

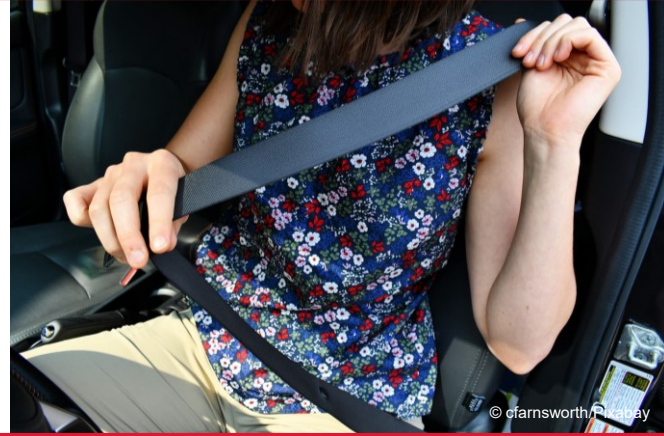


Northern Europe Regional Committee Meeting



COPENHAGEN | MARCH 16, 2023

Safety Moment – Seat Belts



SEAT BELTS: THE FACTS

Wearing a seat belt reduces the risk of fatal injury by:

Up to 50%
for occupants in the front seat



Up to 75%
for occupants in the back seat



Crashing at 60 miles per hour is equivalent to falling from a 5-story building.

This sudden deceleration could also damage internal organs.



Source: <https://www.nhtsa.gov/risky-driving/seat-belts>, <https://www.grsroadsafety.org/arc/seat-belts-the-facts-infographic-2-2/>



Agenda

Welcome and Safety Moment

Committee Chairman's Opening Remarks

ABS Address

Market Outlook and Trends

ABS in Northern Europe

Break

Regulatory Update

Sustainability Update

Technology Update

Q&A

Committee Chairman's Closing Remarks

ABS Closing Remarks

Committee Chairman's Opening Remarks

MR. PALLE LAURSEN | MARCH 2023



ABS Address

JOHN MCDONALD | MARCH 2023



Our Safety-Centric and Mission-Driven Strategy Has Served Us Well

Our Mission Drives Our Existence

To serve the public interest as well as the needs of our members and clients by promoting the security of life, property and preserving the natural environment.

Our Strategy Ensures Relevancy and Sustainability

To be the global leader in classification, consulting and software services related to complying with safety and environmental requirements and managing risk and reliability for the marine, offshore, energy, and government sectors.

We will achieve this through investments in

- People
- Digital Technology
- New Products and Services

that support the advancement and application of industry standards and best practices.

Our Values Define Our Culture

The SPIRIT of ABS –

Safety | People | Innovation | Reliability | Integrity | Teamwork | Quality



Our Safety-Centric and Mission-Driven Strategy Has Served Us Well

5 Elements

- Being the Marine and Offshore Industry Class Leader
- Being the Recognized Marine, Energy and Government Sector Technology Authority and Leader
- Leveraging Our Domain Expertise and Client Relationships to Create New Growth Opportunities by Creating Value for Our Clients
- Investing in the Transformation of Class Services and People Development
- Securing and Enhancing Long-Term Sustainability and Market Relevance

Four Areas of Excellence

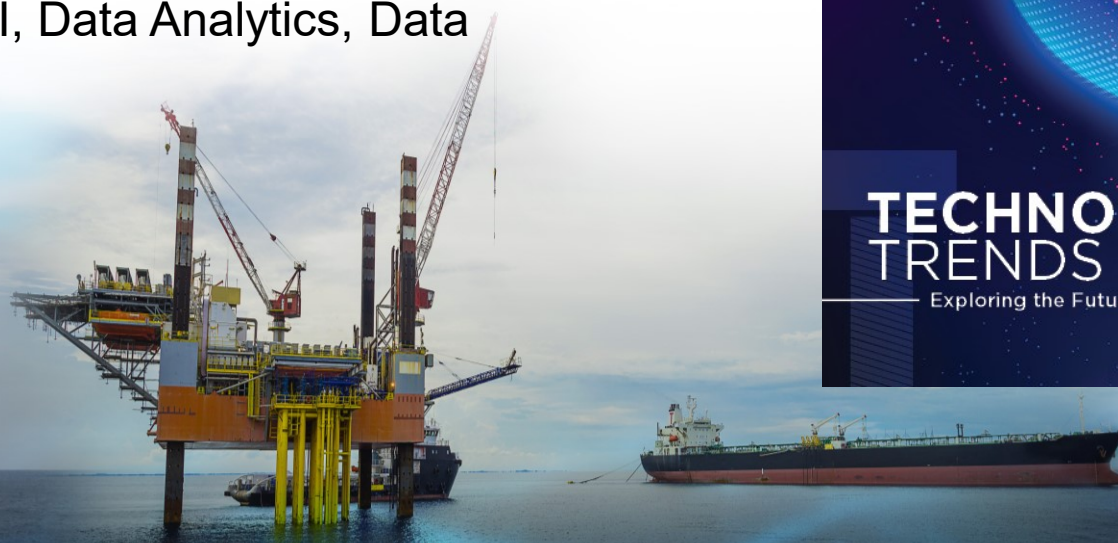
- Outstanding Client Relationships and Business Development Capability
- Exceptional and Timely Product Development
- Most Efficient Service Providers in Our Space
- Most Effective and Efficient Talent Development and Learning Capability



Executing Our Safety-Centric and Mission-Driven Strategy

Five Key Transformational Technologies

- Renewable Power – Offshore Wind, Nuclear
- Carbon Capture and Storage
- Clean Hydrogen
- Battery Energy Storage
- Digital Technology – AI, Data Analytics, Data Streaming, Etc.



Embracing the New Language of Shipping

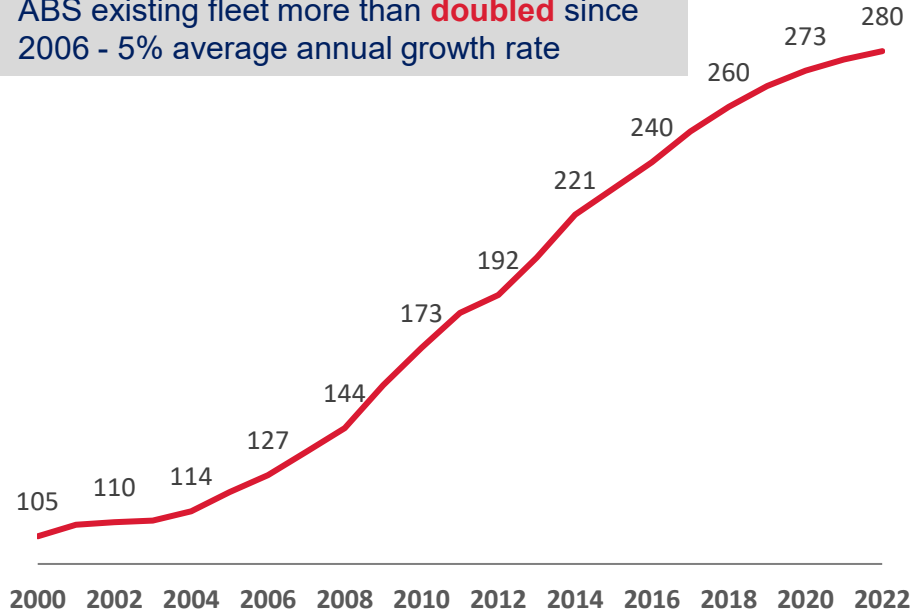
- Acceleration of Low-Carbon to Net Zero Solutions
- Generational Change in Vessel Design and Operations
- Electrification, Alternative Fuels, Renewable Power
- The Hydrogen Economy and Carbon Capture
- Green Financing, Decarbonization Risk and Asset Valuation
- Increasing Need for Cybersecurity
- Growing Importance of ESG
- Mariner Safety, Training and Continuous Learning
- Unintended Safety Consequences of Change

ABS is Well-Positioned to Support You

EXISTING FLEET

280m gt **#2**
11,479 assets **17.1% share**

ABS existing fleet more than **doubled** since 2006 - 5% average annual growth rate



OWNERS

- #1 Greece
- #1 Denmark
- #1 Brazil
- #1 USA
- #1 Singapore
- #1 Hong Kong
- #2 Taiwan
- #2 Japan
- #2 Korea
- #2 Italy

STRONG ORDERBOOK

49m gt **#1**
1,289 assets **25.3% share**

Marine

- #1 Gas Carriers
- #2 Tankers
- #2 Container Carriers
- #2 Bulk Carriers

Offshore

- #1 Exploration
- #1 Production
- #2 Support/Supply

SHIPBUILDERS

- | | | | | | |
|-------|-----------|-----|--------|----------|-------|
| #1 | #1 | #1 | #1 | #1 | #3 |
| China | Singapore | USA | Taiwan | S. Korea | Japan |

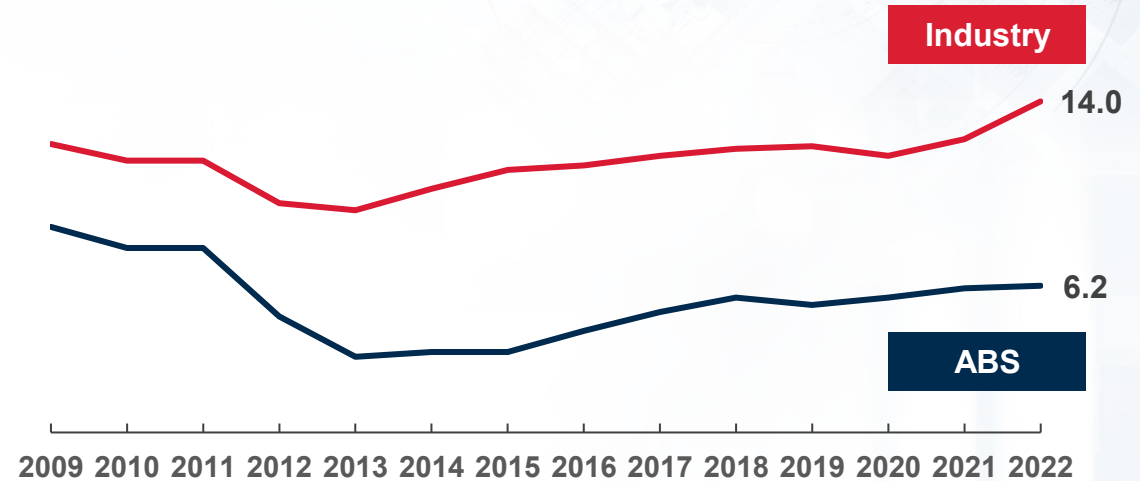
Source: ABS/IHS Fairplay December 2022

How Are We Doing?

Strong Fleet Safety Performance

- Outperformed industry average over past 10 years
 - **59% fewer** hull and machinery casualties
 - **53% fewer** overall casualties
- ABS strong fleet safety performance demonstrates:
 - **Effectiveness** of ABS complete life-cycle safety network
 - **Quality** of owners and operators of ABS-classed vessels

Hull & Machinery Casualty Rates



	Average	10 Years	3 Years
Industry		12.3	14.0
ABS		5.1	6.2

Casualties per 1,000 vessels per year – Seagoing Vessels >500 gt
 Overall casualties includes operational casualties
 Source: Informa (LMIU) Database – December 2022

How Are We Doing?

Superior Port State Performance

- Ranked #1 on a global composite basis since 2017
- Consistent top tier IACS performance

2022 3-year rolling PSC Rankings*

	Global	USCG	Paris MoU	Tokyo MoU
ABS	1	1	1	3
DNV	2	7	2	2
LR	3	8	4	7
NK	4	9	5	4
KR	5	1	8	8

- Ongoing work with owners, operators and Port State Control to enhance safety performance
- New ABS technologies supporting ISM and PSC

ABS PSC Performance Milestones

- **2021** Zero RO-related detentions USCG, Paris, Tokyo
- **USCG** Zero RO-related detentions for the last 13 years
- **Paris MoU** One or fewer RO-related detentions each year for the last 9 years
- **Tokyo MoU** Averaged less than one RO-related detention per year for the last 6 years



ABS Wavesight™

Delivering software as a service (SaaS) products dedicated to helping shipowners and operators streamline compliance while maintaining competitive operations

1st

ABS affiliated software company



ABS WAVESIGHT™

3 software products installed on more than

5,000 Vessels

13

New customers in 2022

41%

Organizational growth in 2022

ABS Wavesight product portfolio key benefits:

- **Risk-based business intelligence** with the ability to support **predictive decision-making** using **artificial intelligence**
- **CII** impact calculation and prediction to avoid risk and **improve the score**
- Deep **insight** into fuel spend while **improving the efficacy** of vessel routes
- Seamless **integration** of industry-trusted, **third-party data** into **one single platform**

Nautical Systems

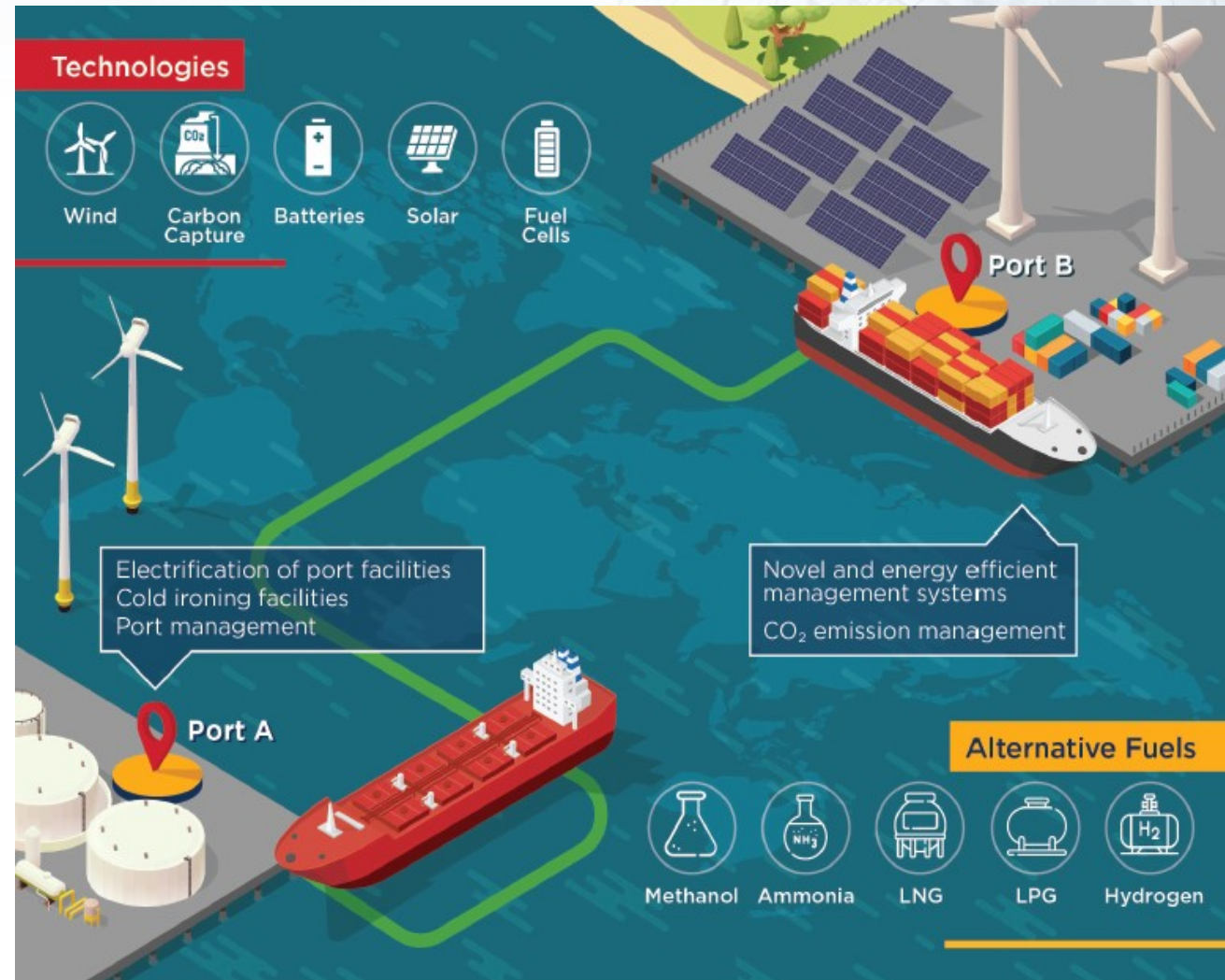
eLogs

My Digital Fleet™



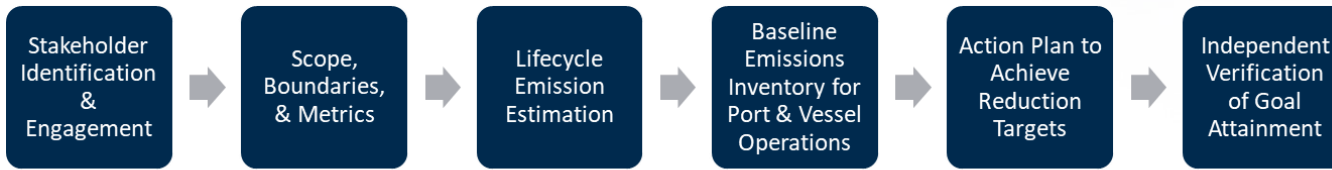
Vision for Green Shipping Corridors

- Decarbonization pathways involve accelerating operational efficiencies and deploying alternative fuels at scale.
- The industry is diverse, disaggregated and globally regulated.
- Green Shipping Corridors help shrink the challenge of coordination between stakeholders down to a more manageable size while retaining scale.
- Any combination of these fuels and technologies could apply based on the techno-economic feasibility of the corridor.



Developing Green Shipping Corridors

Green Corridor Development Process



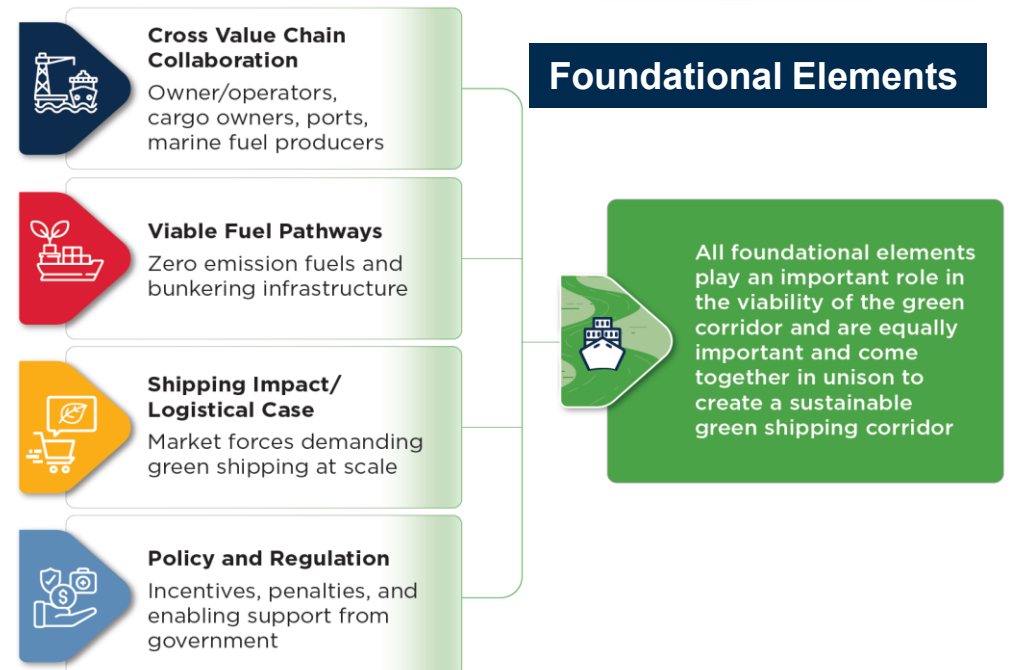
ABS Role

- Facilitator in Design, & Development
- Corridor Analysis & Optimization
 - Pre-feasibility / Feasibility studies
 - Green Corridor Modeling & Simulation / Optimization / LCA
- Project Management and Technical Support for Projects Implementation
- Independent Measurement, Verification, and Validation (Carbon Accounting, ESG reporting)
- Government Advisory Support on Policy and Regulatory Initiatives / Penalties

Key ABS GSC Engagements

- **Gulf of Mexico GSC** (ABS Lead for Blue Sky Maritime Coalition)
- **Antwerp/Bruges – Houston GSC** (ABS Lead)
- **Great Lakes GSC** (Formative with ABS Engagement)
- **Simulation Support to Singapore GSCs** (In Discussion)
- **GSC Development Discussions with Hydrogen Hubs, Clean Energy Marine Hubs, and Various Countries/Ports Around the World**

Foundational Elements



Next Generation of Training

ABS LNG Academy in Doha, Qatar

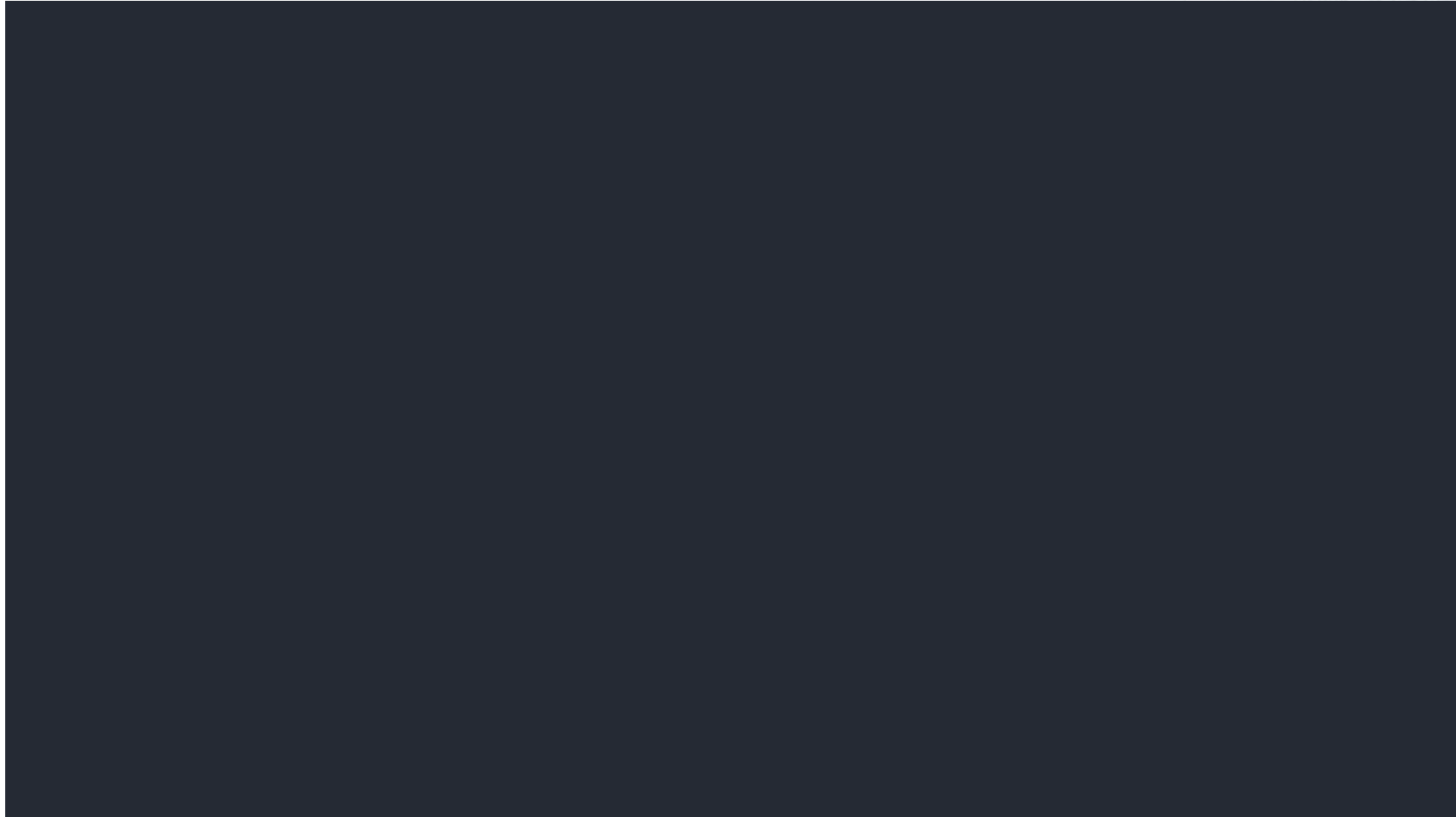
The Maritime Epicenter for LNG-Related Training and Development

- Coordinated effort between industry partners offers a one-stop-shop for LNG-related training
- Dedicated simulator training space for industry-leading gas handling and engine simulator training
- Immersive video wall improves content visualization
- Virtual field trips onboard the world's first gas carrier Metaship



Located on the 2nd Floor of the Al Malki HQ Building on New Al Mirqab, Jawaan Street in Doha

Video – ABS Global LNG Academy



Market Outlook and Trends

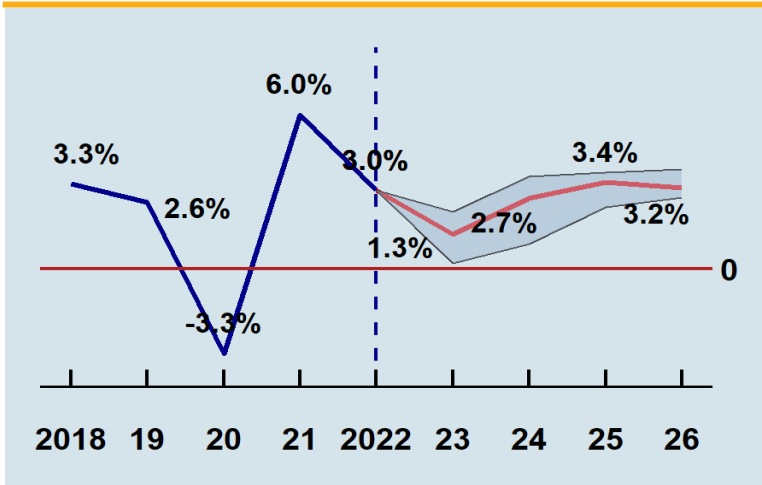
VASSILIOS KROUSTALLIS | MARCH 2023



Macro Business Environment

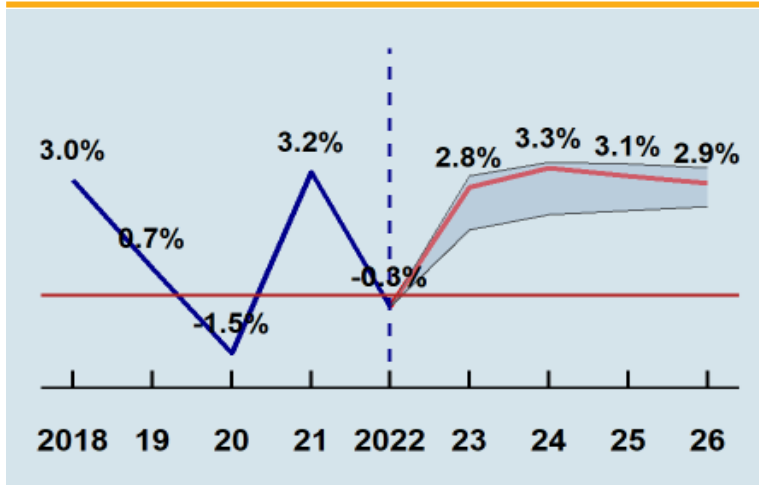
Significant headwinds from high energy prices, inflation, China slowdown and COVID policies, supply chain disruptions and lingering Russia – Ukraine conflict All driving a highly uncertain economic outlook

World GDP 2018-26 %YoY



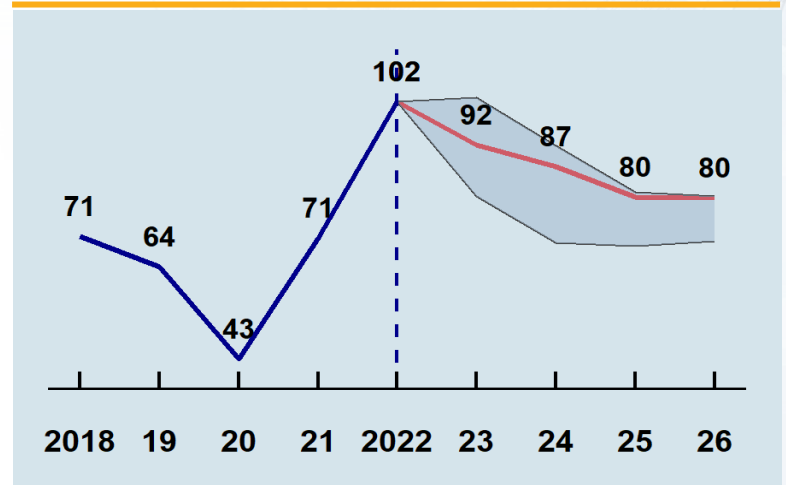
- Global economic prospects have deteriorated further... Global recession projected for 1H23

World Seaborne Trade %YoY tonne-mile



- Resilient seaborne trade from crude and products, gas and grain trade flow changes

Brent Oil Price 2018-26 US\$/b



- Oil price high volatility near term.... Price gradually declining to \$92/b average in 2023

Three Megatrends and Some Wildcards

Decarbonization

- **Energy Transition** *Seaborne trade and fleet growth*
- **Fuel Transition** *New construction / Retrofits*
- **Offshore Transition** *Renewables*

Technology

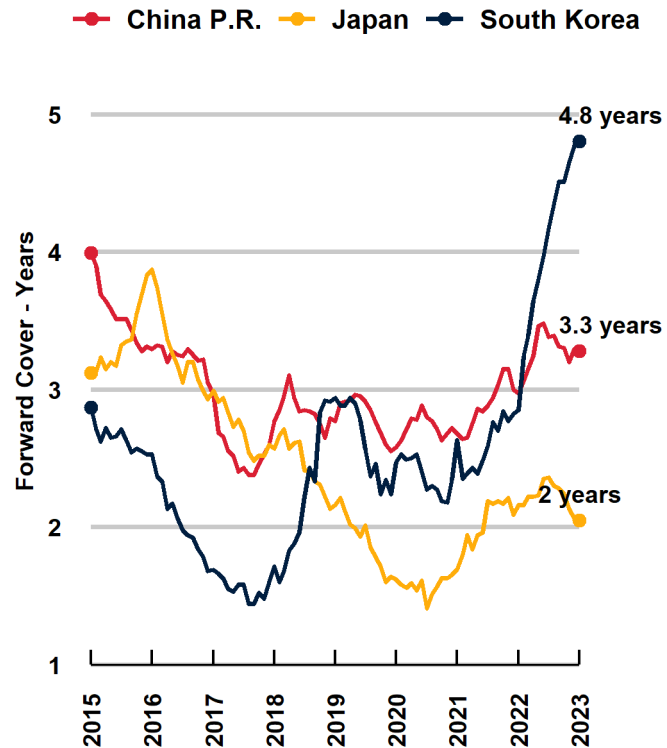
- **Digital Transformation to Enhance Efficiency, Compliance, Transparency...** *Asian mega yards, vessel design, operation (autonomy), supply chain - ports and multi modal*

Markets, Trade and Supply Chain Security

- **Shift to Asia....** *Fleet ownership, financing...*
- **China transition, “Belt & Road,” Emerging markets**
- **De-risking Supply Chains....** *3D printing / reshoring*

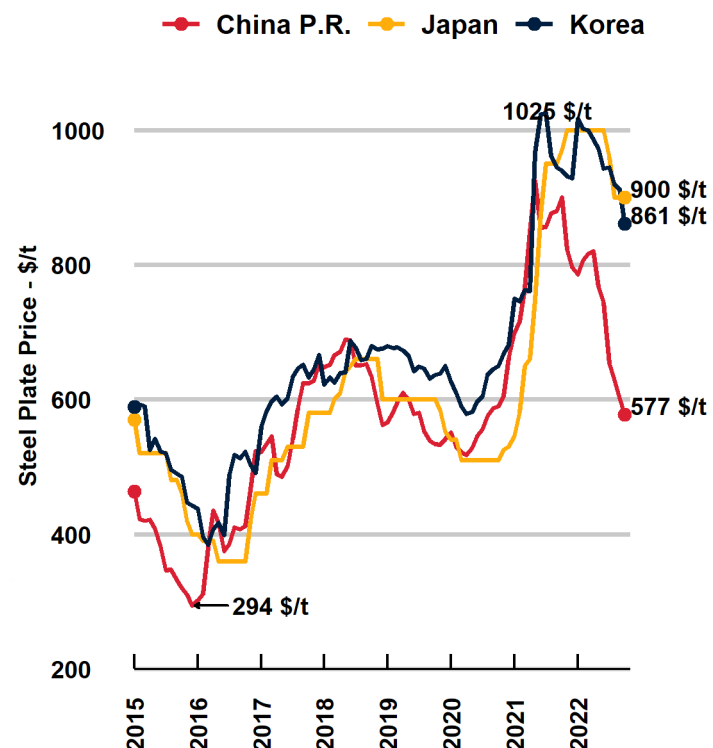
Fleet Supply Side Outlook

Shipyard Forward Cover



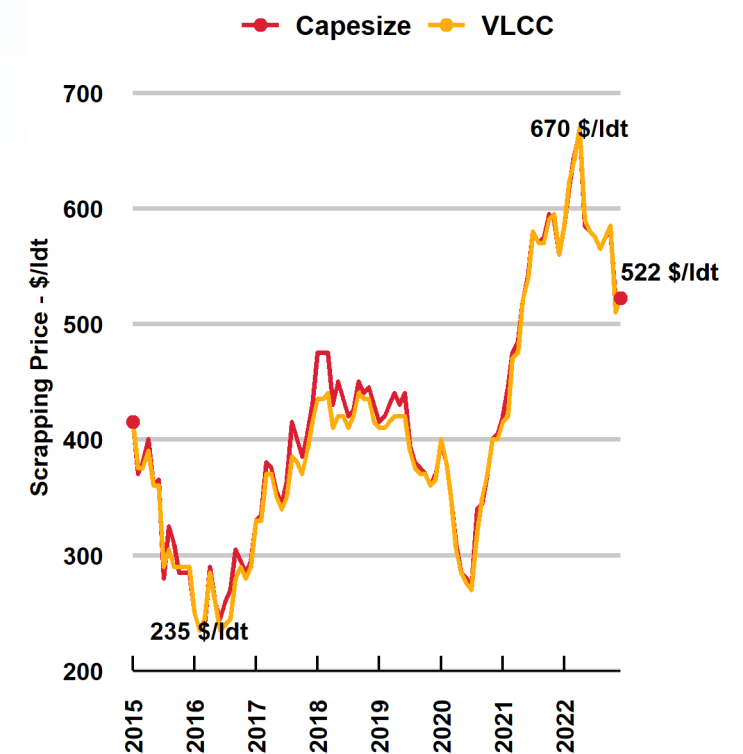
- Delivery slots from 2025+ in China and Korea
- Possible earlier slots in Japan
- Subject to vessel type/size

Steel Price



- Steel and ship price reached record highs in 2021 compounded by inflation, supply chain issues
- Steel price declining with ship price firm from continued new orders and limited shipyard capacity

Scrapping Price

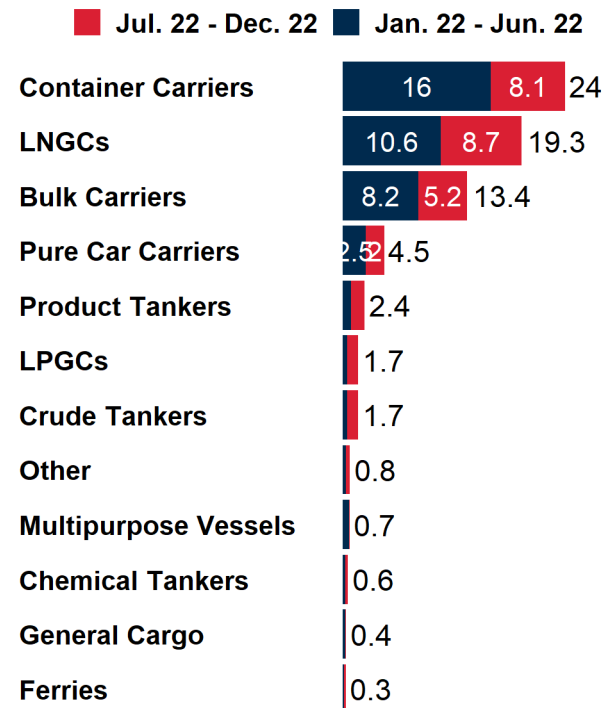


- Scrapping price declining from record level
- Still elevated and weak rates may drive scrapping
- Scrap ↔ New Orders ↔ Environmental Regs.

New Orders – Regulations – Alternative Fuels – Delivery Lead Time – Ship Price – Scrap Price

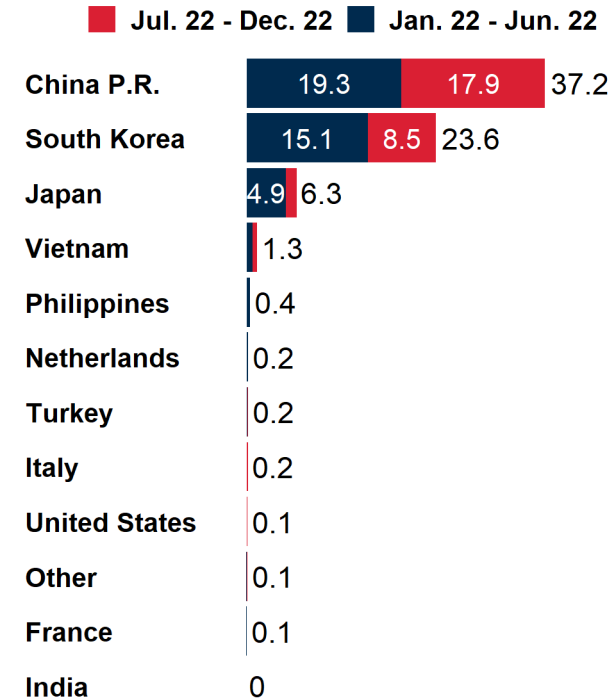
12 Months New Order Trends *January 2022- December 2022*

What has been ordered? mGT



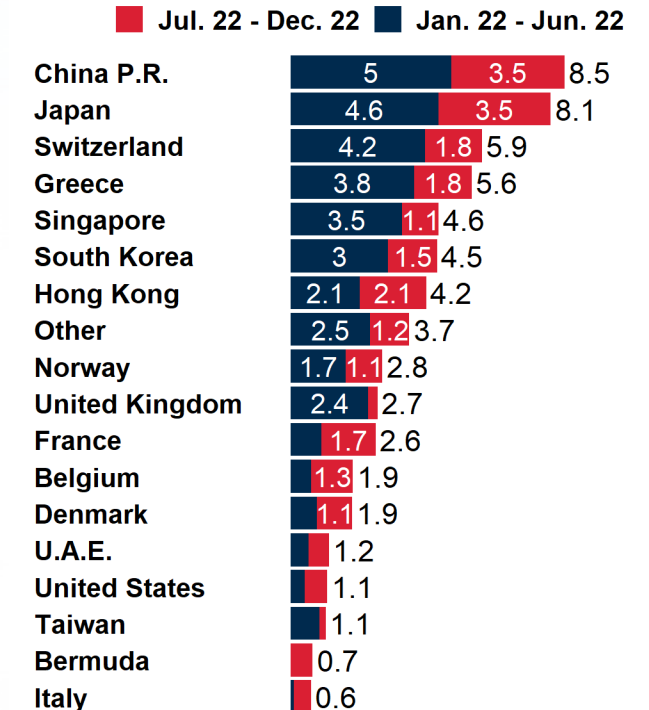
- **24 mGT container carrier new orders - 34% of total new orders**
- LNG Carrier #2 with 19 mGT – 28%
- Bulk Carrier #3 with 13 mGT – 19%

Where are the new orders? mGT



- **By GT** - 53% for China, 34% Korea and 9% Japan
- **By CGT** - 49% for China, 38% Korea and 8% Japan

Who ordered? mGT

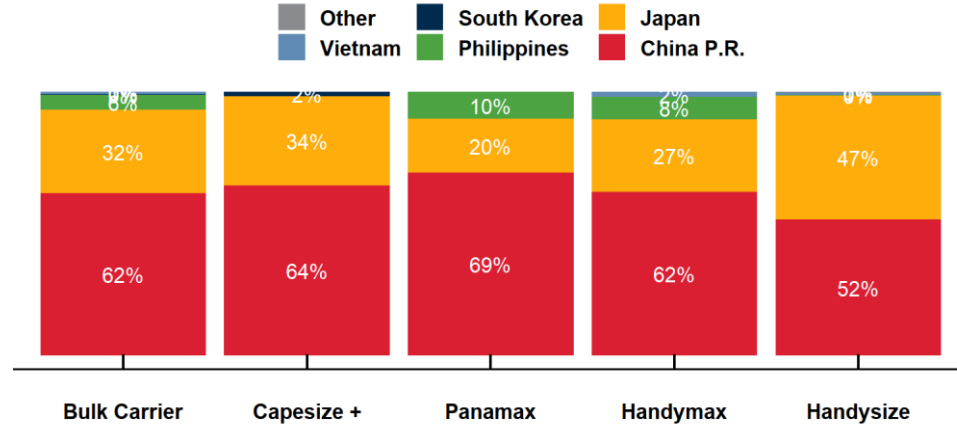


- **Asian shipowners leading...** China/HK 13 mGT, Japan 8 mGT, Singapore 5 mGT, Korea 5 mGT, Taiwan 1mGT.... 44%
- **Europe** - Switzerland #3 6mGT, Greece #4 6mGT, Norway/UK/France 3 mGT each... 28%

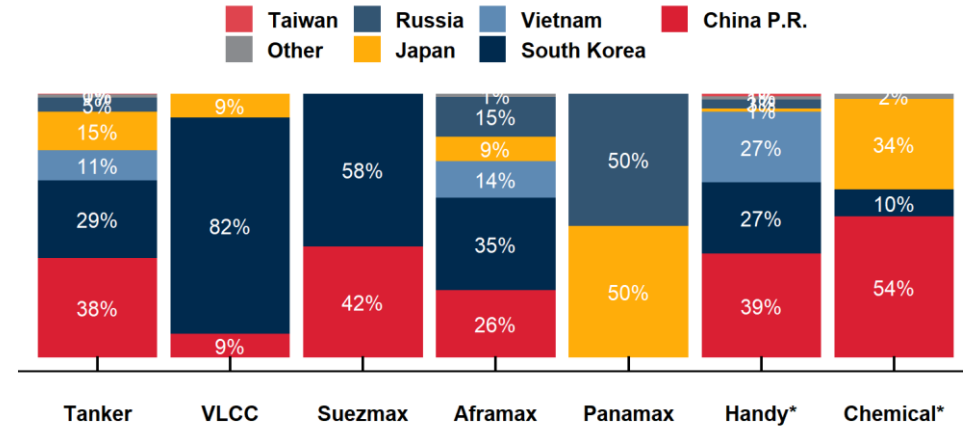
World Orderbook and Shipbuilding

Which shipbuilding area and what ship type/size....

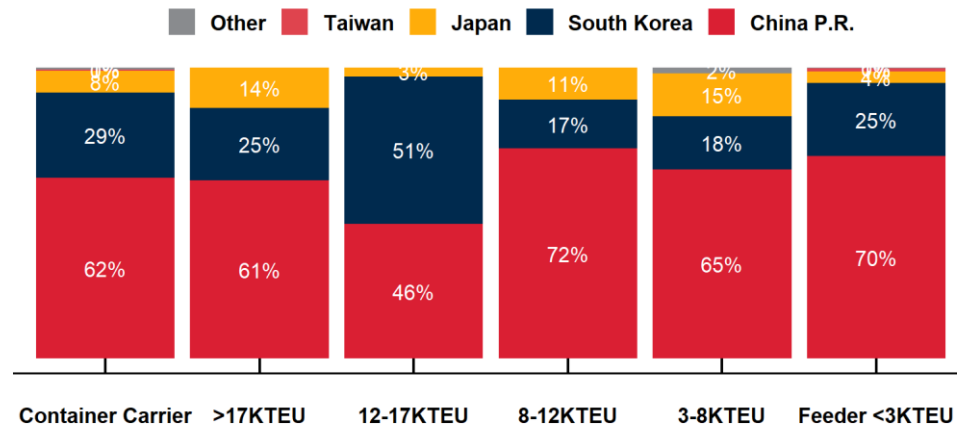
Bulk Carrier



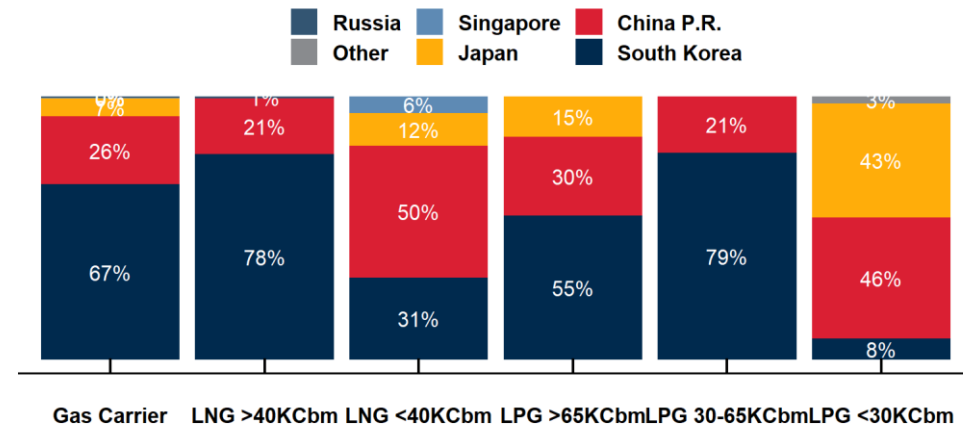
Oil and Chemical Tanker



Container Carrier

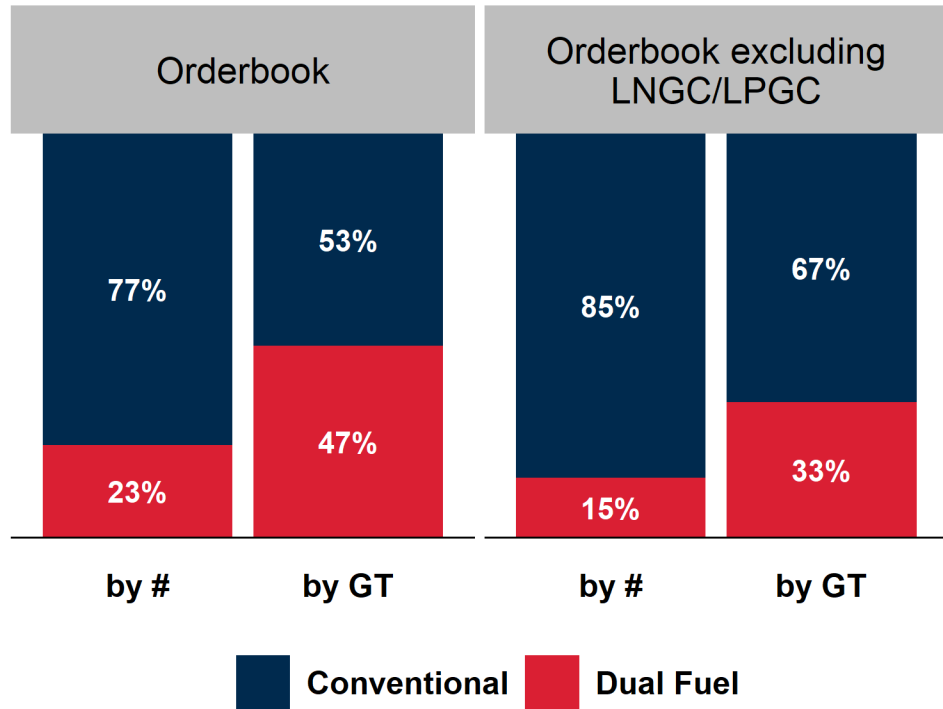


Gas Carrier



Dual-Fuel Orderbook

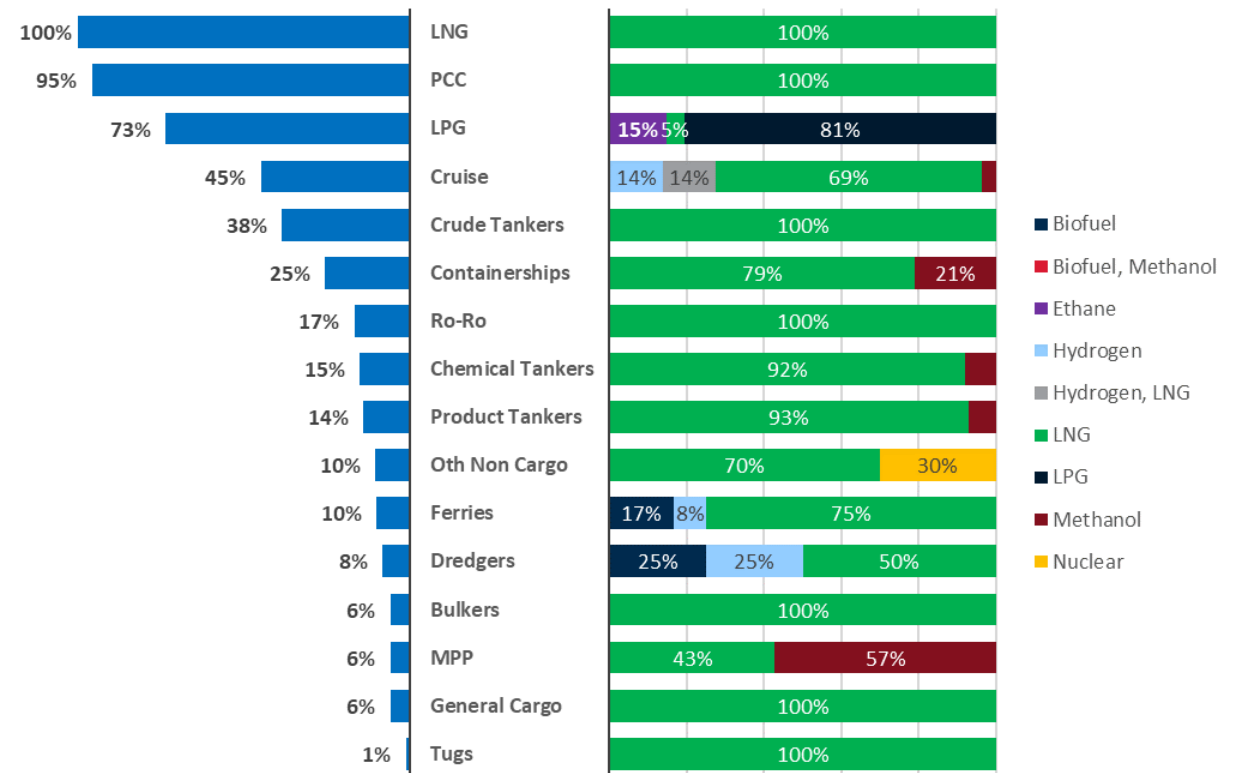
What is the Dual-Fuel share ?



- LNGCs and LPGCs readiness for dual-fuel
- Focus on deep sea larger vessels, Short sea / Coastal vessels and Passenger

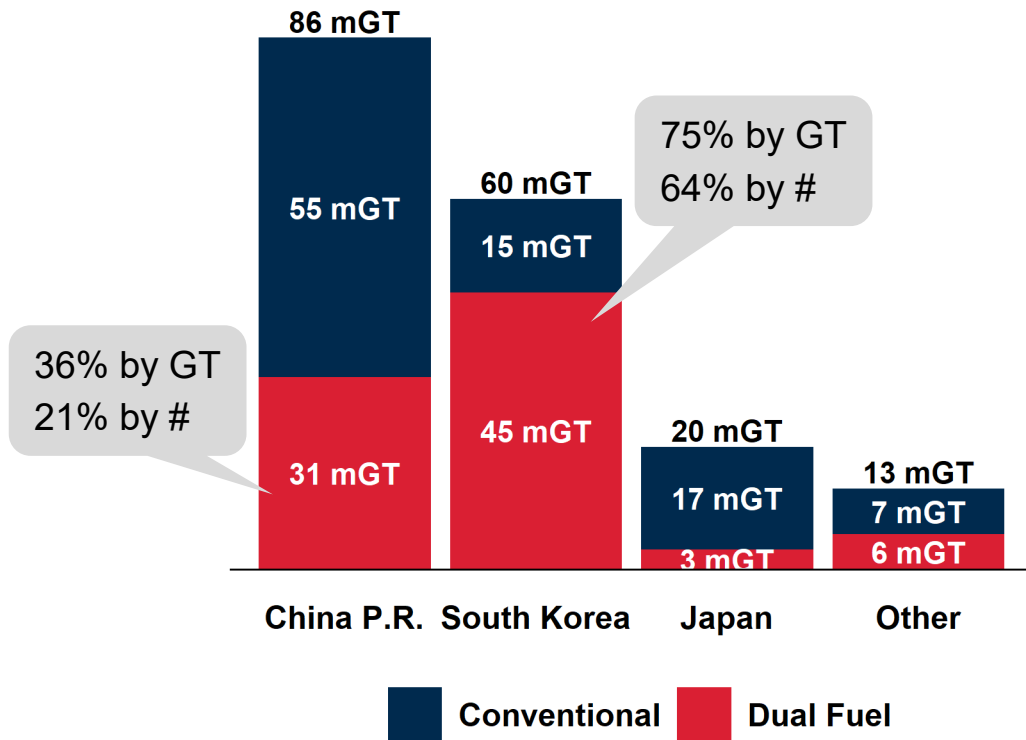
What is the Alternative Fuel Mix?

- Mostly LNG ... 81% of the orderbook ... 86% exc. LNG/LPG
- Followed by Methanol with 6%... 10% exc. LNG/LPG



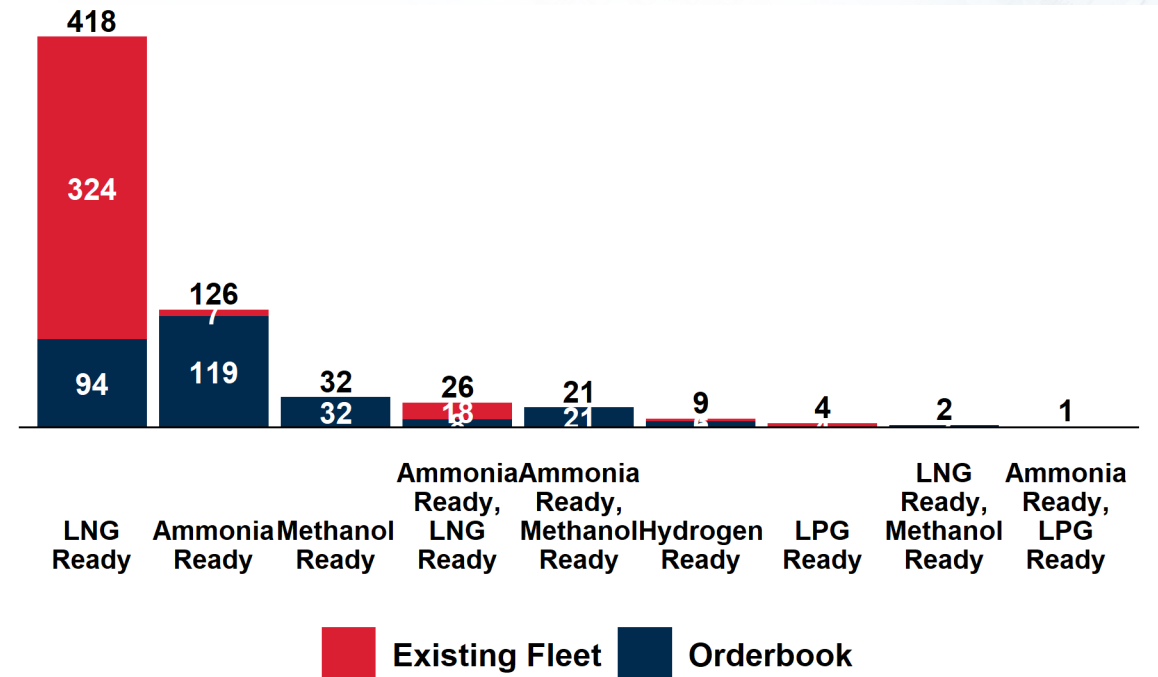
Dual-Fuel Orderbook

Where are Dual-Fuel Vessels built?



- Excluding Gas Carriers, in terms of GT:
 - 53% of Korea orderbook is dual-fuel
 - 29% of China orderbook is dual-fuel

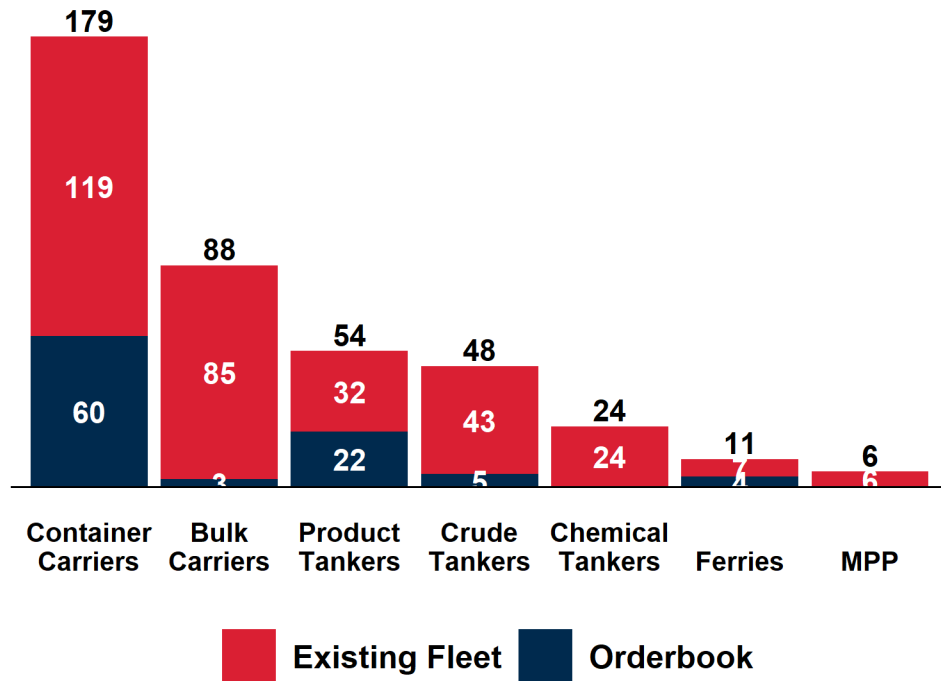
Dual-Fuel Ready... Which alternative fuel?



- Dominated by LNG Ready

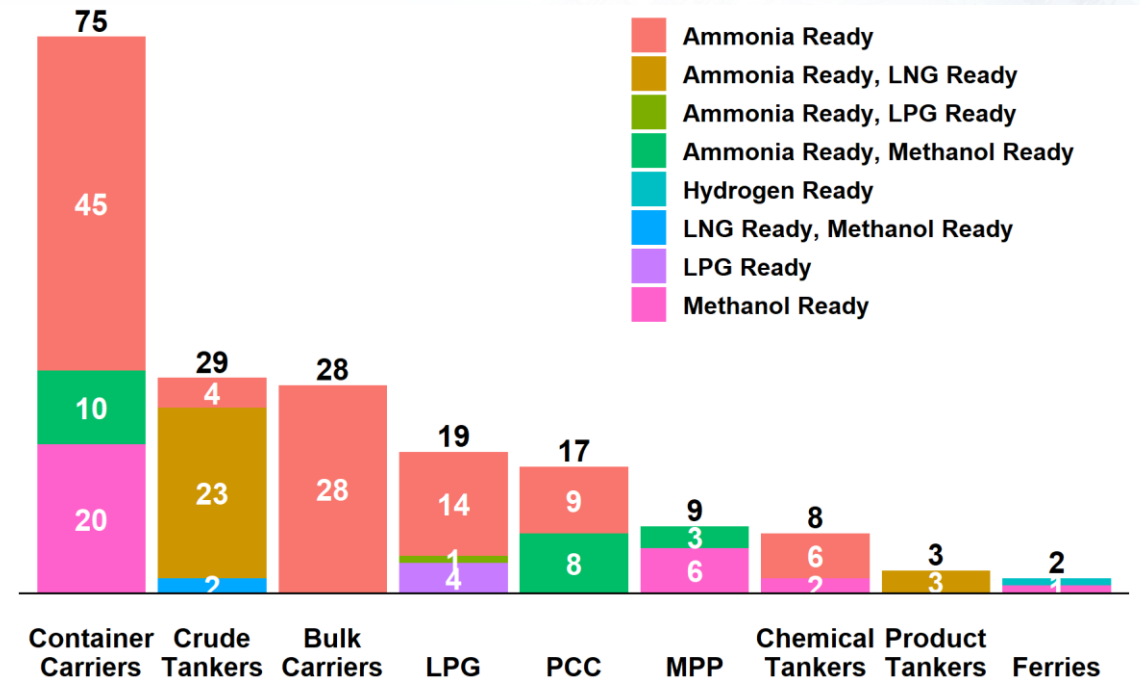
Alternative Fuel Ready

LNG Ready.... Which vessel types?



- Dominated by Container Carriers followed by Bulk Carriers (Chinese built ore carriers).... Crude/Product Tanker rising

Other Alternative Fuel Ready trends....

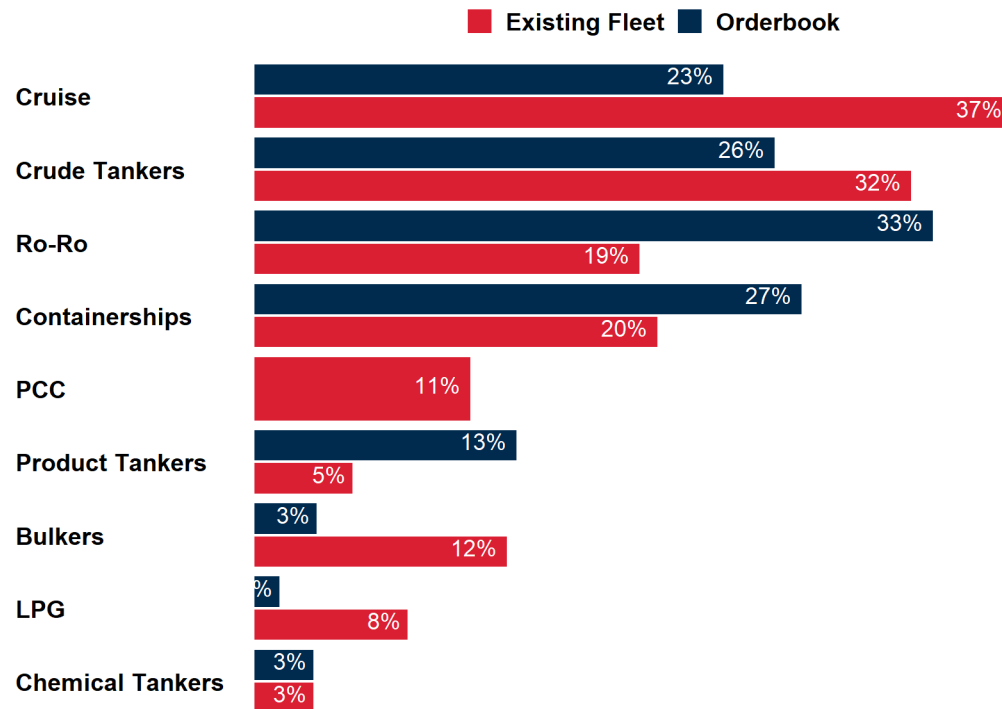


- Alternative Fuel Ready of choice is LNG... with emerging alternative fuels... Ammonia and Methanol (container carriers)

Scrubbers

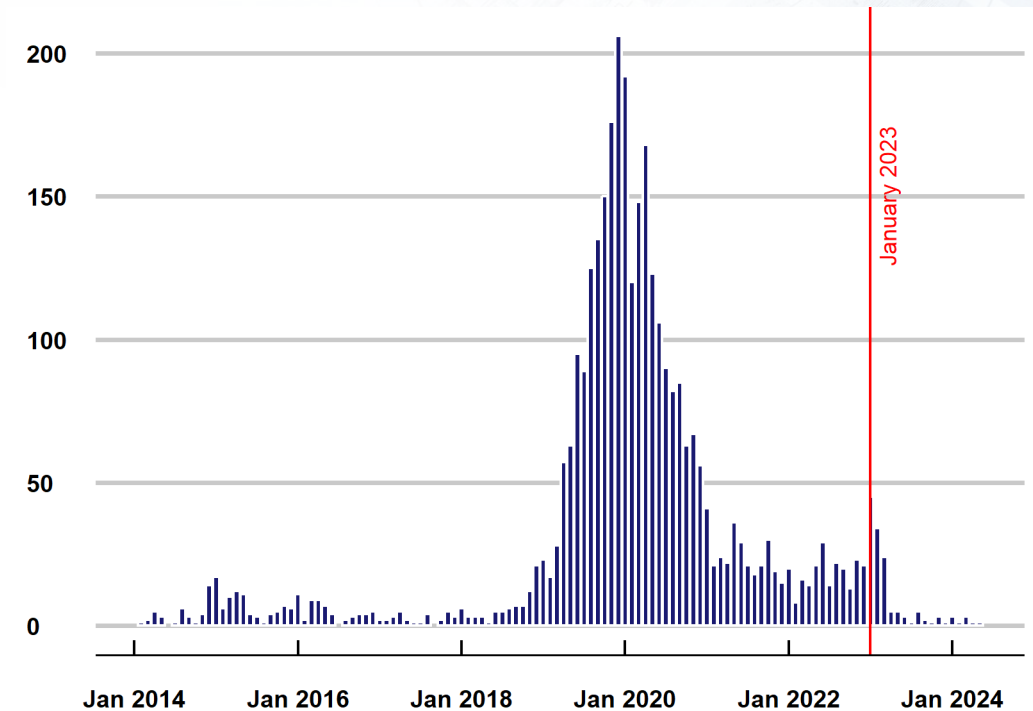
Scrubber retrofit tapering down.... Oil price volatility and stakeholders' sustainability drive

Scrubber installation status – Vessel types



- 60% Cruise (existing fleet / orderbook) fitted with scrubber followed by 58% Crude Tankers, 52% RORO and 47% Container Carriers
- Active retrofits on PCCs with orderbook is dual-fuel LNG

Scrubber retrofit slowing down...

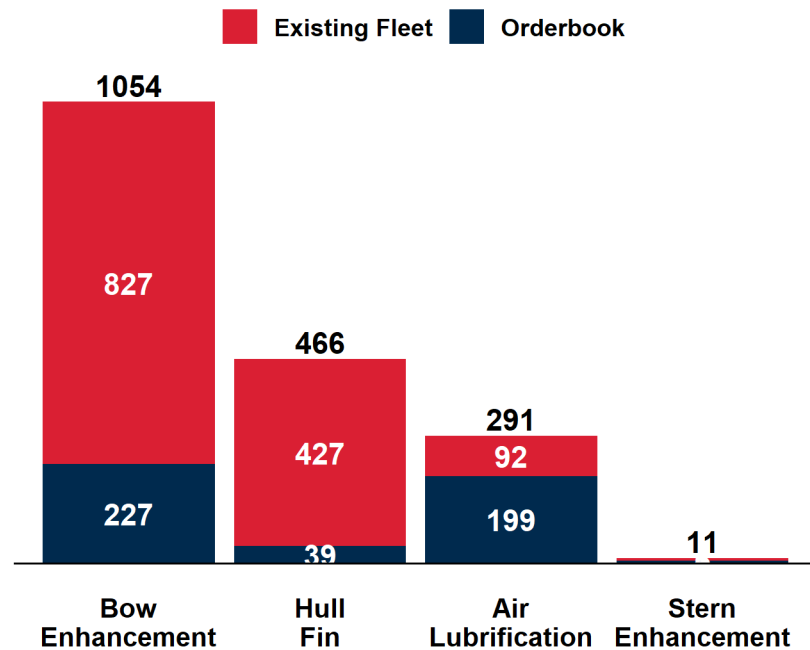


- Retrofit peaked in 4Q19-2Q20 tapering to average of 95 retrofits per quarter in 2021-1H22
- Spike in projected scrubber retrofits driven by bunker price

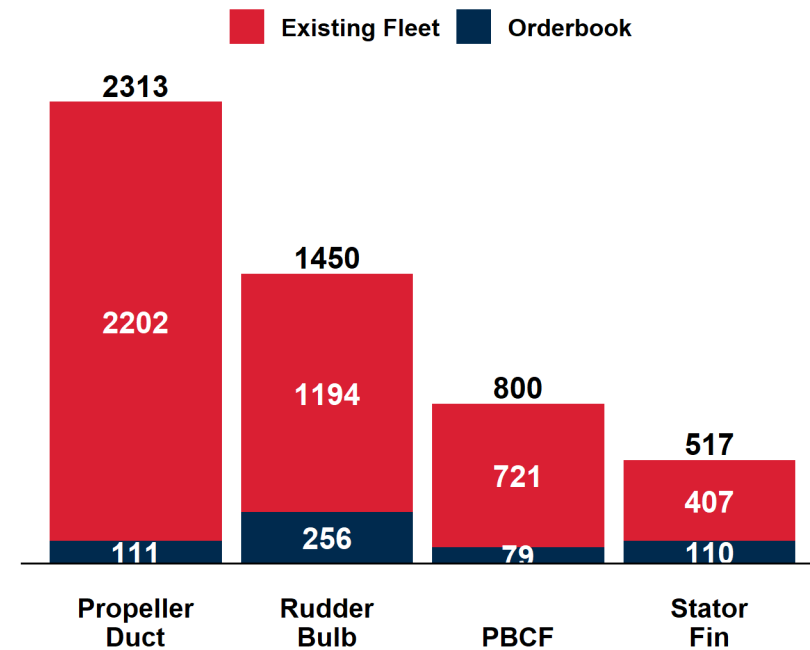
Energy-Saving Devices

What are the “popular” energy-saving devices?

Hull



Propeller and Rudder



Key Takeaways

- 1** Asia Leading New Orders
- 2** China the Major New Construction Area
- 3** In the Coming Years Expect Increased Number of New Orders with New Technology Ships
- 4** Which Fuels in the Next Decade?
 - Big Ships:
 - Conventional Fuels
 - LNG
 - Methanol
 - Ammonia
 - Small Ships: All Fuels, Batteries, Fuel Cells Hybrid, Hydrogen
- 5** Emerging of Carbon Capture and LCO₂ Carriers
- 6** Emerging of New Fuels as Cargoes (Methanol, Ammonia, Hydrogen and CO₂)
- 7** Dual-Fuel Ships
 - Almost half of the orderbook is dual-fuel ships and 81% of this is LNG
 - Most of the dual-fuel ships are built in Korea – 53%
- 8** Not Possible to Replace the Global Fleet Until 2050. Retrofit to Play a Significant Role.
- 9** Increasing Regulatory and Compliance Risk (Compliance Cost)

ABS in Northern Europe

JOSHUA MCMINN | MARCH 2023



ABS Performance At-A-Glance

Existing Fleet

#1

Ranking in Denmark
61.4% market share
15.7 mGT

#2

Ranking in Northern Europe Region
31% market share
20.3 mGT

Orderbook

#1

Ranking in Denmark
69.5% market share
3.2 mGT

#1

Ranking in Northern Europe Region
38.4% market share
4.6 mGT

Total **17 new building** in FY2022

71% Dual-fuel order

12 JDPs with Shipowners,
Designers and Vendors



Surveyors | **21**

Engineers | **2 (+1)**

Sustainability Center | **4 (+1)**

Notable Developments

- CO₂ Shipping and Carbon Capture
 - Project Greens and
 - Onboard Carbon Capture Projects



- Offshore Wind and Alternative Fuels
 - Wind Installation Vessel for U.S.
 - Ammonia Bunkering
 - Methanol Fuel Cells



Break



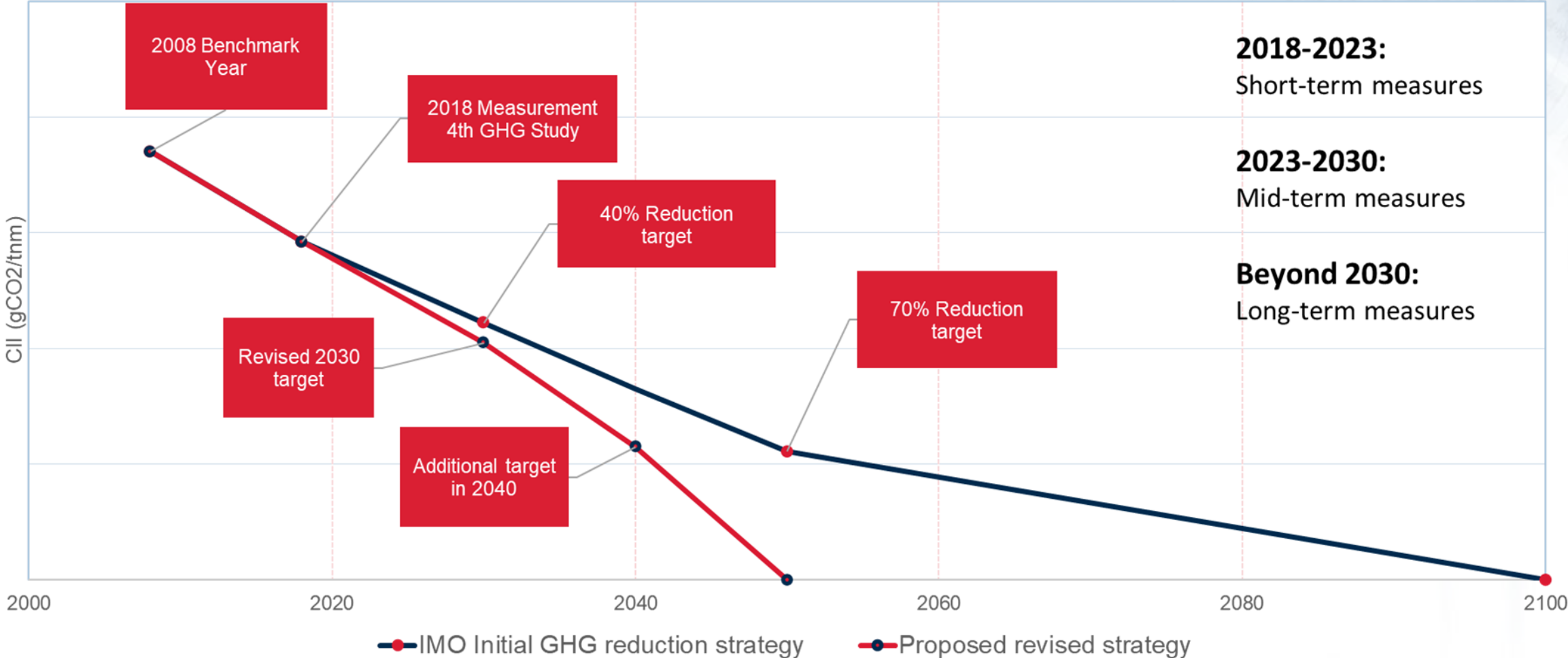
Regulatory Update

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Revision of IMO GHG Initial Strategy

IMO GHG Reduction Targets



2018-2023:
Short-term measures

2023-2030:
Mid-term measures

Beyond 2030:
Long-term measures

Proposals for Mid-term Measures – Incentives for Early Movers

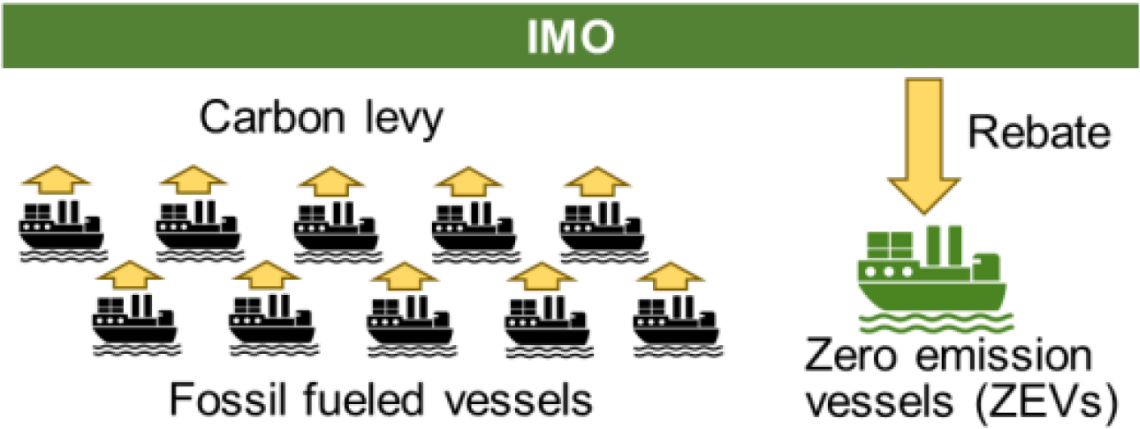
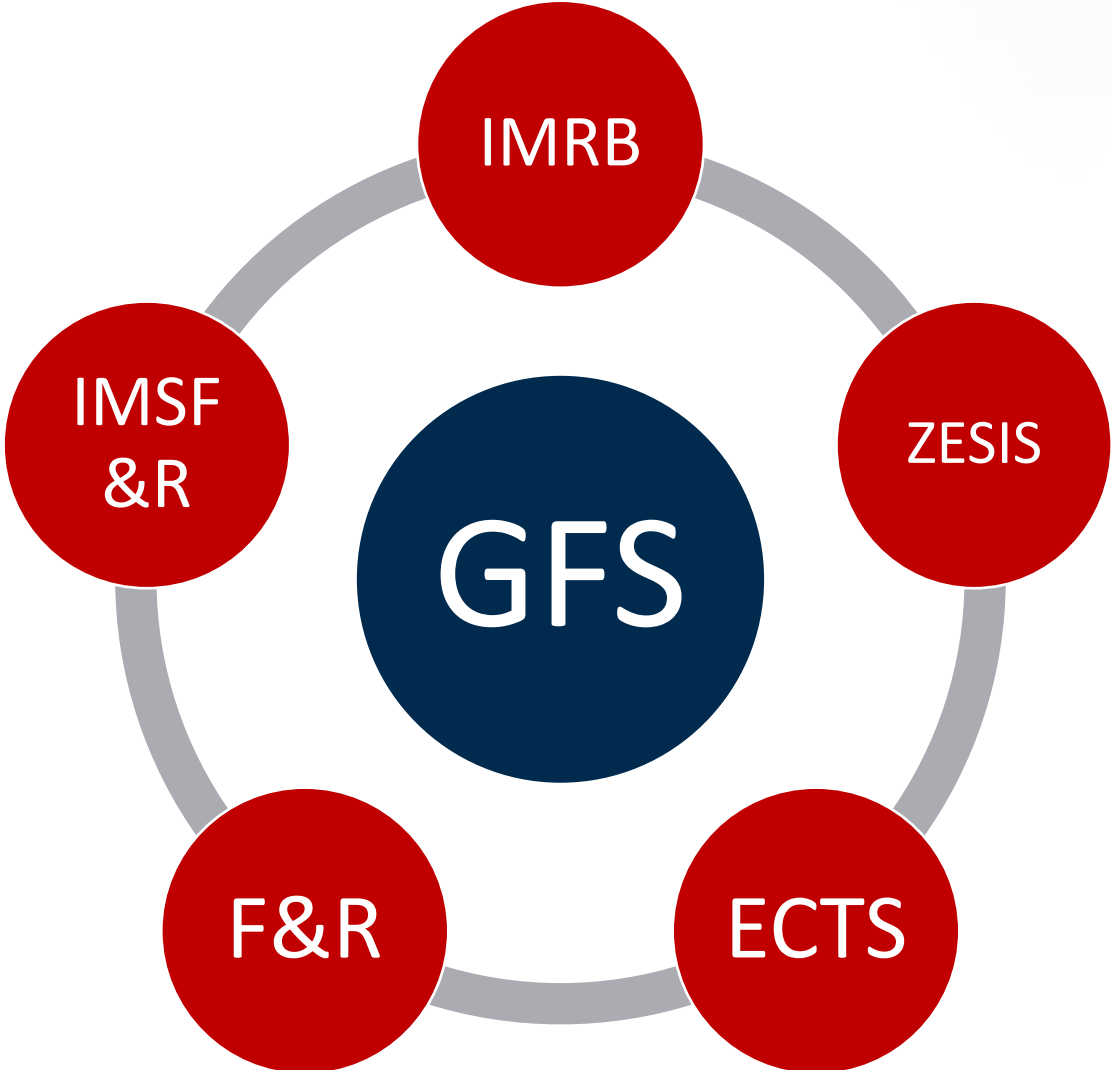


Table 1: Illustrative example of GHG intensity pathways (fuel GHG intensity relative to 2008)

	<i>High ambition</i>	<i>Current minimum ambition of the Initial IMO Strategy</i>
2020	Current value	Current value
2025	95%	95%
2030	85%	85%
2035	70%	75%
2040	50%	65%
2045	20%	50%
2050	0%*	35%**

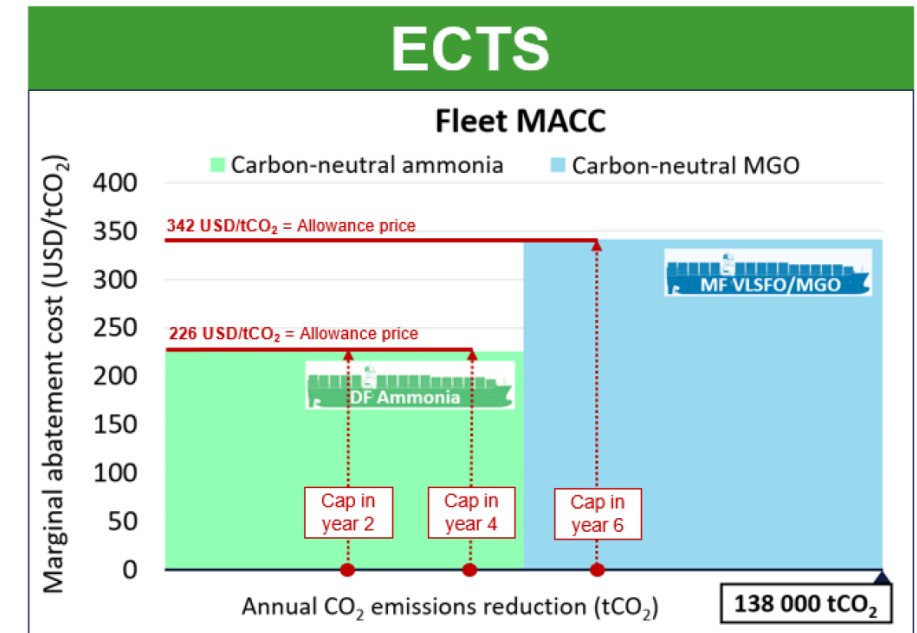
Mid-term Measures Compliance Cost - Capesize bulker

Capesize	LSFO	LNG	Methanol
Deadweight (tn)	181400	181401	181401
Round Trip	Tubarao - Rotterdam- Tubarao	Tubarao -Rotterdam- Tubarao	Tubarao - Rotterdam- Tubarao
Distance (nm)	9968	9968	9968
Fuel oil cons. (tn)	1425.07	1226.4	2947.3
CO2 emissions (tn)	4490.4	3372.7	4052.5
Attained CII	2.483	1.865	2.241
Rating in 2023	C	A	B

- One round trip Tubarao – Rotterdam
- Not considering CH4 slip

IMRB (\$t/CO2)	F&R (\$t/CO2)	ZEVs (\$t/CO2)	IMSF&R (\$t/CO2)	ECTS (\$t/CO2)
0.624	12.5	100	100	226

Fuel Type	Cost IMRB (\$)	Cost F&R (\$)	Cost ZEVs (\$)	Cost IMSF&R (\$)	Cost ECTS (\$)
LSFO	\$2,802	\$56,130	\$449,040	\$449,040	\$1,014,829
LNG	\$2,105	\$42,158	\$337,267	\$337,267	\$762,222
Methanol	\$2,529	\$50,657	\$405,254	\$405,254	\$915,875

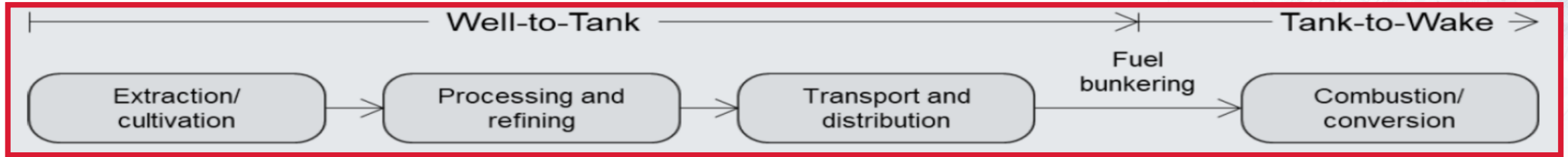


Source: ISWG-GHG 13/4/1

Revised Draft Lifecycle GHG/Carbon Intensity Guidelines

- Incentivize the uptake of alternative low-carbon and zero-carbon fuels:

$$GHG_{WtW} [gCO_{2eq}/MJ] = GHG_{WtT} + GHG_{TtW}$$



$$GHG_{TtW} = [(1 - C_{slip}) \times (S_F \times C_{fCO2} + C_{fCH4} \times GWP_{CH4} + C_{fN2O} \times GWP_{N2O}) + (C_{slip} \times GWP_{CH4}) - e_{occs}] / LCV$$

Fuel burned

CO2 emissions

CH4 Emissions

N2O Emissions

Fugitive CH4 Emissions

CO2eq. savings from OCCS

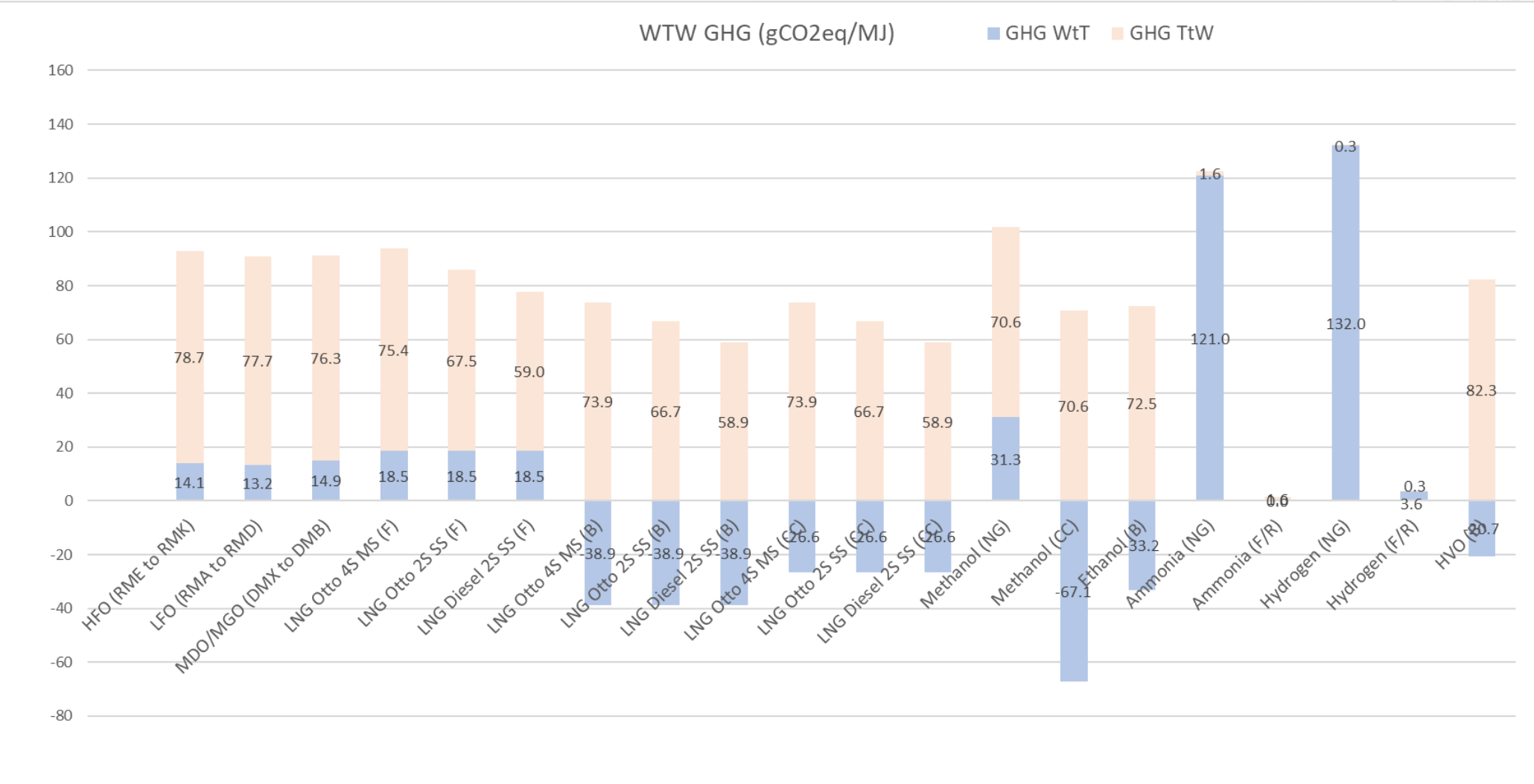
- Using the GWP100 factors in the IPCC 6th AR: **GWP100 factor for CH4 = 29.8**

LNG	0,0491	18.5 SINTEF 2020 17.7 Sphera	LNG Otto (dual fuel medium speed)	2.75 MEPC245 (66) MRV Regulation	[0]	0,00011 TBM	3.1
			LNG Otto (dual fuel slow speed)				1.7
			LNG Diesel (dual fuel slow speed)				0.2
			LBSI				N/A

FUEL LIFECYCLE LABEL		CARBON SOURCE	
MAIN LABEL	SUB-CATEGORY	INCLUDE CO ₂ EMISSIONS IN TIP	S _F
FOSSIL	HEAVY/LIGHT FUEL OIL	YES	1
FOSSIL	DIESEL/GAS OIL	YES	1
FOSSIL	LNG	YES	1
FOSSIL	LPG	YES	1
FOSSIL	...	YES	1
BIOMASS	...	FOR INFO	0
CAPTURED CARBON	FOSSIL	FOR INFO	0**

- Adopt the LCA guidelines at MEPC 80 - EEDI 4 as first test of the application

Updated Draft Lifecycle GHG/Carbon Intensity Guidelines



Pending determination:

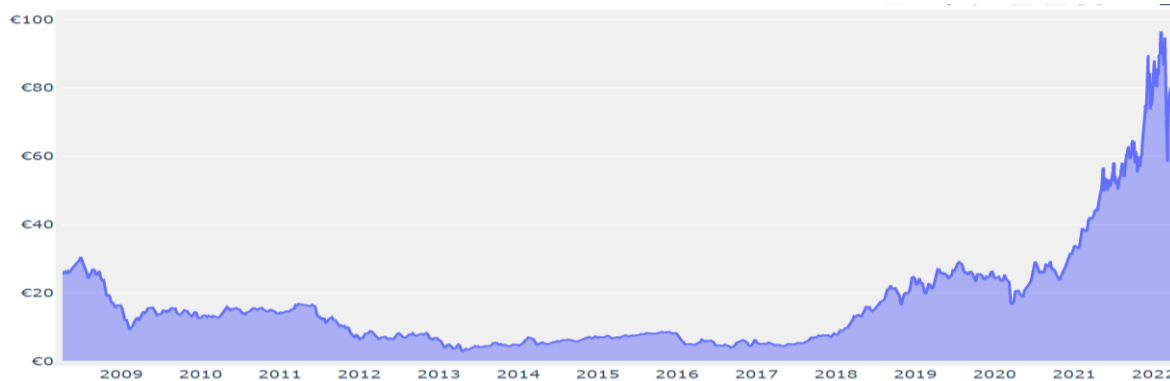
Fuel Type	C _f CH ₄	C _f N ₂ O
Methanol	TBM	TBM
Ammonia		TBM
Ethanol	TBM	TBM

SF =1 for calculating GHG_{TtW}

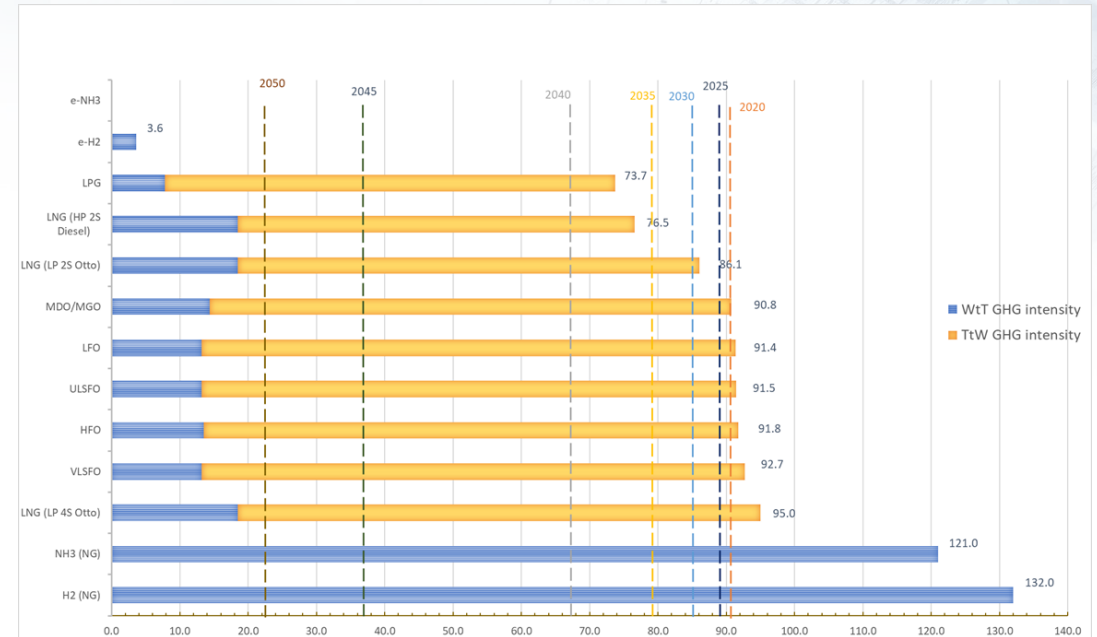


EU “Fit for 55” Package

- The ‘Fit for 55’ subject to negotiation in Brussels
- **FuelEU Maritime Regulation**, agreed at EP level:
 1. Adoption by EP Plenary on October 17th
 2. The Council adopted its General Approach on June 2nd
 3. Final adoption is expected 1st quarter of 2023
- The **EU ETS**, agreed on December 18, 2022:
 1. Extension of the EU ETS to shipping by January 1, 2024
 2. A three-year phase-in period (40%, 70%, 100%)



Source: Sandbag



- Importance of incorporating **fuel-flexible concepts** and technologies (readiness), for **future proofing**
- Fuel-ready solutions will ensure competitiveness and mitigating compliance cost

EU ETS & FUELEU Compliance Cost Capesize

Capesize	LSFO	LNG	Methanol
Deadweight (tn)	181400	181401	181401
Round Trip	Tubarao -Rotterdam- Tubarao	Tubarao -Rotterdam- Tubarao	Tubarao -Rotterdam- Tubarao
Distance (nm)	9968	9968	9968
Fuel oil cons. (tn)	1425.07	1226.4	2947.3
CO2 emissions (tn)	4490.4	3372.7	4052.5
Attained CII	2.483	1.865	2.241
Rating in 2023	C	A	B

Fuel Type	CO2 under EU ETS (tn)	Cost 2024 (40%)	Cost 2025 (70%)	Cost 2026 (100%)
LSFO	2245.2	€ 86,719	€ 151,757	€ 216,796
LNG	1686.3	€ 65,133	€ 113,983	€ 162,832
Methanol	2026.3	€ 78,263	€ 136,960	€ 195,657

Council						
Fuel type	2025	2030	2035	2040	2045	2050
LSFO	-€ 57,672	-€ 125,645	-€ 244,598	-€ 465,511	-€ 1,026,289	-€ 1,298,182
LNG (Otto med).	€ 0	-€ 72,149	-€ 200,648	-€ 439,289	-€ 1,045,072	-€ 1,338,784
LNG (Otto slow)	€ 0	€ 0	-€ 78,561	-€ 335,445	-€ 987,536	-€ 1,303,702
LNG (Diesel slow)	€ 0	€ 0	€ 0	-€ 204,993	-€ 915,259	-€ 1,259,630
LNG (LBSI)	€ 0	€ 0	€ 0	-€ 185,820	-€ 904,636	-€ 1,253,152
Parliament						
Fuel type	2025	2030	2035	2040	2045	2050
LSFO	-€ 57,672	-€ 125,645	-€ 363,551	-€ 669,430	-€ 1,111,256	-€ 1,383,148
LNG (Otto med).	€ 0	-€ 72,149	-€ 329,147	-€ 659,574	-€ 1,136,857	-€ 1,430,569
LNG (Otto slow)	€ 0	€ 0	-€ 216,883	-€ 572,569	-€ 1,086,338	-€ 1,402,503
LNG (Diesel slow)	€ 0	€ 0	-€ 75,854	-€ 463,271	-€ 1,022,875	-€ 1,367,246
LNG (LBSI)	€ 0	€ 0	-€ 55,126	-€ 447,207	-€ 1,013,547	-€ 1,362,064

One round trip Tubarao - Rotterdam

EU ETS cost:

- Assuming **96.56** Euros per ton CO2 and no free allowances
- Only CO2 emissions, not CH4 and N2O

FuelEU Compliance Cost based on EC and EP proposal:

- Assuming **91.088** grCO2eq/MJ reference value (average in year 2020)
- Assuming vessels will continue to use LSFO or LNG (no pilot fuel considered).
- Assuming following GWP values:

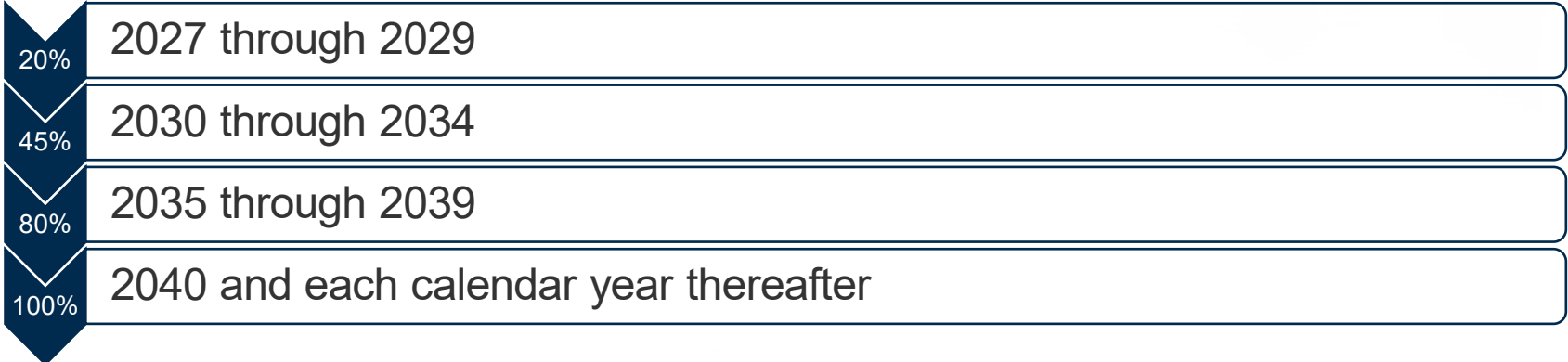
<i>GWPCO2</i>	1.0
<i>GWPC_{H4}</i>	28.0
<i>GWPN_{2O}</i>	265.0

Introduced U.S. Clean Shipping Act of 2022

- New section in Clean Air Act : “212A. Marine Zero Greenhouse Gas Fuel Standard”



- ‘Carbon intensity baseline’ in calendar year 2024 - Reductions in lifecycle carbon intensity (grCO2eq./MJ):



Implementation	Harmonization	Exemptions	Averaging	Reporting	Port Emissions
Ships > 400GT on voyages between U.S. ports or U.S. and foreign countries	Harmonization with IMO if IMO standards are same or stricter	Voyages for 30 days or fewer during a calendar year	Vessels under common ownership or control	Per calendar year in consistency with IMO DCS/EUMRV	By Jan. 1, 2030 no GHG emissions at anchorage or berth



CARB At Berth 2020 Regulation

- The 2020 Regulation took effect on January 1, 2021
- Emissions controls will phase in following dates:

Provision	Description
January 1, 2023	Container and refrigerated cargo vessels
January 1, 2023	Cruise (passenger) vessels
January 1, 2025	Roll-on roll-off vessels
January 1, 2025	Tanker vessels that visit the Ports of Los Angeles or Long Beach
January 1, 2027	All remaining tanker vessels

- All vessels from **January 1, 2023** must comply with:
 - The visit reporting requirements (section 93130.7(e)(4))
 - The opacity requirements (section 93130.6)

Circumstances that may qualify for an Exception, a VIE/TIE or remediation

Circumstances	Exception	VIE/TIE	Remediation Fund	Responsible Parties
Safety/emergency, research, vessel commissioning, or innovative concept	X			
Visits without reductions		X	*	Terminal, Vessel
Vessel equipment repair		X	X	Vessel
Terminal equipment repair		X	X	Terminal, Port
Terminal upgrades/construction		X	X	Terminal, Port
Delays, but reductions occur		X	X	Terminal, Vessel, CAECS
CAECS equipment failure, or CAECS failure to perform		X	X	Terminal, Vessel, CAECS

* Visits may use a VIE or TIE if available, but not all visits qualify for remediation.

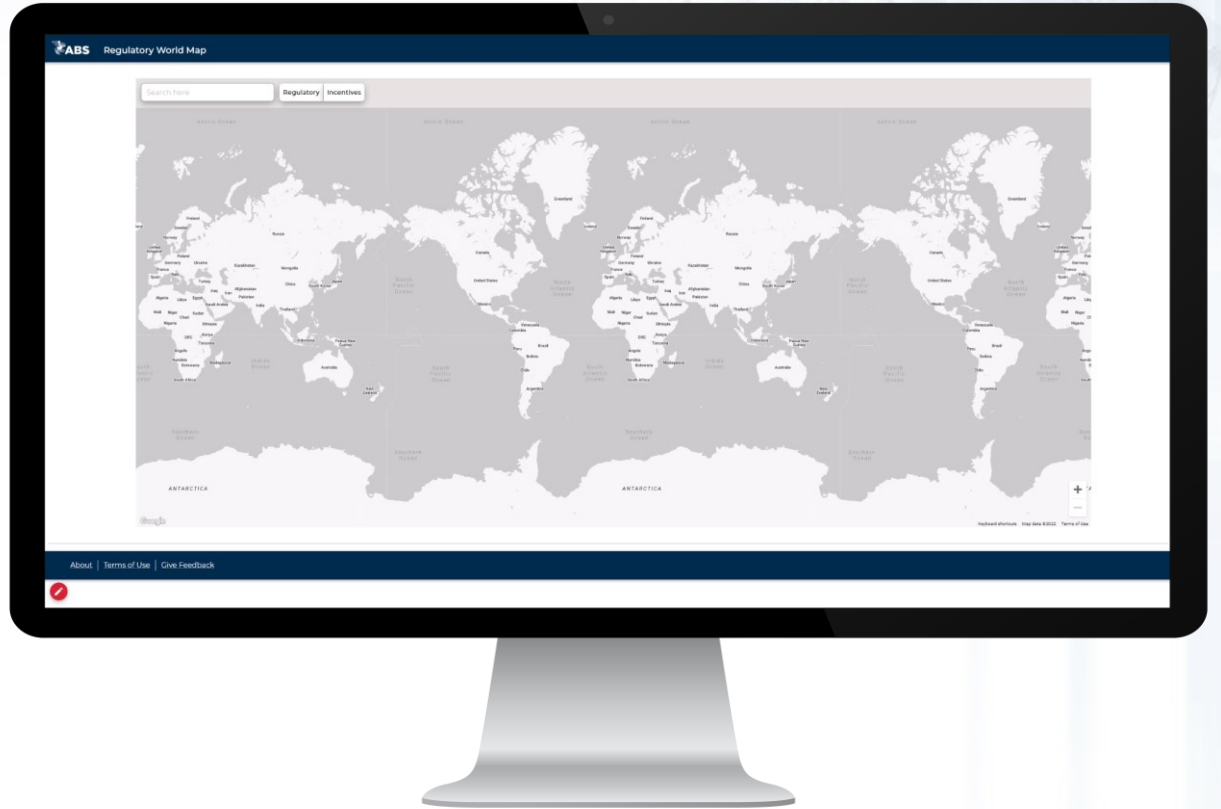
New ABS Web Apps for Regulatory Requirements

ABS Regulatory World Map

- Quickly find regional, national and port-specific requirements before entering port
 - Air Emissions, Vessel Discharges, Ballast Water, Biofouling, Ship Recycling, Onshore Power Supply, Special Reporting and Certification, and Port State Control Concentrated Inspection Campaigns

ABS Regulatory Tracker

- Stay up-to-date with IMO requirements
- Features a reliable and intuitive way to quickly identify upcoming regulations that might affect new designs or retroactively impact existing vessels
- Both tools available through the ABS MyFreedom™ Client Portal



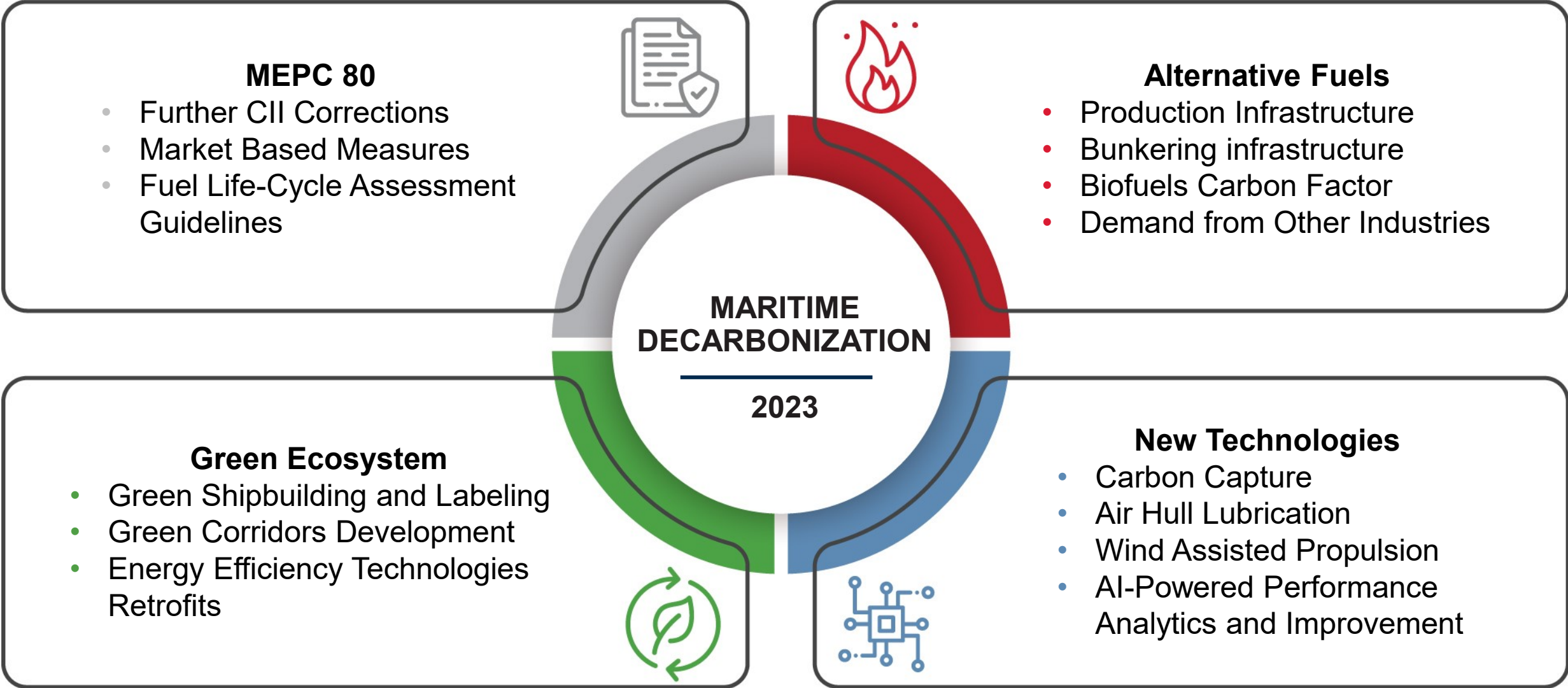
Industry-leading online tools and easy-to-search database for latest regulatory requirements impacting vessel design, construction and operations

Sustainability Update

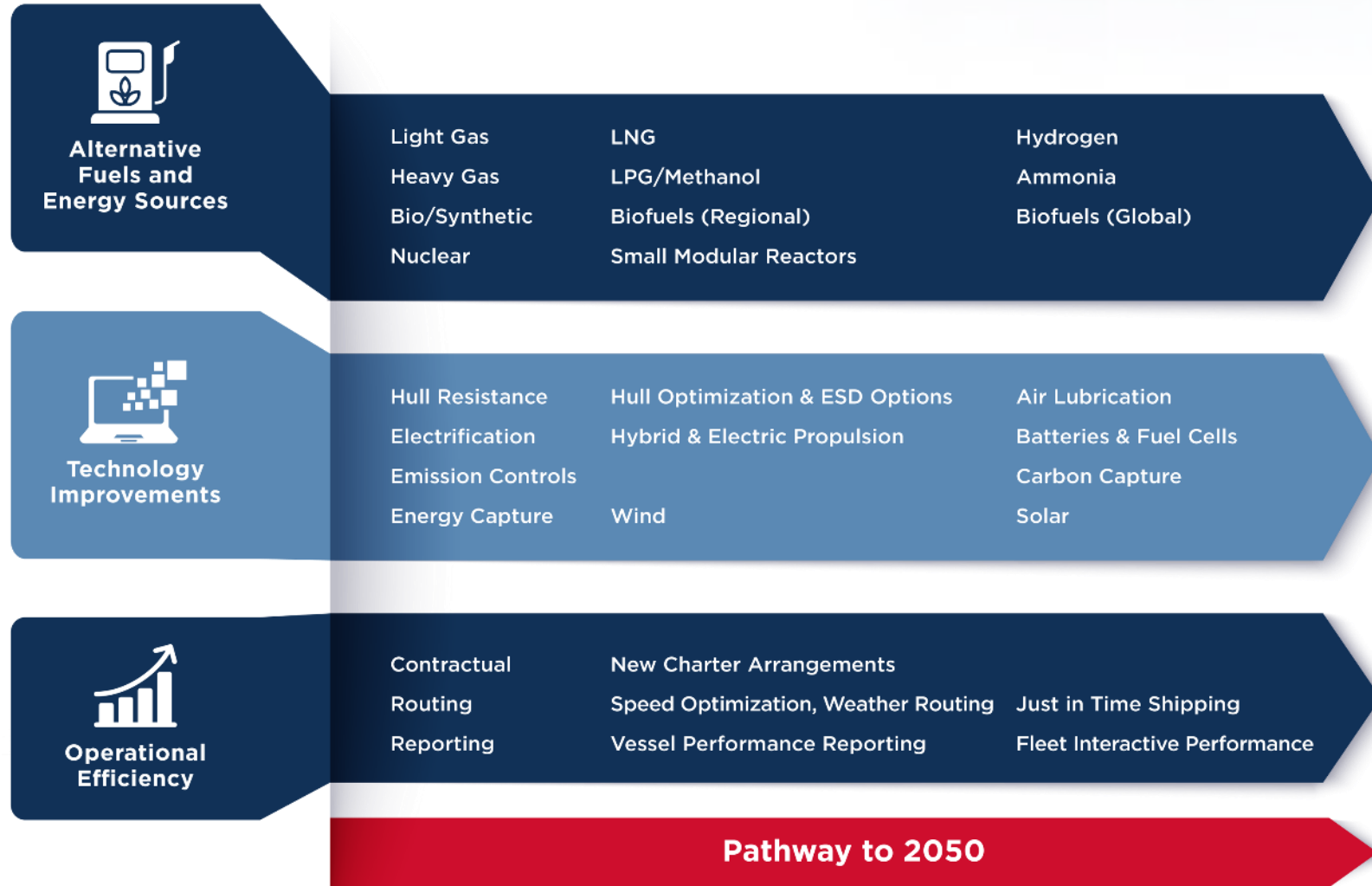
PANOS KOUTSOURAKIS | MARCH 2023



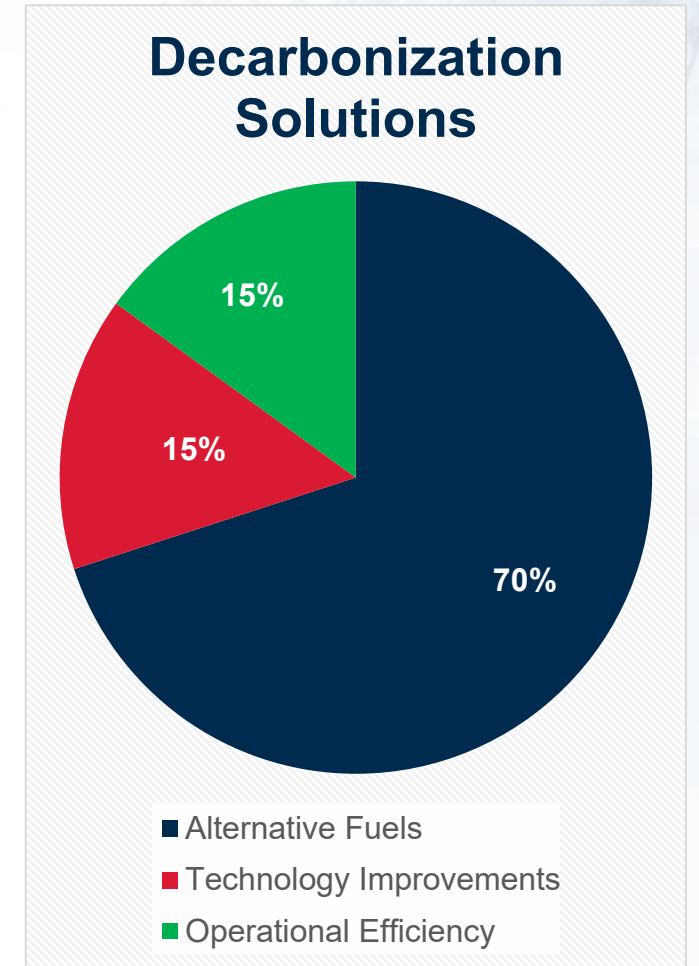
Maritime Decarbonization in 2023: What to Expect



Decarbonization Solutions

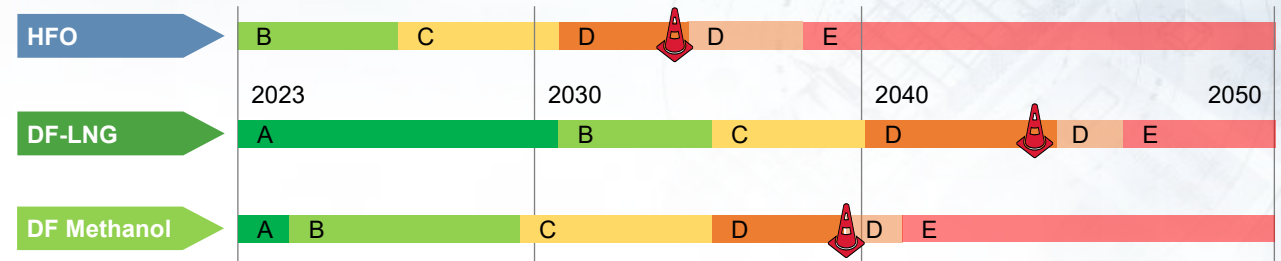
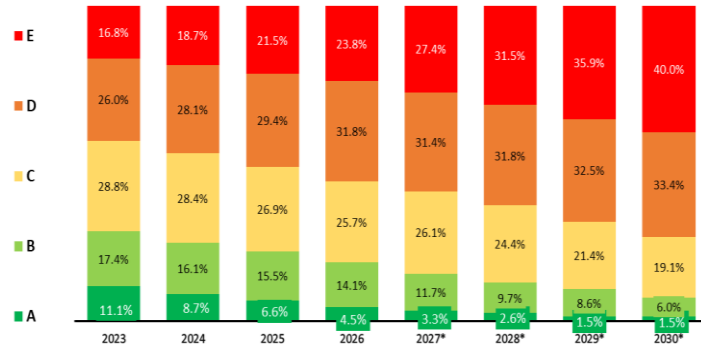


2050

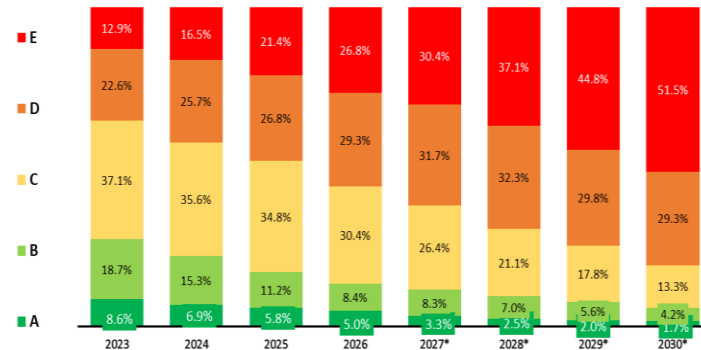


CII Impact

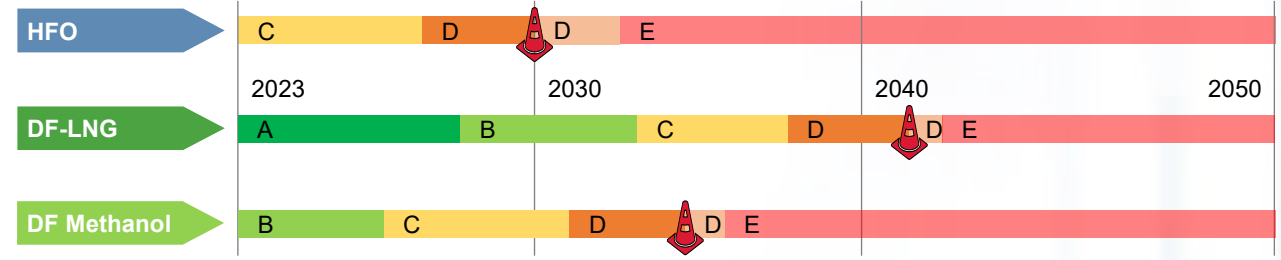
Global Tanker Fleet



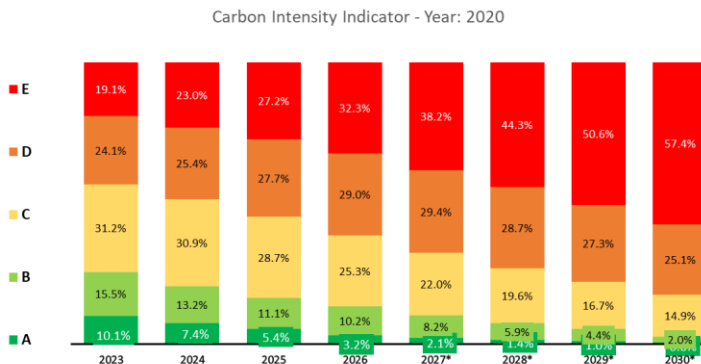
Global Containership Fleet



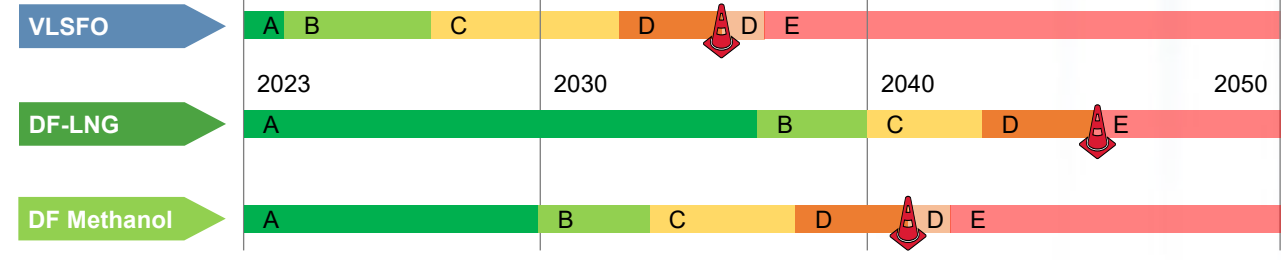
14k TEU conventional vs. DF options



Global Bulk Carrier Fleet



Kamsarmax Bulker conventional vs. DF options



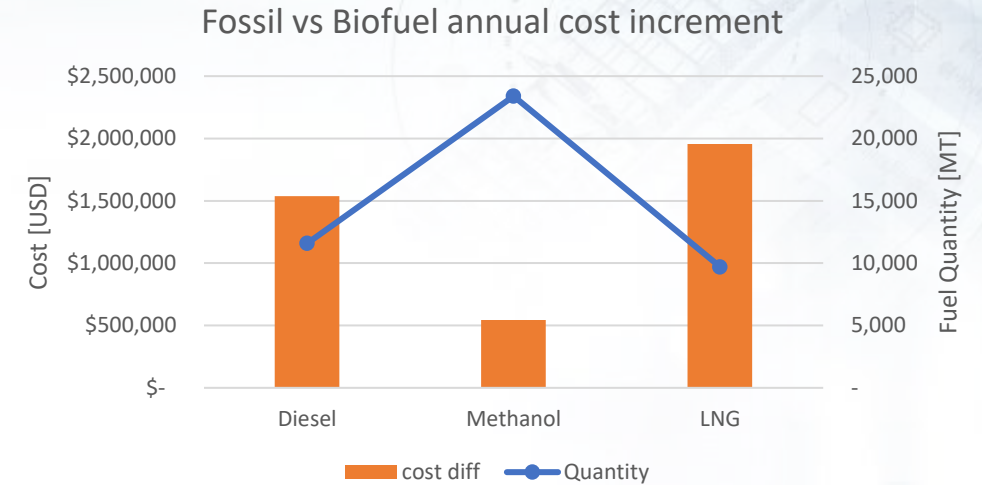
*The current CII regulation covers until 2030; the extension to 2050 is based on assumption

Improvement action required. Additional CAPEX



Biofuels Effect on CII

- Biofuel blends may reduce the carbon factor for TtW CO₂ calculations for CII
- CII based on TtW emissions
- S_F to be prorated for biofuel blends
- Case Study: VLCC tanker



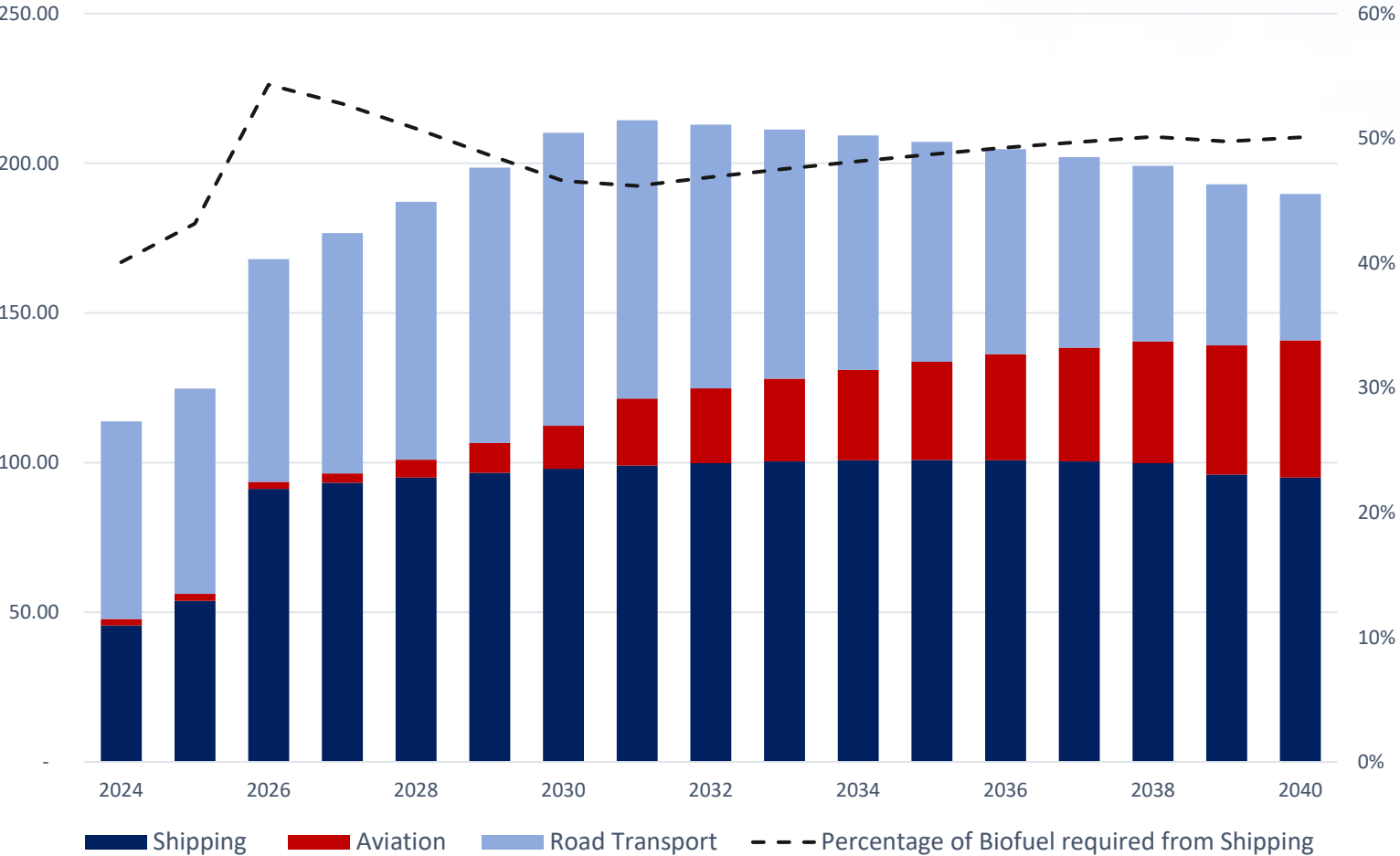
Vessel	MEPC 76 Reduction factor - 2%								Assumed Reduction factor - 2%																			
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
HFO	D	D	D	D	D	D	D	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Biodiesel (B30)	A	A	B	B	B	B	B	C	C	C	C	C	C	D	D	D	D	D	D	E	E	E	E	E	E	E	E	E

Vessel	MEPC 76 Reduction factor - 2%								Assumed Reduction factor - 2%																			
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Methanol	C	C	C	D	D	D	D	D	D	D	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Bio-Methanol (30%)	A	A	A	A	A	A	A	B	B	B	B	C	C	C	C	C	D	D	D	D	E	E	E	E	E	E	E	E

Vessel	MEPC 76 Reduction factor - 2%								Assumed Reduction factor - 2%																			
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
LNG	B	B	B	B	C	C	C	C	C	C	D	D	D	D	D	D	E	E	E	E	E	E	E	E	E	E	E	E
Bio-Methane (30%)	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D	E	E	E

Fueling the Future: The Growing Demand Across Industries

Biofuel Demand Across Industries



Will Shipping's Future Fuel Demand Be Fulfilled?

- Shipping, like aviation, is a hard-to-abate sector; low-carbon fuels are the best way to decarbonize.
- Depending on the net-zero ambition, renewable fuels might account for 7–37% of transportation energy demand by 2050.
- This could potentially lead to a competition between the sectors in the energy markets.



Carrying Low/Zero Carbon Fuels as Cargo



Why?

Large sized carriers

Challenges

Big picture

- 29% of the existing fleet of LPGCs capable of carrying ammonia
- 33% of the new orders are ammonia carriers

Existing Fleet

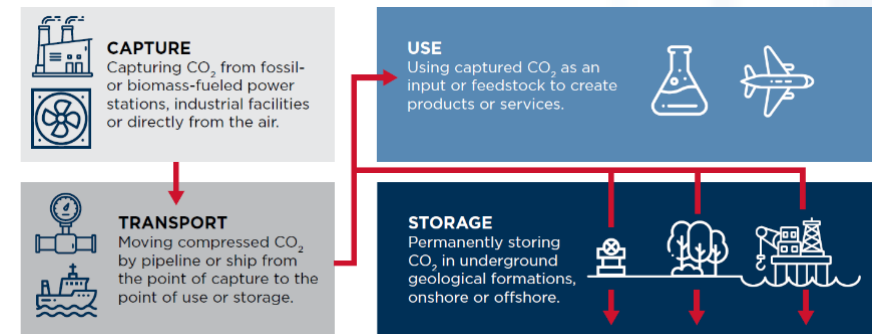
Size	Fleet	Ammonia	%
< 5,000 cbm	597	69	12%
5,000 – 29,999 cbm	474	227	48%
30,000 – 64,999 cbm	133	124	93%
> 65,000 cbm	353	31	9%
Total	1557	451	29%

Hydrogen

- Reaching the required temperature of -253°C is a technical challenge
- Requires high amount of energy for liquefaction
- Any degrading of insulation results in rapid pressure rise, boil-off and required venting
- Trend shifting to cryo-compressed hydrogen
- Cryogenic temperatures required but less so (~ -190°C)
- High pressure (250-350 bar) allowed offers flexibility with handling boil-off

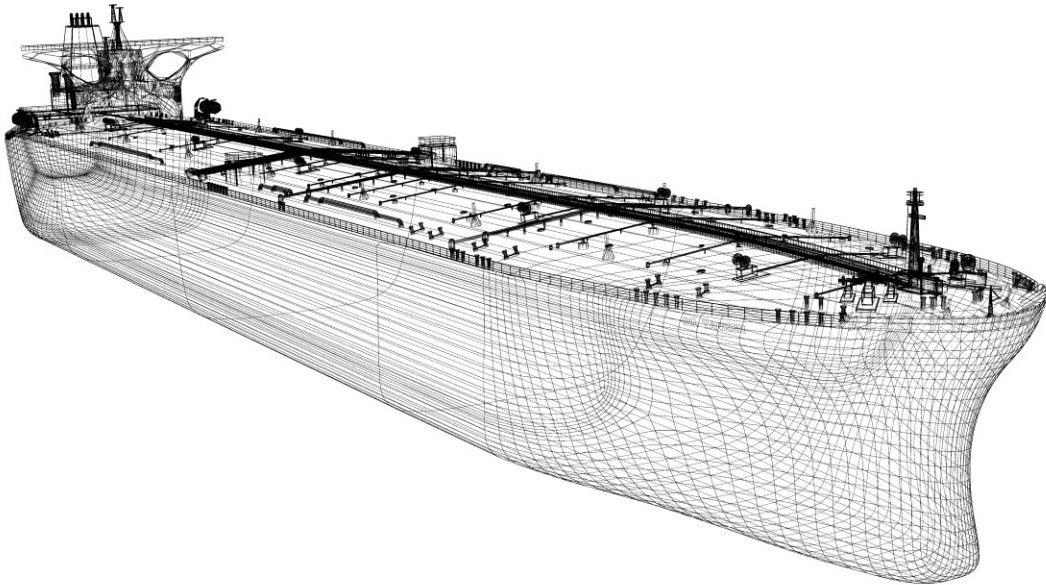
CO₂

- LCO₂ must be carried within a temperature and pressure range that will prevent formation of solid CO₂



Multi-Gas Carriers

A multi-gas options strategy would need to effectively address all the individual risks that might arise from having two or more gases on a vessel.



Potential design of such carrier will be analyzed taking into consideration:

- Applicability of international regulations and codes and potential conflicts among cargoes
- Material availability and compatibility with all potential cargoes (adequate properties)
- Individual gas characteristics (flammability, toxicity, corrosivity, etc.)
- Constraints due to gas characteristics
- Increase in overall cost due to engineering design constraints (for instance LCO₂ is carried only in Type C tanks)
- Technology development and readiness to handle various cargoes (reliquefaction plants, cargo pumps and compressors)
- Hazardous areas and ventilation requirements

Technology Update

PATRICK RYAN | MARCH 2023



TECHNOLOGY TRENDS

Exploring the Future of Maritime Innovation

“Innovation in the maritime industry is cyclical, and we’re on the verge of a new wave of technologies and change.”



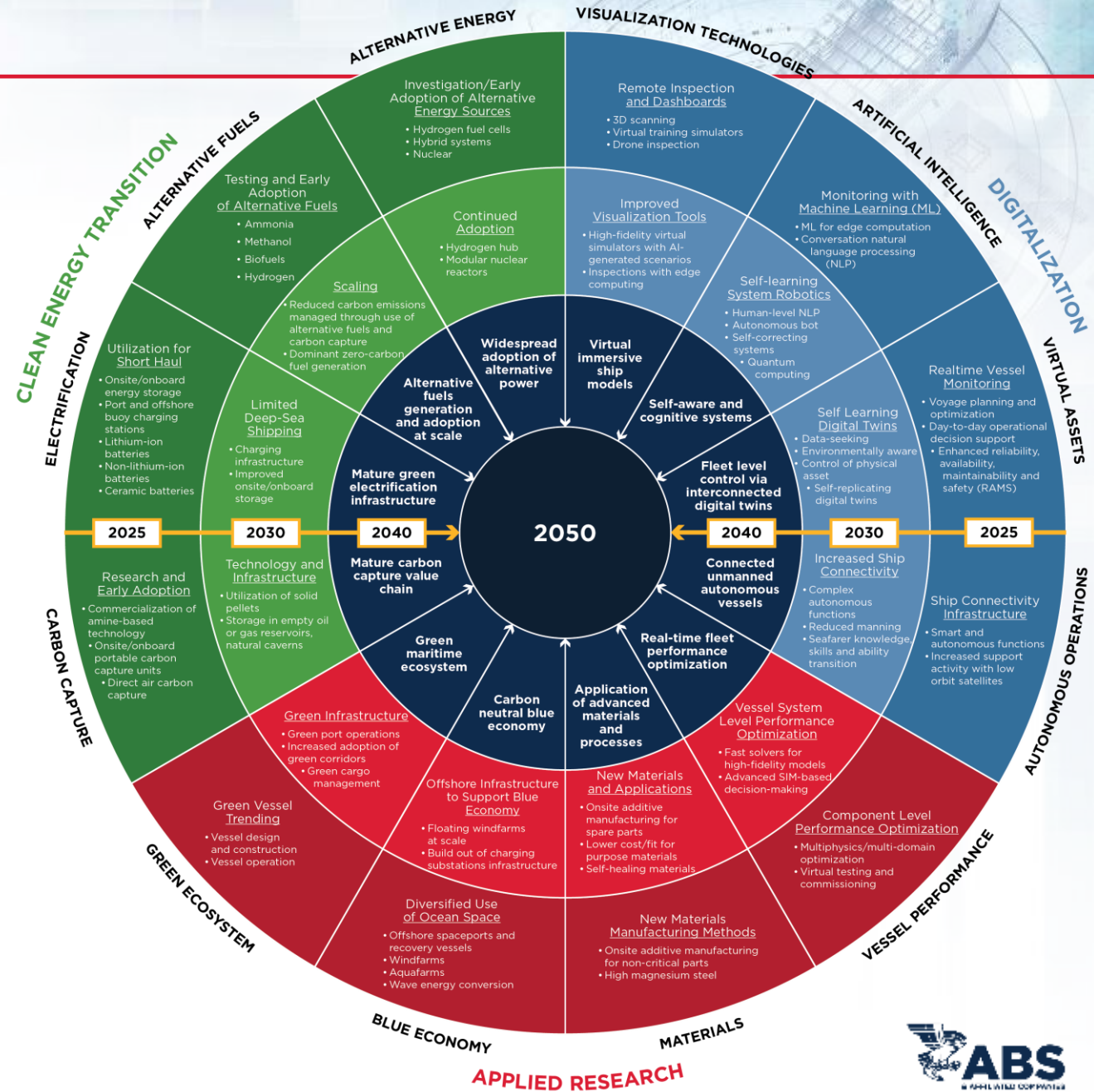
Innovation Outlook

Sustaining innovation for Net-Zero Carbon Environment



enabled by a

Digital Ecosystem



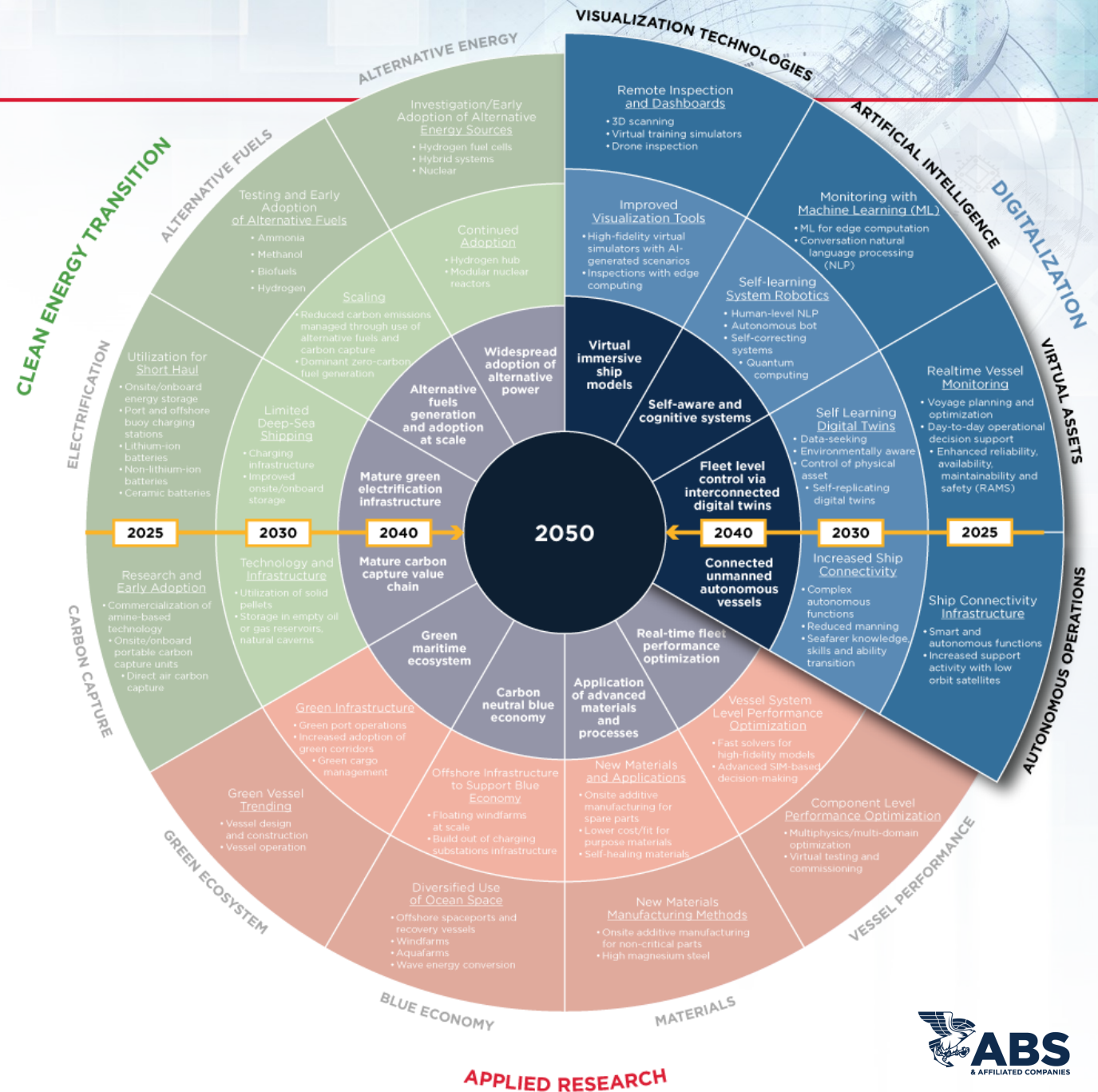
Digitalization

TECHNOLOGY ENABLERS

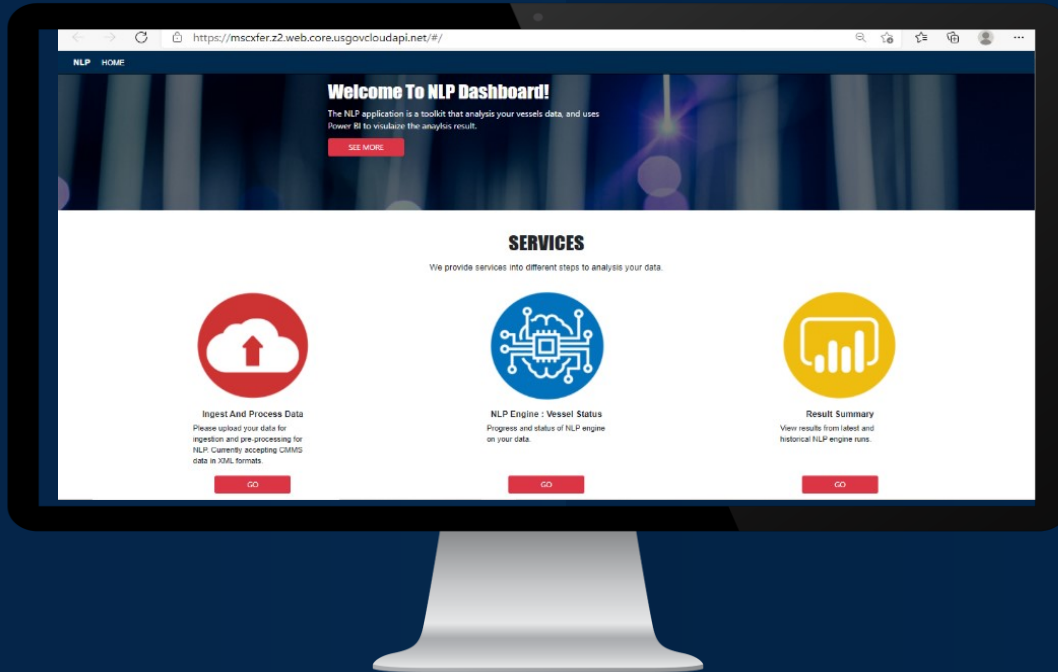
- Connectivity
- Visualization
- Artificial Intelligence
- Machine Learning
- Modeling and Simulation

DRIVERS

- Efficiency and Performance
- Condition-based Maintenance
- Remote Operations



Artificial Intelligence



APPLICATION

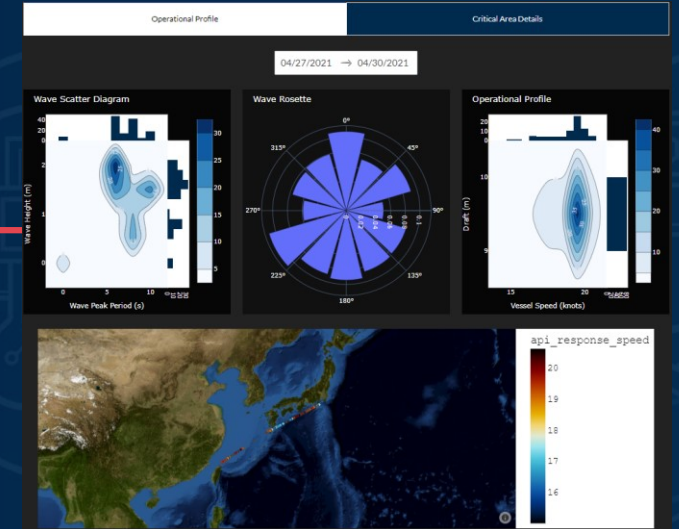
Natural Language Processing (NLP)

Plato Chat Bot with (NLP)

NLP Dashboard

TECHNOLOGY

Dataiku – New Time Series Data Platform



RESEARCH



Rapid component identification to build virtual vessel component list using AI



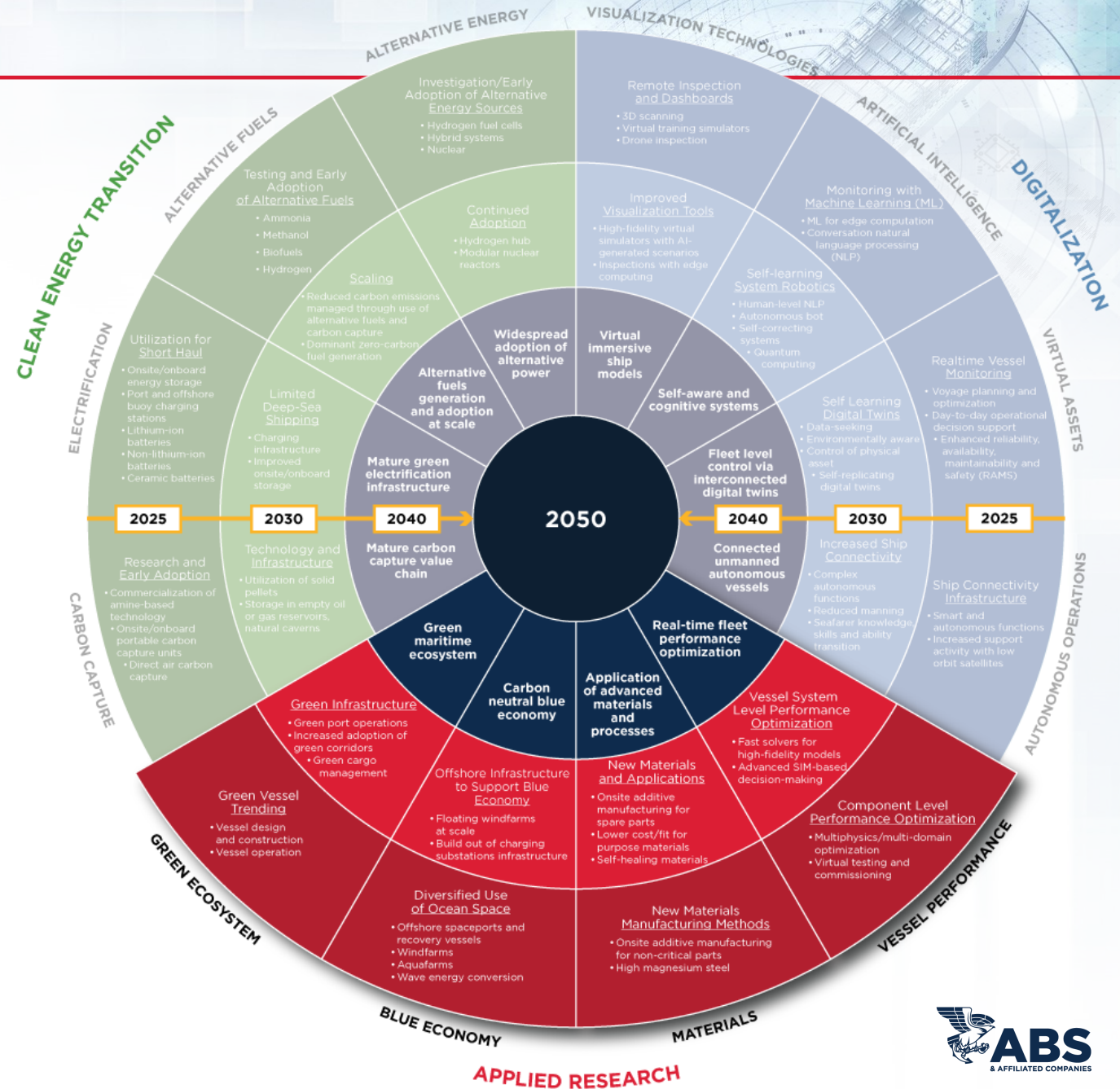
Applied Research

TECHNOLOGY ENABLERS

- Nanotechnology
- Biomimicry
- Additive Manufacturing
- Computer Aided Engineering (CAE)
- Generative Design
- Advanced Sensors

DRIVERS

- Diversifying Use of Ocean Space
- Clean Energy Transition
- Fit for Purpose Materials
- Efficiency and Performance



Vessel Performance

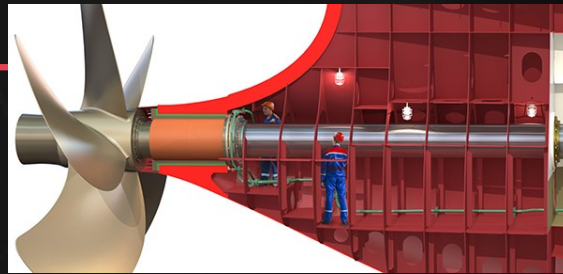


TECHNOLOGY

Development of NextGen Engineering Applications

RESEARCH & APPLICATION

Performance and Optimization

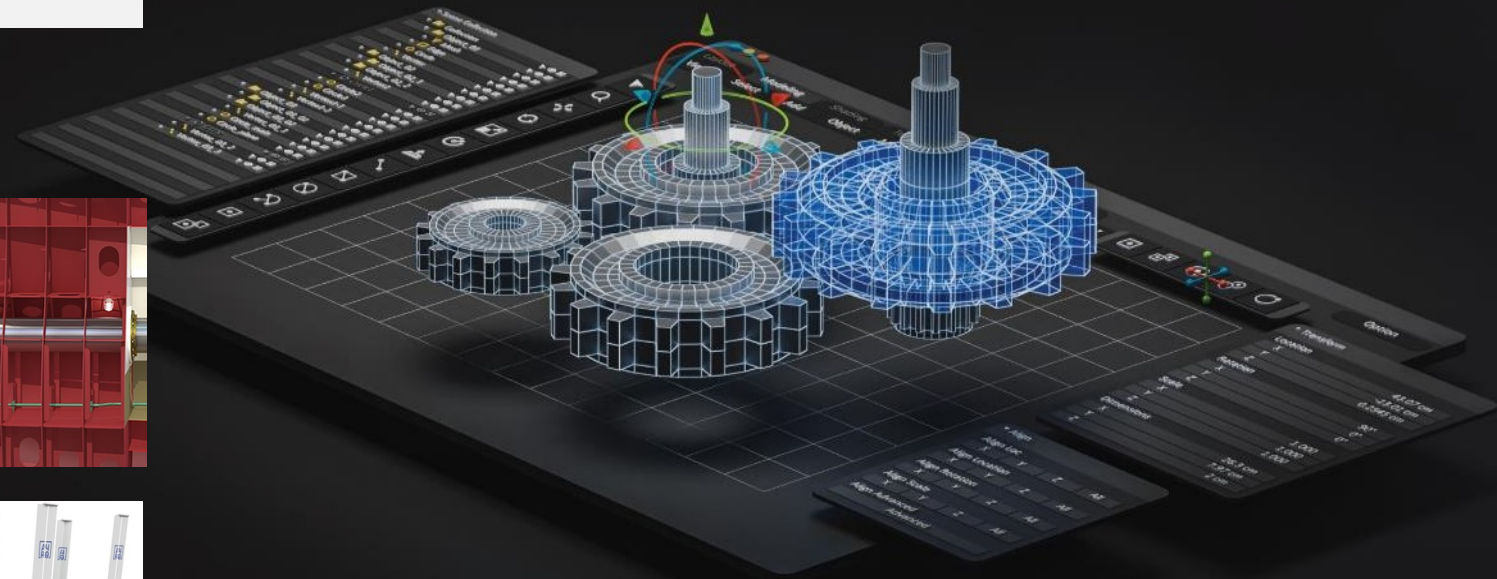


INNOVATIVE VESSEL DESIGN

ABS AiP for Sterntube-less Vessel Designs

MODELING & SIMULATION

Hybrid Power Configuration



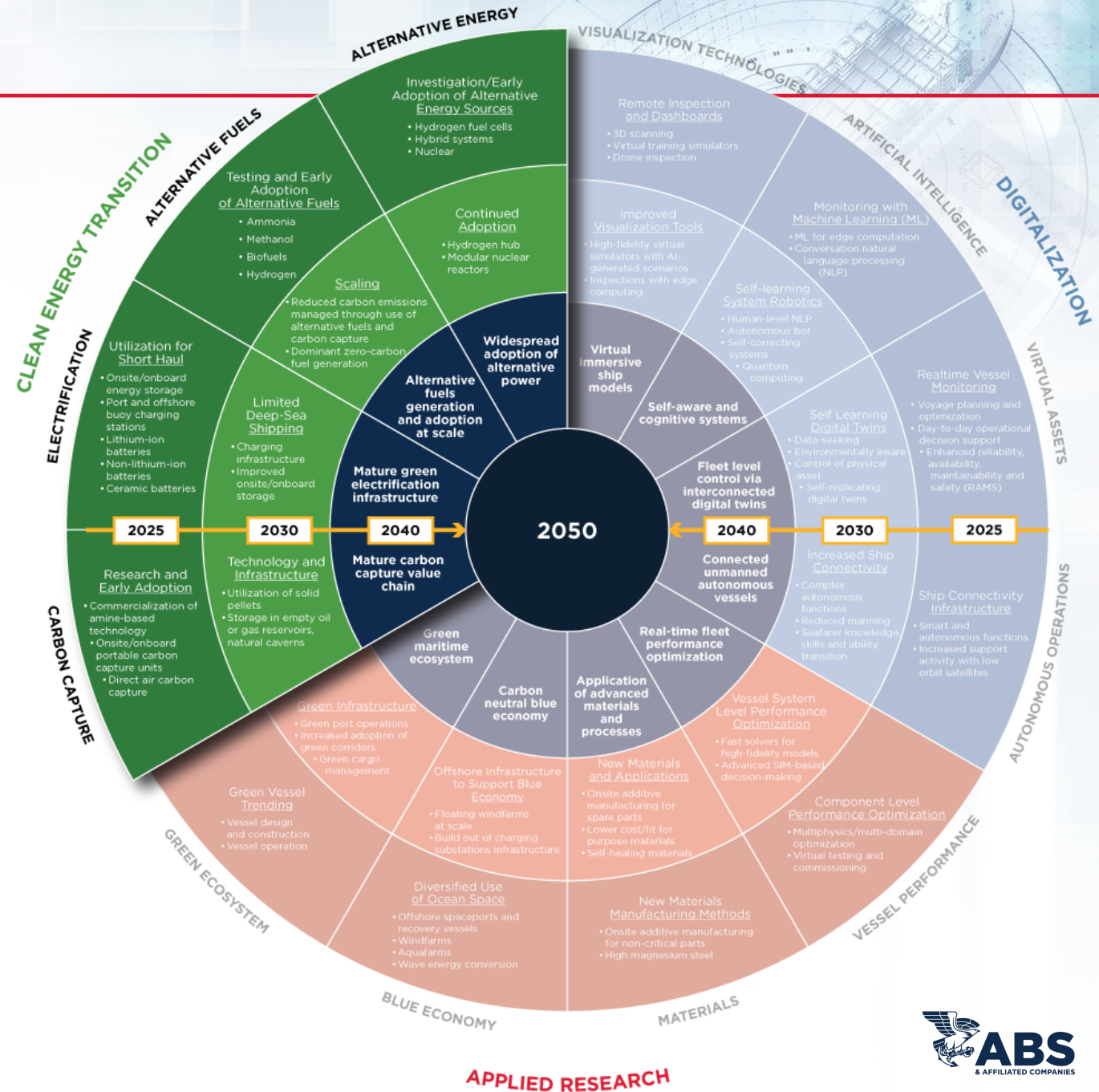
Clean Energy Transition

TECHNOLOGY ENABLERS

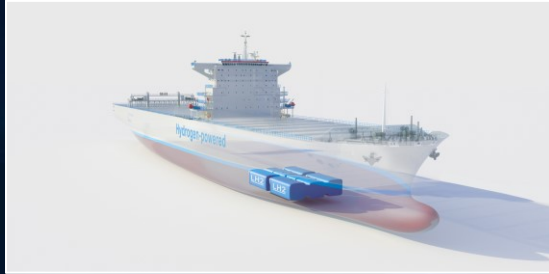
- Carbon Capture Technology
- Electrification Developments
- Nuclear Reactor Developments

DRIVERS

- Regulatory Targets
- Societal Pressures
- Finance Requirements
- Corporate Governance



Alternative Fuels/Energy



TECHNOLOGY

Generation, Transport, and Storage

NTQs and AiPs for Ammonia, Methanol, and Hydrogen generators

Guide for Building and Classing Liquefied Hydrogen Carriers

Publication on Offshore Production of Green Hydrogen

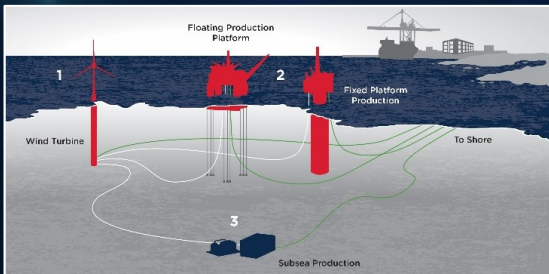


APPLICATION

Industry Partnerships

Offshore Wind: Digital Twin Development

Advanced Nuclear Maritime Demonstrator



RESEARCH

University Research Engagements



Lessons from onshore use of ammonia



SAFETY



Q&A



Committee Chairman's Closing Remarks

MR. PALLE LAURSEN | MARCH 2023



ABS Closing Remarks

JOHN MCDONALD | MARCH 2023



Thank You

WWW.EAGLE.ORG

