

# Challenges from alternative fuels

MANIFESTS Genius Workshop

Sergio Alda, Senior Project Office

Unit 1.1 Sustainability

Vigo, 4 June 2025



# EU decarbonization targets for shipping

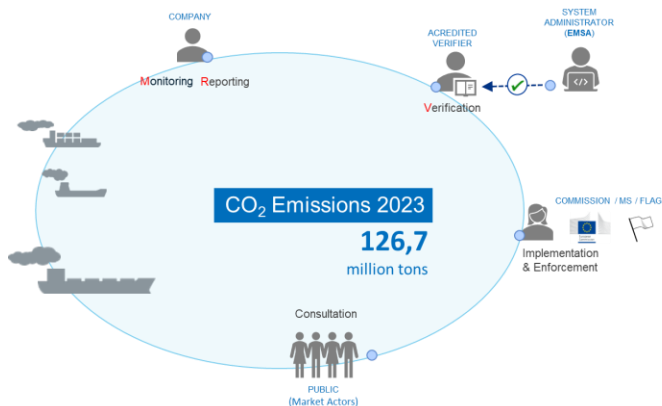
**First concrete step to bring the maritime sector in line with the European ambition of climate-neutrality by 2050 and assist to increase the EU's greenhouse gas (GHG) reduction target for 2030 of 55 % compared to 1990 levels**

## EU ETS 203/87/EC extension to maritime

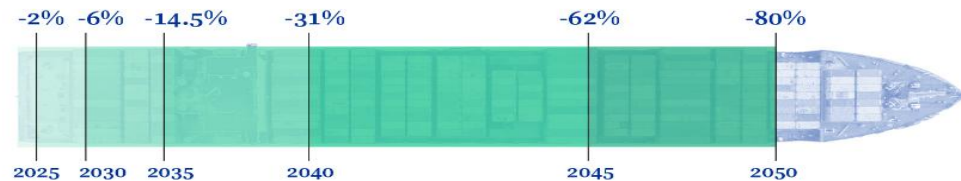
- **Cap-and-trade' system:** puts a price on GHG emissions to harness economic forces
- Phase-in 2024 (40%, 2025 (70%), after 2026 100% emissions

## FuelEU Maritime Regulation (EU) 2023/1805

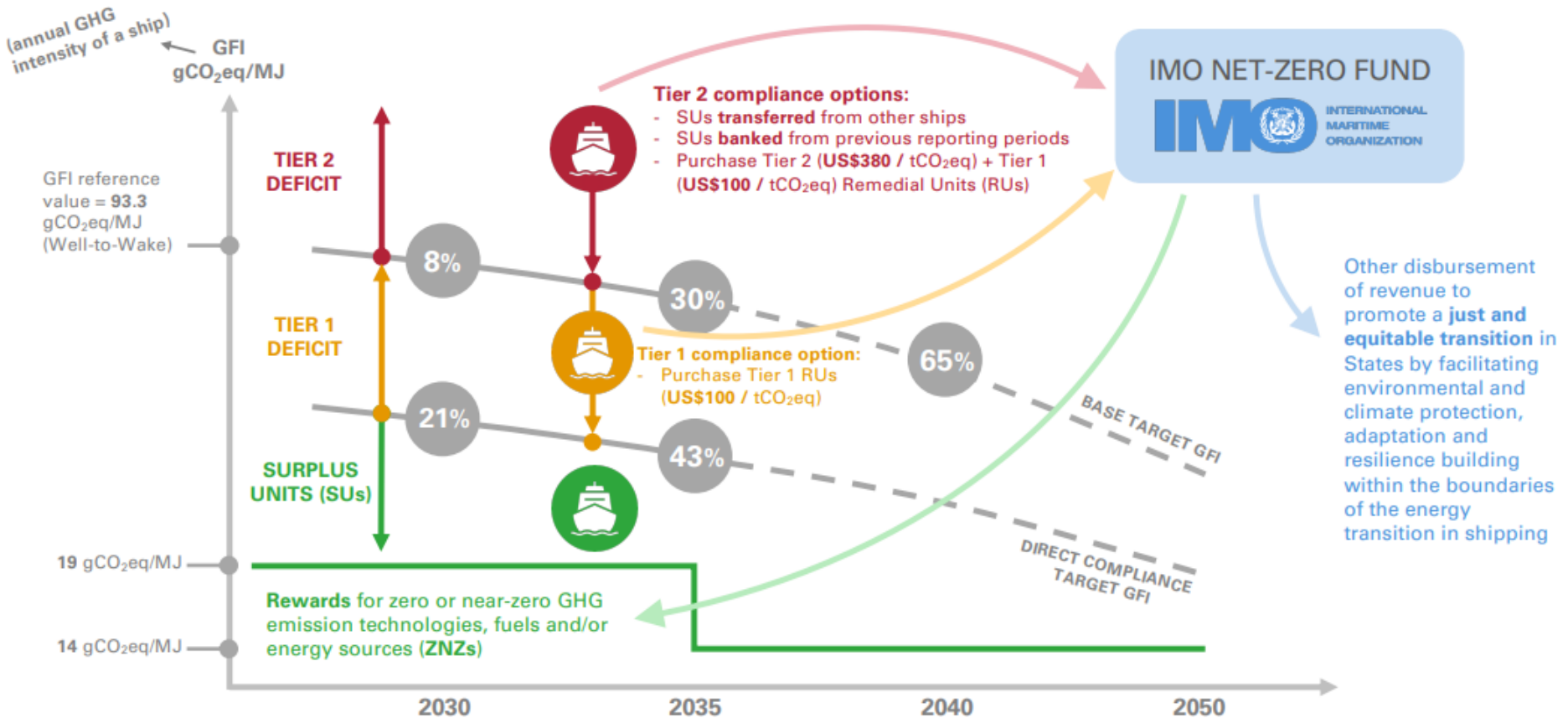
- **Limits the GHG intensity of the energy used on-board**
- Obligation to use OPS or zero-emission technology from 2030



Annual average carbon intensity reduction compared to the average in 2020

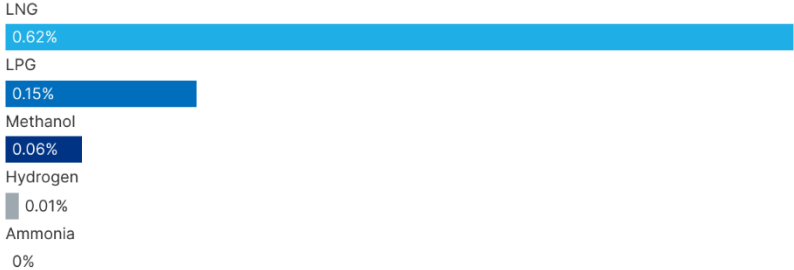
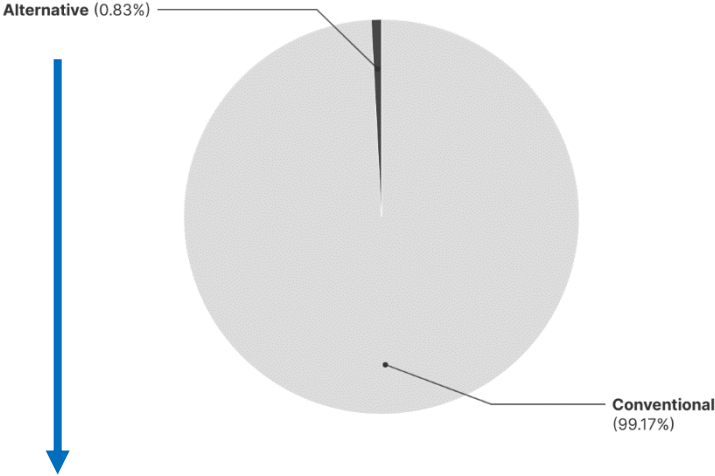


## Illustration of the IMO Net-Zero Framework

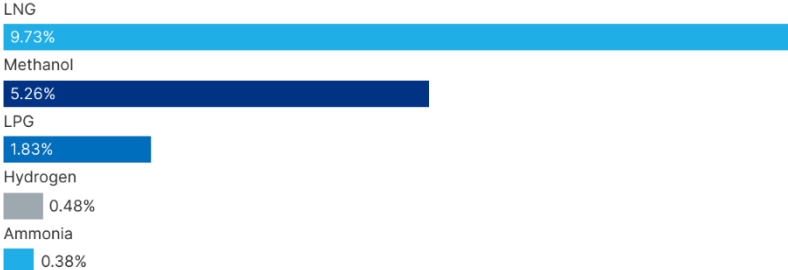
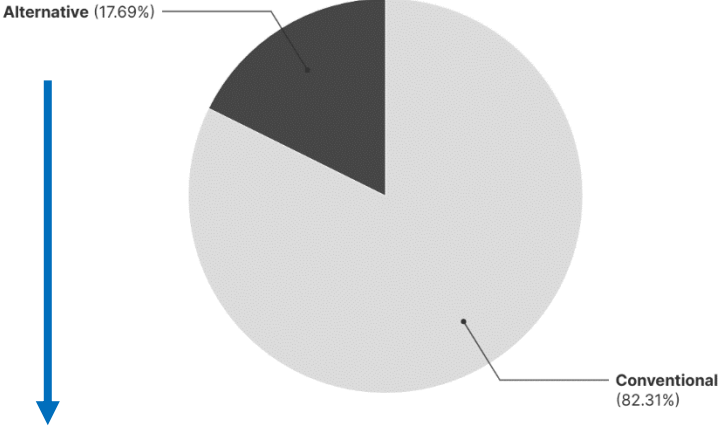


## World fleet – all ship types

In operation



On order for delivery until 2033



## Ammonia

No commercially operating vessel  
25 vessels orderbook for delivery until 2027  
Fortescue Green **Pioneer**

## Methanol

43 ships in operation  
300 additional vessels are expected for delivery until 2028 -  $\approx$  60% are containerships

From 2019 to 2023 – double the no. of ships methanol-ready

## Hydrogen

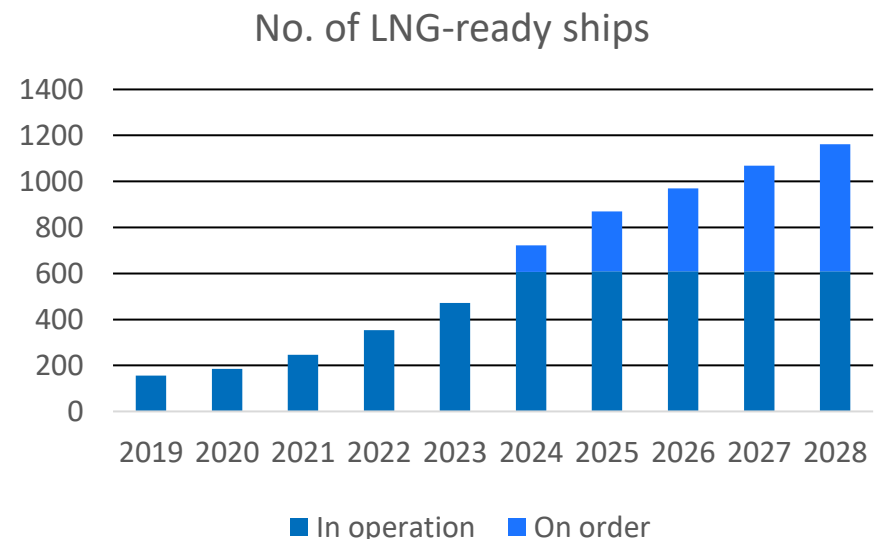
3 ships in operation using hydrogen in the mix  
9 ships in orderbooks for delivery until 2026

## LNG-ready vessels

3x more ships operating in 2023 compared with 2019

Containerships: 20%

Crude oil tankers: 13%



Source: Alternative Fuels Insight. Extracted on 01-10-2024.

## LPG

Used in gas tankers – LPG cargo as fuel

No evidence of other ship types, operating or on order

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## Fuel cells

5 ships in operation

1 under testing

20 on order for delivery until 2029

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## Batteries

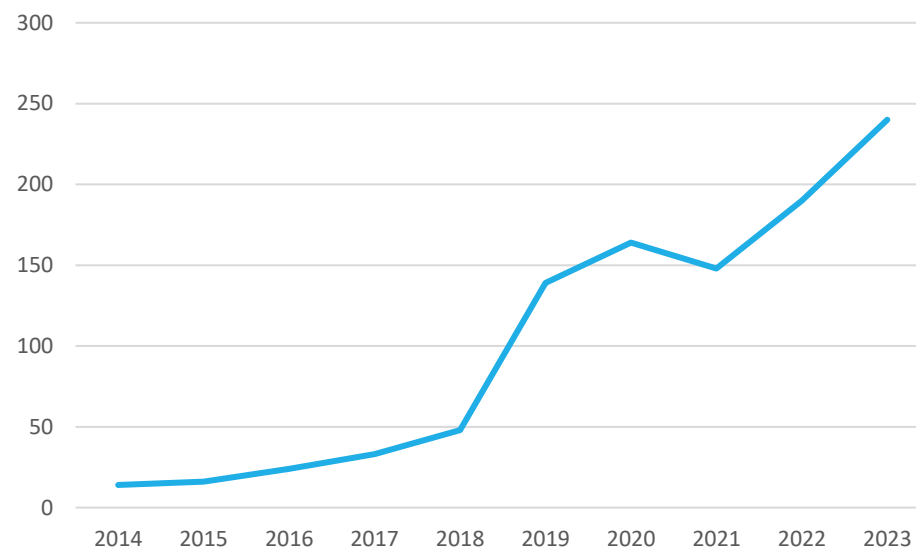
+900 battery ships in operation

3x more than five years ago

Additional 451 on order for delivery until 2027

Lithium-ion cell technology is the most common

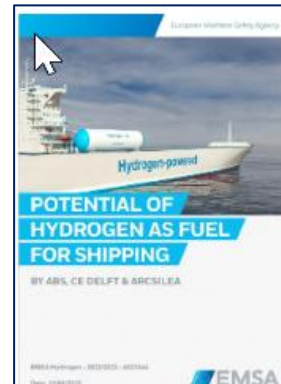
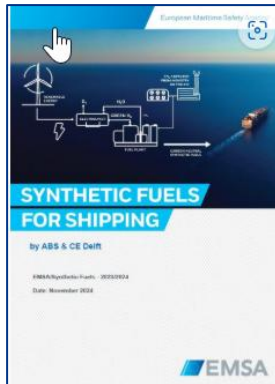
## No. of batteries installed onboard each year



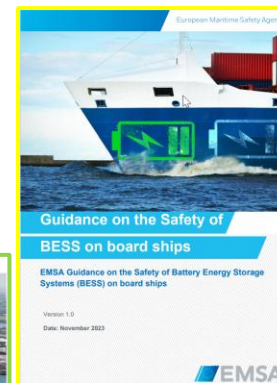
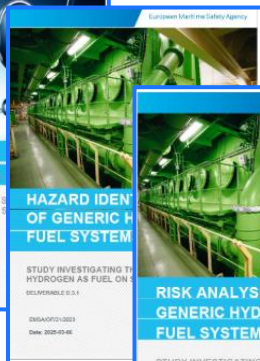
Source: Alternative Fuels Insight. Extracted on 21-03-2025.

# Reports, studies & guidance on alternative fuels and sources of power

- ✓ Studies on the potential of new fuels, alternative sources of power or promising technologies for shipping



## Studies & guidance focusing on onboard safety aspects of alternative fuels



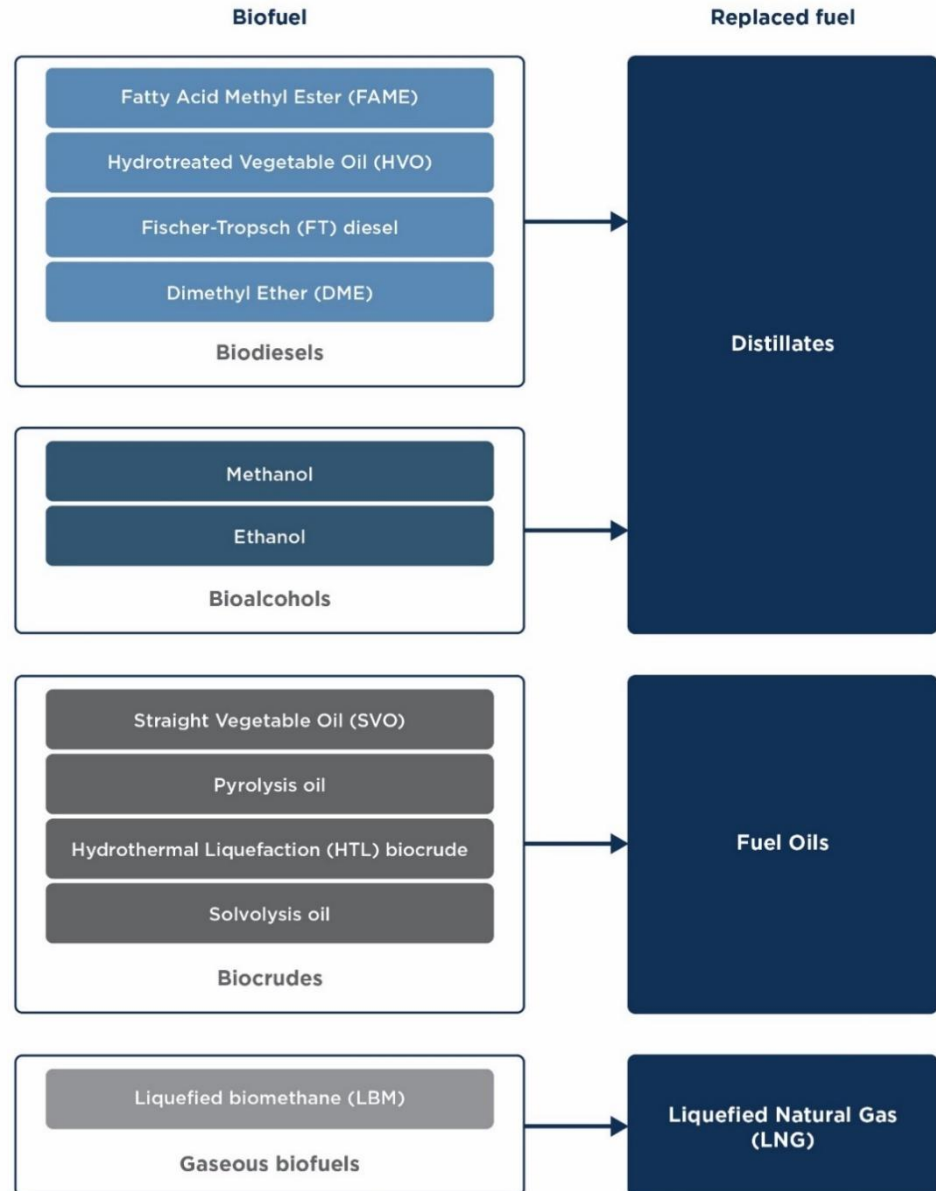
European Maritime Safety Agency



## UPDATE ON POTENTIAL OF BIOFUELS IN SHIPPING

BY ABS, CE-DELFT & ARCSILEA

EMSA/Biofuels - 2021/2022 - 4837444  
Date: 16/09/2022





## Bio-DME

- Rigorous safeguards needed (IGF)
- Risk of bunkering DME in a state not supported by the tank
- Thermal expansion regarding cold DME filling limits
- Overload of vessel reliquefaction system when filling ambient DME

## Bio-Methanol

- Rigorous safeguards needed (IGF)
- Toxicity risk
- Incompatibility of materials
- Flammable vapour release out of PRVs
- Electrostatic discharge

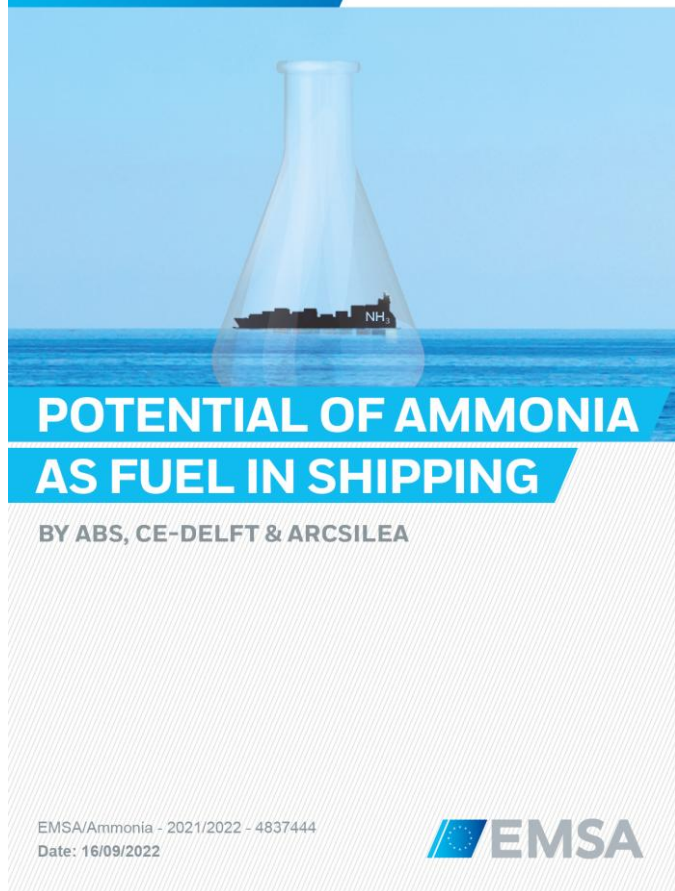
## FT-diesel, HVO & FAME

- No additional bunkering safety risks from the “bio” component
- Operational risks due to potential shorter storage stability or contamination

## Bunkering Guidelines and Checklists structured in phases:

- Pre-Bunkering (compatibility assessment)
- Connection
- Transfer
- Disconnection
- Simultaneous Operations

European Maritime Safety Agency



## Ammonia as a fuel presents a series of advantages and is a promising fuel:

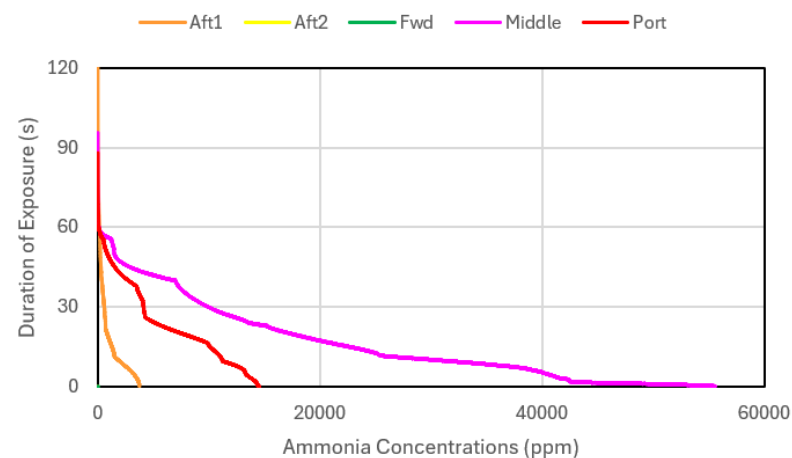
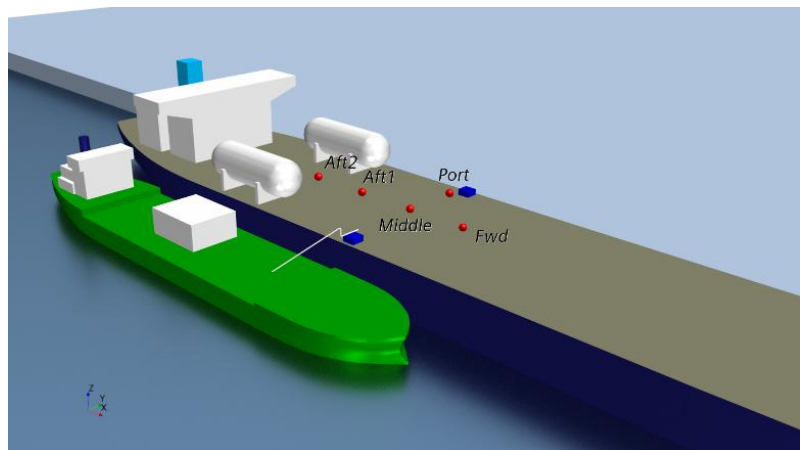
- Known and well-established production process
- Naturally carbon-free (i.e. attention needed to NO<sub>x</sub>, N<sub>2</sub>O and Pilot fuel)
- Known to shipping as a cargo (IGC covers it)
- It has been used for many decades and there is substantial knowledge available
- There are challenges to overcome to handle its corrosivity and toxicity: bunkering, engine, fuel supply systems.
- Ammonia spills may cause severe harm, potentially more harmful in seawater than in freshwater,
- Stricter safety for bunkering or when vessel enter and leave ports (similar to LNG, but for different reasons)

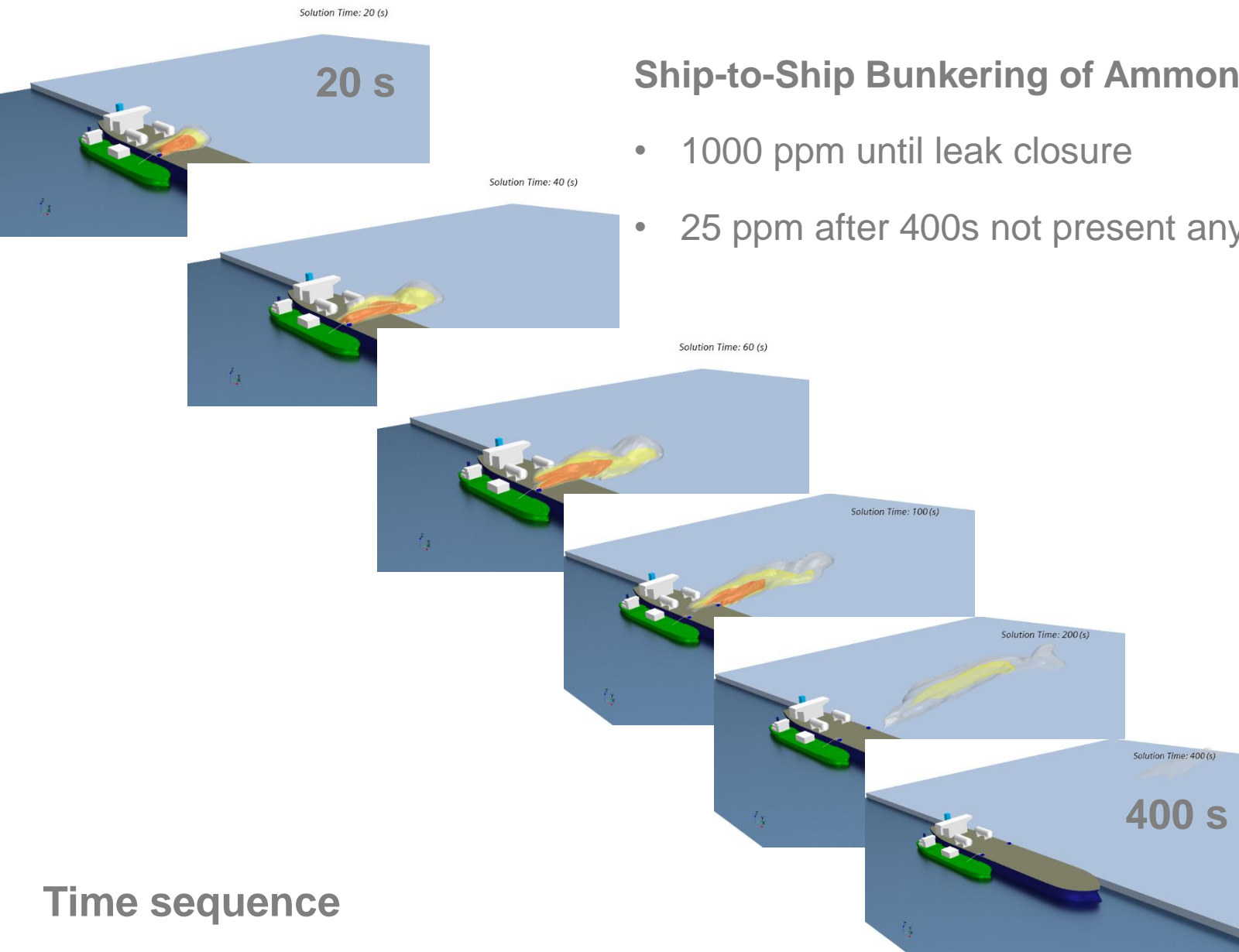
## Gas dispersion modelling - part of a consequence analysis

### Scenarios:

1. Ship-to-Ship Bunkering of Ammonia at a Port
2. Ammonia Release from a Vent Mast
3. Ammonia Accidental Releases in the Engine Room

Establish a credible leakage scenario (rupture, shape, size, flow, time)





## Ship-to-Ship Bunkering of Ammonia at a Port

- 1000 ppm until leak closure
- 25 ppm after 400s not present anywhere

Time sequence



**Major concerns are related to hydrogen's flammability range, leakage, flame speed and detonation/deflagration issues.**

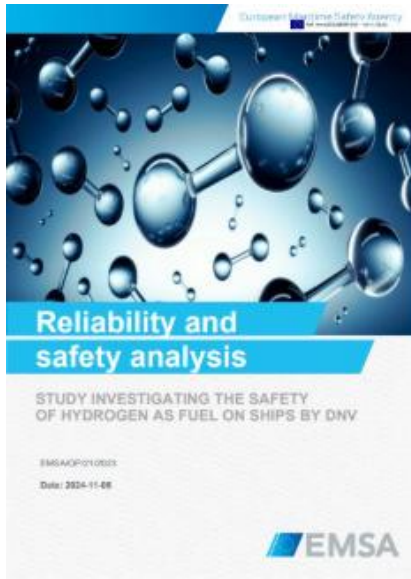
- Hydrogen has a very high flammability limit, which poses a very high risk, combined with very low energy requirement for ignition.
- Hydrogen's flame speed is much higher than other gases
- Material selection to assess compatibility to use with hydrogen is vital to maintaining the integrity of the system and minimising the risks of material failure.
- Attention should be paid to the location of the fuel-treatment room with its own unique risks



## PART I – Hydrogen Properties, Regulations and Accidents Review

### Some conclusions:

- Technical measures more effective for mitigation and control than operational measures
- ISO 2015 and NASA 1997 - Regulators are advised to assume an ignition source is present even when acceptable standards for certified electrical equipment are followed
- Hydrogen leakages should be prevented from reaching areas where combustion could occur

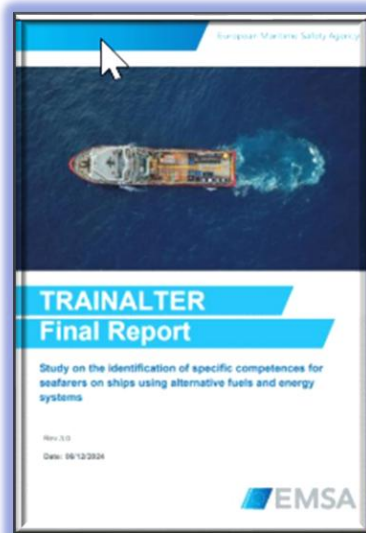


## PART II – Reliability analysis

### Some conclusions:

- Heat exchangers, compressors, pumps and filters have higher leak rates compared to other components
- Traditional gas detectors have long response time - likely too long to prevent a critical gas cloud from occurring on open deck
- Strategically mounted excess flow valves and restrictive orifices can be used to reduce leak rates, but have limitations
- Lack of hydrogen-specific failure data and uncertainties wrt suitability for ship applications result in a high degree of uncertainty in leak frequency analysis in QRAs for hydrogen fuel system installations

## ✓ Study on additional crew **training requirements** & competences (TRAINALTER)



Agenda Item 3.2 OTSOPA 25/03/02

Agreement For Cooperation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances, 1983

Meeting of the Working Group on Operational, Technical and Scientific Questions Concerning Counter Pollution Activities (OTSOPA)

Brest (France): 20 – 22 May 2025

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### Alternative Fuels Update

Presented by EMSA

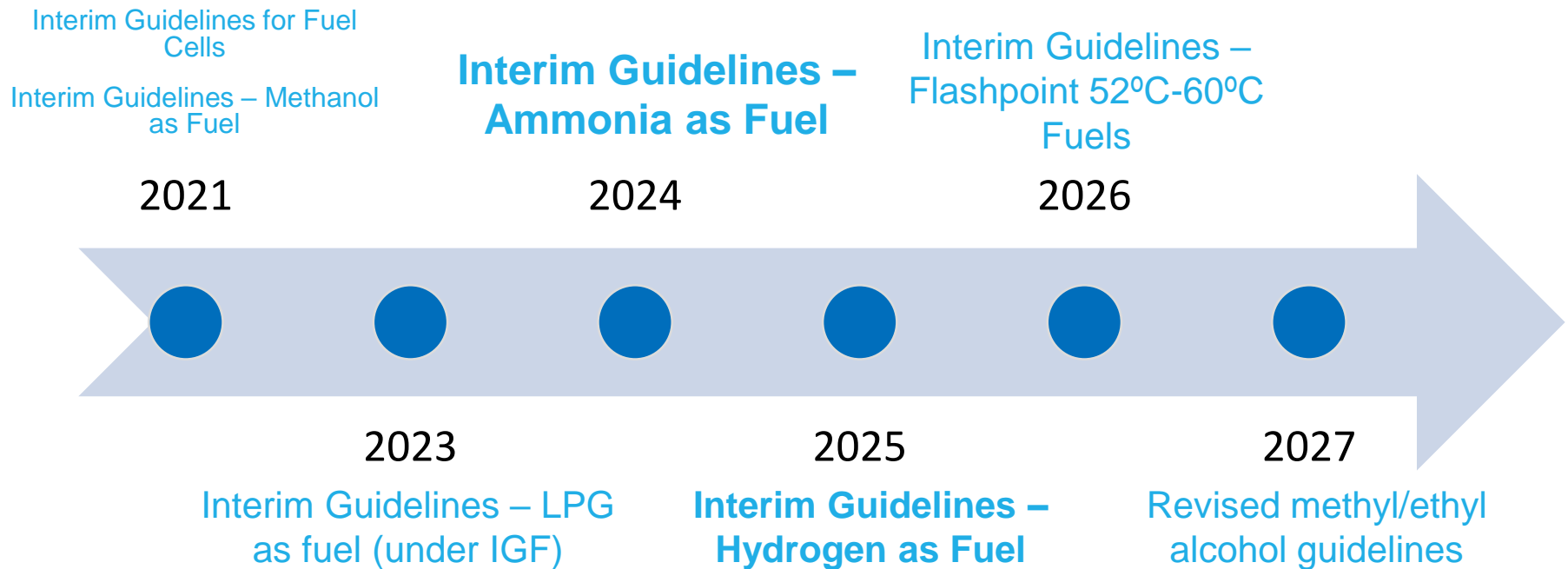
**Issue: Studies on the potential of new fuels or promising technologies for shipping**

Actions requested

1. OTSOPA is invited to:
  - a. **consider** the information provided on alternative fuels.

## ➤ Studies on **response techniques** for potential releases into the marine environment.

## IMO – Work on Safety of Alternative Sources of Power





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