

Echandia – Zero-Emission Solutions for Heavy-Duty Applications

Presentation from seminar with METS & FKAB , Gothenburg – 20th of April 2022



Presenting today



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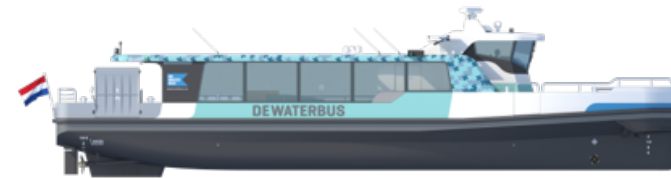
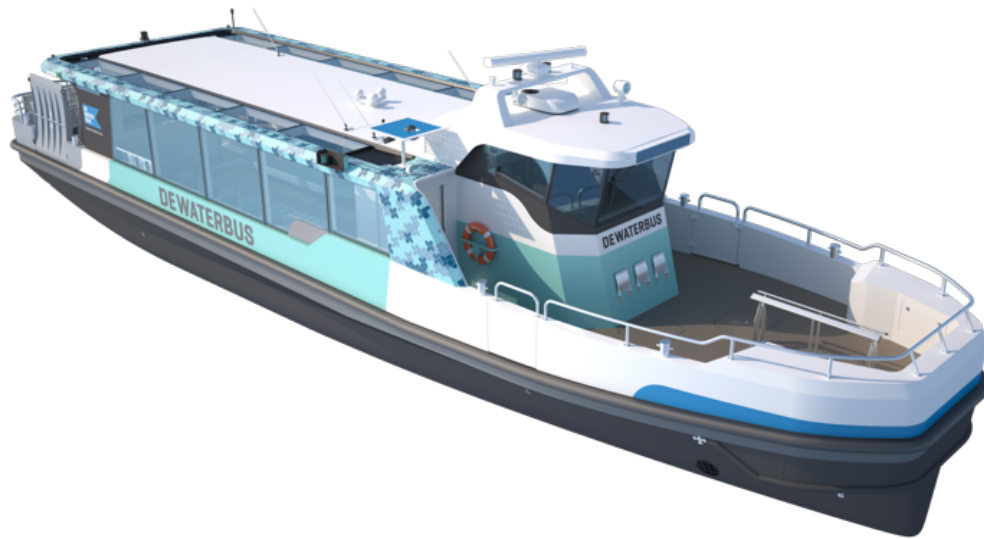


RSD 2513-E-Tug “Sparky”



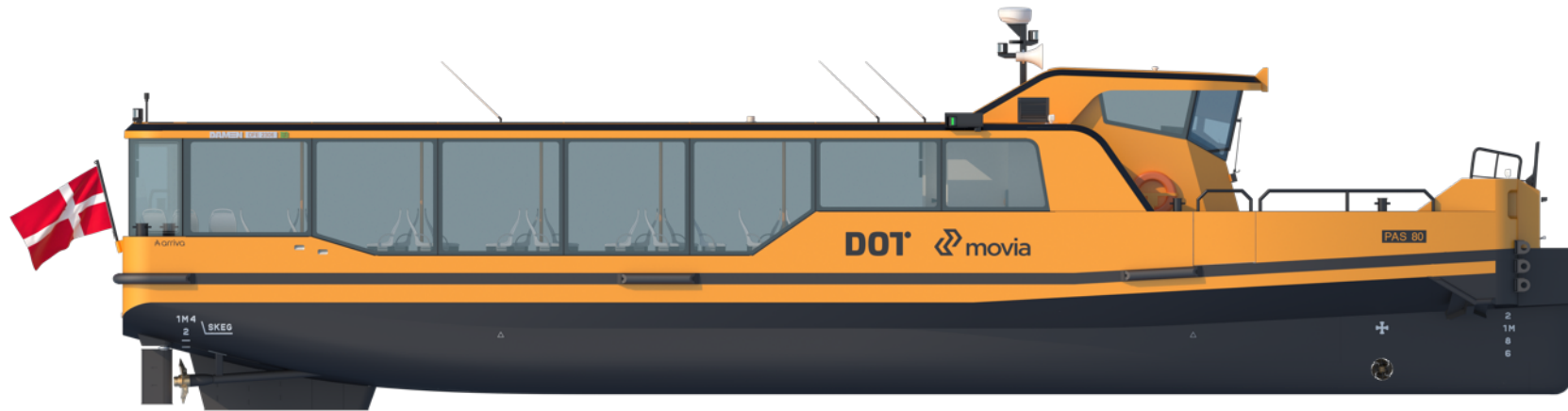
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DFe 2306 Waterbus - Rotterdam



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First hydrogen-powered high speed commuter ferry

Order won – October 2021

Pilot installation of integrated fuel cell and battery system in 2022/23 – operational by 2023



Unique concept: The worlds first hydrogen powered commuter ferry reaching 30 knots



60-80% lower fuel consumption



Place for 150 pax and 28 bikes

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Regulatory Impact on The Maritime Market

How is the EU and IMO driving the maritime market?





From 100 to
zero-emission
in three decades

Summary of regulatory frameworks – EU & IMO

SMALL

EU

- ETD from 2023
- Fuel EU maritime (2025-)

Inland waterborne

National

Regional

Local

MEDIUM

IMO (International)

- EEDI
- EEXI

EU

- ETD from 2023
- Fuel EU maritime (2025)
- Infrastructure (2025/30)
- Inland waterborne
- ETS

National, regional, local

LARGE

IMO (International)

- EEDI + EEXI
- CII > 5.000 GT (2023)
- Enhanced SEEMP (2023)

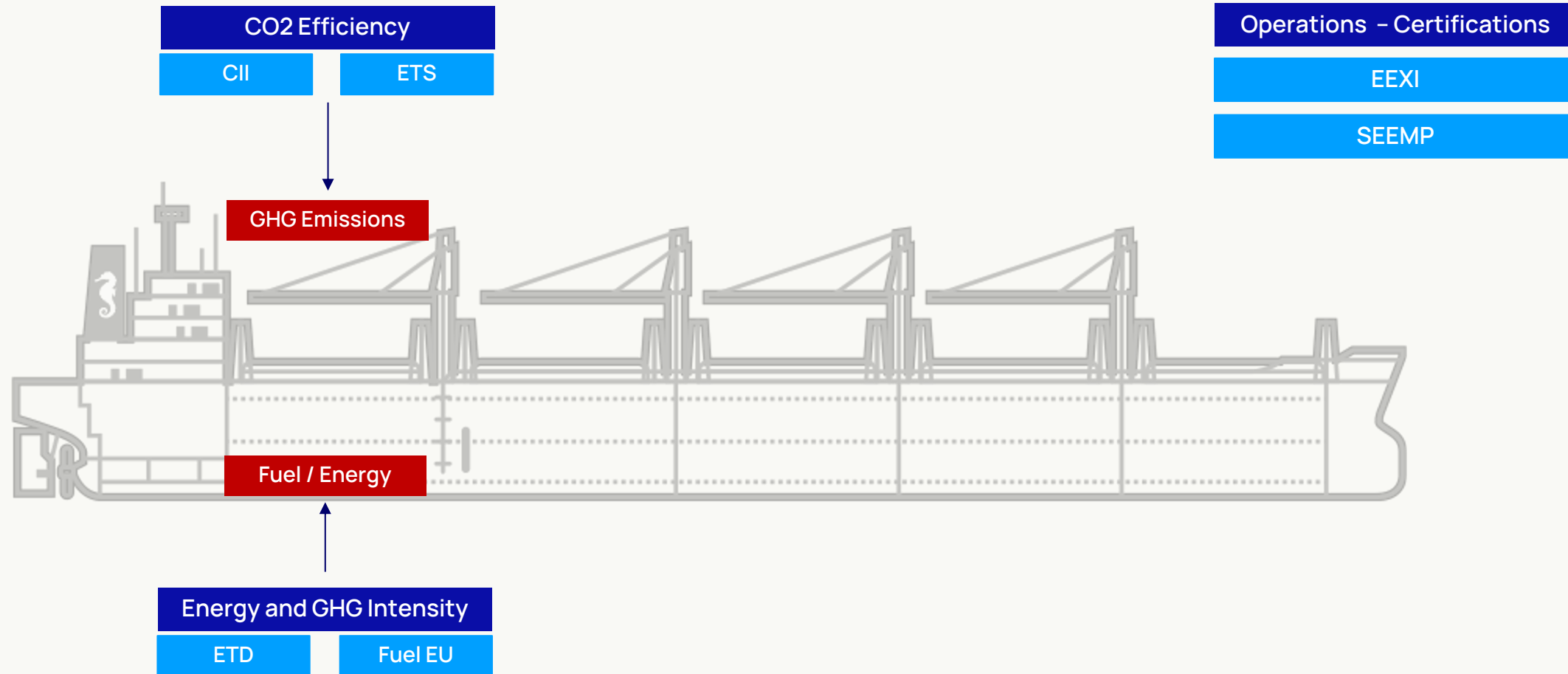
EU

- ETD from 2023
- ETS > 5.000 GT (2023)
- Fuel EU maritime (2025)
- Infrastructure (2025/30)
- Inland waterborne

National, regional, local

Summary of regulatory frameworks – EU & IMO

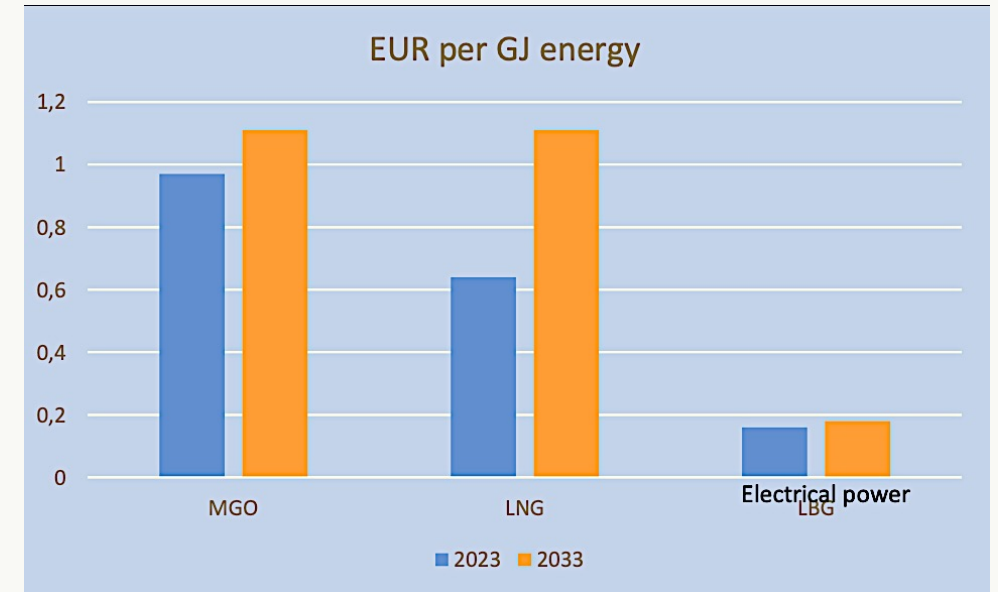
Where do regulations and directives focus



Impact of the Energy Taxation Directive (ETD)

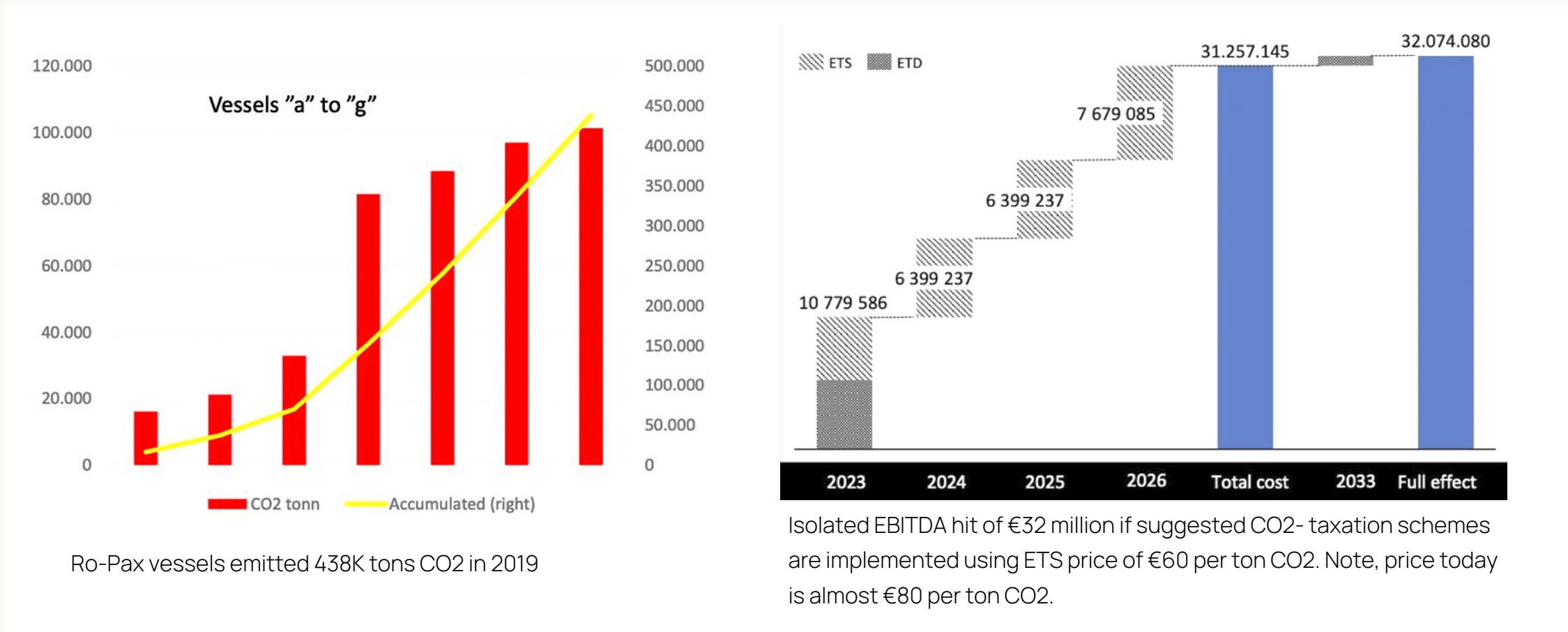
ETS price expected to increase as EU - Green Deal is implemented across the industry

- Directive set to remove the tax exemption for conventional fuels (1st January 2023)
- For fuel oils (HFO/MGO), the proposed tax rate will be €0,97 per GJ or approximately €37 per tons increasing to €1,11 per GJ in 2033
- LNG will be taxed at a rate of €0.64 per GJ, increasing to €1,11 per GJ in 2033
- Alternative fuels will be tax exempt or have limited taxes for a ten-year period 2023 – 2032
- Electricity and advanced biogas will have a proposed tax at a rate of 0,16 EUR per GJ in 2023 increasing to €0,18 per GJ in 2033.



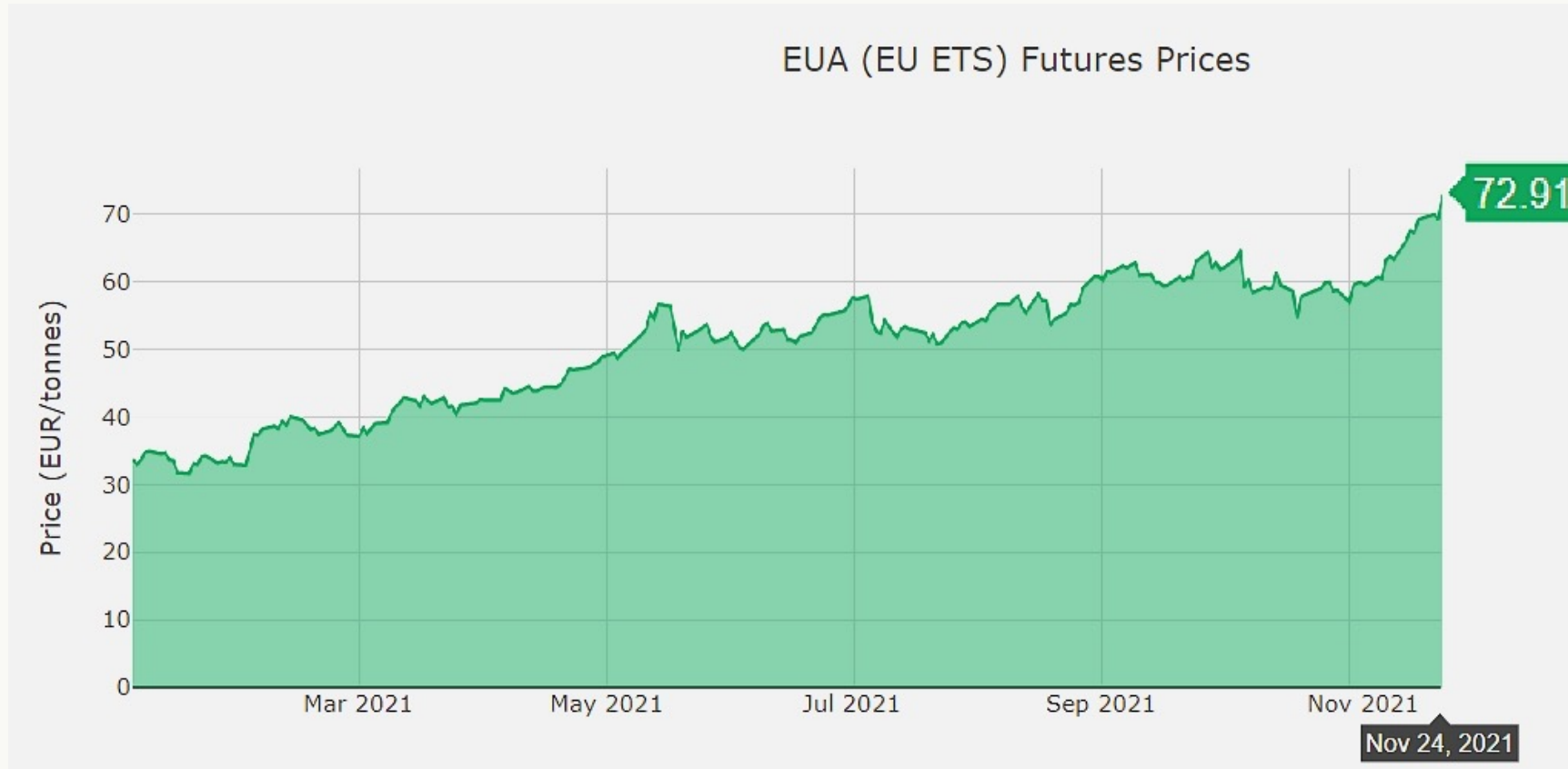
ETS represent significant cost risk for operators

Cost impact for company "X" running with MGO & HFO



ETS price on the rise (€ per ton of CO₂)

ETS price expected to increase as EU - Green Deal is implemented across the industry



The European benchmark price for carbon allowances on November 22, 2021, climbed above 71 euros (USD79.79) per tonne for the first time since the European Union's carbon market launched in 2005



Market Analysis

The Future for Batteries & Fuel Cells

Currently – 591 ships confirmed with battery installations



Showing delivery year of existing orders only. Future contracts will increase the number of battery installations in 2022 and onwards.

Number of ships with batteries by ship type



A combination of solutions for global shipping

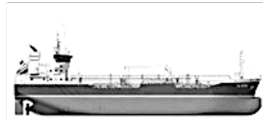
Regulatory frameworks drives change



At harbour
shore charging



Shorter range
Zero-emission
port calls



ICE, hybrids, batteries and fuel-cells



Shorter range
Zero-emission
port calls



At harbour
shore charging

Example journey

USBOY

North
Atlantic
Ocean

EGSUZ

JPYOK

SGSIN

- Tougher restrictions for port calls and at quay
- Electrification progress from inland waterways and out
- Deep sea shipping to utilize ICE-hybridization, batteries and FC

Developing segments – Battery Systems & FC



FISHING



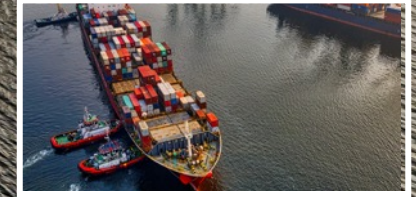
FERRY - CRUISE ROPAX



WORKBOATS - TUGS



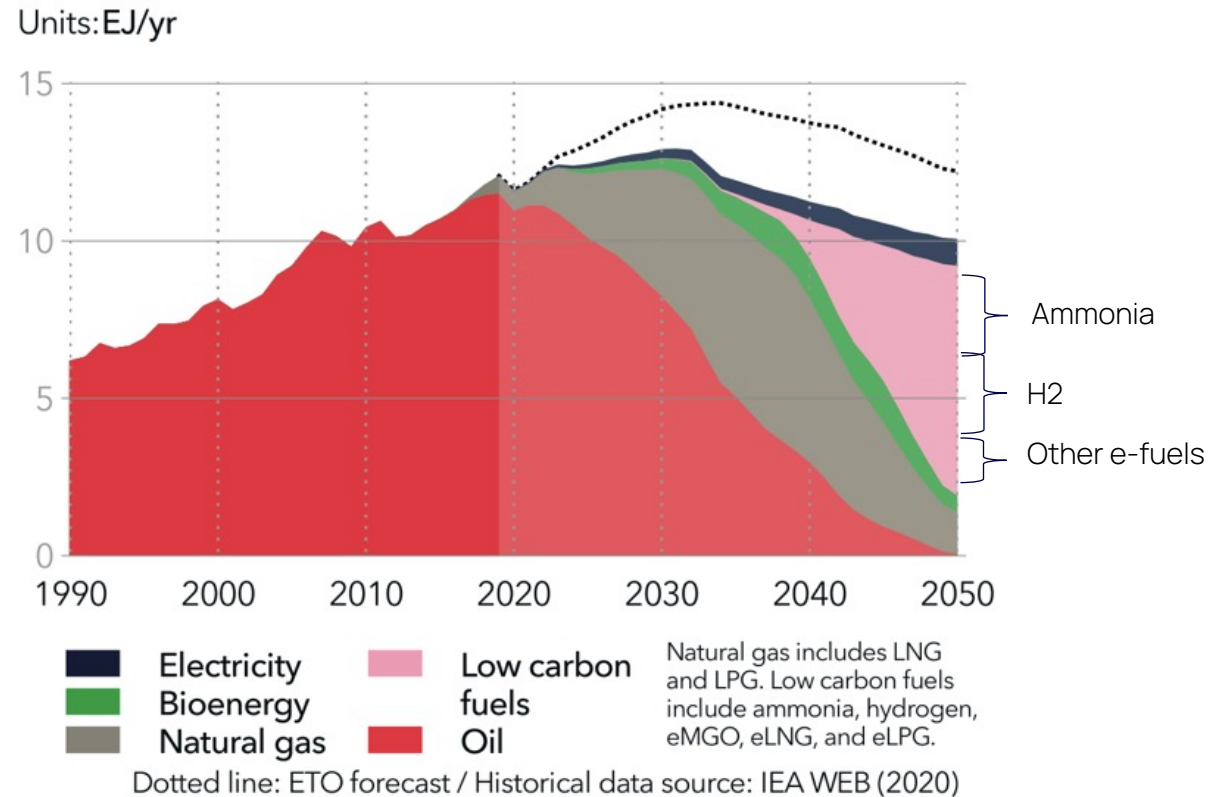
NAVAL - DEFENCE



COMMERCIAL DEEP SEA

Market development 2020 – 2050

Energy demand by carrier



- LNG + battery hybrids will dominate in the mid term perspective
- Low carbon fuels including ammonia and H2 will dominate long term

Electric propulsion and onboard power

Different ways to use batteries on a vessel

Batteries can perform multiple roles onboard vessels

Spinning reserve

- Backup for running generators
- Fewer generators needed online

Peak shaving

- Act as buffer
- Level power seen by engines

Optimize load

- Optimize operating point of gen'
- Reduce maintenance

Immediate power/stiffening of grid

- Instant power in support of generators and fuel cells

Harvest energy

- Recover energy from cranes, equipment
- Accommodate energy from renewables

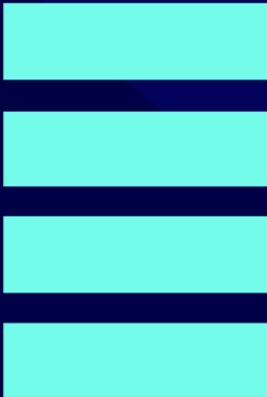
Backup power (UPS)

- Battery system provides backup power, UPS-like functionality

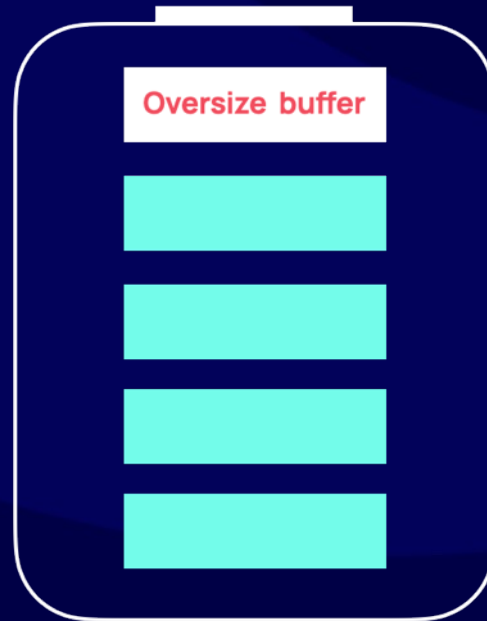
Use smaller systems and more of installed capacity

Lighter, longer life, greater use of installed capacity

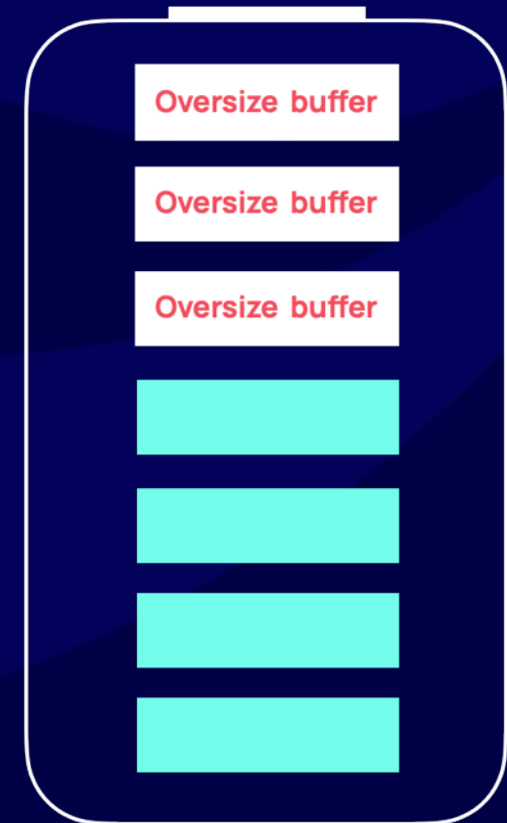
Required energy



Echandia LTO



Alternative

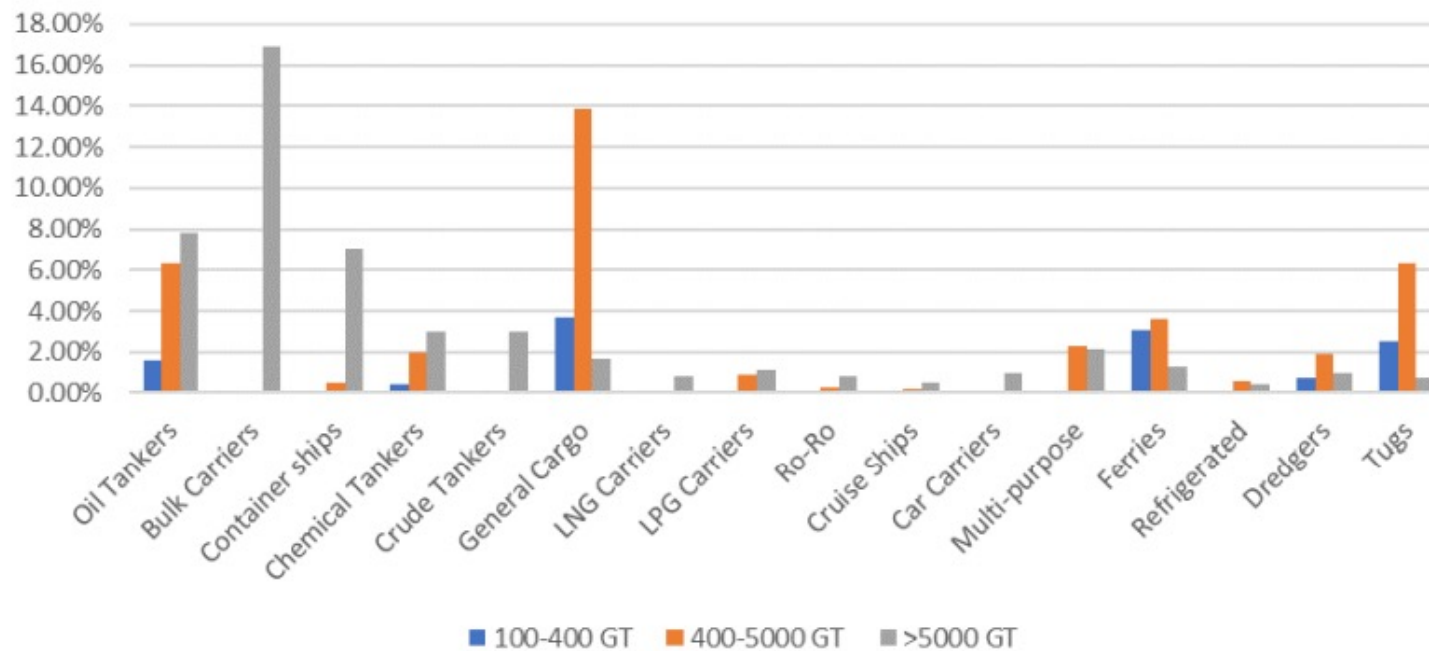


What about fuel cells?

Under what circumstances will fuel cells take off?

Fit for 55 – EU regulatory impact on fuel cell fleet

Share of total fleet by ship type and size



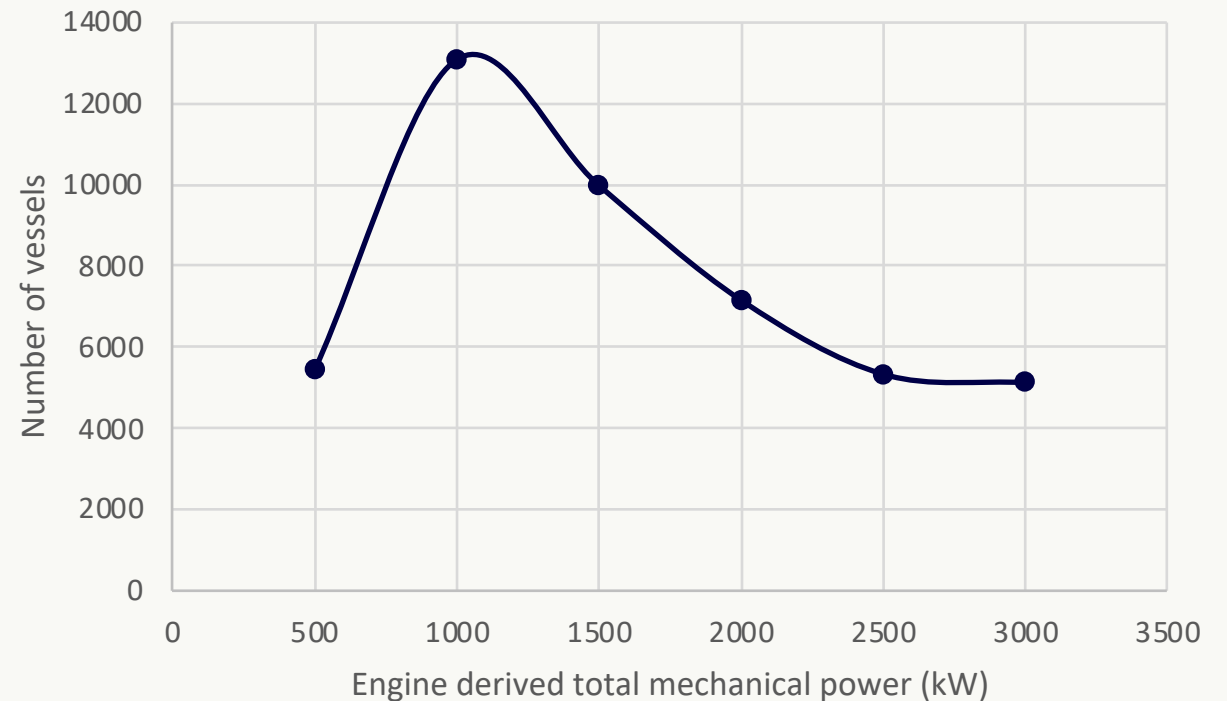
The initiative is expected to boost the penetration of fuel cell-powered vessels (18.9%) in the fleet as well as electric propulsion (5.4%) by 2050 (compared to no penetration of these technologies in the baseline).

Vessels suitable for electrification with fuel cells

46 000 vessels operating today suitable for electrification with FC

Relevant vessel types:

- Inland waterway dry cargo
- Cruise/passenger
- Offshore service vessels
- Tankers
- The market could evolve from smaller vessels based on compressed H₂ as energy carrier, possible LH₂ – no impact on fuel cell type development.
- Larger vessels will require direct ammonia fuel cells or efficient e-Fuel onboard reformers.



Source: Clarksons Register. Global vessel count with main engine < 3 MW

Conclusion

1. Regulations will have great impact
2. Still early days – electrification is coming
3. All vessels will have battery systems onboard