

Powering a **clean** future

Driving innovation towards Zero-emission in the ocean space

Offshore Support Journal Conference
London 2023

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Mission: Powering
a clean future

Vision: To be the leading
provider of zero
emission solutions for
the ocean space



750+

Projects

>5 000 000

Operating hours

650+

MWh

150

Car and
Passenger
ferries

36

Cruise
and Yachts

132

Offshore
and Subsea

152

Tugs/Workboat/
Fishing/Research

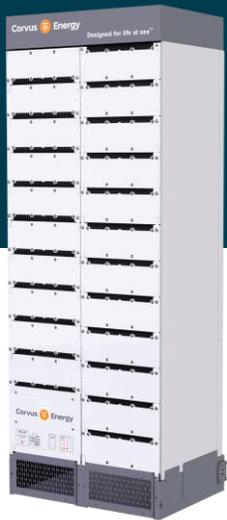
68

Merchant
vessels

186

Port
equipment
Shore stations ++

Different products for different applications



Corvus
Orca Energy



Corvus
Blue Whale



Corvus
Dolphin Power



Corvus
Dolphin Energy
NextGen

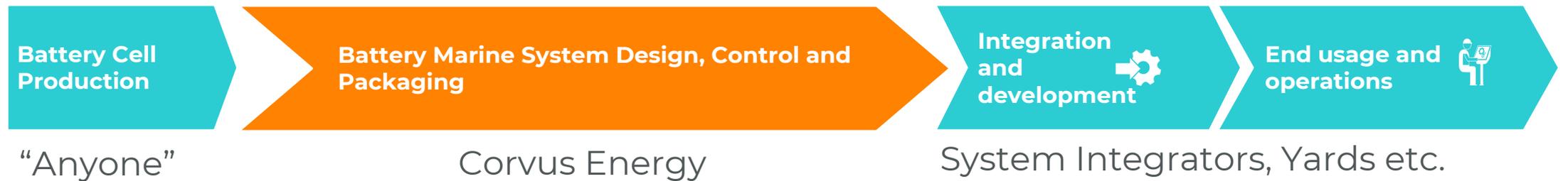


Corvus
BOB Container

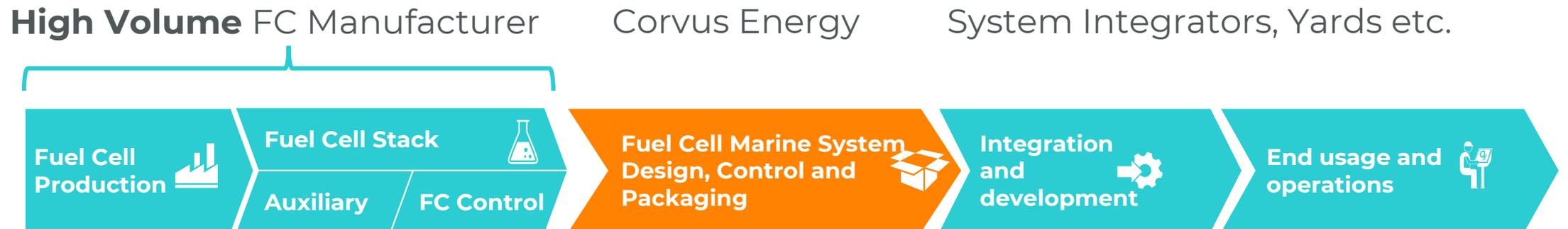


Corvus
Fuel cell

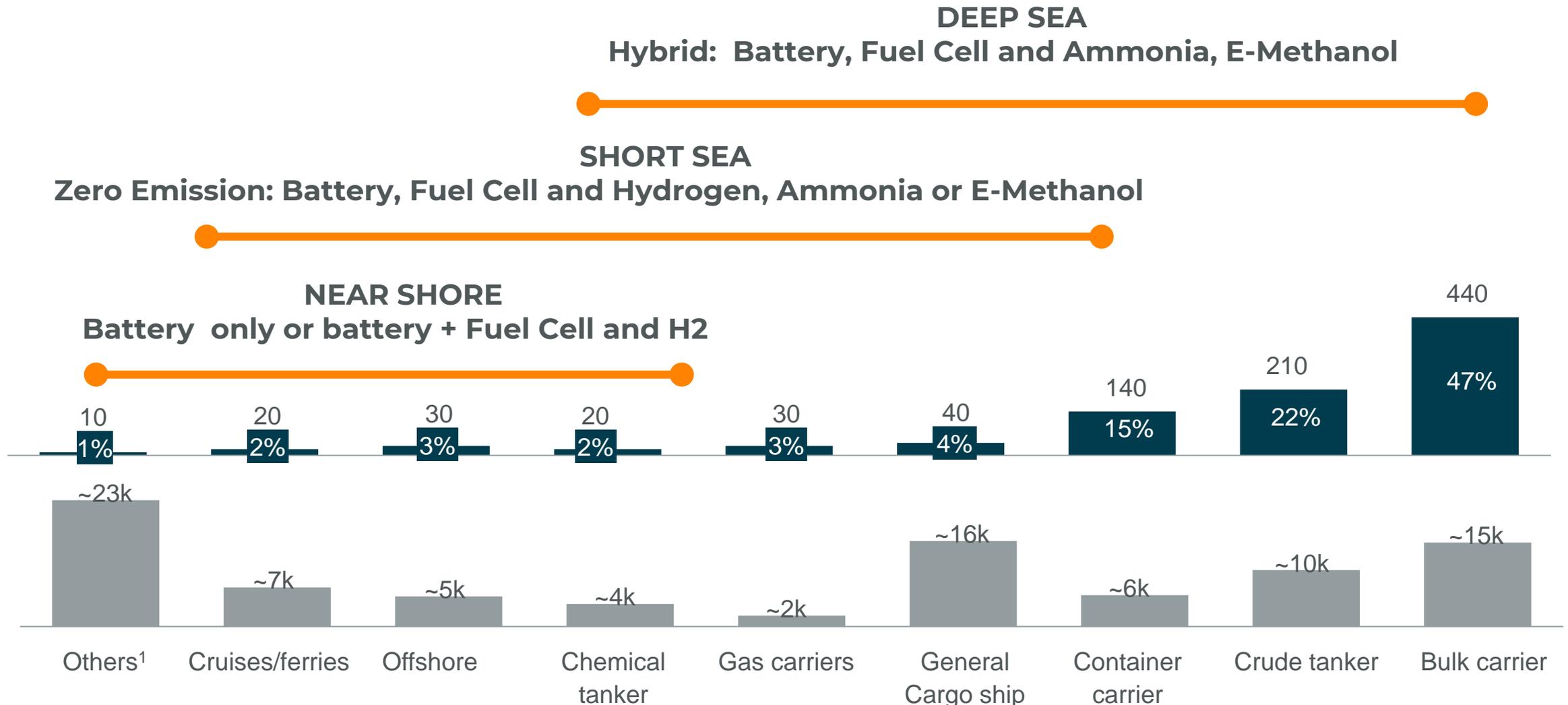
Battery Value Proposition



Fuel Cell Value Proposition

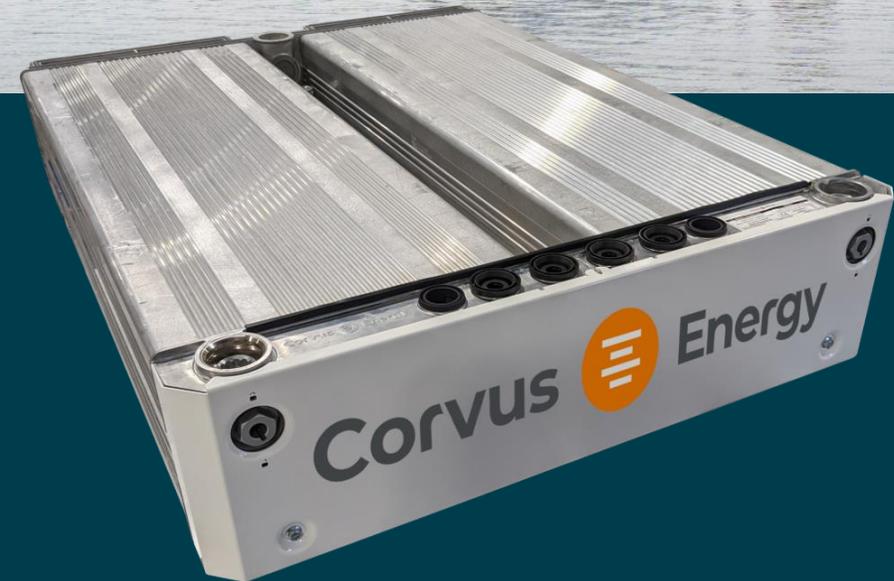


Zero-emission technologies per vessel type



¹ Source: Clarksons WFR; IMO, UNCTAD; BCG

First Blue Whale in operation



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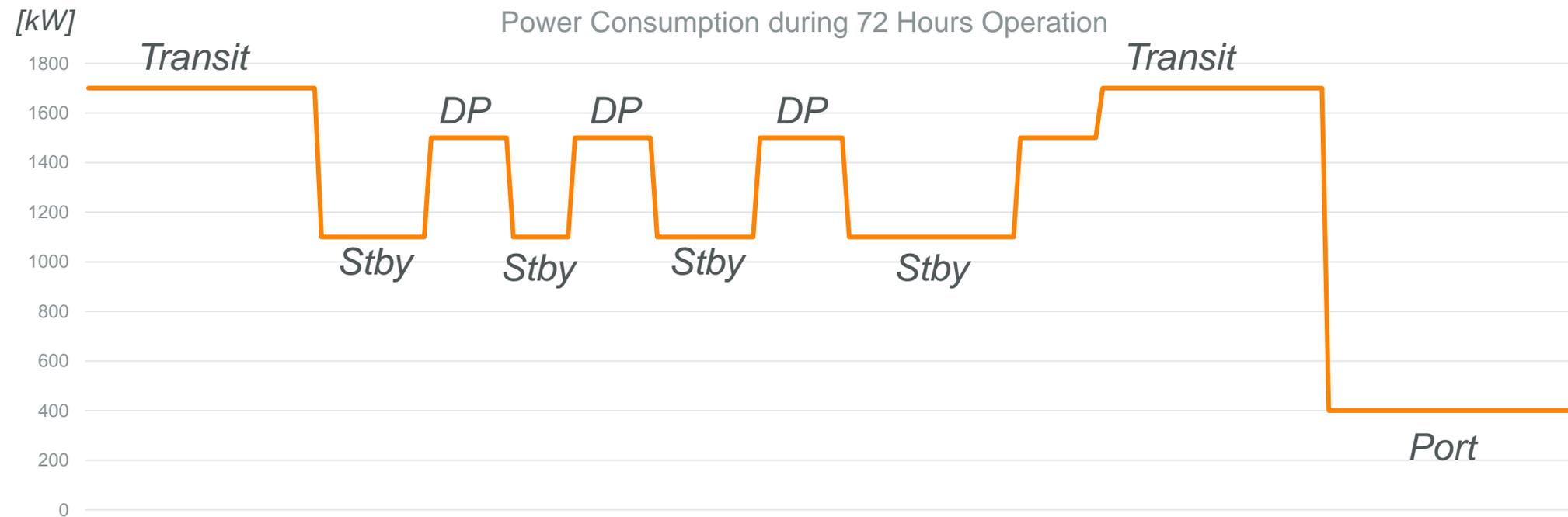
Worlds first Inherently gas safe
Marine PEM Fuel Cell

Case examples

CO₂ PSV vs Zero-Emission PSV

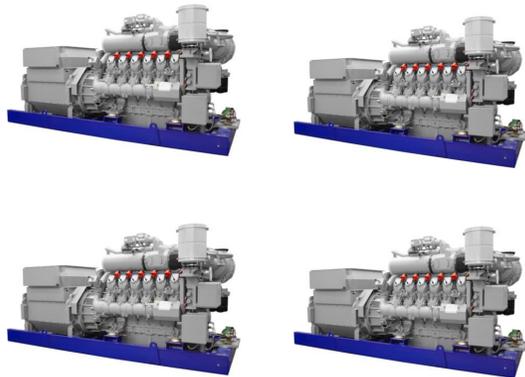
The Case – Reach Zero-emission with today's technology

Example: Offshore PSV in the North Sea operating on a short-duration route (72 Hours)



3 Possible Solutions – 1 Diesel and 2 Zero-emission

Basecase	Full-Electric	Compressed H2
Diesel Operation	Port + Offshore Charging	H2 every 72 hours



Main Assumptions

Diesel Case	Full-Electric	Compressed H2
EU CO2 tax 220 USD/Ton	Offshore Charging available outside zone at ~4 MW	H2 Operatation only outside zone – Battery for Full-electric DP operation
Diesel at 0.75 USD/kg	kWh-price at 0.15 USD/kWh	H2-Price at 5 USD/kg
Conventional Diesel Engine Maintenance – 4 DG PSV 10 USD/Running hour	10-year overhaul/battery replacement interval	5-year overhaul/FC membrane replacement interval
No change to the vessel – Base case	Space from reducing some tank/storage-capabilities inside hull, no change to deck	Space from reducing a few tank/storage-capabilities inside hull, some reduction in deck space for H2 Storage

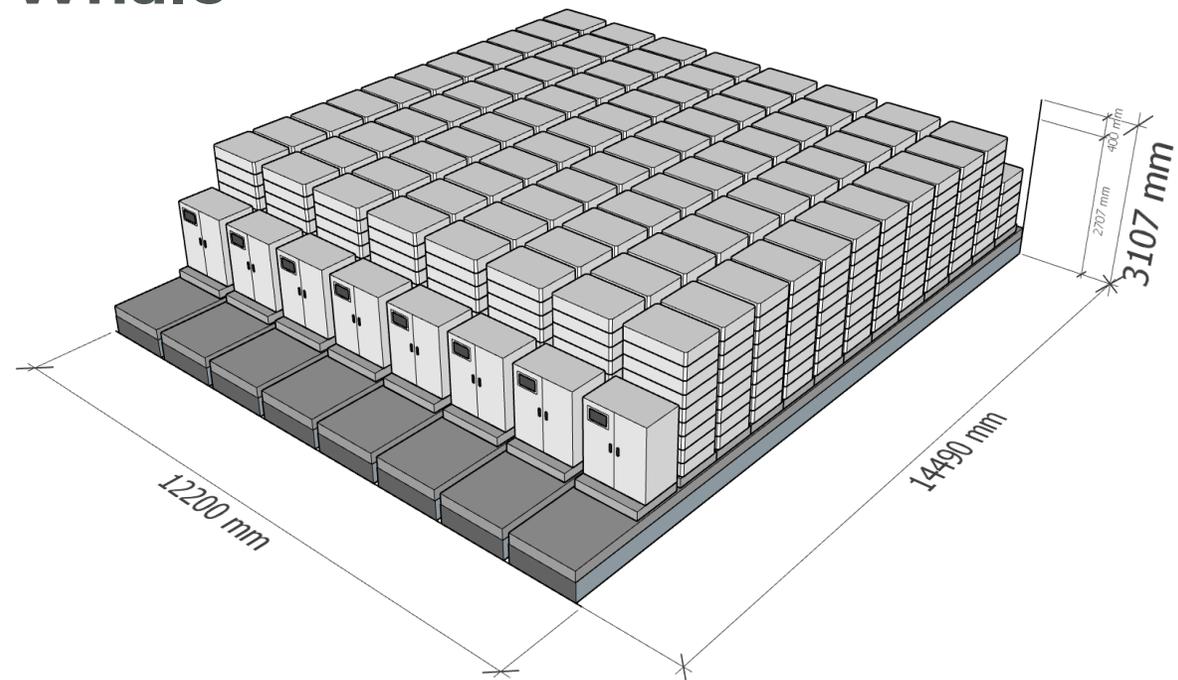
Full-Electric Alternative – Large Blue Whale Installation

35,7 MWh Corvus Blue Whale

12.2 mB x 14.49 mL x 3.11 mH

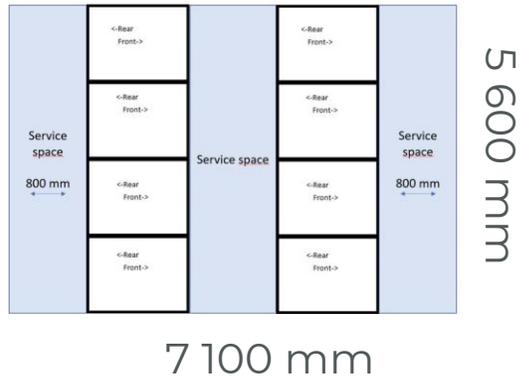
System Description

No of Modules	832
No of Pack controllers	8
No of Stacks	93



Compressed Hydrogen + FC + Battery Installation

2560 kW FC

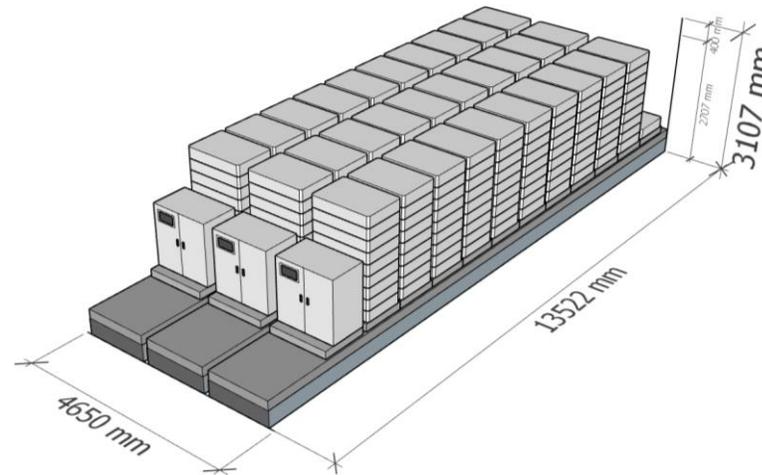


x 8

320 kW Corvus Fuel Cell

11,7 MWh ESS

4.65 mB x 13.52 mL x 3.11 mH



11,7 MWh Corvus Blue Whale

6000kg H2



x 12

Hexagon Purus 500 kg H2

Size, weight & cost comparison - CAPEX

Battery alternative	Cost USD	Space	Weight
35,8 MWh Blue Whale	18,500,000	177 m2	301T

Fuel Cell alternative	Cost USD	Space	Weight
2,6 MW Fuel Cell (100%)	4,096,000	40 m2	20T
11,3 MWh Blue Whale	5,900,000	63 m2	95T
12 x 500kg H2 units	6,000,000	180 m2	130T
Total Fuel Cell	15,996,000	283 m2	245T

Operational Cost – 72- hours round-trip

	<u>Basecase</u>	<u>Full-Electric</u>	<u>Compressed H2</u>
<u>Fuel Cost</u>	<u>14,300\$</u>	<u>8,800\$</u>	<u>29,000\$</u>
<u>Emission Cost</u>	<u>13,500\$</u>	<u>0\$</u>	<u>0\$</u>
<u>Maintenance Cost*</u>	<u>4,500\$</u>	<u>7,600\$</u>	<u>2,800\$</u>
<u>Total</u>	<u>32,300\$</u>	<u>16,400\$</u>	<u>31,800\$</u>



* Mainly driven by large replacement/overhaul cost for the 3 solutions after 5/10 years - averaged out over each trip + Depreciation

Considerations for choice of solution – ESS or ESS + H2

The **value of zero emission** – License to operate, sustainable operation

The **cost of flexibility** on a vessel (H2 vs Electric)

The **cost of fuel** – Diesel vs H2 vs kWh EL

The **fuel predictability** – Where to get H2

The **efficiency of required energy** – Global view

The **charter agreement** – long-term vs short-term

The **charging infrastructure** and energy origin



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