

Ren luft konference 17. marts 2021

Grøn omstilling i praksis

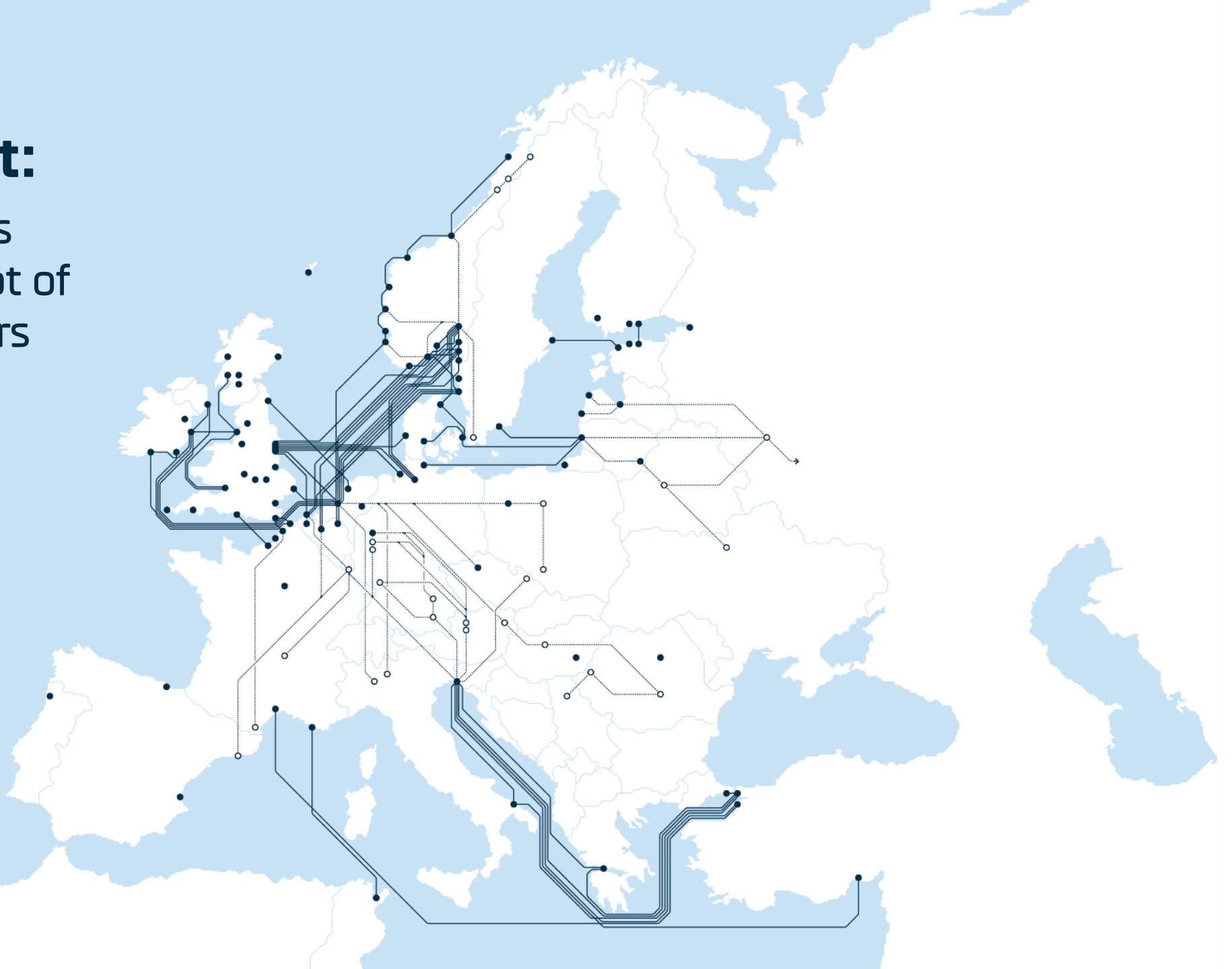
Hvad har vi lært, hvad arbejder vi med og et bud på storskala grøn omstilling af hele erhvervet.

Af Jakob.Steffensen@dfds.com

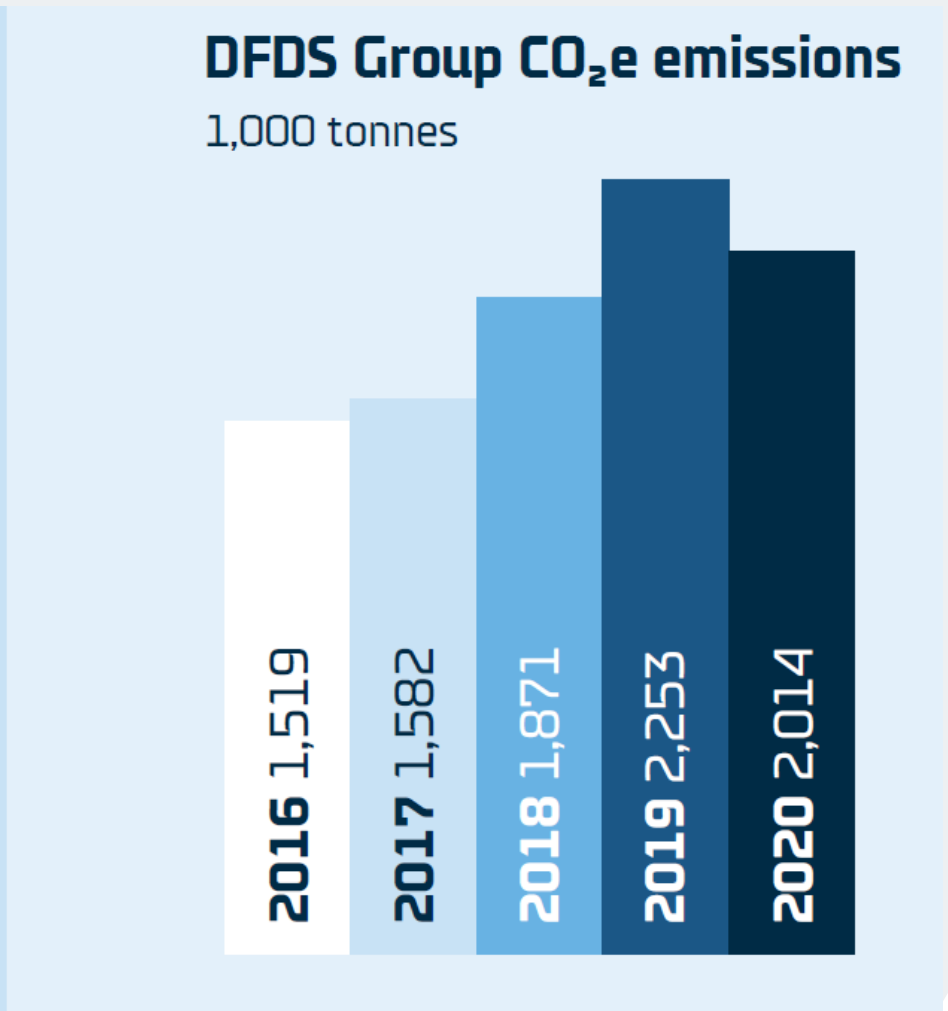
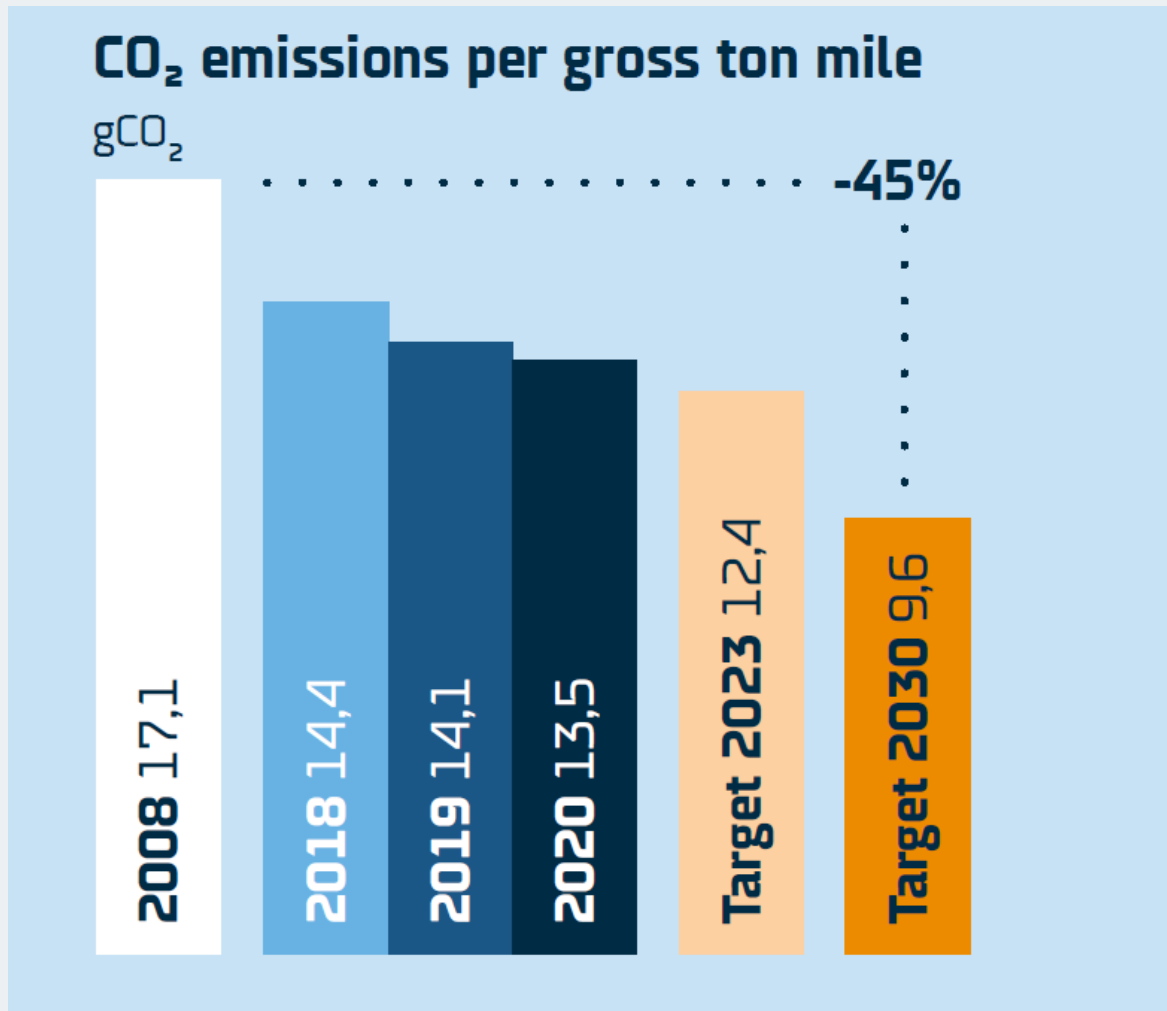


DFDS in short:

- 8,200 employees
- 60 ships and a lot of trucks and trailers



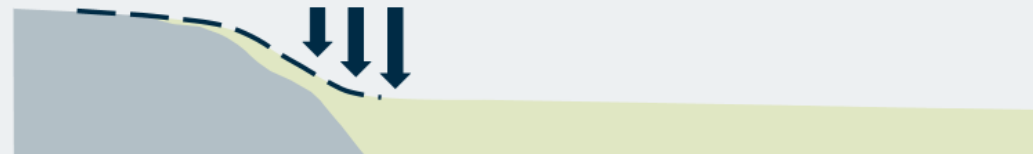
96% of the DFDS emissions come from our ships
Air pollution is more than CO₂, but CO₂ is an important KPI for change



The DFDS Climate Action Plan is quite straight forward: Improve efficiency of the existing fleet, then implement zero emission tonnage

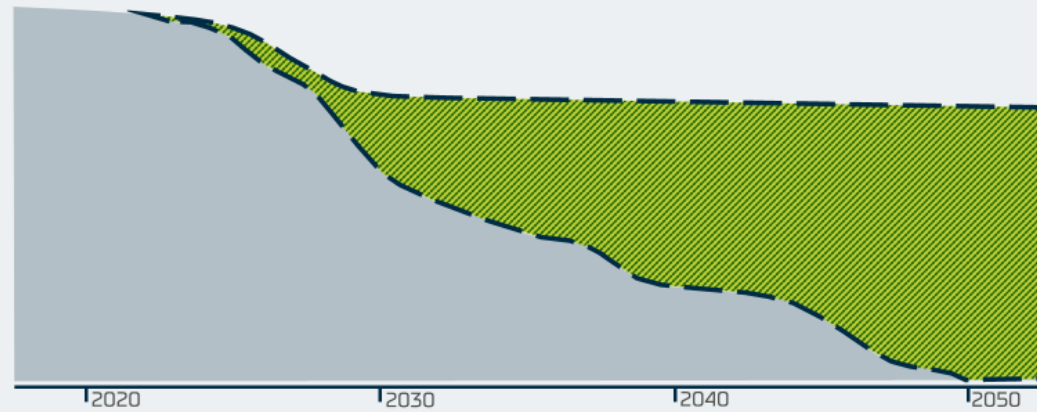
Short-term: Improve energy efficiency

Reduce emissions with 45% by 2030, - focus on the existing fleet



Long-term: Replace fossil with non-carbon fuels

Become climate neutral by 2050, focus on newbuids



Green Hydrogen (H₂)

Green hydrogen is produced by electrolysis of water using renewable energy. It is a clean, sustainable fuel that can be used in various applications, including shipping.

Storage Temperature: -253°C

Storage Pressure: 700 bar

DFDS Logo

Green Methanol (CH₃OH)

Green methanol is produced by combining green hydrogen with captured CO₂. It is a clean, sustainable fuel that can be used in various applications, including shipping.

Storage Temperature: 15°C

Storage Pressure: 25 bar

DFDS Logo

Green Ammonia (NH₃)

Green ammonia is produced by combining green hydrogen with nitrogen from the air. It is a clean, sustainable fuel that can be used in various applications, including shipping.

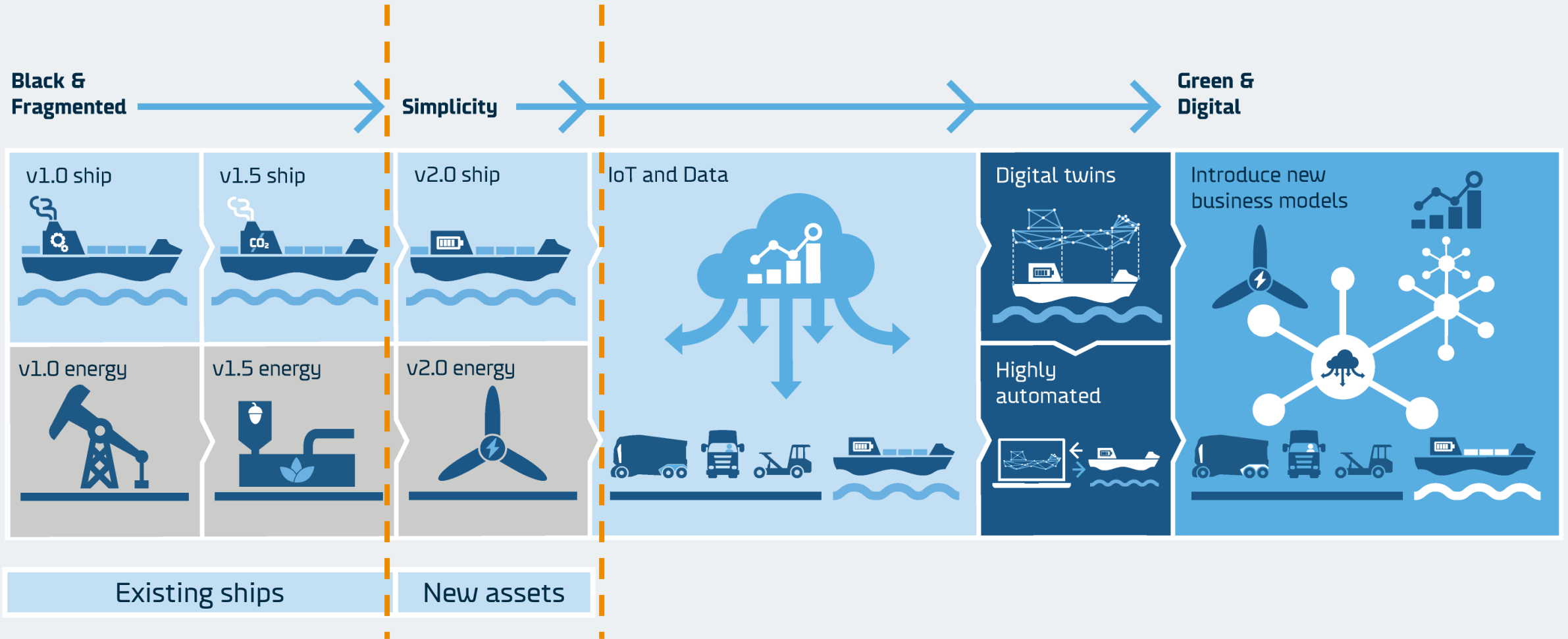
Storage Temperature: -33°C

Storage Pressure: 10 bar

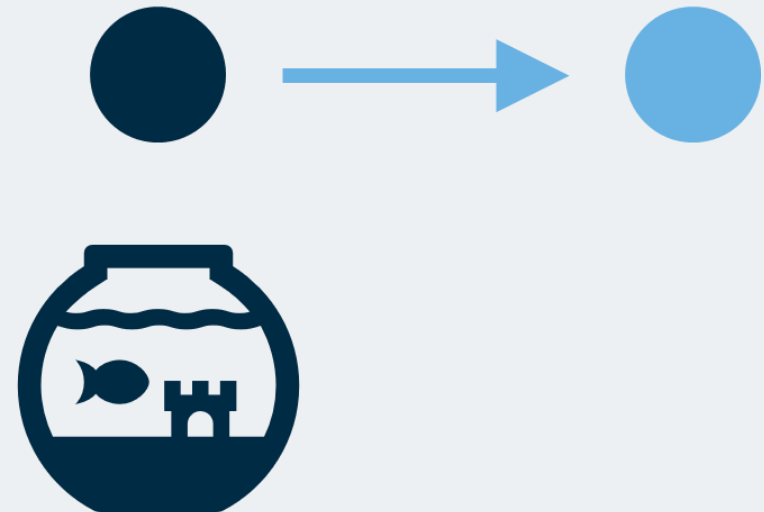
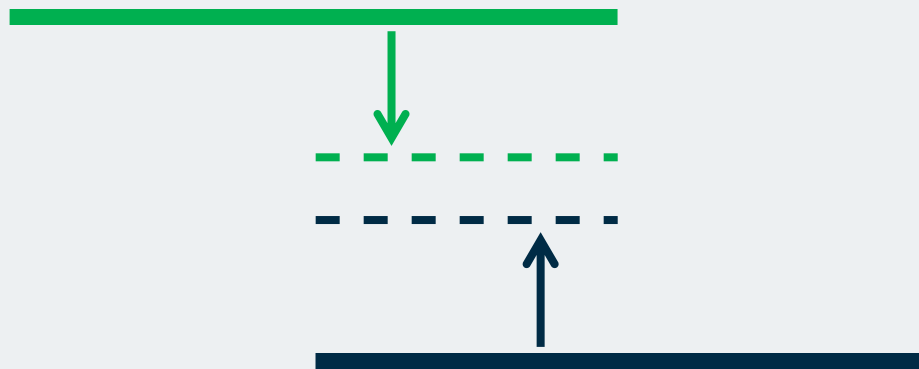
DFDS Logo

Zero Emission shipping and logistics roadmap

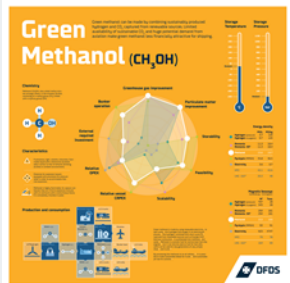
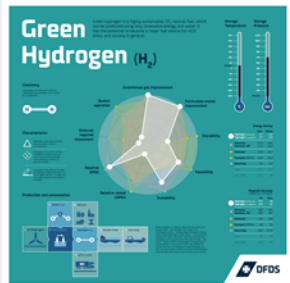
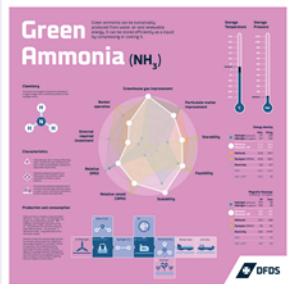
Digitalization and scale are the key components to bring down cost



The biggest obstacle is the price gap between green and black
We need to learn fast in order to reach our targets



DFDS need to be engaged in order to ensure zero emission fuel availability within our network



Power-to-Ammonia (Esbjerg) 1GW

Green hydrogen → green ammonia → green fertilizers

Green Fuels for Denmark (Copenhagen) 1.3GW

Green hydrogen → green Methanol → eJet fuel

The first large scale zero emission ferry for international voyages
Copenhagen Oslo, 1800 passengers, 24MW and 44 tons H2 storage



This nice picture is by courtesy of Knud E Hansen

A potential path to general large scale decarbonization of shipping:
Removing existing inefficiencies to enable green to compete with black



Leverage the new opportunities that zero-emission tonnage brings and innovate on Business and Operation Model to improve efficiency

The recipe

- Removal of today's inherent inefficiencies
- Extreme servitization of physical assets
- Cross sector and value stream integration to reduce risk for all stakeholders
- Access, not ownership, of assets
- Finance zero emission tonnage as green bonds

The required ingredients

- Zero Emission propulsion technologies
- Zero Emission storage and bunkering technologies
- Zero Emission fuel availability
- High level of digitalization
- High level of Standardization
- High quality twinning of physical assets

- Digitize all communication to, and control of, physical assets
- Direct digital access to all customers and stakeholders
- The right partners
- Access to attractive financing
- Scale

Green Methanol (CH₃OH)

Green methanol can be made by combining sustainably produced hydrogen and CO₂ captured from renewable sources. Limited availability of sustainable CO₂ and huge potential demand from aviation make green methanol less financially attractive for shipping.

From our former ideas, decarbonized materials, we feel like a compressed packaged material is the organic material to handle to support CO₂ capture across the region. The research we conducted has CO₂ capture plant built from the basic forms, and inside the unit to a nearby port from where it is transported to the ship. The CO₂ capture plant is integrated into the ship's system, making the fuel delivery to the ship.

Storability

Feasibility

Scalability

Energy density

	MJ/L	MJ/kg
Hydrogen (compressed)	47	120
Hydrogen (compressed)	47	97
Ammonia (compressed)	11.3	18.4
Ammonia (compressed)	11.3	18.4
Methanol	15.6	19.7
Paraffin (HFO)	35.8	36.5
Electricity	3.6	0.7
HFO	42.1	42.6
LNG (LSP)	20.3	48

Marginal Seaways

	Wp	Tonn	CB
Hydrogen (compressed)	707	181	181
Hydrogen (compressed)	543	181	181
Ammonia (compressed)	284	129	129
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Methanol	213	91	91
Paraffin (HFO)	35	4747	78
Electricity	923	78	78
HFO	75	164	164
LNG (LSP)	164	164	164

Production and consumption

- 2 Water split
- 3 Electrolysis
- 4 Hydrogen (H₂)
- 5 Banker boat
- 6 42D ship
- 7 42D trucks
- 8 Sectors
- 9 Power gen.

Characteristics

- Downside: requires complex, and expensive, gas treatment.
- Hydrogen burns with an almost invisible blue flame which can be a sign of a leak or a fire.
- Hydrogen is highly flammable and its ignition range is wider than air - 4% to 75%.

Relative OPEX

Relative vessel CAPEX

Green Ammonia (NH₃)

Green ammonia can be sustainably produced from water, air and renewable energy. It can be stored efficiently as a liquid by compressing or cooling it.

Green hydrogen is made by using renewable energy to split water into hydrogen and oxygen. It can be used in a variety of ways, such as in a fuel cell, or in a process to produce ammonia. Ammonia is a key component in the production of fertilizers and other chemicals. It can also be used as a clean energy carrier.

Chemistry

Ammonia is an inorganic compound composed of a nitrogen atom and three hydrogen atoms.

Characteristics

- Colorless gas with a strong suffocating odor. Causes eye, nose and throat irritation. High levels may be fatal.
- Potential explosion hazard in compressed gas. Use with caution. Ventilate to prevent vapor build-up.
- Ammonia has chemical properties and is corrosive. Ammonia gas dissolves in water to form ammonium hydroxide. Ammonia solution can cause severe eye irritation.

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