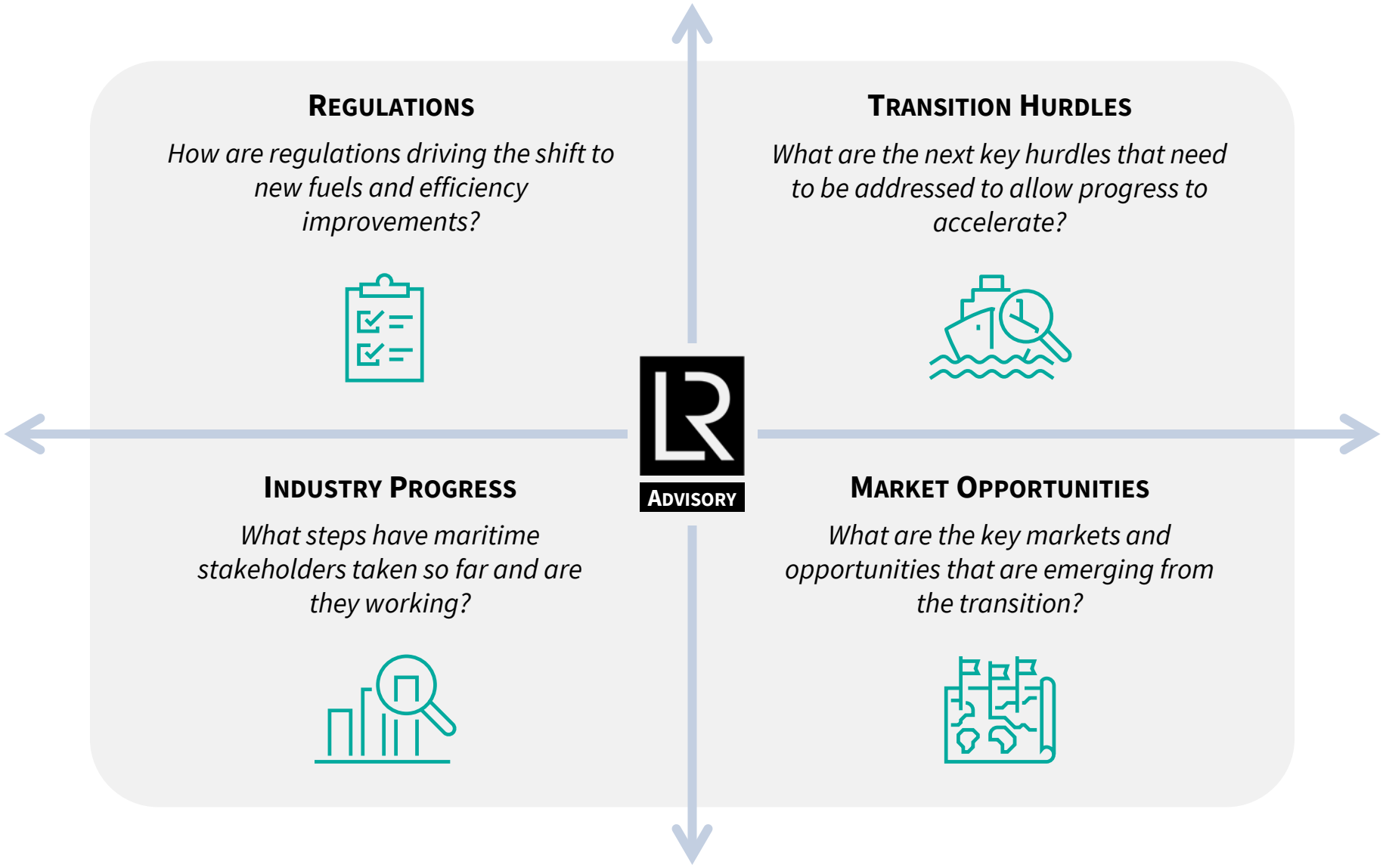
To 2030 and Beyond

Pathways through the Energy Transition

Jack Spyros Pringle, Marine Money Asia 2024

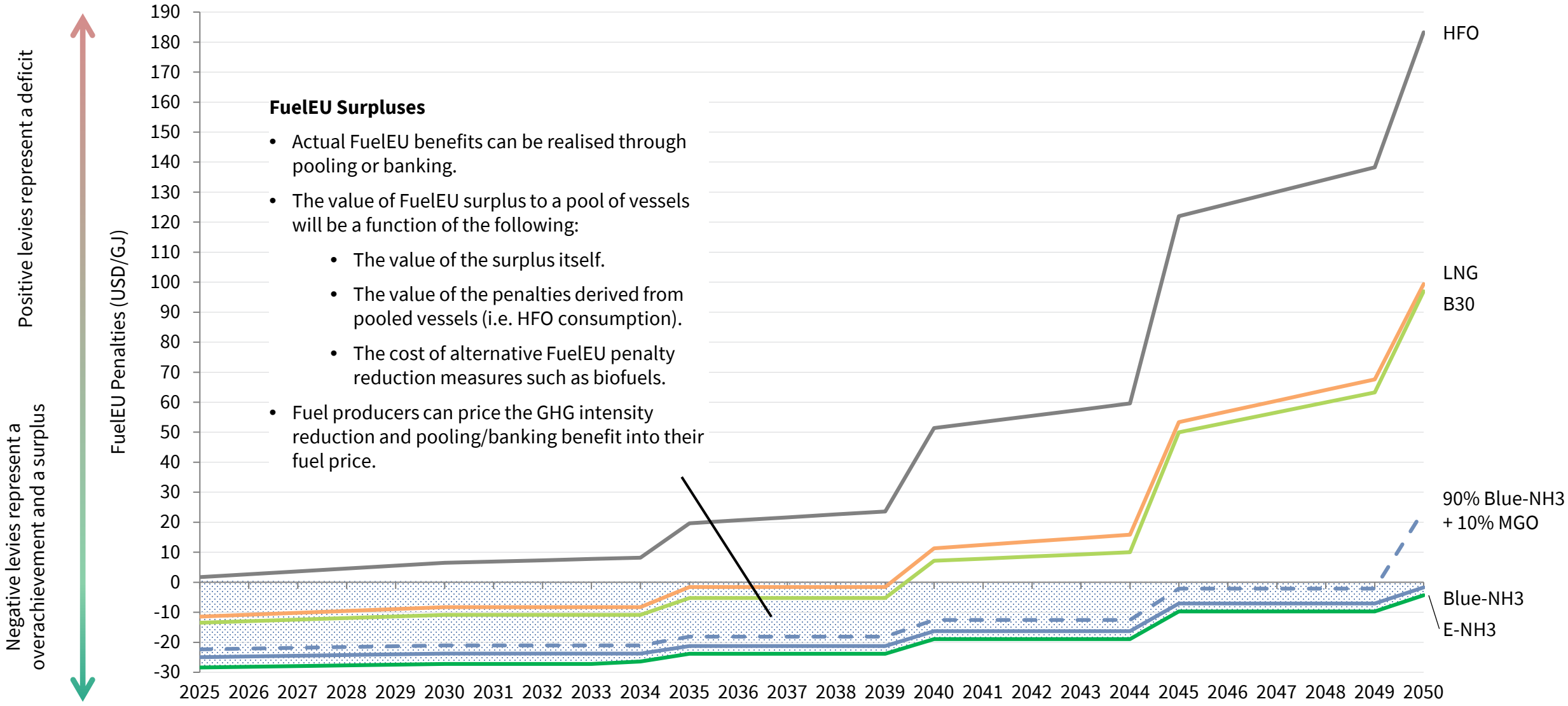
25 September 2024

To 2030 and Beyond: Pathways through the Energy Transition



1. Regulations: Emission levies designed to drive alternative fuel uptake

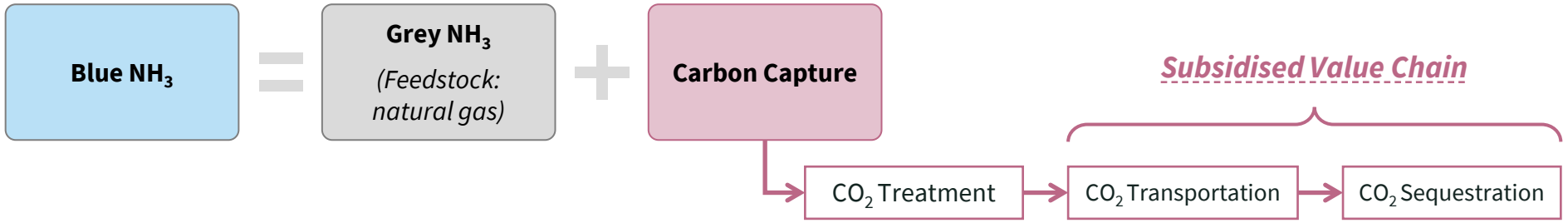
FuelEU Maritime is prompting a fuel producers to take a deeper look at maritime



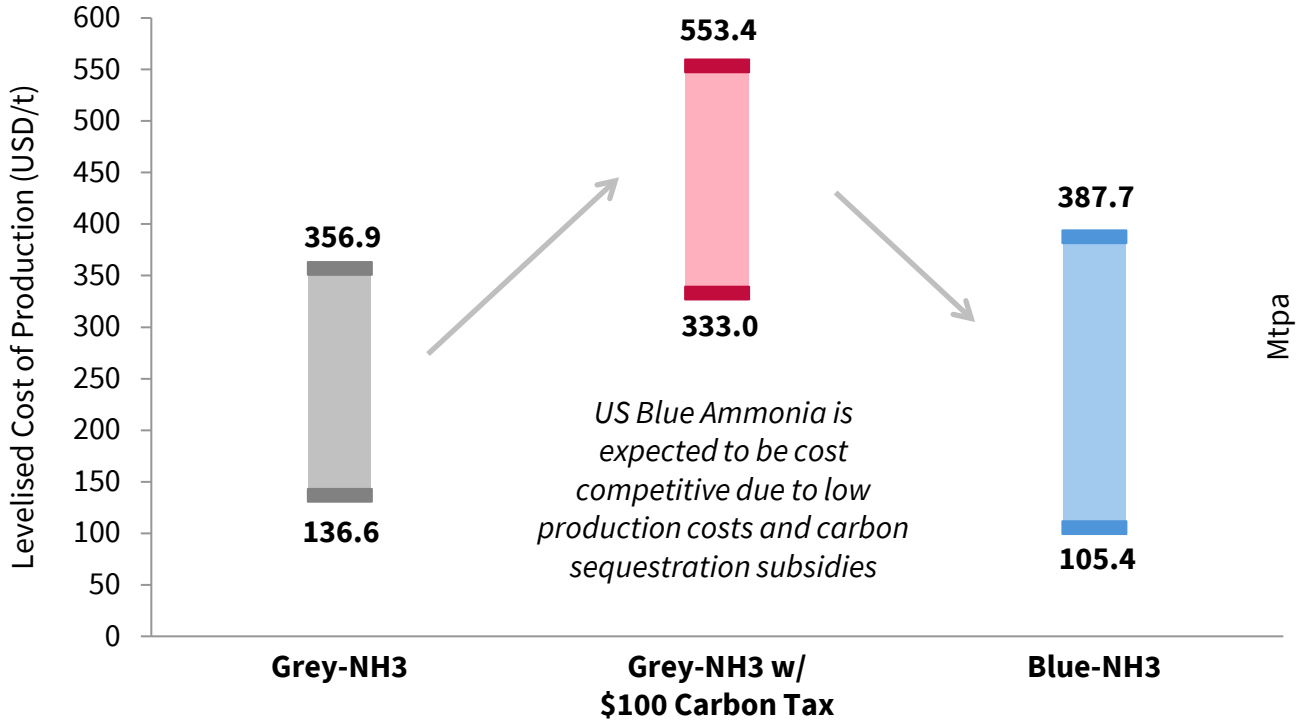
Sources: LR Advisory, EU

1. Regulations: Subsidies for fuel producers are beginning to work

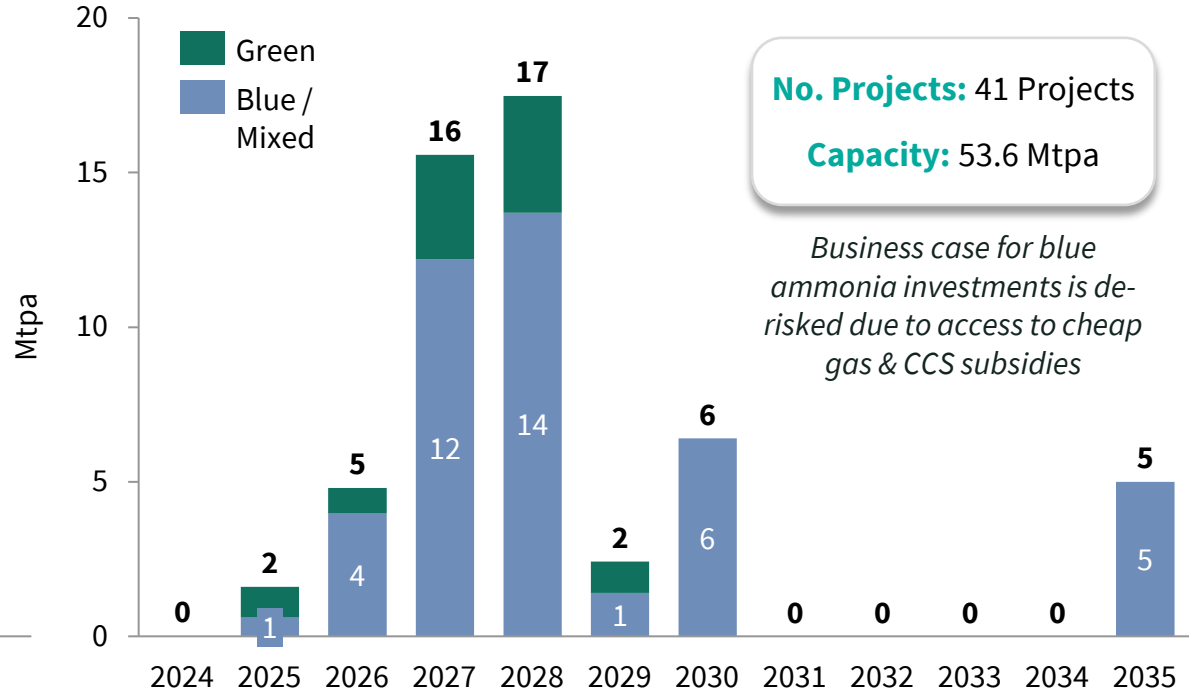
US Blue Ammonia is expected to be cost competitive over Grey Ammonia due to the US IRA 45Q CO_2 sequestration subsidy



US Ammonia - Levelised Cost of Production (USD/t)



US Ammonia Production – Announced Capacity (Mtpa)



Sources: LR Advisory, S&P, IEA

2. Transition Hurdles: A multifaceted approach that goes beyond future fuels

What are the major additional barriers to shipping's decarbonisation journey?

Efficiency Improvements

Emissions improvements from technologies can be limited and are often uncertain

Chartering and operational optimisation requires push from the cargo interests

Bunkering Infrastructure

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

Port	Conv.	LNG	Biofuel	MeOH	NH3	H2
Singapore						
Rotterdam						
Fujairah						
Zhoushan						
Antwerp						
Panama						
Hong Kong						
Busan						
Gibraltar						
Houston						

Legend: *Available at Scale* → *Not Available*

Human Factors

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

Engineering principles like risk-based vessel design & certification

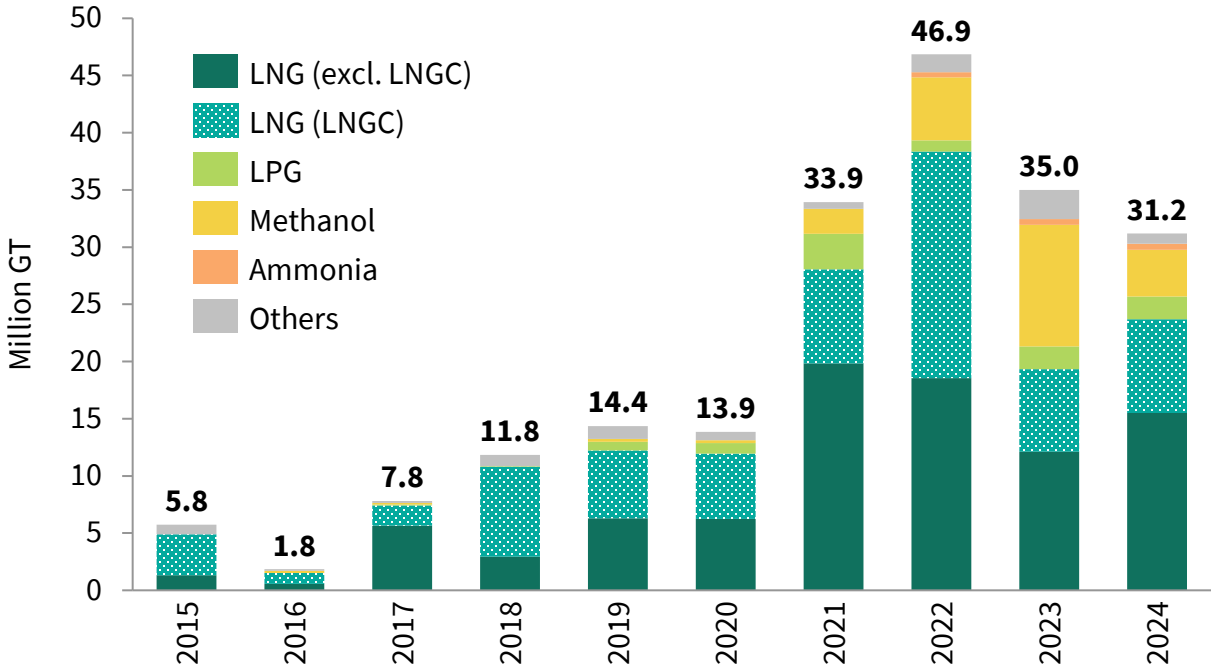
Enhancements to safety & environmental management systems & approach

Training gaps identified across STCW, MLC and ISM frameworks

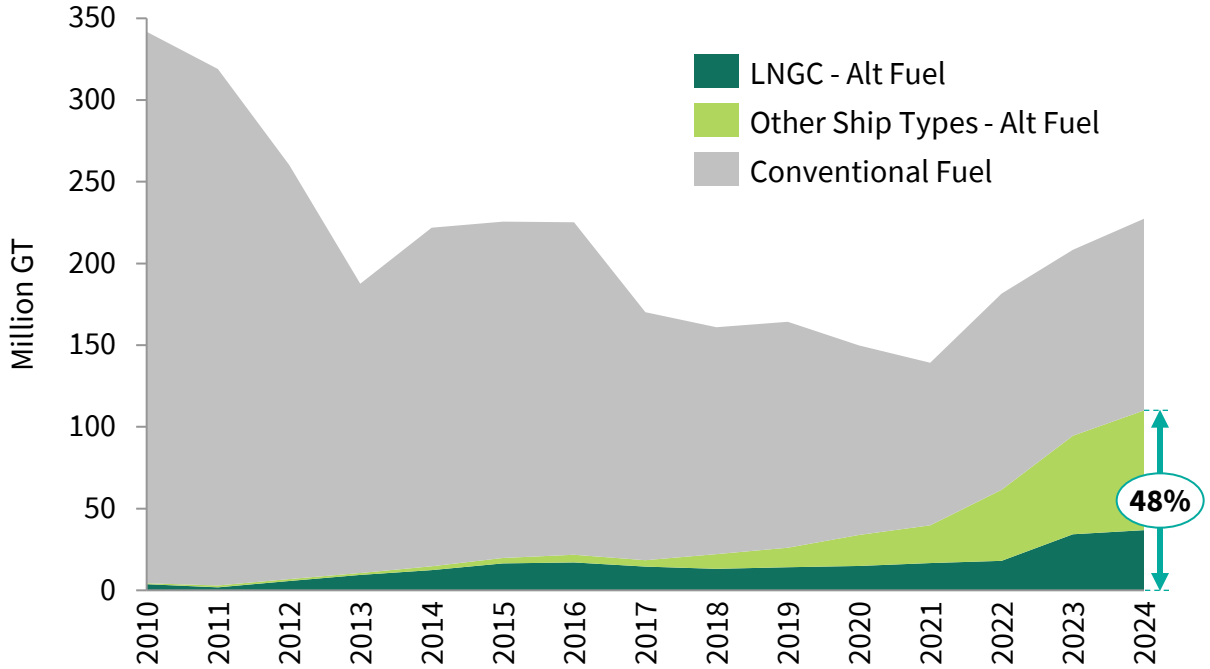
3. Industry Progress: Alternative fuelled newbuild contracting is growing

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 In Service	634 On Order

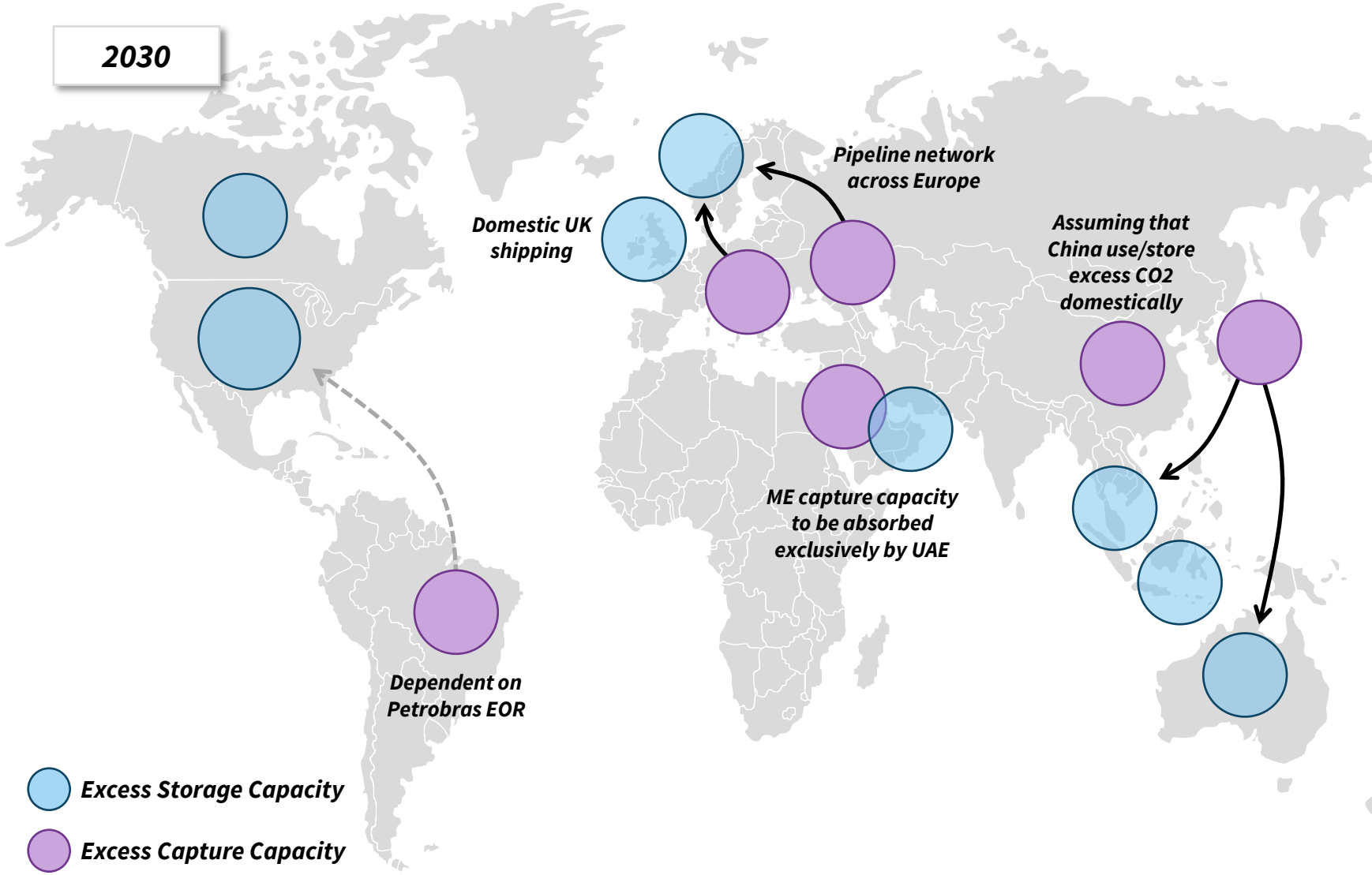
Methanol DF Vessels
253 On Order

Ammonia DF Vessels
28 On Order

Source: Clarksons Research, August 2024

4. Market Opportunities: LCO_2 Shipping

Two distinct LCO_2 markets begin to emerge in 2030 with Japan and Europe having significant volumes of excess carbon



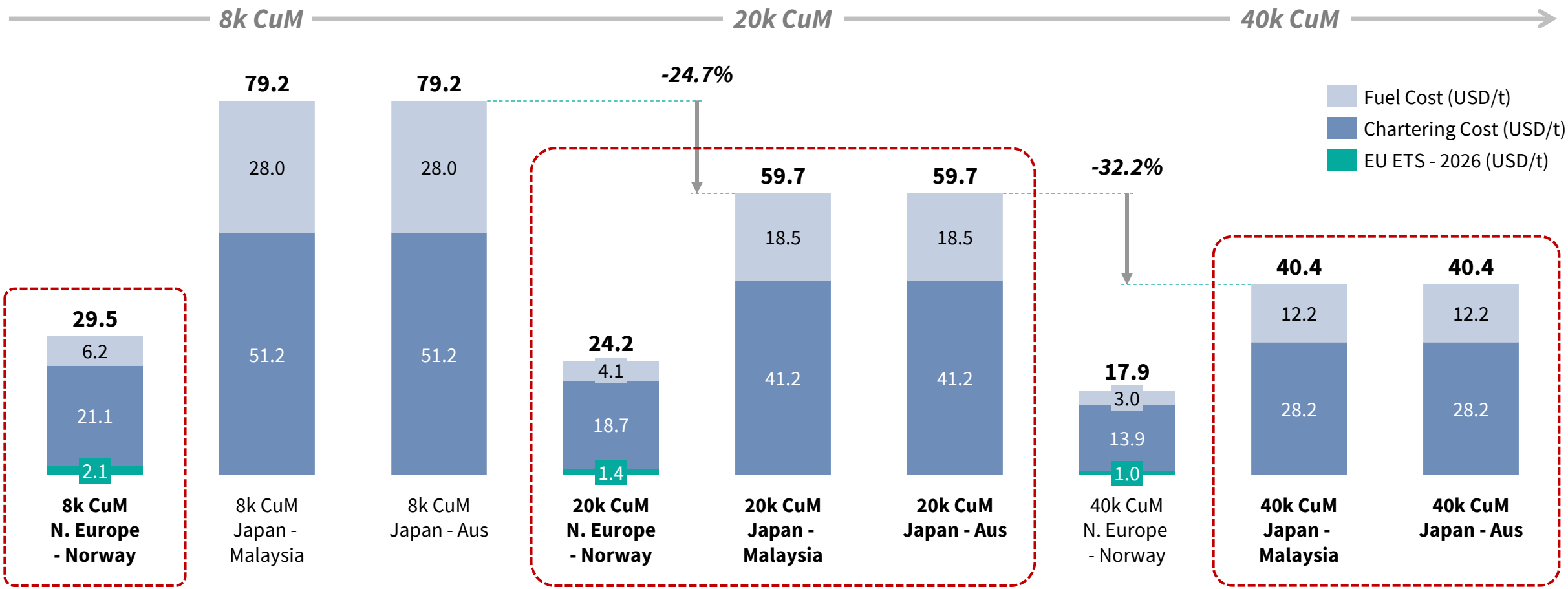
Key Considerations

- Medium Pressure vs. Low Pressure LCO_2 carriers?
  - Could be defined by the landside infrastructure specification
  - Medium pressure limits landside CAPEX but limits vessel size
- Pipeline network will be key, especially in Europe
- Vessel sizing for non-project-based vessels will be a challenge - which is the least costly option?
- Multi-gas carriers are an attractive option but will be operationally and commercially impractical
- Cargo purity is a challenge - how do you handle this in a fragmented market?

Sources: LR Advisory, CCS Institute

4. Market Opportunities: LCO_2 Shipping

Is there an optimal vessel size for flexible deployment in Europe and the Far East?



Optimal sizing for N. Europe trades due to fragmented market

Is a 20k LCO2 Carrier a safe bet?

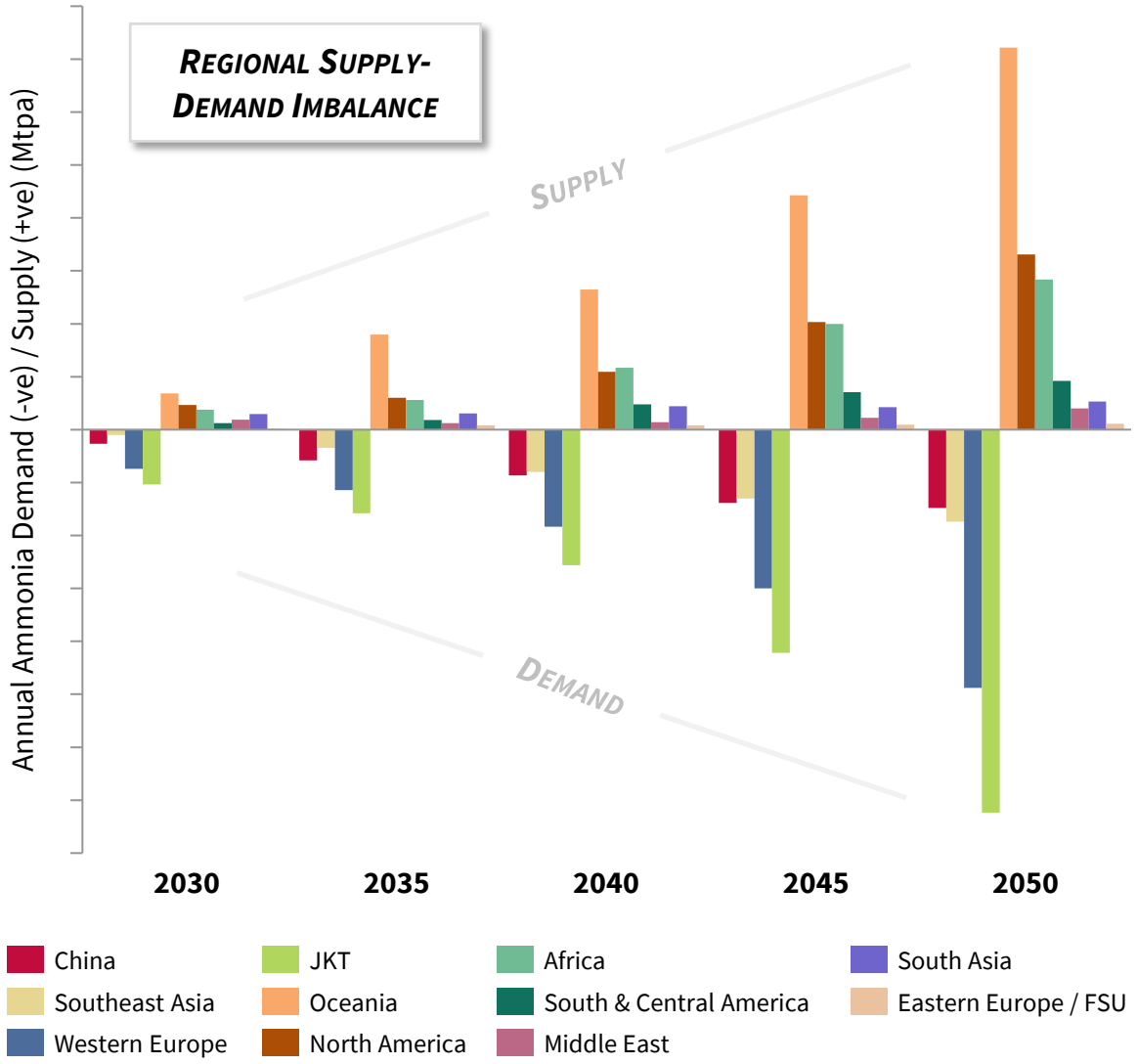
Potentially suitable for both EU & Far East trades, allowing owners to re-deploy vessels if the either LCO_2 market doesn't materialise due to lack of or low subsidies

Optimal sizing for Far East trades due to lowest Unit Shipping Costs

Source: LR Advisory

4. Market Opportunities: Ammonia Shipping

JKT will be the main demand pull for clean ammonia whilst Oceania, N. America & Africa will be the main exporting regions

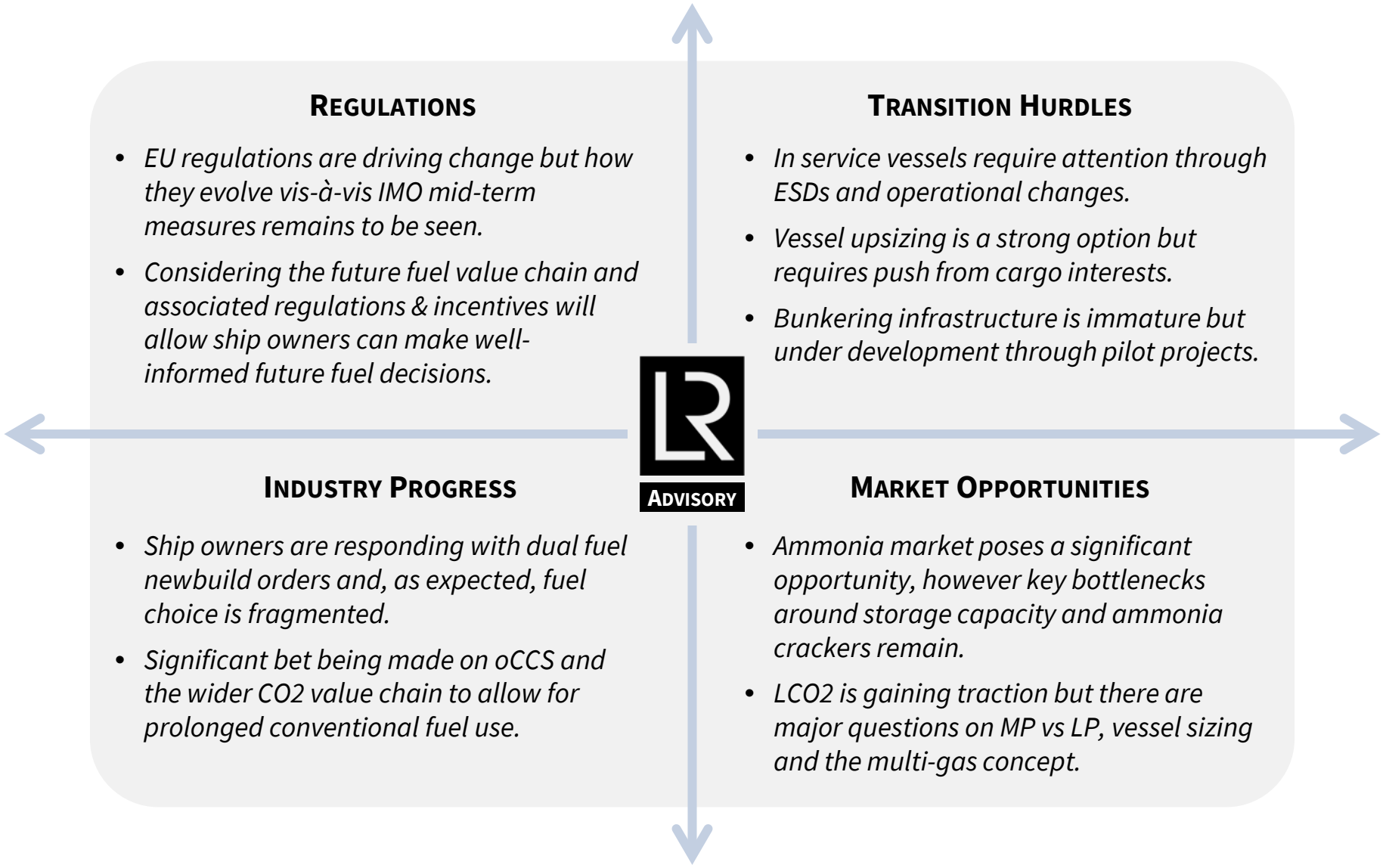


KEY CONSIDERATIONS

- Two major clean ammonia demand end-uses:
  - Hydrogen carrier & power generation
  - Maritime fuels
- Will bottlenecks around ammonia storage capacities be addressed in before VLACs are delivered?
  - Only two terminals in S. Korea can currently handle VLAC parcel sizes
  - Japan currently have no VLAC-suitable NH3 tank facilities
- There is a significant number of VLACs currently on order, many of them being speculative orders.
- Will H2 players opt for domestic H2 production instead of using ammonia as an H2 carrier?
  - There is a distinct lack of industrial-size ammonia crackers and have a current development horizon of approx. 3 years
- Will the structure of the ammonia carrier chartering market be closer to the early LNGC days or that of LPG carriers?
  - Long-term project-based contracts vs. spot

Source: LR Advisory

Summary: Progress is accelerating but major uncertainty remains



Thank you

Jack Spyros Pringle

Energy Transition Advisory Lead

Jack.Pringle@lr.org

+65 9728 5188