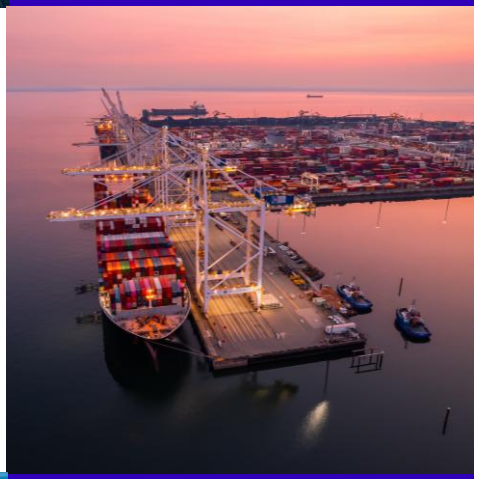

UK National
Clean Maritime
Research Hub
Clean Maritime
Assembly 2026
Collaboration | Innovation | Transformation
UKRI
Engineering and
Physical Sciences
Research Council
Funded by
UK Government

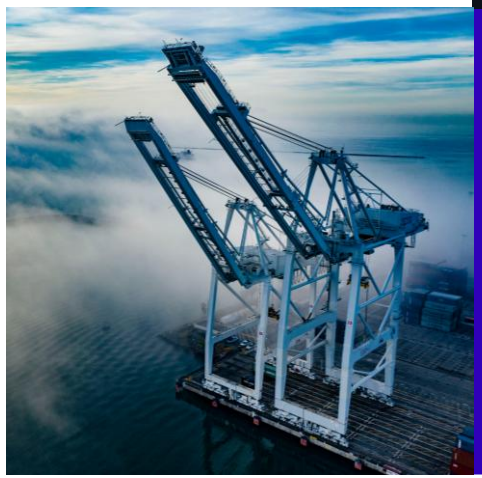
Highlights and Headlines

Session 1

Enabling the Clean Maritime Transition

- Daniel Barton, The Waves Group
- Elaine Scott, Port of Tyne





Clean Maritime Assembly 2026

Alternative fuels – an operational perspective

June 2026

www.waves-group.co.uk

Alternative fuels
Operational Perspective

- Describe the three most popular alternative fuels
- Risks
- Benefits
- Considerations
- Risk assessment
- Training

LNG

Truck to Ship LNG Bunkering (Waves Group)

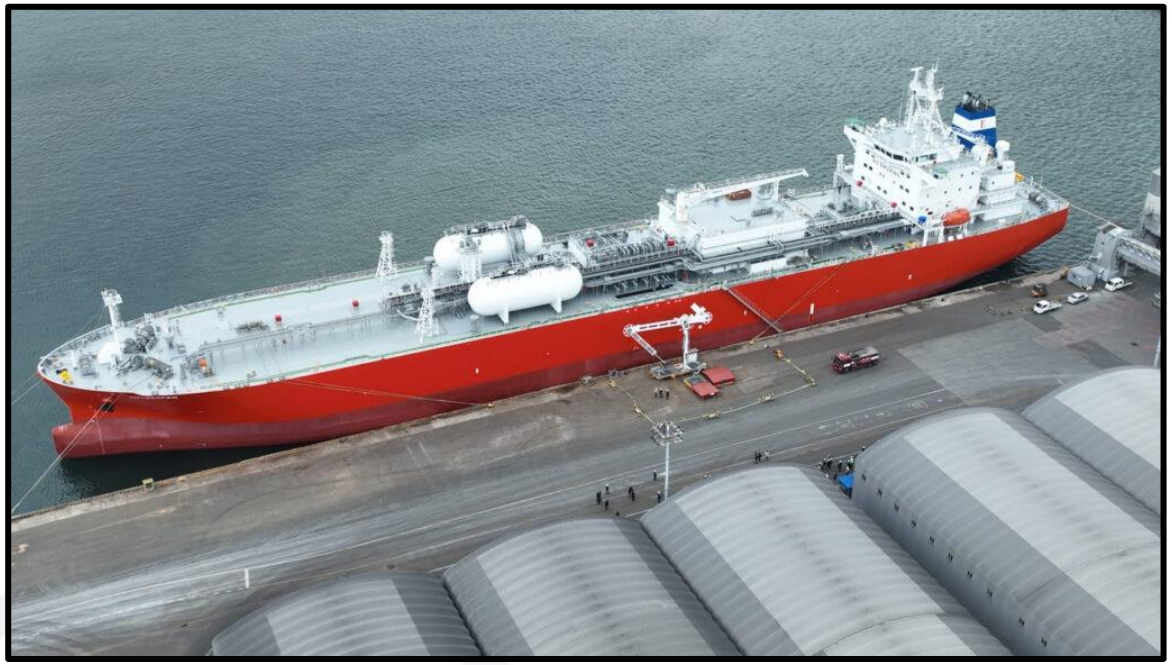
- Liquefied Natural Gas
- Primarily Methane
- CH_4
- Less CO_2 emissions (-25% at the exhaust)
- Non Toxic, colourless, odourless
- Cryogenic
- Specialist training
- PPE
- Green Credentials?

Methanol

Ship to Ship Methanol Bunkering (Port Authority of Singapore)

- Aliphatic alcohol
- CH_3OH
- Primarily used in the plastics industry
- Less CO_2 emissions (-16%)
- Produced from fossil fuels, primarily natural gas and coal
- Green and Blue production
- Risks
- Special training
- PPE

Ammonia



Shore to Ship Ammonia Bunkering (Ulsan Port Authority)

- Chemical
- NH_3
- Primarily used in fertiliser
- Zero CO_2 emissions
- Produced from fossil fuels, primarily coal and natural gas
- Green and Blue production
- Risks
- Special training
- PPE

Risks

- Low flash point.
- Cold temperatures (LNG and Ammonia)
- Leakage of liquid and vapour
- Toxicity
- Waste management

Benefits

- Less CO_2 at the exhaust
- Green credentials of the fuel
- Emissions trading schemes to encourage green production.

Considerations

- Availability of Fuel
- Bunkering method, location and infrastructure
- Simultaneous Operations
- Special features for vessels to comply with regulations
- Dry docking

Risk Assesment

- **For the Vessel**
  - Risk based design analysis for the vessel

- **For bunkering and storage**
  - Bunkering method and Location?
  - Local regulations?
  - Storage or portable tanks? DSEAR/COMAH
  - HAZID and HAZOP techniques are used to establish safe method

- **Dry docking**
  - Local regulations and permitting

Training

- **For Crew**
  - For ship - IGF training for low flashpoint fuels – seatime/refreshers.
  - 30 days seatime on IGF vessel

- **For bunkering**
  - For bunkering supplier and operatives

- **For builder and repair yards**
  - Expertise is generally required and training is recommended

Thank you.

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PORT OF TYNE

portoftyne.co.uk

Decarbonisation at Ports — Opportunities & Challenges

Elaine Scott, Director of Innovation

Clean Maritime Assembly: 25 June 2026

The BIG Picture:

Port of Tyne at a Glance

- **650** acres of freehold land
- Trust Port supporting **10,500** jobs
- GVA **£766m**
- **Connectivity** (air, rail, metro, road)
- Deep Sea **13.5m**
- **90%** of the world's largest vessels
- **200** Acre Tyne Clean Energy Park
- Rail Connections to East Coast Main Line
- UK's first Maritime Innovation Hub
- Bulks, Renewables, Offshore, Automotive Containers, Ro-ro, Cruise, Ferry, Estates

About Us

- **2nd biggest** car exporter in UK
- **1 in every 8** lightbulbs in UK
- Base for the world's biggest windfarm – Dogger Bank
- Marshalling Port for the Sofia and Hornsea 3 windfarms
- **40%** UK's tea
- Regional centre for cruise and ferry
- UK's first Maritime Innovation Hub
- Key to delivering NE Mayoral Strategic Authority goals

PORT OF TYNE

Why Ports Are Central to Decarbonisation

Ports as Enablers

Maritime handles 92% of freight transport. Ports are unique nodes in the maritime supply chain – they directly control shore-side emissions and enable vessel operators to access clean fuels and shore power.

UK Maritime Decarbonisation Strategy

UK domestic maritime targets: at least **30% GHG reduction by 2030**, 80% by 2040, and net-zero lifecycle emissions.

Global Emissions

Maritime transport accounts for ~3% of global GHG emissions, more than the bus and rail sectors combined. Without intervention, this share will rise.

Port-Side Scope 1 & 2

Ports control direct emissions from cranes, handling equipment, buildings, and vehicles, and indirect grid-electricity emissions. Electrification is the primary short-term lever.

A Changing Regulatory Landscape

IMO Net Zero Framework

FuelEU

UK ETS

Why this matters?

- Cleaner fuels and shore power become more important
- Robust emissions data becomes essential
- Policy direction affects timing and investment decisions

Key Operational Challenges Ports Face

Legacy Assets

Port equipment has 15+ year lifespans. Replacing mid-life assets creates double cost: write-off + replacement..

Grid Constraints

National Grid capacity is limited. Lead times for new grid connections exceed 18 months.

Sticky Carbon

Some emissions are hard to abate, heating systems, specialist plant equipment.

Data Fragmentation

Emissions data is often siloed across departments, requires significant processing time, and cannot drive action without interpretation. Data is useful; *information* is vital.

Capital Constraints

Green investment requires balancing sustainability, affordability, value, time and risk. Need for robust business cases.

Scope 3 Complexity

Majority of port emissions sit in Scope 3 — supply chain, leased assets, etc — where the port has limited direct control.

Key Opportunities at Ports

Asset Electrification

Convert diesel cranes, forklifts and handling equipment to electric. Reduces Scope 1 directly

Onsite Renewables

Roof-mounted solar on warehouse buildings, wind energy partnerships. Reduces Scope 2 and provides energy resilience.

Shore Power

Provision of electrical power to vessels at berth eliminates auxiliary engine emissions. A key enabler for vessel decarbonisation.

Smart Operations

LED retrofit across all structures and assets delivers immediate energy savings. Automation also improves operational and carbon efficiency.

Green Corridors & Collaboration

Partnerships with other ports, tug operators, shipping lines and energy suppliers to drive Scope 3 reductions across the maritime value chain.

Energy Hub Role

Ports as clean energy hubs: integrating offshore wind energy, green hydrogen, ammonia bunkering infrastructure, and grid-level storage.


PORT OF TYNE
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Port of Tyne
Decarbonisation
PORT OF TYNE

Our Environmental Impact – The Starting Point

Port-owned fleet, plant equipment

SCOPE 1 CO_2e

Equiv. to ~7,000 homes annually

ENERGY CONSUMPTION

70–80%

SCOPE 3 SHARE

Vessels & supply chain emissions

2030

Net Zero Target

Scope 1 & 2

2040

All-Electric

Full fleet electrification

2050

Net Zero Target

Scope 1, 2 & 3

Taking a wider view – Our Five Focus Areas for Decarbonising

Education

Training colleagues on climate impacts. UK-first Port Carbon Literacy Program.

Energy

Expand onsite renewables, use transitional fuels, replace ICE plant with electric.

Reporting & Policies

Sustainable travel, sustainable purchasing policies, transparent KPI reporting.

Supply Chain

Require suppliers to provide emissions data. Purchase only from those on an emissions reduction journey.

Biodiversity

Create biodiversity hotspots. Fortifies local climate resilience. Net gain, not just no-loss.

Governance Framework

Climate Governance Committee (cross-departmental oversight, quarterly reporting to Board) + Sustainability Steering Group (day-to-day progress). Goals must be achievable, demonstrable, and verified.

Sustainable Purchasing — 5 Decision Dimensions

Every procurement decision assessed against: **Sustainability · Affordability · Value · Time · Risk**. Embedded in business case process with colleague training for consistency.

Our Main Challenges

- Infrastructure costs and grid upgrades can run into millions, with lead times of around 24–30 months.
- Land availability matters because generation and storage can compete with operational space.
- Environmental data sits across multiple systems, making performance hard to track consistently.
- Some technologies are still hard to justify when carbon savings do not yet match cost.
- Scope 3 progress depends on shipping lines, tenants and suppliers moving too.
- 'Chicken and Egg' dilemma for Shore Power & Alternative Fuels

Our Main Opportunities

- Technology is advancing quickly across electrification, battery storage, smart energy management and low-carbon fuels.
- UK SHORE and related funding can help ports test innovation, reduce risk and strengthen business cases.
- Green shipping corridors can create demand for coordinated action between ports, vessel operators and energy partners.
- Think ‘out of the box’ solutions in maritime: vessel design, logistics planning including shipping routes

PORT OF TYNE

Our journey so far to Net Zero and All Electric

NO ORDINARY RIVER.

portoftyne.co.uk

- **Electric Vehicles:** Port has replaced its diesel light commercial vehicles with electric alternatives and put in place charging infrastructure
- **Transitional Fuels:** From June 2024 the Port's HGV fleet moved to using HVO as it's primary fuel.
- **Electrification of Cargo Handling Equipment** 1st crane has successfully operated on full electric.
- **690kWp solar array scheme installed on Warehouse 21 – our largest warehouse**
- Artemis – **UK first electric foiling pilot vessel**
- **Carbon Literacy Trust** for Ports
- **Green Shipping Corridor** project between Port of Tyne and Ijmuden
- **Efuels feasibility** study with Hitachi

PORT OF TYNE

Clean Energy Testbed through the 2050 Maritime Innovation Hub

NO ORDINARY RIVER.

portoftyne.co.uk

- Collaboration with partners (academia, SMEs, cross-sectoral) to develop innovative environmental solutions and to co-create energy test-bed opportunities for the Port and its customers.
- We are creating feasibility study opportunities and testbeds for new clean energy solutions and trial emerging technology.
- **Living Laboratory** to support clean energy businesses.

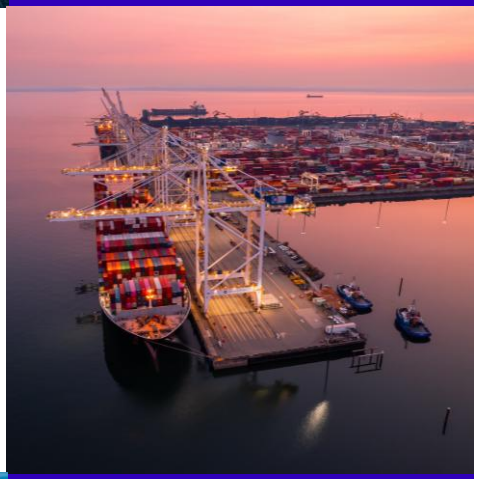

PORT OF TYNE

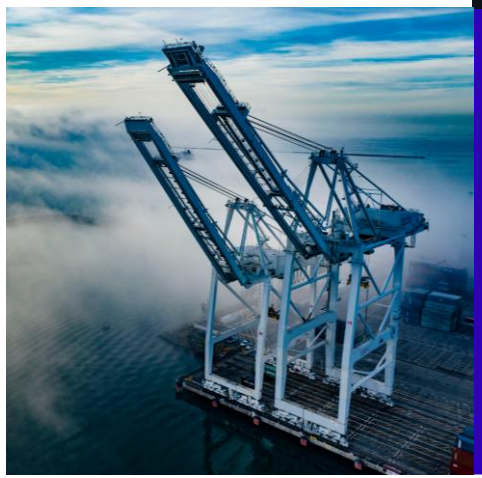
Highlights and Headlines

Session 2

Risk & Asset Management

- Sujit Viswanathan, DNV
- Moya Crawford, DeepTek
- Sarah McCann, NorthStandard





WHEN TRUST MATTERS

Future Fuels: Navigating Real, Manageable Risks

UK Clean Maritime Research Hub – Clean Maritime Assembly 2026

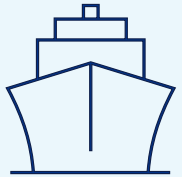
Capt. Sujit Viswanathan - DNV

25 June 2026

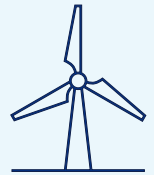
A global assurance and risk management company

160+	~13,000	~100,000	100+	6%+
years	employees	customers	countries	of revenue in R&D

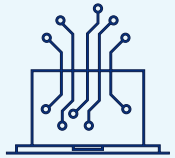
Ship and offshore classification and advisory



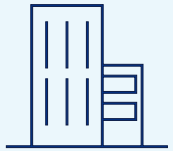
Energy advisory, certification, verification, inspection and monitoring



Software, cyber security, platforms and digital solutions



Management system certification, supply chain and product assurance



DNV

Topics

01 Alternate fuels status

02 Technology trade-offs

03 Hazards & risk management

04 Retrofit - the challenges

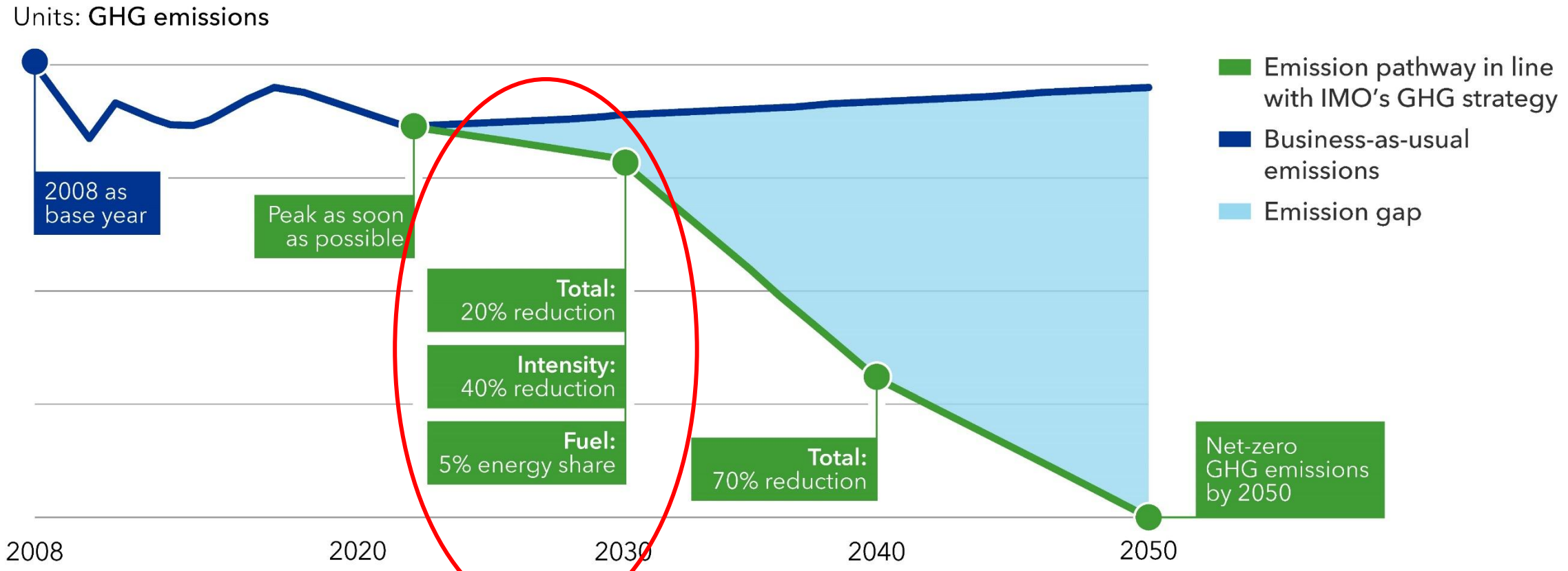
05 Human Element

06 Summary and take aways

Alternate Fuels on vessels

“*where we are and where we are headed”*

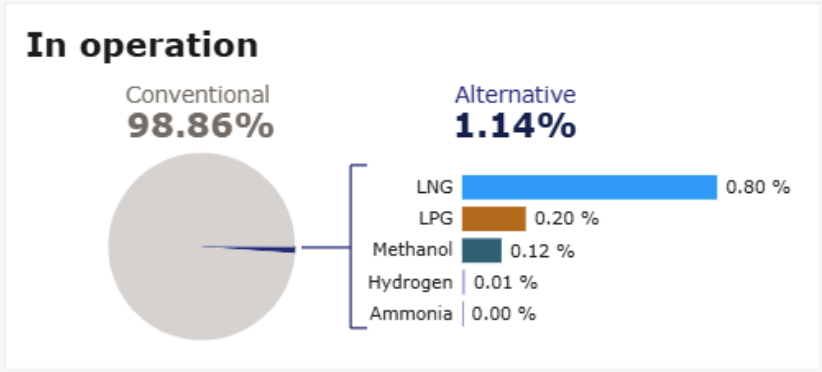
IMO decarbonization ambitions significantly strengthened

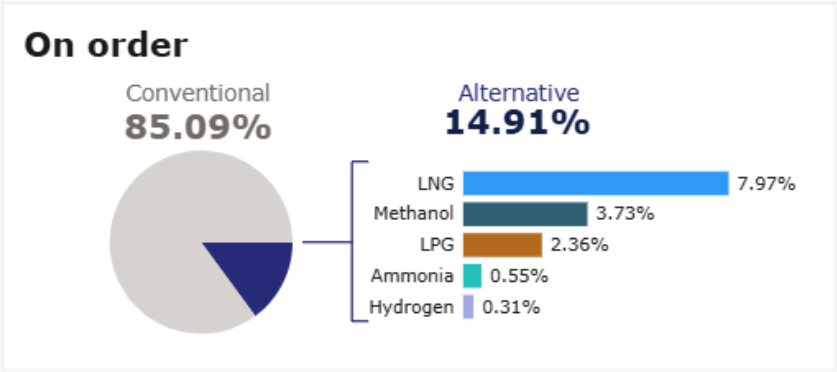


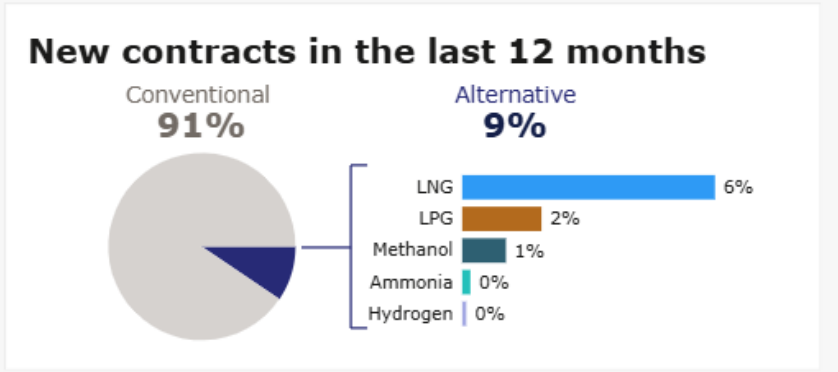
Total: Well-to-wake GHG emissions; **Intensity:** CO_2 emitted per transport work; **Fuel:** Uptake of zero or near-zero GHG technologies, fuels and/or energy sources

Conventional vs Alternate Fuels – an uptake overview

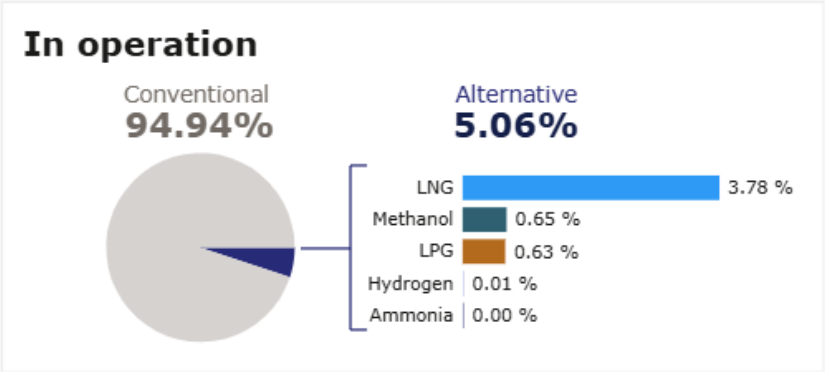
Number of Ships

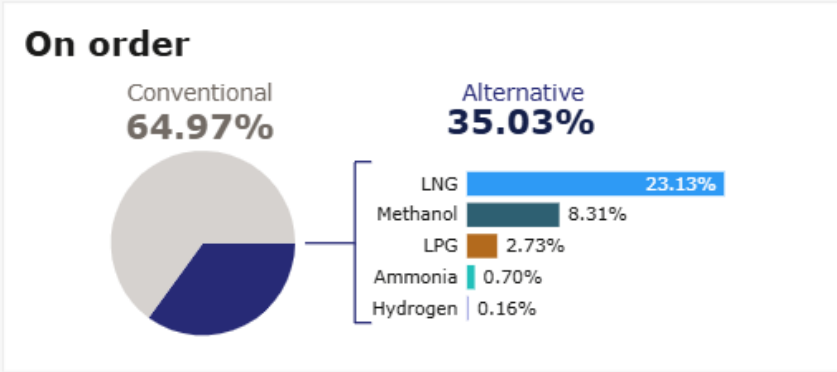


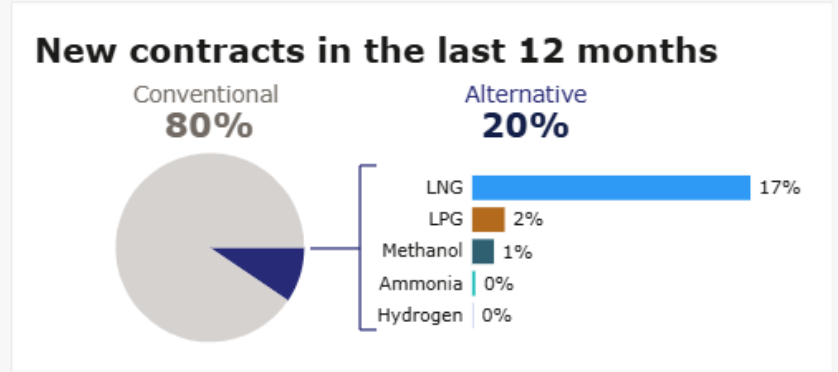




Gross tonnes

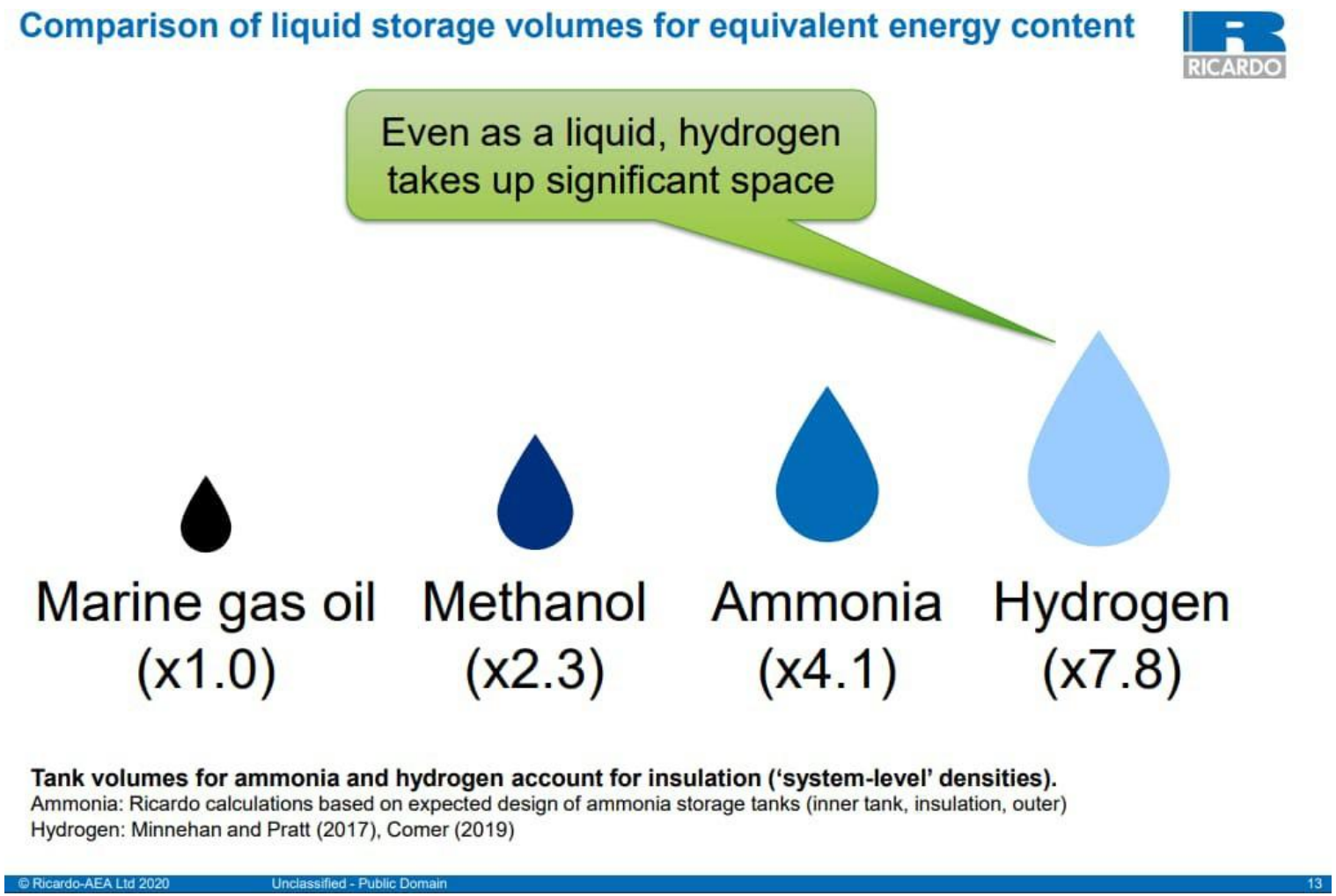






Technology trade offs

Storage vs loss of revenue space



DNV

Battery Vessels

Distribution of battery fleet

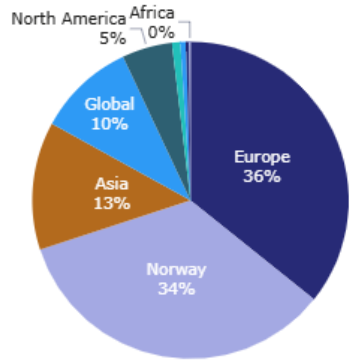
Battery ships in operation

1392

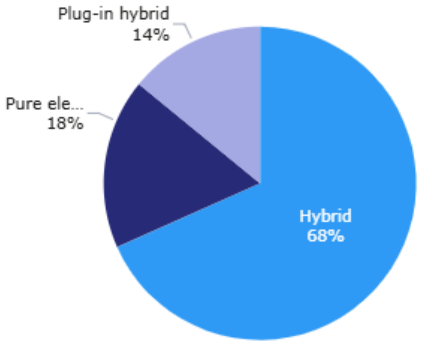
Battery ships on order

516

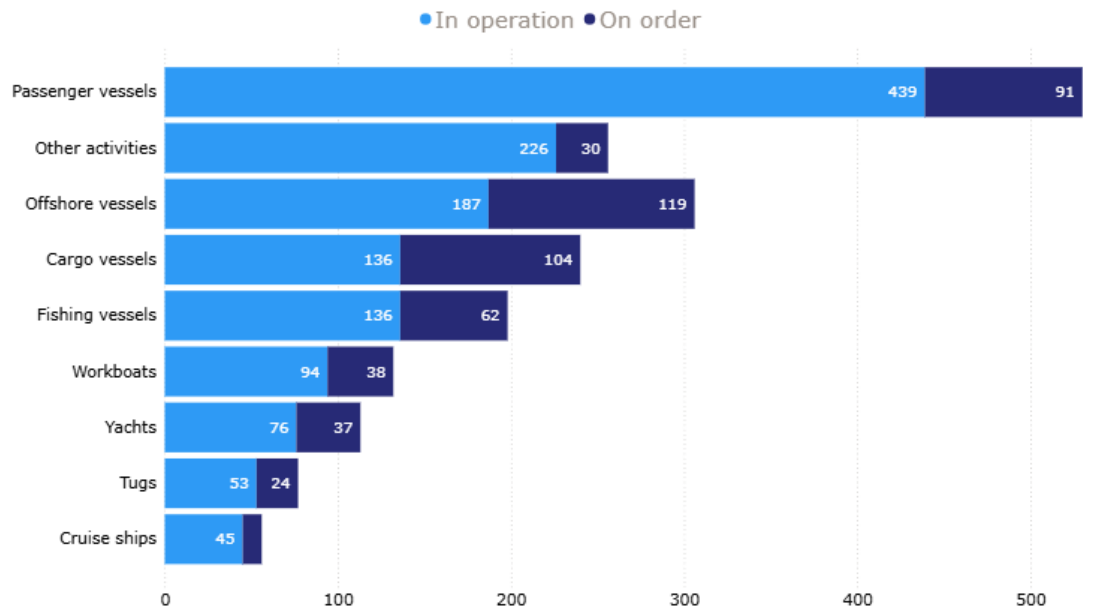
Battery ships by region



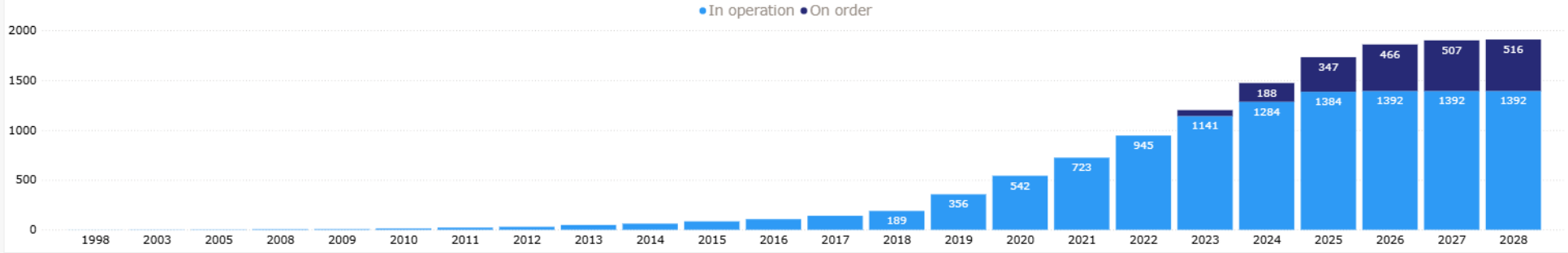
Battery ships by application



Battery ships by ship type



Growth of battery fleet



Ocean Going ships

Short Sea/Near Shore
Offshore O&G/Wind

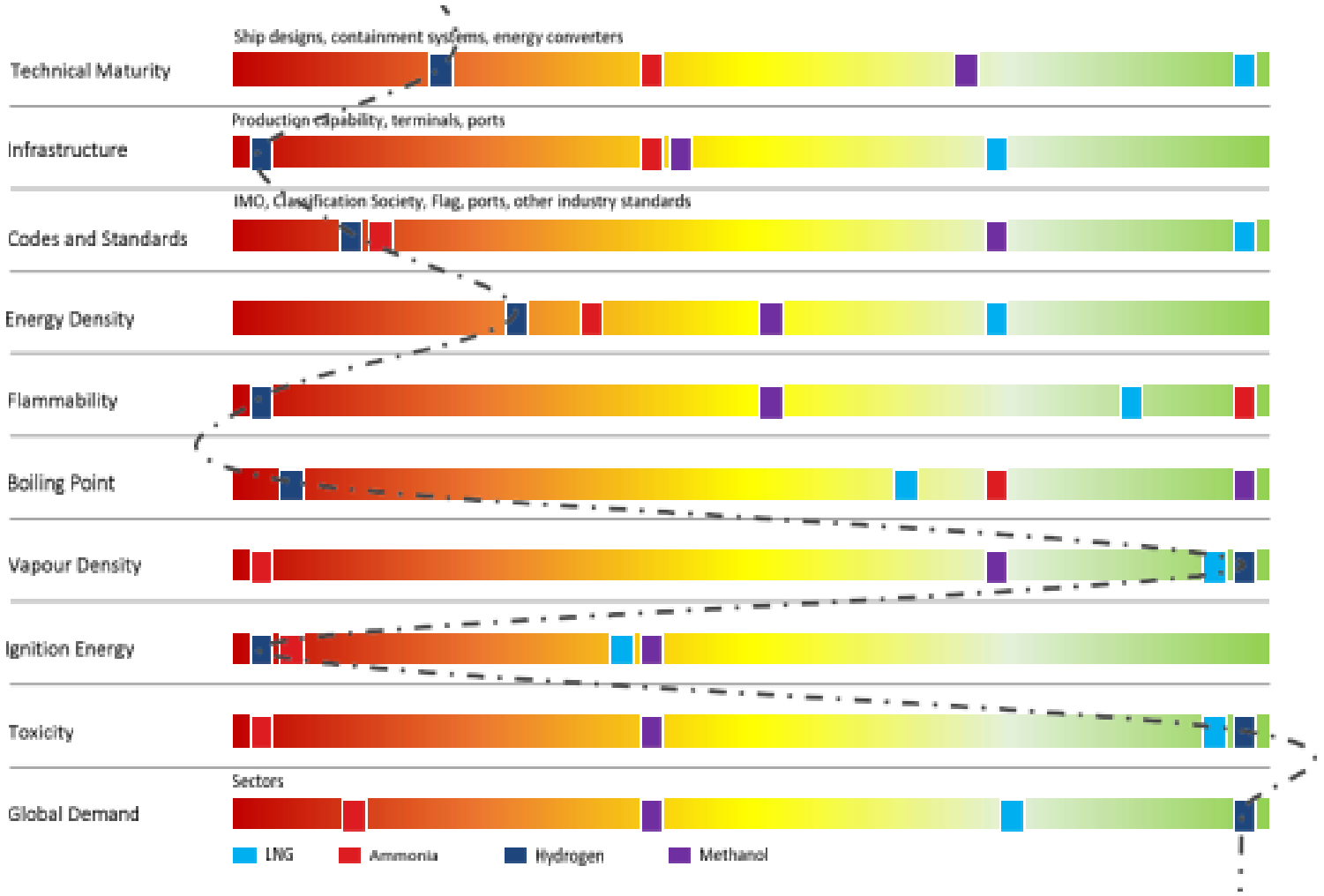
Harbour/Coastal

Role of efficiency improvement & Electrification

Role of sustainable fuel

Hazards and Risk Management

Future Fuels – Heat Map Comparison



Courtesy – Shell International

Key takeaways

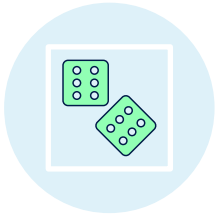
- The heat map shows a transition landscape — no single fuel wins across every criterion.
- **LNG and methanol** look more deployable near term where maturity, infrastructure and standards are stronger.
- **Hydrogen and Ammonia** carry high decarbonisation potential, but safety and handling risks need tighter controls.
- Adoption will depend on aligning vessel design, ports, regulation and sector demand — not fuel chemistry alone.

Risk Management Methodology

Systematic Approach

Hazard Identification (HAZID): Early-stage identification of potential threats.

Hazard & Operability Study (HAZOP): Detailed process safety review.



Quantitative Risk Assessment (QRA): Calculating probability and consequence (e.g., for LNG bunkering zones).

Bow-Tie Analysis: Visualizing threats, barriers, and consequences (specifically for Battery/EES systems).

FMEA: Failure Mode and Effects Analysis for critical machinery.

Risk comparison table across 5 fuels

Risk factor	LNG	LPG	Methanol	Ammonia	Hydrogen
Primary hazard	**Cryo + flamm.**	**Flamm. + pressure**	**Flamm. + toxicity**	**Toxicity**	**Flammability**
Storage	Cryo -162°C	Pressurised ambient	Ambient liquid	Refrig./press.	**Cryo -253°C or HP**
Vapour density	Lighter	Heavier	Heavier	Lighter	Much lighter
Detection	Upper / ceiling	Lower / bilge	Lower spaces	Upper / vent.	Upper / ceiling
Flammable range	5–15%	2–10%	6–36%	15–28%	**4–75%**
PPE	Yes (cryo)	Yes (pressure/cold)	Yes (bunkering)	**Extensive**	Yes (cryo/pressure)
Emergency showers	Yes	Yes	**Critical**	**Critical**	Yes
Escape	Standard	Standard	Standard	**Toxic cloud**	Heat radiation
Material	**Embrittlement**	Standard	Corrosion	Corrosion + toxicity	**H_2 embrittlement**
Boil-off	**Required**	Yes	N/A	**Required**	Yes (compressed)
Secondary barrier	**Required**	As needed	No	As needed	As needed
HAZID	IGF Code	IGF Code	IMO Circ.1621	+ toxic zone	QRA
Hazard zone	**Zone 0**	Zone 1/2	Zone 1/2	Zone 1/2 + toxic	**Zone 0/1/2**

LNG - Dispersion

Battery Failure

Ref: Maritime technologies forum – Felicity Ace

Ref: bbc.co.uk– Fremantle Highway

Ref: International Business times – Morning Midas

Battery Fire risks

⚠️ Why These Fires Are Different

- **Thermal Runaway** → self-sustaining, high heat (>600°C), re-ignition risk
- **Propagation Risk** → spreads unit-to-unit (vehicles / battery racks)
- **Confined Spaces** → explosion + toxic gas accumulation
- **Detection Gap** → fires often identified only after escalation

🚧 Operational & Assurance Challenges

- **Firefighting at sea** = limited resources, delayed support
- **Traditional suppression ineffective** → containment strategy (“let it burn”)
- **Cargo risks**: misdeclaration, poor securing, damaged units
- **Design limitations**: dense stowage, insufficient segregation

Fires are energy driven requiring containment more than suppression

Retrofit – Challenges and Risk Management

- World's first Methanol conversion project of a mega container carrier – 20000 TEU (LOA 400m)
- 7-year-old vessel retrofitted in CHI-Shanghai in 2025.

Challenge Area	What Made It Challenging	How It Was Handled / Mitigated	Outcome / Insight
System Integration Complexity	Retrofit into legacy design	Tailored engineering + interface control	Proven retrofit viability
Multi-Stakeholder Coordination	Many suppliers, first-of-kind	Strong coordination & clear stakeholder alignment	Enabled delivery at scale
Construction & Installation Approach	Block install impractical	Shift to phased build	Reduced risk, smoother execution
Operational Safety & Systems Interaction	New fuel, new risks	Trials + system validation	Safety concept established
Cargo Capacity Trade-off	Methanol tanks required significant space, reducing container capacity	Design optimisation	Trade-off understood
Technology Maturity & First-of-a-Kind Risk	Limited precedent	Iterative "prototype" approach	Clear pathway created
Future Fuel Uncertainty	Evolving fuel landscape	Flexibility in design	Future-ready vessel

Human Element

INTERNATIONAL MARITIME ORGANIZATION

- MSC 111th Session in London – May 2026
- The Committee approved new guidelines to promote the :
  - Interim Guidelines for the safety of ships using **hydrogen** as fuel; and
  - Interim Guidelines for the safety of ships using **ammonia** as fuel.
- The Committee approved two new sets of interim guidelines for training seafarers on ships using alternative fuels and technologies:
  - Interim guidelines on **training for seafarers** on ships using **methyl/ethyl alcohol** as fuel; and
  - Interim guidelines on **training for seafarers** on ships using **ammonia** as fuel.
- "***one ship, one code***" principle to gas carriers using alternative fuels - the IGF Code or IGC Code - improving consistency and clarity in the regulatory framework

DNV

Guidance and Framework

Ref (Lloyd's Register Bureau Veritas Marine & Offshore DNV - Rules and Standards)

DNV Document	Bureau Veritas (BV) Equivalent	Lloyd's Register (LR) Equivalent
DNV-RU-SHIP Pt.6 Ch.2 - Ships using gases and low-flashpoint fuels (IGF implementation)	**NR529 Gas-Fuelled Ships** (LNG/CNG/LFP fuels), plus **NR670 Methanol & Ethanol-Fuelled Ships**, **NR671 Ammonia-Fuelled Ships**, **NR678 Hydrogen-Fuelled Ships**	**LR-RU-012 Rules and Regulations for Classification of Ships using Gases or other Low-Flashpoint Fuels** (includes LNG, methanol, ammonia, hydrogen appendices and IGF implementation)
DNV-ST-0026 - Competence management for LNG and alternative-fuel personnel	BV generally relies on IMO STCW/IGF compliance and training schemes rather than a direct class standard equivalent	LR Training & Certification schemes; no direct LR class-rule equivalent to ST-0026
DNV-ST-0012 - Competence requirements for battery and electrical energy storage systems	BV training and approval programs; no widely used standalone class standard directly equivalent	LR Academy and competency frameworks; no direct rules equivalent
DNV-CG-0660 - Battery power safety philosophy	BV Guidance Notes and Rules for Battery Systems (often issued as Guidance Notes/NI documents rather than Rule Notes)	LR battery guidance documents and risk-based design assessments; no exact counterpart
DNV-CG-0667 - Carbon Capture & Storage (CCS) onboard ships	BV CCS notations and guidance documents for onboard carbon capture projects	LR ShipRight and CCS guidance notes for onboard carbon capture
DNV-CG-0156 - Methanol carriage and methanol fuel safety	**NR670 Methanol and Ethanol-Fuelled Ships**	**LR-GN-047 Guidance Notes for Methyl and Ethyl Alcohol Fuels** together with LR-RU-012 Appendix LR1
DNV-RP-G105 - LNG bunkering safety and risk assessment	**NR620 Bunkering Ships** (LNG, ammonia, methanol bunkering)	LR guidance on LNG bunkering and alternative-fuel operations under LR-RU-012 and associated guidance notes
DNV-RP-F112 - Hydrogen induced stress cracking (HISC)	BV materials qualification guidance for hydrogen service and offshore equipment (project-specific documents rather than a single RP equivalent)	LR materials and hydrogen-fuel guidance; hydrogen requirements incorporated into LR alternative-fuel rules and hydrogen appendices
DNV-ST-F101	**NI 565 / offshore pipeline and subsea system rules**, BV offshore pipeline standards (project dependent)	LR Energy pipeline design and integrity standards;

Key takeaways and closing message

Maritime GHG reduction is **necessary** — and **achievable** through an integrated transition.

Momentum is building, but pace depends on technology maturity, fuel availability and operational readiness.

THREE MESSAGES TO CLOSE ON

1. **Action now**

   Hard-to-abate does not mean wait; complexity should shape the roadmap.

2. **Integrated mix**

   No single solution carries the sector; efficiency, operations and new fuels must work together.

3. **Manage evolving risks**

   As transition pathways mature, safeguards, competence and emergency readiness must be reviewed and updated.

Closing message: **act now**, scale pragmatically, and **manage evolving risks**.

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www.dnv.com

sustainaVERSE™

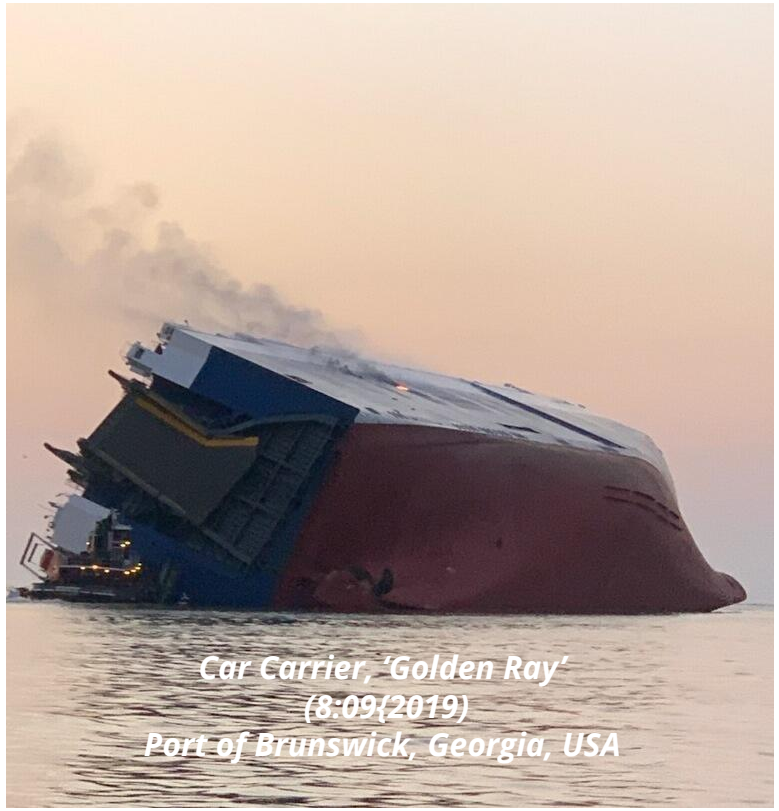
Emergency Response / Wreck Removal / End of Life Fate of Vessels powered by and/or containing ‘Alternative Fuels’

Deep Tek Limited / D’Arcy Thompson Simulator Centre Limited

2026.06.24

Marine Salvage and Wreck Removal as a Global Industry

The very existence of the global marine salvage industry, insurers and P&I Clubs is evidence that there are marine causalities even with modern, highly regulated shipping regimes.



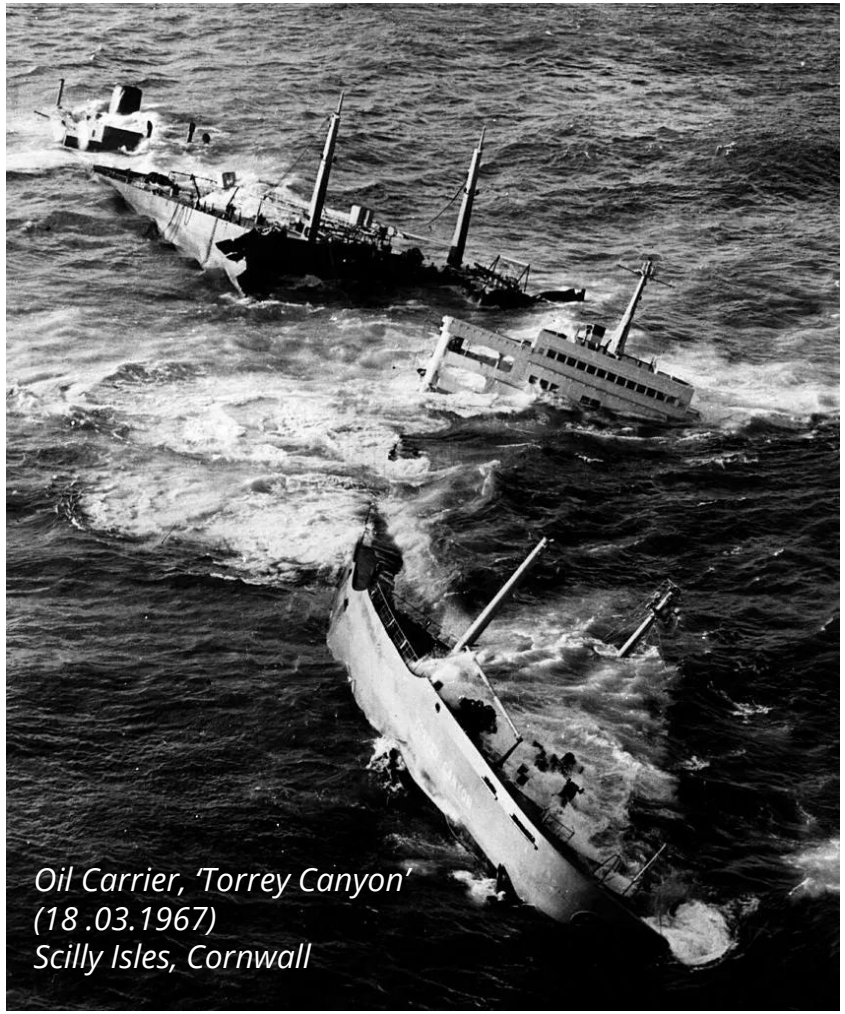
Car Carrier, 'Golden Ray'
(8:09(2019)
Port of Brunswick, Georgia, USA

Car Carrier 'Felicity Ace'
(1.03.2022)
N38º 38.255´ W029º 09.231´,
approximately 3000 metres water depth

List of Car Carrier Casualties: https://en.wikipedia.org/wiki/List_of_roll-on/roll-off_vessel_accidents

mv Torrey Canyon

SIMULATION-LED™



Oil Carrier, 'Torrey Canyon'
(18 .03.1967)
Scilly Isles, Cornwall

Courtesy of The Independent

LIFE: The Salvor

The Dutch family company, Wijsmuller responded under a 'No Cure/No Pay', Lloyds Open Form Agreement. Salvage Master, Captain Hans Stal boarded the stranded tanker with his team to try to pump out ballast, patch damage, and refloat the vessel. During those efforts, an explosion occurred in the engine-room area. Several salvors were injured, and Stal suffered fatal injuries, dying before he could be evacuated to hospital.

PROPERTY: mv 'Torrey Canyon'

Unlike the sinking of RMS Titanic, which altered the regulatory, industrial and societal mindset with regard to the infallibility of designers, builders and owners and safety of life at sea in a unified fashion; the grounding of the 'Torrey Canyon' left the underlying issue – innovation and change within the shipping industry, without consideration of salvors' requirements to be able to respond at speed, with the equipment, training and capacity required.

ENVIRONMENT: International Tanker Owners Oil Protection Fund (ITOPF)

In fairness, the International Tanker Owners Oil Protection Fund (ITOPF) was formed, initially to handle the claim (at a time when environmental compensation law had not caught up with industry).

Must History Repeat Itself?

SIMULATION-LED™

Courtesy of Lloyds Register

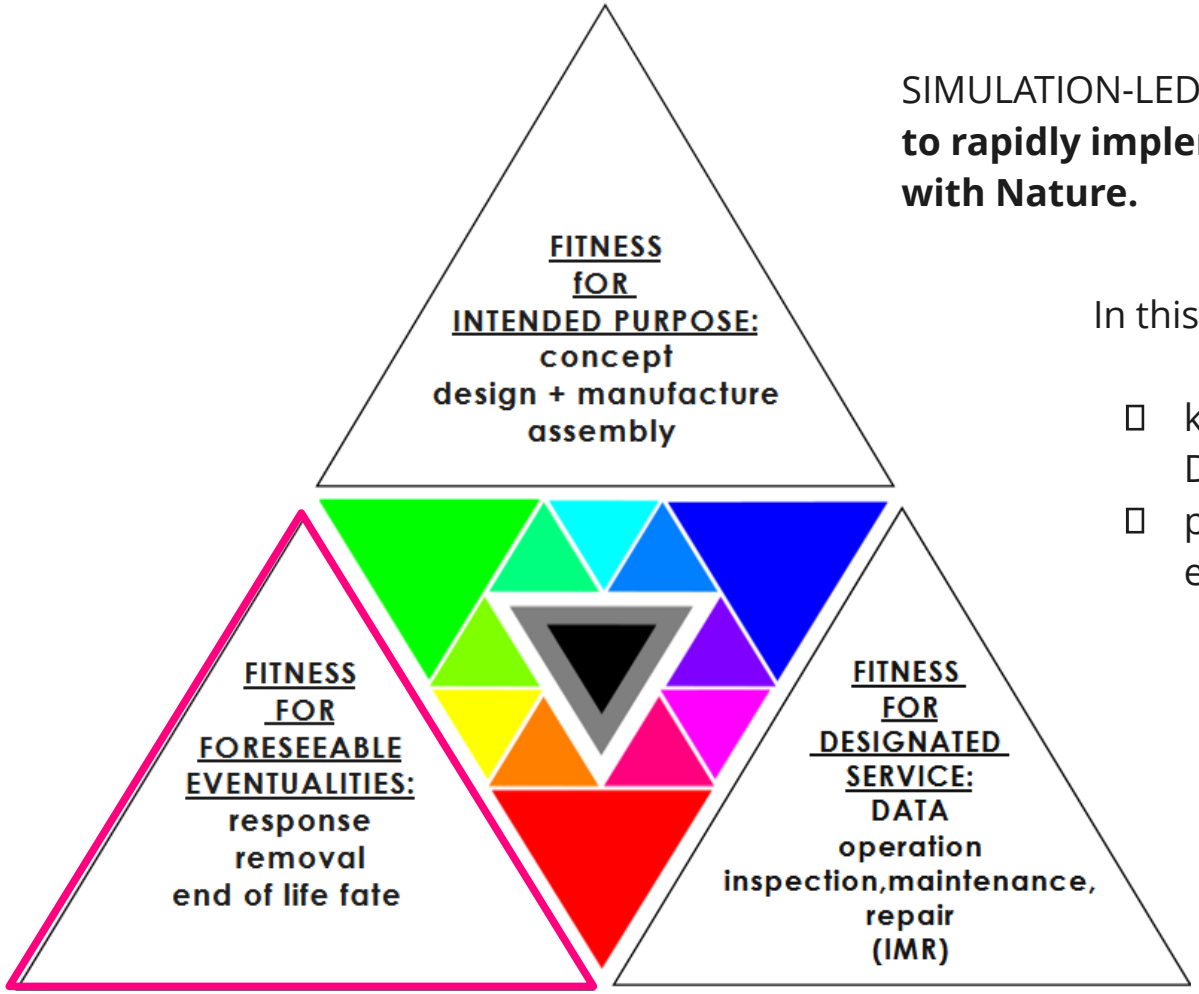
Alternative Fuel Technologies under development/in use

- **Nuclear**
- **Hydrogen**
- **Carbon Capture**
- **Methanol**
- **Ammonia**
- **LNG**
- **BioFuel**
- **Electric**

https://www.lr.org/en/services/maritime-training/technical-and-operational-efficiency/alternative-fuels-course/

‘Fitness for…’ a holistic, lifeTIME Approach

SIMULATION-LED™



SIMULATION-LED™ as a generic methodology
to rapidly implement innovation and change in balance with Nature.

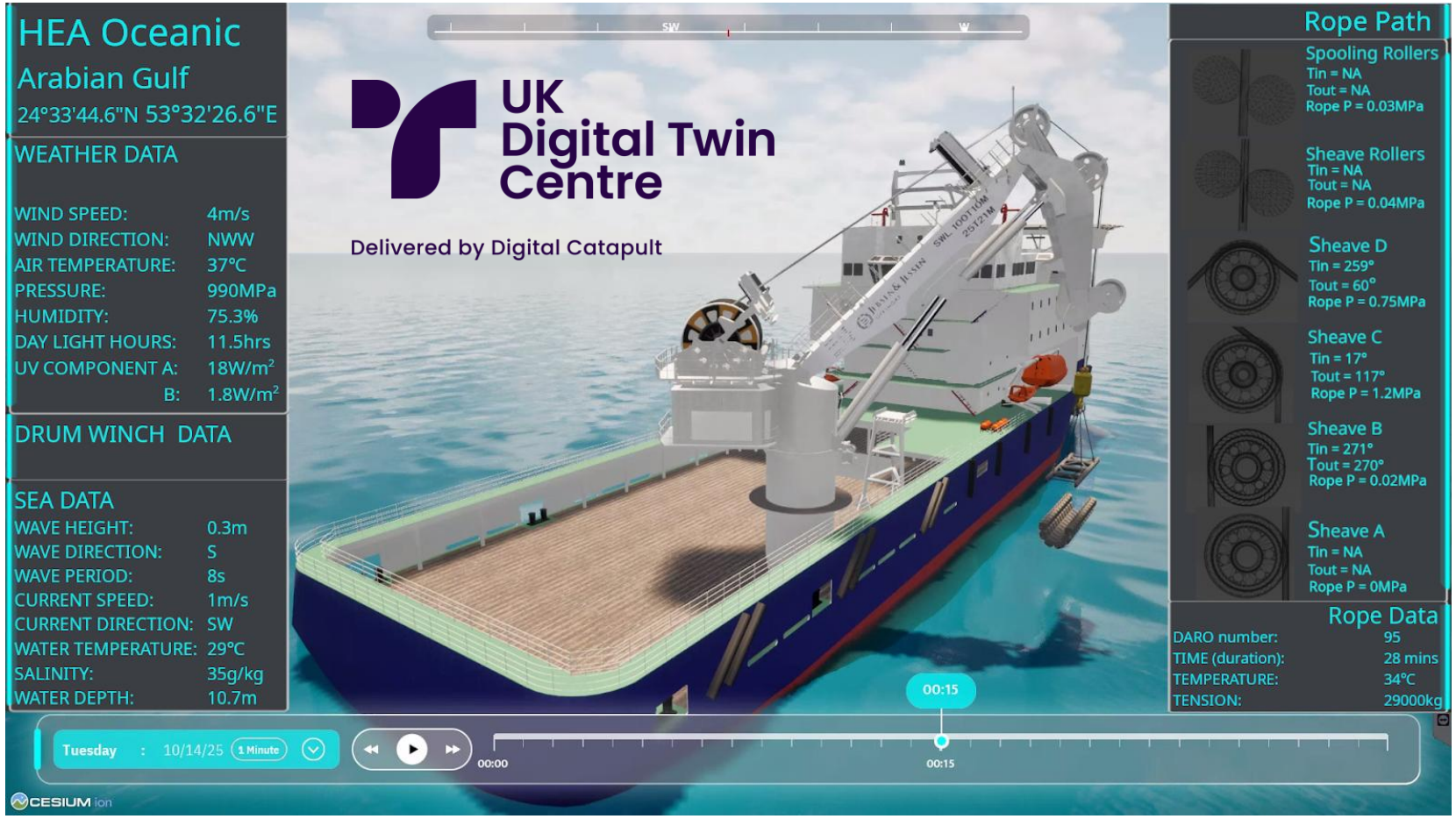
In this diagram the following are embedded:

- key requirements of Principles-Based Design and Development; and the
- protection of LIFE, PROPERTY and the ENVIRONMENT are embedded.

The TIME (of day and/or season, and length of period over which FUNCTION is to be delivered, in a PLACE, or PLACES, needs to be considered from the outset. This capability is built into the sustainaVERSE™

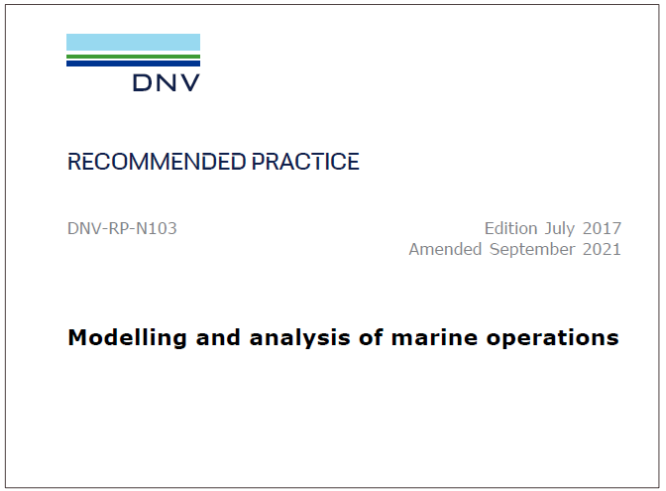
sustainaVERSE™ platform as a integration tool from CONCEPT

HMPE
(which is weightless in water) replaces steel as the strength member

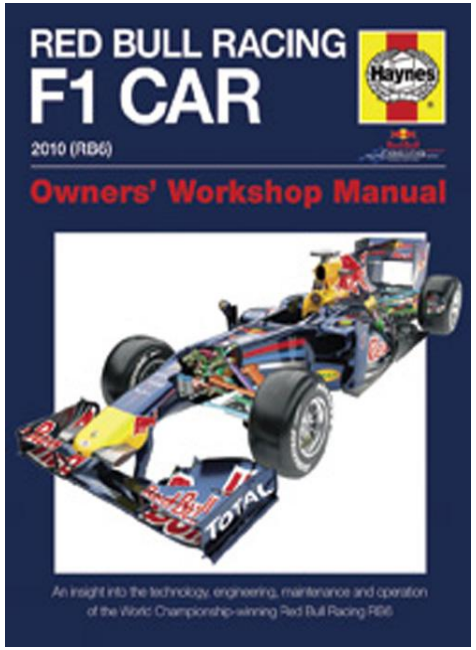


Ability to predict remaining rope Safe Working Life (SWLi) in operation, is essential for Class Society certification.
Assurance that Equipment will deliver Function in Service essential for investment and insurance

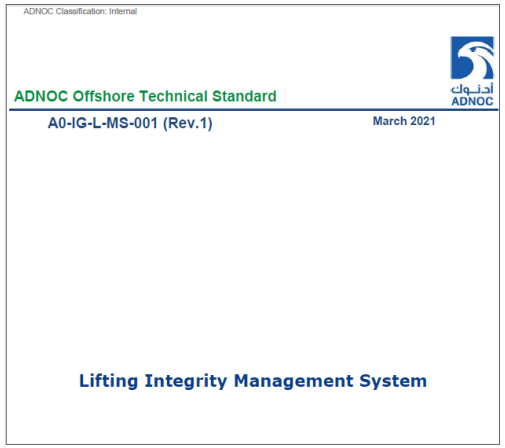
TAKEAWAY: Implementing Innovation is a Complex Task



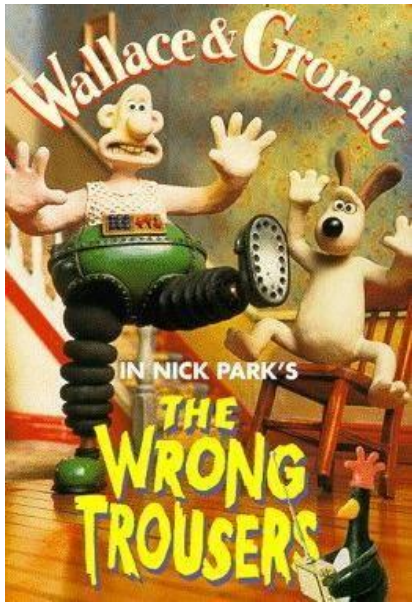
Reliable Data are a 'lifeblood ' . They are difficult to secure, and time-consuming and expensive to Quality Assure



Building an integrated engineering Team, and achieving effective communication is essential – we need to aspire to be a 'Red Bull' in our own domain



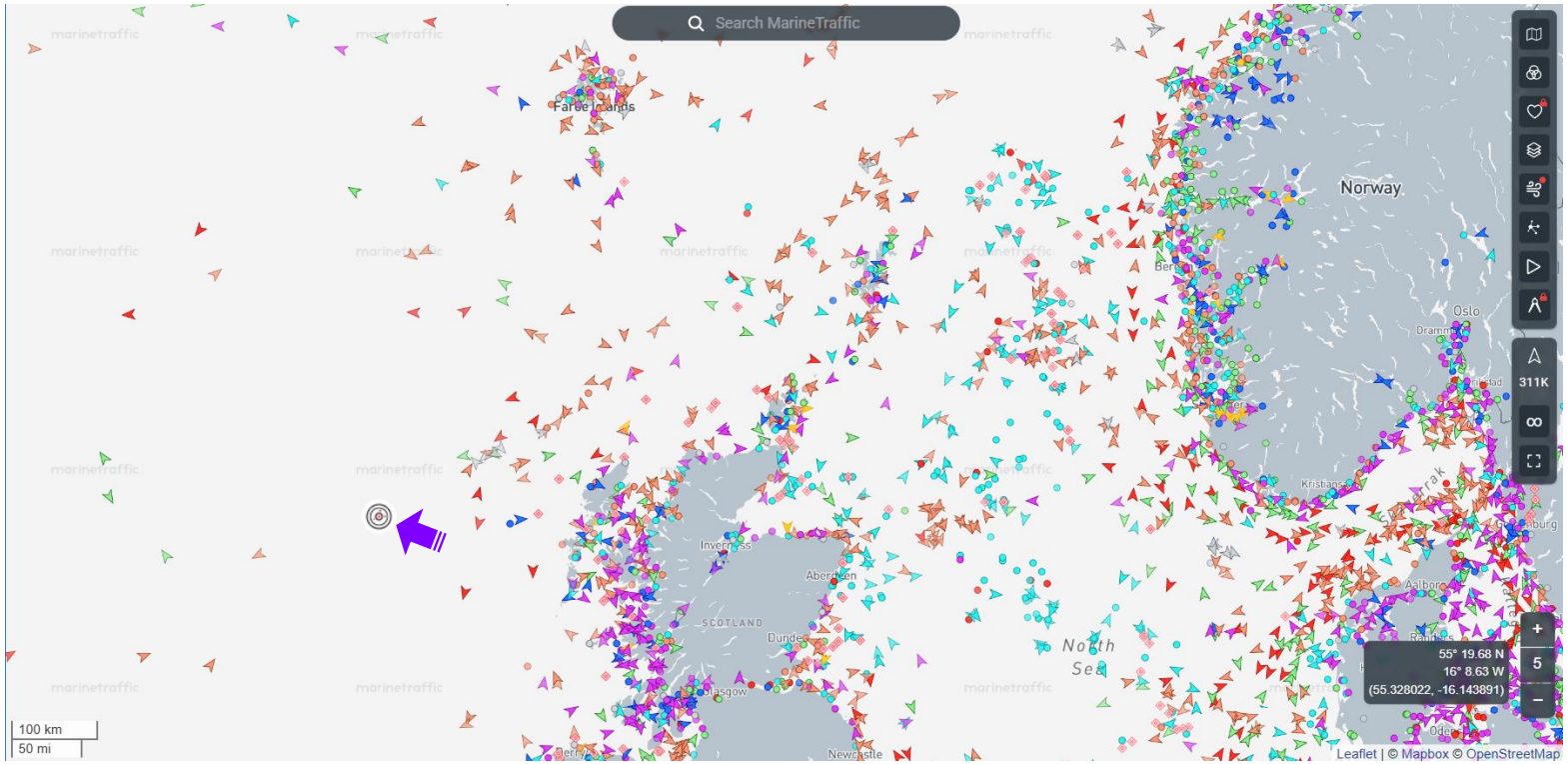
National and Industry regulations are often proscriptive



As well as the commercial imperative being to deliver the 'RIGHT TROUSERS'

Application to Salvage / Wreck Removal

'Felicity Ace' as a first reference model to ask the question - what difference to the preparedness for and the scale of emergency response, would fuel, place , vessel type and cargo necessitate?



Using models that can be placed in any part of the world, and which can be made to behave as if they were actively acted on by environmental forces, we create a forum in which domain expertise, in the form of hindsight, insight and foresight can be better utilized.

Traversing Domain Expertise across lifeTIME

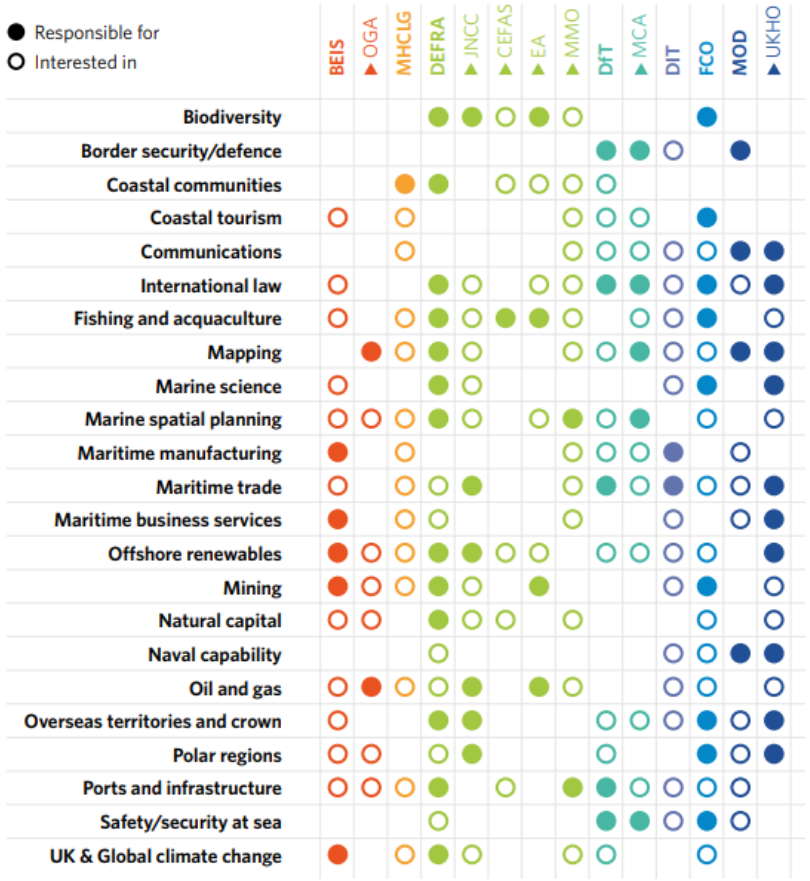


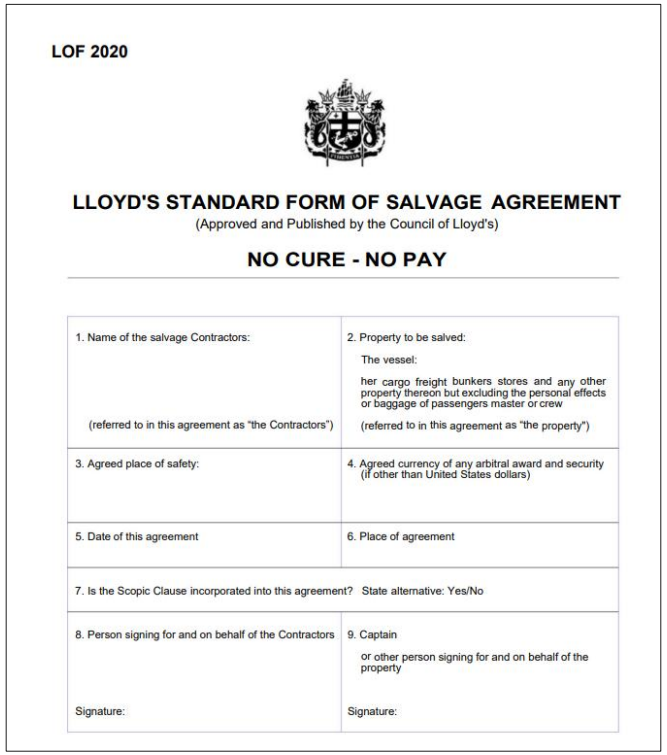
Figure 37, Foresight Future of the Sea Report, 2018
https://assets.publishing.service.gov.uk/media/5afab2f440f0b622e060e2b7/foresight-future-of-the-sea-report.pdf

SIMULATION-LED™

This is a huge challenge!
Industry and Academia need to be actively brought into the process, now.

Engineers, Harbour Masters, Insurers, Financiers, Chemists, Biologists, Ecologists, Thermodynamicists. Anthropologists etc., etc. in depth knowledge
from many diverse disciplines needs to be brought into 'Fitness for Foreseeable Eventualities' debate, in a way that addresses fragmentation

Useful Equitable Commercial Instruments and Mechanisms



LOF 2020

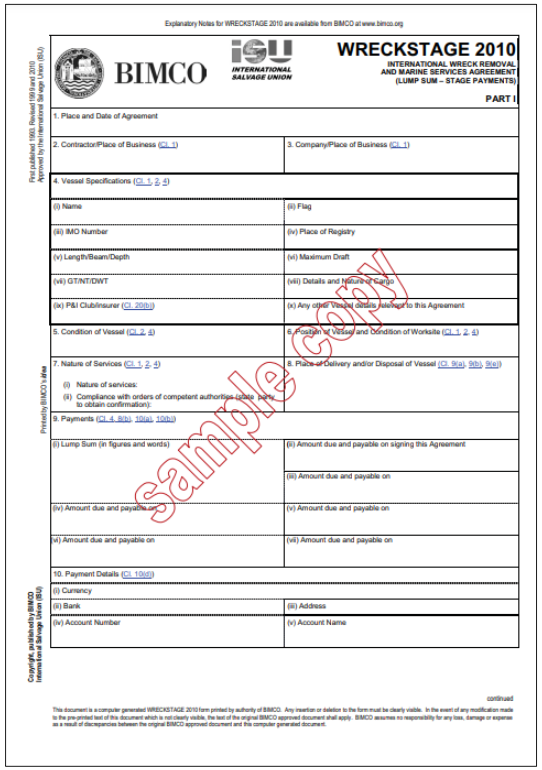
LLOYD'S STANDARD FORM OF SALVAGE AGREEMENT

(Approved and Published by the Council of Lloyd's)

NO CURE - NO PAY

1. Name of the salvage Contractors: (referred to in this agreement as "the Contractors")	2. Property to be salved: The vessel: her cargo freight bunkers stores and any other property thereon but excluding the personal effects or baggage of passengers master or crew (referred to in this agreement as "the property")
3. Agreed place of safety:	4. Agreed currency of any arbitral award and security (if other than United States dollars)
5. Date of this agreement	6. Place of agreement
7. Is the Scopic Clause incorporated into this agreement? State alternative: Yes/No	
8. Person signing for and on behalf of the Contractors Signature:	9. Captain or other person signing for and on behalf of the property Signature:

Lloyds OPEN FORM (LOF) can be re-purposed for extreme innovation, where innovator takes the risk



Explanatory Notes for WRECKSTAGE 2010 are available from BIMCO at www.bimco.org

BIMCO ISU INTERNATIONAL SALVAGE UNION

WRECKSTAGE 2010

INTERNATIONAL WRECK REMOVAL AND MARINE SERVICES AGREEMENT (LUMP SUM – STAGE PAYMENTS)

PART I

1. Place and Date of Agreement	
2. Contractor/Place of Business (Cl. 1)	3. Company/Place of Business (Cl. 1)
4. Vessel Specifications (Cl. 1, 2, 4)	
(i) Name	(ii) Flag
(iii) IMO Number	(iv) Place of Registry
(v) Length/Beam/Depth	(vi) Maximum Draft
(vii) GT/NT/DWT	(viii) Details and Nature of Cargo
(ix) P&I Club/Insurer (Cl. 20(b))	(x) Any other Vessel details relevant to this Agreement
5. Condition of Vessel (Cl. 2, 4)	6. Position of Vessel and Condition of Worksite (Cl. 1, 2, 4)
7. Nature of Services (Cl. 1, 2, 4) (i) Nature of services: (ii) Compliance with orders of competent authorities (state ports to obtain confirmation):	8. Place of Delivery and/or Disposal of Vessel (Cl. 9(a), 9(b), 9(e))
9. Payments (Cl. 4, 8(b), 10(a), 10(b))	
(i) Lump Sum (in figures and words)	(ii) Amount due and payable on signing this Agreement
	(iii) Amount due and payable on
(iv) Amount due and payable on	(v) Amount due and payable on
(vi) Amount due and payable on	(vii) Amount due and payable on
10. Payment Details (Cl. 10(d))	
(i) Currency	
(ii) Bank	(iii) Address
(iv) Account Number	(v) Account Name

sample copy

continued

This document is a computer generated WRECKSTAGE 2010 form printed by authority of BIMCO. Any insertion or deletion to the form must be clearly visible. In the event of any modification made to the pre-printed text of this document which is not clearly visible, the text of the original BIMCO approved document shall apply. BIMCO assumes no responsibility for any loss, damage or expense as a result of discrepancies between the original BIMCO approved document and this computer generated document.

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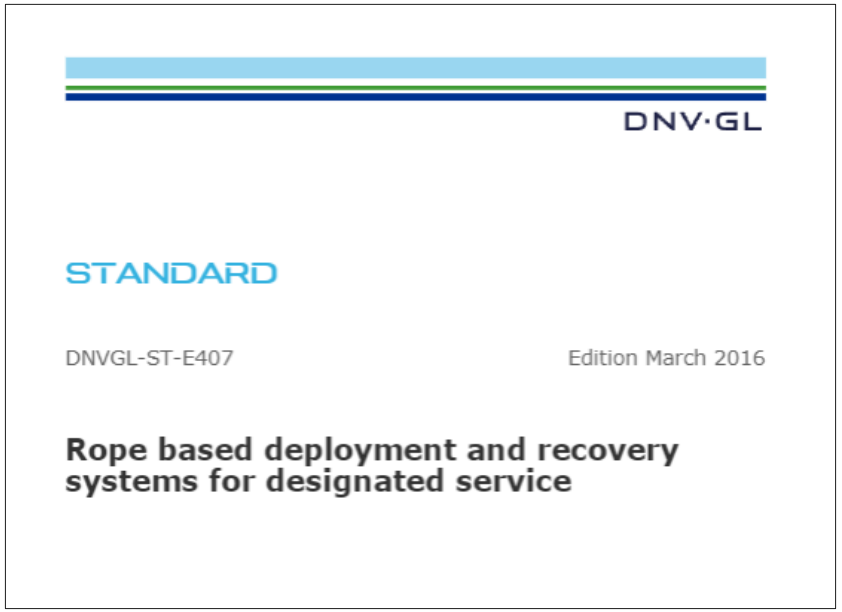
We use an adaptation of WRECKHIRE, because it protects the innovator and accommodates change



DNV·GL

STANDARD

DNVGL-ST-E407 Edition March 2016

Rope based deployment and recovery systems for designated service

*And use it in tandem with the principles of 'E407, as a generic standard to **rapidly implement innovation and change, in balance with NATURE, for the creation of common WEALTH***

DATA ownership in a Digital ‘Knowledge Economy’

Tackling who has access to data, how, when and on what terms, in advance of any incident is an absolute must.

-4: COMPONENTS	-3: COMP. SYSTEMS	-2: SUB-SYSTEMS	-1. SYSTEM (VESSEL)	0. ENABLERS	1. ASSET OWNER	2. DATA INTEGRATOR
FILAMENT OEM	DAR SYSTEM OEM	CRANE SYSTEM OEM	NAVAL ARCHITECT	OPERATOR	**CONFIDENTIAL** – IN HOUSE USE FOR COMPETITIVE ADVANTAGE	STRATEGIC USE OF INTER-ACTIVE DATA, TO CREATE VALUE FROM SYSTEMS OF SYSTEMS APPROACH, IN 7D
			SHIPYARD	INSURER		
			SYSTEMS INTEGRATOR	LIABILITY/P&I CLUB		
				DATA INTEGRATOR		
CERTIFIER	**CERTIFIER**	**CERTIFIER**	**CLASS**	**ASSURER(S)**	**ASSURER(S)**	**DATA ASSURER(S)**

DATA are combined for viewing against the TIMEline and / or TIMEscale, but otherwise securely held.

STATUS

- Crane System has 5-year certification under DNV-ST-E407
- Digital Twin of HEA OCEANIC / Crane System / Payload is supporting the development of new,, remotely operated crane system
- Deep Tek is working with two global classification societies ‘o implement innovation
- Developing ‘Fitness for Foreseeable Eventualities as a pillar of SIMULATION-LED™

NEXT STEPS

- For Deep Tek/D’Arcy Rope – develop response to waves
- Build better engagement P&! Clubs
- Bring in specific salvage industry concerns to engage with academic partners, regulators including IMO
- Use Principles-Based Approach to validate proportionate requirements.

THANKS

- to T&T Salvage for sharing reports and information on the ‘Golden Ray’; and
- Durham Energy Institute and the Clean Maritime Research Hub for being a catalyst for this important discussion

CONTACT

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e: moya.crawford@darcythompson.net

D’Arcy Thompson Simulator Centre Limited
Walter Bower House
Eden Campus
Guardbridge
St Andrews
Fife, KY16 0US

Navigating Decarbonisation

The Insurer's perspective

Clean Maritime Assembly

Sarah McCann

SENIOR SOLICITOR – EXTERNAL AFFAIRS

25 June 2026

NorthStandard

P&I Clubs

What is a P&I Club?

- An Association of Shipowners providing third party liability insurance cover
- Is a mutual insurer (sharing of risks)
- Owned and controlled by their shipowner members
- Non-profit making
- Exist solely for the benefit of their members
- A service provider as well as providing insurance

P&I marine liabilities

We cover marine liabilities arising from vessel operations including:

Collisions with vessels

Damage to fixed and floating objects

Loss of, or damage to cargo

Pollution from the vessel, or its cargo.

Loss of life and injury to crew, passengers and third parties.

Wreck removal

What is driving decarbonisation?

IMO GHG Strategy

Global and Regional regulations

Improving energy efficiency

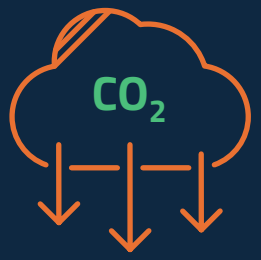
Environmental and social responsibility

Innovation and market expectations

The role of operational efficiency

Operational measures
can deliver immediate, cost-effective emissions reductions

Address behavioural inefficiencies



Can yield
significant fuel and emissions savings

Enhancing
commercial and port performance

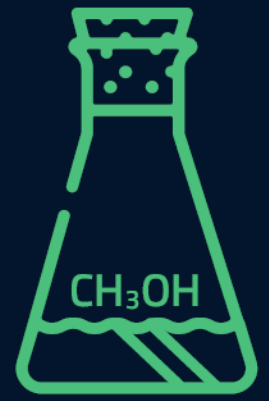
Different fuels

Biofuel

LNG

Hydrogen

Ammonia



Methanol

Global liability convention for low carbon fuels

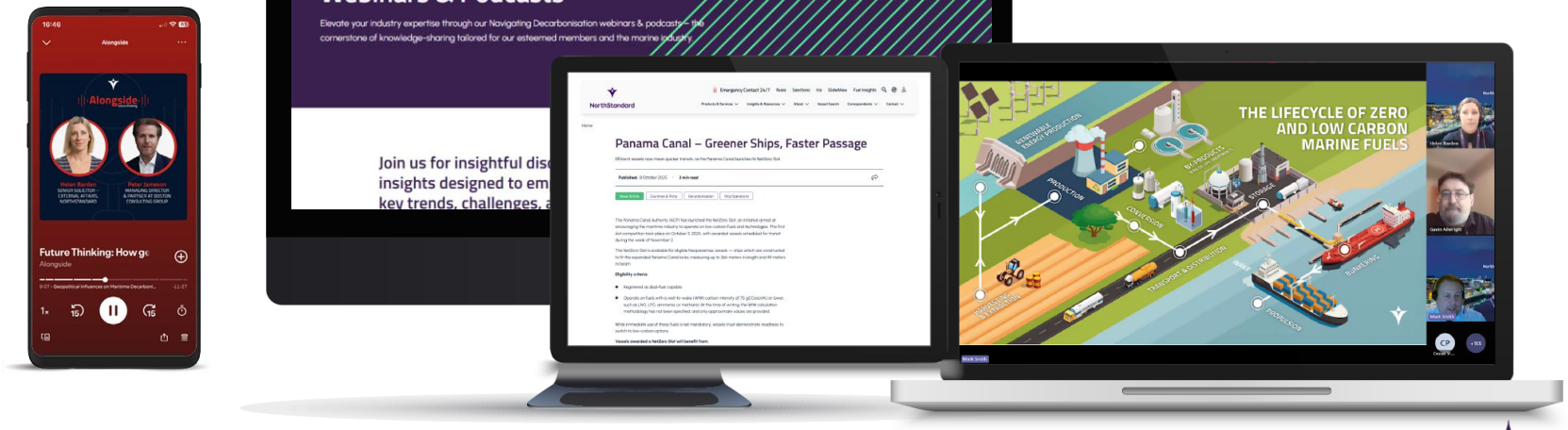
Supporting our Members

- Dedicated Expertise Group
- Operationally focused guidance
- Loss prevention
- Contractual implications
- Industry and policy engagement

Decarbonisation expertise

Navigating decarbonisation:
Knowledge & insights

- Webinars
- Podcast
- Seminars
- Case studies
- Articles
- White papers



20+
decarbonisation resources published

40m+
estimated resources reach

500+
webinar views

Navigating Decarbonisation –
The Insurer's Perspective

Thank You

Sarah McCann

SENIOR SOLICITOR – EXTERNAL AFFAIRS,
NORTHSTANDARD

Clean Maritime Assembly
25 June 2026

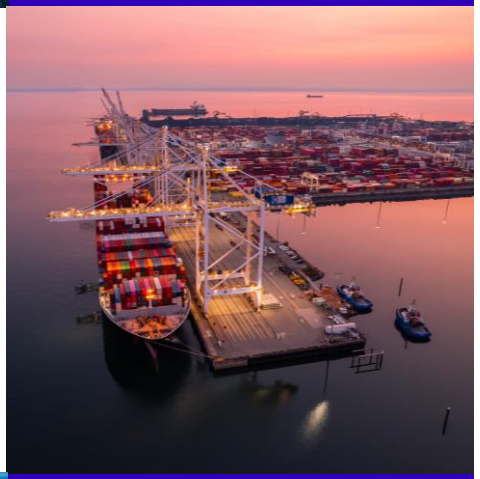
NorthStandard

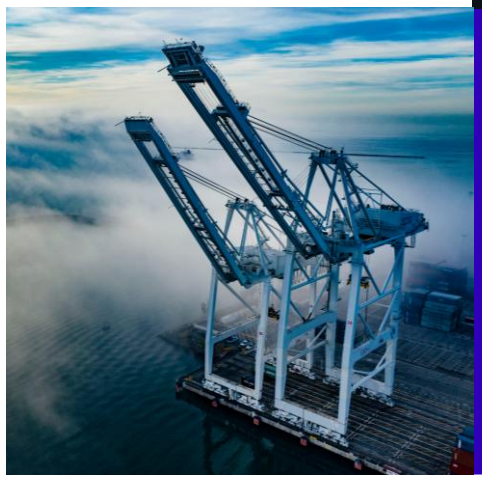
Highlights and Headlines

Session 3

Decarbonisation in Practice

- Francesco Sandrelli, UK Chamber of Shipping
- David Browbank, Brookes Bell





UK CHAMBER of SHIPPING

Decarbonisation Overview and Safety of Alternative Fuel WG

Francesco Sandrelli, Policy Director (Environment)

26 June 2026, Clean Maritime Assembly, Durham University

Agenda

1. IMO GHG Reduction - Where we are now;

2. UK (UK ETS) + Offshore (ETS systems);

3. Safety of Alternative Fuels WG;

Introduction – UK Chamber Members

220 Members, 110 Shipowners, >800 vessels, >18m GT, operating UK and globally

- Passenger Shipping (Cruise & Ferry)
- Dry Trades (Container, Bulk, Short Sea, Aggregates)
- Wet Trades (Tankers, Gas Carriers)
- Offshore & BROA (OSV, AHTS, SOV, Dive, MODU, WTIV etc)
- Harbour Towage
- Ship Operators, Law firms, Insurers, Classification, Marine service providers etc..

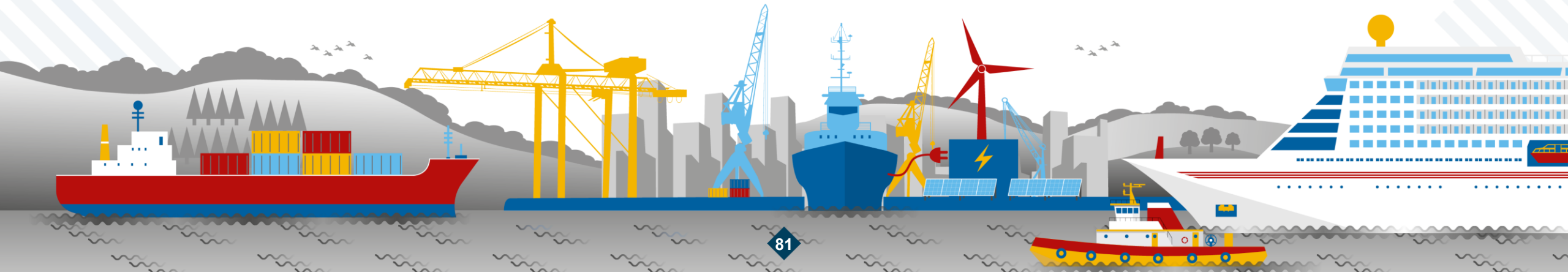
IMO Net Zero Framework

Where We Are Now

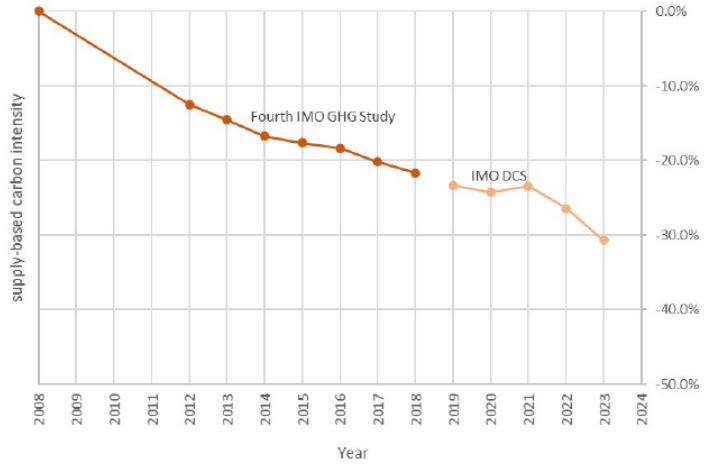
- MEPC/ES.2 – Adjournment;
- MEPC.84 – Additional ISWG-GHG 22 September 2026;
- GHG 23 / MEPC.85 / ES.2 (?) – Adoption (??);
- **4 Circulars MARPOL Annex VI amendments** (6 months circulation - in advanced)

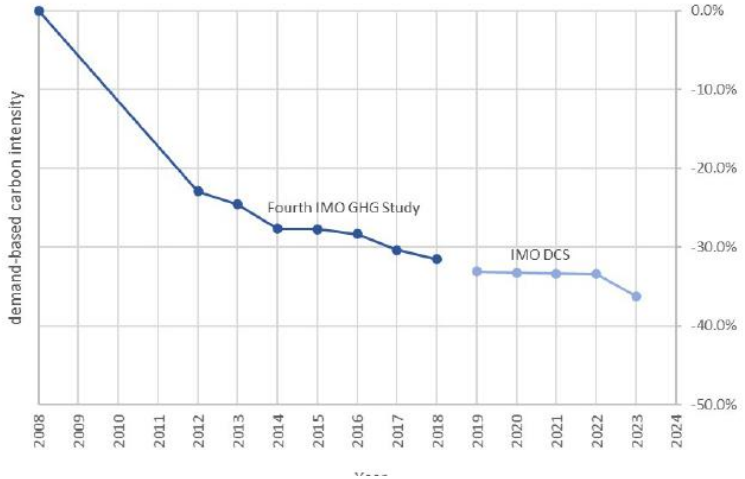
  - Situation still very political with Member States split into three broad camps –
    - Those who still want the IMO Net Framework;
    - Those who are here to reject the Net-Zero Emissions by or around 2050;
    - Those who are looking for a compromise;
  - Are we talking about Shipping decarbonisation (?)

Shipping Decarbonisation, Fuels, Energies – INTERTANKO MEPC.84/7/33



Shipping is Decarbonising – MEPC.83



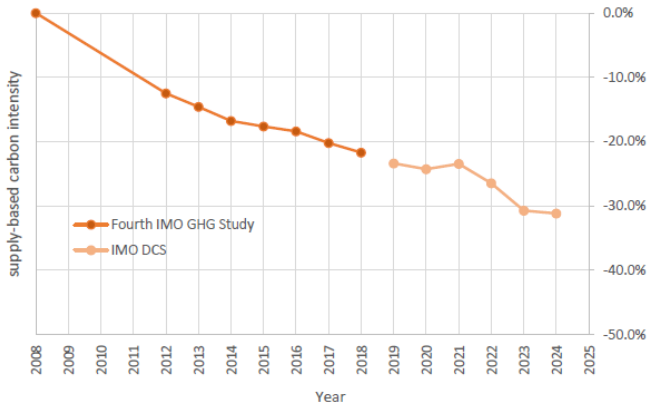


Year	Anthropogenic CO_2 emissions	International shipping CO_2 emissions	International shipping contribution to total	Reduction of international shipping contribution
2008	32,204	921	2.86%	
2012	34,959	775	2.23%	22.16%
2013	35,225	761	2.18%	23.93%
2014	35,239	764	2.17%	24.21%
2015	35,380	780	2.21%	22.65%
2016	35,810	811	2.29%	19.90%
2017	36,573	838	2.34%	18.22%
2018	34,793	830	2.27%	20.69%
2023	37,400	656	1.75%	38.67%

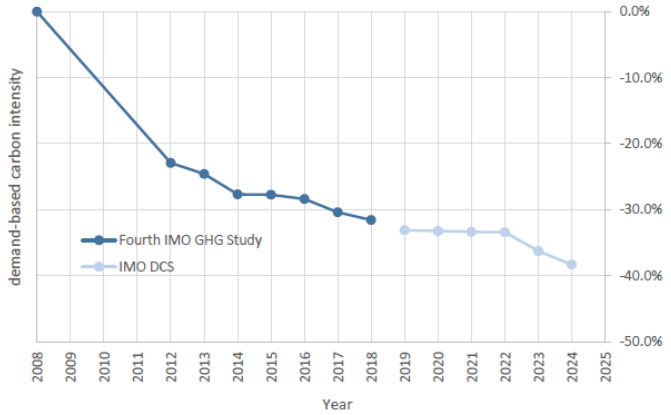
Source: INTERTANKO, MEPC.83/6/13, Comments on the Report Short-Term GHG Measure, MEPC83/6/10

Source: IMO Secretariat, MEPC.83/6, Report on annual carbon Intensity and efficiency of the fleet (2023), Supply-based (AER) UP and Demand-Based (EEOI) Bottom

Shipping is Decarbonising – MEPC.84



Year	Anthropogenic CO_2 emissions (Mt)	International shipping CO_2 emissions (Mt)	International shipping contribution	Reduction of international shipping contribution
2018	36,300	830	2.29%	-22.79%
2023	37,300	656	1.76%	-40.61%
2024	37,600	692	1.84%	-37.85%

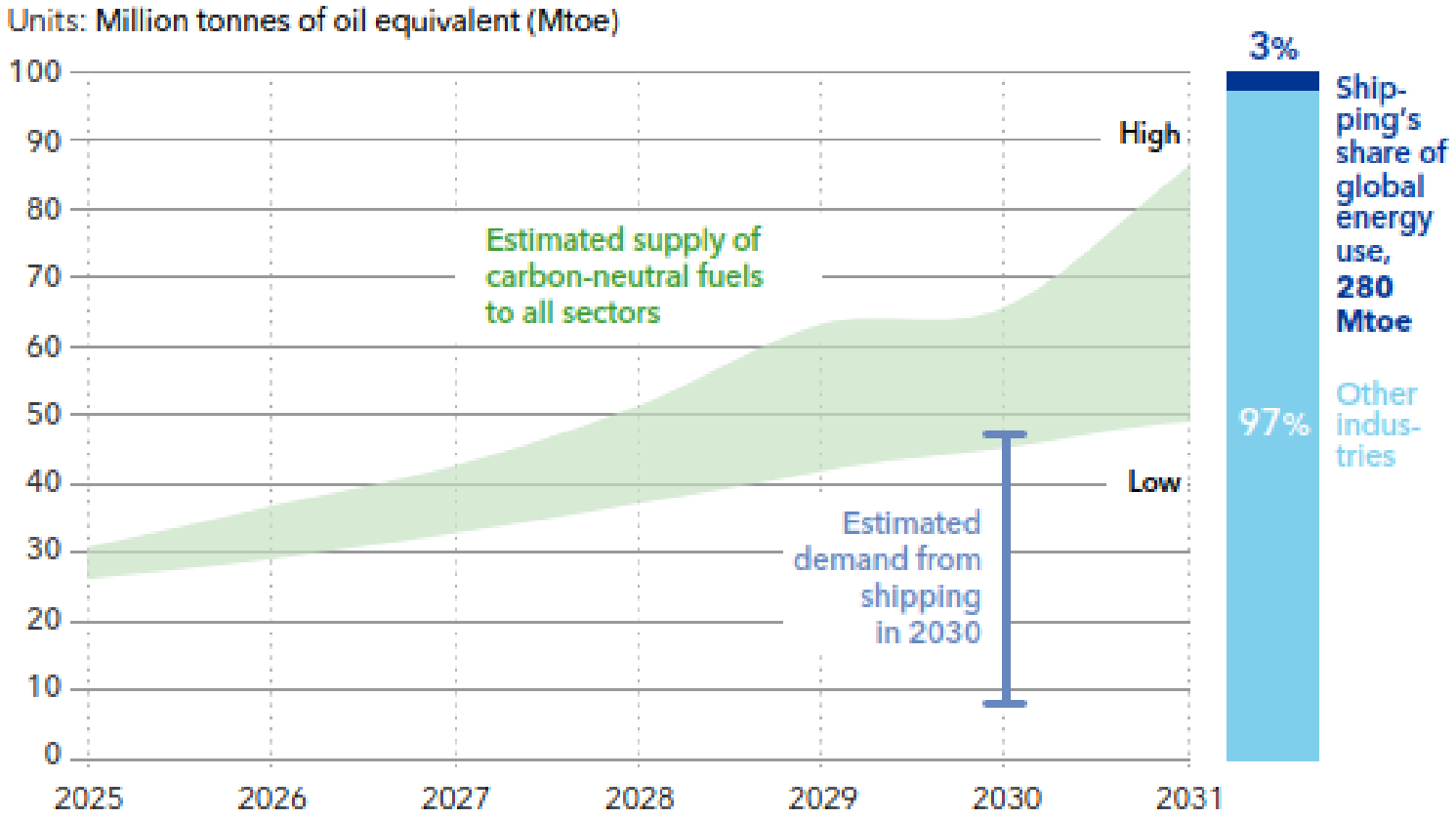


Year	Total distance travelled	Total hours underway	Total fuel	Total CO_2 emissions
	nm	hrs	Mt	tons
2024	1,731,903,177	150,703,725	223	691,492,741
2023	1,638,421,345	142,637,834	211	655,703,233
2024/2023	1.057056	1.056548	1.056872	1.054582

Source: INTERTANKO, MEPC.84/7/33, Assessment of fuel pathways to meet the level of ambition of the 2023 IMO GHG Strategy;

Source: IMO Secretariat, MEPC.84/6/2, Report on annual carbon Intensity and efficiency of the fleet (2024), Supply-based (AER) UP and Demand-Based (EEOI) Bottom

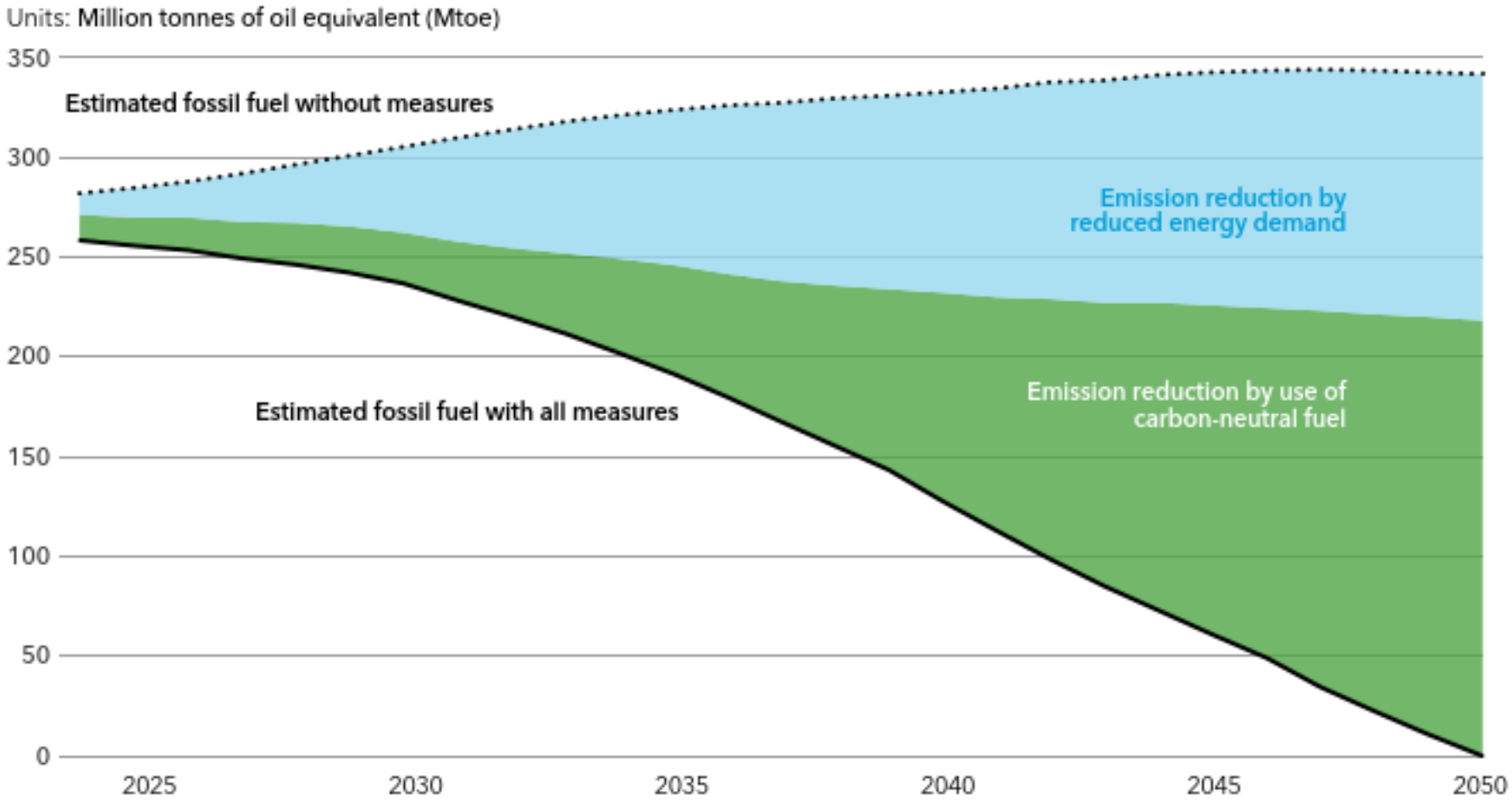
Energy Transition – Challenges ahead



Source: DNV, Energy Transition Outlook 2024 – Maritime Forecast to 2050, DNV

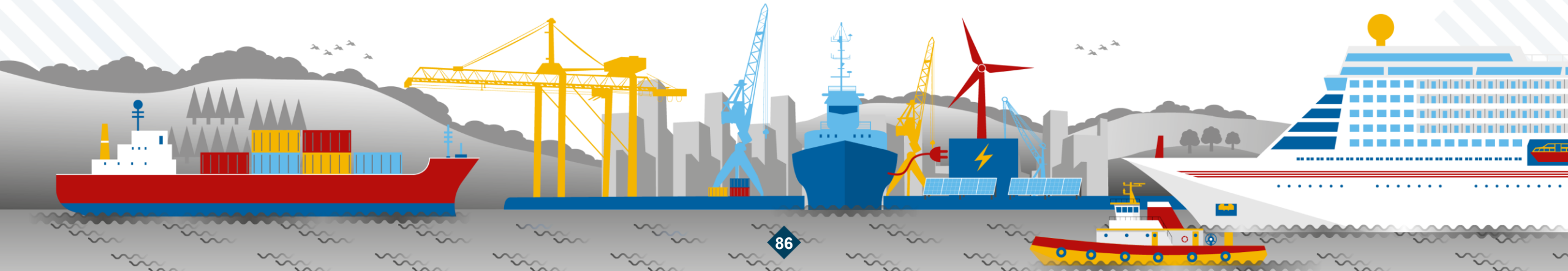
1. Competition with other sectors
2. Capacity development will take time
3. Price likely to be high
4. Infrastructure requirements
5. Shipping needs every solution (multi-layer approach)

Energy Efficiency is still essential



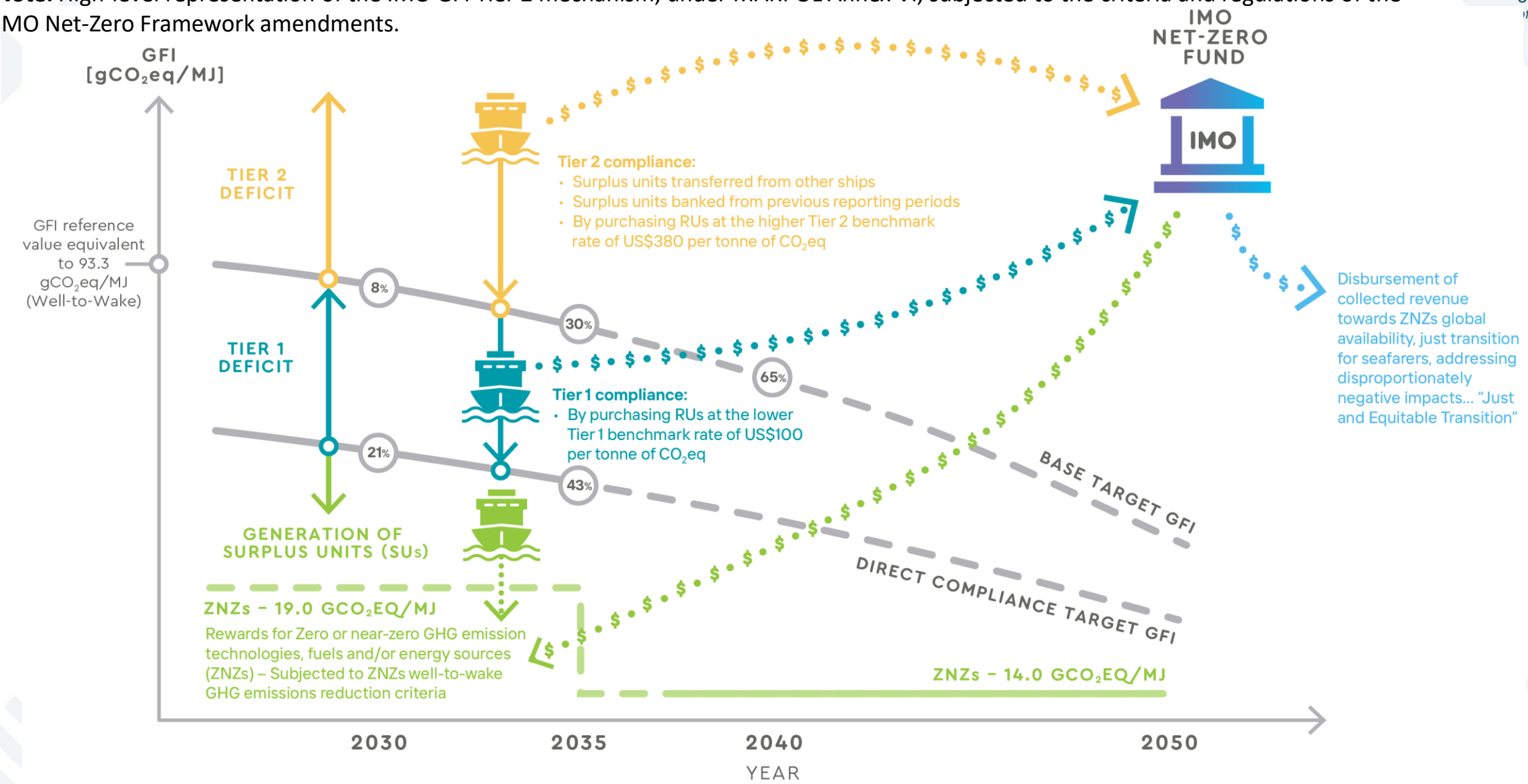
Source: DNV, Energy Transition Outlook 2024 – Maritime Forecast to 2050, DNV

Four MARPOL Annex VI Proposals (Circular Letters)



IMO Net Zero Framework - Structure

Note: High-level representation of the IMO GFI Tier 2 mechanism, under MARPOL Annex VI, subjected to the criteria and regulations of the IMO Net-Zero Framework amendments.



Source: SGMF, Graphical representation , received on 16/05/2025

Four MARPOL Annex VI Chapter 5 - Summary

	Submitted by	Key changes relative to NZF agreed at MEPC 83	New or revised proposal?
NZF as levy	Tuvalu	Use of the NZF architecture to represent a levy, in addition to a fuel standard which an RU1 GHG price is applied to all GHG emissions	Revised - identical to the concept and specifications submitted to MEPC 84
NZF as is	Australia, Canada, UK, South Africa	No changes except to update dates to represent a year's delay in entry into force	Revised - Identical to the specifications approved in principle at MEPC 83
NZF softer start harder finish	Brazil	Change to the GFI trajectories (base and direct), to initially soften the short-term stringency relative to 'as is', but counterbalance this by clarifying higher mid-term ambition)	New– a combination of parameters that had not previously been proposed
LISCR concept	Liberia	Fundamental redesign, removing all GHG pricing, fund and clarity in the GFI trajectory	Revised – a reworking/modification of the concept submitted to MEPC 84

Source: Created by Tristan Smith UCL Energy Institute, IMO Marpol Amendments Options for 85, Dated 11/06/2026;

1. Circular 5215 – Tuvalu
2. Circular 5216 – Australia, Canada, UK, South Africa;
3. Circular 5214 – Brazil;
4. Circular 5213 – Liberia;

Circulars – Targets Comparisons and Fuel EU

Year	Brazil Base (%)	Brazil Direct (%)	UK Base (%)	UK Direct (%)	Tavalu Base (%)	Tavalu Direct (%)	FuelEU Reduction (%)
2029	3	3	6	19	6	100	2
2030	4	4	8	21	8	100	6
2031	6	19	12.4	25.4	12.4	100	6
2032	8	21	16.8	29.8	16.8	100	6
2033	12.4	25.4	21.2	34.2	21.2	100	6
2034	16.8	29.8	25.6	38.6	25.6	100	6
2035	21.2	34.2	30	43	30	100	14.5
2036	25.6	38.6					14.5
2040							31
2041	70		65		65		31

Source: Created by a Member (Thank you) and Francesco Sandrelli, Dated 16/06/2026;

Topic	IMO Net-Zero Framework	New Proposal (Circular 5213 Liberia)	Same?
New Chapter 5 MARPOL VI	Yes	Replaces NZF in same location	✓
GFI metric	**Yes** - WtW	**Yes** - WtW	✓
GFI trajectory basis	**Politically set** - fixed, predetermined declining GFI trajectory tied to IMO climate goals.	**Market-derived** - recalculates GFI based on real fuel uptake (GFI Max/Min)	✕
GFI registry	**Yes**	**Yes**	✓
Long-term decarbonization aim	**Yes** – **aligned** to 2023 GHG strategy	**Yes** – **not aligned** to 2023 GHG strategy	**X**
5-year reviews	**Progress checks** - it does not reset ambition.	**Redefines** the whole trajectory every five years based on emerging fuels	✕
Compliance flexibility	**Yes**	**Yes**	✓
Economic GHG pricing	**Yes** – core element	**No** – fully removed (Pooling system)	✕
IMO Net-Zero Fund	**Yes** - global fuel standard plus GHG pricing, with revenues managed through an IMO Net-Zero Fund.	**No** - explicitly rejects any fund or revenue collection mechanism	✕
Commercial Viable Fuel criteria	**No** - mandates reductions regardless of current fuel availability or cost.	**Yes** - Affordability, availability, scalability required to determine "evidence-based, market-conditioned ambition."	✕
Tech neutrality (incl. OCCS, wind)	**Fuel-centric** - rewarding zero/near-zero fuels to be defined. **Technologies formula for reward etc.. Not there**	**Fuel-centric & explicitly recognised** technologies (i.e. onboard carbon capture, wind-assisted propulsion, other energy-saving innovations), **but formula needs to build up.**	**ish**
Enforcement	Through **ship certification and economic measures**	Enforcement is **certification-based only (cure period)** instead of financially punitive (**penalties** by **Flag Administration**).	✕

Source: Created by Jen Riley Smith (LR _ UK COS Secondments) and Francesco Sandrelli UK CoS , Dated 19/04/2026, updated 16/06/2026;

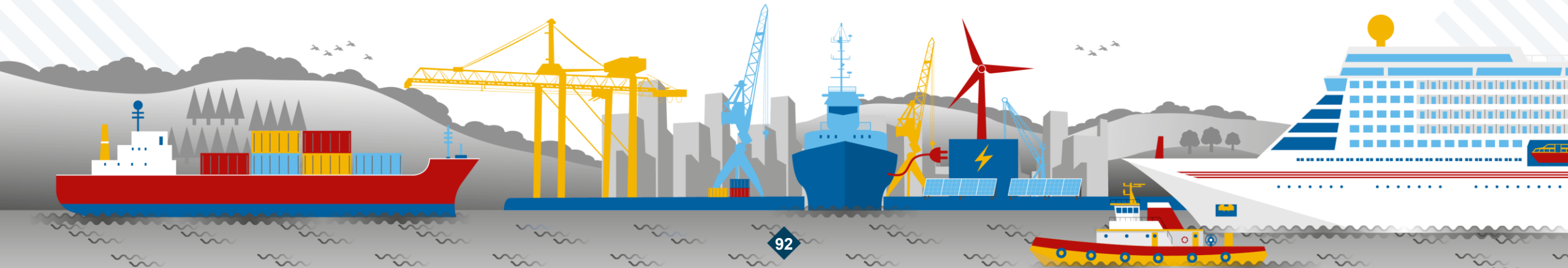
Conclusion

- Situation is very political – compromise;
- Industry Representatives (no IMO paper);

Statements MEPC.84 Industry

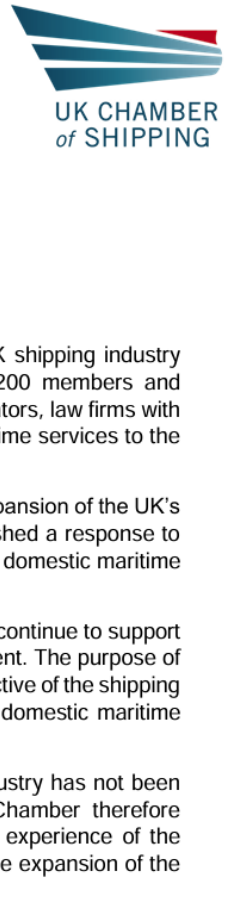
- IMO CII/DCS, regional systems on-going;
- Shipping is decarbonising;

UK ETS – Updated -Extract LR/UK CoS event 23.04.2026



UK ETS – Policy Documents - examples

- 2024.10.10 - UK ETS Lessons Learned from EU ETS
- 2025.01.23 - UK CoS replied to the consultation;
- 2025.03.07 - High Level Letter with International/National Shipowners Associations (11 Other Associations)
- 23 July 2025 – UK ETS Interim Pending Issues and Initial Summary Document
- 2025.10 UK ETS next steps to compliance
- 2026.01 UK CoS replied to the International Voyage Consultation



UK ETS Lessons Learned from EU ETS

Introduction and Purpose:

The UK Chamber of Shipping (Chamber) is the trade association for the UK shipping industry servicing domestic and/or international markets. The Chamber has over 200 members and associate members, which range from shipowners, ship managers, ship operators, law firms with maritime expertise, insurers, classification societies, to others providing maritime services to the shipping industry.

In March 2022, the UK Government issued a consultation on the proposed expansion of the UK's Emissions Trading Scheme (ETS). In July 2023, the UK ETS Authority published a response to this consultation, indicating its intention to extend the scope of the UK ETS to domestic maritime greenhouse gas (GHG) emissions in 2026.

The Chamber has sought to provide input as and when required and so as to continue to support the government in its efforts, the Chamber has prepared the following document. The purpose of the paper is to highlight key takeaways and recommendations from the perspective of the shipping industry following the extension of the EU ETS to specific international and domestic maritime emissions in January 2024.

It is crucial to highlight that the extension of the EU ETS to the shipping industry has not been without significant challenges, some of which remain outstanding. The Chamber therefore considers there to be an opportunity for the UK Government to utilise the experience of the industry in shaping its own policy and regulatory framework with respect to the expansion of the UK ETS.

Source: Uk Chamber Website, UK ETS Lessons Learned from EU ETS., accessed 09 June 2025

Parliamentary Engagement

Engagement:

- Over 40 Parliamentary Questions tabled across both Houses
- 1 Statutory Committee appearance
- 3 explicit references to the Chamber in UK Parliamentary proceedings.
- 1 Parliamentary drop-in delivered
- 1 cross-party Parliamentary roundtable delivered.
- Commitment from Gov to rethink future ETS engagement, awaiting proposals.

Question

Lord Berkeley
Labour
Life peer
Lords

To ask His Majesty's Government what representations they have received from shipping operators about concerns about the absence of sufficient shore-power infrastructure, limited port grid capacity and lack of alternative fuels at scale; and what plans they have to address those concerns before the commencement of the UK Emissions Trading Scheme for the maritime sector.

Current Concerns – 1.Lack of Guidance and FAQS

- Lessons from EU ETS – Implementing an ETS system is complicated;

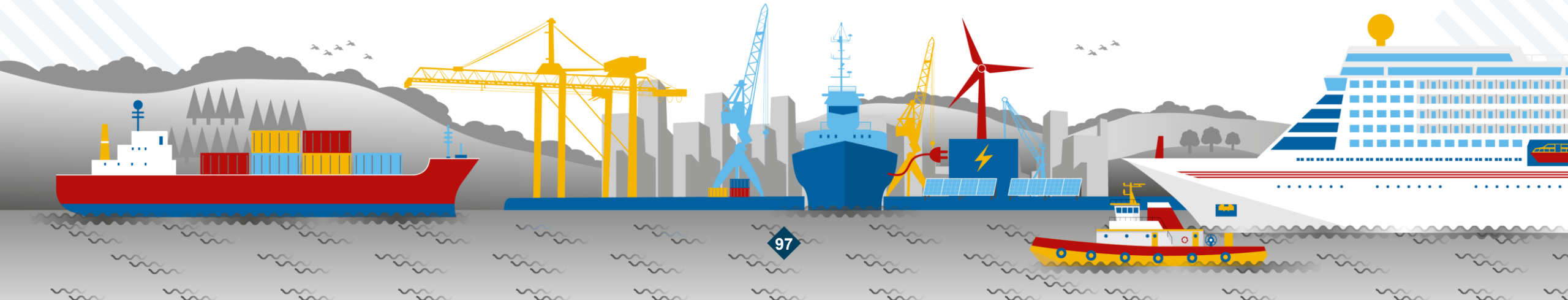
Area	EU	UK
Legislation	6 MRV EU Regulations / 8 ETS Instruments	Greenhouse Gas Emissions Amendments
FAQS	EU MRV EU ETS THETIS – ship specific	Participating in the UK ETS (generic)
Guidance	i.e. Guidance Document no. 1) etc.. – Ship Specific	HOW TO COMPLY (BEFORE 1st JULY)??
Webinar	EMSA Webinars Thetis MRV	EA generic METS 18/06/2026
Helpdesk	fitfor55@emsa.europa.eu	etmaritimehelp@environment-agency.gov.uk
WG	Numerous carried out from 2023	DfT Planning to establish a WG this year

Current Concerns – 1.Lack of Guidance and FAQS

- We are collecting Q&As from the industry (Through ECSA , ICS, CLIA etc..) – One central place is needed

Topic	SI regulatory reference (wh	Question	Submitted to EA	Environment Agency Response
Notification of change of responsibility	UK ETS Draft SI, Schedule 2A, Part 2, 4.(1)	What is the expectation from Verification bodies regarding this written agreement? What checks need to be made (is it simply the case of presence / absence of a mandate)?	12/03/2026	There is no role in UK ETS for the Verification bodies in respect of the written agreement.The declaration of delegated responsibility is completed in the EMP workflow as part of the initial EMP application. Any variations affecting an existing delegation and any additional delegations that are made when new ships are included in the EMP are also notified in the EMP workflow. If any material change to the written agreement relating to delegation of UK ETS responsibility occurs, the EMP holder that has included a ship in its EMP on this basis must inform the regulator of the changes in METS within 14 days. When completing the Annual Emissions Report (AER) in METS, the maritime operator will be asked to describe any changes made to its EMP during the scheme year and will need to list all ships in which it has performed maritime activities in the scheme year, whether it was the maritime operator of the ship for the whole scheme year or only part of it.
Ships to which this Schedule applies	UK ETS Draft SI, Schedule 2A, Part 2, 5.(1)	On the understnading that for reporting year 2027 offshore ships will be in scope, when can the industry expect to receive specific technical guidance on this segments inclusion into the UK ETS?	12/03/2026	To be answered by DESNZ/ DfT directly as this is a policy issue.The Environment Agency can accept evidence that demonstrates compliance with the ERC criteria. This is a more flexible approach than that adopted under the EU ETS.
Meaning of “port of call”	UK ETS Draft SI, Schedule 2A, Part 2, 6.(3)	What happens if a UN LOCODE is obtained after the date the order is made?	12/03/2026	Anything additional relating to future policy to be answered by DESNZ/ DfT.From the regulator’s perspective, the legislation will provide that only UN LOCODEs extant at the date the Order is made are included in the definition of a port.
				To be answered by DESNZ/ DfT directly as this is a policy

Notes on Offshore Vessels (EU and UK ETS)



Background - ECSA IMCA, EUDA, Paper July 2025

Two key Challenges:

1) Vessel Movements;
2) Vessel Types;

Two industry Solutions:

1) Virtual Port Calls;
2) Negative list;

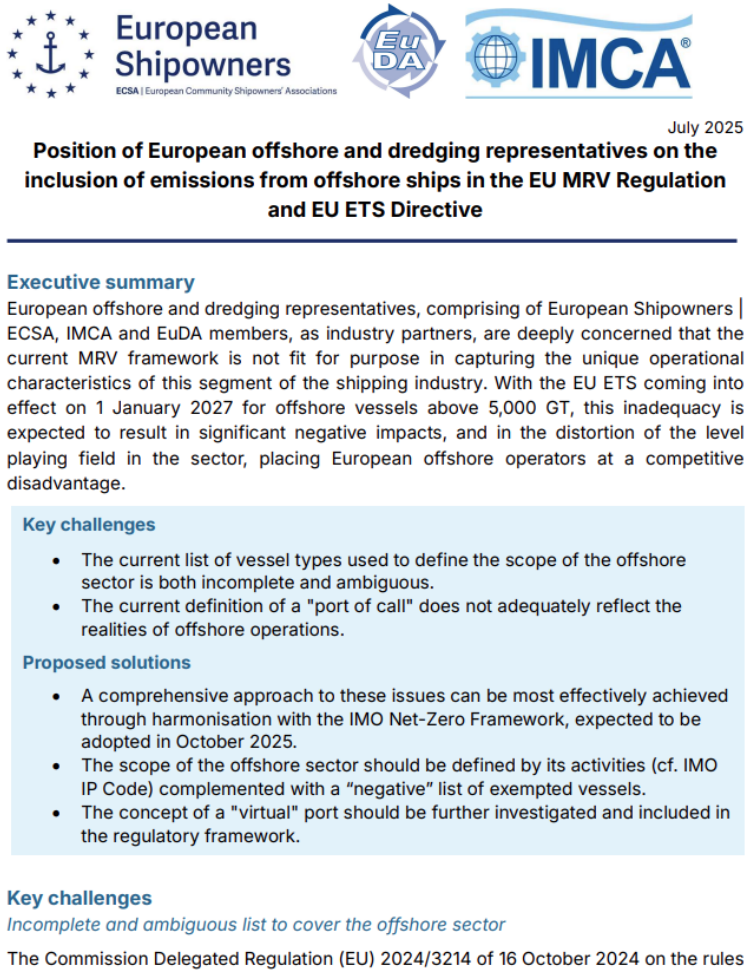
Industry has expressed concerns/solutions since 2023
ECSA Concerns on the inclusion of Offshore Vessels EU ETS Jan 2024;

CE Delft Study, Extension of EU-ETS to the offshore sector Nov 2023;

UK CoS, Replied to EU MRV Consultation, Sept 2024;

UK CoS, DNV Offshore Seminar EU MRV Challenges, Nov 2024;

UK CoS, UK ETS Update – Offshore, IMCA Seminar, Nov 2025



European Shipowners
ECSA | European Community Shipowners' Associations

July 2025

Position of European offshore and dredging representatives on the inclusion of emissions from offshore ships in the EU MRV Regulation and EU ETS Directive

Executive summary

European offshore and dredging representatives, comprising of European Shipowners | ECSA, IMCA and EuDA members, as industry partners, are deeply concerned that the current MRV framework is not fit for purpose in capturing the unique operational characteristics of this segment of the shipping industry. With the EU ETS coming into effect on 1 January 2027 for offshore vessels above 5,000 GT, this inadequacy is expected to result in significant negative impacts, and in the distortion of the level playing field in the sector, placing European offshore operators at a competitive disadvantage.

Key challenges

- The current list of vessel types used to define the scope of the offshore sector is both incomplete and ambiguous.
- The current definition of a "port of call" does not adequately reflect the realities of offshore operations.

Proposed solutions

- A comprehensive approach to these issues can be most effectively achieved through harmonisation with the IMO Net-Zero Framework, expected to be adopted in October 2025.
- The scope of the offshore sector should be defined by its activities (cf. IMO IP Code) complemented with a "negative" list of exempted vessels.
- The concept of a "virtual" port should be further investigated and included in the regulatory framework.

Key challenges

Incomplete and ambiguous list to cover the offshore sector

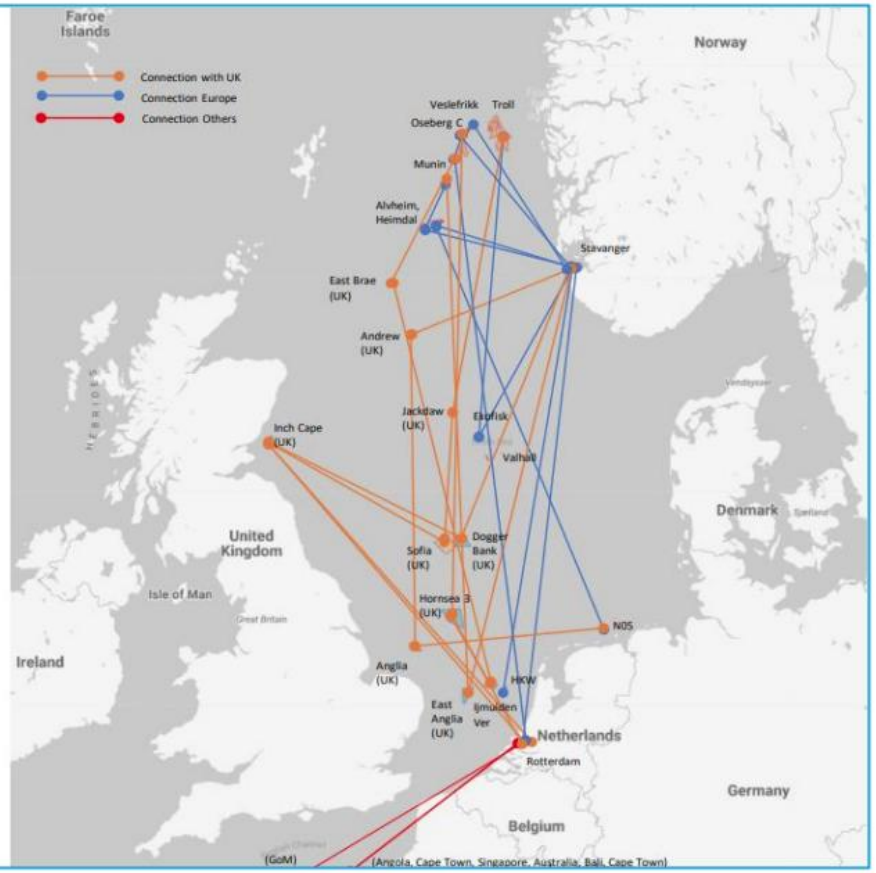
The Commission Delegated Regulation (EU) 2024/3214 of 16 October 2024 on the rules

Source: ECSA, IMCA, EUDA, Position of European offshore and dredging representatives on the inclusion of emissions from offshore ships in the EU MRV Regulation and EU ETS Directive July 2025, Accessed 10/10/2025;

ETS Challenges – Vessel Movement

Vessel Positioning

Order	Origin Country	Origin Destination
1	UNITED STATES	UNITED STATES
2	UNITED STATES	UNITED STATES
3	UNITED STATES	NETHERLANDS
4	NETHERLANDS	NORWAY
5	NORWAY	NETHERLANDS
6	NETHERLANDS	NETHERLANDS
7	NETHERLANDS	NORWAY
8	NORWAY	NORWAY
9	NORWAY	NETHERLANDS
10	NETHERLANDS	UNITED KINGDOM
11	UNITED KINGDOM	UNITED KINGDOM
12	UNITED KINGDOM	NORWAY
13	NORWAY	NORWAY
14	NORWAY	NORWAY
15	NORWAY	NORWAY
16	NORWAY	NORWAY
17	NORWAY	UNITED KINGDOM
18	UNITED KINGDOM	UNITED KINGDOM
19	UNITED KINGDOM	UNITED KINGDOM
20	UNITED KINGDOM	NETHERLANDS
21	NETHERLANDS	ANGOLA
22	ANGOLA	ANGOLA
23	ANGOLA	SOUTH AFRICA
24	SOUTH AFRICA	SINGAPORE
25	SINGAPORE	AUSTRALIA
26	AUSTRALIA	INDONESIA
27	INDONESIA	SOUTH AFRICA
28	SOUTH AFRICA	NETHERLANDS
29	NETHERLANDS	UNITED KINGDOM
30	UNITED KINGDOM	UNITED KINGDOM
31	UNITED KINGDOM	NORWAY
32	NORWAY	NORWAY
33	NORWAY	NORWAY
34	NORWAY	NORWAY
35	NORWAY	NORWAY
36	NORWAY	NORWAY
37	NORWAY	UNITED KINGDOM
38	UNITED KINGDOM	NORWAY
39	NORWAY	NORWAY
40	NORWAY	NORWAY
41	NORWAY	NETHERLANDS
42	NETHERLANDS	UNITED KINGDOM
43	UNITED KINGDOM	NORWAY
44	NORWAY	NORWAY
45	NORWAY	UNITED KINGDOM
46	UNITED KINGDOM	NETHERLANDS
47	NETHERLANDS	NORWAY
48	NORWAY	UNITED KINGDOM
49	UNITED KINGDOM	UNITED KINGDOM
50	UNITED KINGDOM	NETHERLANDS



ISSUES

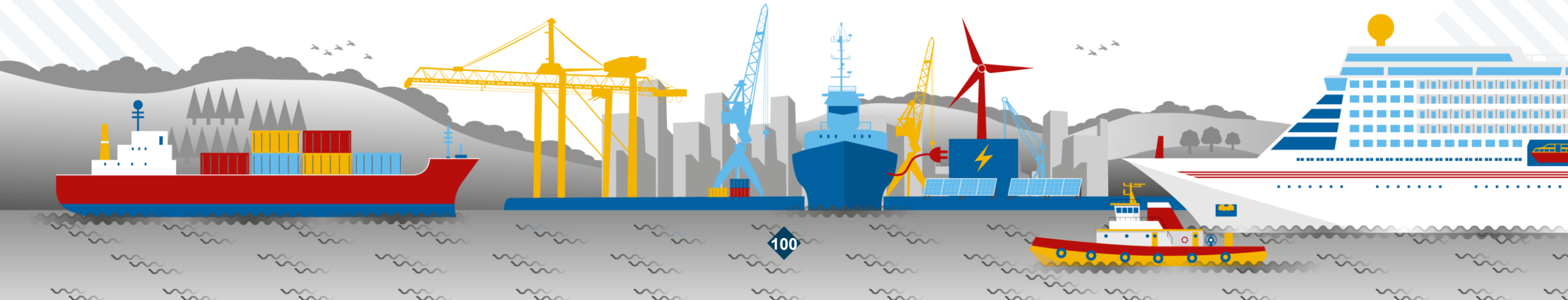
Overcharging ETS allowances between two systems

Possibility for evasion:

- **Market Distortion/Fairness**
- **Clarity/Certainty in rules (between two systems)**
- **Double Counting and Double Payment**

Source: - CE Delft, Extension of EU-ETS to the offshore sector - offshore construction vessel

UK CoS Safety of Alternative Fuel WG - 1 Year Activities



Group Governance – Safety of Alternative Fuel Report

- Chairs:
- Stephen Brown (Shell)
- James Helliwell (V. Group)

- Secretariat - UK Chamber of Shipping
- Francesco Sandrelli
- Paul Markides
- Robert Merrylees

Year at a Glance – Safety of Alternative Fuel Report

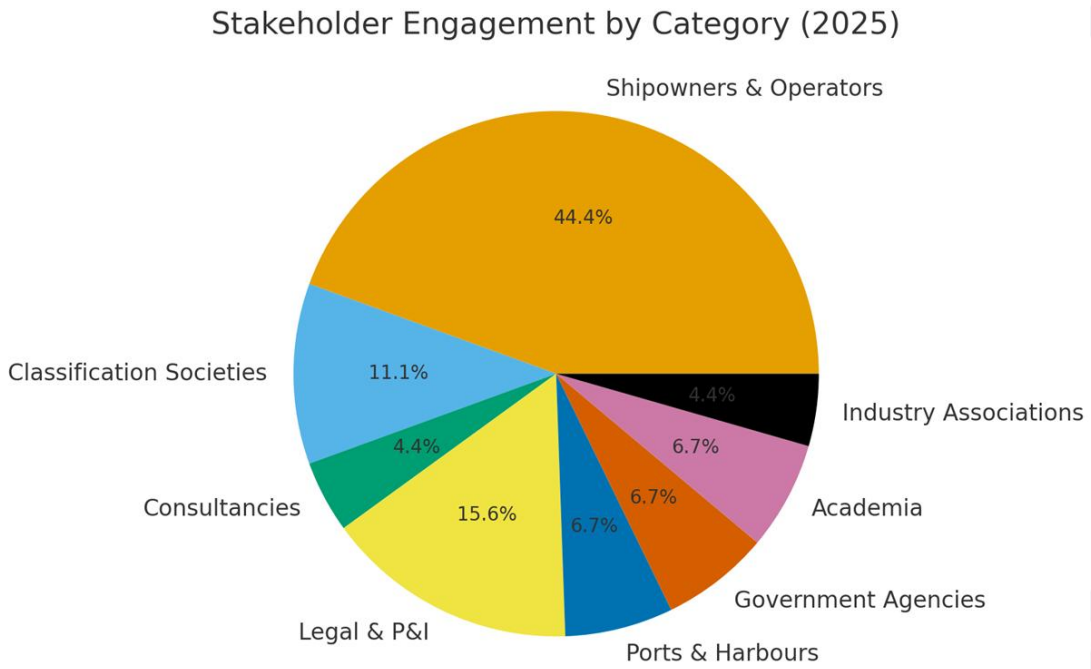
Metric	Achievement
Workshops Held	5 + 1* WG
Organisations Involved Total Participants Hours of Activities with Members	52 206 30 (+7-2024)
Number of Speakers/Presenters	18 (+5 2024)

9 Key Deliverables: 1 Risk Assessment Template, 5 Initial Risk Assessments, Resource Library, Stakeholder Map, 1 Year Report;

Stakeholder Engagement – SAFWG Report

- 52 organization involved

- Shipowners and operators: 22
- Classification societies: 5
- Marine consultancies: 1
- Legal and P&I experts: 7
- Port and harbour authorities: 3
- Government departments and agencies: 3
- Academic institutions: 3
- Other shipping associations: 2
- Equipment manufacturers and fuel suppliers: 6



Stakeholder Engagement – List of Stakeholders

Shipowners and operators: 22

Shell, V. Group, AngloEastern, BP, Bibby Marine, Calmac, Carnival, CEMEX, Evergreen, James Fisher, J.P. Morgan, MOD, MOL, MSC, Northern Lighthouse Board, Northern Marine, P&O, Purus, Stena Line, Svitzer, NYK, Fortescue

- Classification societies: 5 - ABS, BV, LR, RINA, DNV
- Marine consultancies: 1 - Frazer Nash Consultancy
- Legal and P&I experts: 7 -Gard, North Standard, Shipowner Club, (Steamship), Thomas Miller, West P&I, International Group of P&I
- Port and harbour authorities: 3- Forth Port, Singapore MPA, Port of Rotterdam
- Government departments and agencies: 3 - MCA UK, Singapore MPA, UK Health & Safety Executive
- Academic institutions: 3 - Clean Maritime Hub, University of Southampton (SOTON), University of Strathclyde
- Other shipping associations: 2 - ICS, IBIA
- Equipment manufacturers and fuel suppliers: 6

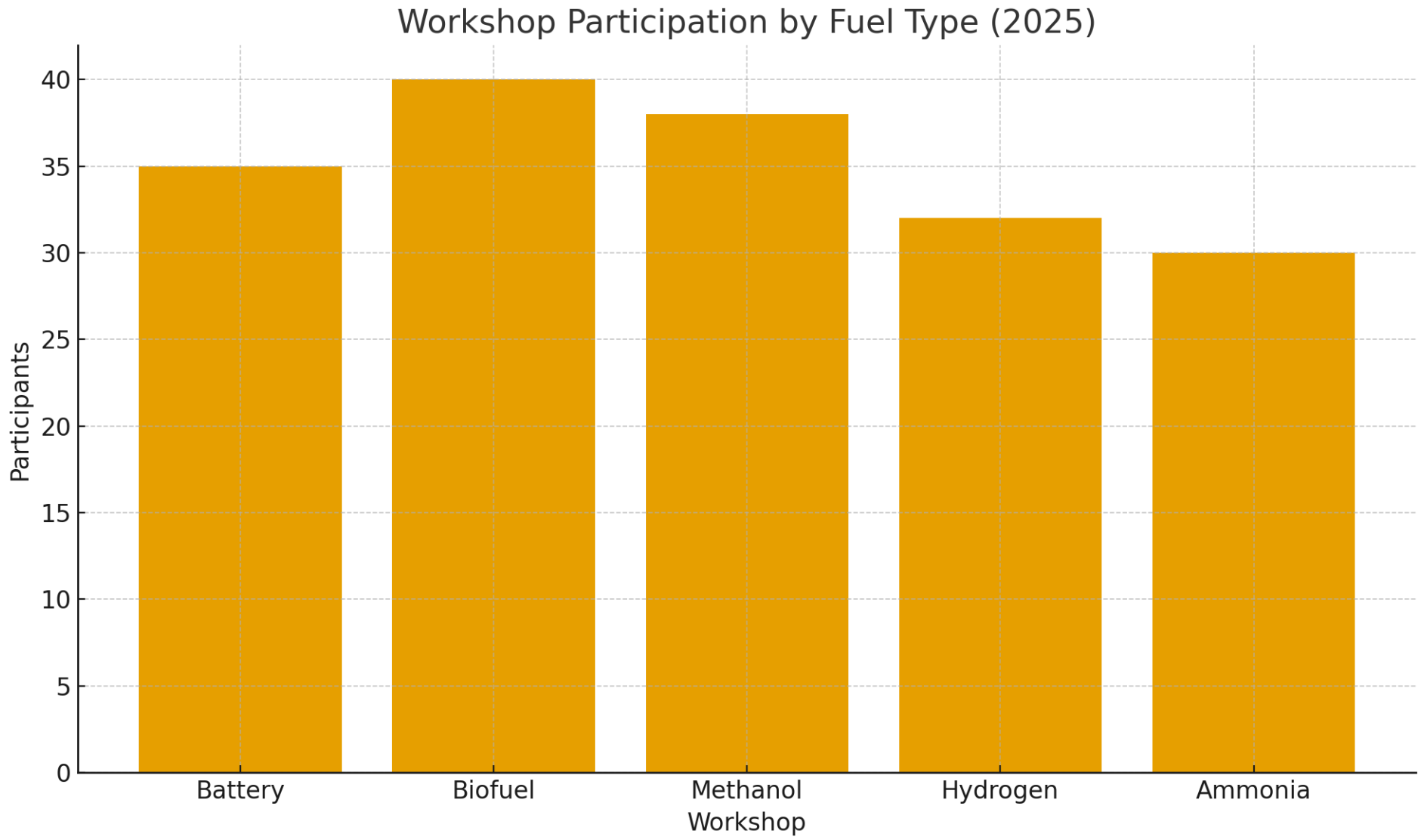
Corvus, Everllence, Wartsila, Alfa Laval;

GiBunkering, Yara;

Workshop Timelines

Date	Events/Workshops	Key Presenting Organisation
30 May 24	Inaugural Meeting	Singapore MPA, West of England, IBIA, RINA (Class)
21 Nov 24	Establishment Meeting	RINA (Class)
11 Mar 25	Battery Workshop	Corvus, Shell, Calmac Ferries
29 Apr 25	Biofuel Workshop	LR/FOBAS, MAN Engine, Glander Bunkering, SVITZER
10 July 25	Methanol Workshop	ABS, Wartsila, V.Ships
01 Oct 25	WG Meeting	ICS, MOL
07 Nov 25	Hydrogen Workshop	DNV, Wartsila, Shell
20 Nov 25	Ammonia Workshop	Yara, Fortescue, Port of Rotterdam

Workshop Participation -



Risk Assessments - Example of Top Hazards

Top Hazards Some examples				
Battery	Biofuels	Methanol	Hydrogen	Ammonia
Thermal runaway due to manufacturing fault/internal cell failure.	Bunkering unknown biofuel grade risking warranty insurance invalidation.	SIMOPS (cargo + bunkering) increasing likelihood of high-consequence incidents.	Limited trained personnel for operation/repair increasing the likelihood of incidents	Hose rupture during transfer leading to loss of containment and toxic release.
Cooling/ventilation failure leading to overheating and thermal runaway.	Cross-contamination Hydroscopic properties of blends causing water/bacteria, sludging and corrosion	Non-visible methanol flame following loss of containment	Hydrogen embrittlement from unsuitable materials causing loss of containment.	Incorrect valve alignment during bunkering leading to toxic release.
Water ingress/condensation leading to short circuit and electrical fire.	Material incompatibility (seals/coatings) leading to component failure and potential loss of containment.	Toxic inhalation exposure following leak/release.	Leaks during construction/maintenance causing gaseous or liquid hydrogen release.	Unfamiliarity of nearby vessels/ports with emergency response escalating incidents

Preliminary Risk Assessment - Example Hydrogen

UK CHAMBER of SHIPPING

Safety of Alternative Fuels Working Group
Hydrogen Risk Assessment

Scope and limitation: The risk statements and impact/probability ratings on this sheet are preliminary hazard descriptions prepared by th
Mitigation measures are intentionally excluded because appropriate controls depend on vessel type, operational profile and company pra
These matrices are intended to inform, not replace, project-level safety cases and design reviews. See the SAFWG Year-1 Report (Legal Dis
and Annex E context sheet for full scope and limitations.

Hydrogen Date conduc 29/04/2025

Risk ID	Event Description	Associated Activity	Impact Rating (1-5)	Impact Description	Probability Rating (1-5)	Probability Description	Risk Score	TECOP Ca
1	As a result of a lack of hydrogen design standards, poor design decisions are made, leading to the possibility of an unsafe operating condition.	Vessel design	5	Loss of containment, fire and explosion, fatalities.	4	Some hydrogen design standards now exist in the industry.		Technical
2	As a result of the novelty of hydrogen as a marine fuel, limited expertise are available to participate in the risk based certification process, leading to the possibility of an unsafe operating	Vessel design	5	Loss of containment, fire and explosion, fatalities.	4	There are some expertise in hydrogen safety available in other industries.		Technical
3	As a result of the use of materials not suitable for use with hydrogen, hydrogen embrittlement can occur, leading to a loss of containment.	Vessel construction	5	Loss of containment, fire and explosion, fatalities.	5	Hydrogen embrittlement is a known problem and incidents of incorrect material selection in hydrogen systems have occurred.		Technical
4	As a result of failure to account for the negative Joules Thompson effect of hydrogen when designing systems, equipment damage and failure can occur, leading to a loss of containment.	Vessel design	5	Loss of containment, fire and explosion, fatalities.	5	The negative Joules Thompson effect is a known property of hydrogen and incidents have occurred when failing to account for this in system design.		Technical
5	As a result of inadequate tightening of piping and system connections during construction or maintenance, a liquid hydrogen leak can occur, leading to a loss of containment.	Vessel construction, maintenance	5	Loss of containment, cryogenic burns, brittle fracture of vessel structure.	5	Leaks in piping systems are a common occurrence in industry.		Technical
6	As a result of inadequate tightening of piping and system connections during construction or maintenance, a gaseous hydrogen leak can occur, leading to a loss of containment.	Vessel construction, maintenance	5	Loss of containment, fire and explosion, fatalities.	5	Leaks in piping systems are a common occurrence in industry.		Technical
7	As a result of lack of adequate training for leak detection procedures, a hydrogen leak remains undetected, leading to a	Vessel construction, operations	5	Loss of containment, fire and explosion, fatalities.	5	Helium leak testing procedures are novel in the maritime industry and will be unfamiliar to most		Technical
8	As a result of the novelty of hydrogen as a marine fuel, there is	Vessel construction,	5	Loss of containment, fire and	5	Hydrogen is novel in the maritime industry and there		Technical

Year 2 Activities and Deliverables discussion

- Gap Analysis, control and mitigation for Selected Projects;
- Establishment of an Alternative Fuel Accident/Incident Database;
- Additional activities – i.e. Resource Library, Technical Workshops/Webinars;

- Report first Year will be published - End of Month;

- Group Open to Experts – Please contact me;

UK CHAMBER of SHIPPING

CONTACT.

UNITING UK SHIPPING

Francesco Sandrelli

Policy Director, Environment

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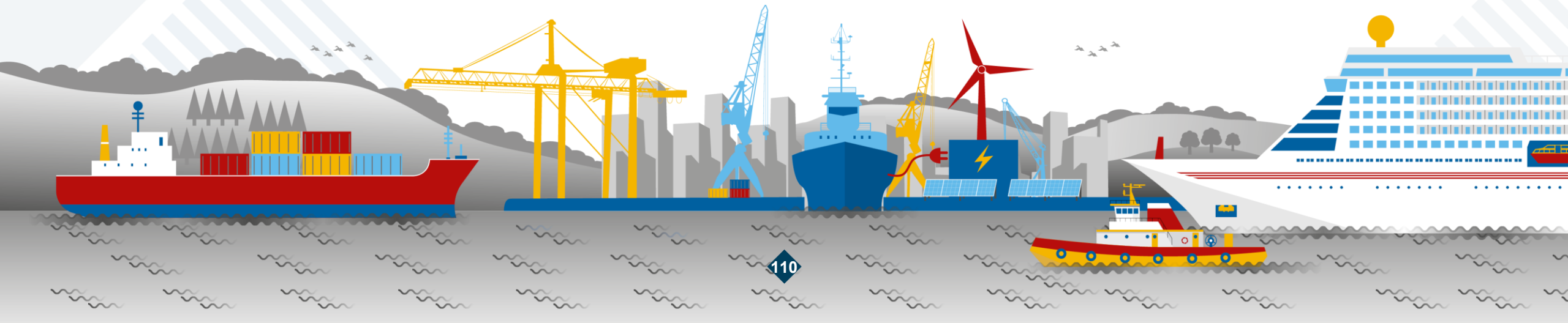

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UNITING UK SHIPPING

Uniting, promoting and championing an environment for shipping in the UK to thrive; helping to deliver a greener world and a more prosperous nation

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Decarbonisation in Practice: Managing Risk in Marine Biofuels

Brookes Bell

David Browbank

An introduction to Brookes Bell

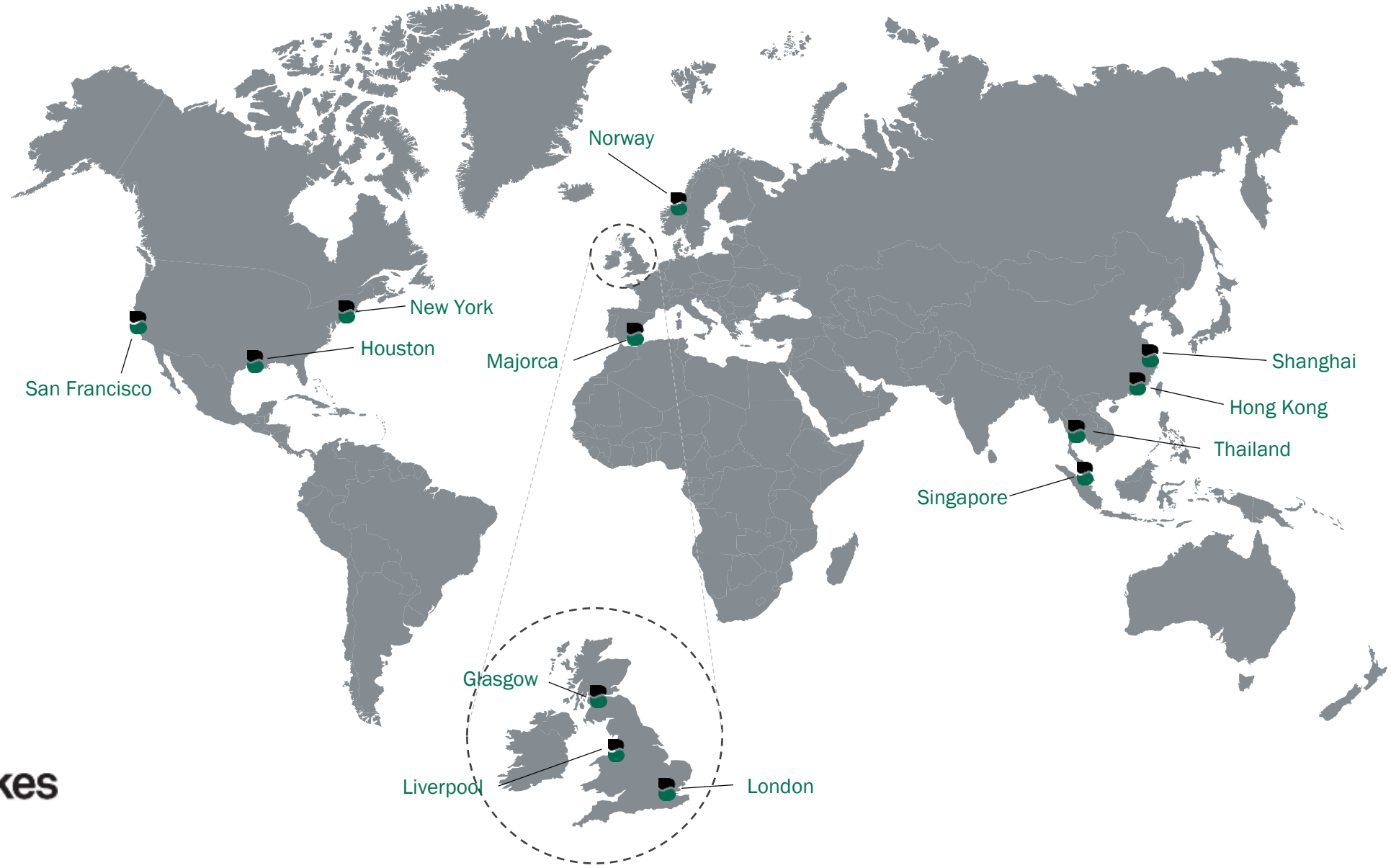
Brookes Bell

Who is Brookes Bell

- Multi-disciplinary technical and scientific consultancy, serving the marine and energy markets since 1903.
- Global reach including operations in Europe, Asia and the Americas.
- Casualty investigation, forensic analysis, technical dispute resolution, expert witness work and forensic laboratory analysis.

Brookes Bell

A global presence



Brookes Bell

Our team

- Master Mariners
- Marine Engineers
- Cargo Scientists
- Fire Investigators
- Fuel Chemists
- Materials Scientists
- SCRs
- Naval Architects
- Metallurgists
- Paint Consultants
- Tribologists
- NDT Technicians

Brookes Bell

What we do best

- Vessel Operations
- H&M Claims
- P&I Claims
- Fuel & Bunkers
- Bulk & Liquid Cargo
- Personal Injury
- Superyachts
- Casualty & Salvage
- Paint & Coatings
- Tribology
- New Build Disputes
- Design / Simulation
- Material Failures
- NDT Inspections

Brookes Bell

Current marine fuels

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Current marine fuels

The marine sector currently utilises a broad range of fuels, with conventional fossil fuels such as HFO and MGO still representing the majority of global marine fuel consumption.

- Fossil fuels – HSFO, VLSFO, ULSFO, LSMDO, LSMGO.
- Biofuels – B5 up to B100.
- LNG / LPG.
- Methanol. Ammonia. Hydrogen.

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Current issues associated with marine fuels

Routine testing to ISO 8217 helps ensure fuels meet defined safety and quality parameters

- SOLAS – Safety of Life at Sea.
- MARPOL (**Mar**ine **Pol**lution) – sulphur, micro carbon residue.
- Fuel stability, sediment and contamination concerns – TSE, TSP, Forensic analysis
- Financial – density.

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Biofuels

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Why Biofuels Matter in Practice

Why biofuels are gaining attention

- The marine industry is transitioning toward lower-carbon fuels.
- Biofuels are increasingly being supplied and used across the global fleet.
- While many operational principles remain familiar, biofuels may behave differently from conventional marine fuels.
- Understanding those differences is becoming increasingly important from both an operational and risk perspective.

Operational reality

- Biofuels are not a single fuel type
- Fuel behaviour can vary significantly depending on:
  - feedstock
  - production pathway
  - blend ratio
  - storage and handling practices

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Biofuel Does Not Necessarily Mean Biodiesel

Biofuel (broad / umbrella term)

Marine biofuel discussions and routine screening have historically focused on FAME-type biodiesel blends and traditional FAME markers

Current marine reality

Modern marine biofuel blends may also contain:

- non-FAME renewable blend components
- upgraded renewable products
- waste-derived or synthetic bio-components

These fuels may behave differently from traditional FAME biodiesel and may not exhibit typical FAME characteristics during routine analysis.

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Feedstocks and Traceability in Marine Biofuels

Feedstocks

Marine biofuels may be produced from a wide range of renewable feedstocks, including (but not limited to):

- used cooking oil (UCO)
- animal fats
- palm oil mill effluent (POME)
- agricultural residues
- other waste and residue streams

A full list of approved feedstocks and waste-derived materials is referenced within the ISCC materials list and associated certification schemes

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Feedstocks and Traceability in Marine Biofuels

- Animal fats from rendering (cat 1)
- Animal fats from rendering (cat 2)
- Animal fats from rendering (cat 3)
- Brown grease / grease trap fat
- Crude tall oil (CTO)
- Empty Palm Fruit Bunches (EFB) oil
- Food Waste
- Palm Fatty Acid Distillate (PFAD)
- Palm oil mill effluent (POME) oil
- Sewage Sludge
- Soapstock Acid Oil
- Spent Bleaching Earth
- Used Cooking Oil
- Waste/residues from processing of vegetable or animal oil
- Wastewater from ship transport
- Cashew Nut Shell Liquid (CNSL)
- Biogenic fraction of end-of-life tyres
- Residue of FAME end distillation

ISCC International Sustainability & Carbon Certification

Lists of material eligible for ISCC EU certification

(08 October 2025)

Table 1: Raw material			
Declaration of material on ISCC EU certificate	**Additional information**	**Classified as waste/residue material in the following EU Member States (or UK)**	**RefuelEU Aviation ("A") / FuelEU Maritime ("M")**
Sewage sludge *	Sewage sludge is a remainder of the wastewater treatment process. Points of Origins are wastewater treatment facilities. Fats, oils and grease ("FOG")	NL, UK	A,M

https://www.iscc-system.org/wp-content/uploads/2025/10/ISCC_EU_material_list_251008.pdf

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Feedstocks and Traceability in Marine Biofuels

Traceability & certification

Certification systems track how fuel is produced and supplied

Two main approaches:

Segregated supply chains

- Materials are kept separate throughout the supply chain
- What is delivered can be directly traced to its source

Mass-balance systems

- Materials are mixed during supply (secondary refining)
- Sustainability is tracked on paper, not physically

In mass-balance systems, the sustainability claim may not reflect the actual composition of the fuel delivered

As a result, the fuel onboard may not be identical to its commercial or sustainability description

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Potential Advantages of Marine Biofuels

Marine biofuels are increasingly being considered as a practical transitional fuel within the maritime sector, particularly where existing vessels and infrastructure must continue to operate during decarbonisation.

Advantages

- Potential reduction in lifecycle greenhouse gas (GHG) emissions
- Can often be used within existing marine fuel infrastructure and engines
- Supports compliance with evolving decarbonisation targets and regulations
- Waste- and residue-derived feedstocks may reduce reliance on fossil fuels
- Increasing availability across major marine bunkering hubs

One of the primary attractions of marine biofuels is that they can often be introduced without requiring a complete redesign of vessels, fuel systems, or bunkering infrastructure,making them a realistic near-term option rather than a future concept.

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Potential Challenges of Marine Biofuels

Challenges

- Storage stability and fuel ageing
- Compatibility and co-mingling considerations
- Contamination and fuel quality concerns
- Variability between feedstocks, blend components and production pathways
- Increased importance of onboard fuel management and housekeeping
- The variability of biofuel blend components and feedstocks may increase the complexity of technical investigations and root cause assessment

GHG Performance

- Biofuels may provide lifecycle greenhouse gas (GHG) reductions compared with conventional fossil fuels. However, the overall environmental benefit can vary significantly depending on factors such as feedstock origin, production pathway, land-use impacts, and the robustness of certification and traceability systems.

These are not reasons to avoid biofuels, but they do mean that fuel management discipline becomes more important, not less.

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Examples of Operational Fuel Issues

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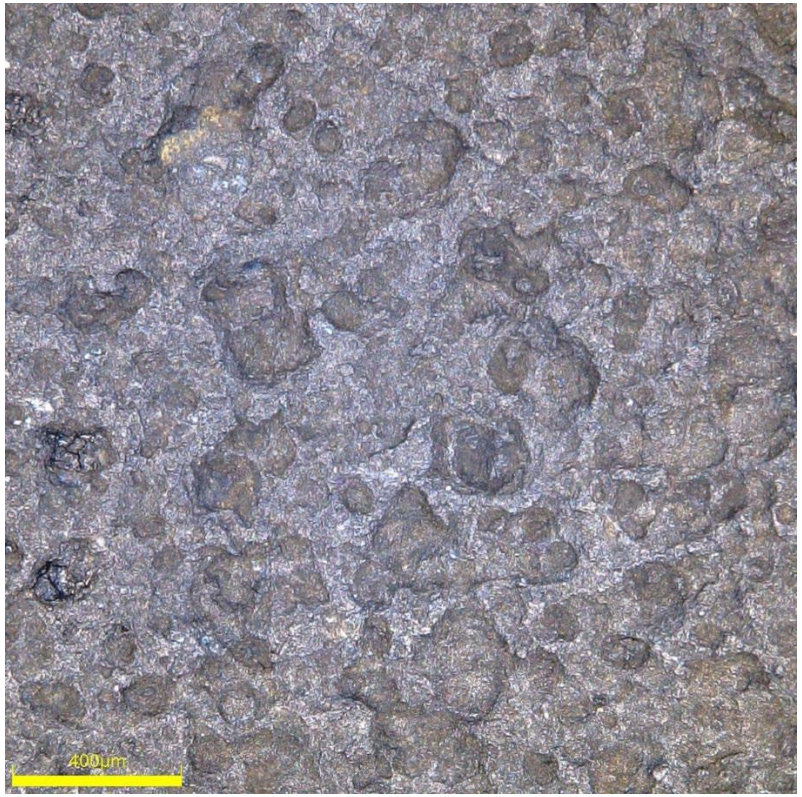
When fuel chemistry affects performance

Plunger 1 at 0° position, detail 1 of 5, 140x



Plunger 1 at 0° position, detail 2 of 5, 140x

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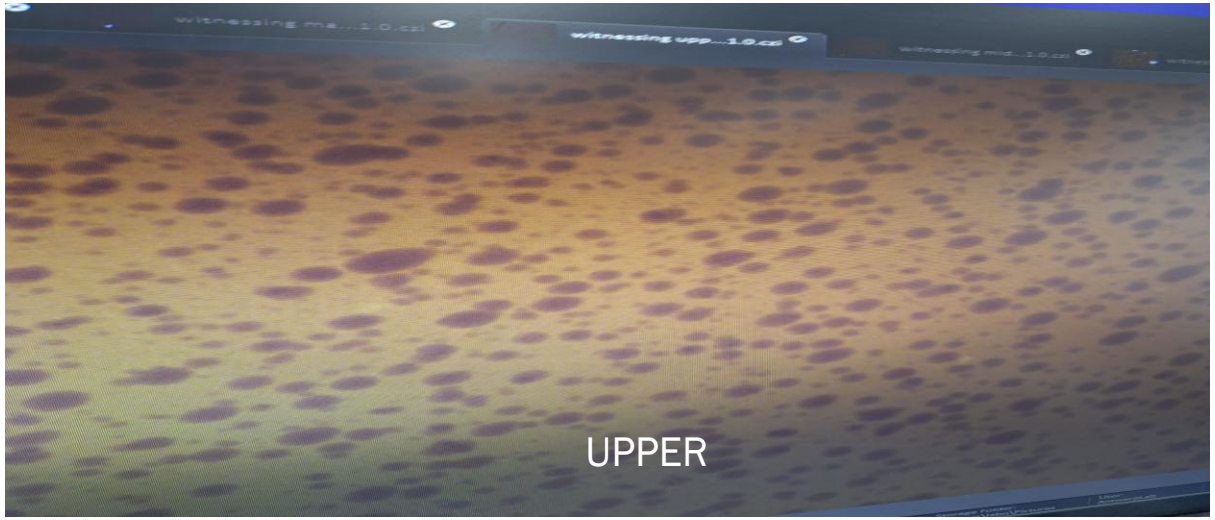
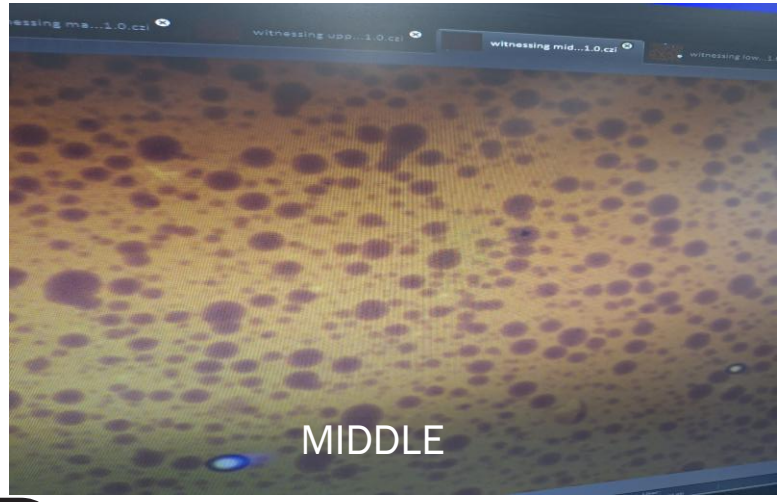
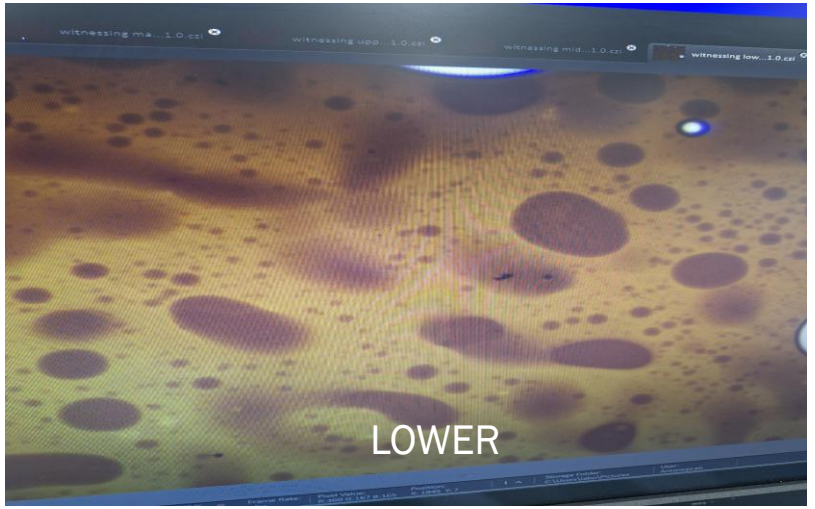
On-spec fuel, unexpected behaviour







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Safeguards

Managing Risk in Practice

- Understanding the nature of the renewable blend component is increasingly important
- Certification, traceability and mass balance documentation should be reviewed alongside fuel testing results
- Fuel behaviour may vary depending on feedstock, production pathway and blend composition
- Where operational experience is limited, phased introduction and onboard monitoring may help identify potential issues before wider use
- Early investigation of abnormal fuel behaviour may reduce operational impact
- Combined fuel chemistry and marine engineering assessment may be required in complex cases

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Thank you

Questions

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