ADVENT

Serene

Fuel Cell Solutions for Marine applications

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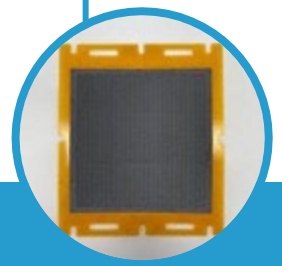
Technical Solution Director - Marine

Path to Growth

+10 Years Developing the Ideal Fuel Cell

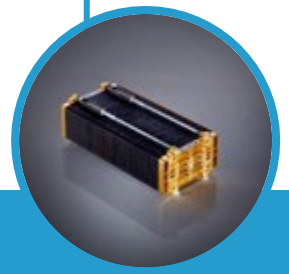
2012

Advent and BASF separately commercialize HT-PEM technology



2015

SerEnergy markets hydrogen-powered fuel cells using methanol

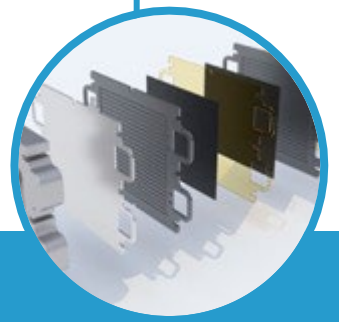


2021

Advent enters **NASDAQ**

Advent acquires **SerEnergy** (now Advent Technologies A/S)

Advent partners with **US DoE** and LANL for next-gen HT-PEM tech



2022

Advent reaches **1,000 Serene systems** installations around the world

Advent receives EU **ratification for €782m** to scale up R&D and Production

Advent's Serene **systems replace diesel-driven emergency power** systems in Germany

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Path to Marine marked

Marine

2013

First shore demonstration PaXell – Meyer Werft

2015

MS Mariella - PaXell World first HT-PEM sailing installation

2017

MS Innogy
Tour boat inland waters

2018

Rivercell II Shore demonstrator 90 kW

2024

100 KW Installation on 50 m Yacht

2025

1,6 MW installation Larger platform

2028

Multi MW installations Full commercial rollout

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Advent World Wide

Advent

- Development and manufacturing of High Temperature PEM fuel cells
- World leading within this technology
- 5 kW Methanol Steam reforming fuel cell unit, **SereneU-5**

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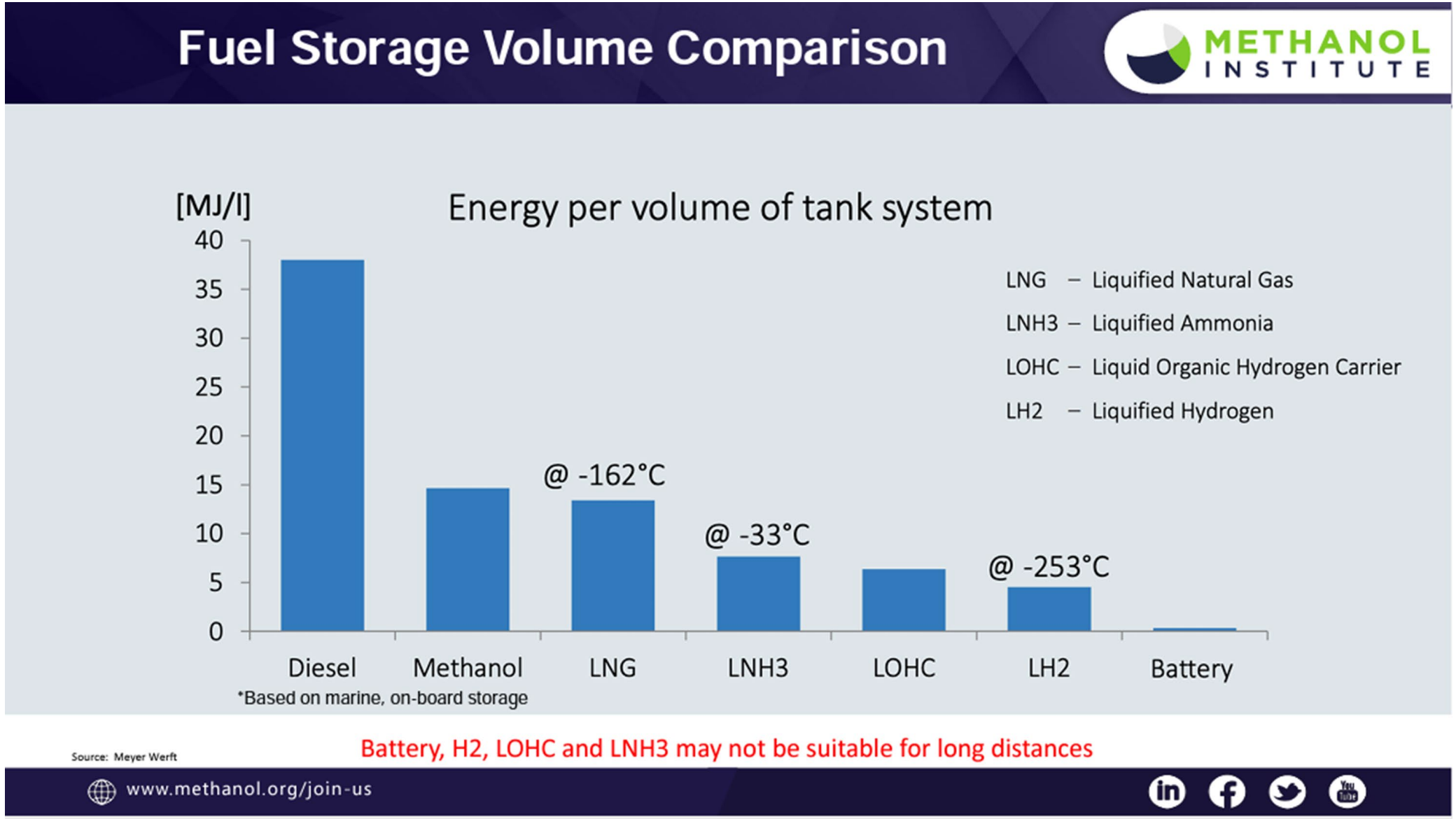
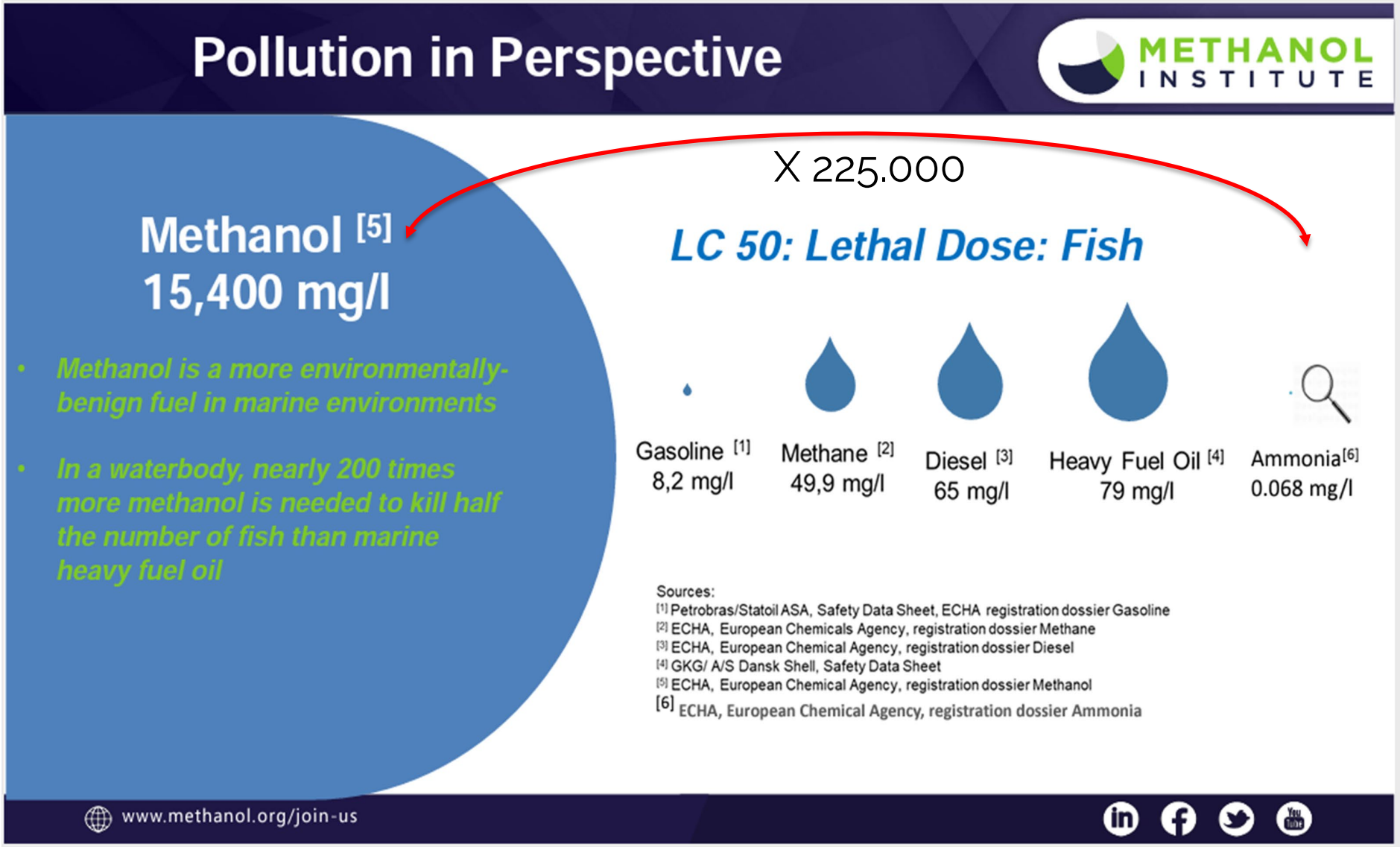
https://www.methanol.org/wp-content/uploads/2021/12/Methanol-Future-Proof-Marine-Fuel-Oct-2021.pdf



Methanol – Safer for the Environment



How we will succeed

- Focus on what we do best core technology development
- Building business on Proven Technology
- Deliver high end solutions in collaboration with likeminded partners
- Work closely with partners to supply a market demand with high-end solutions

In Summary

We built a fuel cell system that can:

- Use **liquid fuel (biomethanol)** to minimize logistics and costs today, (while **cutting CO2 by 80%**)
- Be **zero-emissions** ready with green methanol
- Can operate reliably in **extreme environments**
- Ease of use and deployment allow
- SereneU the **most cost effective and efficient way to decarbonize**

Green

Low-Cost

Proven

Resilient

Configurable

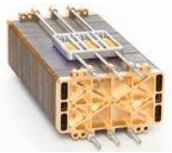
Technology Comparison on Fuel cells (small systems 1w – 20 kW)

Indicative values

Direct Methanol Fuel Cell – DMFC

100% Methanol

Fuel mixer


Fuel cell

Condenser

28% efficiency

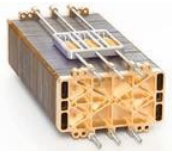
Low Temperature Proton Exchange Membrane - LT PEM

62% Methanol/ 38% water

Evaporator Methanol driven

Reformer

Gas purifier


Fuel cell

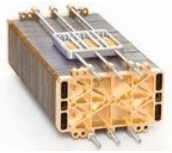
33% efficiency

High Temperature Proton Exchange Membrane - HT PEM

60% Methanol/ 40% water

Evaporator waste heat driven

Reformer


Fuel cell

45% efficiency

Advent Core Technology

1. Membrane
2. Electrode
3. MEA (Membrane Electrode Assembly)
4. Graphite plate
5. Fuel cell stack
6. Alucore
7. GREEN BOX
8. BLUE BOX
9. YELLOW BOX
10. **SereneU - 5**

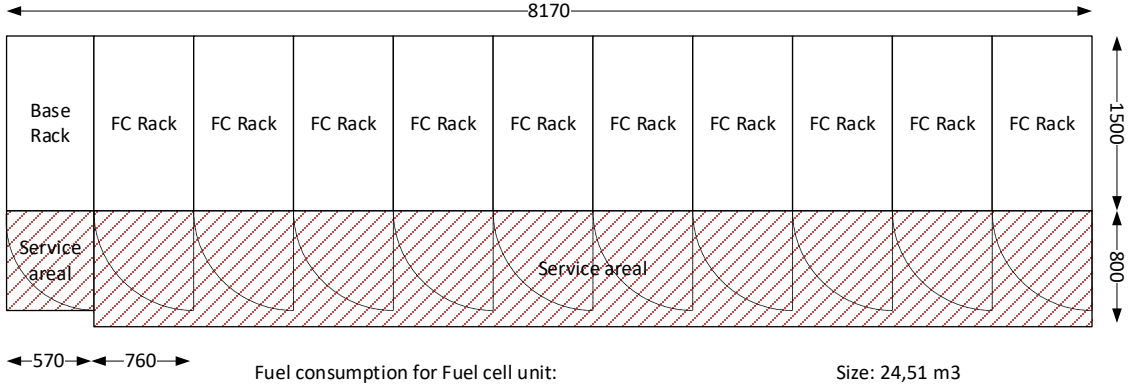
MFCS - Marine Fuel Cell Solution

90 kW installation RiverCell II

1 x base + 3 x FC Racks
(Picture on left side)

Approval in Principle by DNV – multiple installation with approval
Working with LR on installation to have the approval
Giving input to IMO with the knowhow Rivercell II/ PaXell ect..

250kW full size



Fuel consumption for Fuel cell unit:
1 l/kWh (For design)
Max 300 L/h

Size: 24,51 m3
foot print: 12,255 m2

MFCS

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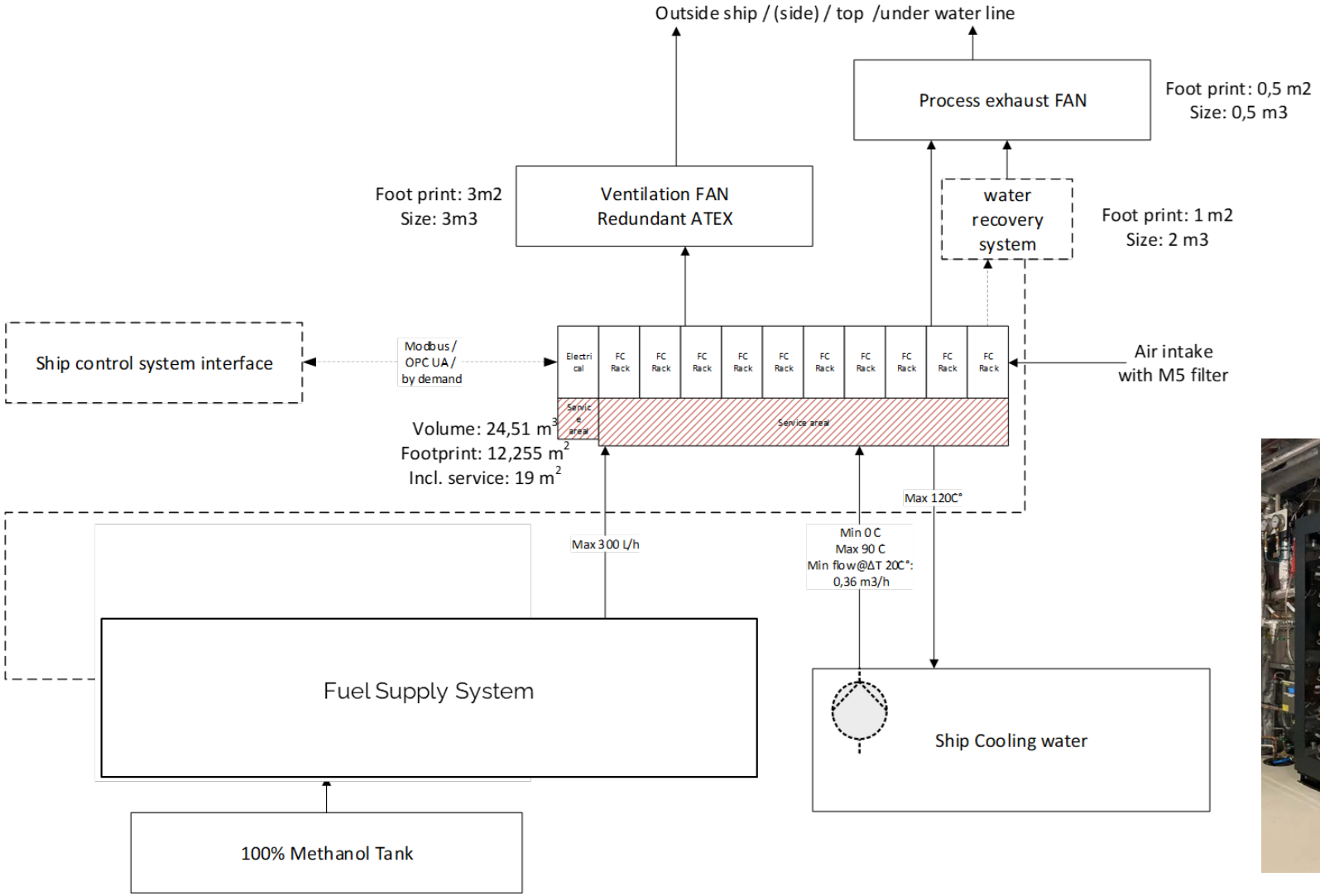
250 kW system layout



Marine activities

- EUDP funded project:
  - Fuel cells for maritime use as a replacement for oil-driven generator sets **(64020-2072)**
    - Partners: **Alfa Laval Aalborg A/S**, **DFDS A/S**, **Maersk Drilling**, **Hafnia Tankers APS**, **Advent Technologies A/S**

Commercial:

- 20 kW FC installation for power support on ship for environmental organization
- 100 kW installation for Yacht – hotel load
  - Not able to announce partner.

Next generations fuel cell

- Higher power density
- Longer life
- Lower cost

But how?

- Larger Rack Power (today 25kW platform → 100 kW)
- New Membrane Technology (ION-PAIR)
  - Longer life
  - Higher power out

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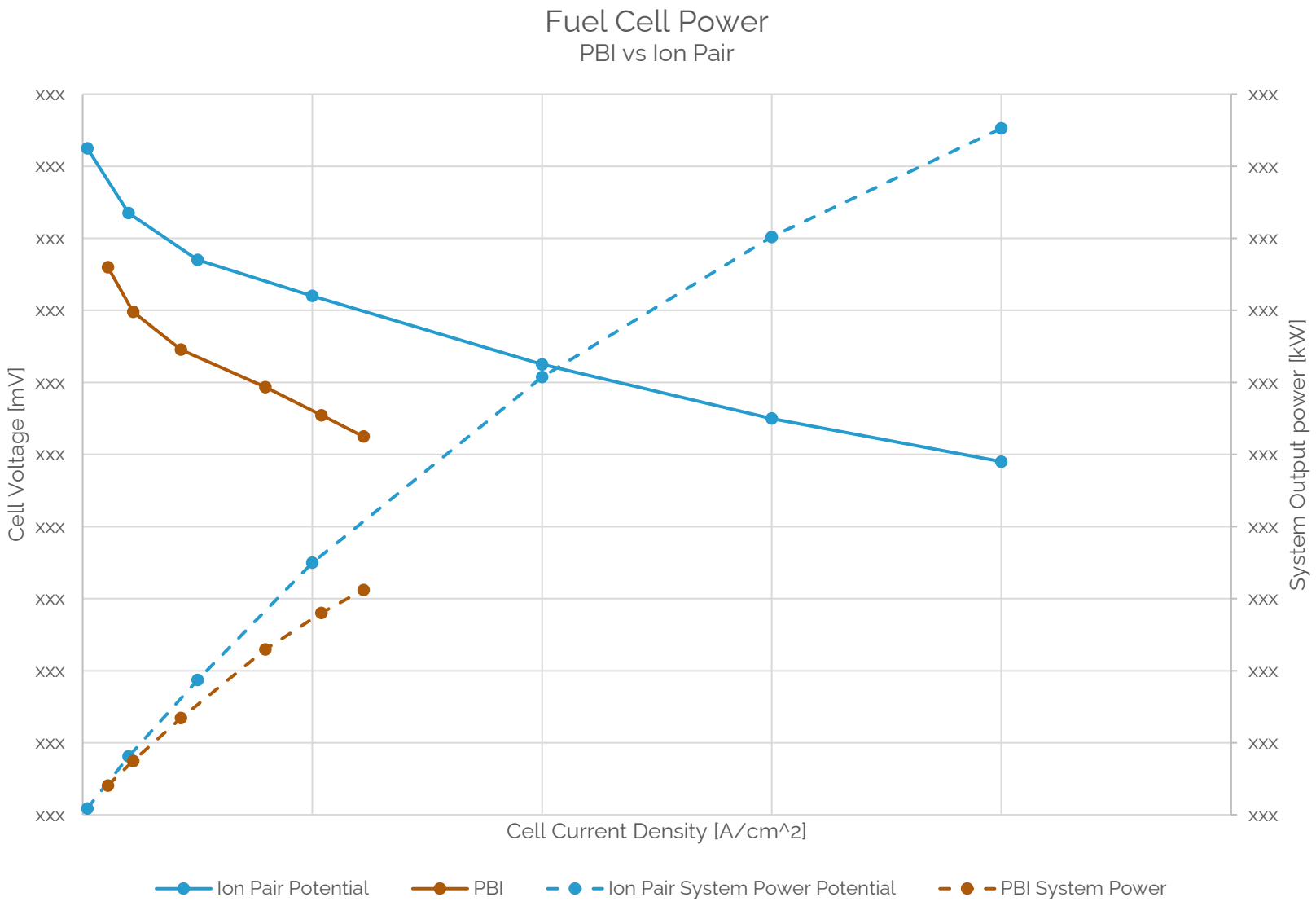
PBI vs ION Pair



ION Pair

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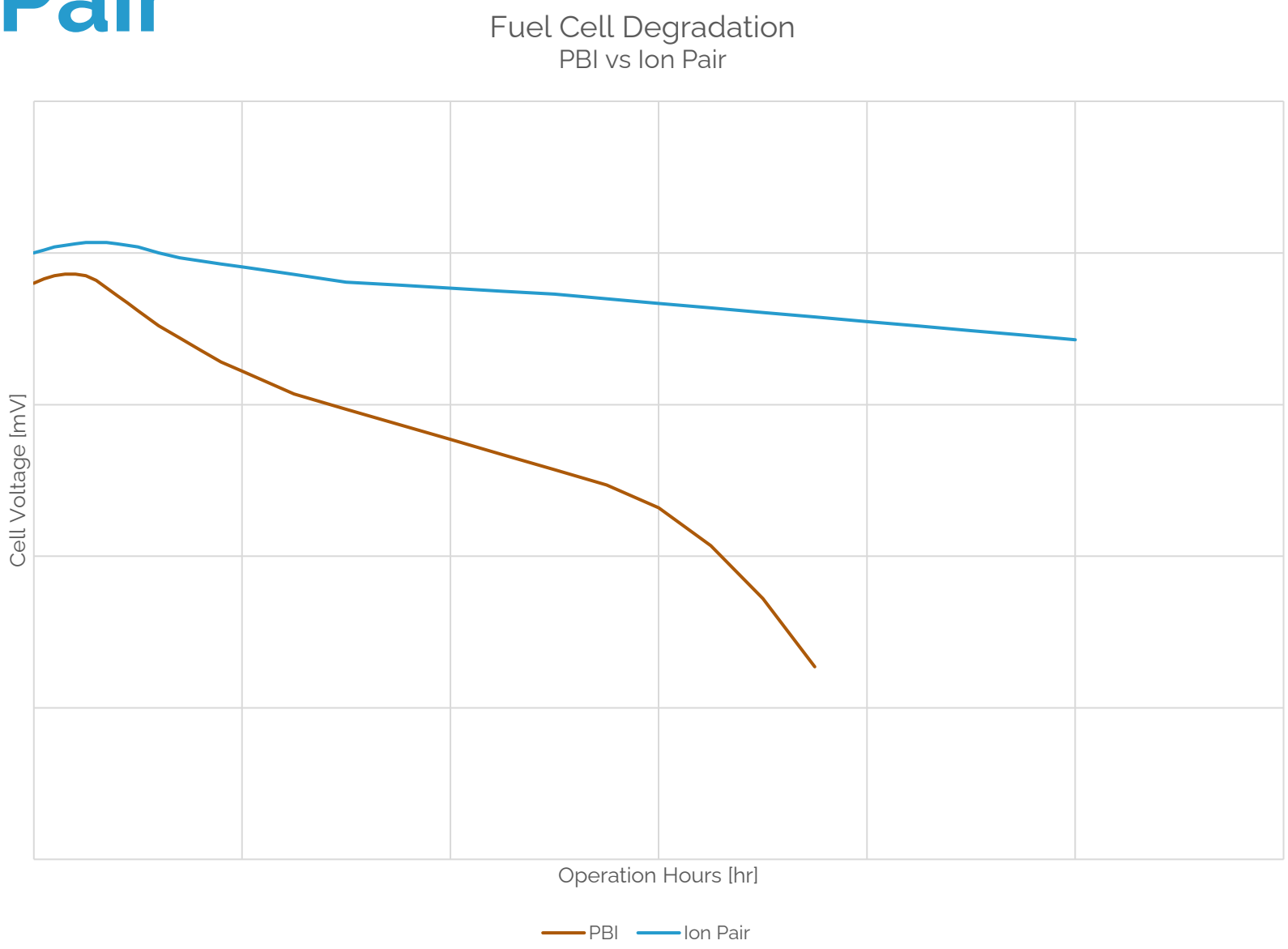
PBI vs ION Pair



ION Pair

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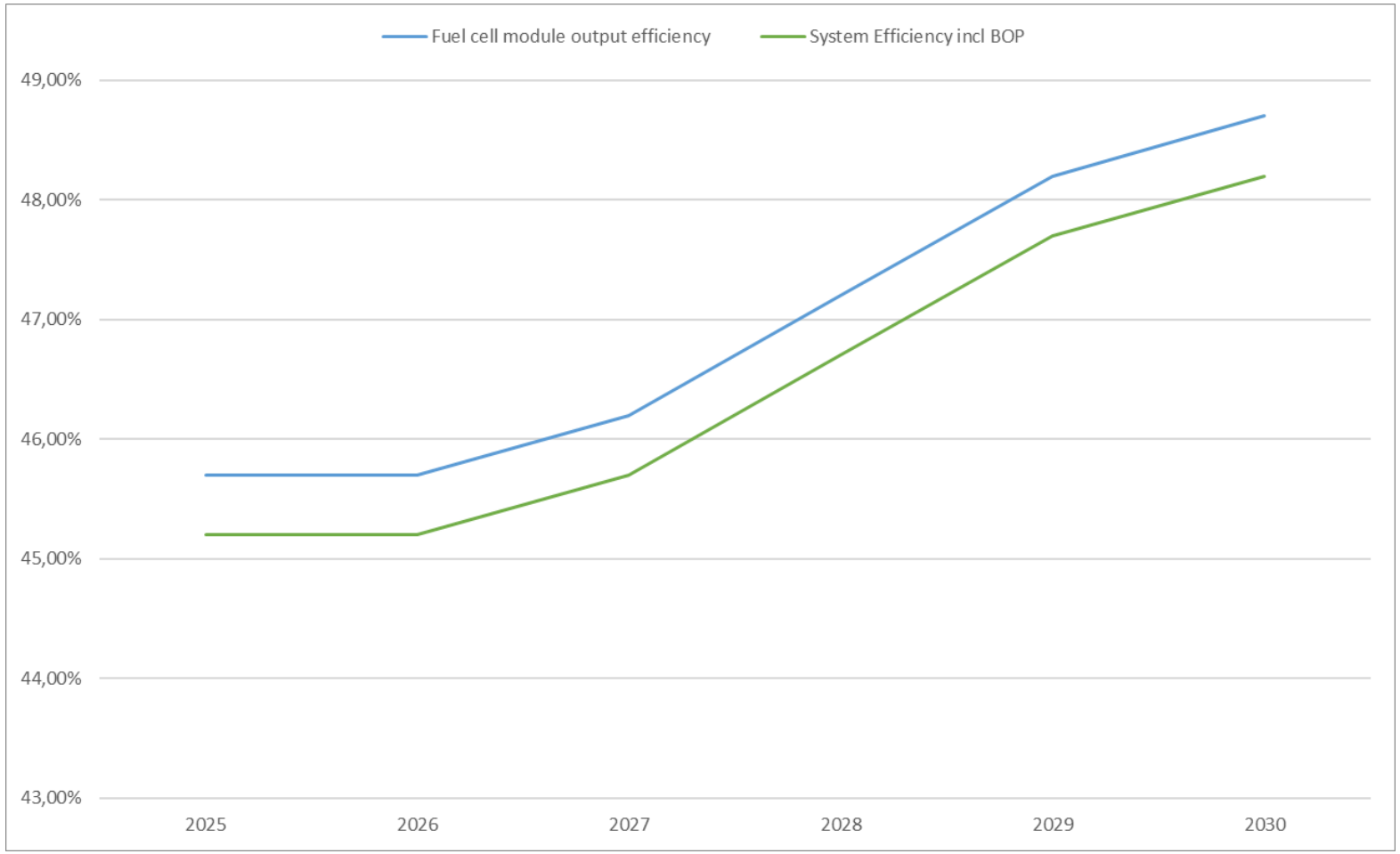
System efficiency

All system is included in the numbers

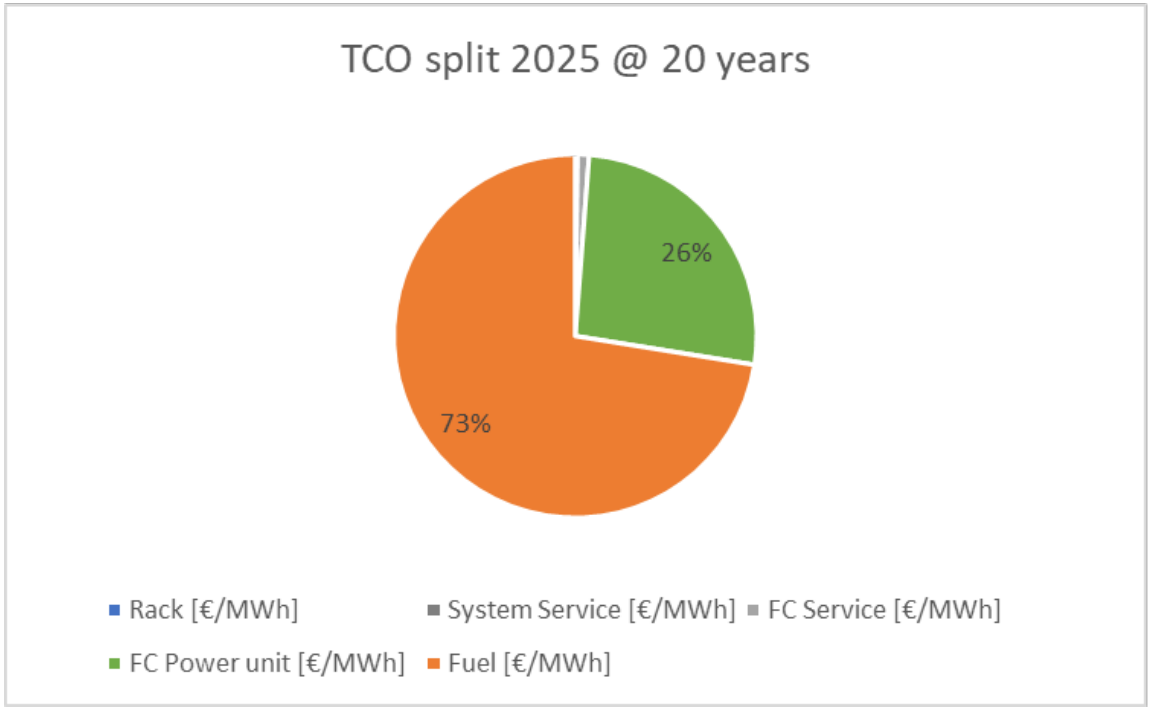
- Additional 4-5 % extra can be gained by converting the waste heat to electrical power
- Utilizing the waste heat as heat will add 30 to 35 %

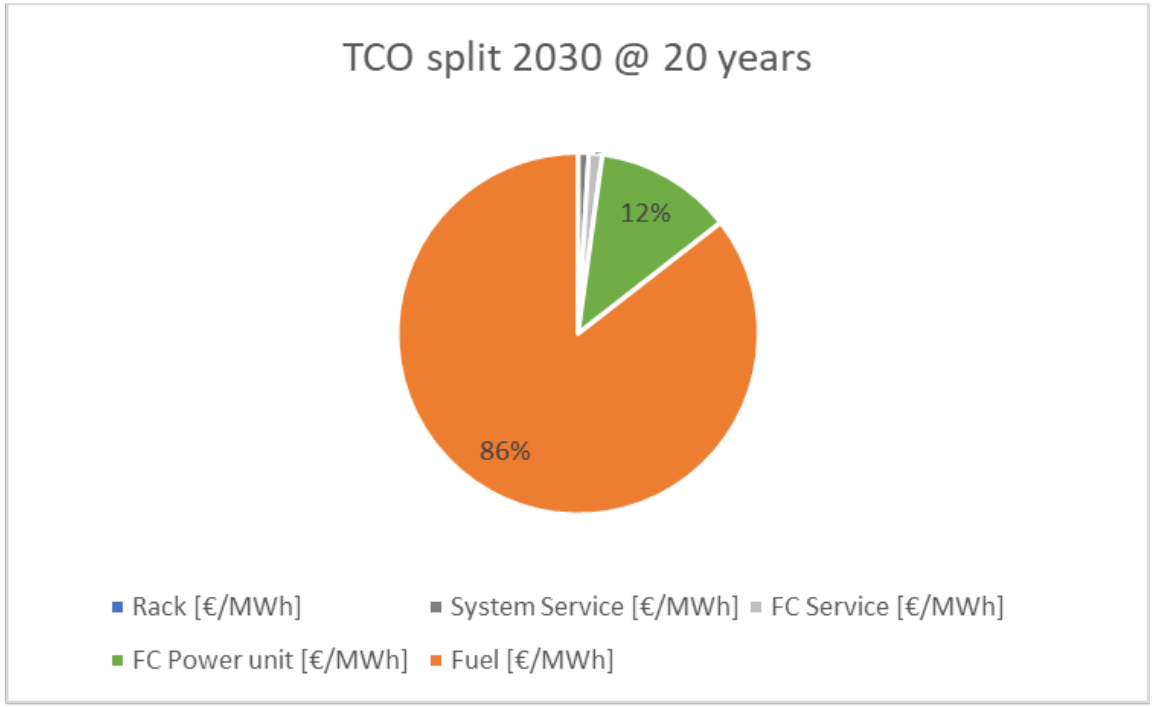


TCO split

- Methanol price is set at 600€/mT
- Efficiency is kept at 45,3% (year 2025 values for both plots)

Down to 200-250€/MWh

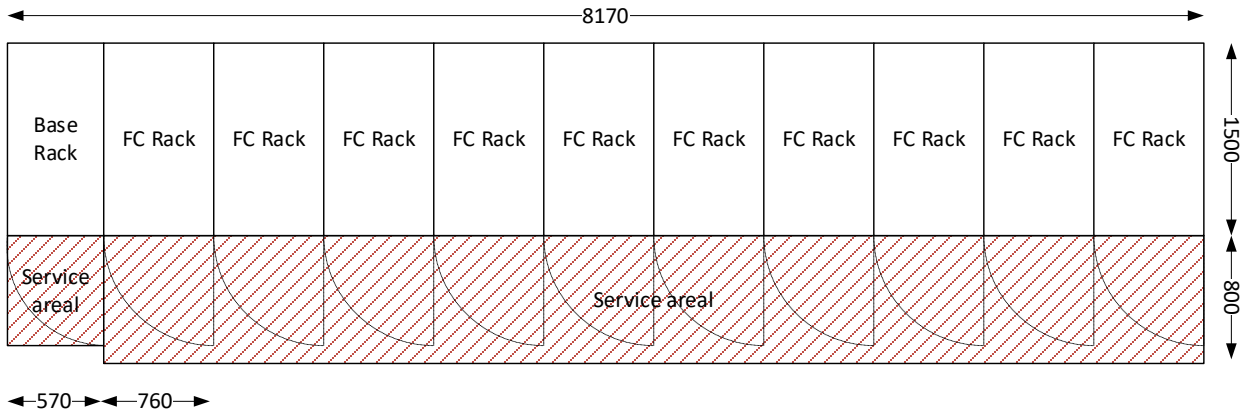




Upgrade of Marine fuel cell solution

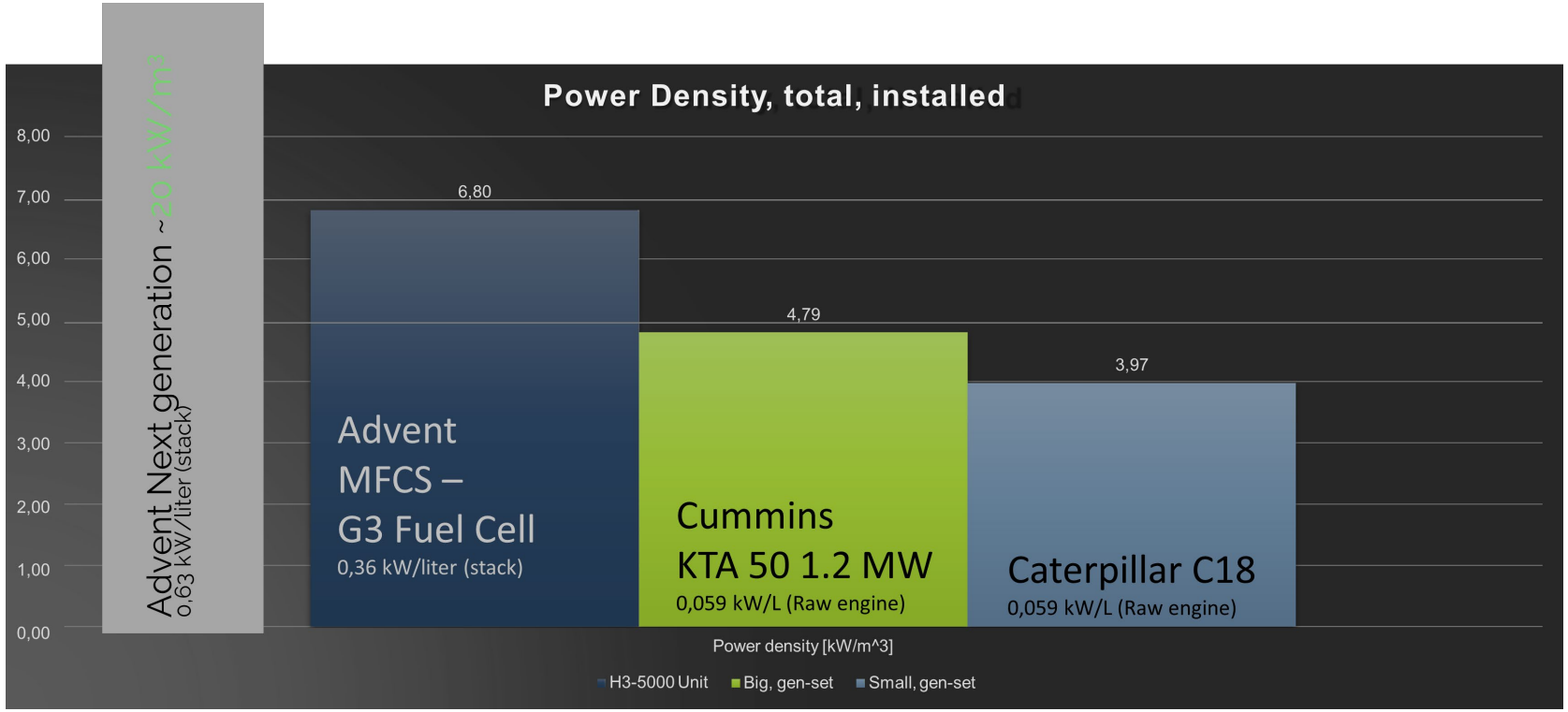
Example 300 kW installation
1 x base + 3 x FC Racks @ 100 kW each
based on Larger platform
(picture on left side)

Max size: 1000 kW MFCU configuration



Comparison with Gen-set - 1 MW redundant

Power density total system installed



- Incl. Service areal
- Incl. Equipment needed - BOP

Disrupt the way of thinking - no need of engine room as we know it

Advent Fuel Cells & You

Working together, we'll replace diesel generators with green low-cost power.

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