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TAL TECH
ESTONIAN MARITIME ACADEMY

UPCOMING EU REGULATIONS ABOUT EMISSIONS OF SHIPPING

Tenured Associate Professor Ulla Tapaninen
Estonian Maritime Academy
Tallinn University of Technology

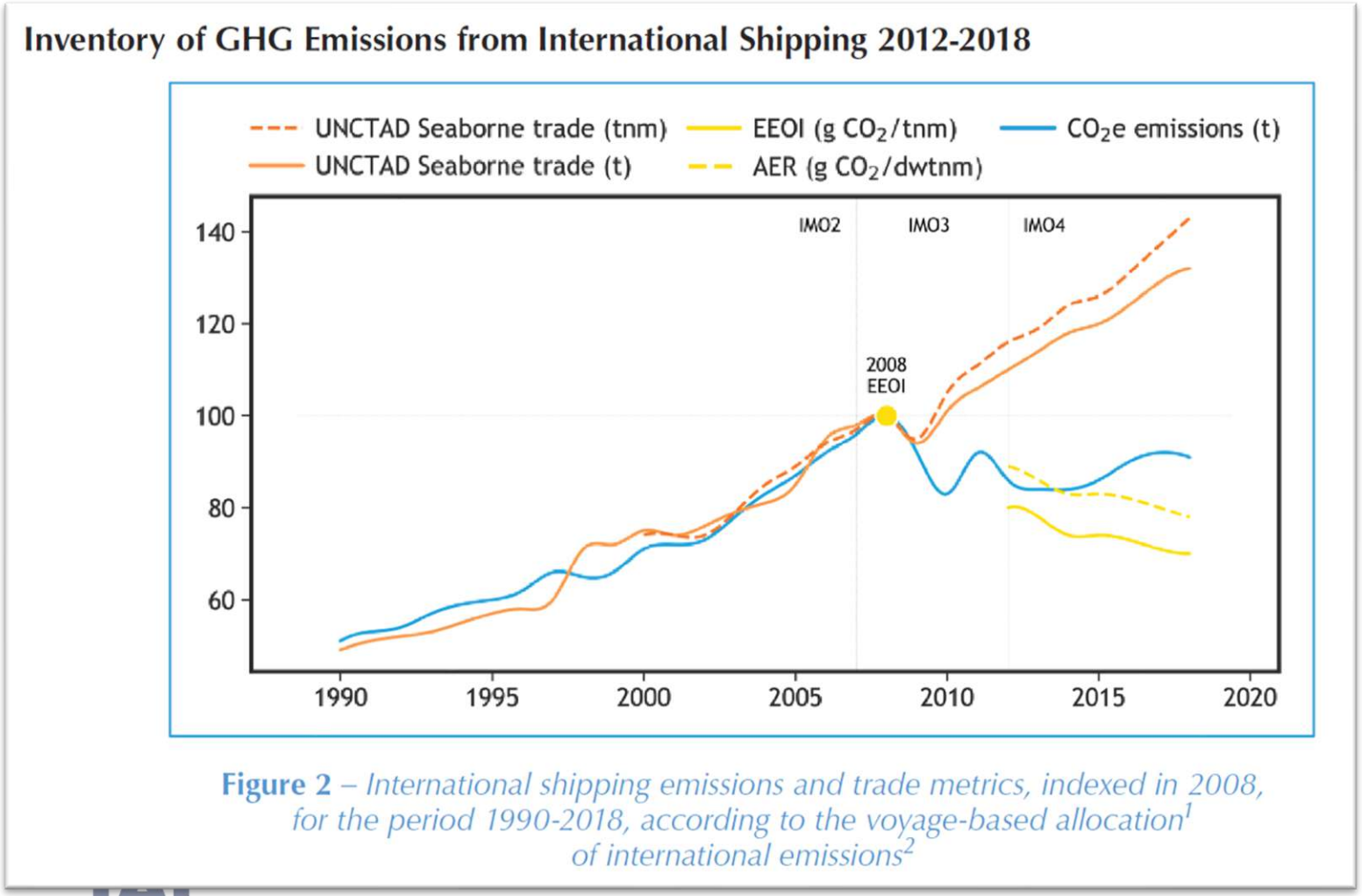
8.3.2024

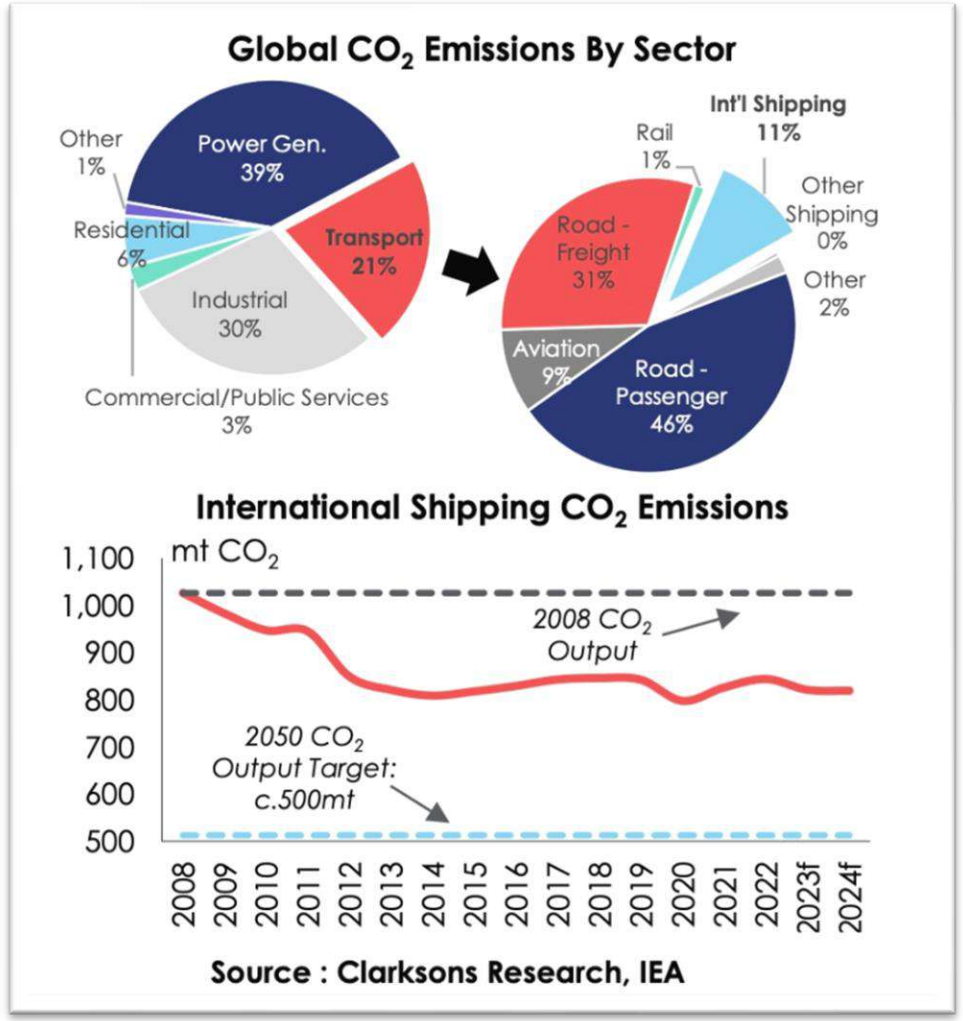
WE HAVE A MISSION!

"In the next 20 years the maritime industry must rebuild its cargo fleet. If this is done with the radical technologies now available, it will lead to the biggest change in ship design since steam replaced sail in the 19th century."

TAL TECH

SHIPPING EMISSIONS





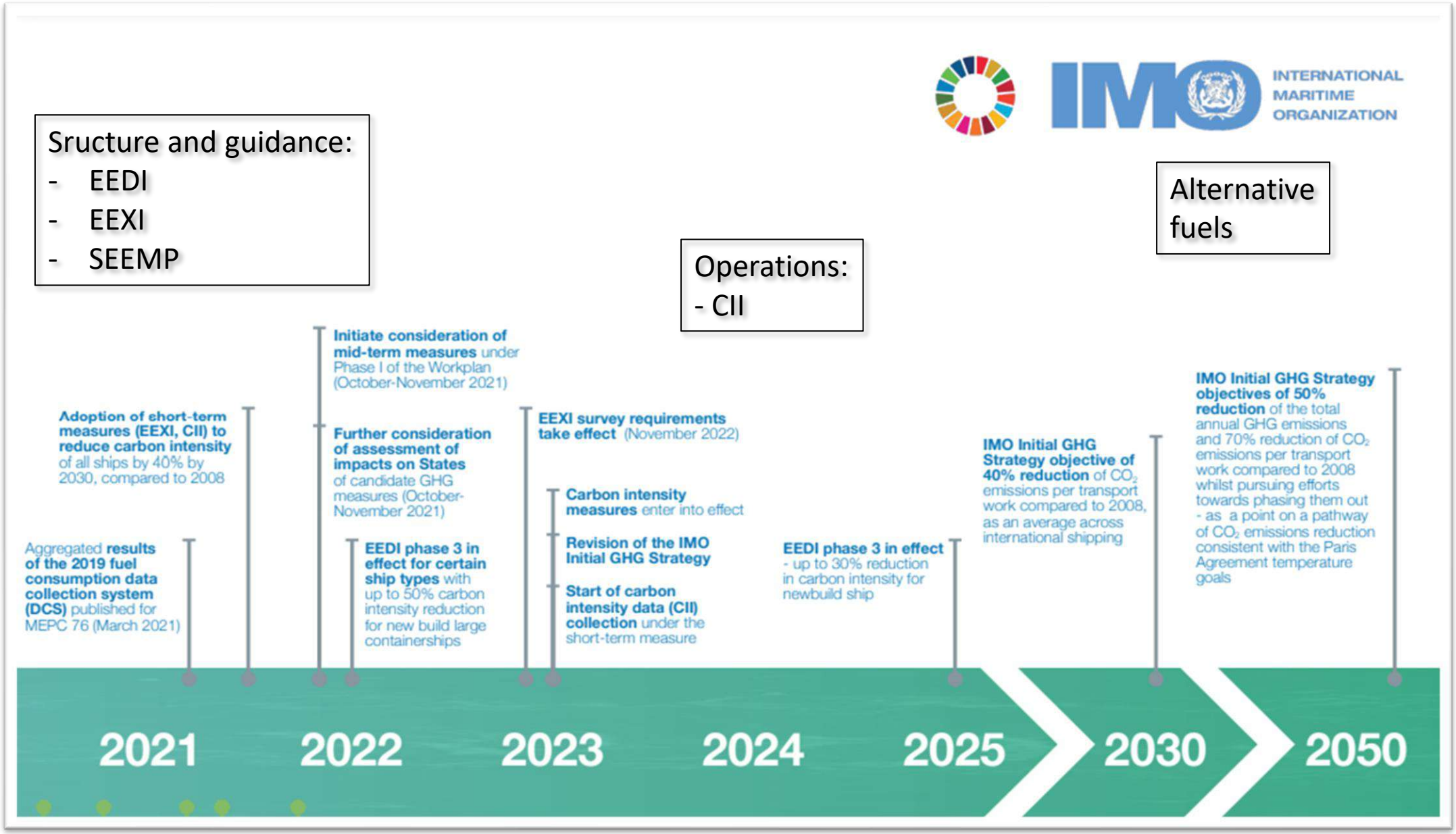
Source: Fourth IMO GHG Study 2020 and Splash 24/7 29/6-23

IMO REGULATIONS

Sructure and guidance:
- EEDI
- EEXI
- SEEMP

Operations:
- CII

Alternative fuels



TAL TECH

Press release | 14 July 2021 | Brussels

European Green Deal: Commission proposes transformation of EU economy and society to meet climate ambitions

Page contents

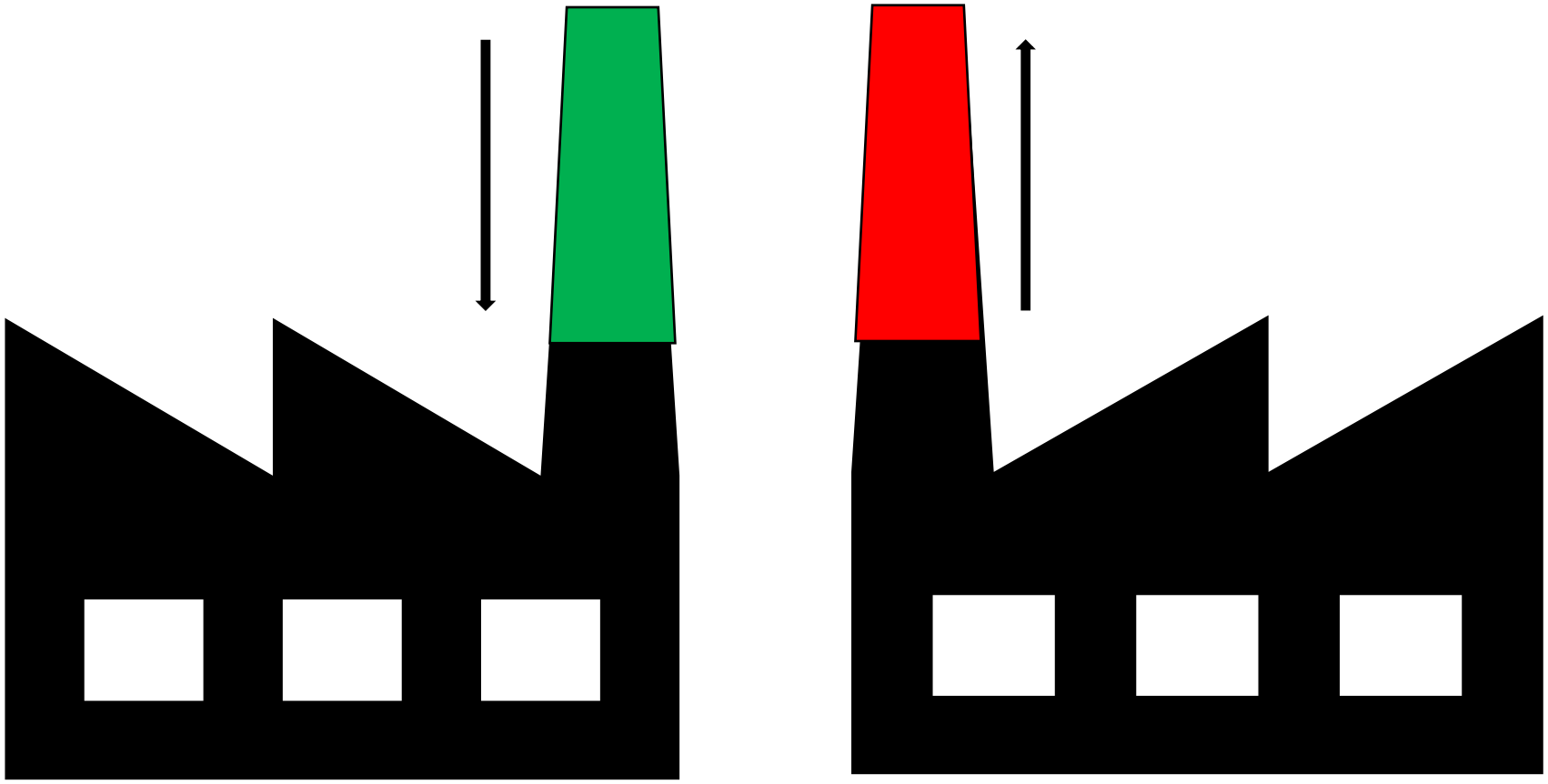
Today, the European Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation **policies fit for reducing net greenhouse gas emissions by at least 55% by 2030**, compared to 1990 levels. Achieving these emission reductions in the next decade is crucial to Europe becoming the world's first climate-neutral continent by 2050 and making the European Green Deal a reality. With today's proposals, the Commission is presenting the legislative tools to **deliver on the targets agreed in the European Climate Law** and fundamentally transform our economy and society for a fair, green and prosperous future.

EU: FIT FOR 55

1. FuelEU Maritime,
   carbon intensity of fuels
2. EU ETS, Emission trading system
3. ETCD - Energy Taxation Directive
4. (AFIR)- Shore-side electricity

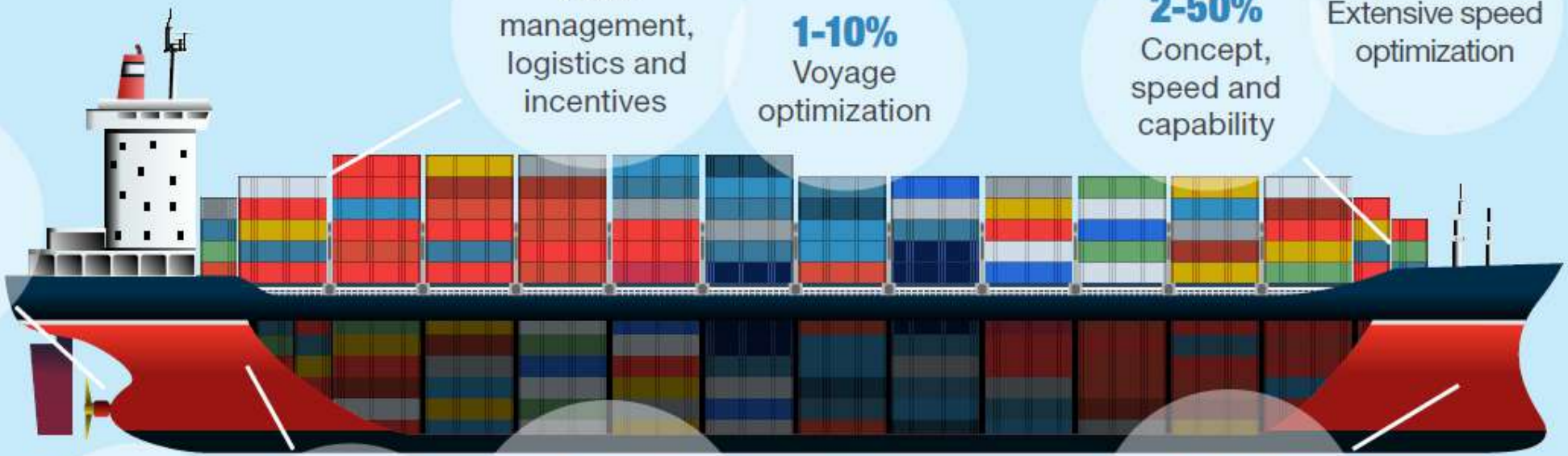
TAL TECH

SHIPPING AND THE EU ETS
„EU EMISSION ALLOWANCES“



A wide variety of design, operational and economic solutions

Achieving the goals of the Initial IMO GHG Strategy will require a mix of technical, operational and innovative solutions applicable to ships. Some of them, along with indication on their approximate GHG reduction potential, are highlighted below.



5-50% Fleet management, logistics and incentives

1-10% Voyage optimization

2-50% Concept, speed and capability

up to **75%** Extensive speed optimization

5-15% Power and propulsion systems

50-90% Full electric

35% Bio-LNG/LPG

90% Biofuel 3rd generation

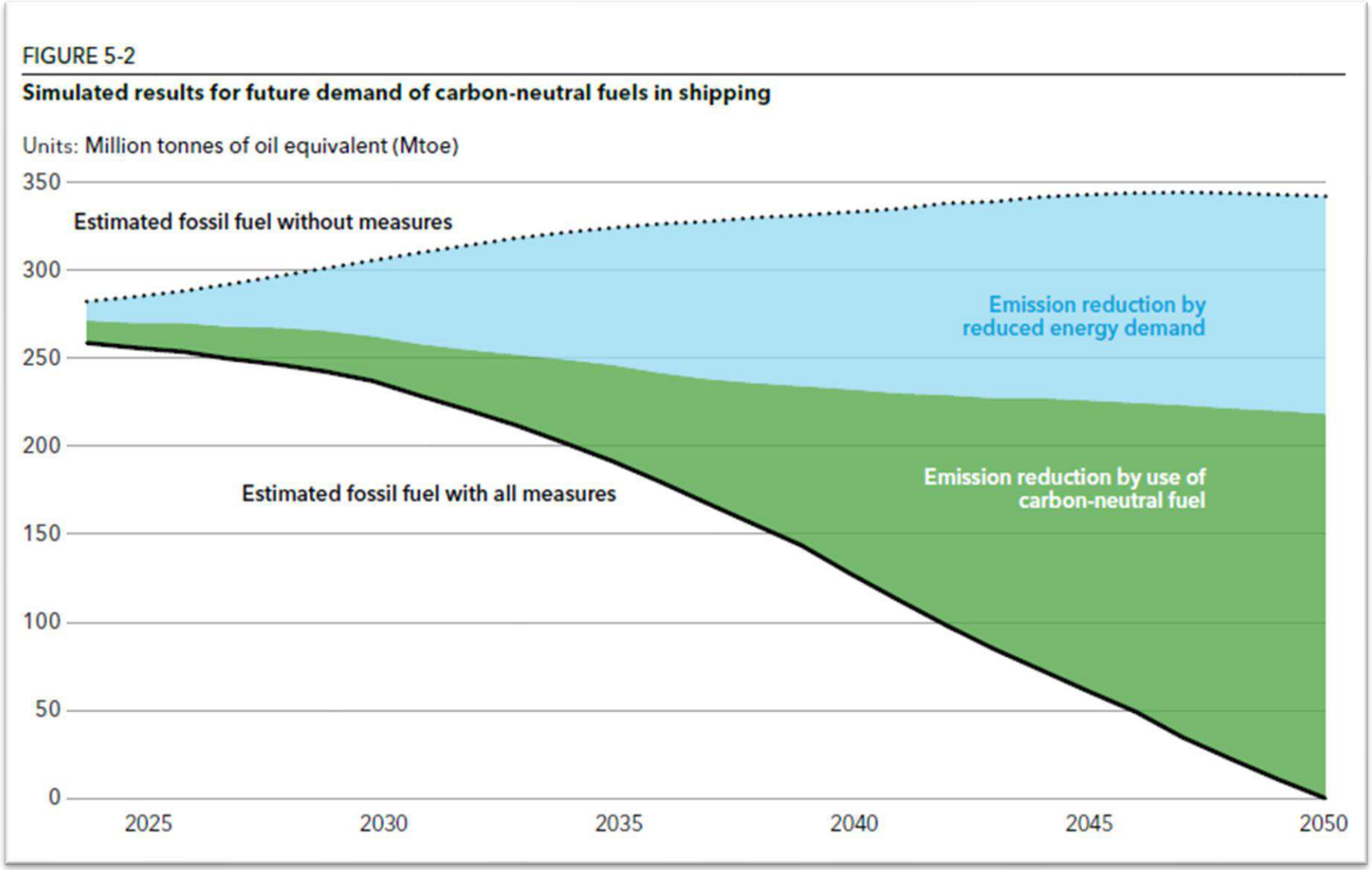
80-100% Hydrogen and other synthetic fuels

1-10% Energy management

2-20% Hull and superstructure

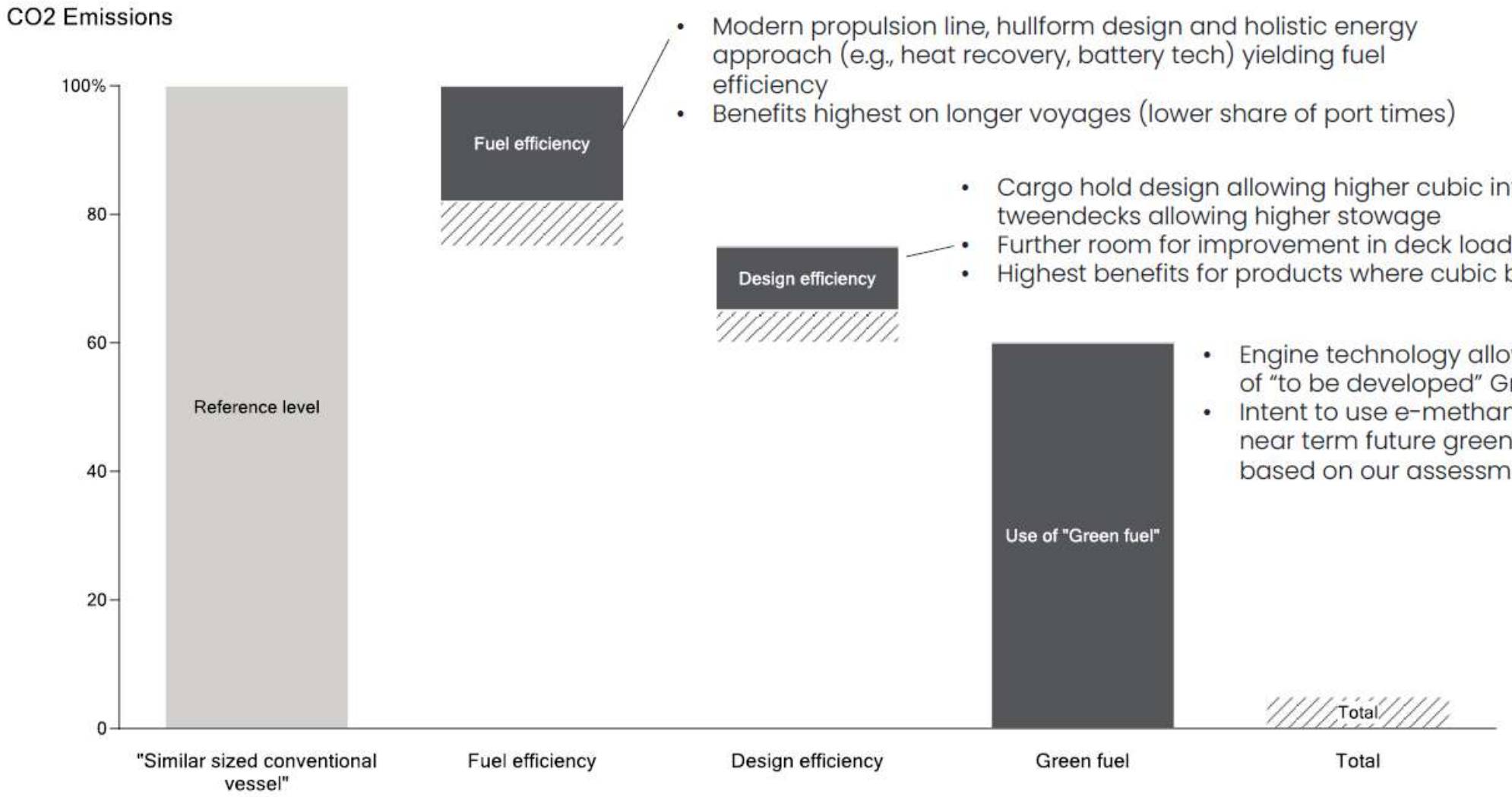
@IMO

THE FUTURE?



Source: DVN: Energy Transition Outlook 2023

ESL Green Shipping concept brings GHG efficiency in variety of ways – illustrative example



- Modern propulsion line, hullform design and holistic energy approach (e.g., heat recovery, battery tech) yielding fuel efficiency
- Benefits highest on longer voyages (lower share of port times)

- Cargo hold design allowing higher cubic intake, tweendecks allowing higher stowage
- Further room for improvement in deck loading
- Highest benefits for products where cubic bottleneck

- Engine technology allowing use of "to be developed" Green fuels
- Intent to use e-methanol (best near term future green fuel based on our assessment)

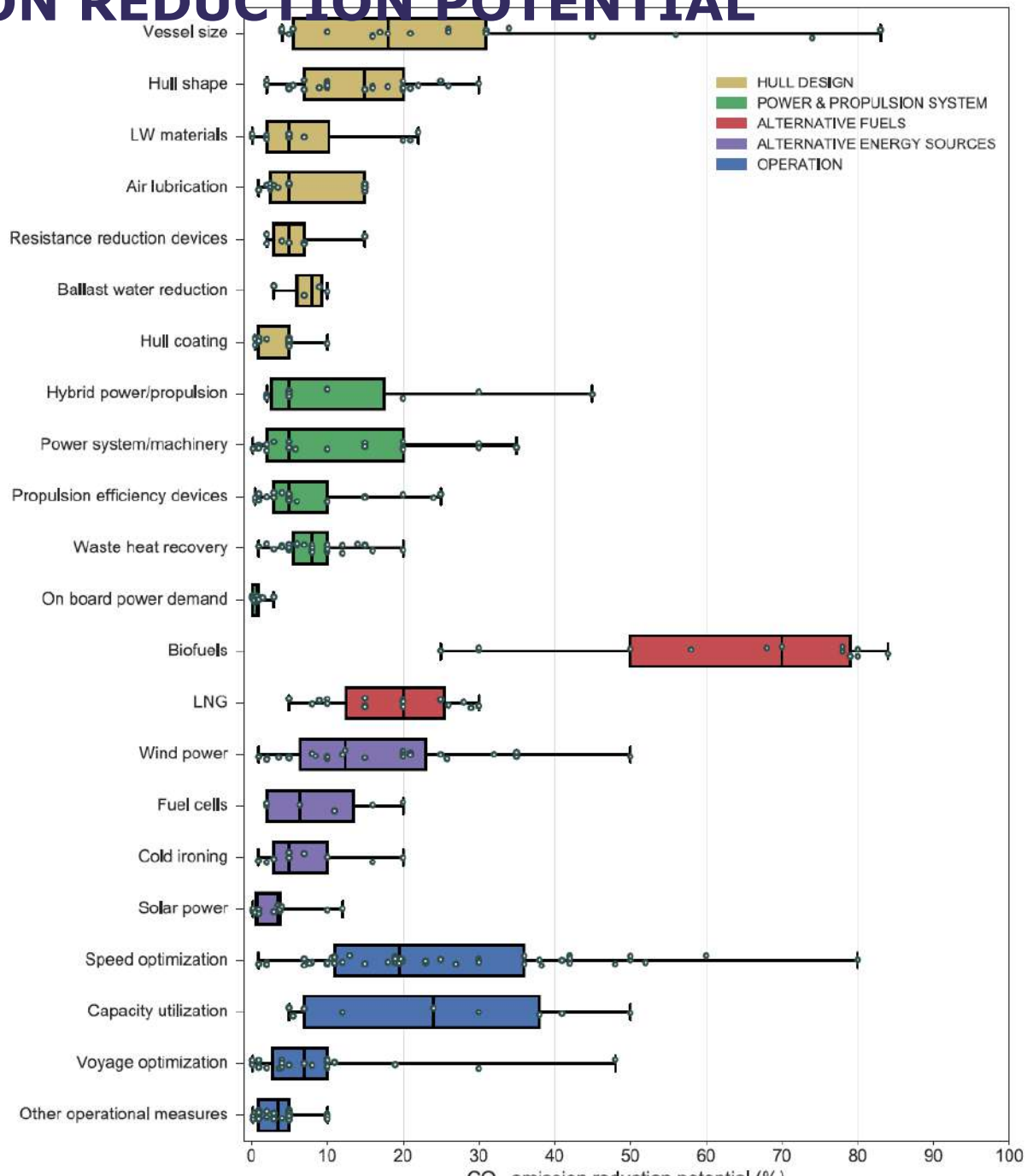
SIX STEPS TO PROMOTE SUSTAINABLE MOBILITY OF GOODS AND PEOPLE

1. Improve the energy efficiency in newbuildings.
2. Pilot various technical solutions to increase energy efficiency, e.g. rotor sails; smart IT- solutions to manage data for maintenance, bunker optimization and safety; air lubrication systems; use of batteries in ports and fairways; information for port arrivals, etc.
3. Reduce speed and improve port operations.
4. Be prepared for the new low or zero carbon fuels.
5. Shippers: evaluate alternative transport modes and operations.
6. Regulators: introduce rules and support mechanisms and carbon taxes to help shipping industry to move towards carbon-neutrality

TAL TECH

Source: Tapaninen U. 2021 ”Six steps to reach carbon-free shipping” in K. Liuhto (ed.) Baltic Rim Economies, Centrum Balticum Foundation, 5/2021. https://sites.utu.fi/bre/six-steps-to-reach-carbon-free-shipping/

CO2 EMISSION REDUCTION POTENTIAL



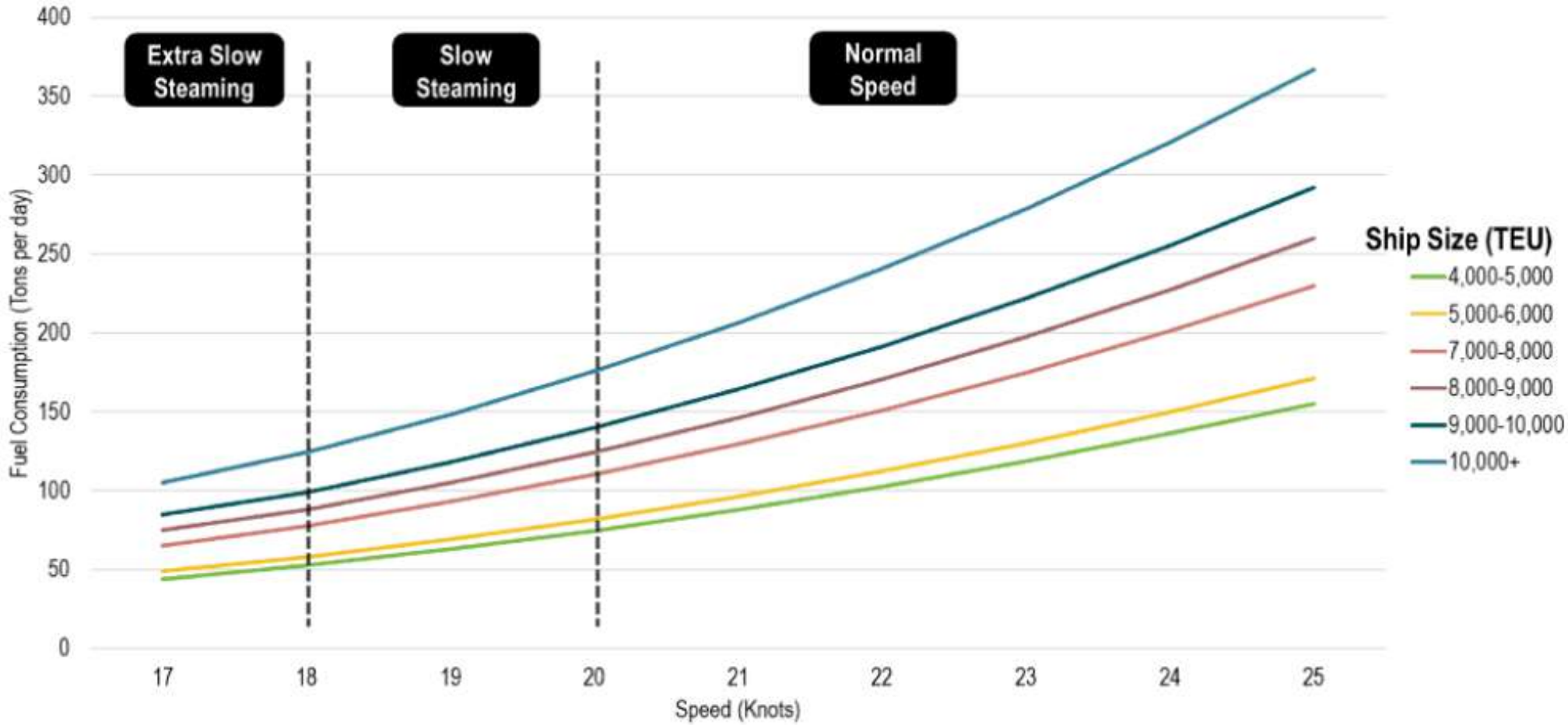
Source: Bouman, E. A., Lindstad, E., Rialland, A. I. and Strømman, A. H. (2017). State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review. *Transportation Research Part D: Transport and Environment.* 52. pp. 408-421.

Table 1: Emissions reported in MRV for different shipping segments

Ship type	Emissions	Emission per distance	Emissions per transport work
	Mtonnes CO_2	kg CO_2/NM	g CO_2 / tonne-NM
Bulk	18.1	290	8.48
Container	44.4	570	20.13
General cargo	6.13	185	28.02
Oil Tanker	18.1	435	8.82
Ro-ro	6.06	338	91.03

Source: Mellin *et al.* 2020

Fuel Consumption by Containership Size and Speed



Fuel Consumption by Containership Size and Speed

The Geography of Transport Systems
Jean-Paul Rodrigue (2020)

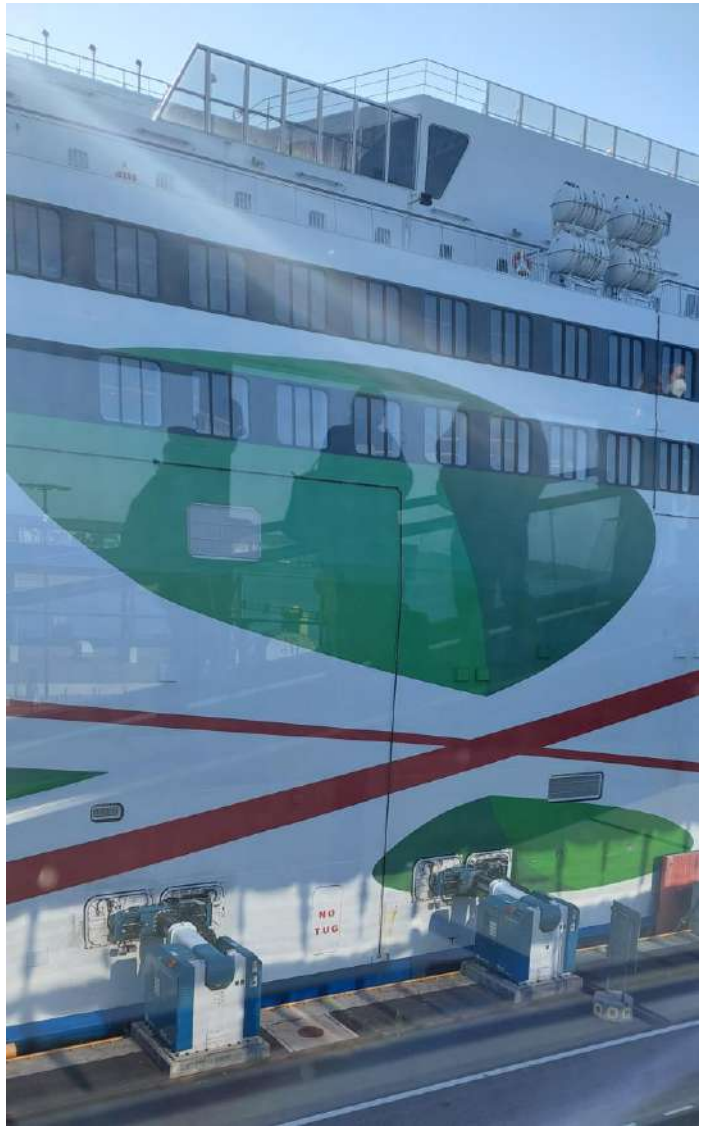
AUTOMOORING SYSTEM IN HELSINKI AND TALLINN

Tallinn's Old City Harbour to introduce automated mooring system

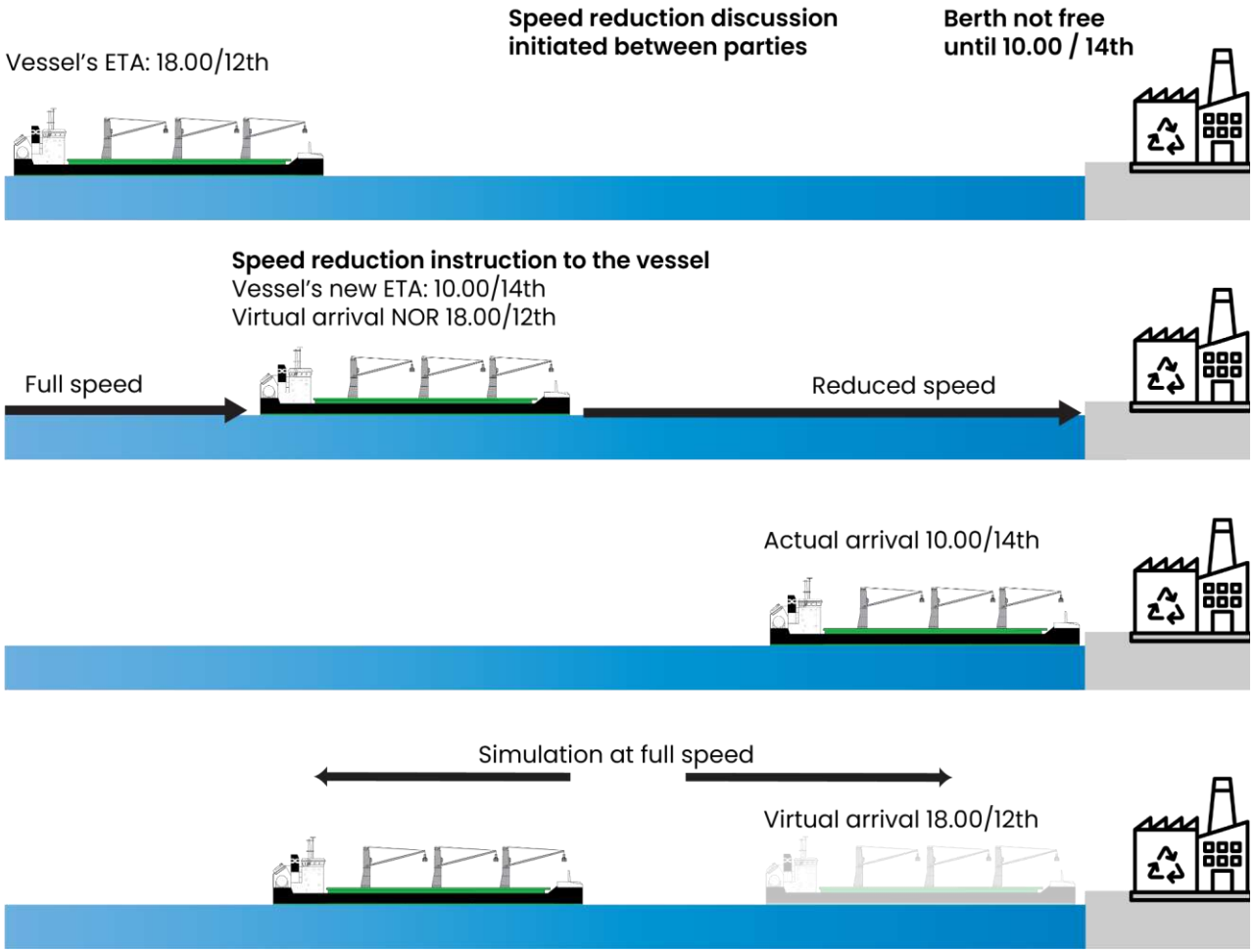
Port of Tallinn has signed contracts with maritime engineering companies Trelleborg and Cavotec for the instalment of automated mooring systems at quays 5, 12 and 13 of the Old City Harbour, which is used by passenger vessels serving the Tallinn-Helsinki route.

According to Peeter Nõgu, head of the infrastructure development division of Port of Tallinn, technological development has greatly contributed to the maritime sector, including the mooring processes of ships. "The new automated mooring equipment installed in the Old City Harbour will fasten our mooring operations while also requiring less man-hours and contributing to environmental sustainability. The new systems are primarily used by the ships sailing on our busiest route between Tallinn and Helsinki, where every extra minute saved either at sea or in port is highly valued."

The shipping industry uses either automated vacuum mooring or automated magnetic mooring systems. According to Peeter Nõgu, Port of Tallinn opted for a vacuum-pad based system, while the magnetic mooring systems are still at an early stage of development and usage. For this reason, the full impact of the electromagnetic waves on either a ship's electronics or the surrounding environment isn't yet fully known.



VIRTUAL ARRIVAL



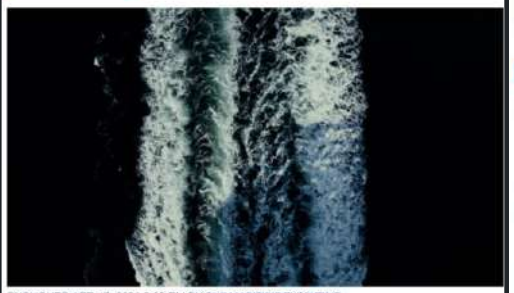
Benefits of Virtual arrival

- reduced energy consumption
- reduced emissions
- less congestion in the port and anchorage area
- more reliable scheduling and line-up of vessels in port
- more efficient resource planning for port operators
- savings are shared between owners and charterer

-24%

Average reduction of CO_2-emissions

Industry Leaders Collaborate to Develop Ammonia Shipping Fuel Guidance



PUBLISHED APR 17, 2021 3:05 PM BY THE MARITIME EXECUTIVE

This week, Lloyd's Register's Decarbonization Hub, A.P. Moller-Maersk, MAN Energy Solutions, Mitsubishi Heavy Industries, NYK Line, Total and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping are joining forces in a new project with the purpose of guiding safe use of ammonia as a fuel for shipping.

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marine insight

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World's First Liquid Hydrogen-Powere Ship Delivered

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Norsepower will fit Vale's VLOC charter with rotor sails

Splash 247.com

LET'S TACKLE DECARBONIZATION

SECTOR | REGION | MARITIME CEO | CONTRIBUTIONS | PUBLICATIONS | EVENTS | JOBS

Bill Gates joins nuclear-powered shipping push

Splash 247.com

MARITIME FORECA

Maersk orders up to twelve methanol-fuelled 16,000 teu ships at Hyundai Heavy

Copenhagen, 26 November 2020

Partnership aims to develop hydrogen ferry for Oslo-Copenhagen

DFDS and its partners have applied for EU support for development of a ferry powered by electricity from a hydrogen fuel cell which only emits water.

VESSEL PERFORMANCE OPTIMISATION

New concept design for ammonia-fuel ready LNG-fuelled ship

SHIP DESIGN | SEPTEMBER 9, 2021

Check out the Netherlands' first electric – and it's got swappable batteries

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FIRST H2 INLAND WATERWAY VESSEL

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07 Jun 2021

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LET'S TACKLE DECARBONIZAT

Norwegian duo set out to build ammonia bunkering terminals

Splash 247.com

LET'S TACKLE DECARBONIZATION

SECTOR | REGION | MARITIME CEO | CONTRIBUTIONS | PUBLICATIONS | EVENTS | JOBS

World's first hydrogen cargo vessel set for Paris debut

The European innovation project Flagships will deploy the world's first commercial cargo tramp operating on hydrogen later this year, plying the river Seine in Paris, gliding passed the Eiffel To

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STENA ELEKTRA © Stena Line

Stena´s pathway to decarbonise its shipping operations

The scale of shipping's challenge to transition from fossil-based fuels to renewables must not be underestimated. We are a global industry, and ships must be able to serve all ports. There is still no easy answer on which technology to use and vessels built today could operate for up

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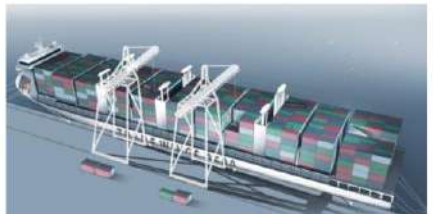
Wind-assisted, LNG-electric containership Trade Wings 2,500 wins BV's AiP

BUSINESS DEVELOPMENTS & PROJECTS

May 17, 2021, by Fatima Bahrol

The 2,500 TEU vessel, which has been designed jointly by VPLP Design, Alwena Shipping, SDARI and AYRO, received an Approval in Principle (AiP) from the classification society Bureau Veritas.

With an overall length of 197 meters and a breadth of 32 meters, Trade Wings 2,500 features six Oceanwings wingsa is installed on a vertical sliding mechanism so that they can be retracted partially while the vessel is in port, thus minimising the impact on cargo operations.



Cruise&Ferry

THE GLOBAL GUIDE TO PASSENGER SHIPPING

INTRODUCING THE NEXT CLEANSEWAGE MEMBRA

Ulstein develops new concept for zero-emission vessel

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Ulstein Thor and Sif will be able to generate clean electricity using a Thorium Molten Salt Reactor

By Alice Chambers
28 April 2022

Ulstein has created a new zero-emission concept vessel, called Ulstein Thor, which will feature a Thorium Molten Salt Reactor (MSR) to generate clean electricity that can be used to power cruise ships.

World's First Zero-Emission Wind and Hydrogen Power Cargo Ship

Concept design for the zero-emission boler (Egil Ulvan Reder)

PUBLISHED MAR 26, 2021 7:44 PM BY THE MARITIME EXECUTIVE

A Norwegian partnership is moving forward with the development of what they are calling the world's first zero-emission cargo ship. After a six-month competition, with more than 31 ship owners bidding on the project, the contract for the construction has been awarded. The team expected to complete the design this year so that the vessel can enter service by 2024.

NEWS ARTICLE | 29 February 2024 | Directorate-General for Mobility and Transport

Commission makes €1bn available for recharging and refuelling points under the Connecting Europe Facility (CEF)

The European Commission is today launching a call for proposals under the Connecting Europe Facility – Alternative Fuels Infrastructure Facility (AFIF). €1 billion is available to support the deployment of alternative fuels supply infrastructure for road, maritime, inland waterway and air transport along TEN-T, the trans-European transport network:

- **Road network**: support for high-power electricity recharging stations and hydrogen refuelling stations, and for megawatt recharging stations for Heavy Duty Vehicles
- **Airports**: support for electricity and hydrogen supply
- **Ports**: support for electricity and hydrogen supply, and for the first time for ammonia and methanol bunkering facilities.

ANALYSIS OF 2 FERRIES WITH DIFFERENT ENERGY SYSTEM

Figure 1. Ferry line route map

sustainability

MDPI

Article

Decarbonizing City Water Traffic: Case of Comparing Electric and Diesel Powered Ferries

Riina Otsason [1,*] and Ulla Tapaninen [2]

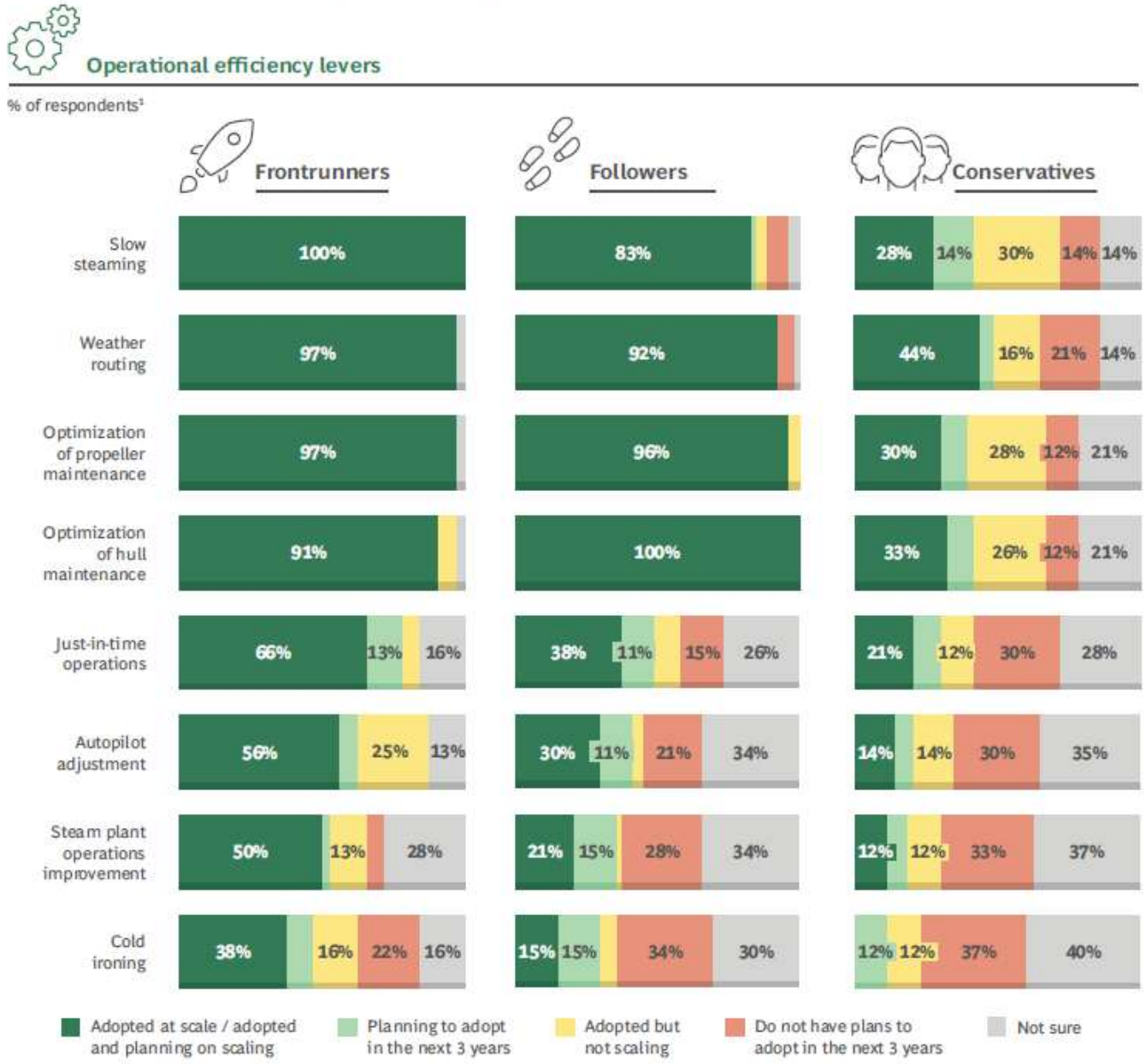
[1] Ph.D. student-junior researcher, Estonian Maritime Academy, Tallinn University of Technology, Kopli 101, 11712 Tallinn, Estonia; E-mail: riina.otsason@taltech.ee
[2] Tenured Associate Professor, Estonian Maritime Academy, Tallinn University of Technology, Kopli 101, 11712 Tallinn, Estonia; E-mail: ulla.tapaninen@taltech.ee
* Correspondence: riina.otsason@taltech.ee

Abstract: The maritime sector is aiming to achieve carbon neutrality by 2050. Shipping companies are therefore investigating efficient and optimal ways to minimize their greenhouse gas emissions. One of the measures is using vessels that operate on alternative non-carbon fuels. This study compares greenhouse gas (GHG) emissions of a diesel fuelled catamaran and its fully electric sister vessel that operate on the same line. The study shows that the GHG emissions of the electric vessel are only 25% of its diesel-powered sister vessel. However, this figure is highly dependent on the source of electricity in the operating country. In this case, energy costs of the fully electric vessel were 31 % cheaper than costs of diesel energy. The payback time without possible subsidy for replacing diesel ferry with electric one for the case would be 17 years and 6 months. We also show that even in winter, when there is very low solar energy production, the additional energy from solar panels is sufficient to cover several options of applications or consumers. This study brings more insight to academic literature on decreasing maritime CO_2 emissions of city water traffic. As managerial implications, it can be used when shipping companies evaluate options to reduce their emissions. The results of the study show that using fully electric vessels have major benefits concerning the carbon emissions but also financial advantages.

Keywords: carbon neutrality, GHG emission reduction, full electric ferry, diesel ferry

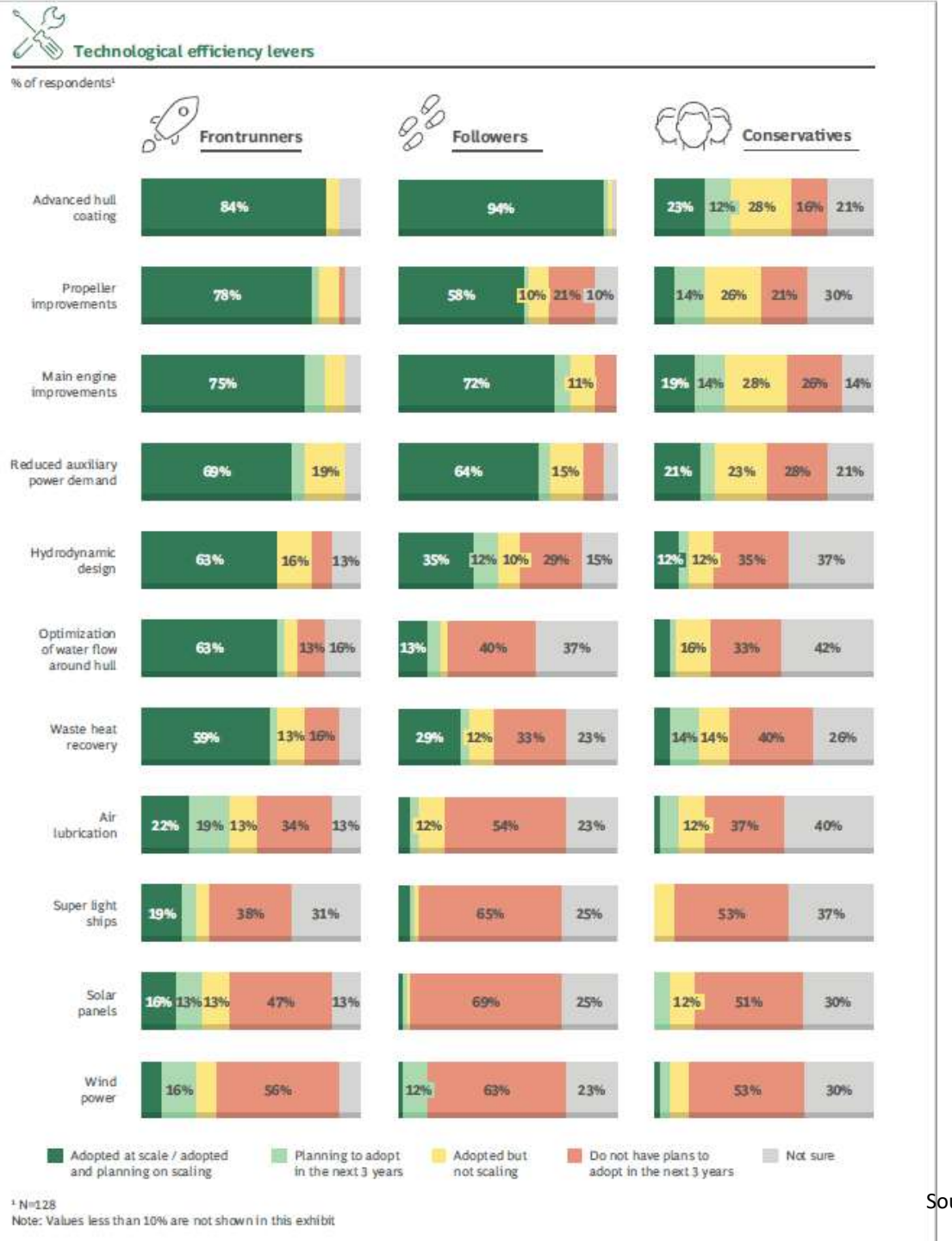
TAL TECH

Exhibit 7 - Frontrunners lead the industry in the adoption of efficiency levers, Conservatives yet to adopt established levers



[1] N=128

Source: BDG 2023: Voyaging Toward a Greener Maritime Future



Source: BDG 2023: Voyaging Toward a Greener Maritime Future

15 FINANCIAL INSTITUTIONS DISCLOSE THE CLIMATE ALIGNMENT OF THEIR SHIP FINANCE PORTFOLIOS

In a first-of-a-kind climate finance report, 15 Signatories of the Poseidon Principles disclose the climate alignment score of their ship finance portfolios. The Poseidon Principles Annual Disclosure Report 2020 shows that 3 banks' ship finance portfolios are aligned with UN decarbonization targets while 12 banks' portfolios are not. The climate assessment offers banks new insight into their lending decisions and provides opportunity to work with their shipping clients to meet society's goals.

International ship finance confirms its leadership role in global climate finance. Announced in June 2019, the Poseidon Principles became the first sector-specific climate alignment agreement for financial institutions. Today, Signatories deliver on their commitment and publish the Poseidon Principles Annual Disclosure Report 2020 – the first sector-specific climate alignment report of its kind.The Poseidon Principles establish a global framework to quantitatively assess and disclose whether financial institutions' lending portfolios are in line with climate goals set by UN maritime agency, the International Maritime Organization (IMO). The IMO's initial GHG strategy prescribes that international shipping must reduce its total annual greenhouse gas emissions by at least 50% of 2008 levels by 2050, whilst pursuing efforts towards phasing them out as soon as possible in this century.

"This report marks a significant milestone for global ship finance and for climate finance reporting as a whole. I commend my fellow Signatories for their pioneering efforts to be transparent and accountable for their role in promoting responsible environmental behavior. I encourage other serious banks and export credit agencies to join us in supporting global seaborne trade in a sustainable manner," says **Michael Parker, Chairman, Global Shipping, Logistics and Offshore, Citi, and Chair of the Poseidon Principles Association.**

Climate assessment will inform future decision-making

The Poseidon Principles Annual Disclosure Report 2020 includes climate alignment reporting from 15 financial institutions, most of which became Signatories in 2019, including **ABN Amro, Amsterdam Trade Bank, BNP Paribas, Bpifrance Assurance Export, CIC, Citi, Credit Agricole Corporate and Investment Bank, Danish Ship Finance, Danske Bank, DNB, Eksportkreditt Norge, ING, Nordea, Sparbanken Vest,** and **Societe Generale**. Financial institutions that joined the Poseidon Principles in 2020 are not required to report before 2021. The assessment by each Signatory includes emissions data collected from clients and the portfolio information from 2019, compared to a decarbonization trajectory for the same year. It shows that 3 financial institutions' ship finance portfolios are aligned with the IMO's initial GHG strategy while 12 banks' portfolios are not. More importantly, the report includes commentary from financial institutions on key takeaways from their climate assessment, and reflections on how it will inform their business activities and decision-making in the future.

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