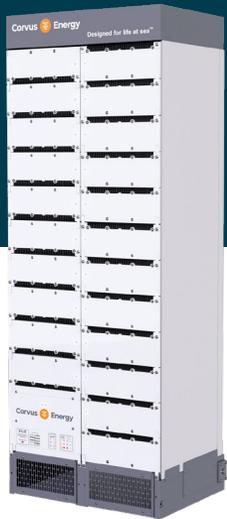




# Maritime Fuel Cell systems

# Different products for different applications



Corvus  
Orca Energy



Corvus  
Blue Whale



Corvus  
Dolphin Power



Corvus  
Dolphin Energy

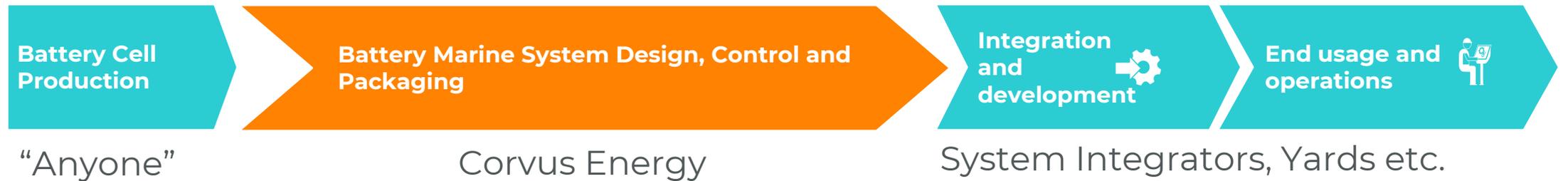


Corvus  
BOB Container

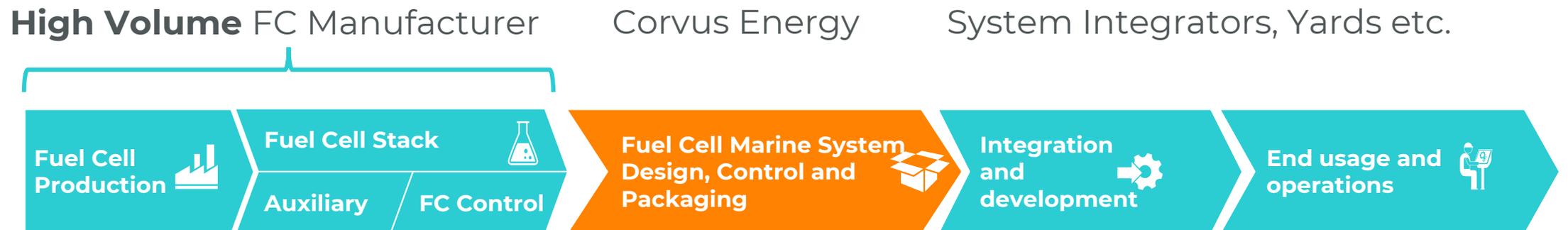


Corvus  
Fuel cell

## Battery Value Proposition



## Fuel Cell Value Proposition



# STRONG CONSORTIUM

– Innovation through collaboration



10M+ USD Budget

**TOYOTA**



Corvus  Energy



 **NORLED**

**USN**

 **Wilhelmsen**

 **LMG MARIN**

Funded by  **Innovasjon Norge**

 **Forskningsrådet**

**H2NOR**

**HyLOCD**



# STRONG CONSORTIUM

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Corvus  Energy



 NORLED

USN



Funded by  Innovasjon Norge  
**H2NOR**  Forskningsrådet  
**HyLOCD**

## Fuel Cell Systems



Corvus  Energy



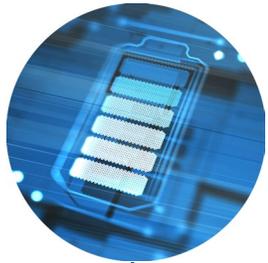
# Main Goal for the H<sub>2</sub>nor Fuel Cell Development Program:

To develop, demonstrate and certify a modularized maritime PEM-based Fuel Cell system suitable for mass production with a power range from 320 kW to 10 MW within 31.12.2023



# Fuel Cell Development Timeline:

Corvus Fuel Cell Development Initiated



2020

Approval in Principle of Corvus Fuel Cell System (PEM)



2022

*Achieved April 2022 (DNV)*

Commercial Deliveries of Type-Approved Corvus Fuel Cell Systems (PEM)



2024

Second Type-Approved Corvus Fuel Cell System (next generation)

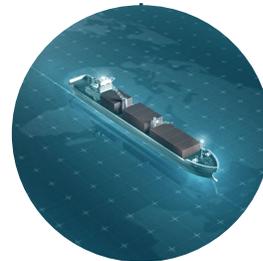


202X

Corvus Energy

**TOYOTA**

Marine PEM Fuel Cell Partnership



Selected Sailing Pilots



Automated Factory

# Approval in Principle from DNV

April 4, 2022

Press Releases

## Corvus Energy Inherently gas safe marine fuel cell system awarded Approval in Principle by DNV

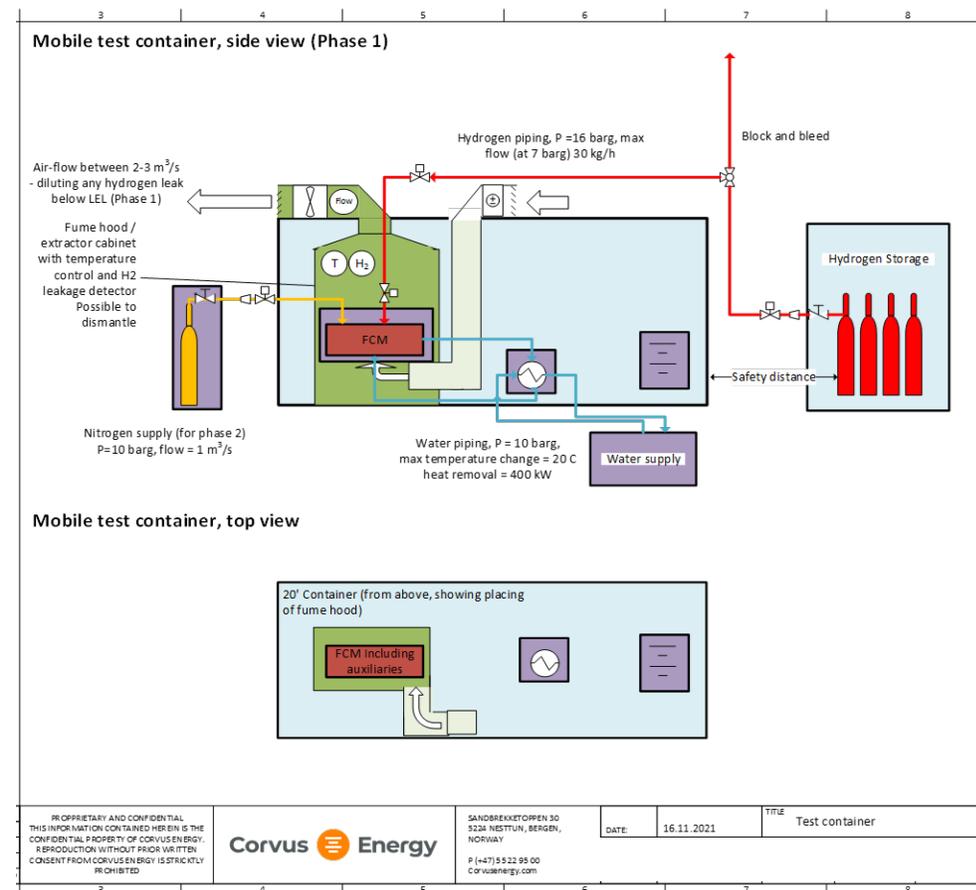
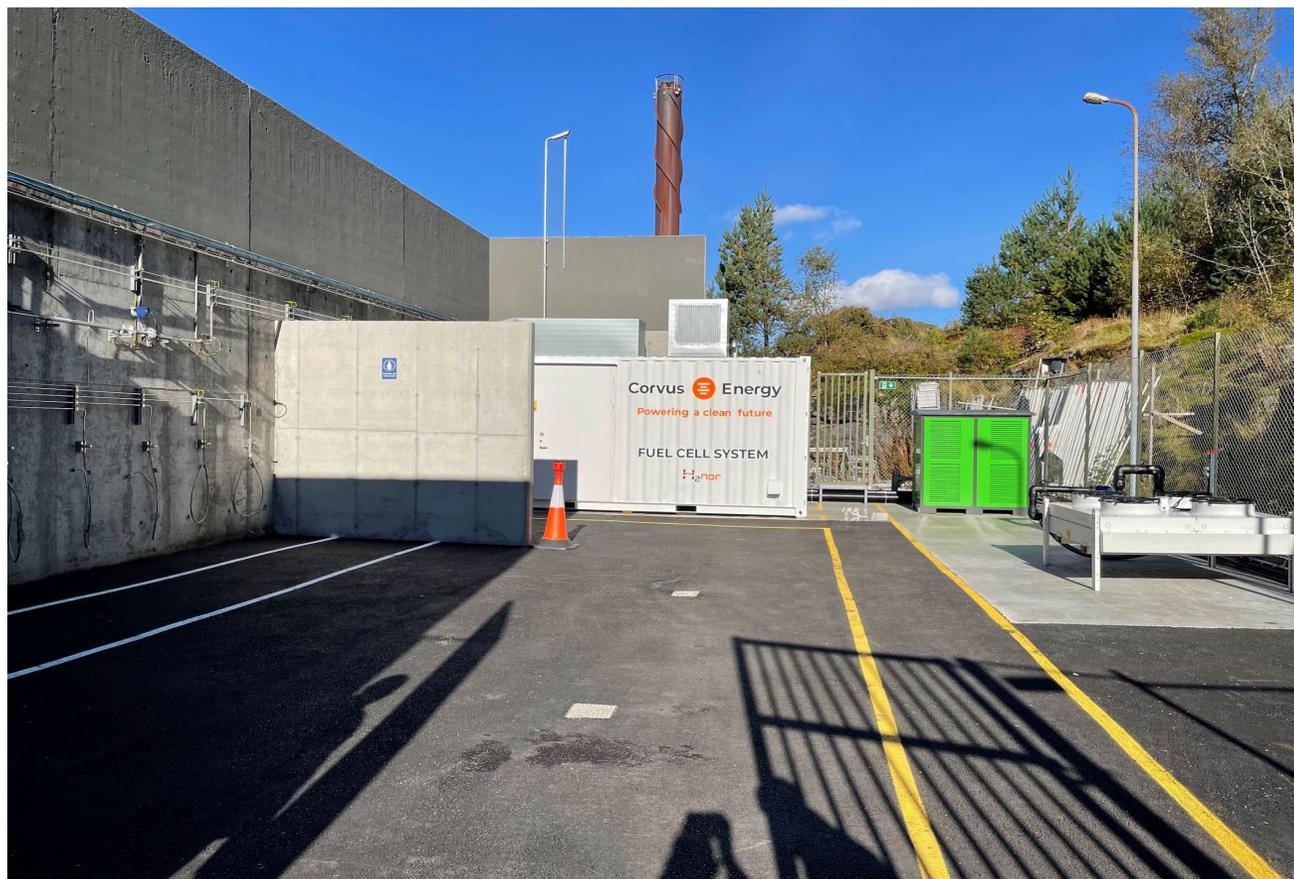
Bergen, Norway and Vancouver, Canada, April 4, 2022—The Corvus Energy Hydrogen Fuel Cell System developed through the H2NOR project has...



- The outcome is a result from a dedicated team, which brought experiences from designing inherently gas safe combustion engines systems.
- The concept is based on IMO's IGF codes, active dialogues with classification companies and other stakeholders involved in the process.

# FC Test Site

Live testing with relevant auxiliaries and combined with energy storage system



## Fuel Cell technical data

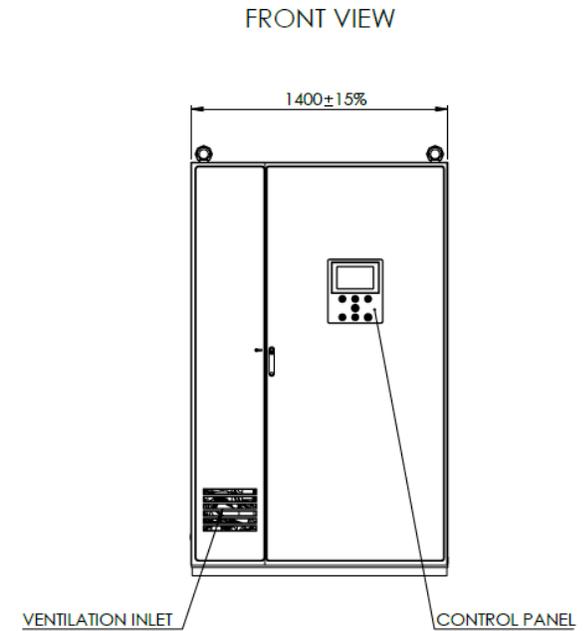
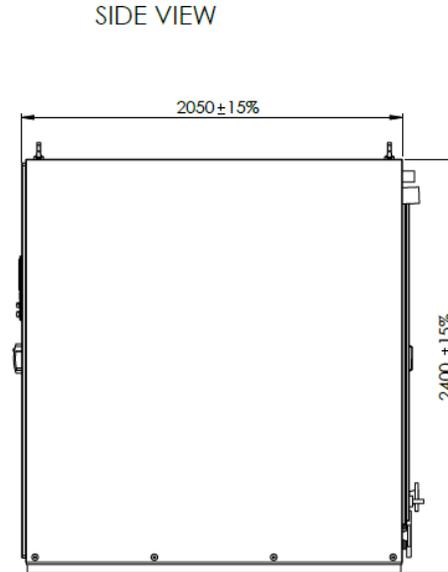
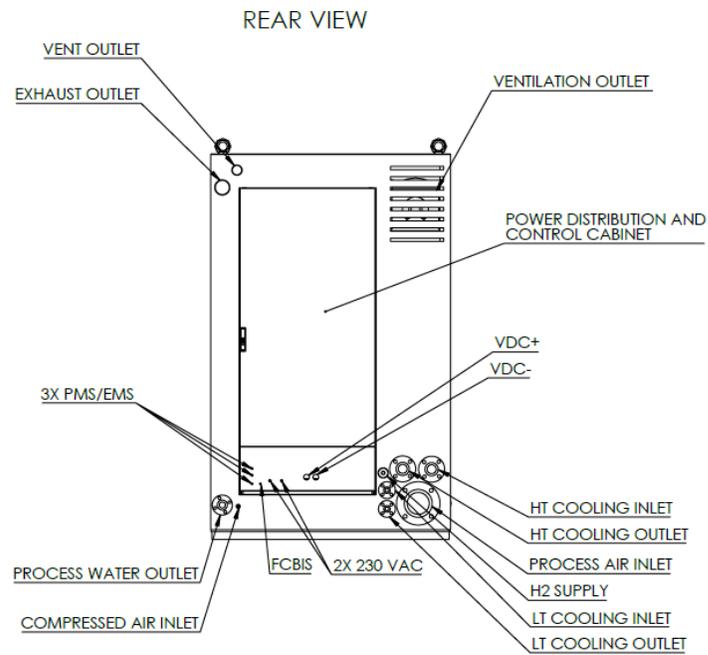
- Power Output 1 pack: 320 kW
- Type approval **Inherently gas safe**
- Technology partner TOYOTA with proven technology, more than 26,000 units produced
- Main Service overhaul interval: 30,000 hrs
- Applications:
  - New builds, under deck
  - Retrofit (containerized solution)



### Gas safe machinery space

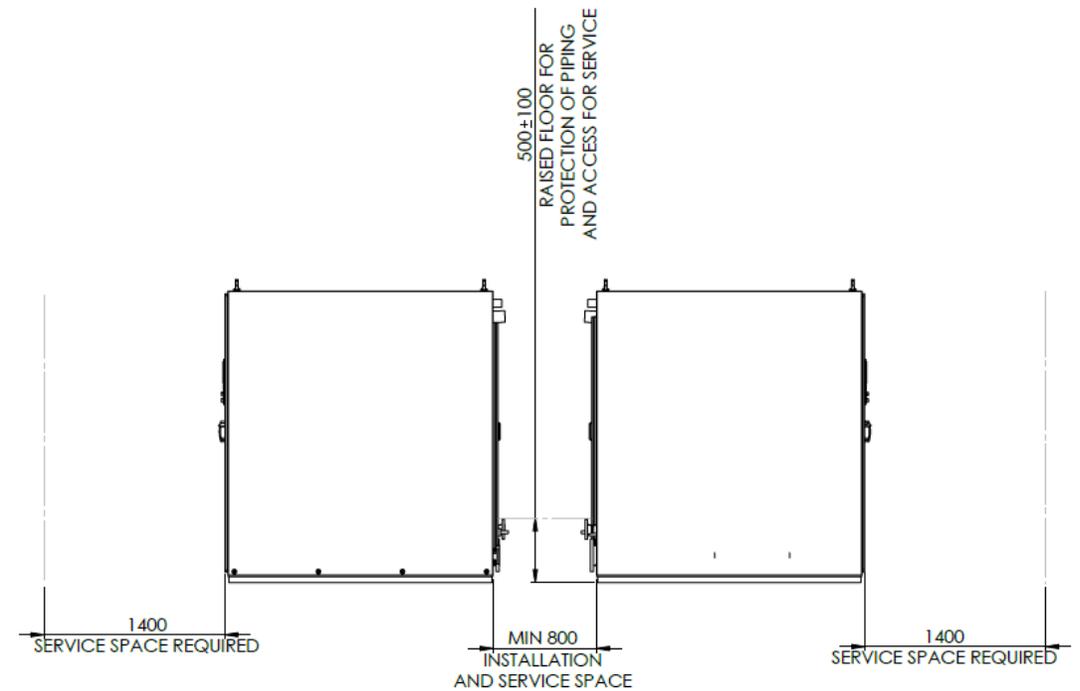
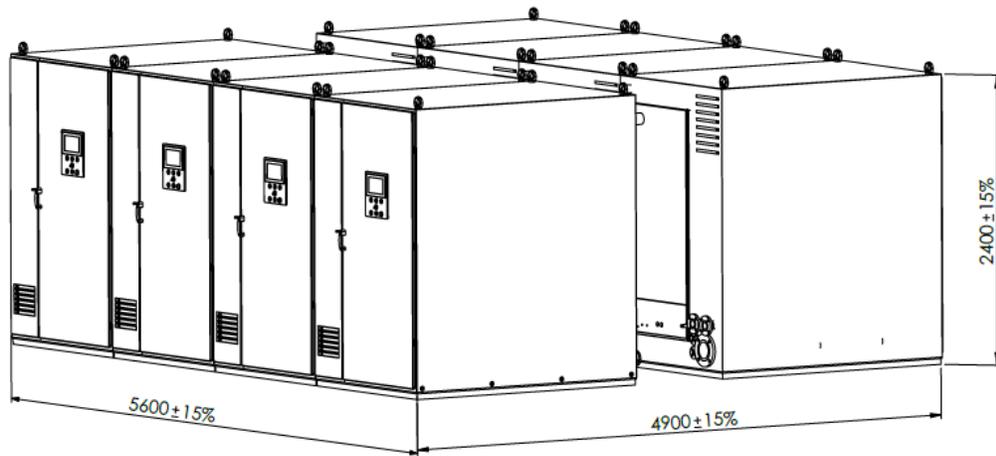


# Module Based Solution Expandable to meet power requirement

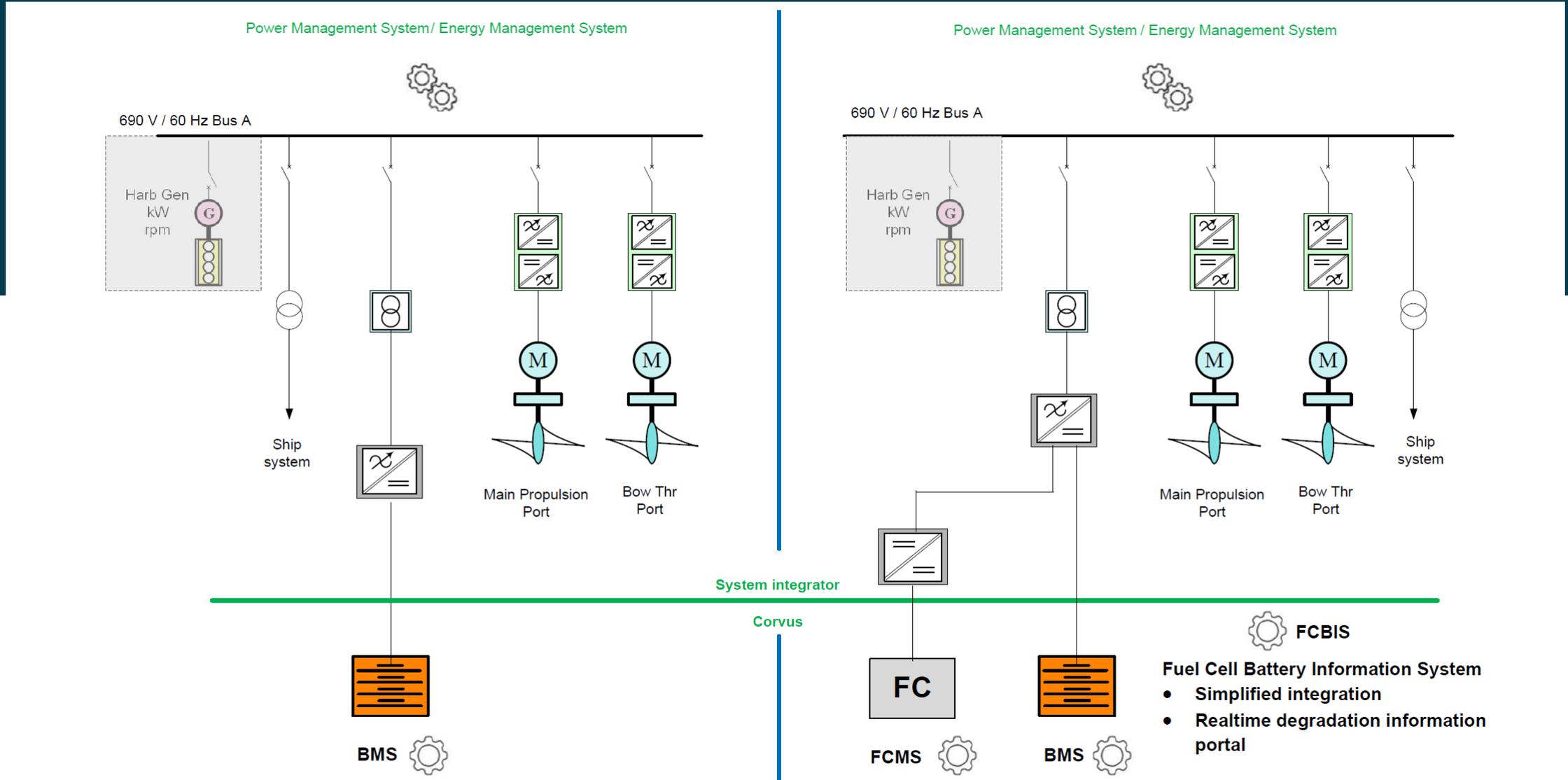


# Cutout of General Arrangement - System

EXAMPLE SYSTEM 2  
2560 kW  
8 PACKS BACK TO BACK PLACEMENT

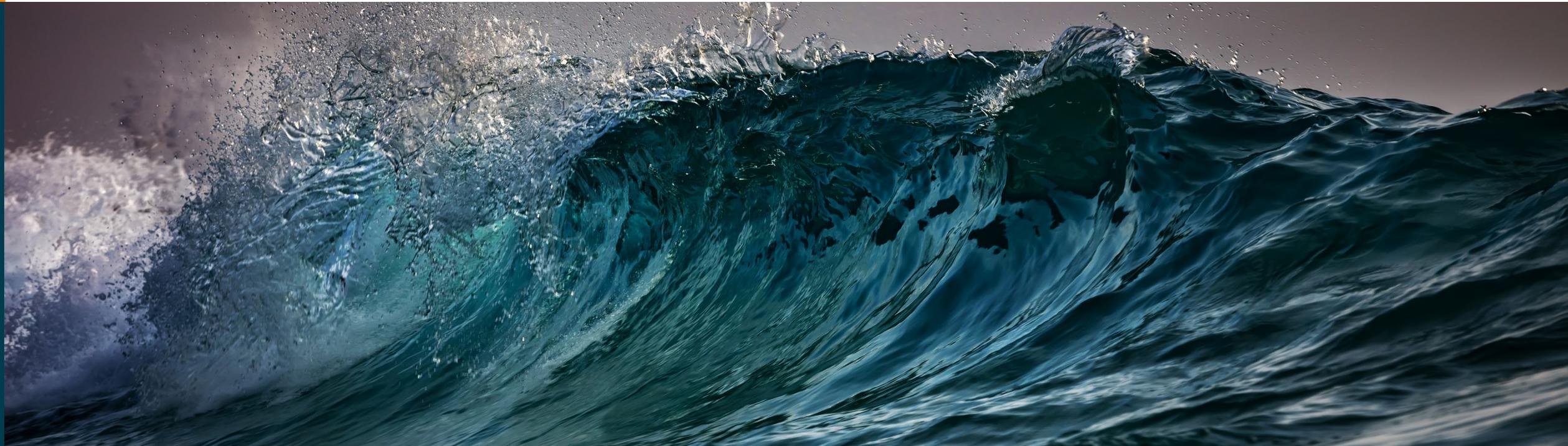


# Current vs. Future Corvus System Deliveries



# Batteries and Fuel Cells. A closer look at the combined use of the technologies.

How they strengthen the performance of each other and extends both range and lifecycle for zero emission vessels.



# FCBIS - Fuel Cell Battery Information System.

## Common features FC & ESS

- Manageable Lifecycle Degredation
- Load profile dependant lifetime estimate
- Optimal operational ranges for longevity

## Improved features FC & ESS combined

Load variations



Stby capability – start/stop



Low power takeouts



Aux System independency



Energy Density (From a system view)



Fuel Cell Power



Battery Power



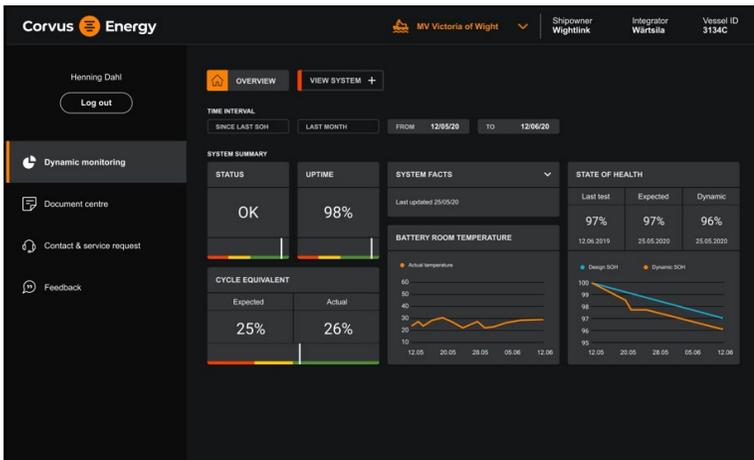
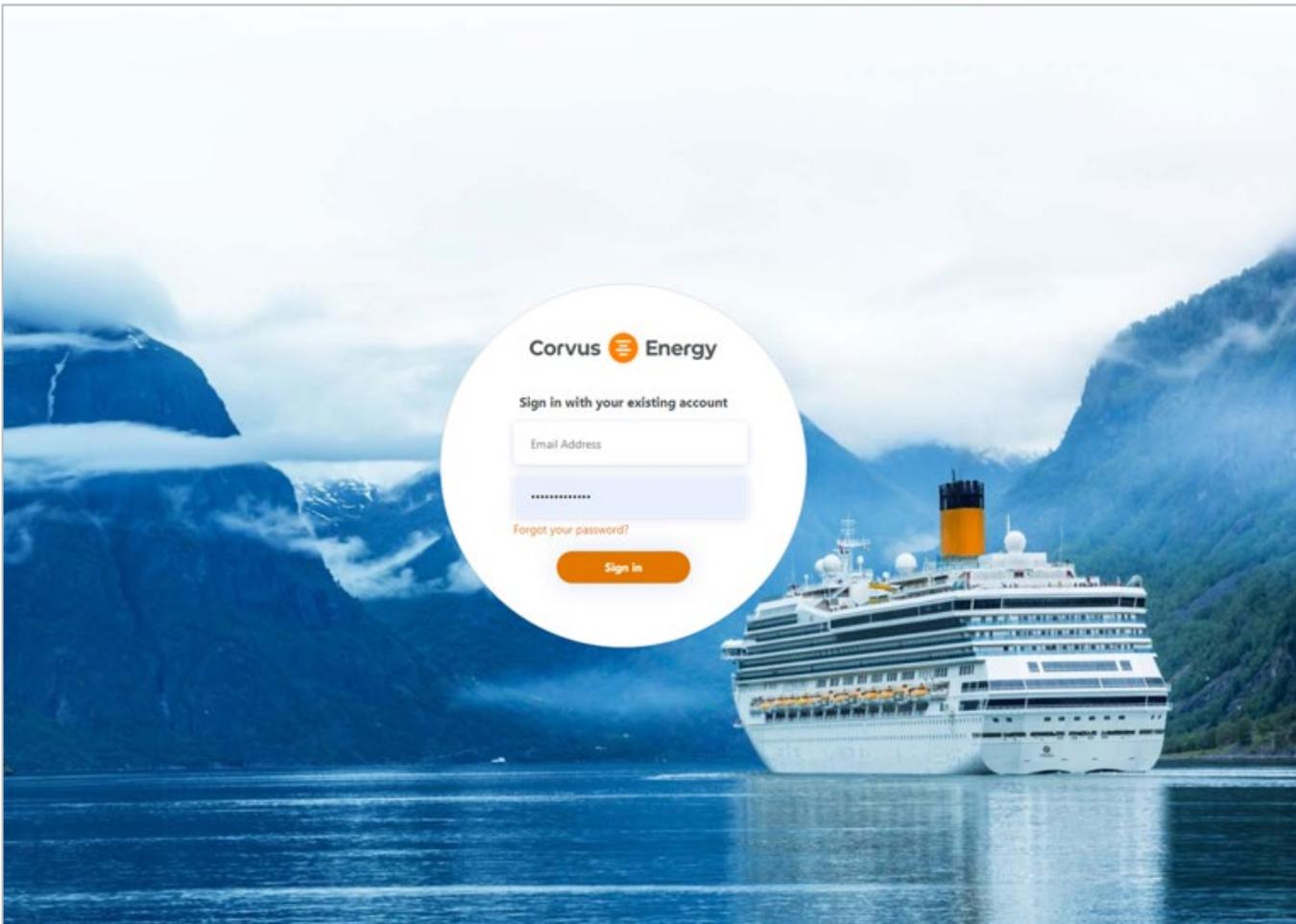
Battery State of Charge



Measurements



# Lifetime Monitoring through the Customer Portal

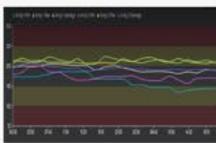


Corvus Energy cloud solutions

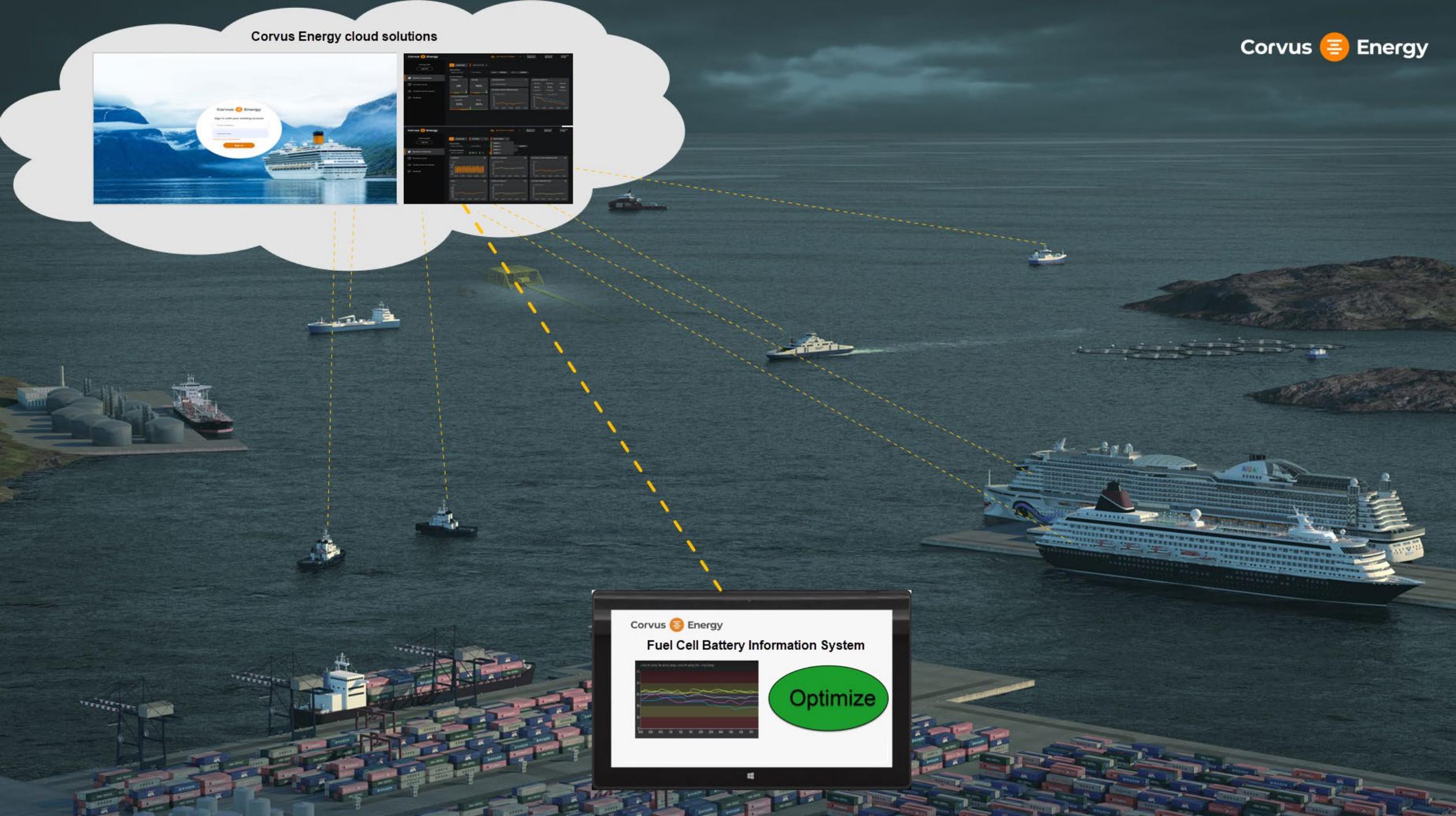


Corvus Energy

### Fuel Cell Battery Information System



Optimize





**Thank you!**

