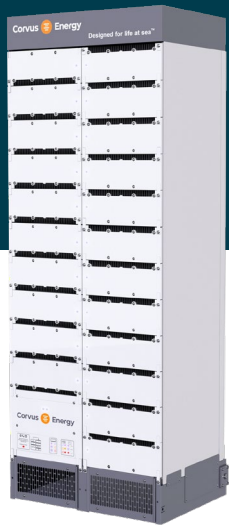




# Maritime Fuel Cell systems

# Different products for different applications



Corvus  
Orca Energy



Corvus  
Blue Whale



Corvus  
Dolphin Power



Corvus  
Dolphin Energy

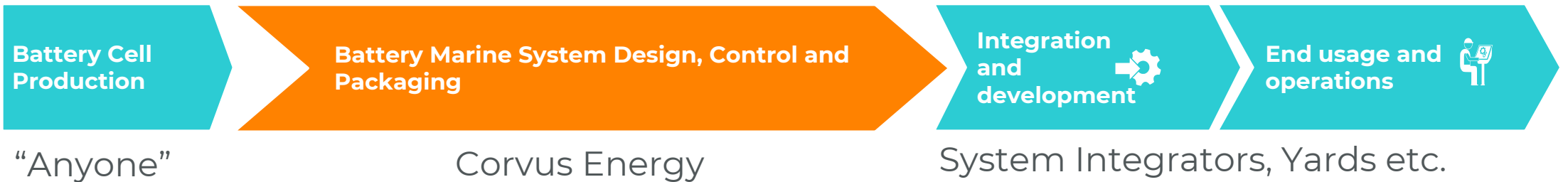


Corvus  
BOB Container

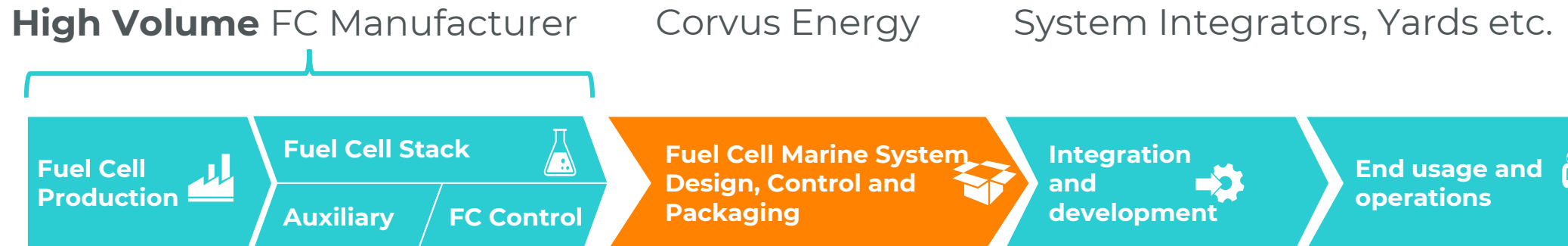


Corvus  
Fuel cell

## Battery Value Proposition



## Fuel Cell Value Proposition





# STRONG CONSORTIUM

– Innovation through collaboration



10M+ USD Budget

TOYOTA



Corvus  Energy



 NORLED

USN

 Wilhelmsen



Funded by  Innovasjon Norge

 Forskningsrådet

H2NOR

HyLOCD



# STRONG CONSORTIUM

– Innovation through collaboration



10M+ USD Budget

TOYOTA



Corvus  Energy



 NORLED

UN



Funded by  Innovasjon Norge

H2NOR

 Forskningsrådet

HyLOCD

Corvus  Energy

## Fuel Cell Systems



Corvus  Energy



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

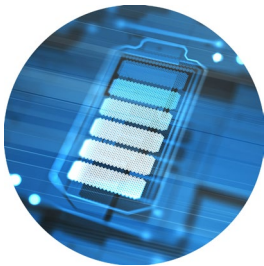
To develop, demonstrate and certify a modularized maritime PEM-based Fuel Cell system suitable for mass production with a power range from 320 kW to 10 MW within 31.12.2023





# Fuel Cell Development Timeline:

Corvus Fuel Cell  
Development Initiated



2020

Approval in Principle  
of Corvus Fuel Cell  
System (PEM)



2022

*Achieved April 2022 (DNV)*

2023



Selected Sailing Pilots

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



2024

2024-25



Automated Factory

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



202X

Corvus  Energy  
**TOYOTA**

Marine PEM Fuel  
Cell Partnership

# 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...

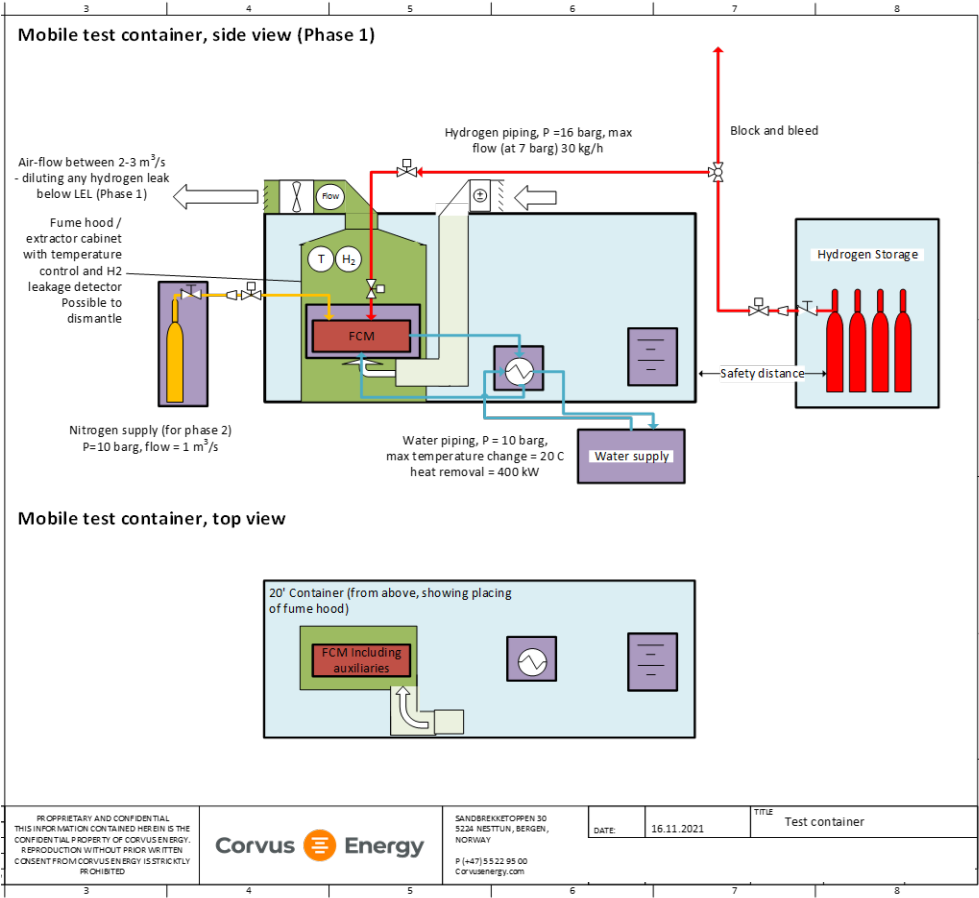
- The outcome is a result from a dedicated team, which brought experiences from designing inherently gas safe combustion engines systems.
- The concept is based on IMO's IGF codes, active dialogues with classification companies and other stakeholders involved in the process.





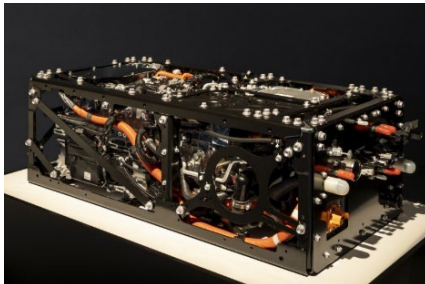
# FC Test Site

Live testing with relevant auxiliaries and combined with energy storage system



## Fuel Cell technical data

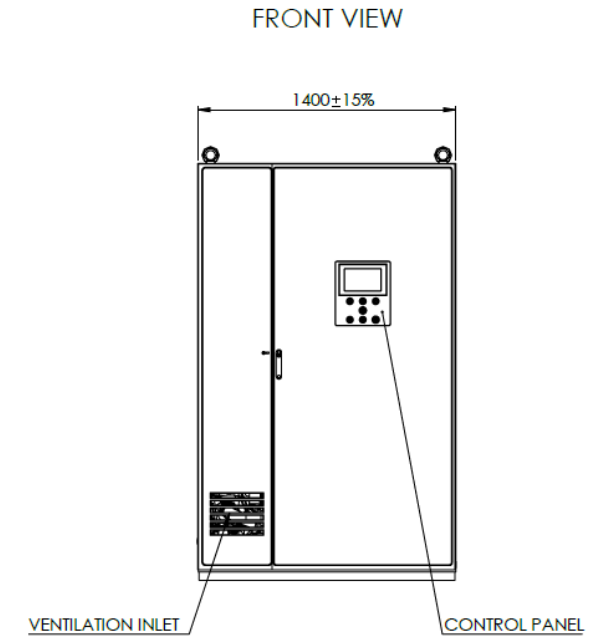
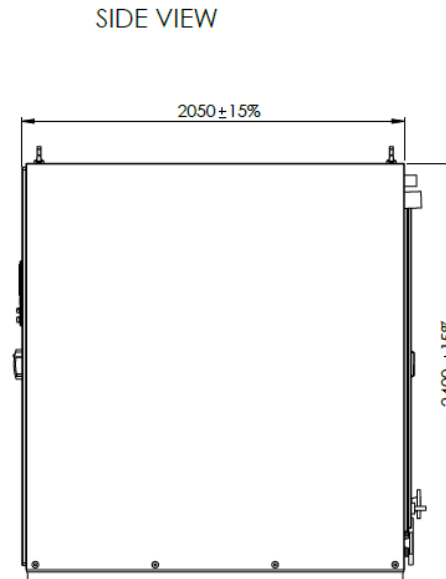
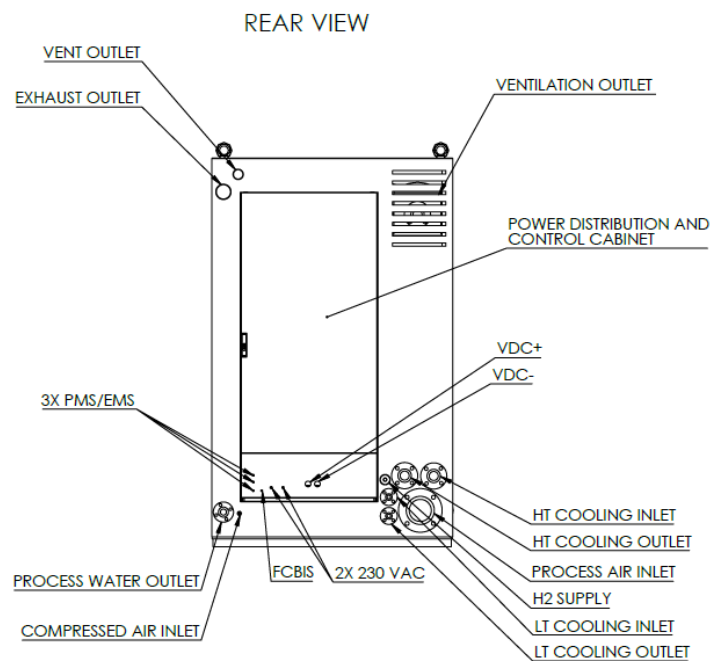
- Power Output 1 pack: 320 kW
- Type approval **Inherently gas safe**
- Technology partner TOYOTA with proven technology, more than 26,000 units produced
- Main Service overhaul interval: 30,000 hrs
- Applications:
  - New builds, under deck
  - Retrofit (containerized solution)



### Gas safe machinery space

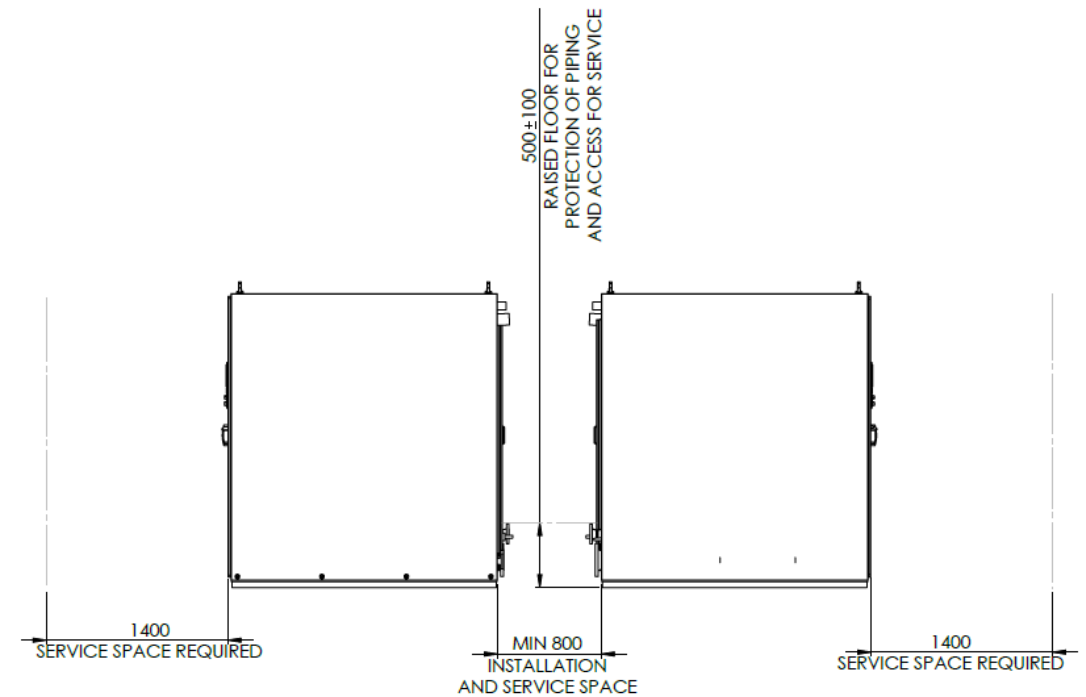
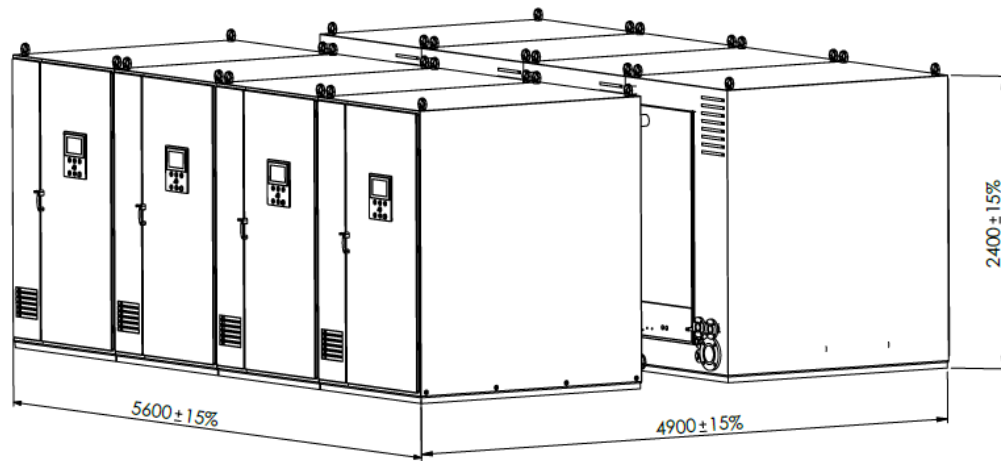


# Module Based Solution Expandable to meet power requirement



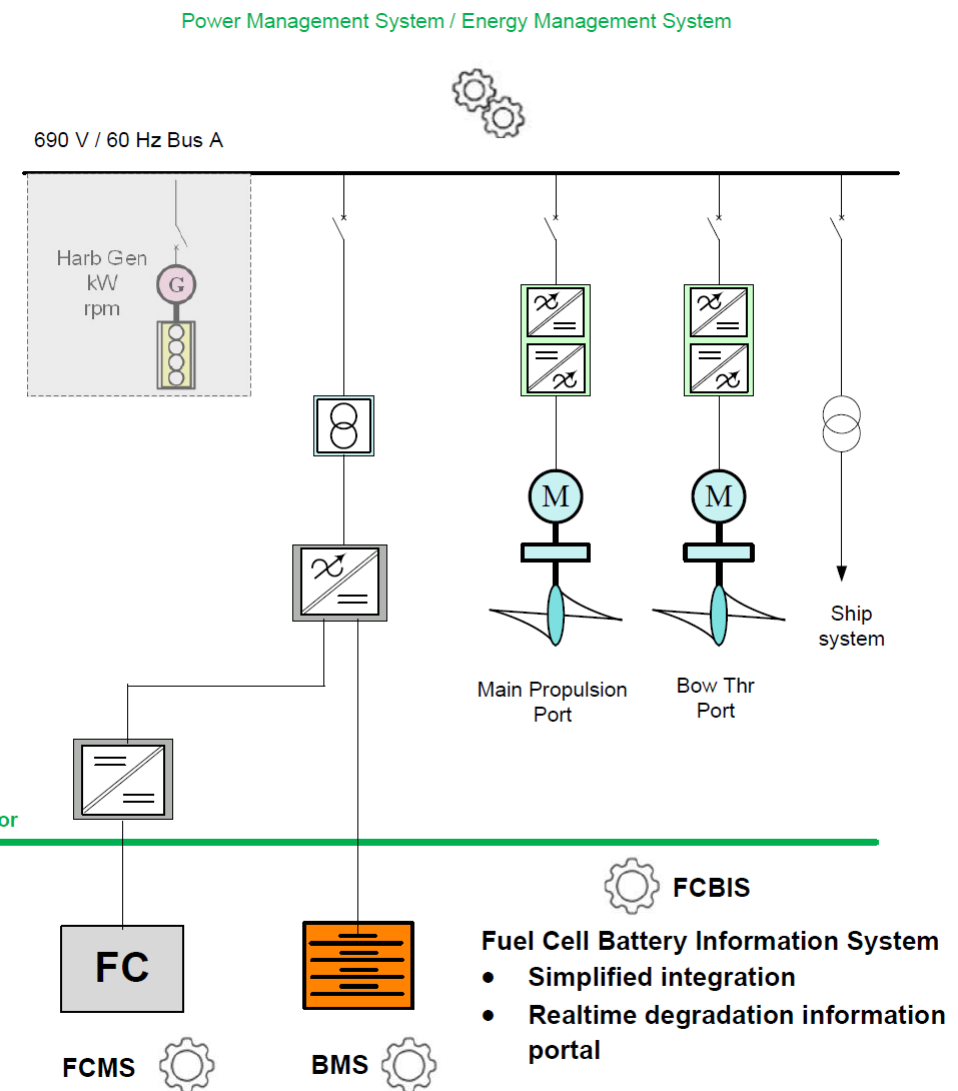
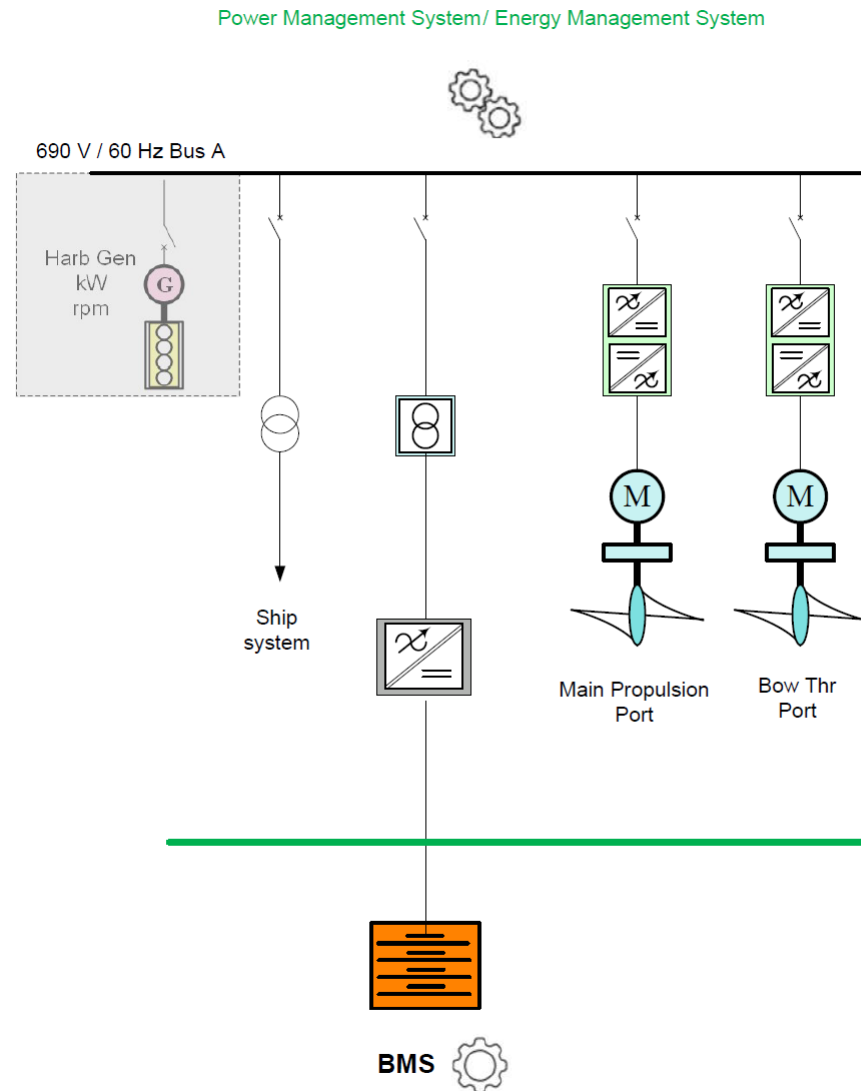
# Cutout of General Arrangement - System

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

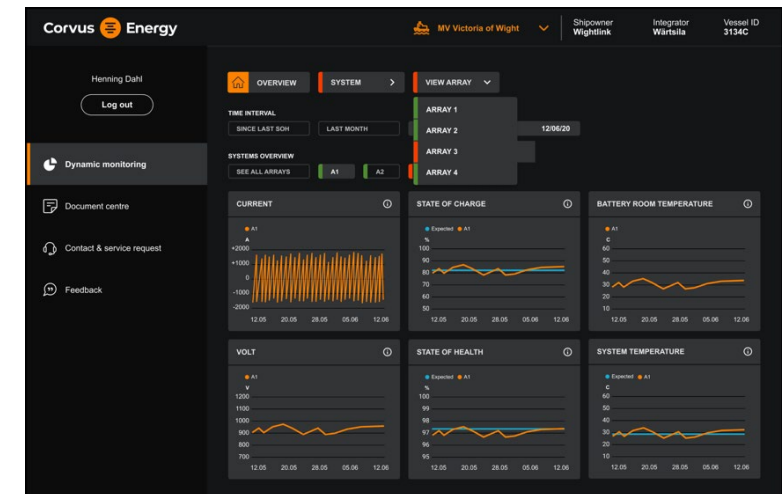
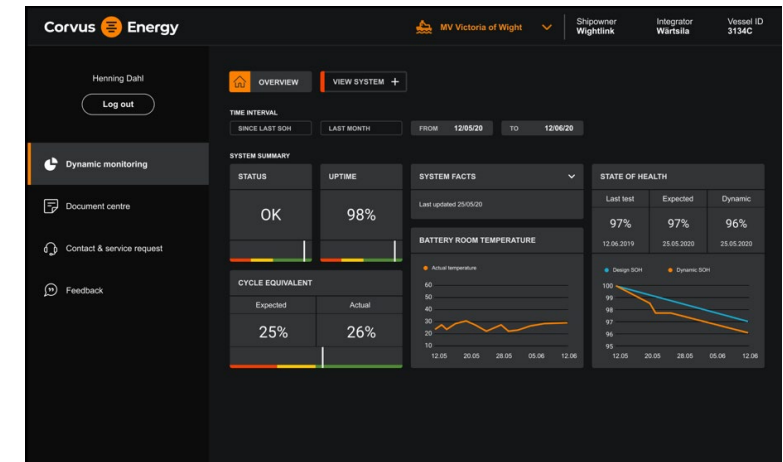
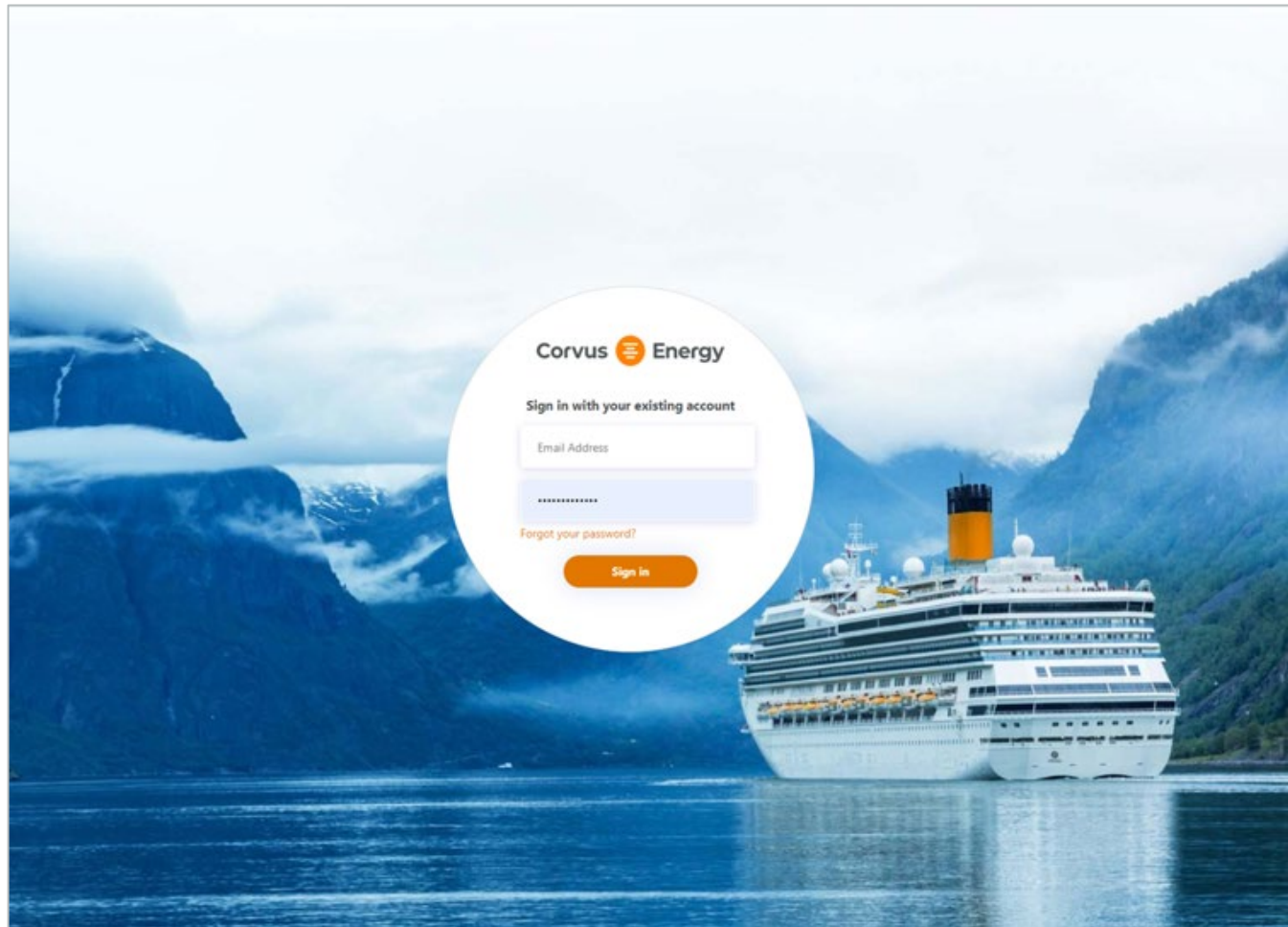


Measurements





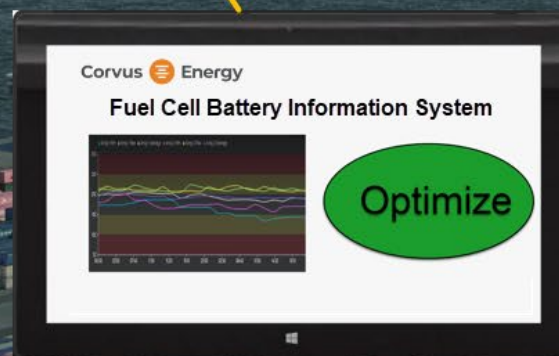
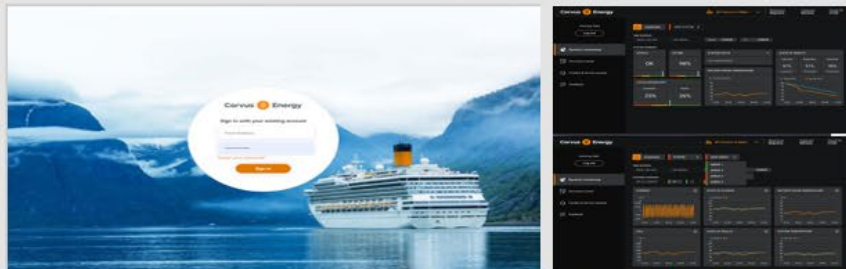
# Lifetime Monitoring through the Customer Portal





Corvus Energy cloud solutions

Corvus Energy







**Thank you!**

