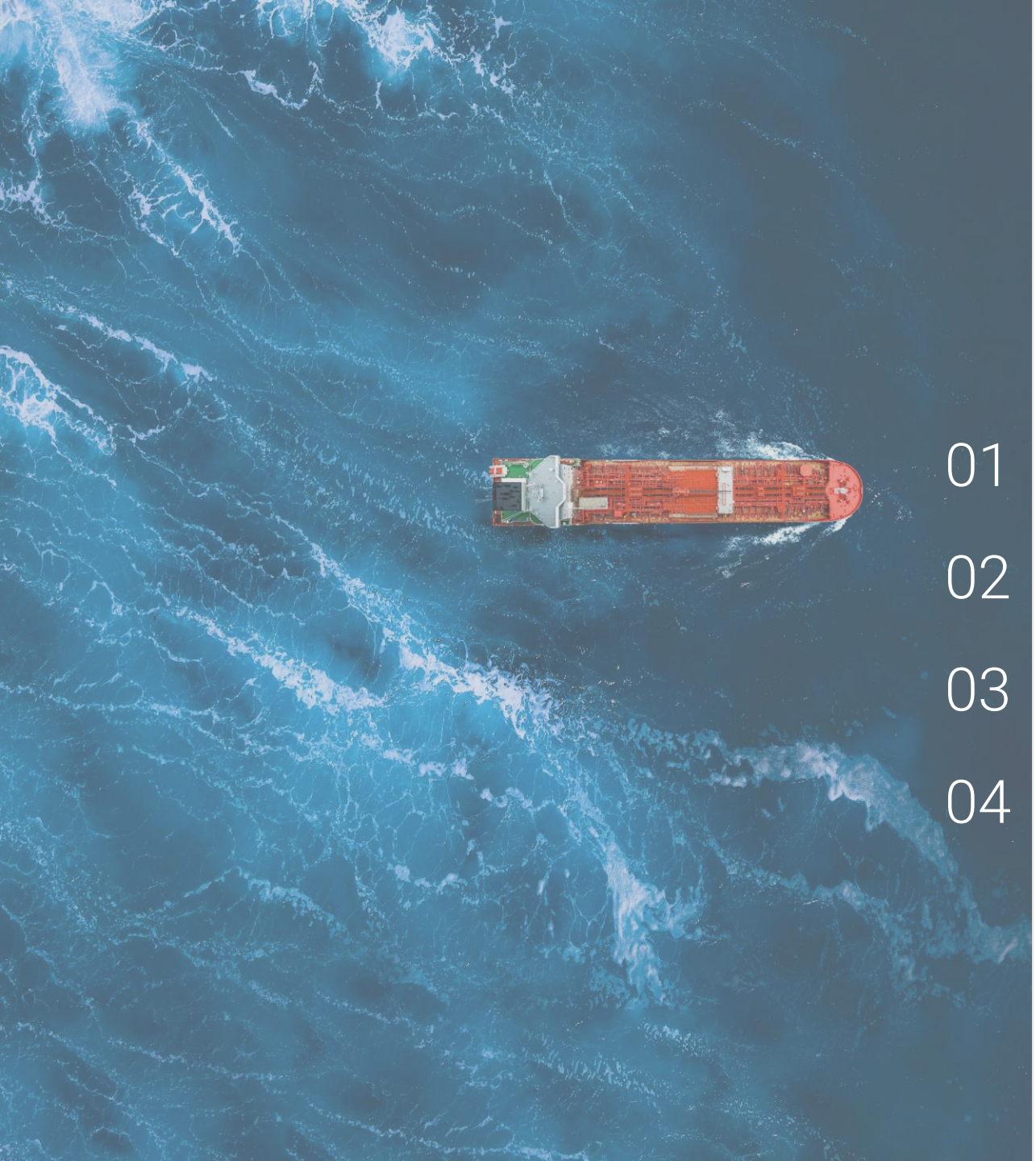
Decarbonization: The role of energy efficiency

How far can existing technologies and energy efficiency take us?

Erik Hjortland, Vice President – Technology, Odfjell SE

| The Shipping Conference - Leadership, 31.10.2023 |

ODFJELL



Agenda

01 Recap: Odfjell`s perspectives on green fuels

02 Odfjell`s Energy efficiency tool-kit

03 Novel technologies in our pipeline

04 Summary & Conclusions

Recap: Fundamental challenges with Green Fuels

1

Renewable Electricity demand

Decarbonizing deep sea shipping through green fuels will require 54% of all renewable electricity in the world

2

GHG Reduction Potential

Production of fuel for aviation and shipping gives the least GHG reduction potential per kwh renewable electricity input

3

Energy Losses

80 % energy loss from renewable electricity production via green hydrogen and e-fuels to the propeller of the ship

4

Carbon Leakages

61% of the global electricity grid is non-renewable
Premature demand of green fuels will increase shipping`s emissions 2-8 times

5

Cost premium

Green fuels are around 10 times as expensive as conventional fuels

Our position so far

- Shipping does not have its own atmosphere – what we do at scale can have consequences outside of our own sector - we must stop silo-thinking: decarbonizing one sector might transfer the emissions to another sector, and increase the net global emissions until sufficient renewable electricity is available

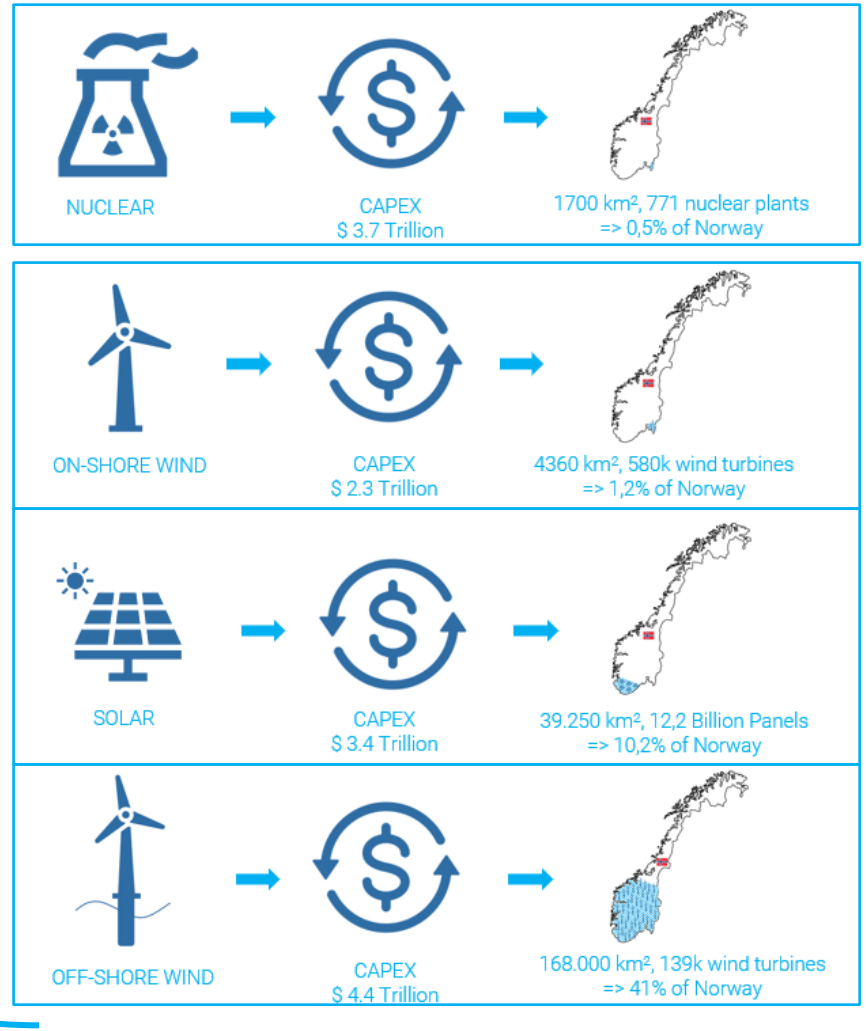
- We believe shipping`s best holistic contribution in the energy transition phase is not to change to green fuels (yet), but to further improve on energy efficiency until sufficient renewable electricity is available – then it will be our turn.

- We cannot energy efficiency ourselves to zero emission, but on the road to zero we can contribute significantly through efficient operation and available technology while renewable energy infrastructure ramps up, bend the emission curve NOW - and buy time

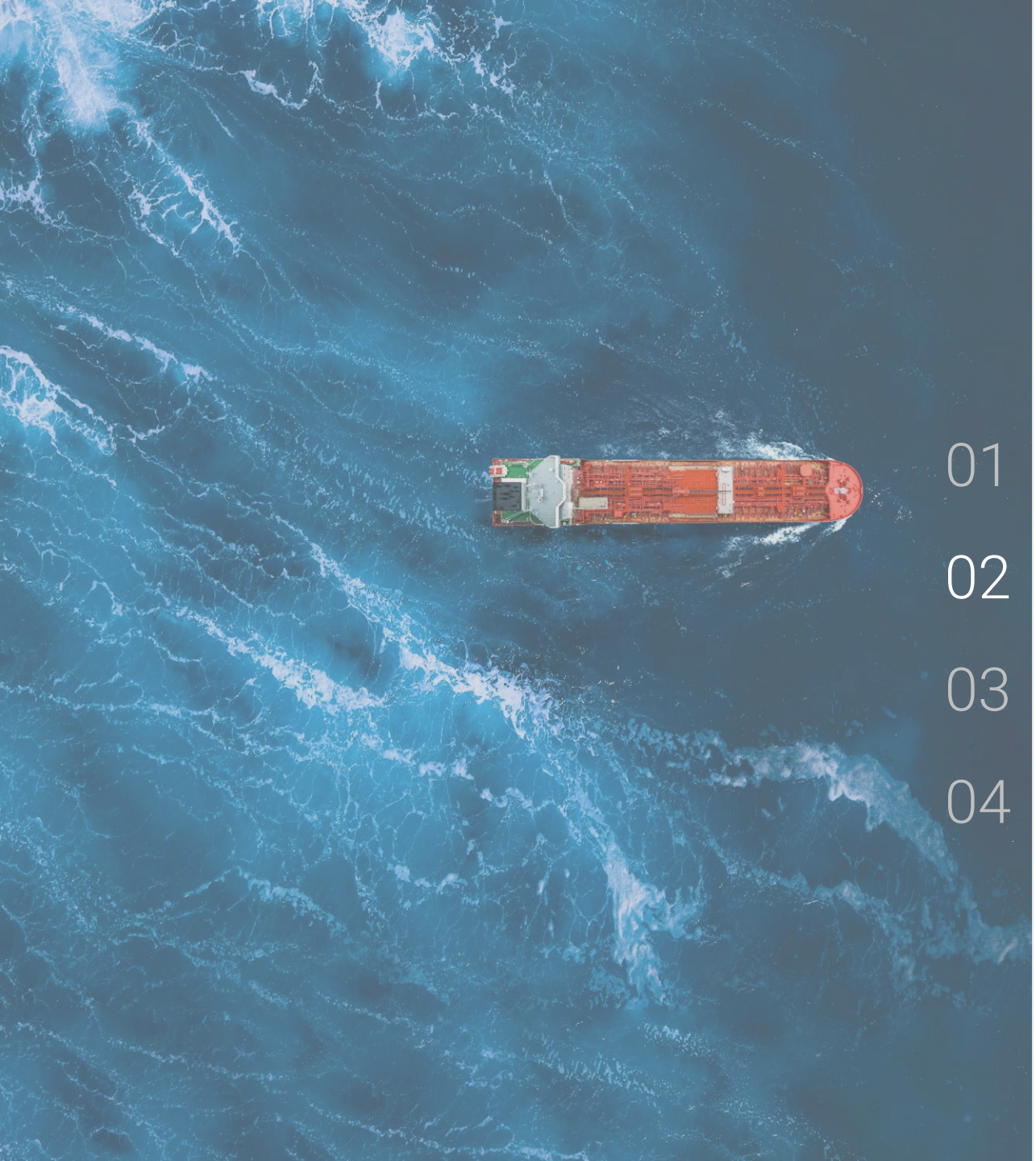
...because: we do need time

Infrastructure required to deliver the renewable electricity demand from deep sea only

- 2.200 carbon-neutral fuel projects announced globally
- Investment decision made on less than 5%



Source: Odfjell SM TechSec, irena.org and miljodirektoratet.no (Onshore wind); BOW/UIB (Offshore wind); ArcelorMittal (Solar); energy.gov (Nuclear)



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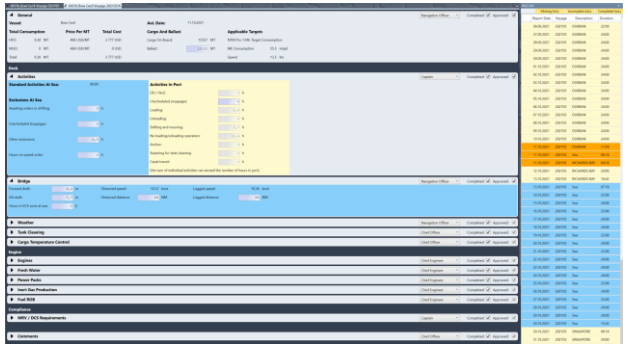
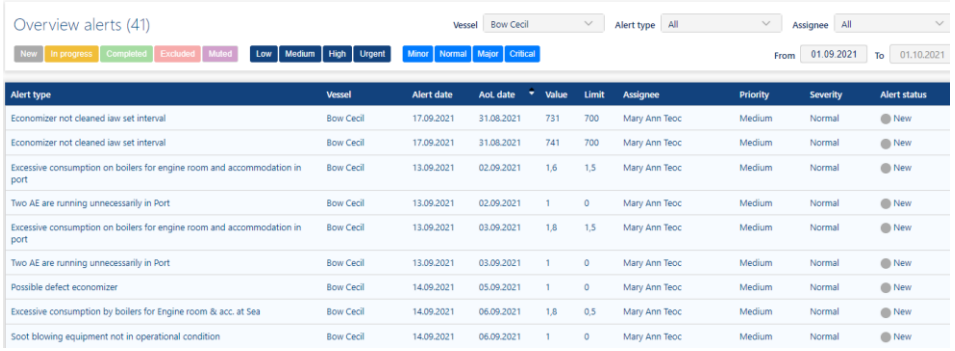
1 Operational Improvements

Odfjell has targeted energy efficiency and emission reductions since 2007, and has dedicated teams that drive the operational improvements

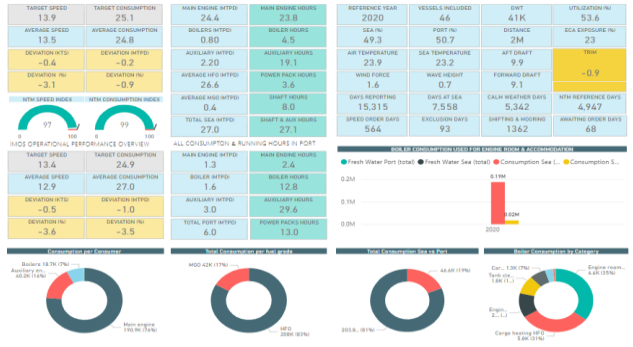
Collection of data from all vessels (2007/2014)



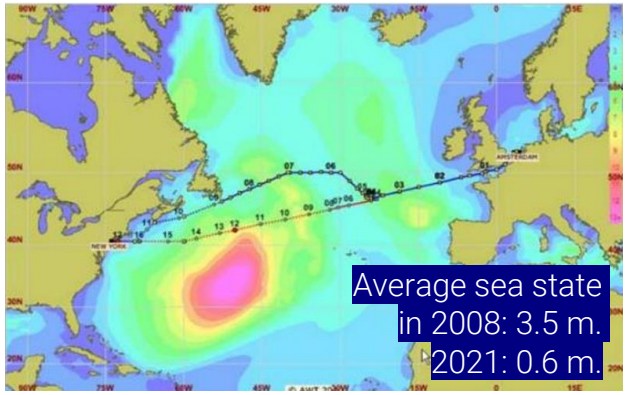
Automatic over-consumption/energy in-efficiency alarms system (2014)



Business Intelligence tools on all data (2015)



Advanced Weather routing (2009)



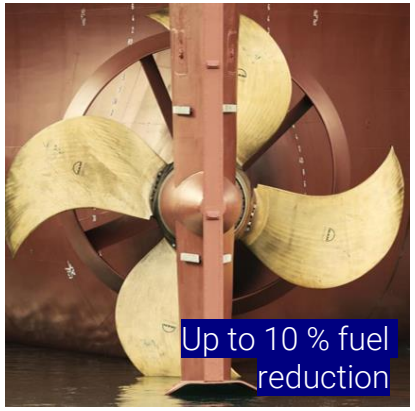
Speed optimization (2007)

Intermediate Hull/propeller polishing (2014)

2 Technical Improvements

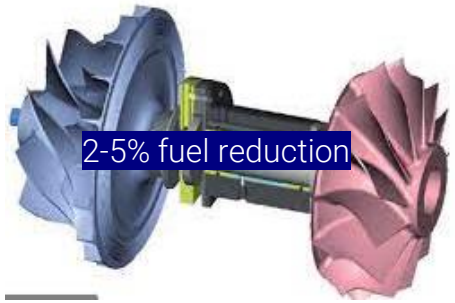
Odfjell has invested more than 30 million USD in retrofit of energy saving devices (ESD). We have done more than 130 ESD-installations since 2014, of which 18 last year and 18 this year. Ship-specific plans are developed for each ship to ensure CII and FEM compliance

Mewis Ducts
29 installations so far



PBCF (2020-)
13 installations so far

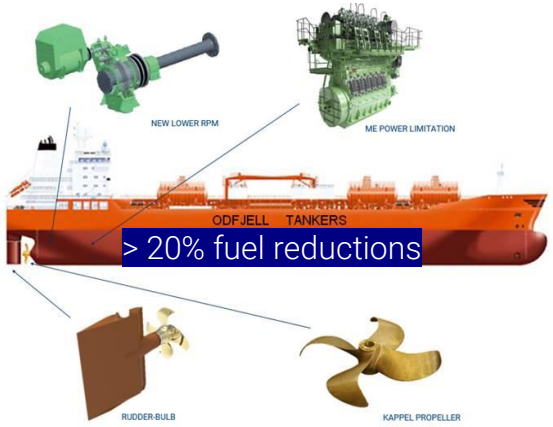
Derating/Turbo charging optimization (2018-)
8 ships



E/R Lights off
(2014-15)
26 ships

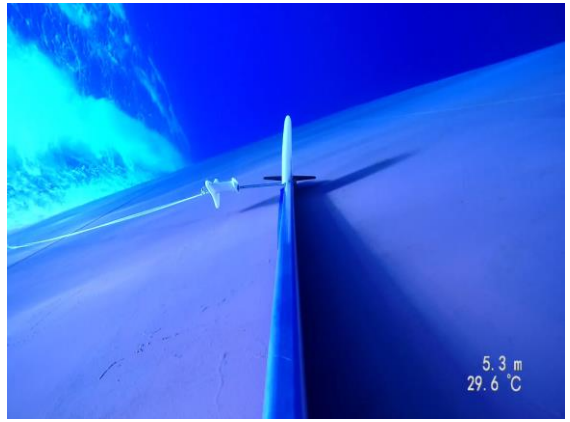
Reversed osmosis (2013-)
33 ships

Propulsion Project (2014-18)
19 ships

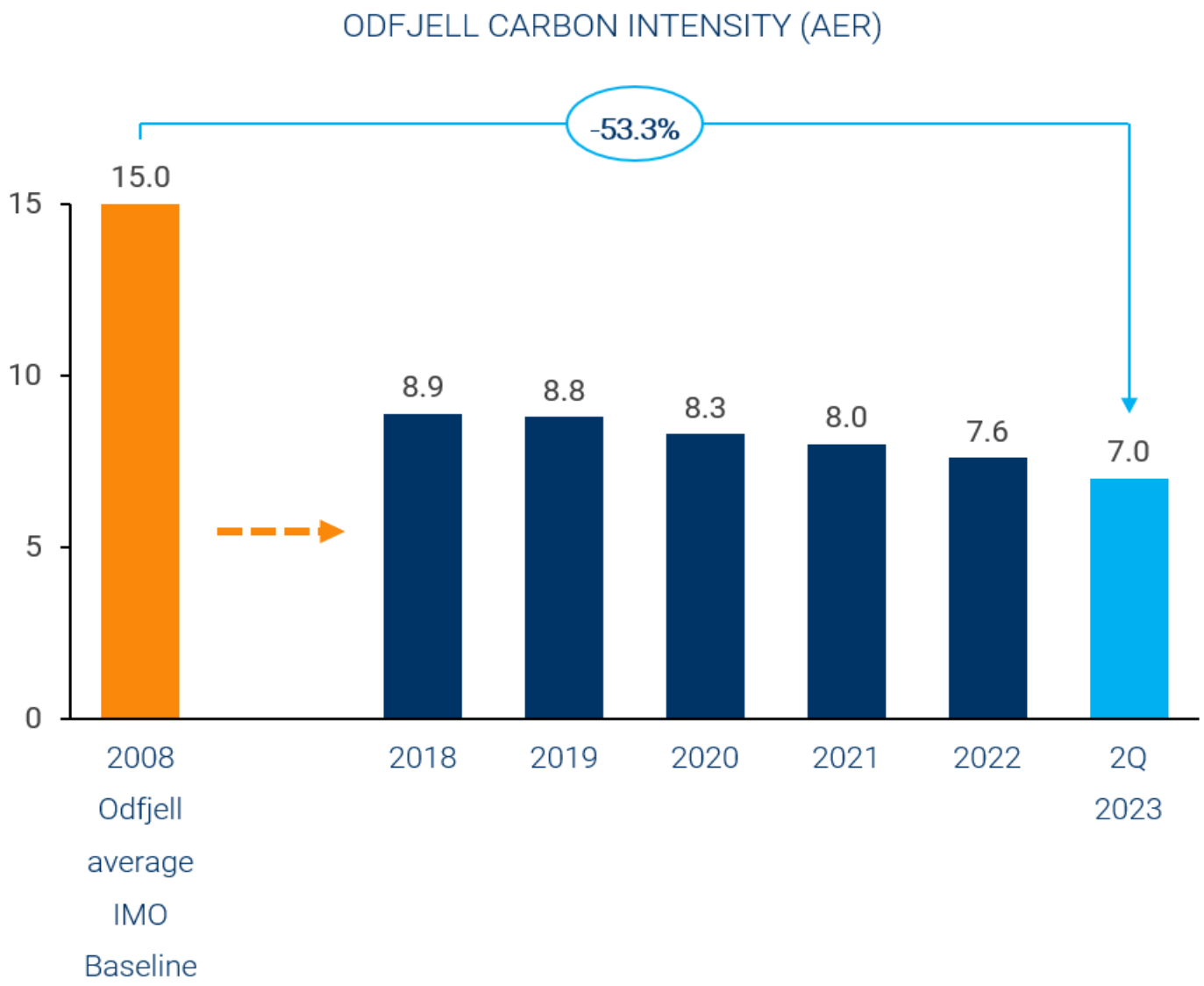


Ultrasound (2021-)
12 ships

In-transit hull-cleaning (2021-)
12 ships

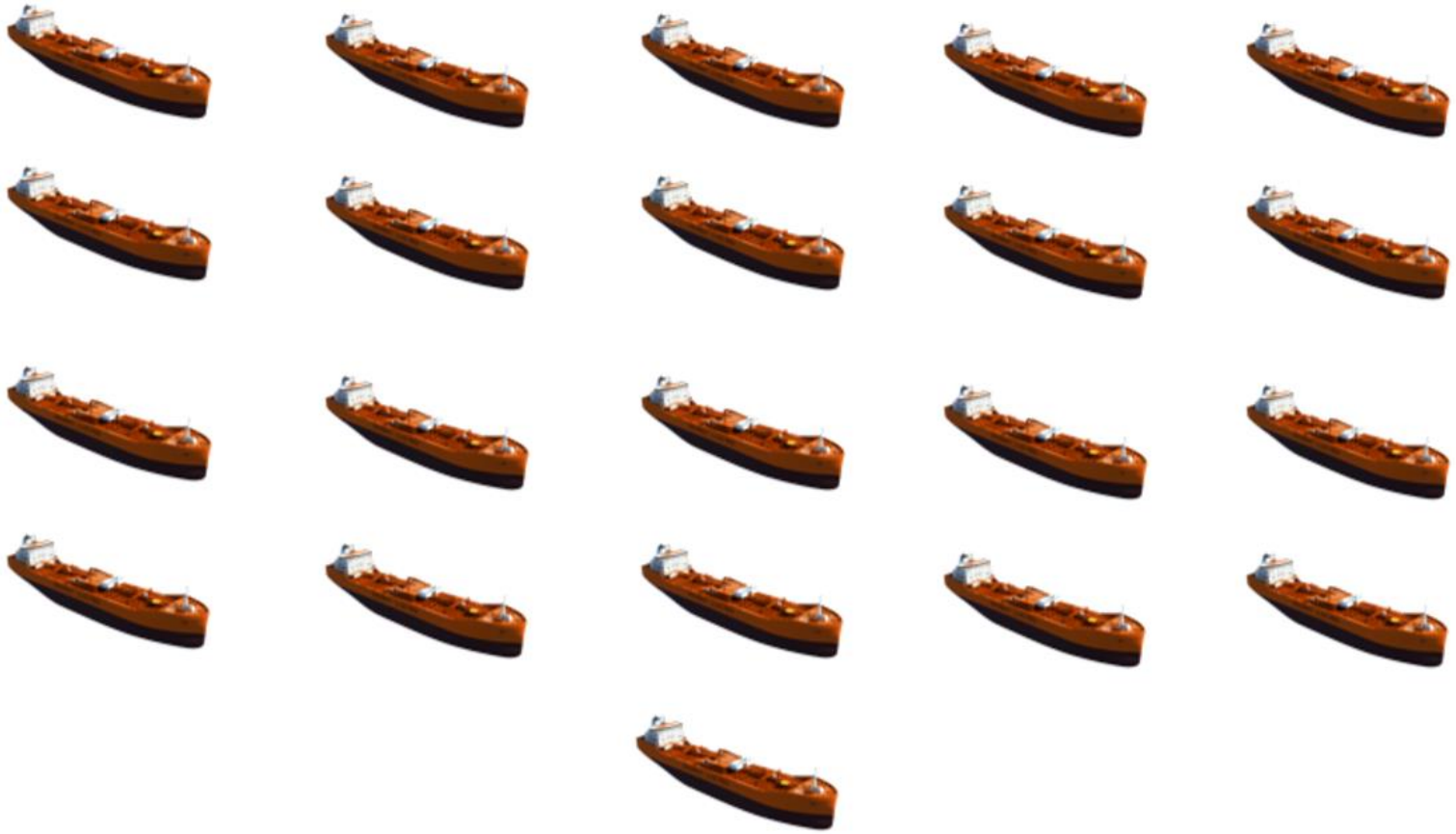


Results - Overall CII Status



“But it is not zero….” – food for thought

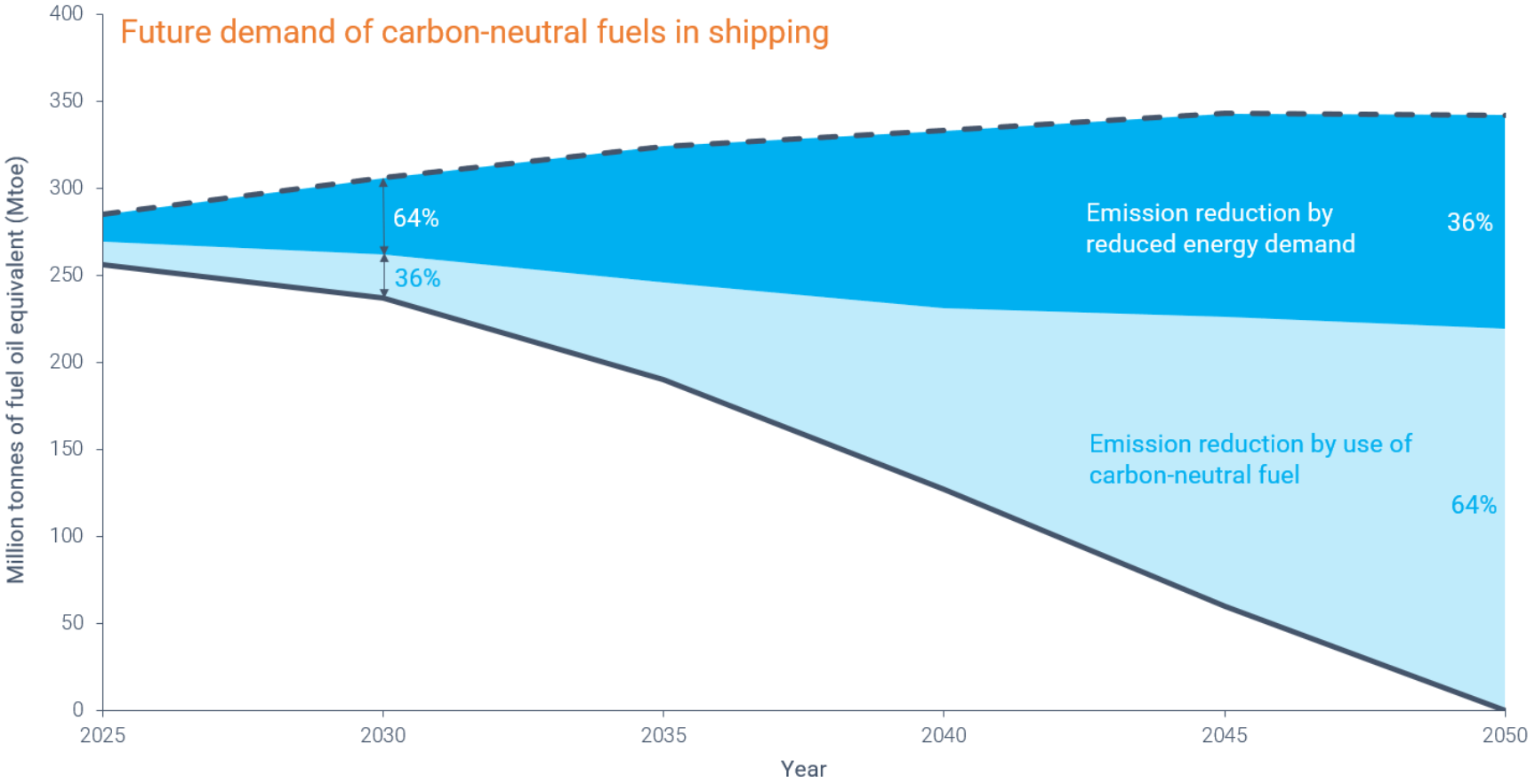
The carbon intensity reductions in Odfjell generates same CO2-reductions as 21 zero emission vessels



21

zero emission vessels

DNV Maritime Forecast 2023 – the role of energy efficiency



" Reducing energy consumption is critical to reduce emissions and sustain increased energy costs"

- DNV Maritime Forecast 2023

Source: DNV Maritime Forecast 2023

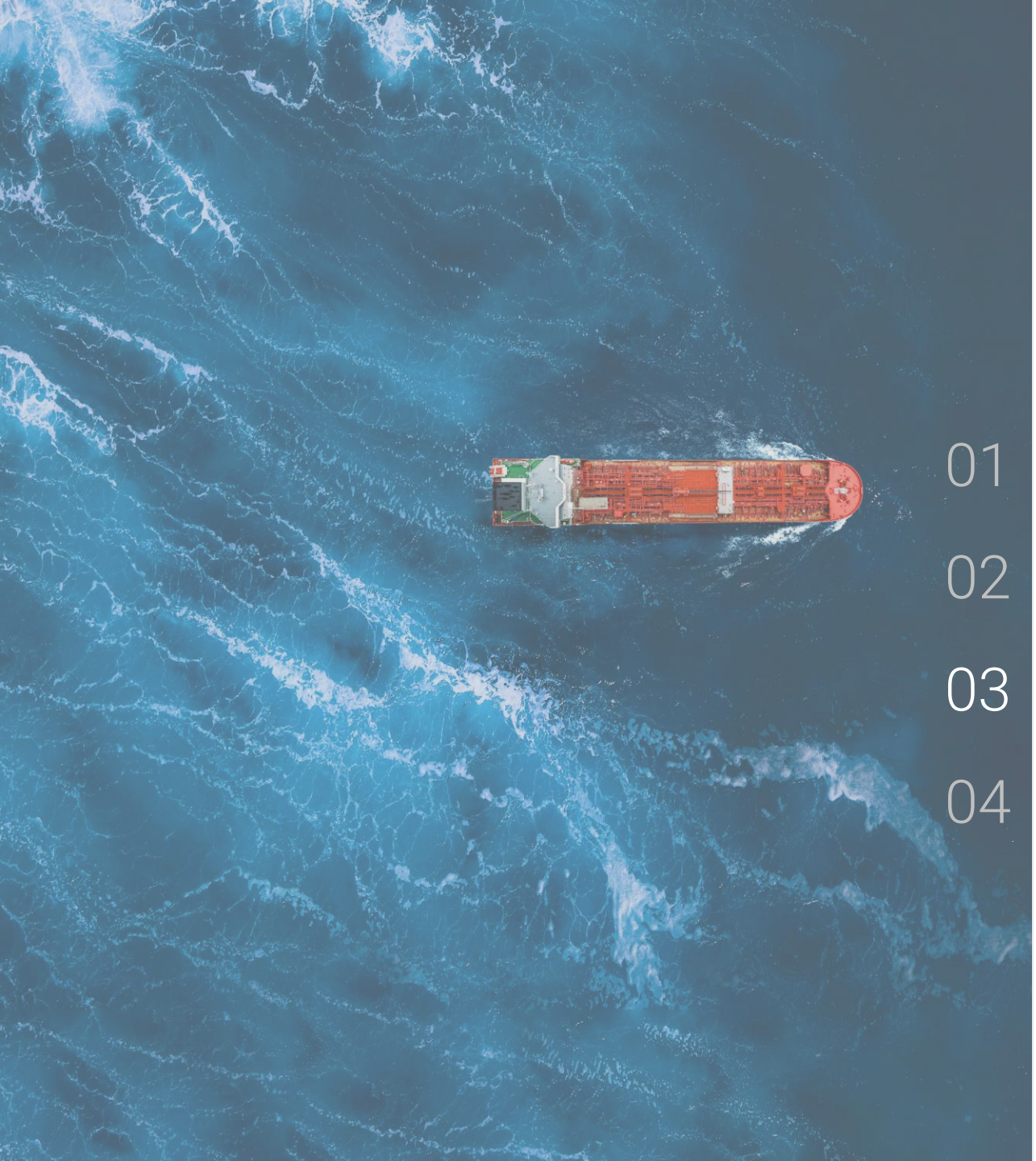
Excellent examples in our own back-yard

Misje Rederi

SeaTrans

Wallenius Wilhelmsen

Utkilen



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The tool-kit is running low – the time has come to notch things up

Air-lubrication (October 2023)

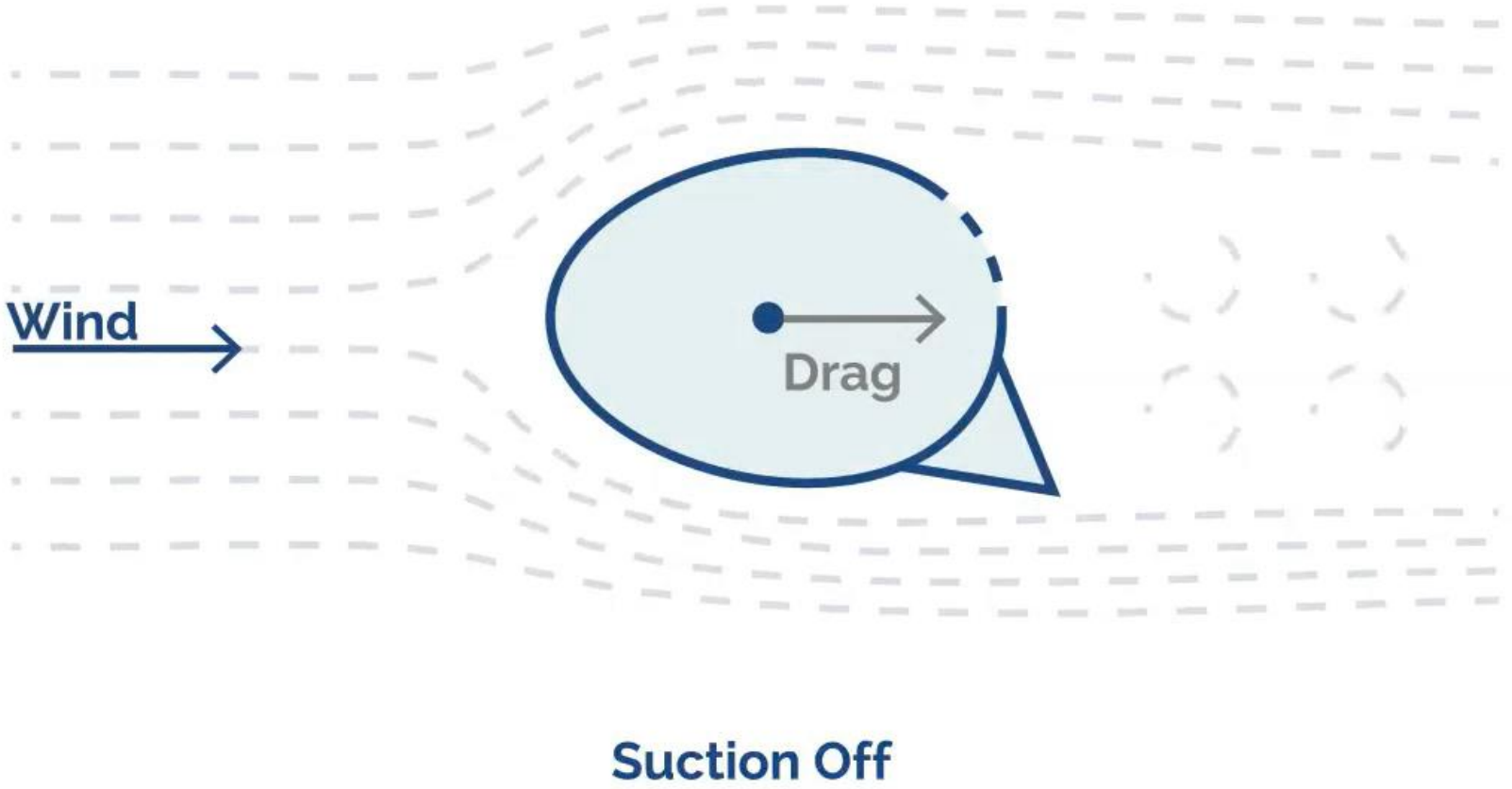
Solide Oxide Fuel Cell (December 2024)

Suction Sails (December-2024)

- Plan is to retrofit 4 sails on a Hudong vessel in December 2024
- First tanker company testing the technology

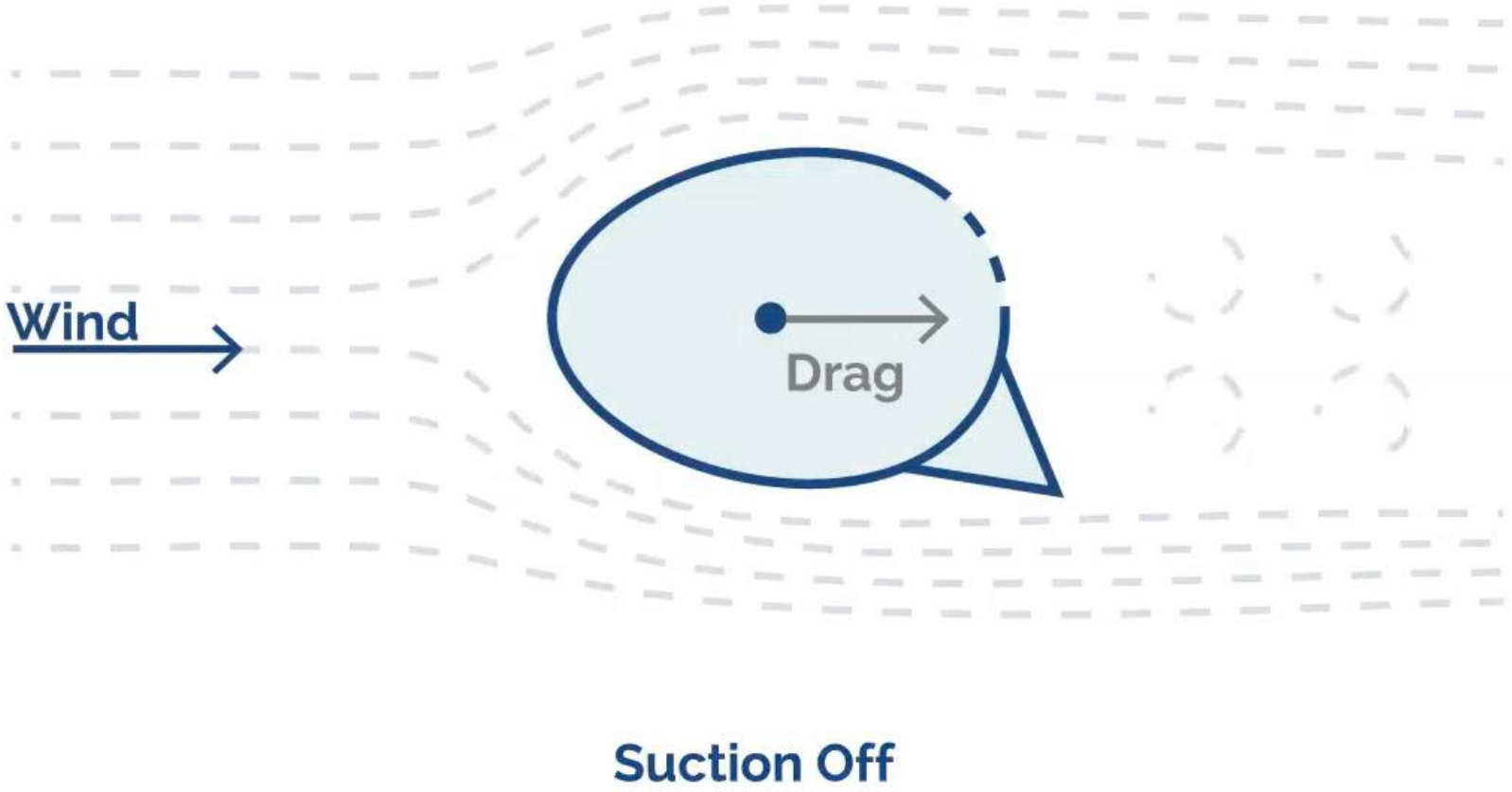
How it works

Suction off



How it works

Suction on



Fuel EU Maritime (FEM)

Effect of WAPS for a vessel`s FEM energy balance

Initial GHG Intensity 91,2

Year	2025	2030	2035	2040	2045	2050
Reduction	2%	6%	15%	31%	62%	80%
Required GHG Intensity	89,3	85,7	77,9	62,9	34,6	18,2

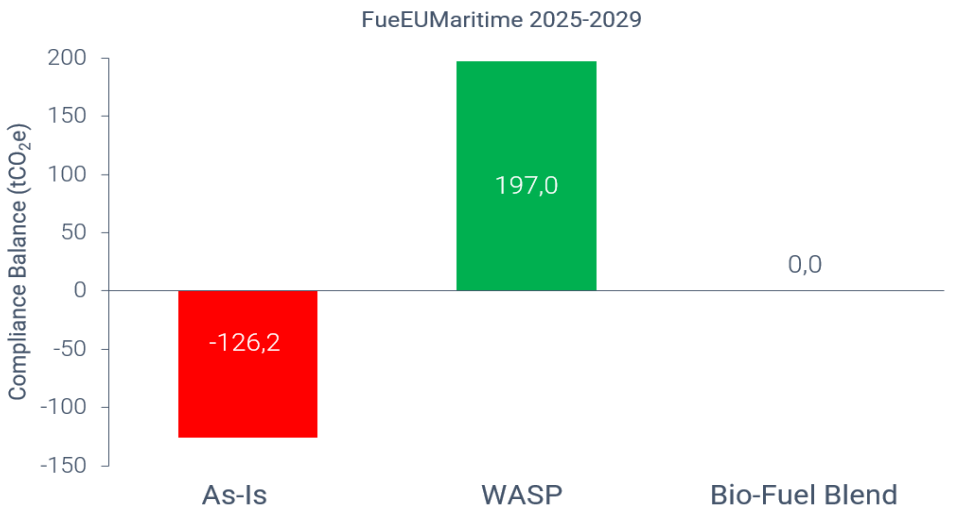
Reward factor *for wind-assisted propulsion - WIND (f_{wind})*	$\frac{P_{Wind}}{P_{Prop}}$
0,99	*0,05*
0,97	*0,1*
0,95	*>0,15*

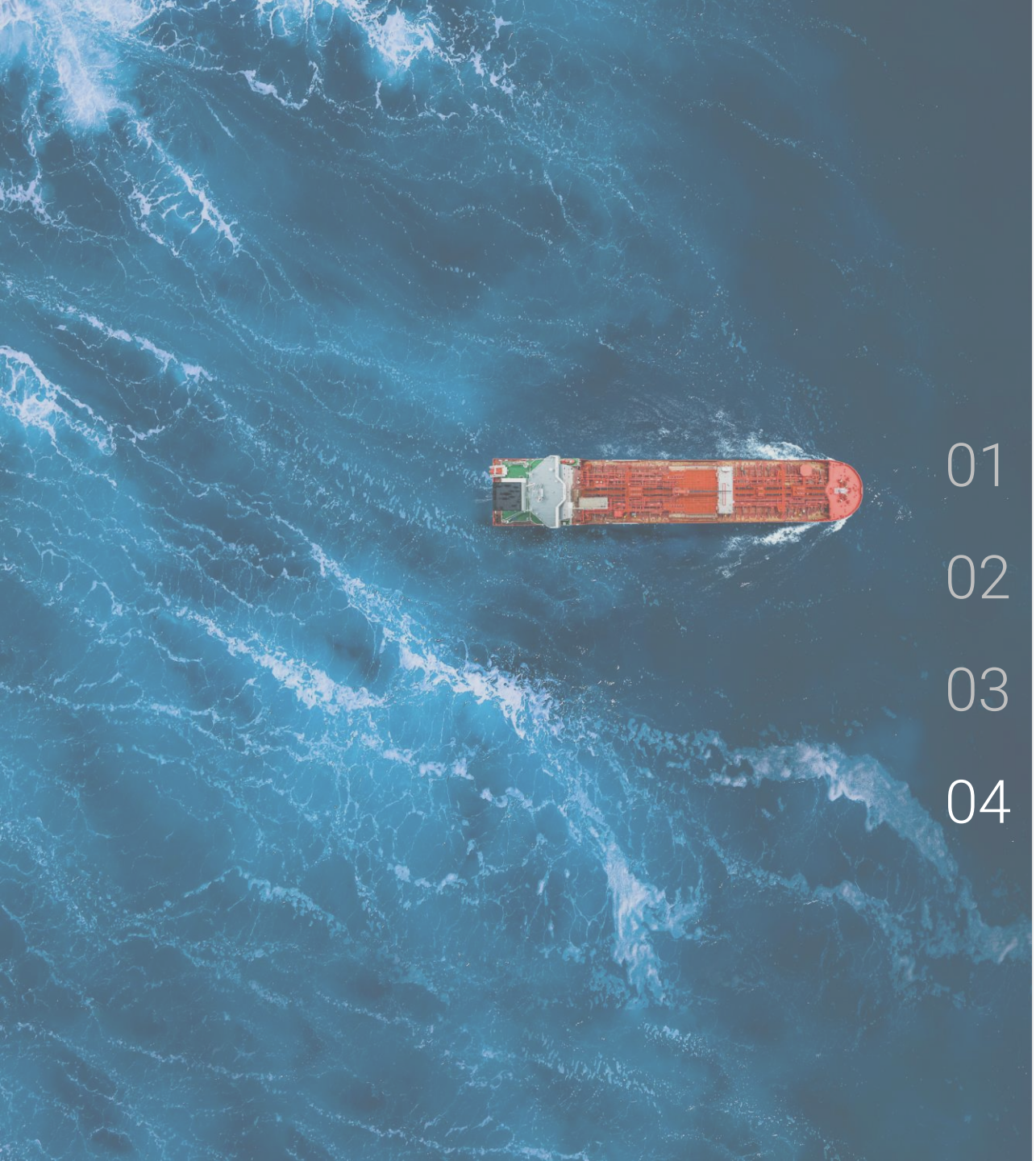
$$GHG\ intensity\left[\frac{gCO2eq}{MJ}\right] = f_{wind} \times (WtT + TtW) \qquad Equation\ (1)$$

$$WtT = \frac{\sum_i^{n\ fuel} M_i \times CO_{2eq\,WtT,i} \times LCV_i + \sum_k^c E_k \times CO_{2eq\,electricity,k}}{\sum_i^{n\ fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k}$$

$$TtW = \frac{\sum_i^{n\ fuel} \sum_j^{m\ engine} M_{i,j} \times \left[\left(1 - \frac{1}{100} C_{slip\,j}\right) \times \left(CO_{2eq,TtW\,i,j}\right) + \left(\frac{1}{100} C_{slip\,j} \times CO_{2eq\,TtW,slip,i,j}\right)\right]}{\sum_i^{n\ fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k}$$

f_{wind} — *Reward factor for wind-assisted propulsion*





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- Energy efficiency works! Odfjell`s improvements in energy efficiency since 2008 equals 21 zero-emission Odfjell vessels

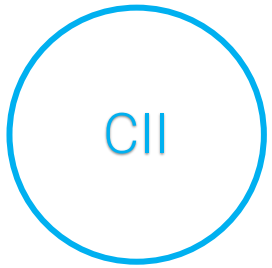
- This has been achieved by utilizing existing technology and without stress on the renewable electricity infrastructure, and has reduced our costs / increased our competitiveness

- 75% of the world fleet has not installed any energy saving devices – the reduction potential is therefore high to quickly bend the curve, as confirmed in the DNV Maritime forecast 2023

Conclusion

Energy efficiency answers to all the known GHG-regulations

Energy efficiency of the ship



Carbon intensity of the ship and its operation

CO2 quotas on EU-voyages

Carbon intensity In the energy used

Carbon intensity in the energy used

Improves EEDI and EEXI (WAPS: 15%)

Improves CII-rating

Reduce # CO2 quotas

Reduce volume requirement of alternative fuels

Reduce volume requirement of alternative fuels


Thank you
for the attention
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