



FreeCO₂ast

Kristian Osnes, Project Manager Havyard Group ASA

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FreeCO2ast Project
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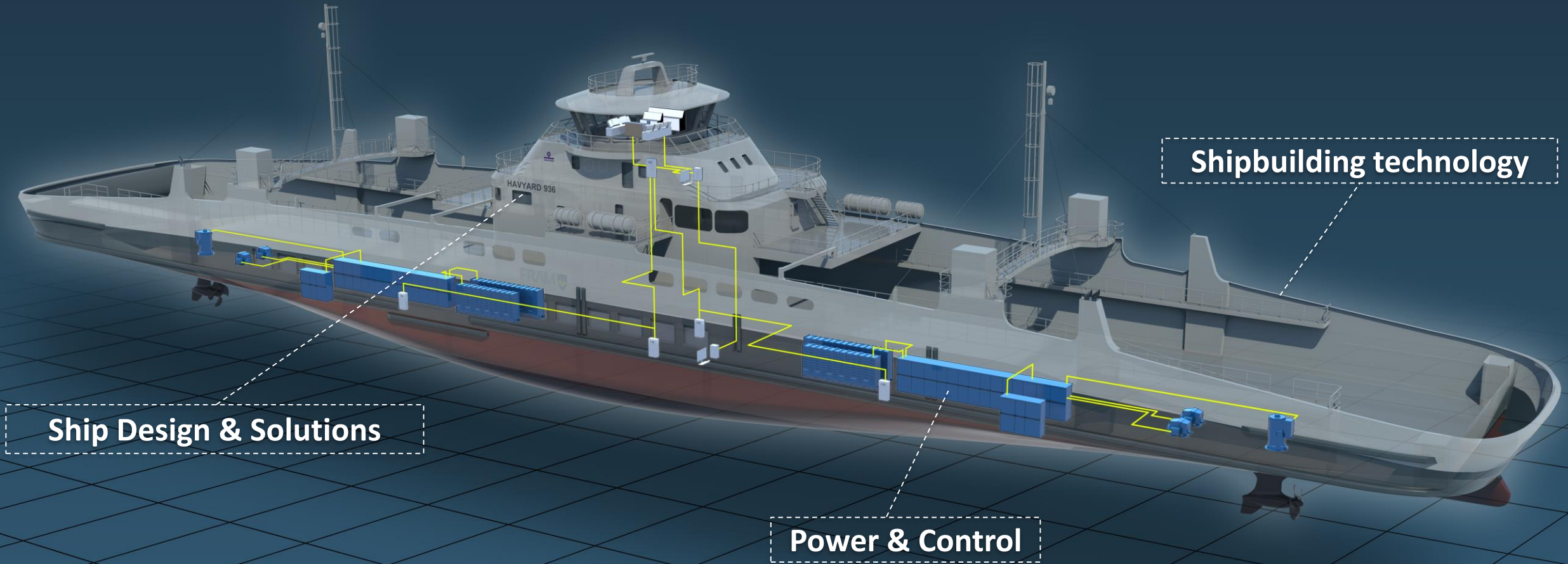
Havyard Group ASA

Havyard Group ASA is a knowledge-based marine and maritime technological company, which deliver innovative and sustainable technology offshore and onshore to customers within seafood, energy and transport



“Change our industry”

Business segments



The road towards zero-emission



“Havila Charisma”



Equinor

Low speed hull lines
Efficiency and engines for operational speed

“Polarsysse”



Syssemmann

New bow shape
New stern shapes

“Esvagt Faraday”



Siemens

New bow & stern
Variable RPM engines
Fuel commitment

“Giskøy”



Vegvesenet

Energy & emission commitment
Batteries

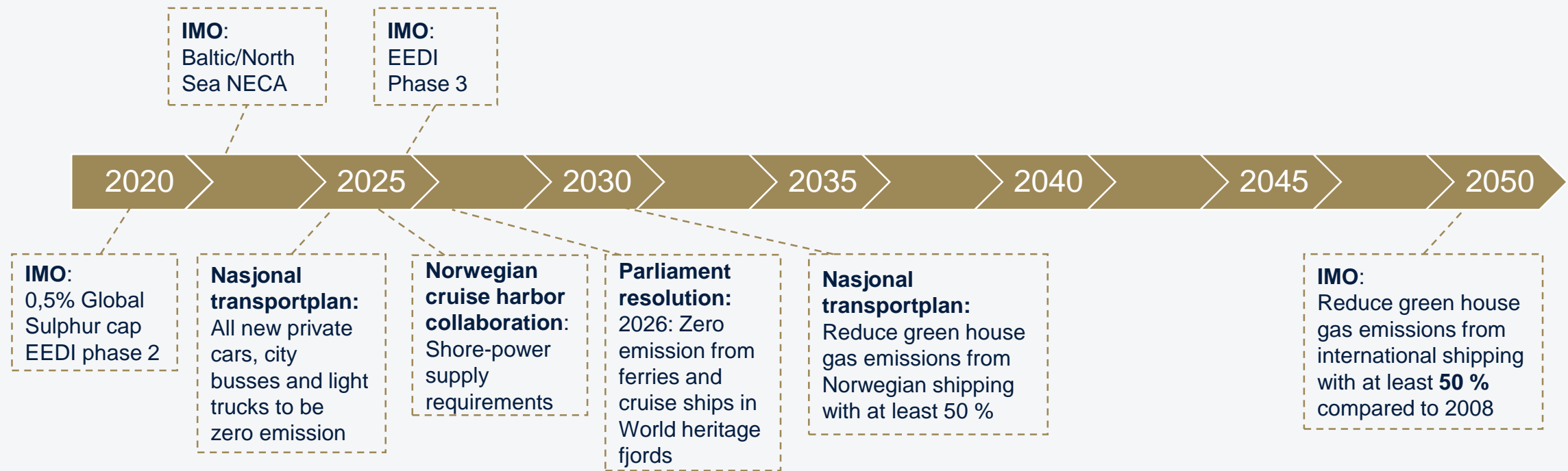
“Havila Kystruten”



Samferdsels- departementet

Energy & emission commitment
Batteries
Energy recovery

The road towards zero-emission





FreeCO₂ast Consortium



Havyard Group
ASA



Havyard Design
& Solutions AS

cmr Prototech



Havyard Ship
Technology AS



Kystruten



norwegian
electric systems



FreeCO₂ast

Pilot-E awarded the project 104 MNOK in 2018.

“The FreeCO₂ast project shall develop a high-capacity hydrogen powertrain approved for zero-emission operation with higher speed and over longer distances.”

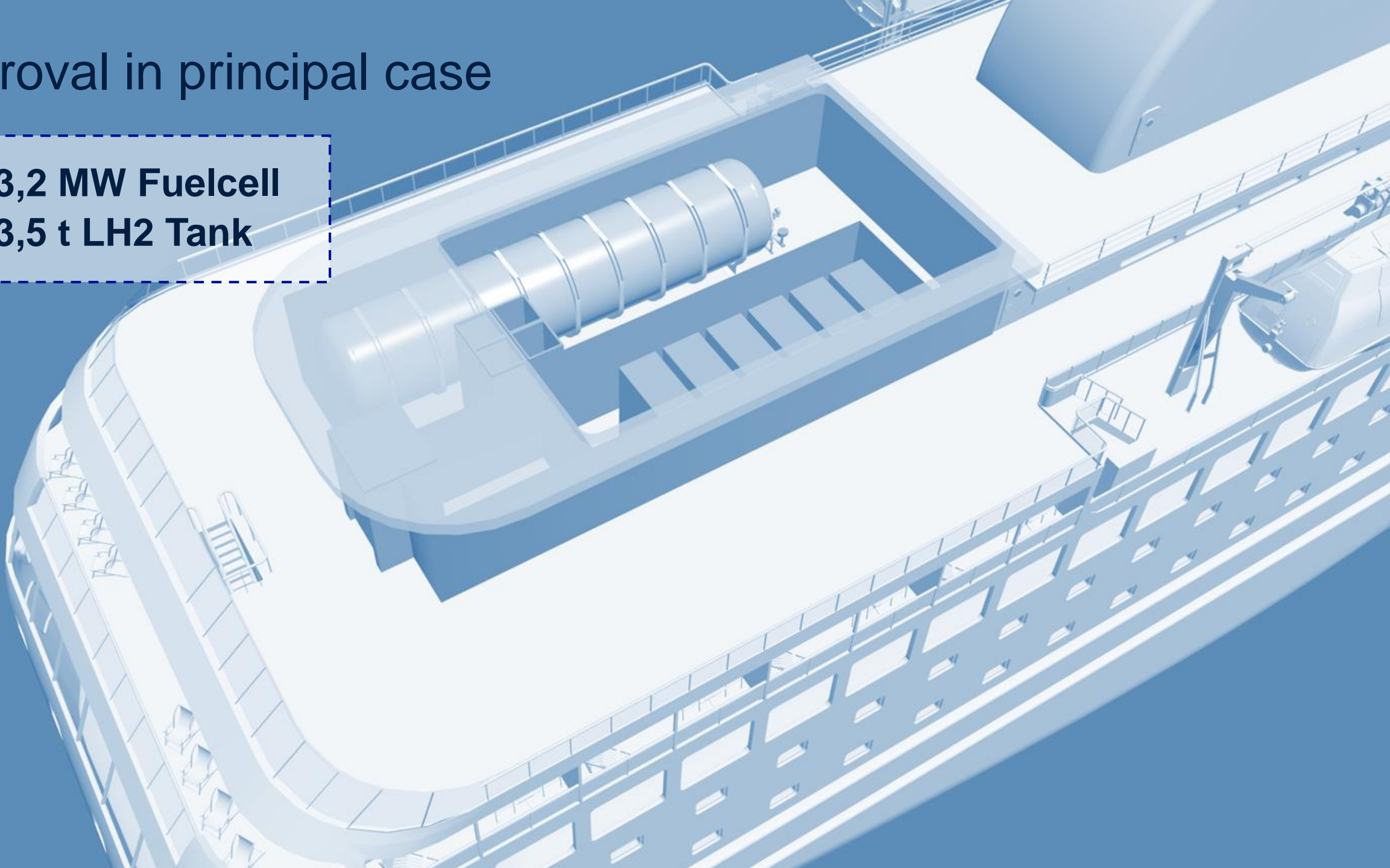
FreeCO2ast targets

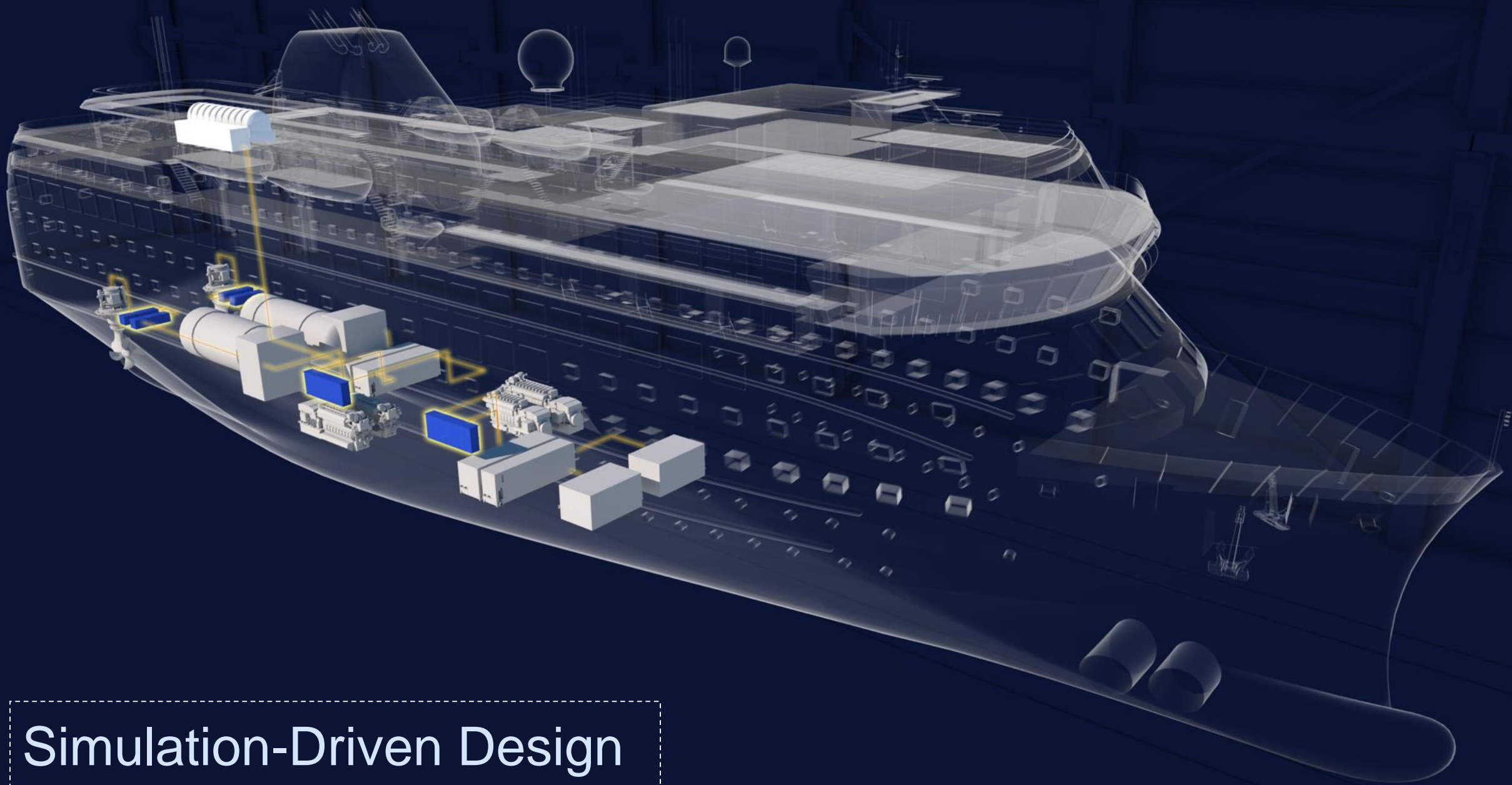
- Develop and approve **Pilot system** for Havila Kystruten
- Expand toolbox for **simulation driven ship design** including hydrogen and total system energy.
- Develop deep knowledge in fuel cell, tank and control system applications. **“X in the loop”** philosophy.
- Explore hydrogen solutions for other vessel segments with **Virtual lab**.
- **Market analysis** for maritime zero emission solutions



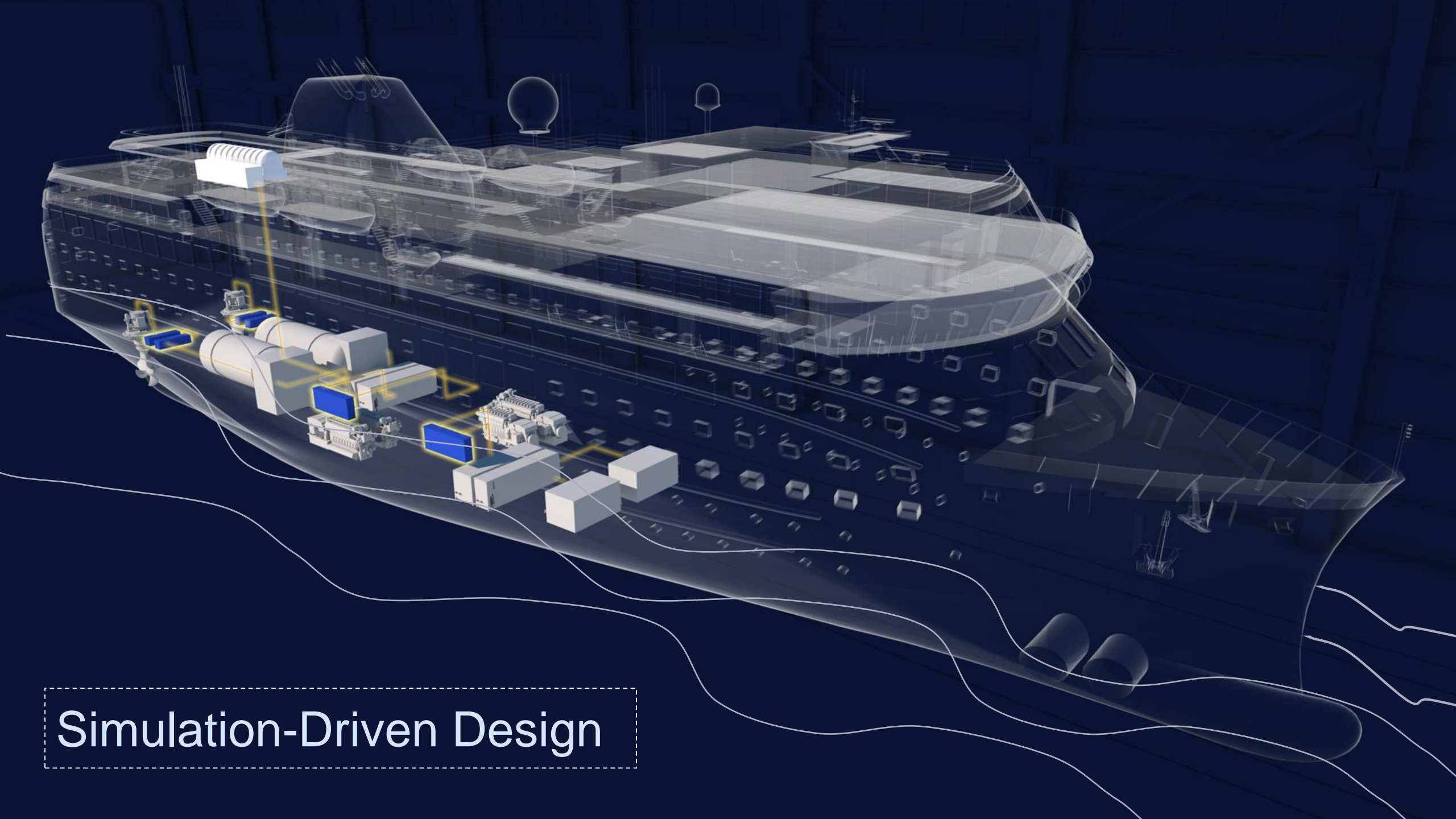
Approval in principal case

- **3,2 MW Fuelcell**
- **3,5 t LH2 Tank**

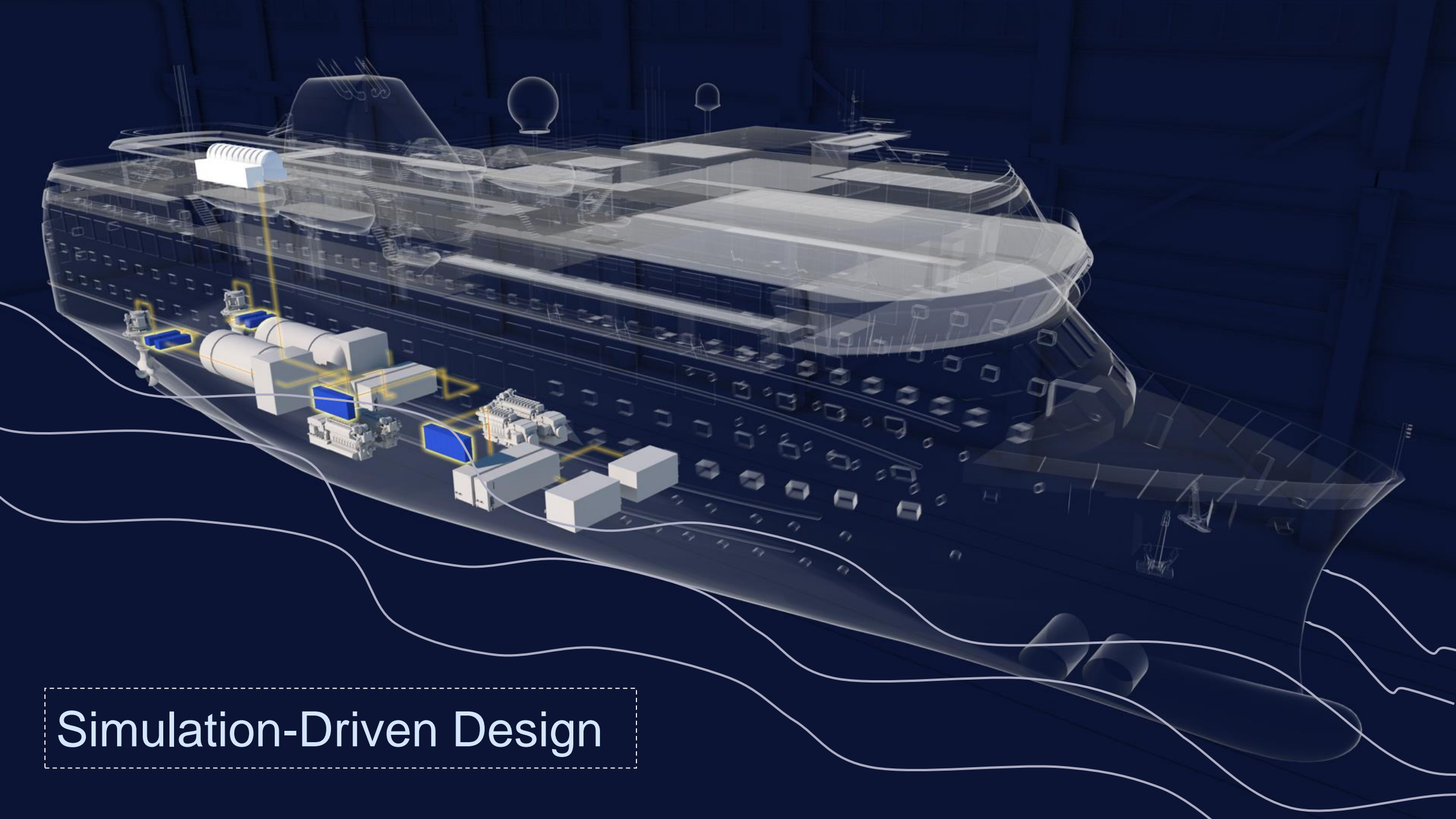




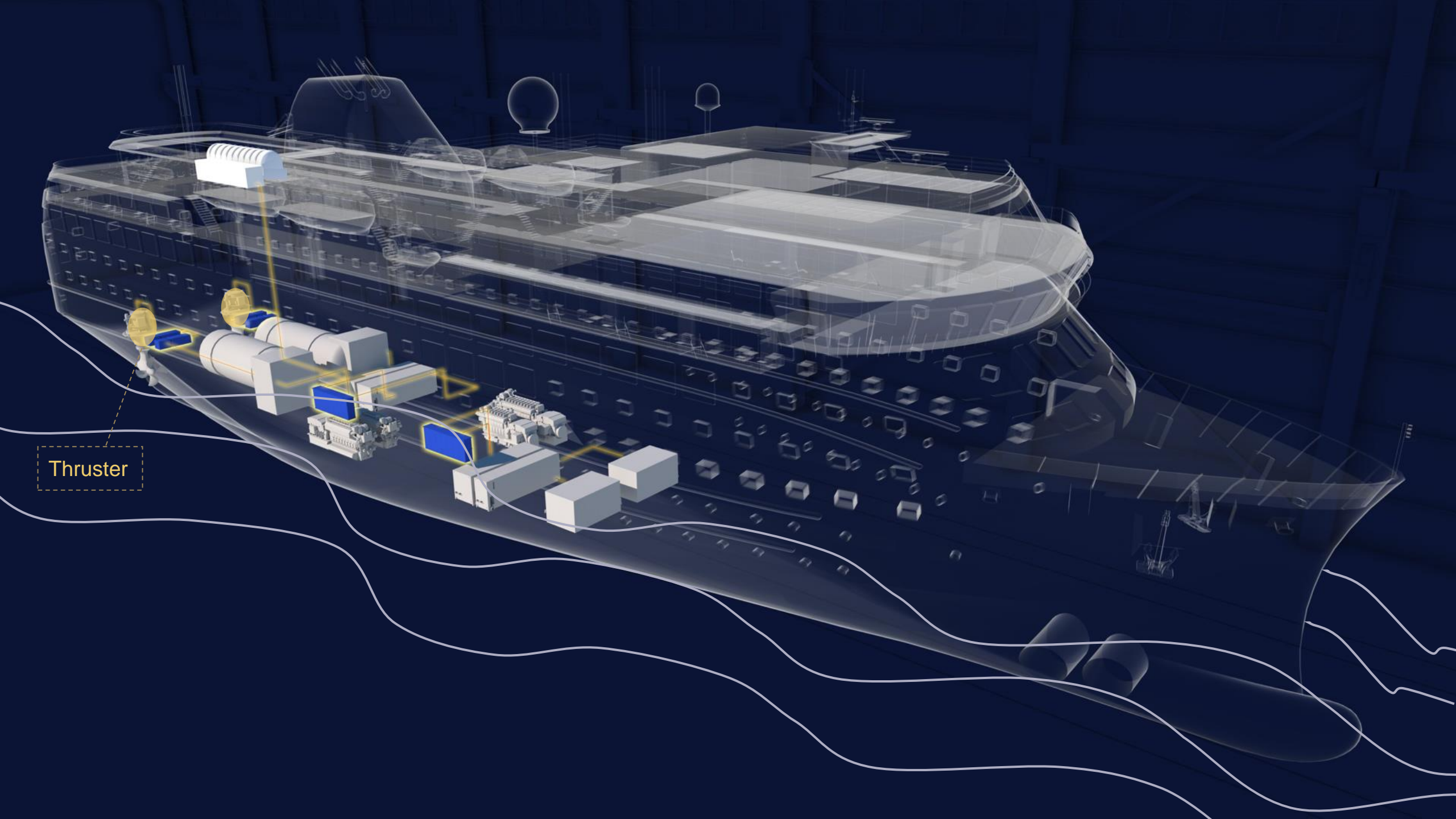
Simulation-Driven Design



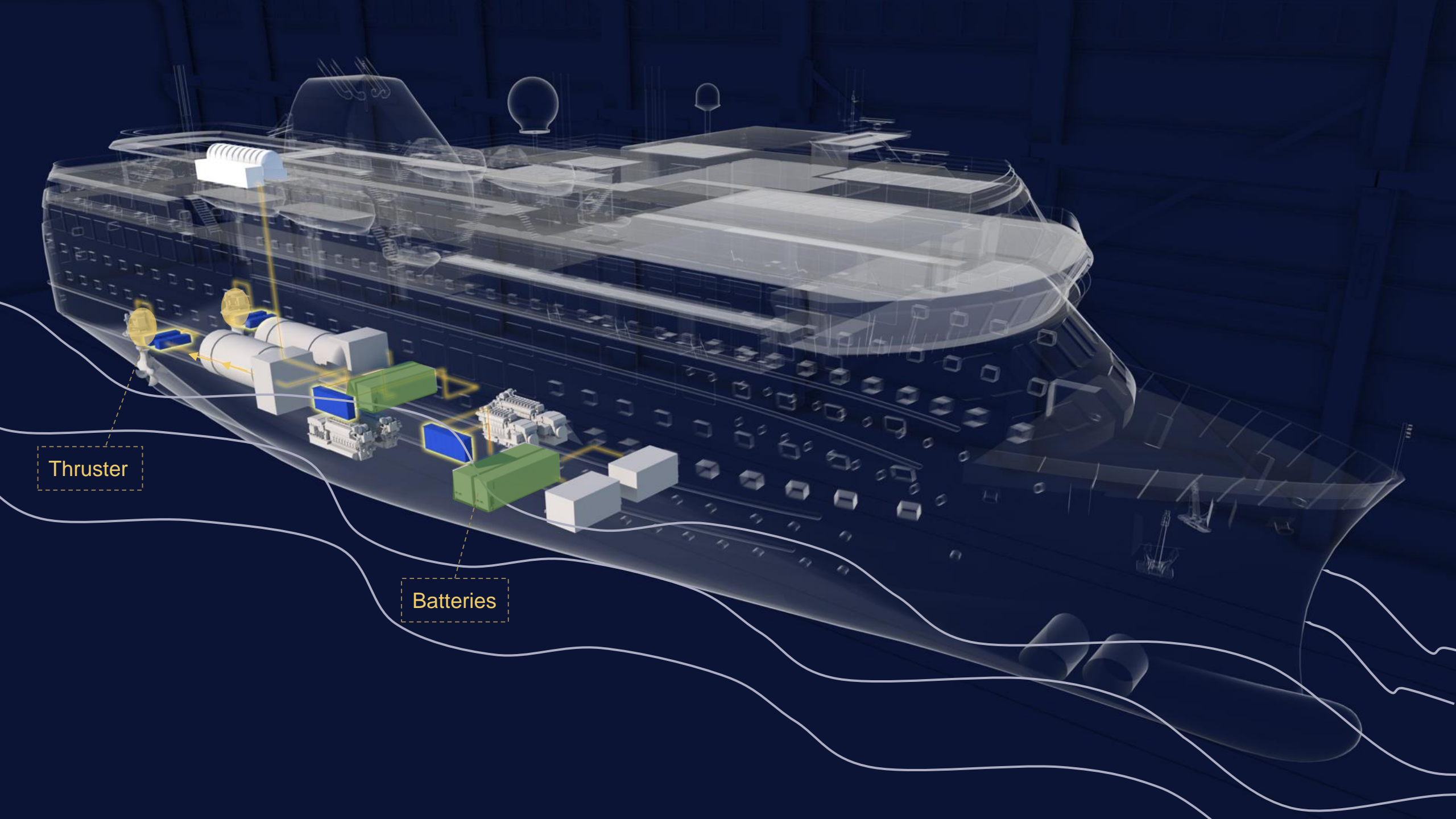
Simulation-Driven Design



Simulation-Driven Design



Thruster



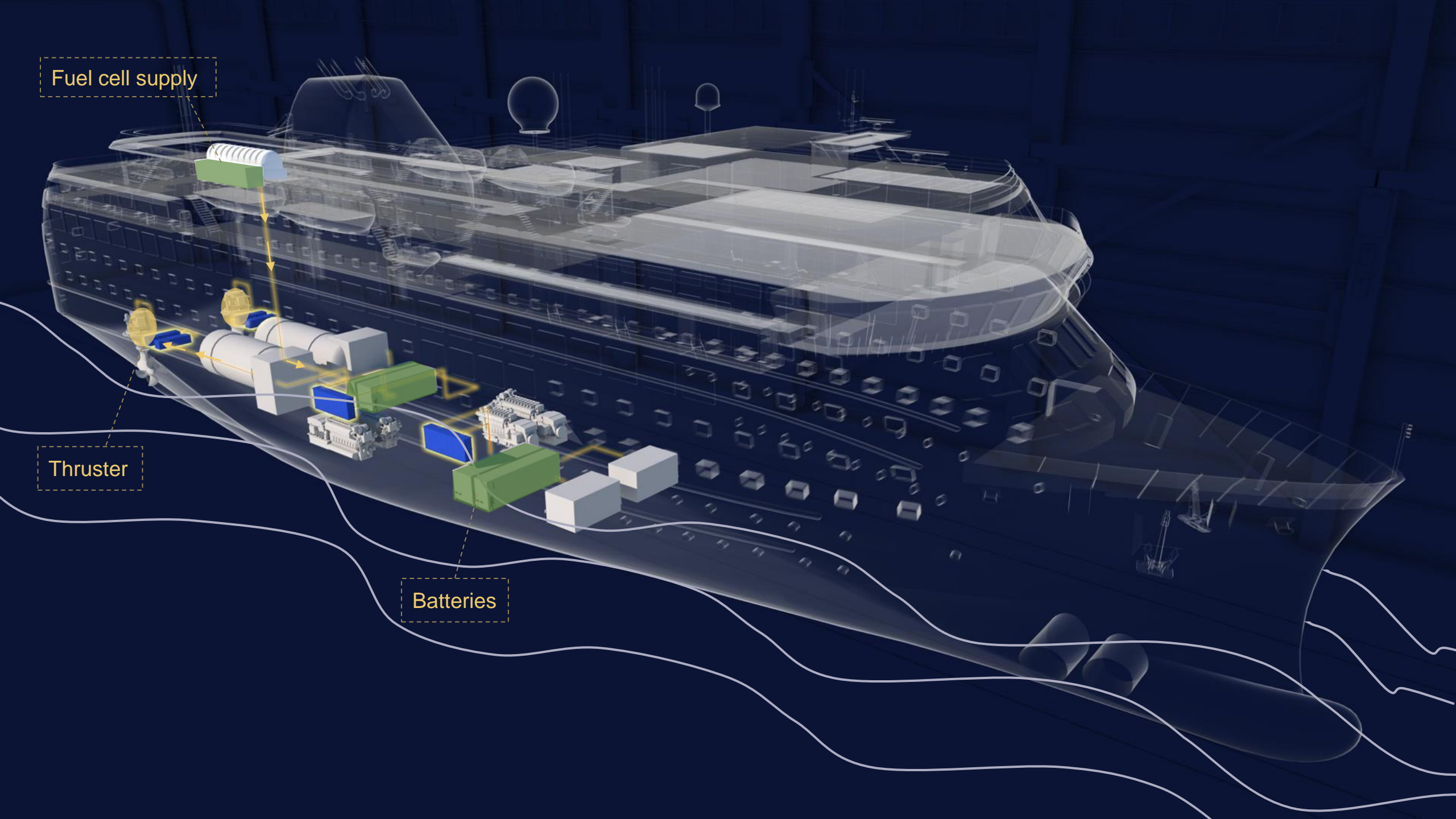
Thruster

Batteries

Fuel cell supply

Thruster

Batteries

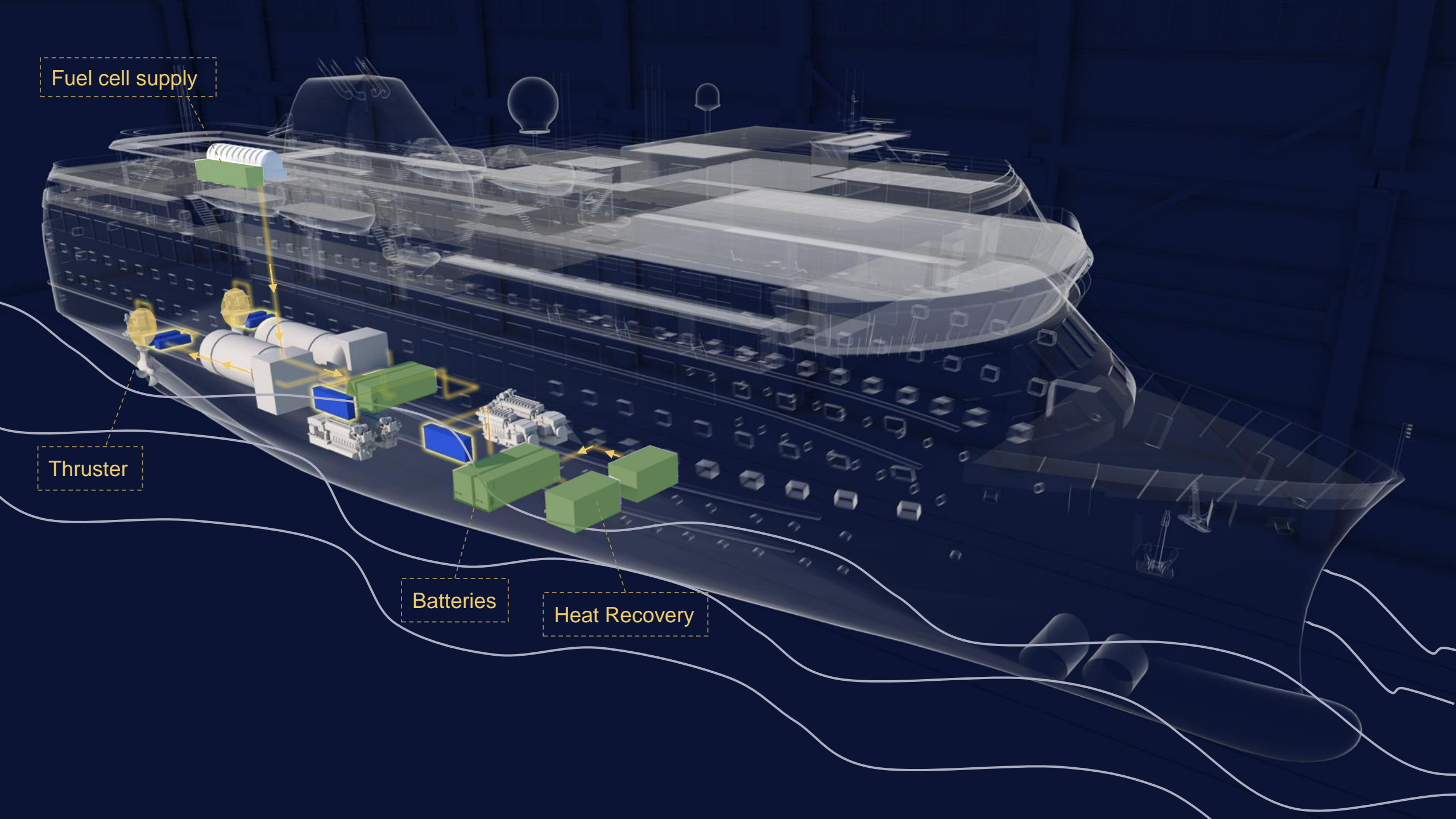


Fuel cell supply

Thruster

Batteries

Heat Recovery



Fuel cell supply

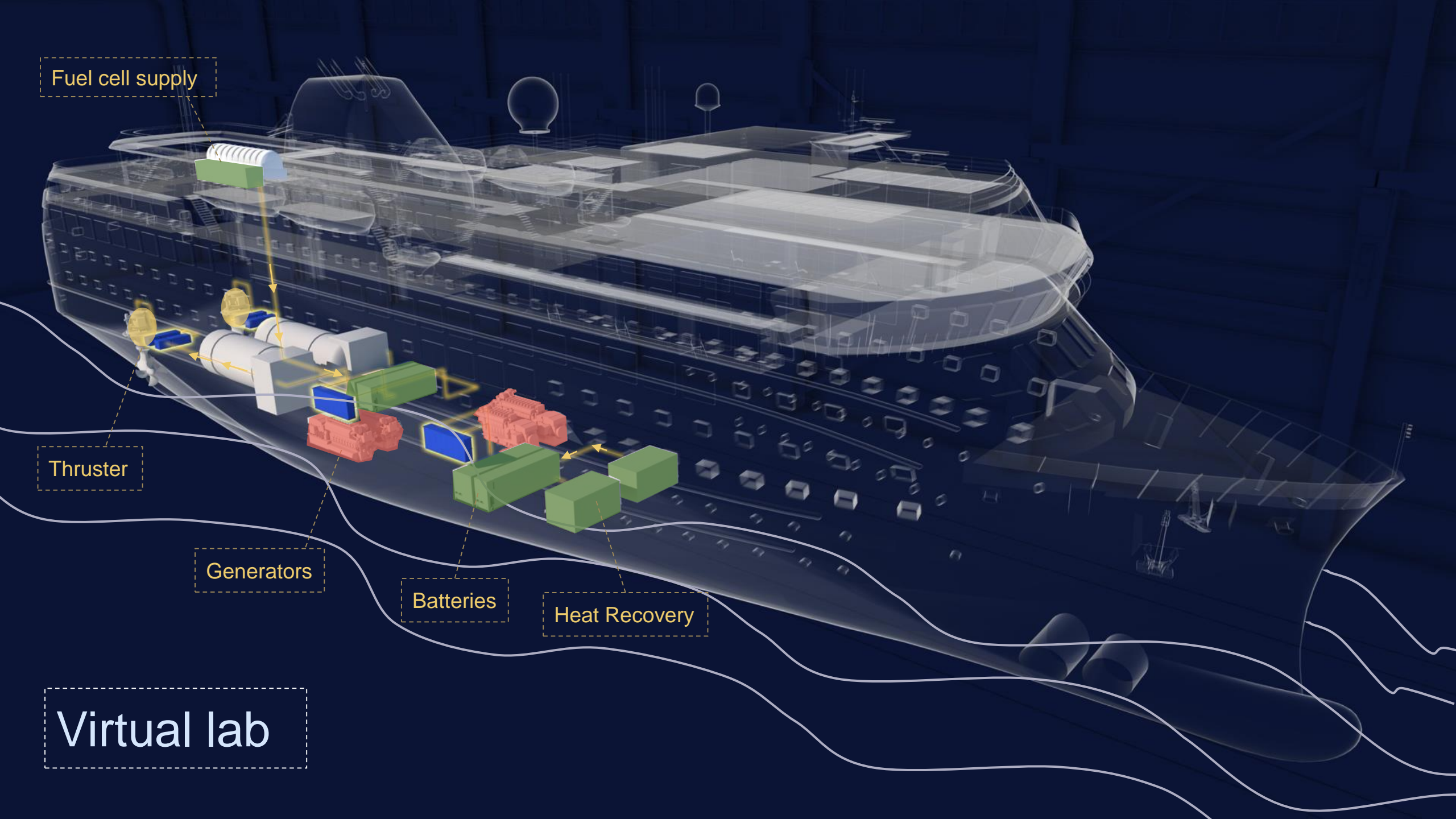
Thruster

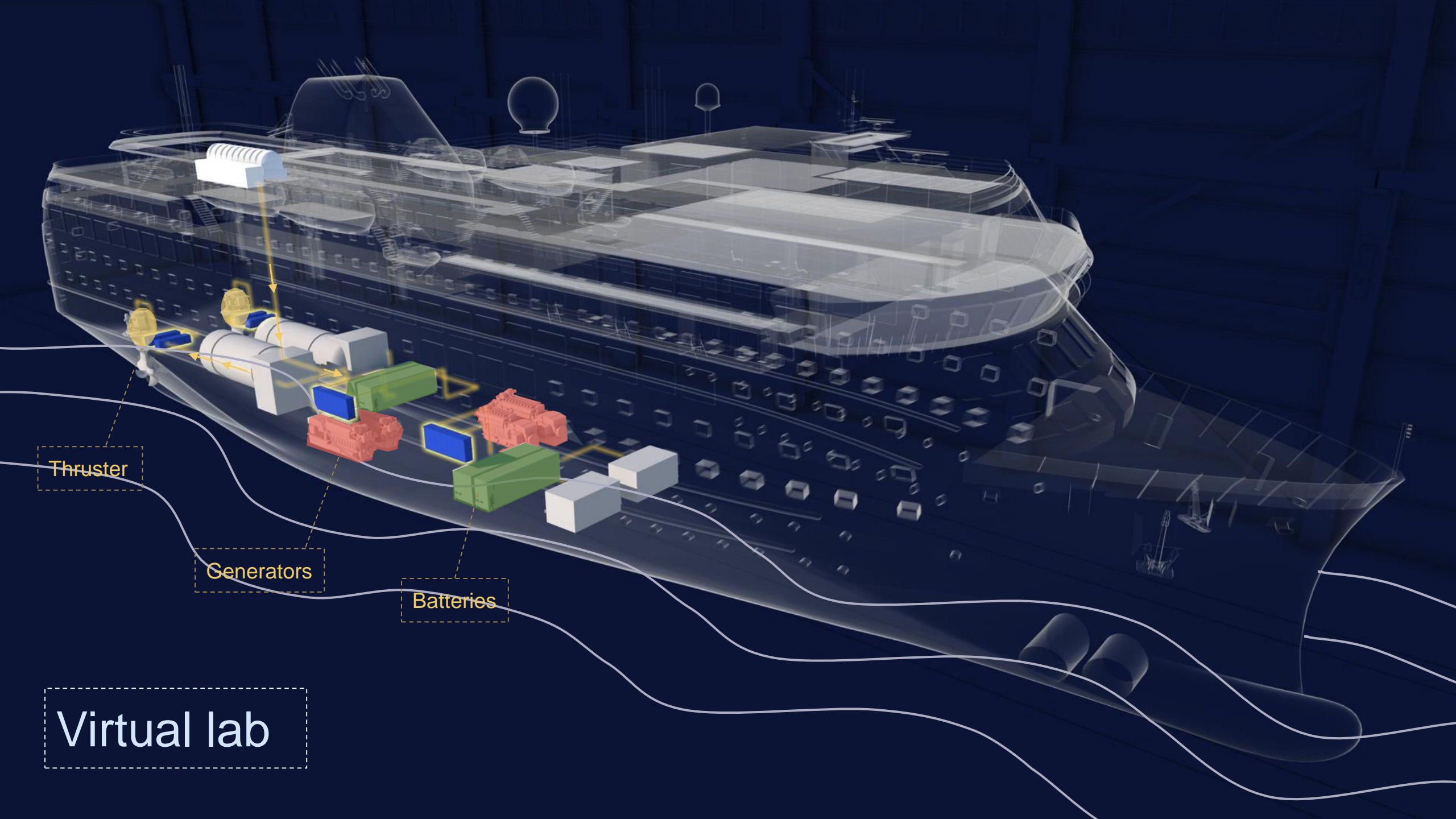
Generators

Batteries

Heat Recovery

Virtual lab





Thruster

Generators

Batteries

Virtual lab

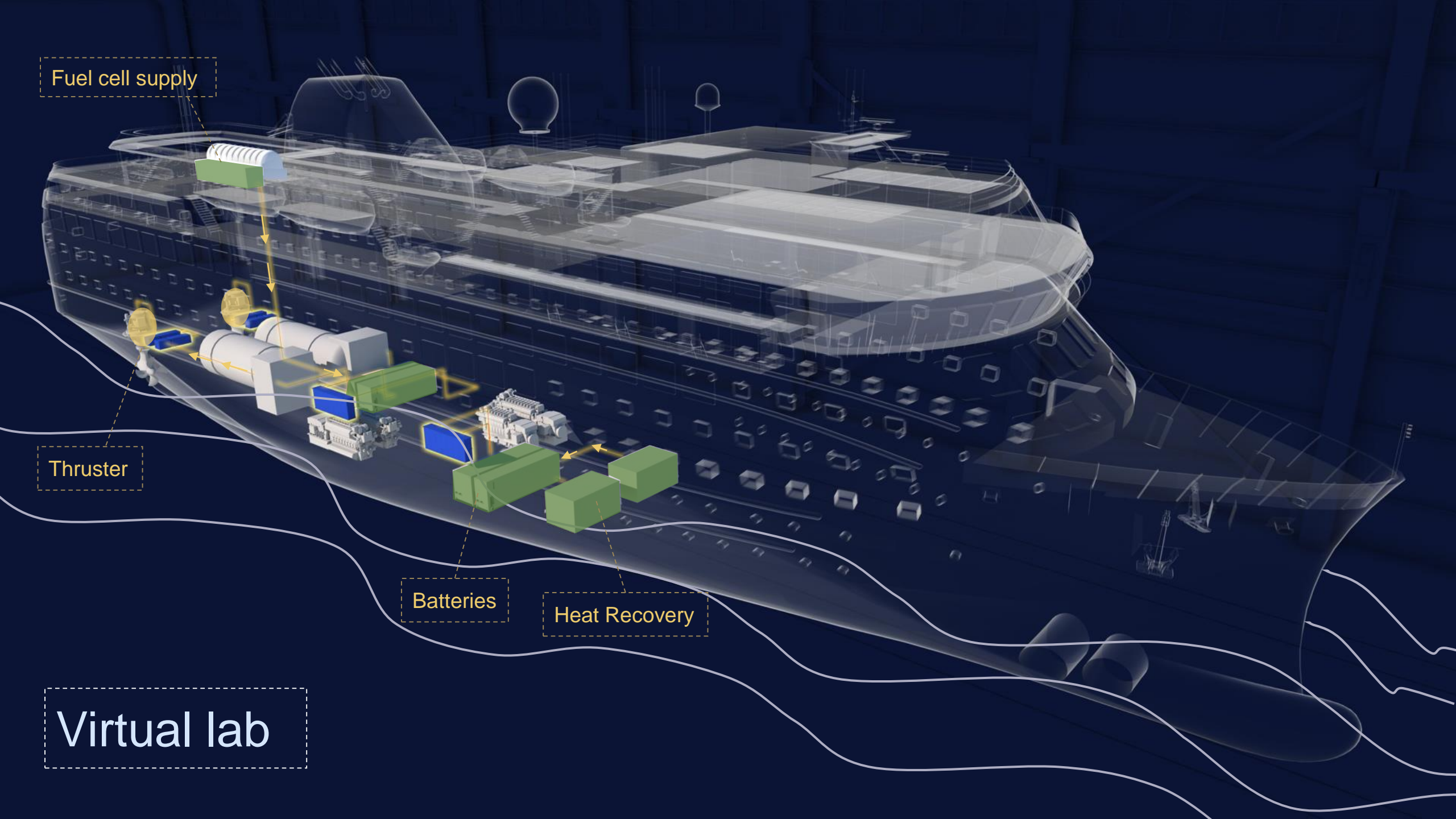
Fuel cell supply

Thruster

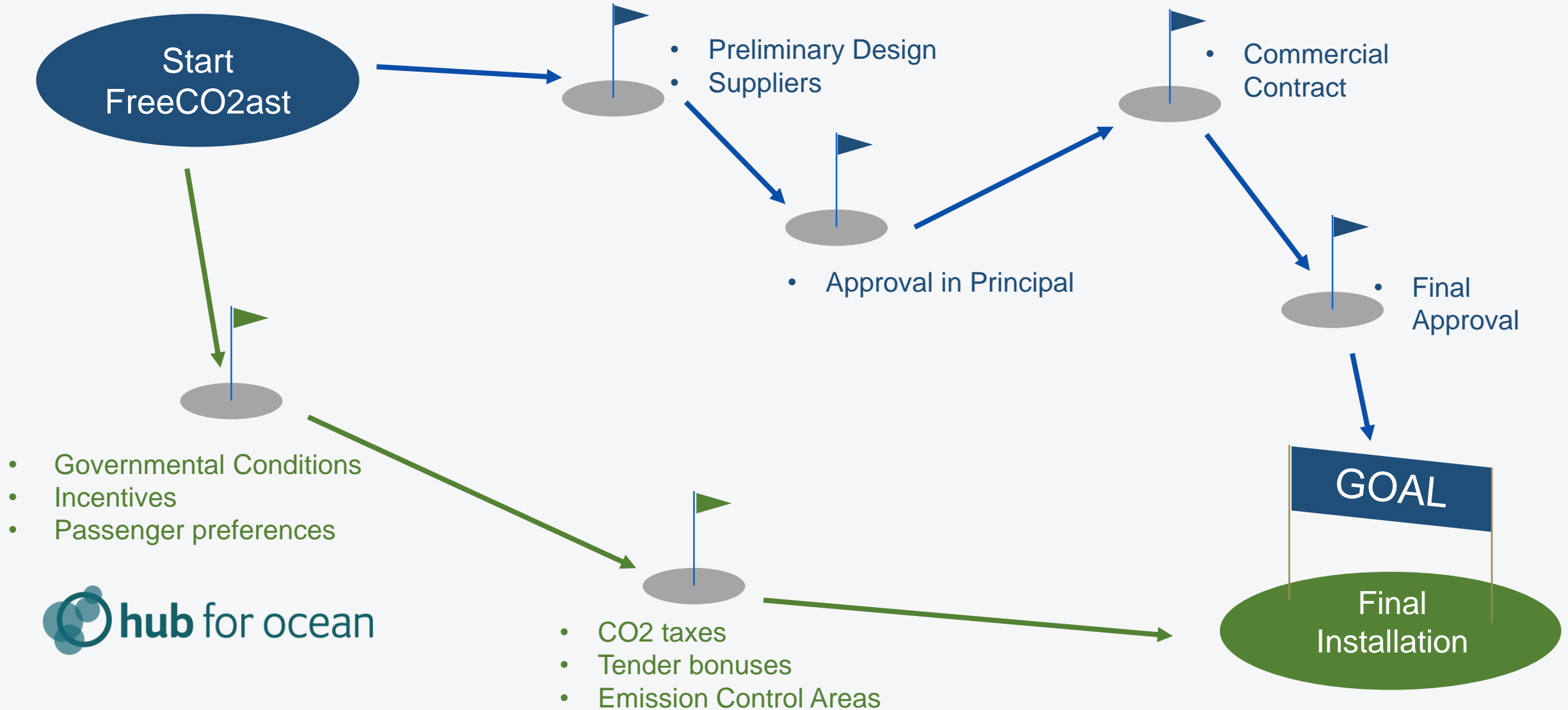
Batteries

Heat Recovery

Virtual lab



FreeCO2ast realization roadmap





Market Analysis

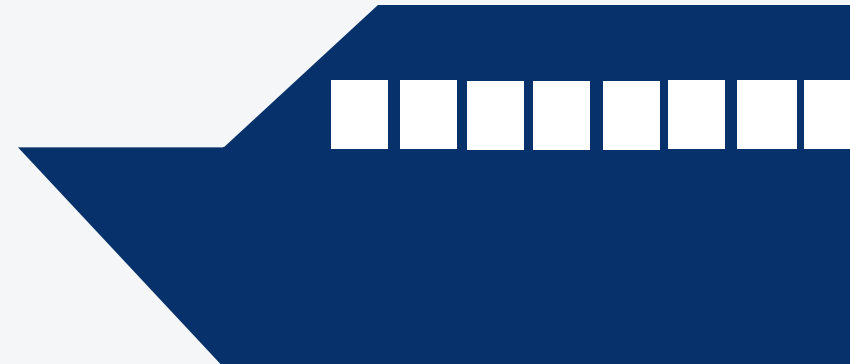
Research questions

- Passenger desire to use zero emission transport?
- Passenger will to pay extra for zero-emission transport 3 years from now?
- Potential passenger fear of being close to hydrogen installations?
- Regulations development?

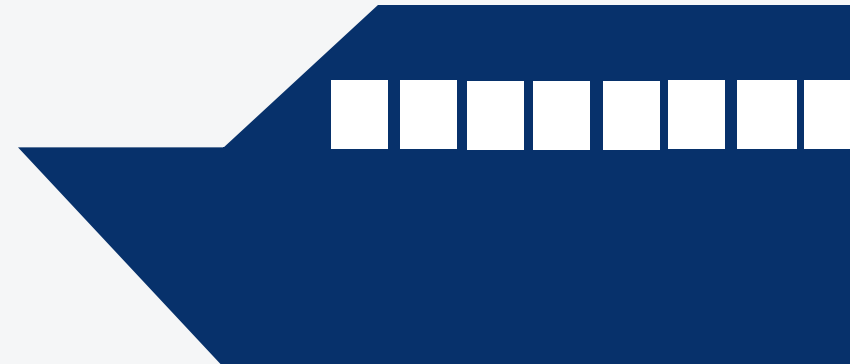
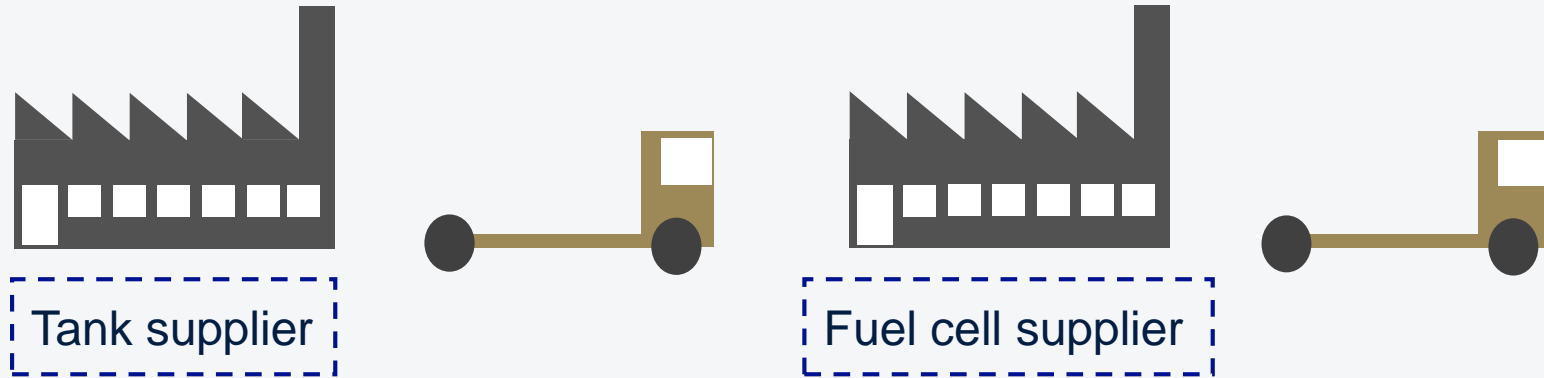
Installation strategy

Challenges:

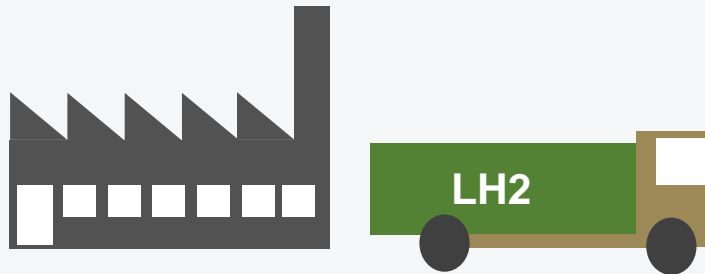
- Timeline require retrofit solution
- Need technology verification
- Extensive commissioning and tuning
- Ongoing tender demands very short yard stay



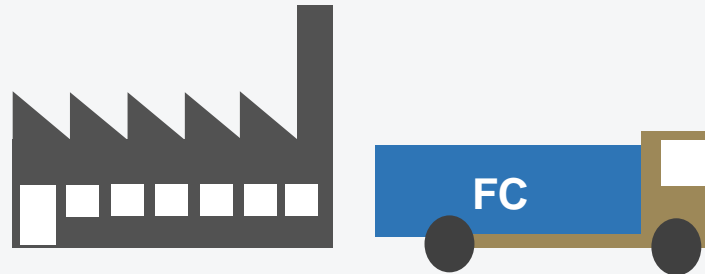
Installation strategy



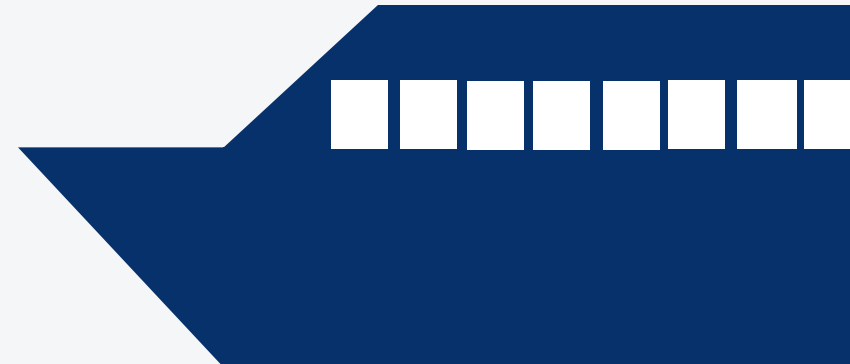
Installation strategy



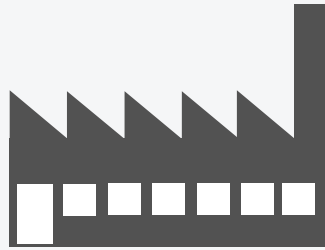
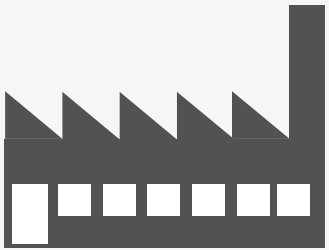
Production LH2 module
Factory Acceptance Test



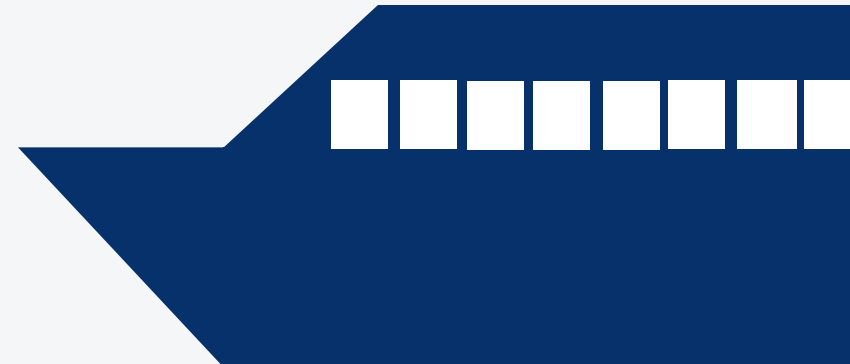
Production FC module
Factory Acceptance Test



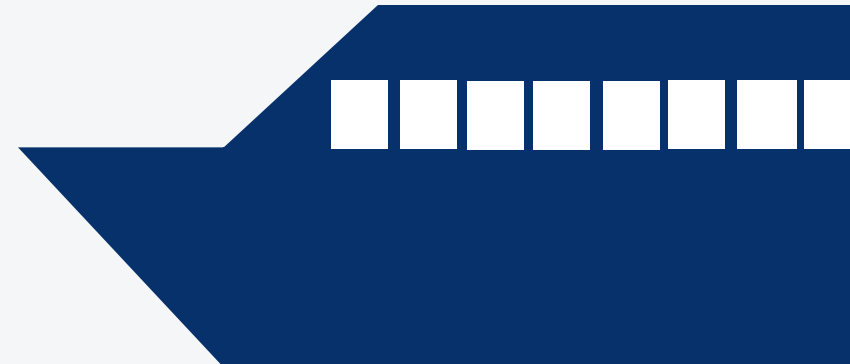
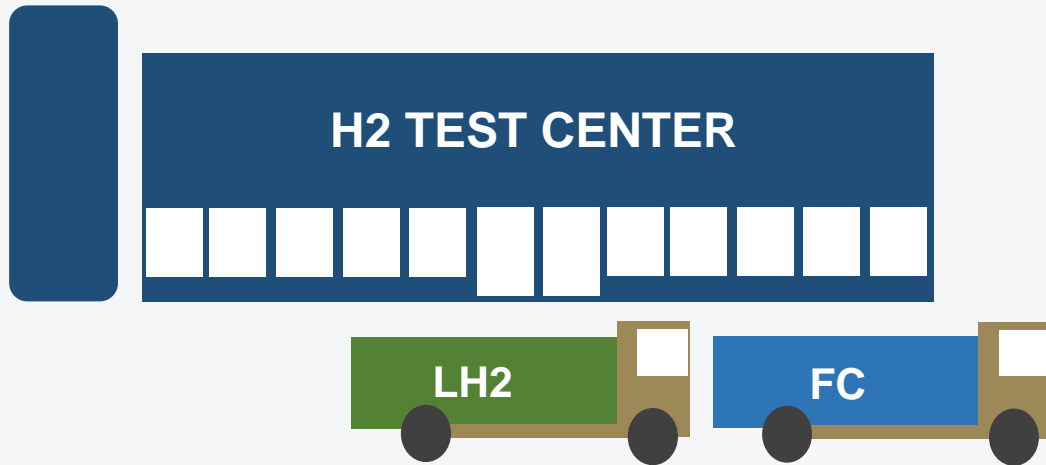
Installation strategy



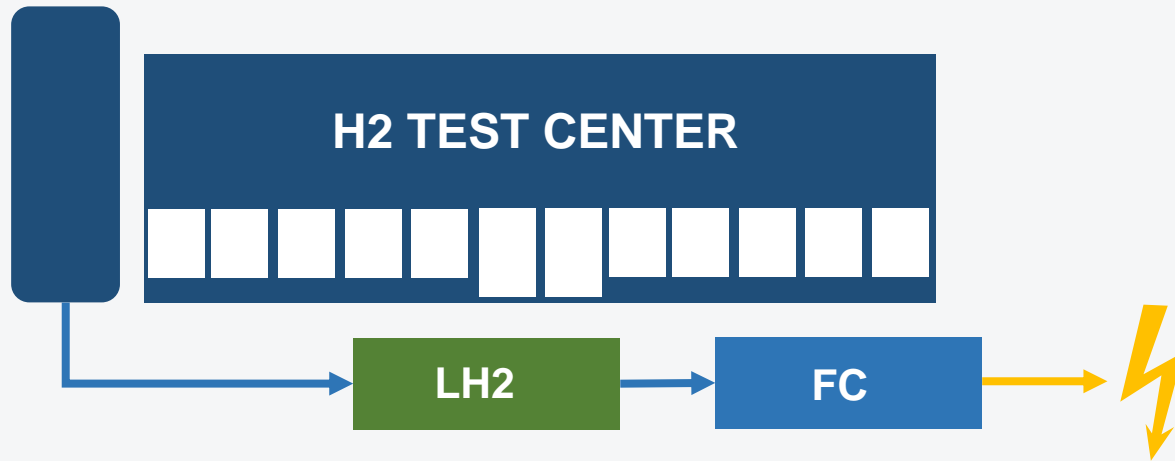
Transportation to test site



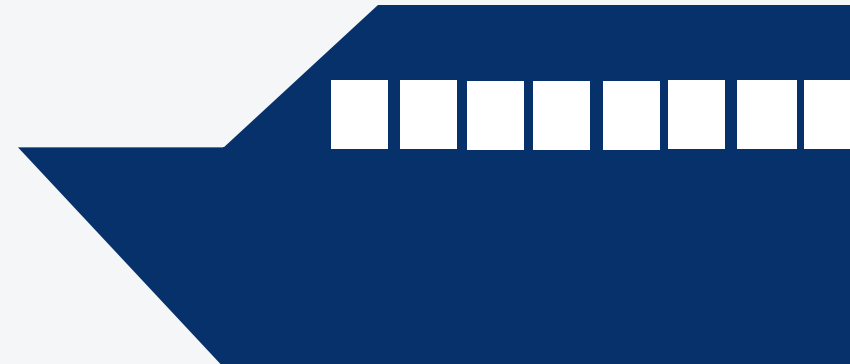
Installation strategy



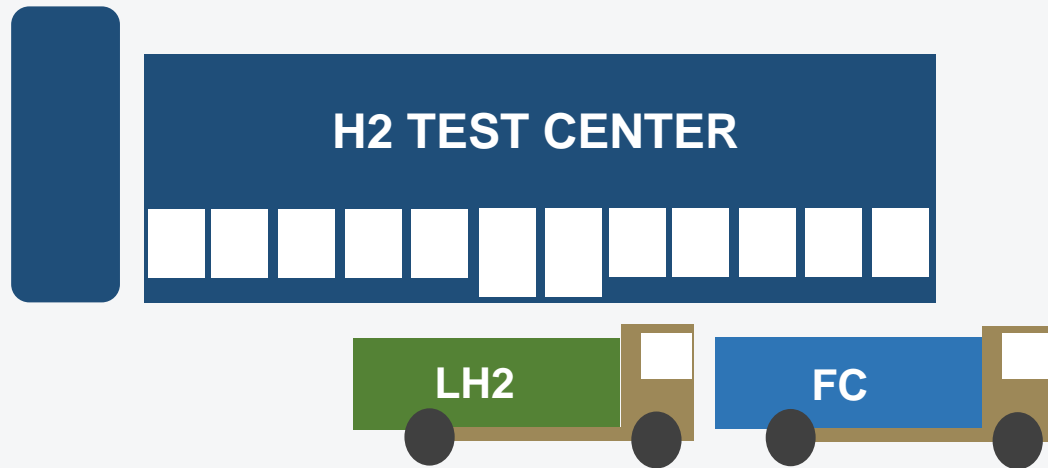
Installation strategy



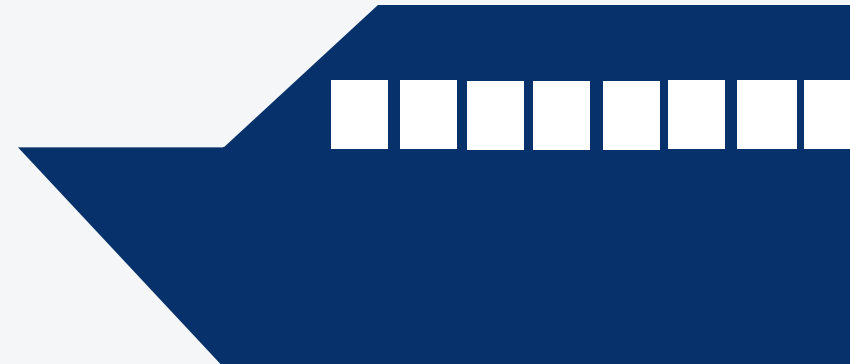
- Onshore Commissioning
- Testing towards simulated environment and other components (Virtual lab, X-in the loop)



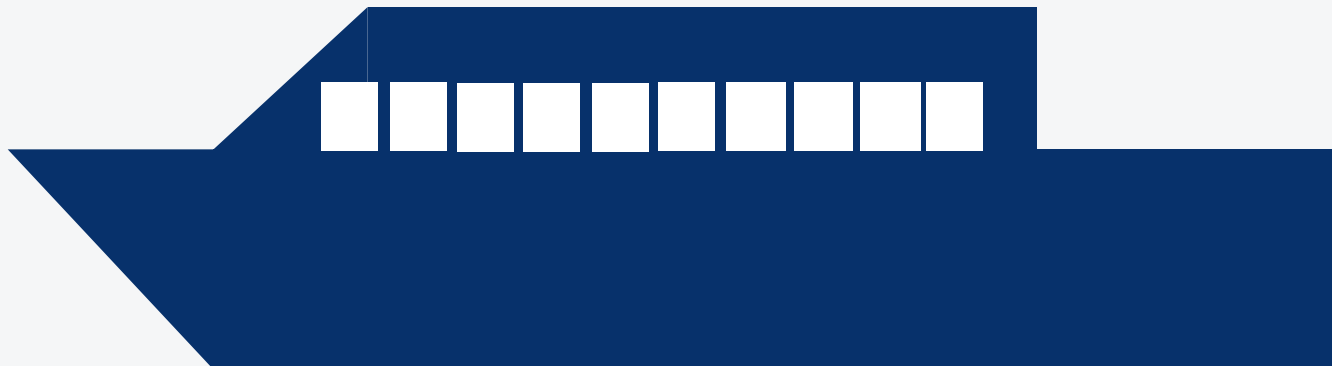
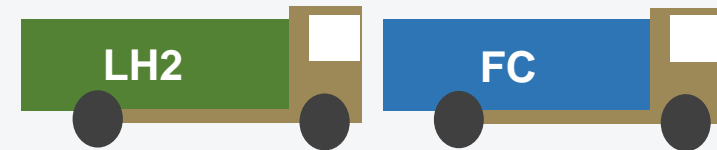
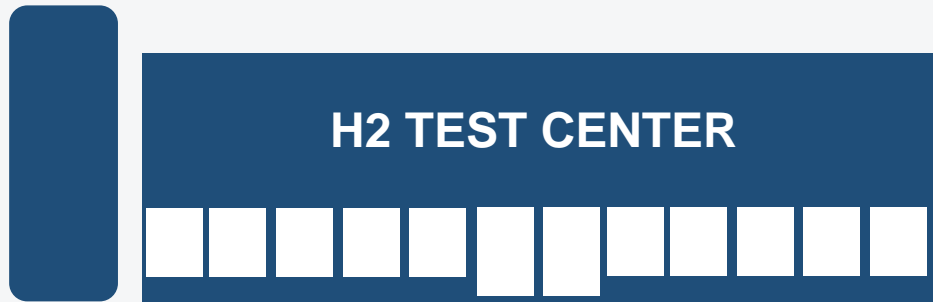
Installation strategy



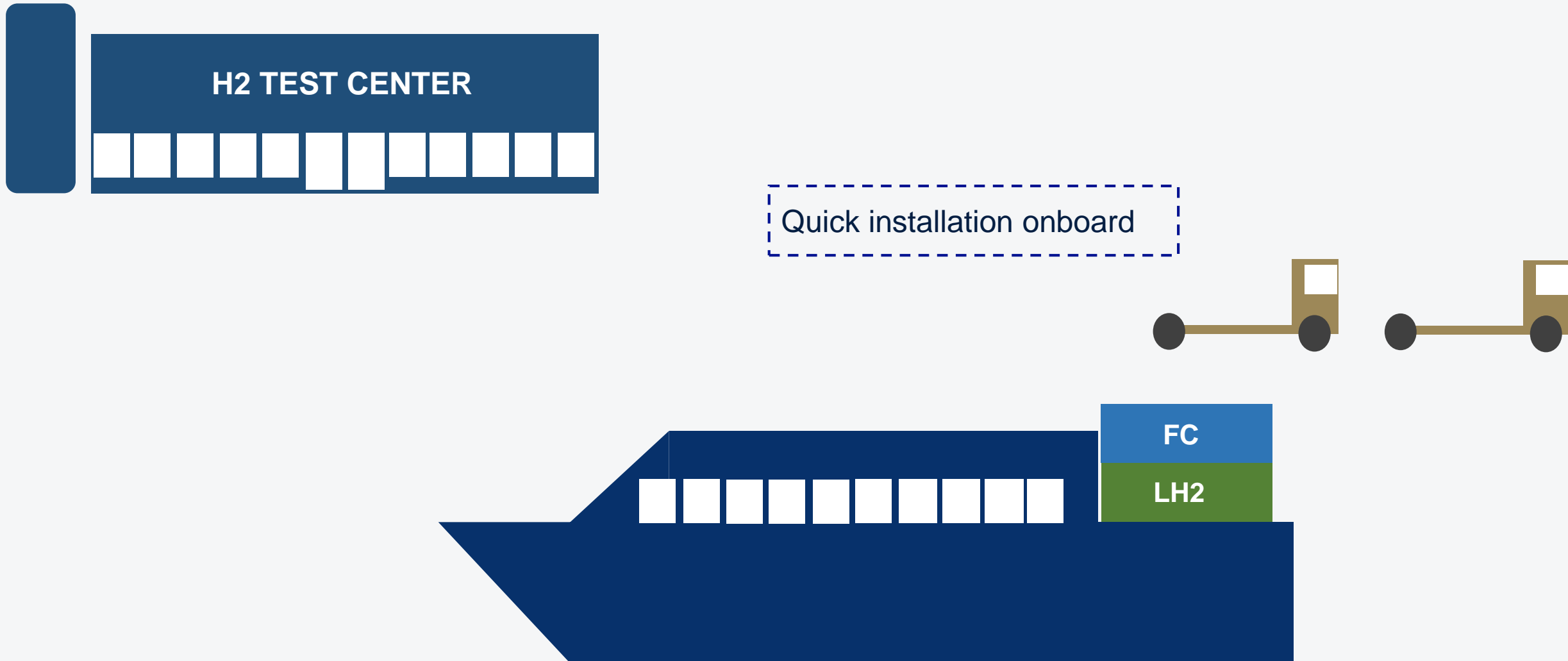
Complete H2 solution prepared for onboard installation.



Installation strategy



Installation strategy



Installation strategy

- Support and tuning during sailing enabled by data exchange from ship to shore
- The ships existing hybrid solution (LNG/battery) takes away risk of downtime

FC

LH2



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