



e1 Marine – Presentation for SMM 22 Methanol to H₂ Generators

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Artist Simulation

Who We Are:



Ardmore Shipping Corporation

- Ardmore owns, and operates a fleet of chemical tankers ranging from 25,000 to 50,000 deadweight tons



Element 1 Powering Innovation

- Element 1 is a global leader in developing methanol to H₂ generation systems used to power fuel cells for mobile applications such as marine, trucking, and rail



Maritime Partners

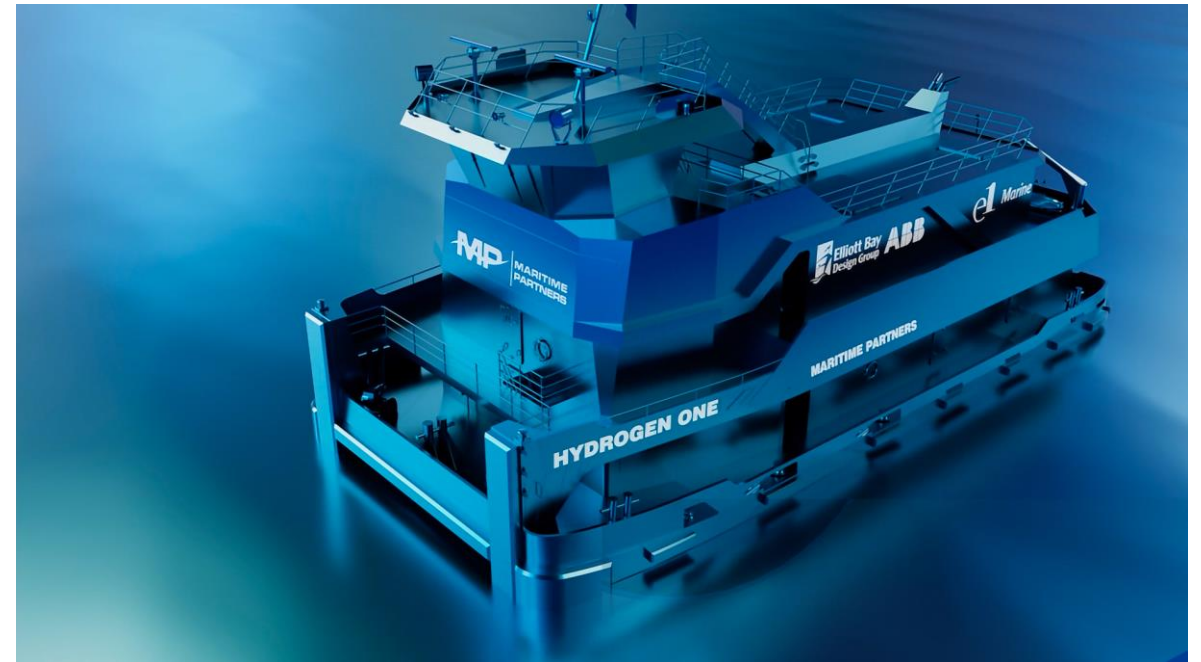
- Maritime Partners owns over 1,600 inland waterway vessels in USA including tugboats, towboats, and barges

Our Vision: Provide a Viable Pathway to Decarbonize Marine Shipping

The H₂ Challenge

Legacy H₂ solutions are **slowing** the adoption of Fuel Cell Power

- Without major change, marine vessels will fall short of environmental standards
- Shipping requires **readily available, easily implementable** solutions to realise the potential of low and zero carbon future fuels
- While H₂ holds the potential to significantly reduce GHG emissions, it is **not yet** a viable decarbonisation solution for the maritime industry
- Methanol to H₂ generation when combined with a PEM fuel cell **on-board** the vessel, is the **missing link** for decarbonising inland shipping
- Methanol to H₂ Generators **can accelerate** the adoption of marine fuel cell power solutions



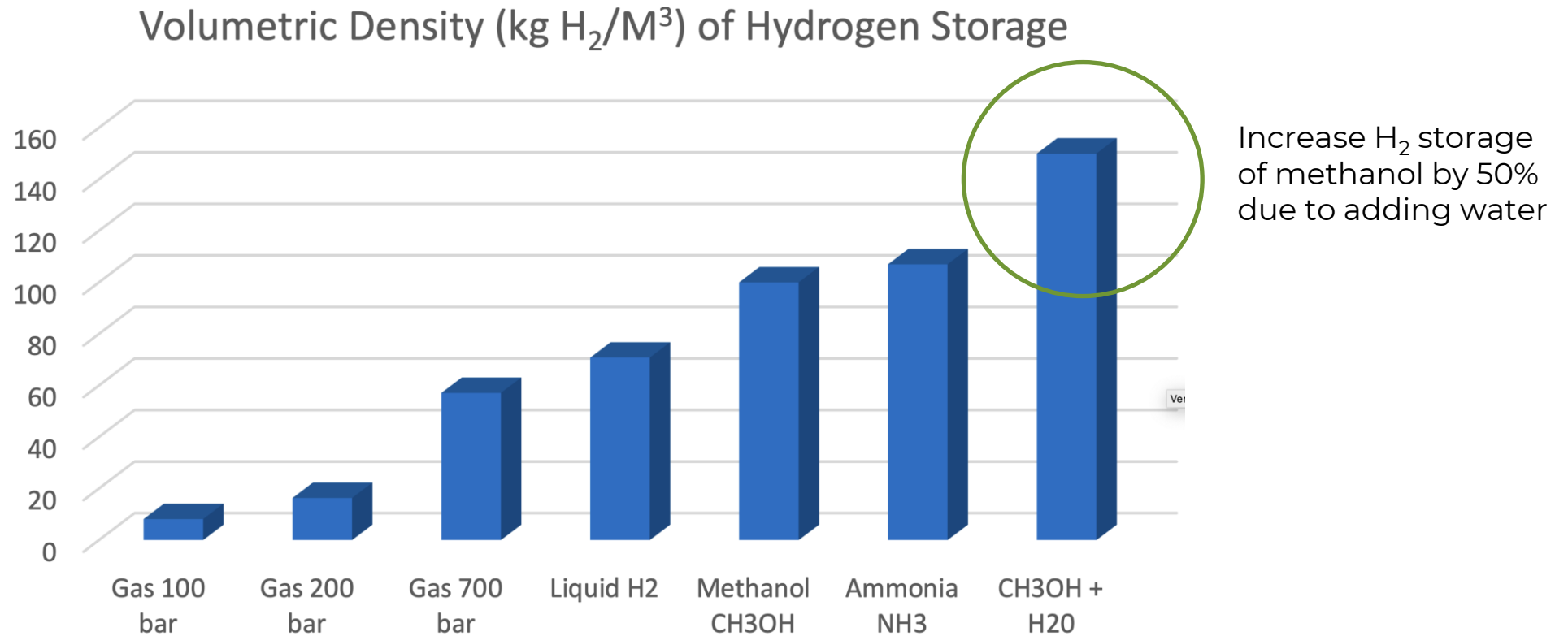
Methanol – The Missing Link



- **Superior, H₂-Dense Transportation Fuel**
- **High-H₂** fuel density solves the challenges of limited range
- **Low-carbon** fuel, with a **renewable future** – Just like H₂ and RNG
- **Widely approved** fuel type and readily available at ports worldwide
- **Increasing global capacity** is forecast to increase from ~153 mtpa in 2020 to 311 mtpa in 2030
- **Reduces** Safety Risk – **No** onboard high pressure H₂ storage required
- **Low-cost** of liquid fuel storage onboard the vehicle (same tanks as diesel)
- **Low-cost** source of H₂ (**with the right technology**)

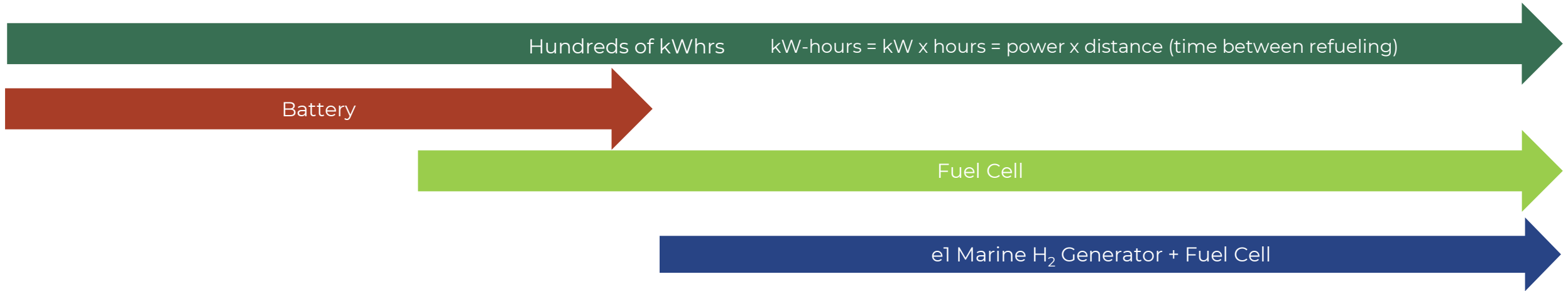
H₂ Storage for Marine Transportation

Volumetric Density Comparisons



Why On-board the Vessel H₂ Generation?

Think in terms of kW-hours



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e1 Marine 2022



The H₂ Solution

e1 Marine's Methanol to H₂ Generator

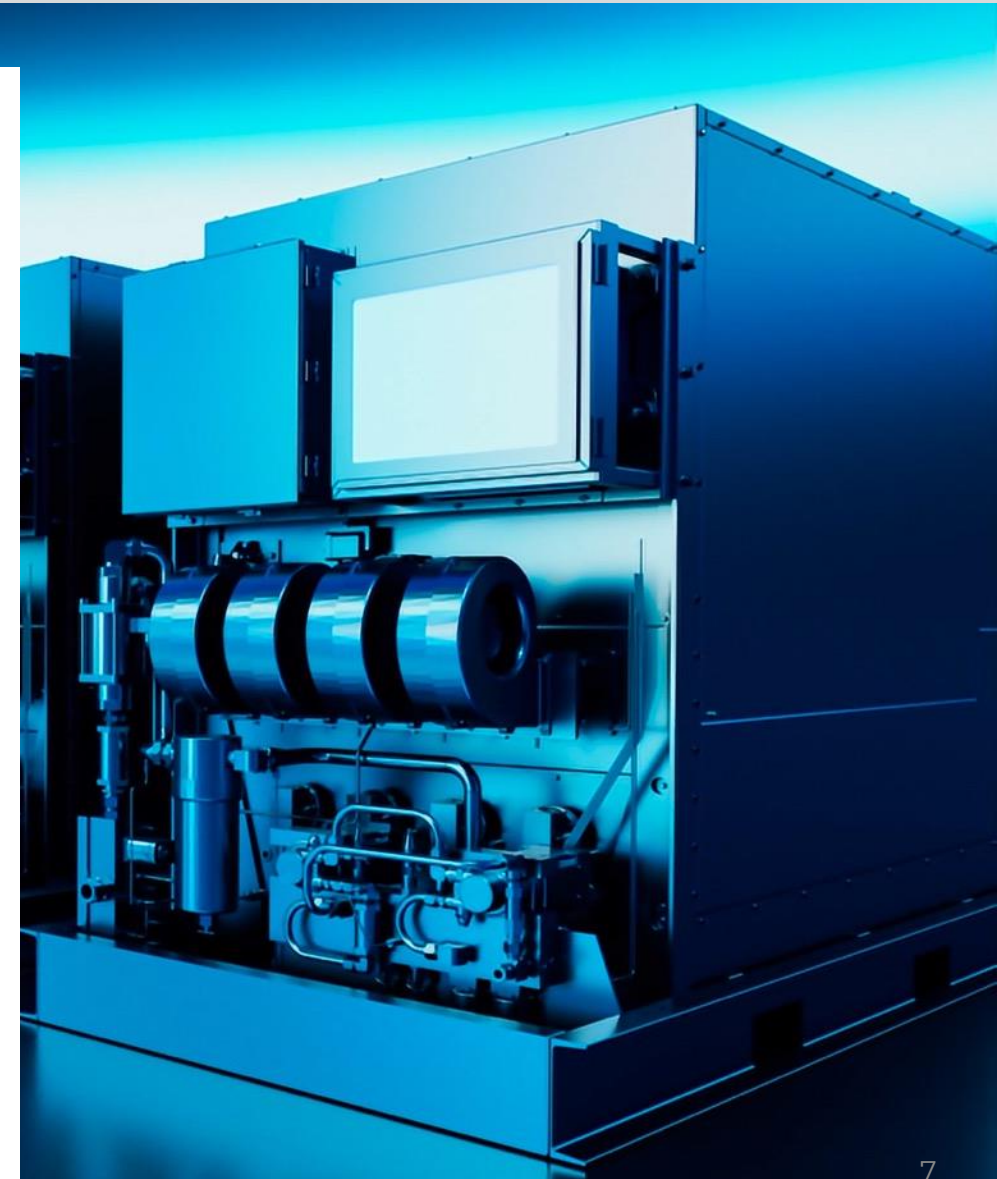
e1 Marine's proprietary technology produces H₂ on demand at the point of consumption, eliminating the logistical, storage, and cost challenges inherent in distributing compressed H₂

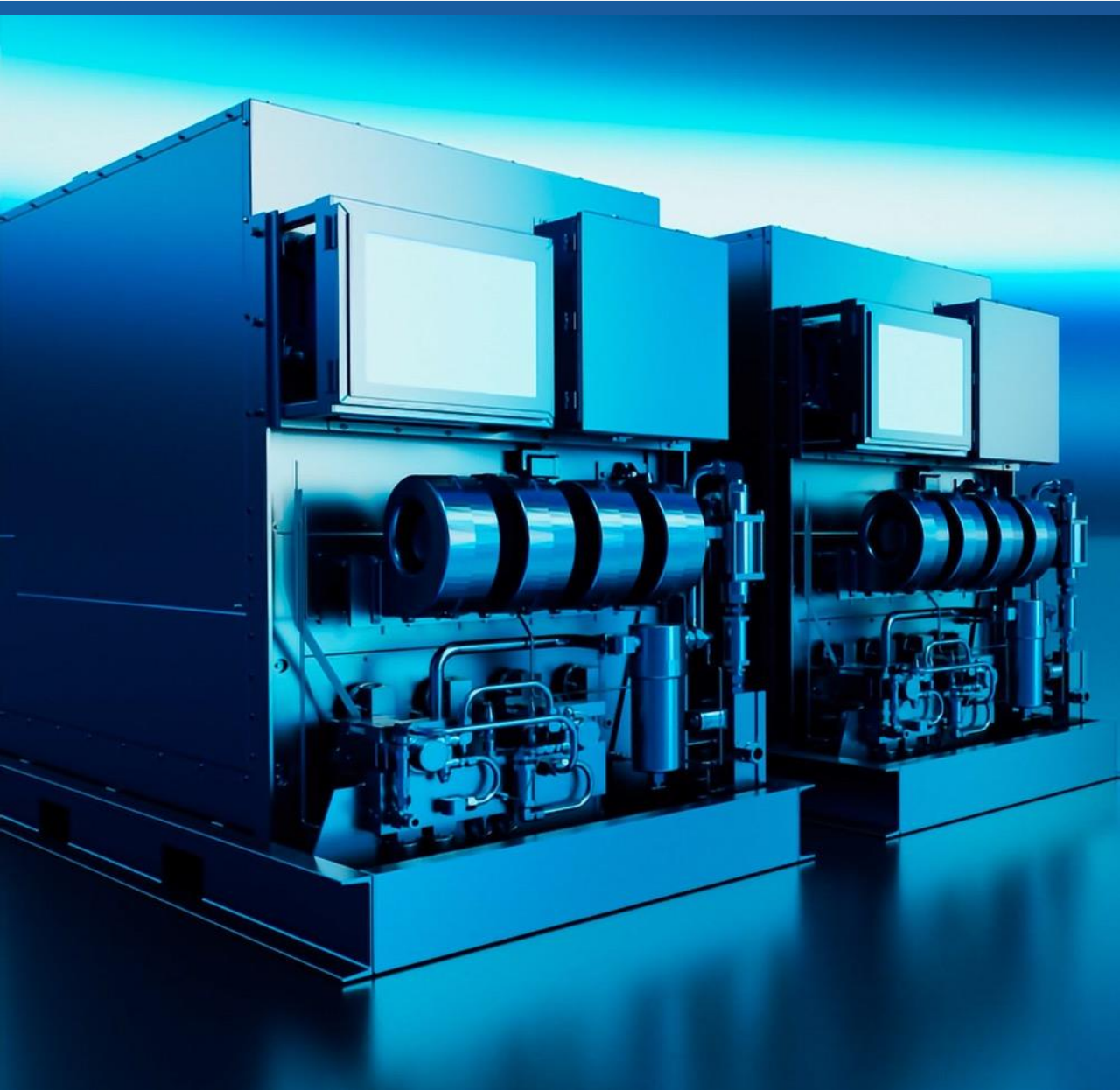
- **Zero** NO_x, SO_x and PM emissions
- CO₂ reduction of ≥ 23% vs traditional diesel engine¹
- Strong scalability prospects
- The methanol reformer > 80% , when combined with a PEM fuel cell, efficiencies of around 42% to 50% are generated
- Quiet (≈80 dB) and mobile

Proven in the telecom industry and successfully trialed in the trucking industry. Ready to Decarbonize Shipping

1. White paper "The Renewable Methanol Pathway to green Hydrogen". Upstream, Midstream, and Downstream Markets of Hydrogen. Webber Research & Advisory. 2020

2. Technology Overview: [Video Link](#)





e1 Marine's Mobile Methanol to H₂ Generator

H₂ On-Demand at the Point of Use on the Vessel

Value Proposition for the Fuel Cell Power Fleet Operator

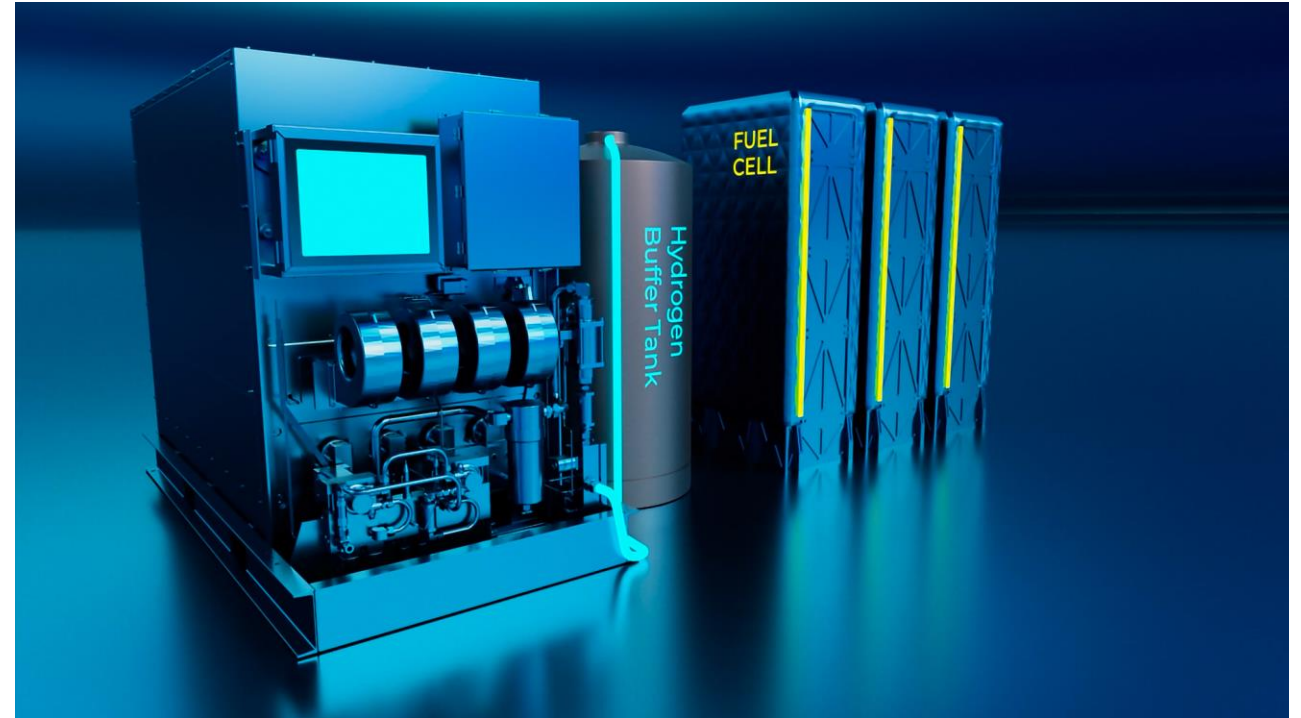
Features	HFO	Methanol	H ₂ Gas
Liquid feedstock	✓	✓	
Existing fuel bunkering	✓	✓	
Available in ports globally	✓	✓	
Familiar safety protocols	✓	✓	
Easier to handle	✓	✓	
High energy density (vol.)	✓✓	✓	
Quiet & low vibration		✓	✓
No pollutants (NO _x , SO _x , VOC, PM 2.5)		✓	✓
Low carbon solution		✓	✓
Zero emission / renewable pathway		✓	✓

Benefits vs Delivered Compressed H ₂ Gas	Methanol + M13
Extended operation for the same fuel storage volume	✓
M13 is compact, easy to site	✓
Simple technology leads to high reliability	✓
Quiet & low vibration provides location flexibility	✓
Lower cost (CapEx) solution accelerates adoption	✓
Lowest cost H ₂ per kg, accelerates adoption	✓
Lower refueling time than H ₂ storage (familiar)	✓
No high pressure H ₂ storage	✓

e1 Marine H₂ Generators

- Can work with all PEM fuel cell systems
- Simple controls and easy interface with the fuel cell
- Provides flexibility to the system integrator

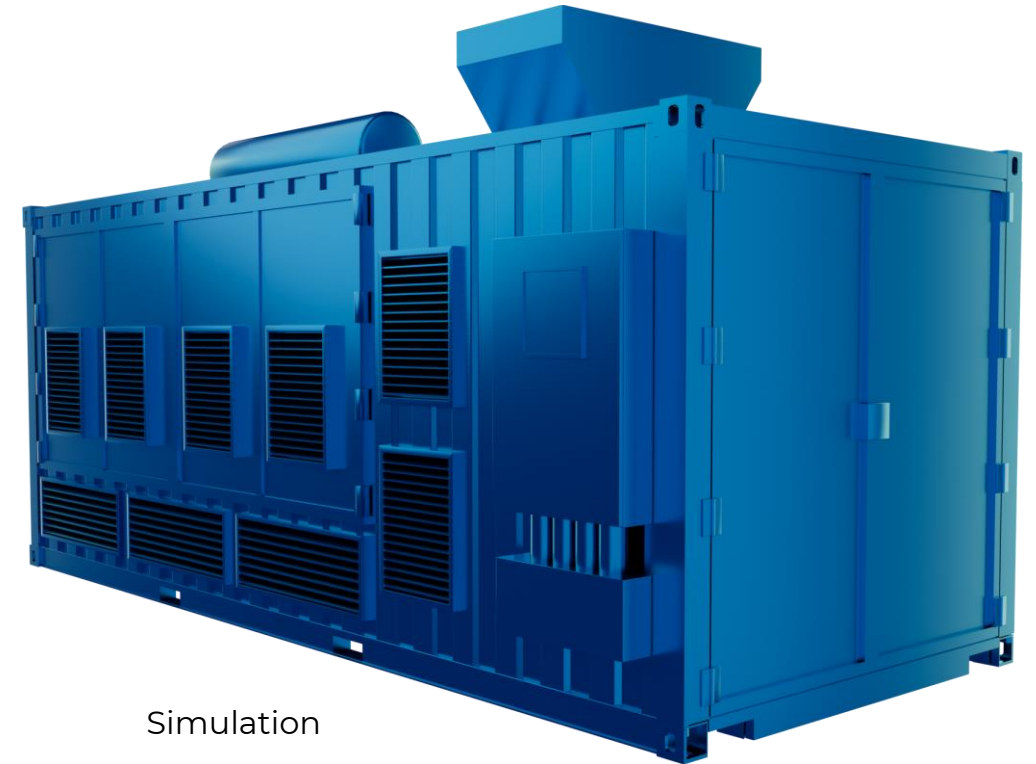
ISO 14687 (2019) is H₂ purity standard for PEMFCs



300kW Containerized Power System

Cold Ironing Solution

- Complete, independent power solution, fully integrated into a 20-foot container to provide 300kW of high efficiency, low emission power for port applications
- Incorporates two M18's and two 200 kW FCM
- With all required safety systems for installation on marine vessels, the containerized power system supports primary propulsion, auxiliary power systems, cold ironing, reefer power, e-vessel charging, and port backup power
- **Advantages include:**
 - On-demand, independent electrical power production
 - Cost effective - High energy efficiency
 - **No** NO_x, **No** SO_x, and **No** Particulate Matter (PM)
 - Net ZERO CO₂ emission with renewable Methanol
 - Low noise - Low vibration
 - Modular, scalable power support, standardized container



Simulation

M/V Hydrogen One

Methanol to H₂ – Fuel Cell Powered Towboat

Overview

- Maritime Partners is partnering with EBDG, e1 Marine, ABB, RIX, and PowerCell to design and build the industry's first long-range towboat compliant with IMO 1030 emissions requirements
- e1 Marine's patented H₂ generator technology converts methanol to H₂ directly onboard the vessel to eliminate the fuel transfer and storage complications associated with all other low carbon emission alternatives

Use

- Operational area of the Gulf of Mexico Intracoastal waterways (GIWW)
- Two barge (unit tow) capability - (2) 30k bbl inland tank barges
- Operator is ACBL; Charter customer is Shell

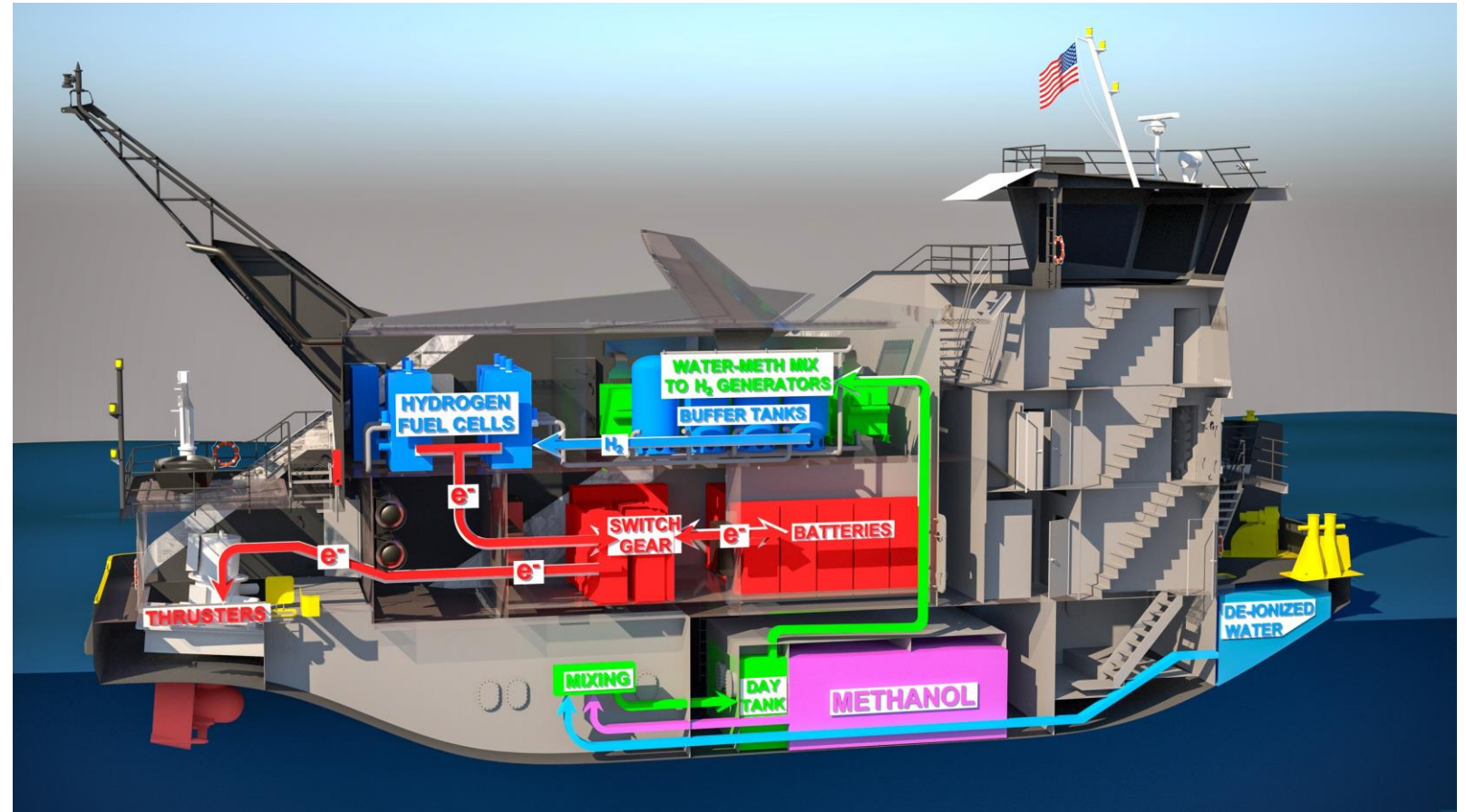


M/V Hydrogen One

Target Q4 2023 Release

Value Proposition:

- Ultra low emissions:
 - No pollution: no NO_x, SO_x, PM
 - Zero CO₂ emission future, just like renewable H₂
- Operational (24/7) fuel endurance of ~4 days between refueling
- Refuel safely and conveniently virtually anywhere
- 24-yr zero emission standby
- No shore power connection required





Marine
Getting hydrogen to work



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