: Depends on production pathway.

Multitude of Options: LNG, LPG, Biofuels, Hydrogen, Methanol, Ammonia, Electric

Energy Saving Devices

ESDs: Immediate carbon intensity reductions.

But emissions improvements can be limited based on ship's operational profile / technical specification.

Operational Pathways

Vessel: Size, Utilisation and Speed Reductions

Routing: Weather Routing and Route Optimisation

"Just in Time" Shipping

Energy Storage Systems

Batteries

Others

Ports are crucial in the decarbonisation of shipping

Preparation for the decarbonised future require numerous critical decisions

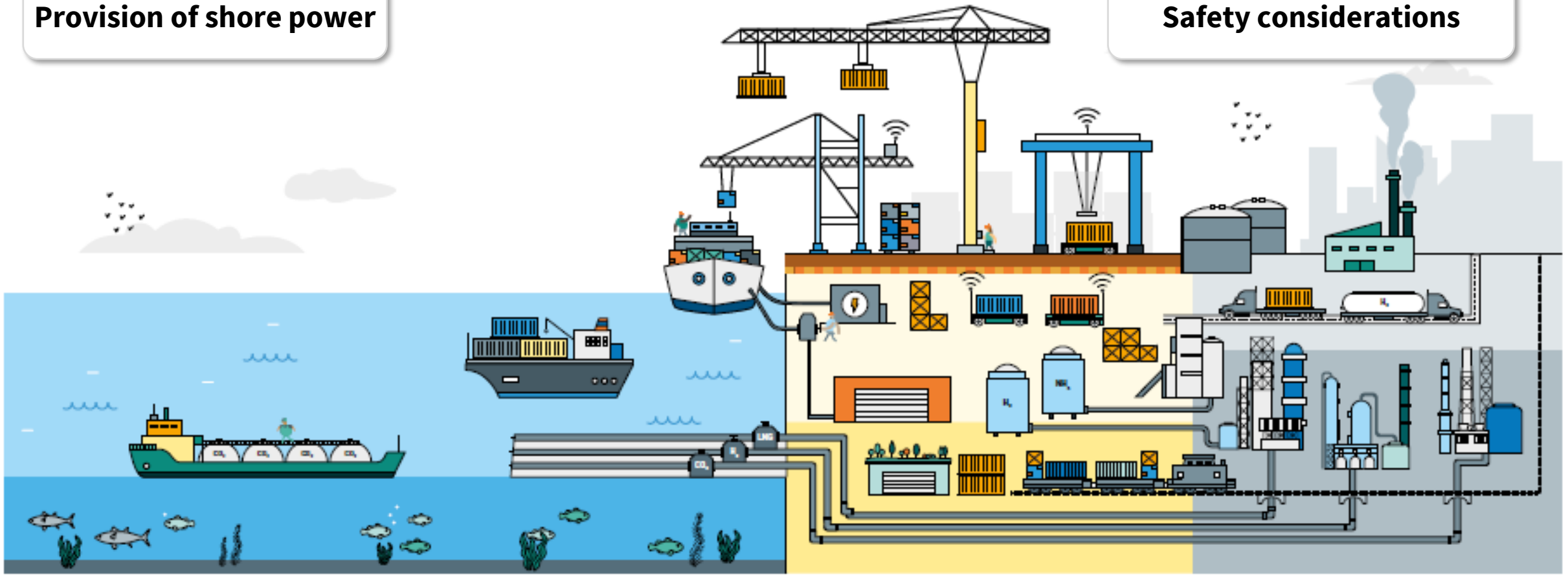
Prepare for multifuel scenario

Operations planning and cooperation

Permitting for bunkering and storage

Provision of shore power

Safety considerations



How can ports & shipping companies collaborate to reduce emissions?

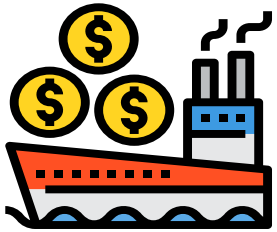
Vessel traffic optimisation will become key in addressing the needs of both ports and vessels

DATA

- Top 3 ports Shanghai, Singapore, Ningbo move on average 100,000 containers per day
- Each of these ports have over 80 reported port breakdowns a year causing delays in operations

DECARBONISATION

- Huge pressure on shipping to decarbonize, both from regulators, shippers and owners/operators
- Widely recognized that optimizing port performance is as important as ships



DIVIDENDS

- 2023 maritime tech investment of $18.8 Bn
- 30% of that investment went to initiatives to optimize logistics and port/terminal management, 30% went to ship operations optimization solutions

NEEDS

- No longer possible to use fixed services/pro-forma, **need for vessel & port rotation optimization**
- **Demand and supply instability means more container repositioning required**
- **Lower freight rate means pressure to reduce operating cost, less room for failure & more accurate data to drive decisions**

Resulting in strategic moves to address these challenges

ONE OCEAN NETWORK EXPRESS

- Implemented flexible service adjustments in line with supply and demand
- Optimize ONE container distribution by efficient container repositioning

MAERSK

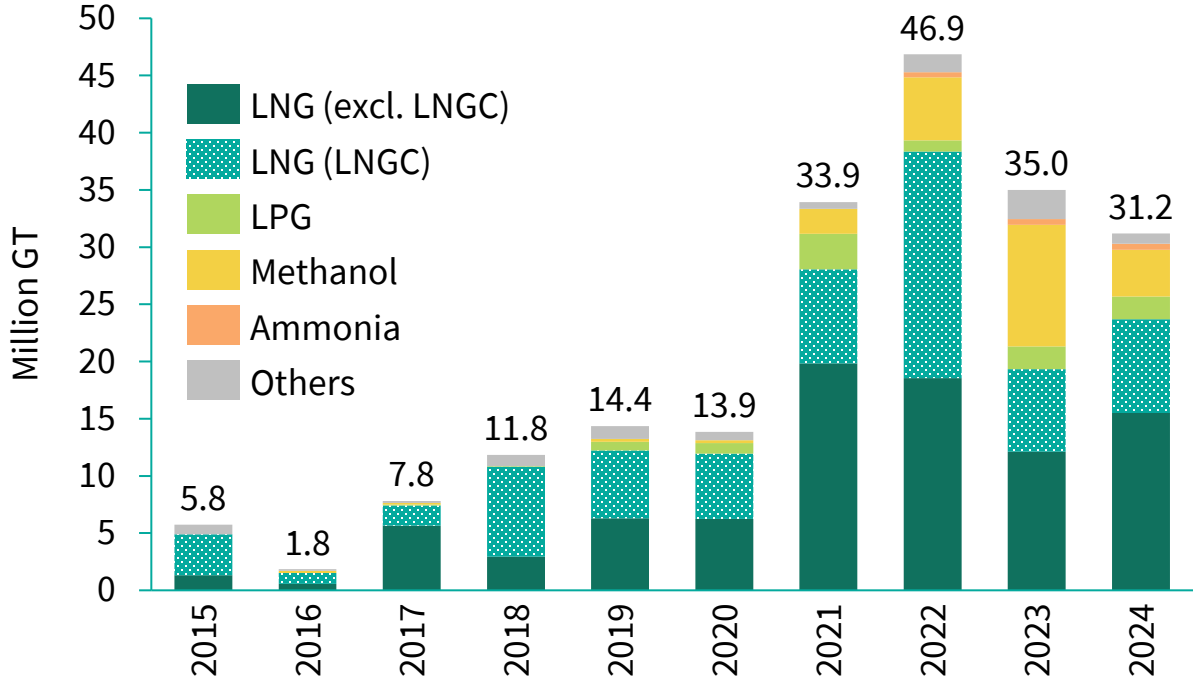
Hapag-Lloyd

- As a part of the agreement, the two companies have set the ambitious target of delivering a schedule reliability of above 90% once the network is fully phased in. This objective is backed by a strong governance model and contractual obligations

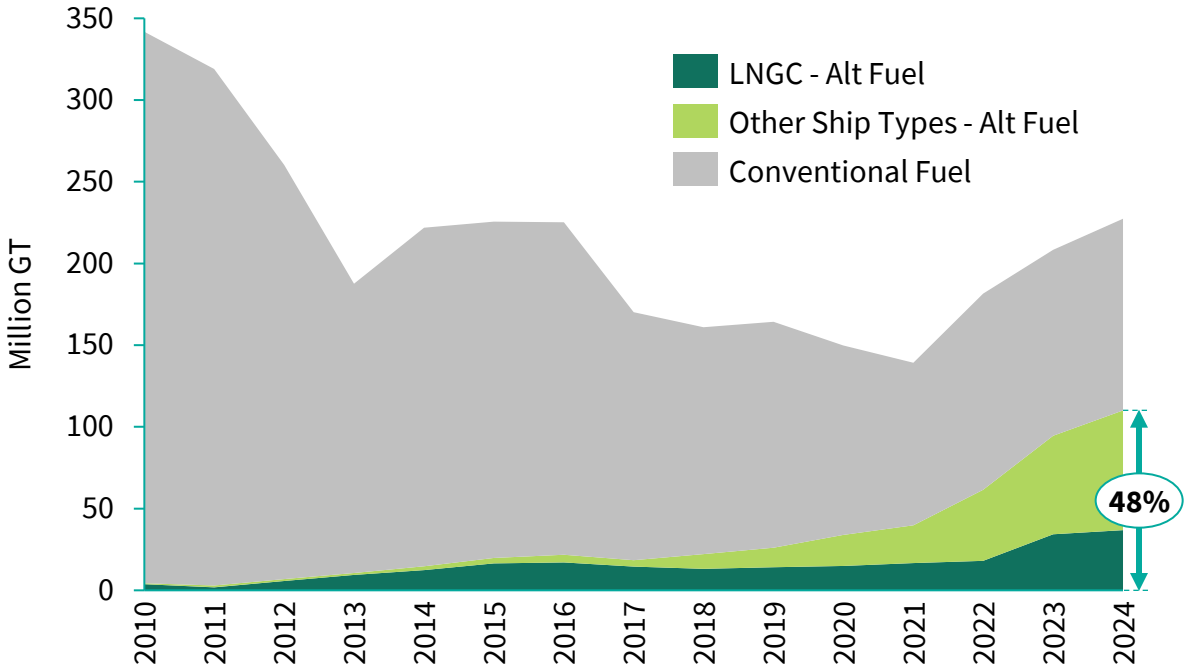
Newbuild Contracting and Alternative Fuels

Definite acceleration in alternative fuelled newbuild contracting in recent years with a sizeable orderbook

Alternative Fuel Newbuild Contracting, 2015-Present



Global Orderbook by Fuel Type, 2010-Present



LNG DF Vessels (Excl. LNG Carriers)	
586	634
In Service	On Order

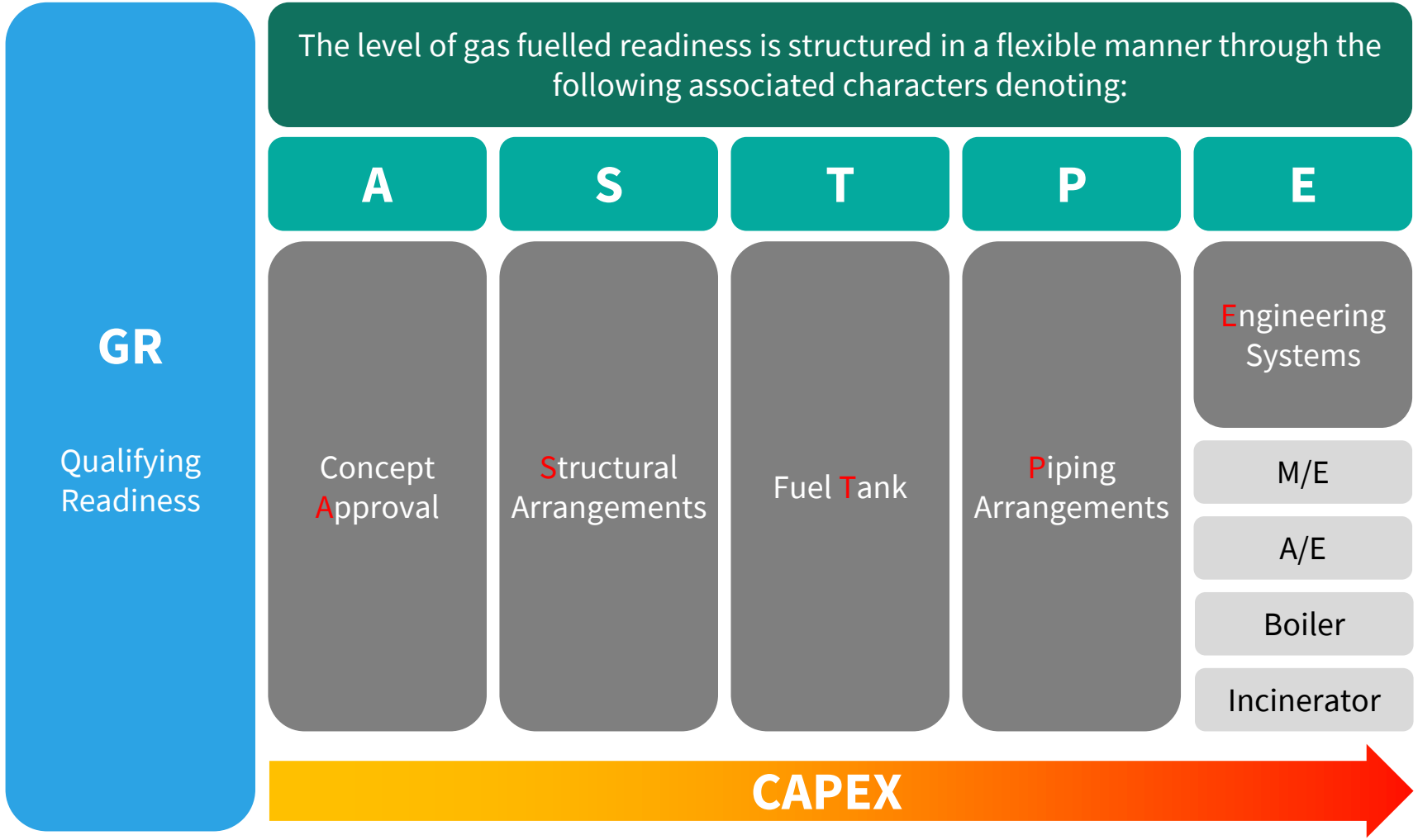
Methanol DF Vessels	
37	253
In Service	On Order

Ammonia DF Vessels	
3	28
In Service	On Order

Source: Clarksons Research, August 2024

Hurdle 1: There is a Difference Between “Capable” and “Ready”

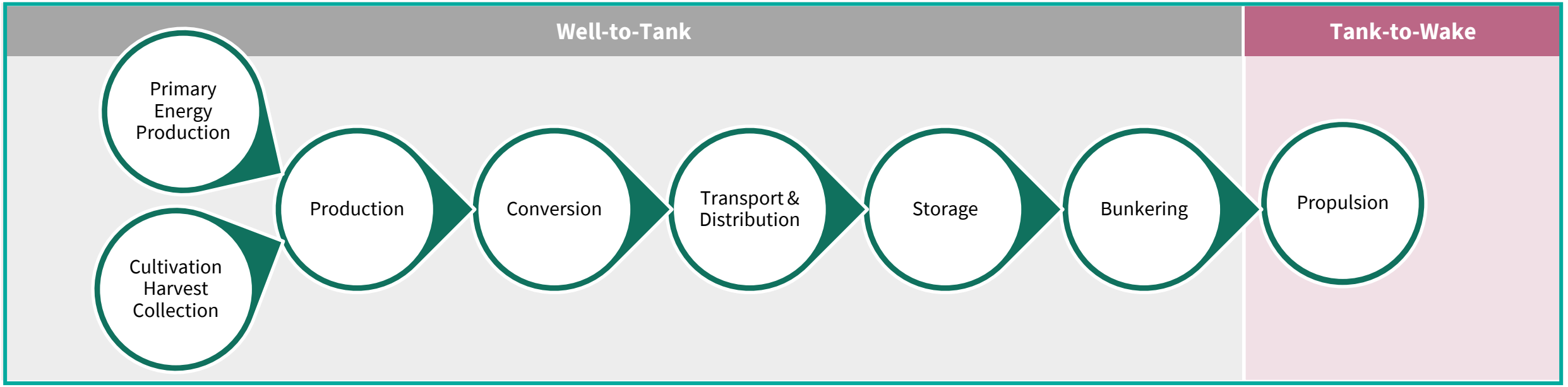
“Gas Ready” can encompass a wide range of readiness



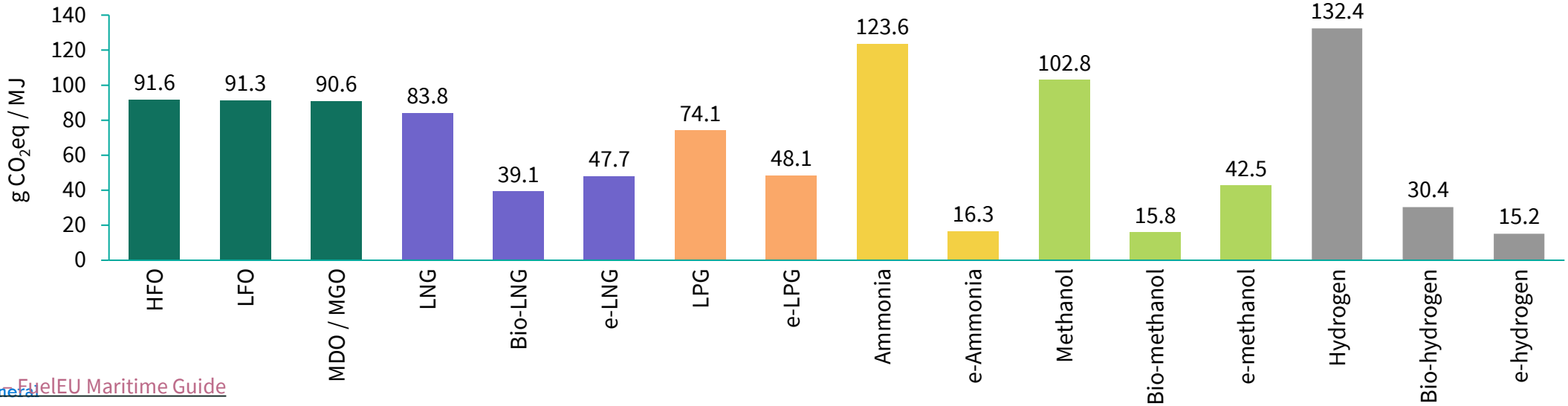
The descriptive note would represent an approval of a conceptual design and / or installation by LR and it is possible that the Flag Administration may or may not accept the use of a toxic fuel or may or may not accept the conceptual design

Hurdle 2: Fuel Production Pathways are Important

Emissions are measured on a well-to-wake basis



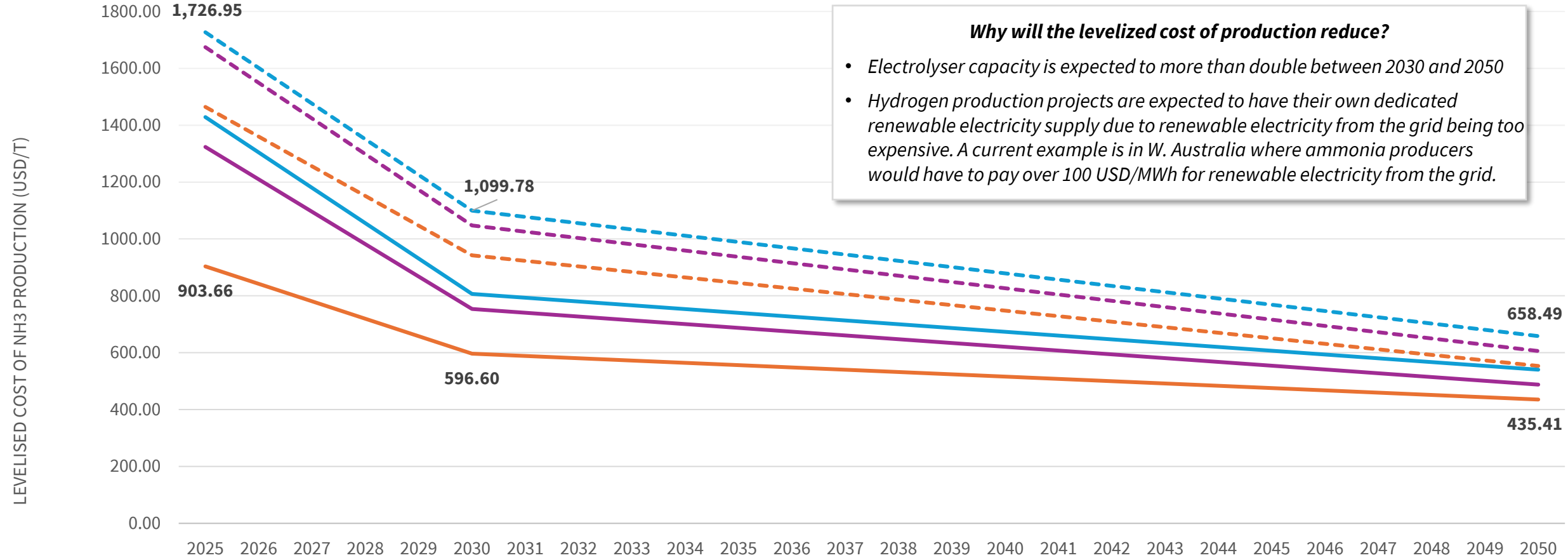
WELL-TO-WAKE GHG EMISSIONS



Source: Sustainable Ships – FuelEU Maritime Guide

Hurdle 3: Fuel Pricing

Zero carbon fuels are currently prohibitively expensive, but this is expected to change moving forwards



Why will the levelized cost of production reduce?

- *Electrolyser capacity is expected to more than double between 2030 and 2050*
- *Hydrogen production projects are expected to have their own dedicated renewable electricity supply due to renewable electricity from the grid being too expensive. A current example is in W. Australia where ammonia producers would have to pay over 100 USD/MWh for renewable electricity from the grid.*

	2025	2030	2050
Solar PV (Low)	903.66	596.60	435.41
Solar PV (High)	1464.45	942.28	553.49
Onshore Wind (Low)	1323.66	754.10	487.91
Onshore Wind (High)	1674.45	1047.28	605.99
Offshore Wind (Low)	1428.66	806.60	540.41
Offshore Wind (High)	1726.95	1099.78	658.49

Hurdle 4: Landside Infrastructure

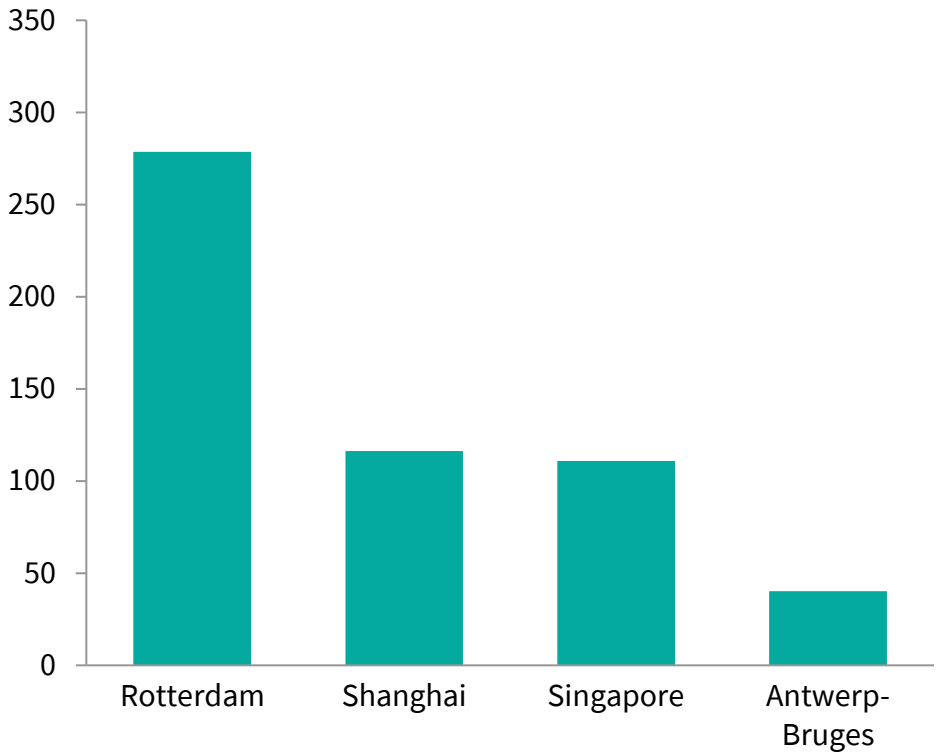
Facilities for alternative fuels are at a nascent stage of development at major bunkering hubs and volumes are minimal

Top 10 Bunker Ports: Fuel Availability

Rank	Port	Conventional	LNG	Biofuel	Methanol	Ammonia	Hydrogen
1	Singapore						
2	Rotterdam						
3	Fujairah						
4	Zhoushan						
5	Antwerp						
6	Panama						
7	Hong Kong						
8	Busan						
9	Gibraltar						
10	Houston						

This information is collected on a best-efforts basis from a range of sources and should be used for guidance purposes only.

Top 4 LNG Bunker Ports by Volume, 2023 ('000 T)



Legend

Available at Scale	Potential / Pending / Pilot Project
Available at Small Scale (Ship-to-Ship)	Not Available / No Announced Plans
Available at Small Scale (Truck-to-Ship)	

Hurdle 5: The Human Factor

Training crew and mitigating human risks is a key challenge for owners and operators

Mitigating human risks

There is need for:

Engineering principles like ergonomics in vessel design *

Enhancements to safety and environmental management systems and approach *

Training crew

Significant gaps in training frameworks to prepare crew:

LR Maritime Technology Forum project: "Operational Management to Accelerate Safe Maritime Decarbonisation"

Gaps identified and recommendations made across STCW, MLC and ISM frameworks

*Based on research commissioned by LR's Decarbonisation Hub and Maersk McKinney Moller Centre for Zero Carbon Shipping

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Thank you