

FutureShip



Zero-Emission Design Concept for a Scandlines Ferry

Fridtjof Rohde (FutureShip), Claus Nikolajsen (Scandlines)





Navigator

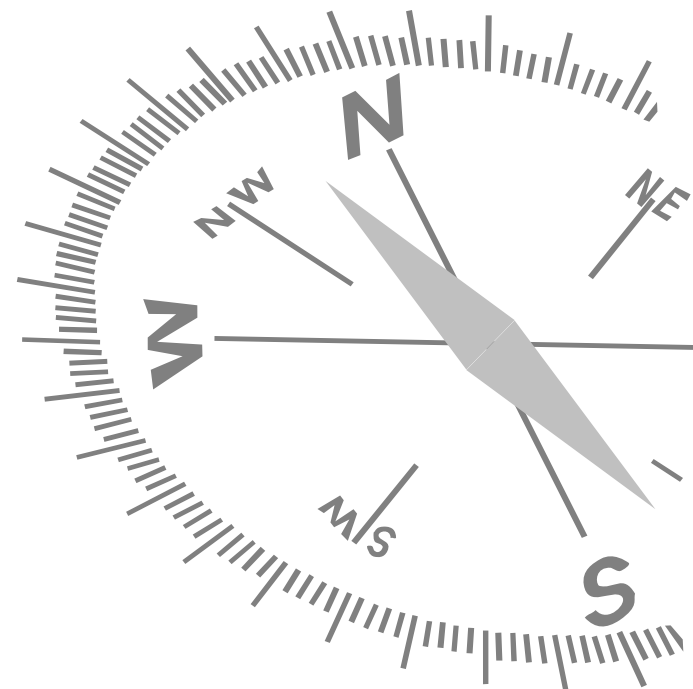


Zero-emission feeder ship as a vision

Starting point – The current ferry connection

Zero emission ferry – Idea and concept

The Scandlines ferry





GL R&D study for 2030 feeder vessel





Navigator

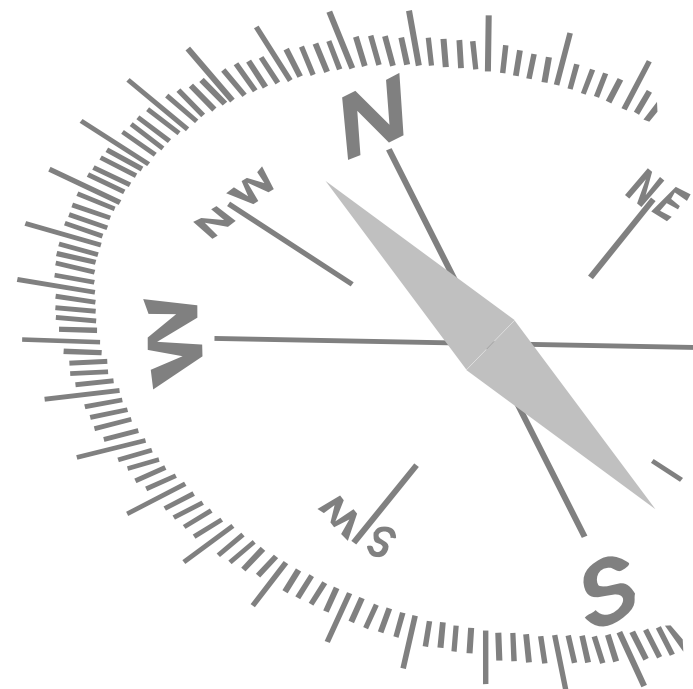
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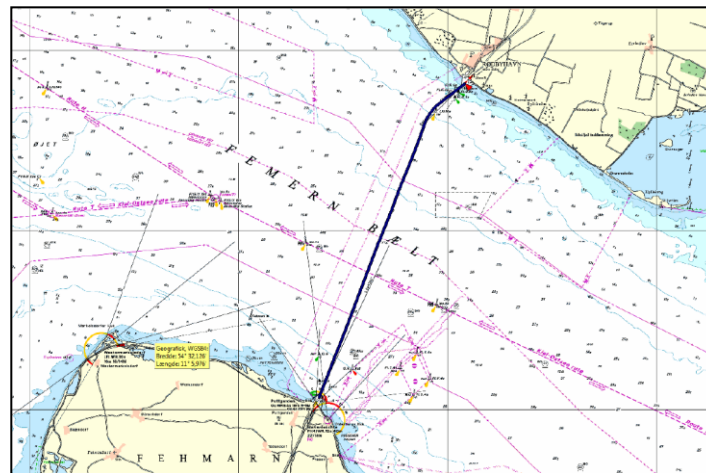
The Scandlines ferry



Ferry connection Puttgarden – Rødby today



- 4 double-end ferries
- depart every 30 min
- short time in port
- 15 – 18kn (21 kn) speed

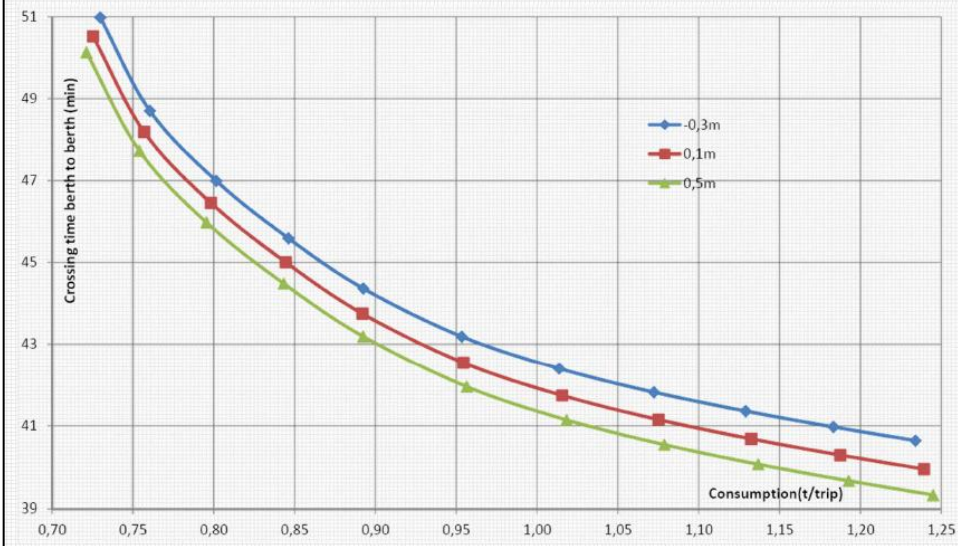


Fast ports save fuel

- both terminals tailored to ferry operation
- operator knows exactly power penalties of extra speed
- time saved in port means less fuel consumed



Crossing time – Oil consumption





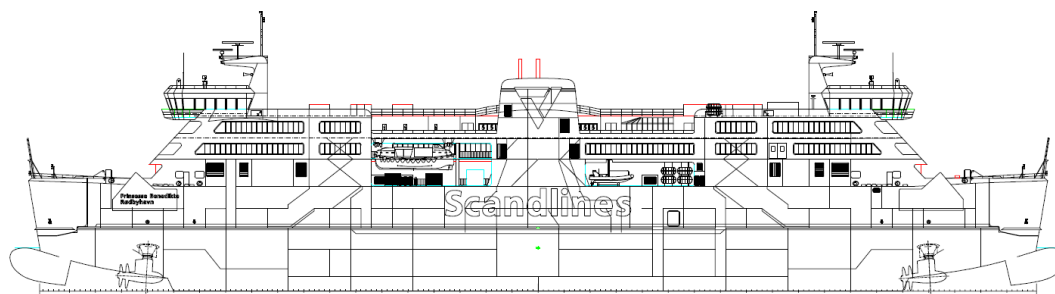
Conventional ferries now in operation



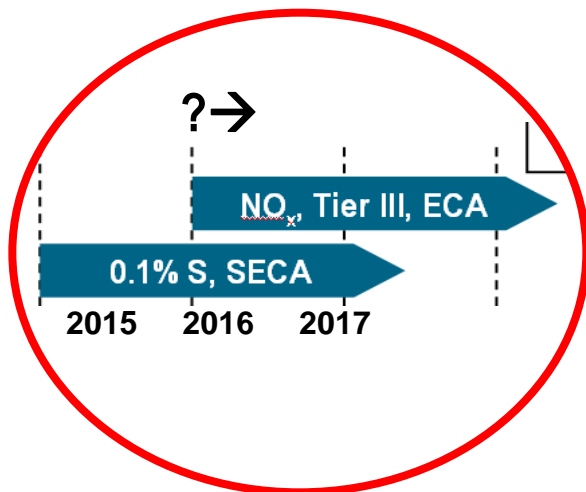
Length: 143.0m

Breadth: 26.0m

GRT: 15187

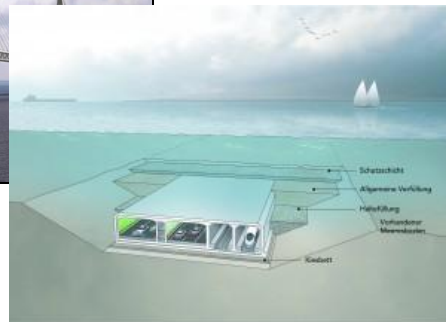


Business environment changes



Ferry crossing in ECA zone

- SO_x reduced by 90%
- NO_x reduced by 75%



Discussed:

Fehmarn Belt **fixed link**

(first bridge, now tunnel favoured)



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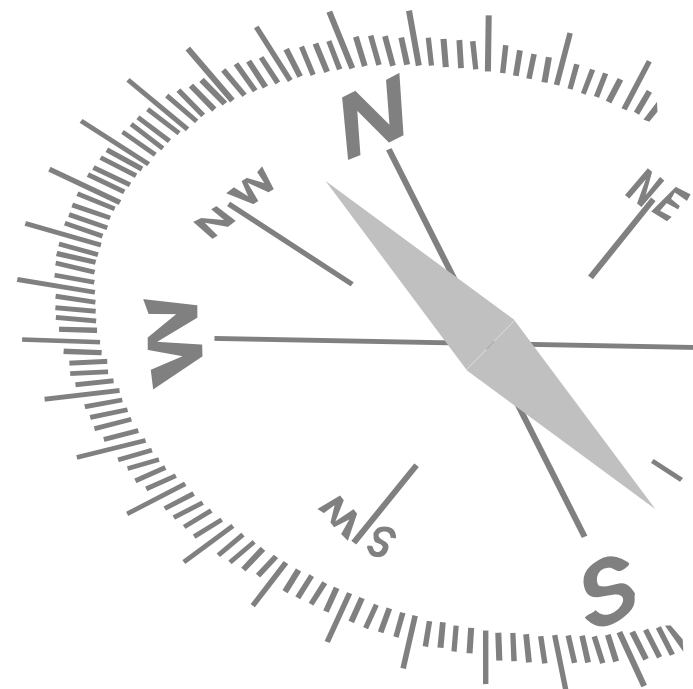
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Zero Emission Concept – Targets

Clear & simple targets:

Zero emissions for

- CO₂
- NO_x
- SO_x





Emissions from ships as a background

Average **sulphur** content in 1 ton of heavy fuel oil:

- worldwide: 24kg
- baltic sea up to 2015: 10kg
- baltic sea from 2015: 1kg

Upon burning of **1 ton** heavy fuel following **emissions** are formed:

- CO₂: 3110kg
- SOX: 50kg
- NOX: 55kg

Implementation Roadmap

Radical new design needed:

- new energy source
- new energy storage
- new energy converter
- reduced consumption



Zero Emission – From Idea to Design

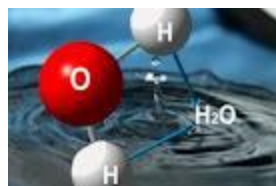
Chosen concept



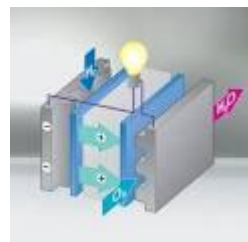
Wind



Hydrogen



Fuel cell & Battery

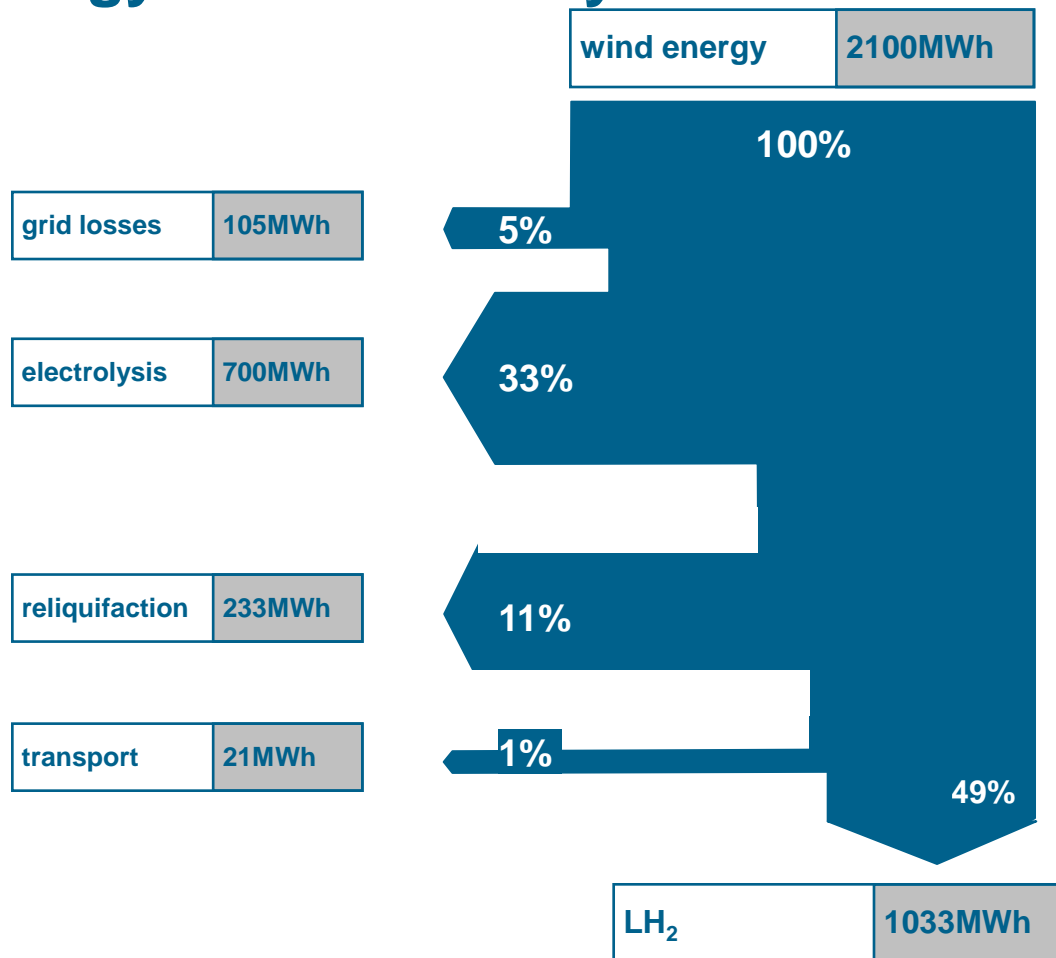


- optimized schedule
- optimized hull
- new propulsors
- many small details





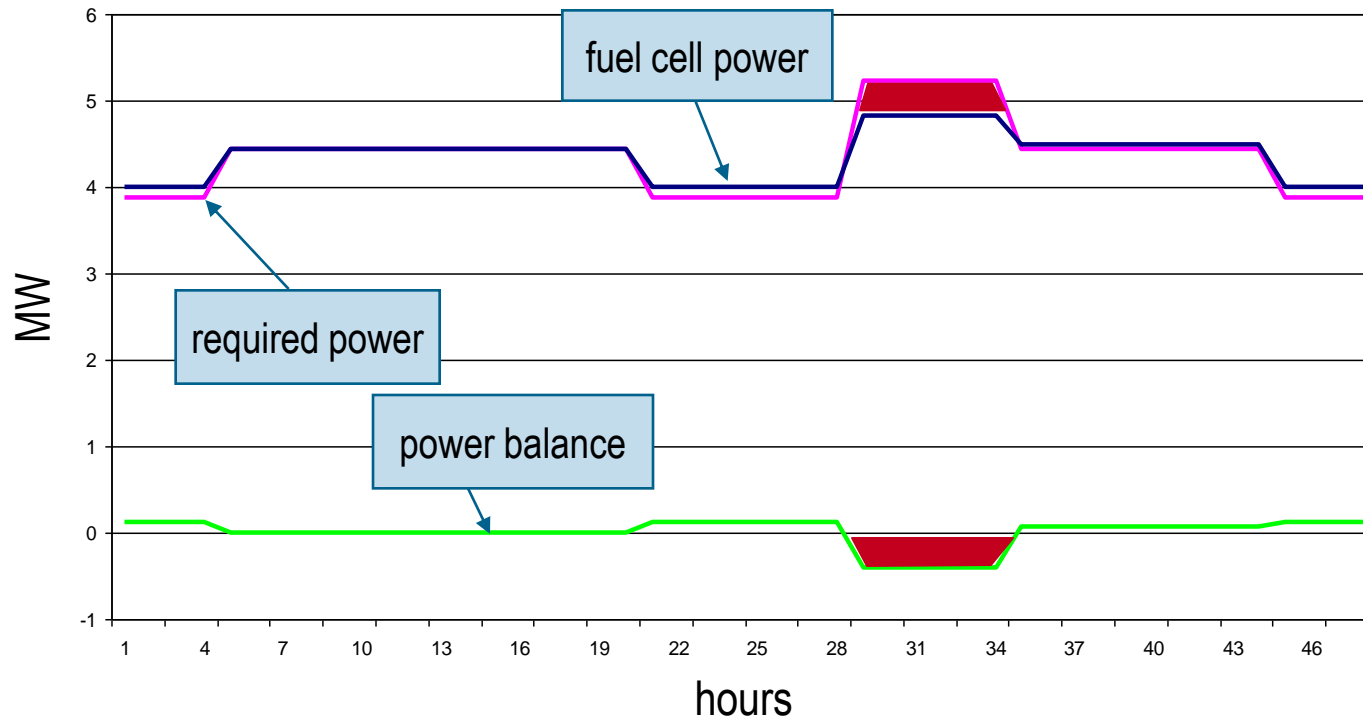
Wind energy involves many losses





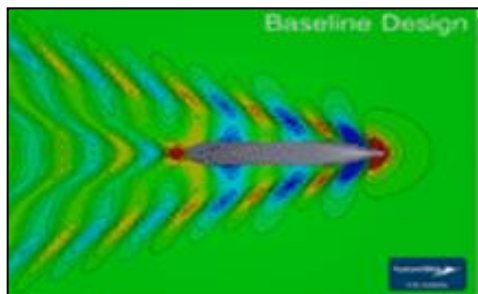
Batteries supplement fuel cells

Energy converter / Energy balance



fuel cells up to 17 kn
batteries for 17 - 18.5 kn

Reduce energy requirements



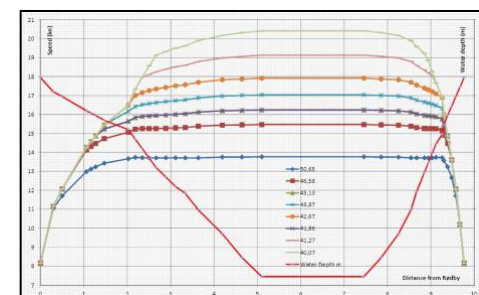
hull optimization



sophisticated insulation



energy efficient consumers



optimized schedule to reduce fuel consumption



Navigator

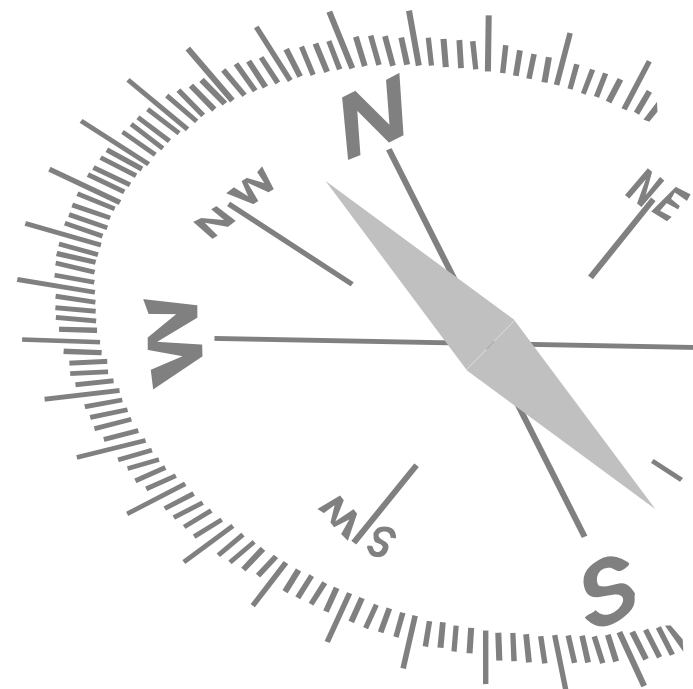
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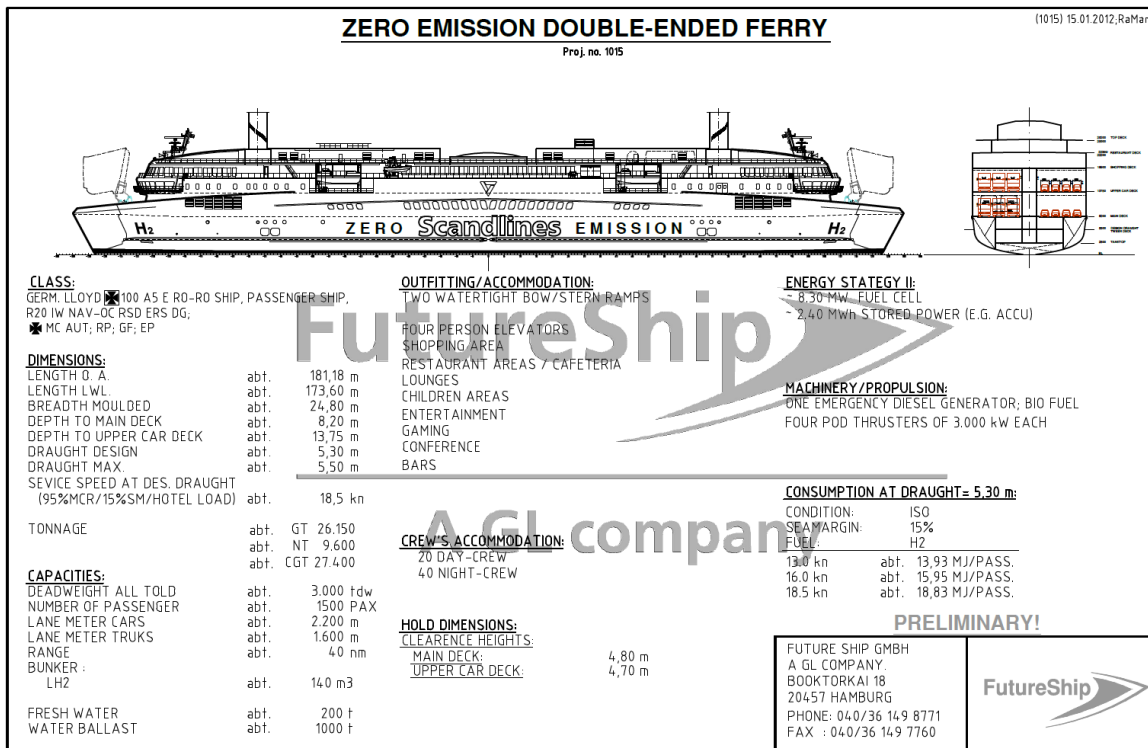


The Scandlines ferry





Conceptual design developed by FutureShip



1500 passengers

18.5 knots

2.200 lane meters

140 m³ H₂ tanks

8300 kW fuel cells

2400 kWh batteries

4 x 3 MW Pods

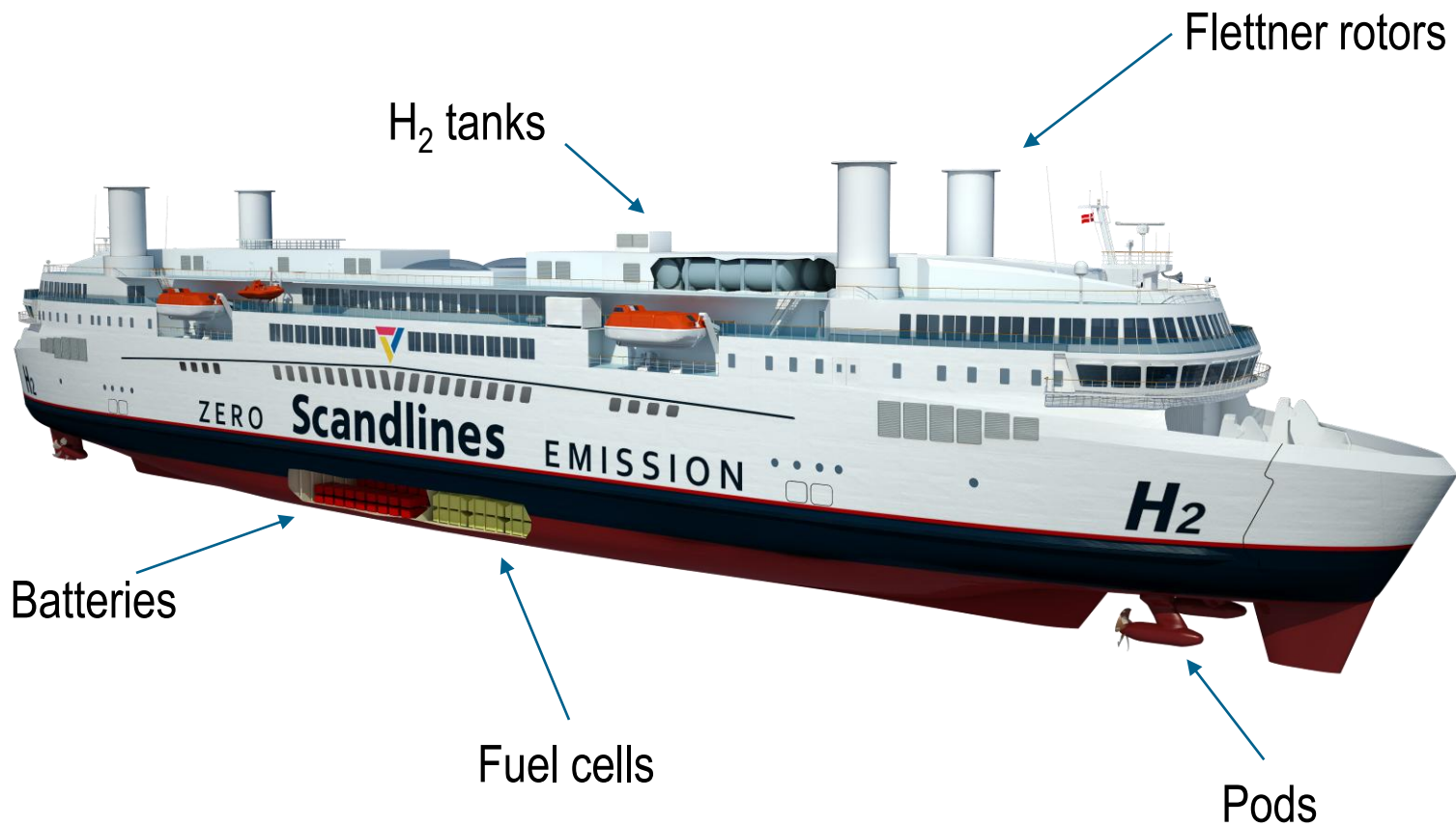
Energy per transit

16.0 kn = 15.95 GJ

18.5 kn = 18.83 GJ



Zero Emission Scandlines Ferry





Before – After



Ø consumption / emissions **today**
per transit:

0.95 t heavy fuel oil

2.96 t CO₂

0.03 t SO_x

0.05 t NO_x



Ø consumption / emissions **tomorrow**
per transit:

0.00 t heavy fuel oil

0.00 t CO₂

0.00 t SO_x

0.00 t NO_x

...to show that real life just has to be scaled up



A H2 bunker station for busses and cars in central Hamburg.



Batteries have started their business in shipping



Dismantling of a 3520kW Diesel engine



Installation of a 399 x 6.5 kWh battery plant



“Princess Benedicte” sailing today in hybrid mode



Zero Emission Scandlines Ferry





Thank you for your attention!



FutureShip

A GL company

Design Practice

Dipl.-Ing. Fridtjof Rohde
FutureShip GmbH
Brooktorkai 18
20457 Hamburg



fridtjof.rohde@gl-group.com