



Zero Emission steam heat and power

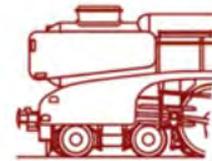
Advanced Steam Traction Trust

7<sup>th</sup> October 2023

Matt Candy

CEO

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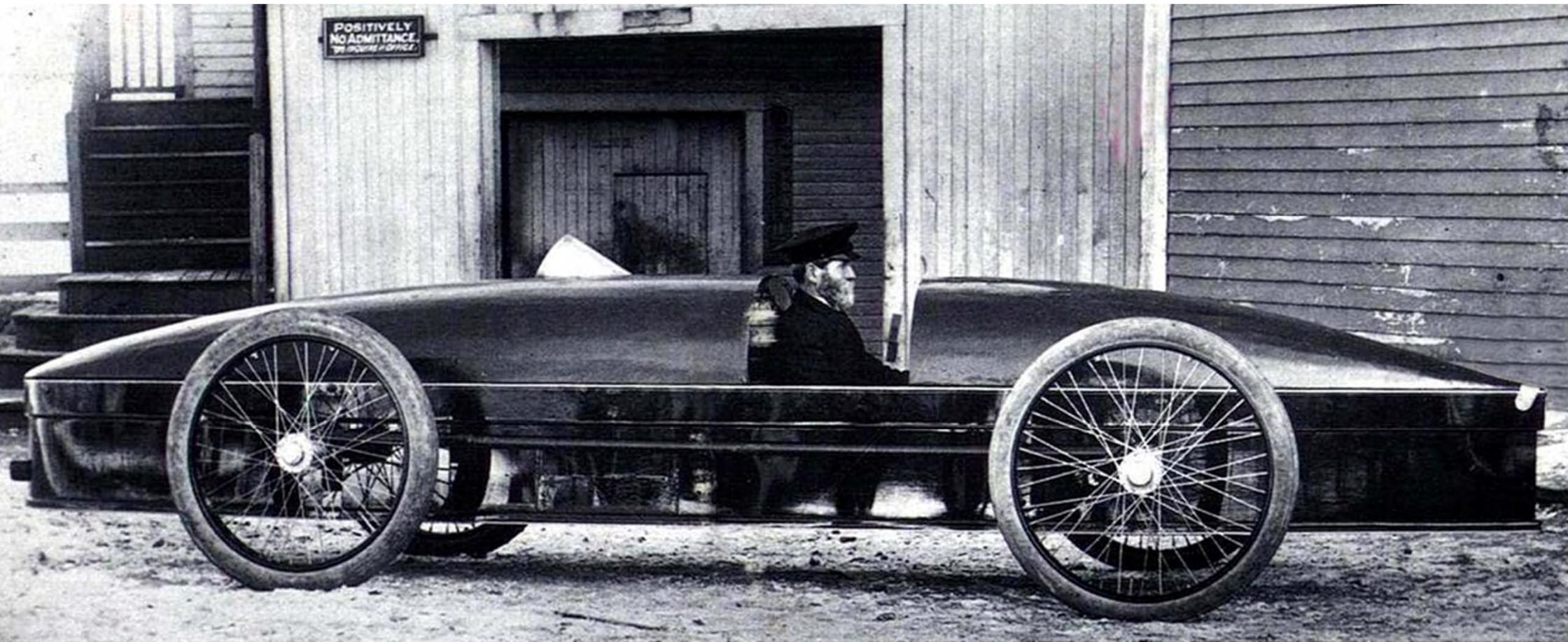
***Advanced Steam  
Traction Trust***



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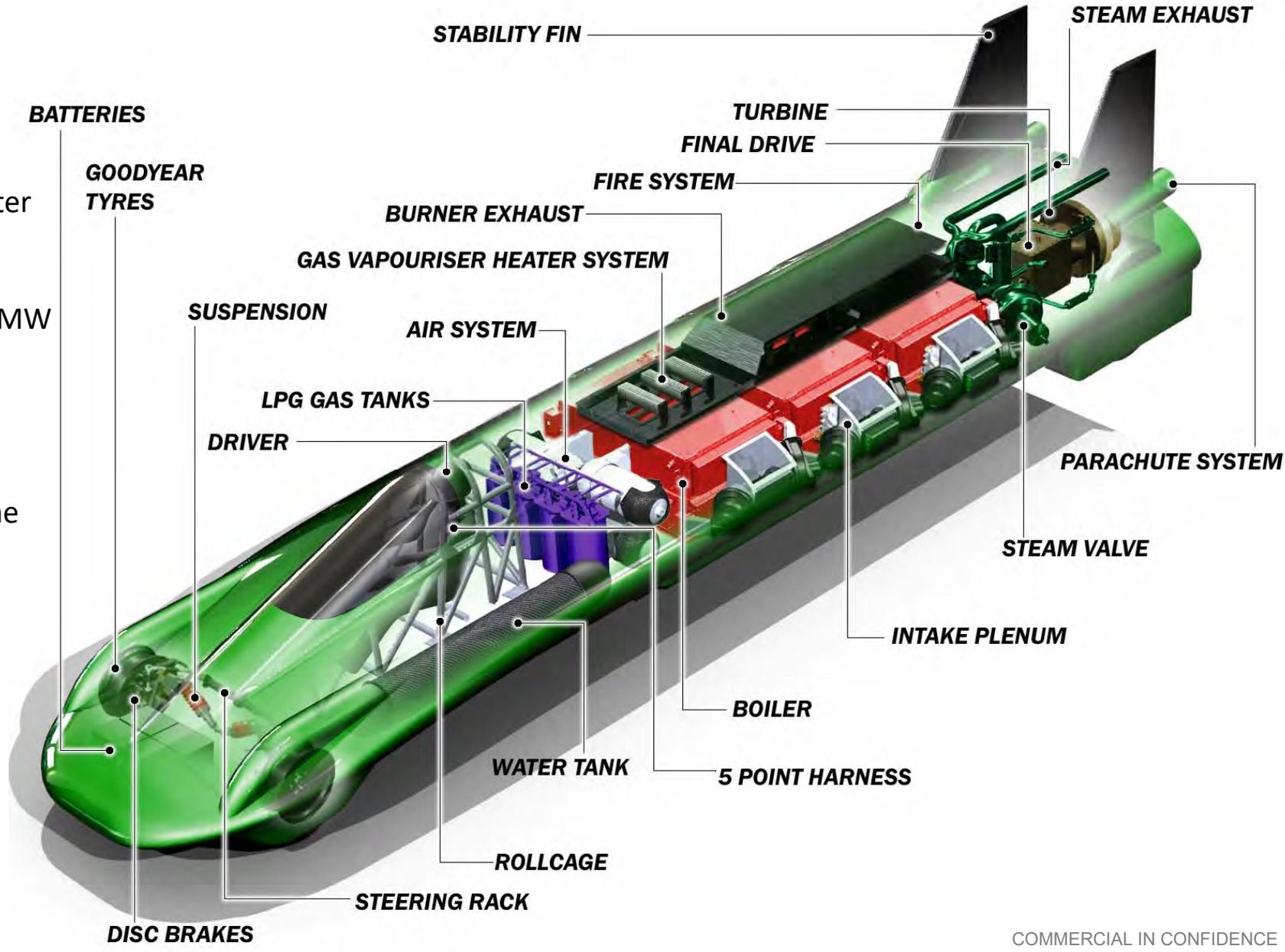


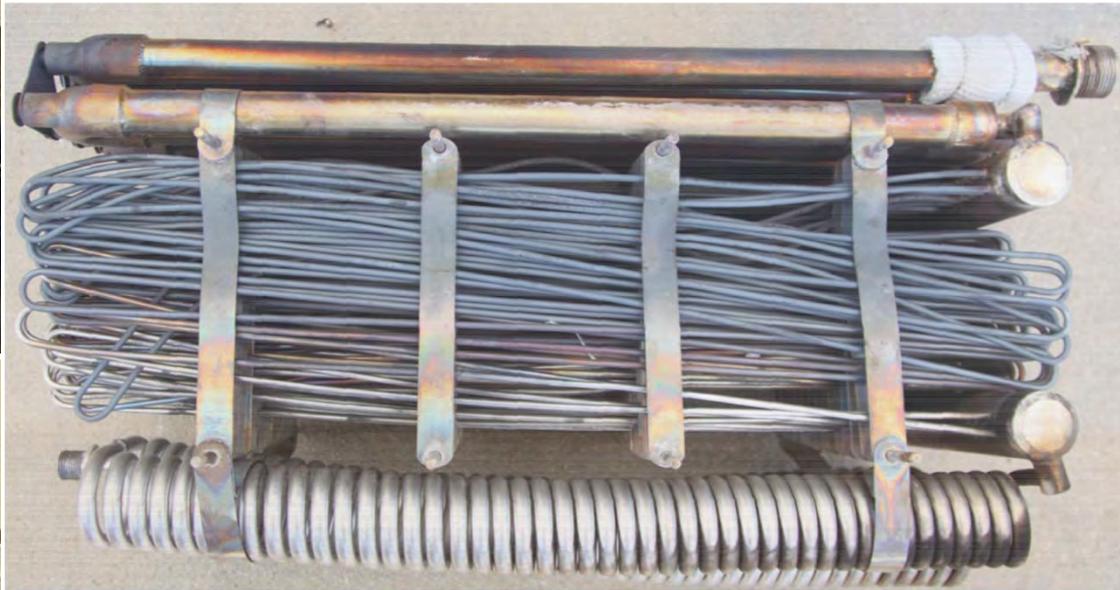
“...set five new world records achieving  
148.166mph...in California 2009...”





140 litres of demineralised water  
 300 bar pressure  
 60 litres of LPG  
 12 micro boilers generating 3MW  
 360 HP  
 Steam at 400°C  
 3km of tubes  
 Super heated steam  
 Two stage Curtis wheel turbine  
 13,000rpm max revs  
 7.6m long,  
 1.7m wide,  
 3 tonnes













STEAMOLOGY



STEAMOLGY









**FIA**  
 FÉDÉRATION INTERNATIONALE DE L'AUTOMOBILE  
*Certificate of Record*

*this is to certify that*  
 The Steam Car Company, LTD.  
 "Inspiration" Steam Powered Streamliner  
 with Charles Sturtevant driving  
 achieved the  
 Category A - Group K - Class 5  
 FIA International Flying Start Land Speed Record of  
 One Mile in 25.743 seconds  
 at an average speed of 159.843 MPH / 257.053 KPH  
 at  
 Edwards Air Force Base, California, U.S.A.  
 on  
 25 August 2009



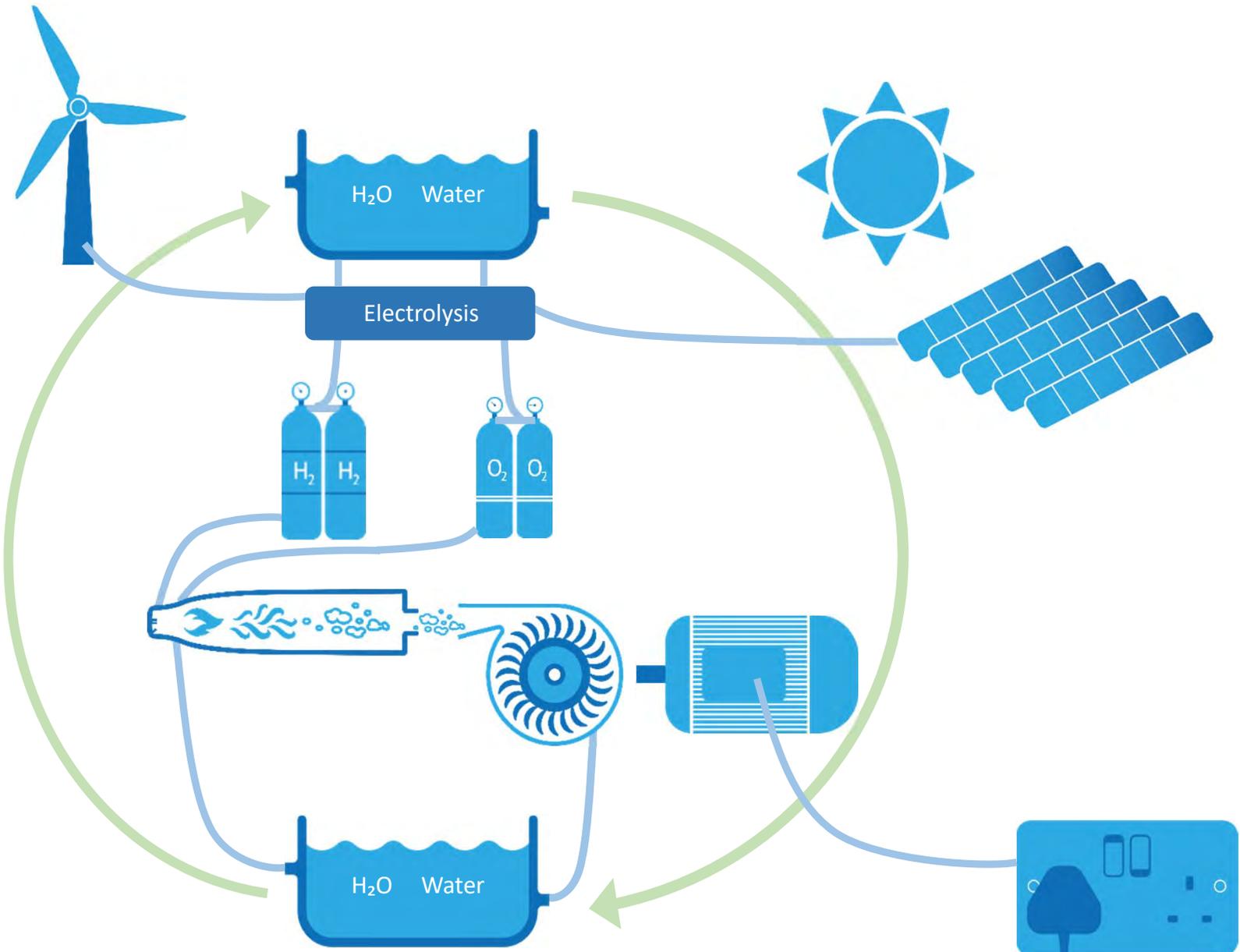


“...transforming water into power...”



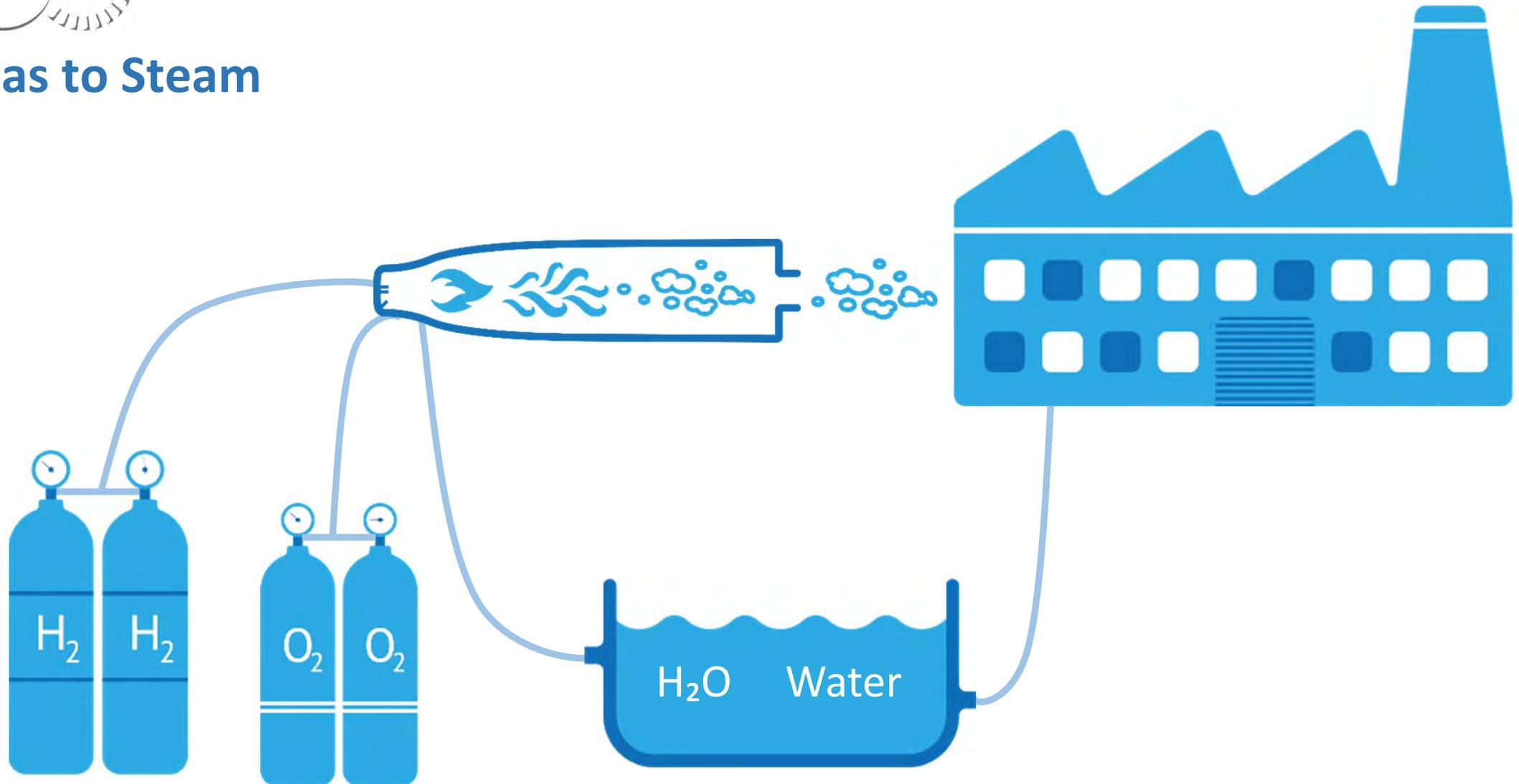
Steamology zero emission energy solutions address three markets with common technology:

- Gas to Steam for industrial applications
- Gas to Power 10 kW to 1MW
- Renewable Energy (RE) storage and power generation





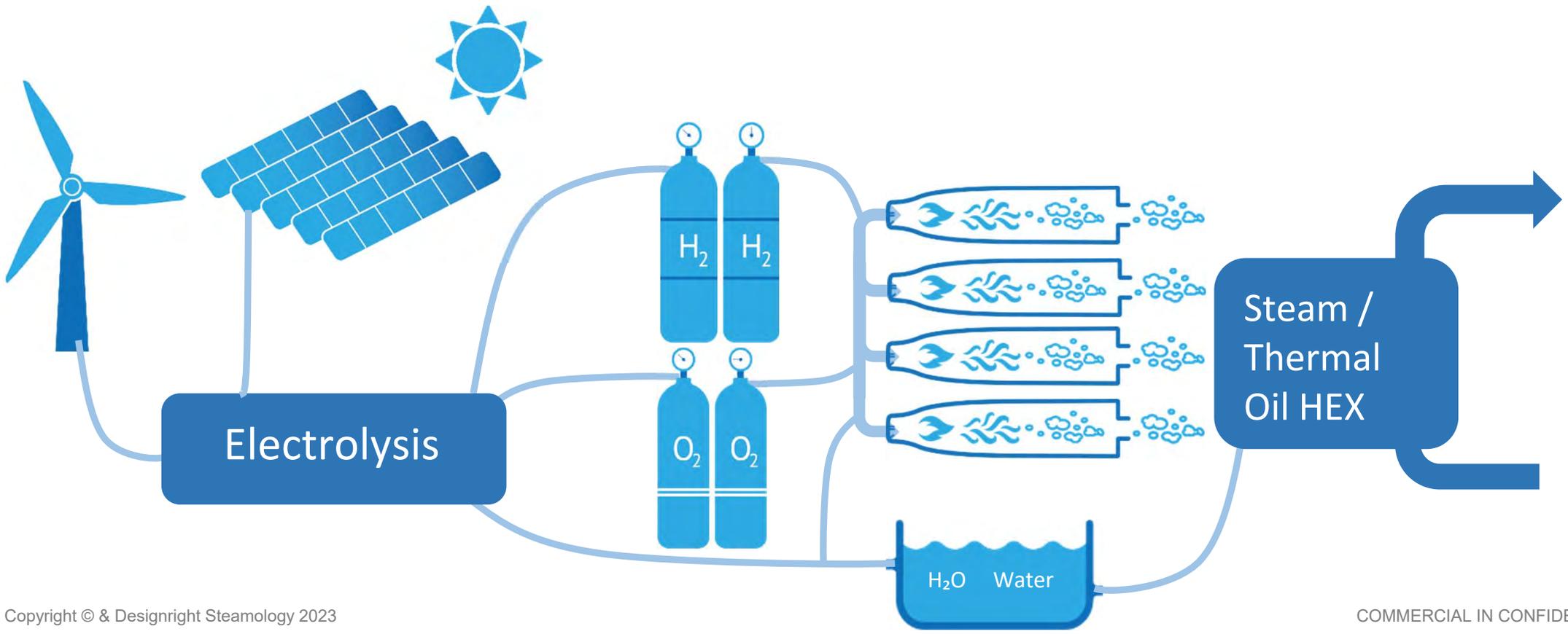
# Gas to Steam





## Zero Emission Industrial Thermal Oil Heating

Renewable Wind and Solar PV powers electrolysis providing hydrogen and oxygen gas to buffer storage. Hydrogen and oxygen fuels Steamology steam generators providing clean heat to thermal oil circuit





## Gas to Power

Zero emission - No CO<sub>2</sub>, NOX, SOX, or particulates

High power and torque - 10kW to 1MW range, scalable and modular units

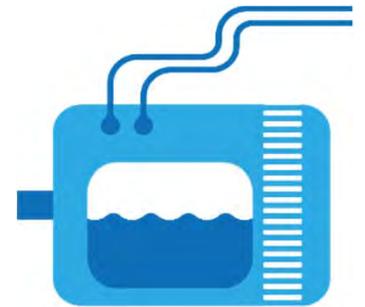
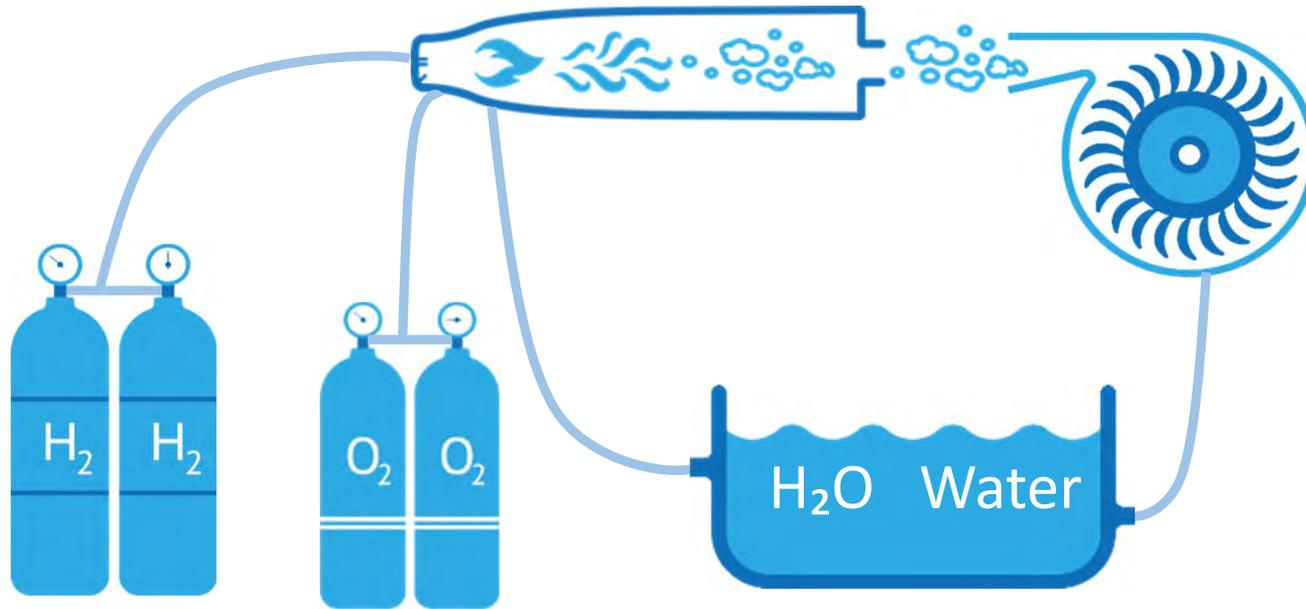
Low noise and thermal signature - Quiet vibration free operation, low temperature signature

Operating temperature agnostic - Functional in a wide range of environments

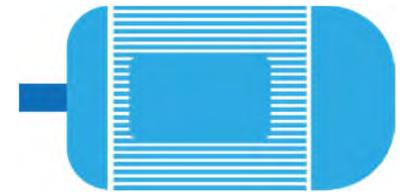
Low maintenance - Few moving parts made of standard engineering materials

No loss of performance over charging cycles – Long life and service interval

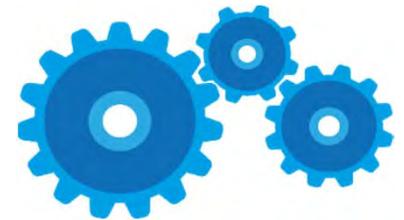
No toxic or scarce materials – No Pb, Sb, Cd, Li or rare earth elements



Hydraulic power



Electric power

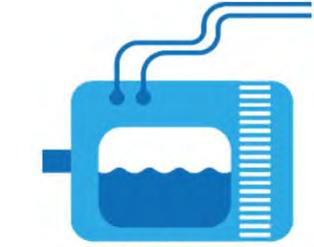
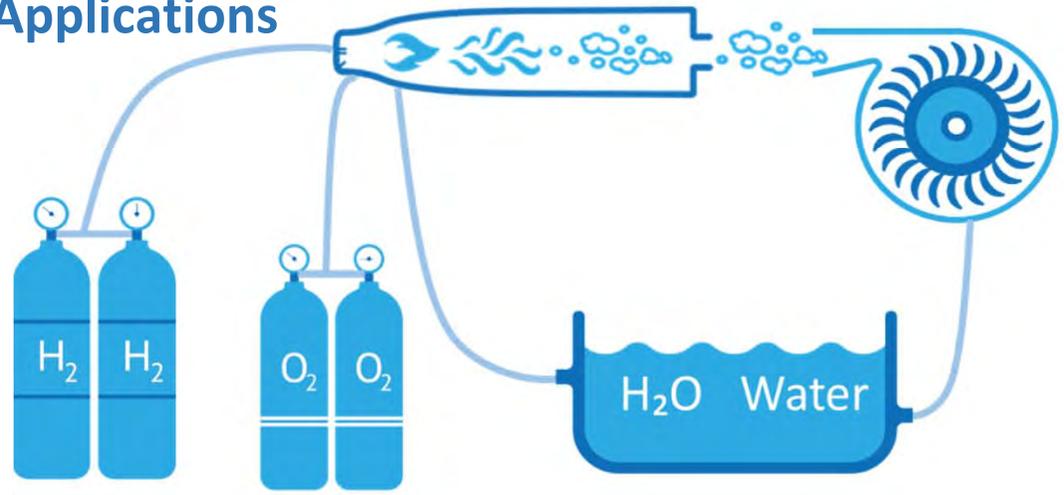


Mechanical power

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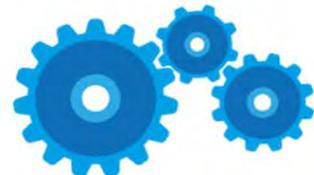
# Gas to Power Applications



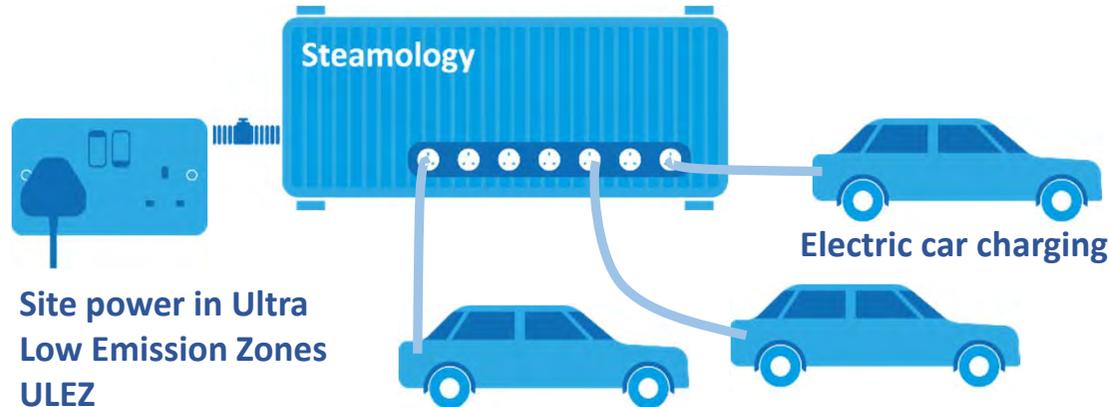
Hydraulic power



Electric power



Mechanical power



Rail power



Construction power



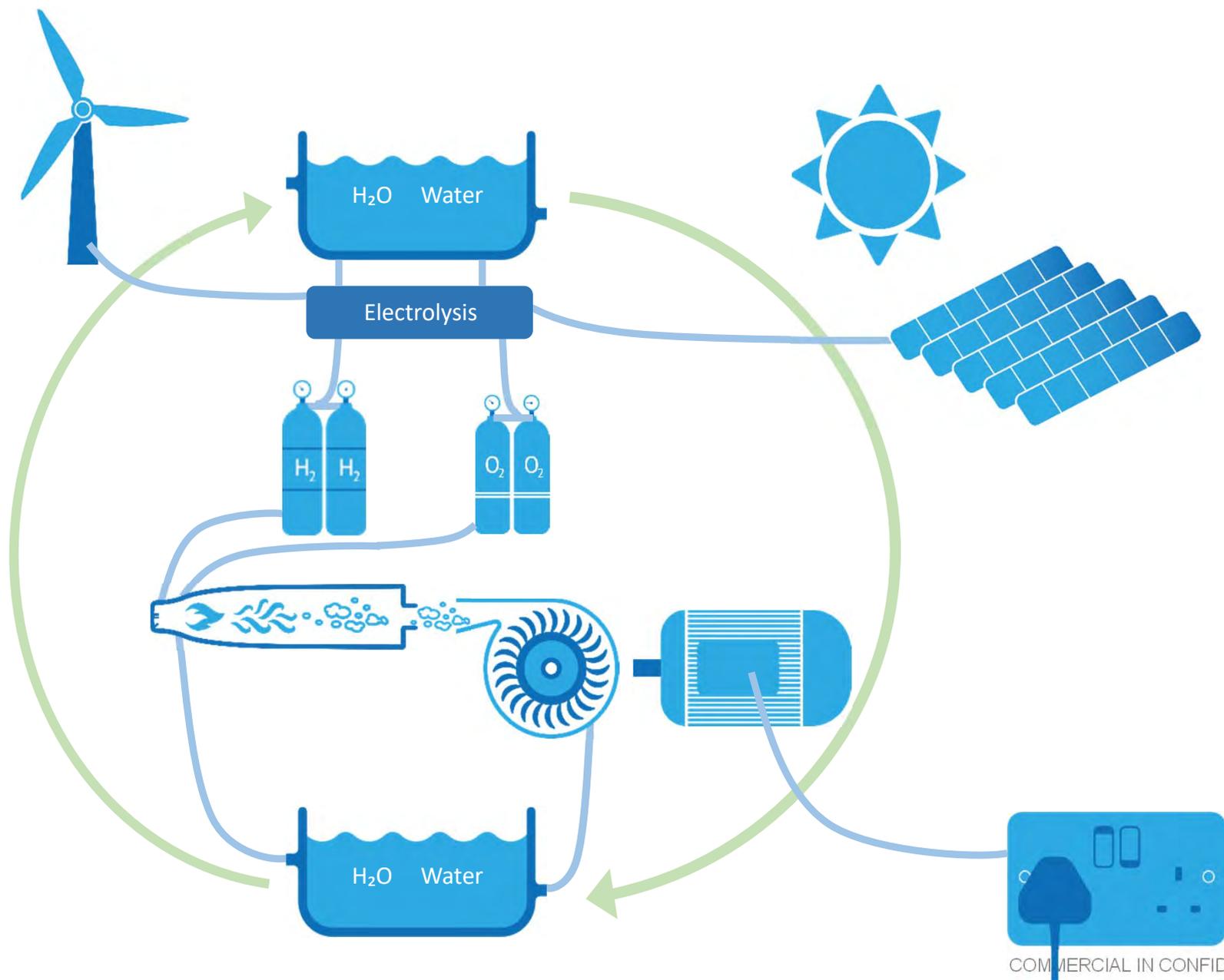
Haulage power



Marine power



# RE Storage and Power



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## Steam Generator

- High efficiency - High Heat Value
- Wide range of fuel purity
- Rated ~600kg/hr (100kW)
- No annual shut down
- Steam is generated in seconds providing rapid response  
‘What you need when you need’
- Steam generators scalable modular power to MW scale
- No moving components ‘spanner friendly’ maintenance
- No exotic materials fully recyclable at end of long life
- Only product of combustion is water, eliminating CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub> and particulates
- Water returned to electrolysis
- Quiet, vibration free









2000L 2078A1

2000L 2078A2

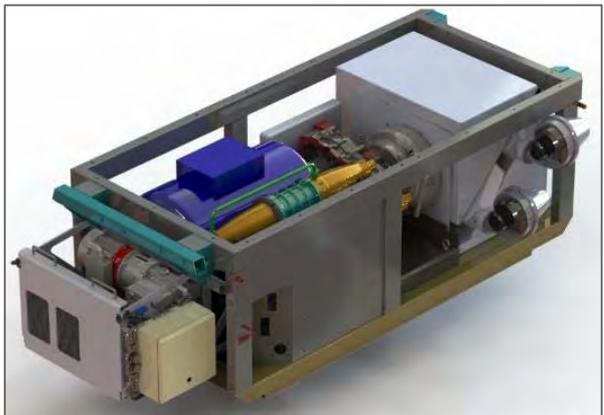
SWL 5000KG



# FOAK 2 Rail Decarbonisation

W2W Zero Emission Power System

100kW range extender



HM Government

We work with  
**Innovate UK**

**vivarail**

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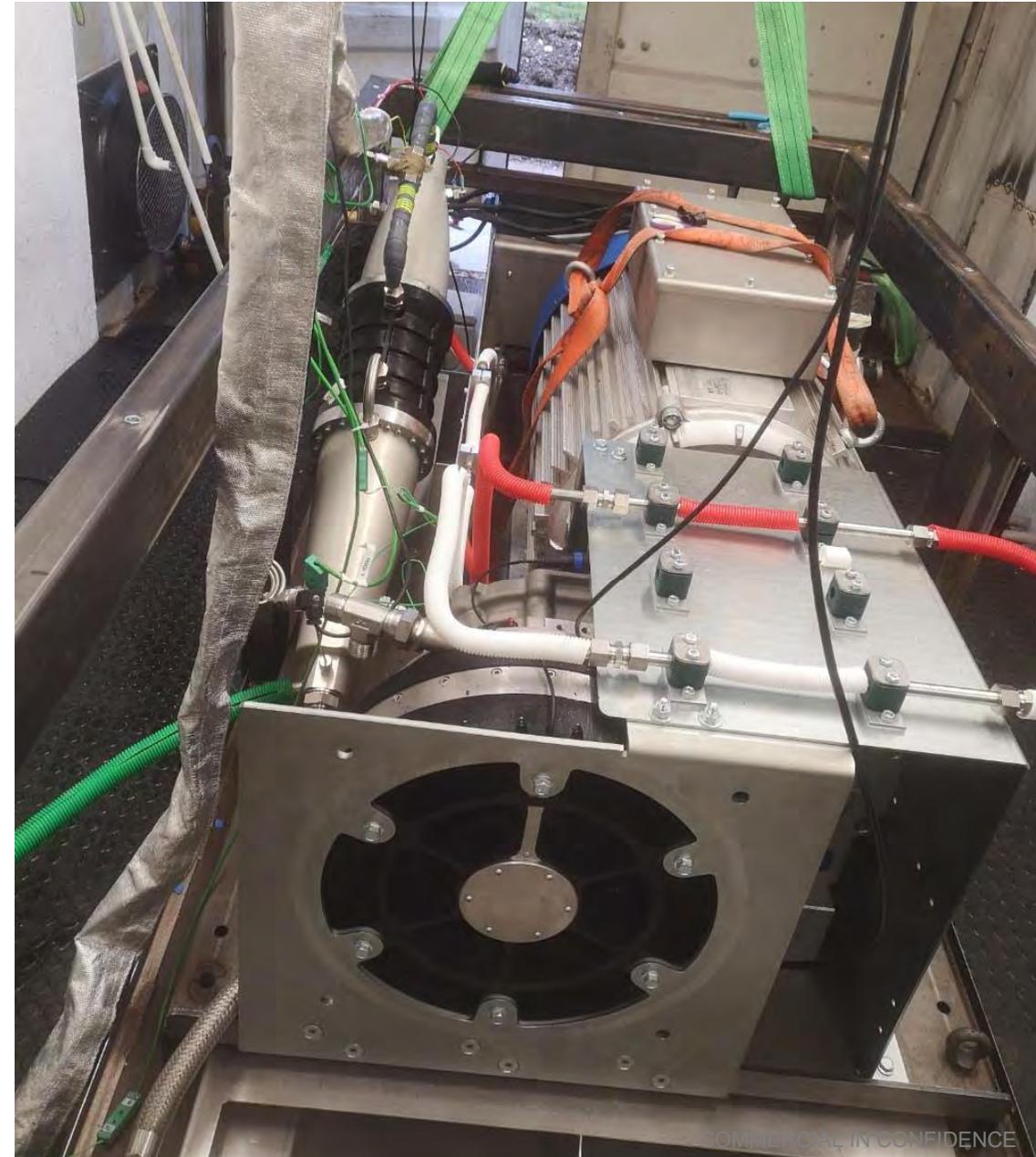
## Rail Decarbonisation

Zero Emission 100kW range extender

Delivering 750V DC to traction motors or battery storage

Power raft is a modular Vivarail design to re-traction Class230 London Underground rolling stock

Demonstrator delivered December 2019 tested with electrical load bank

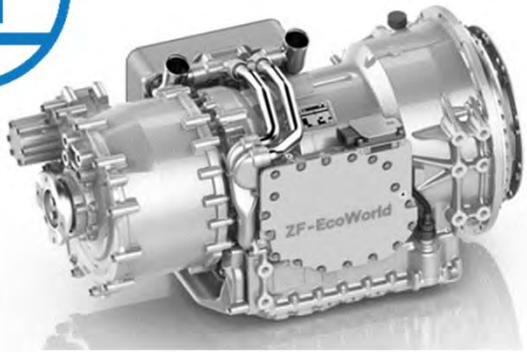




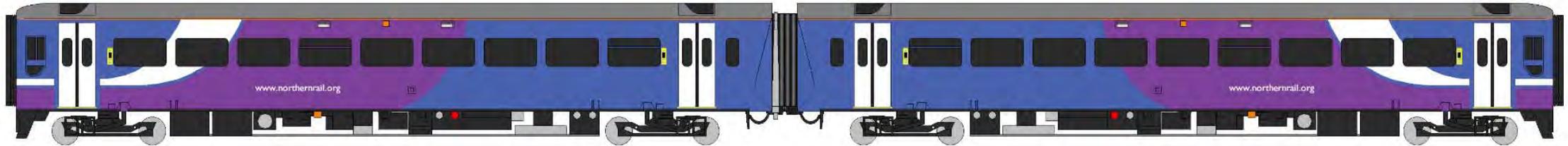
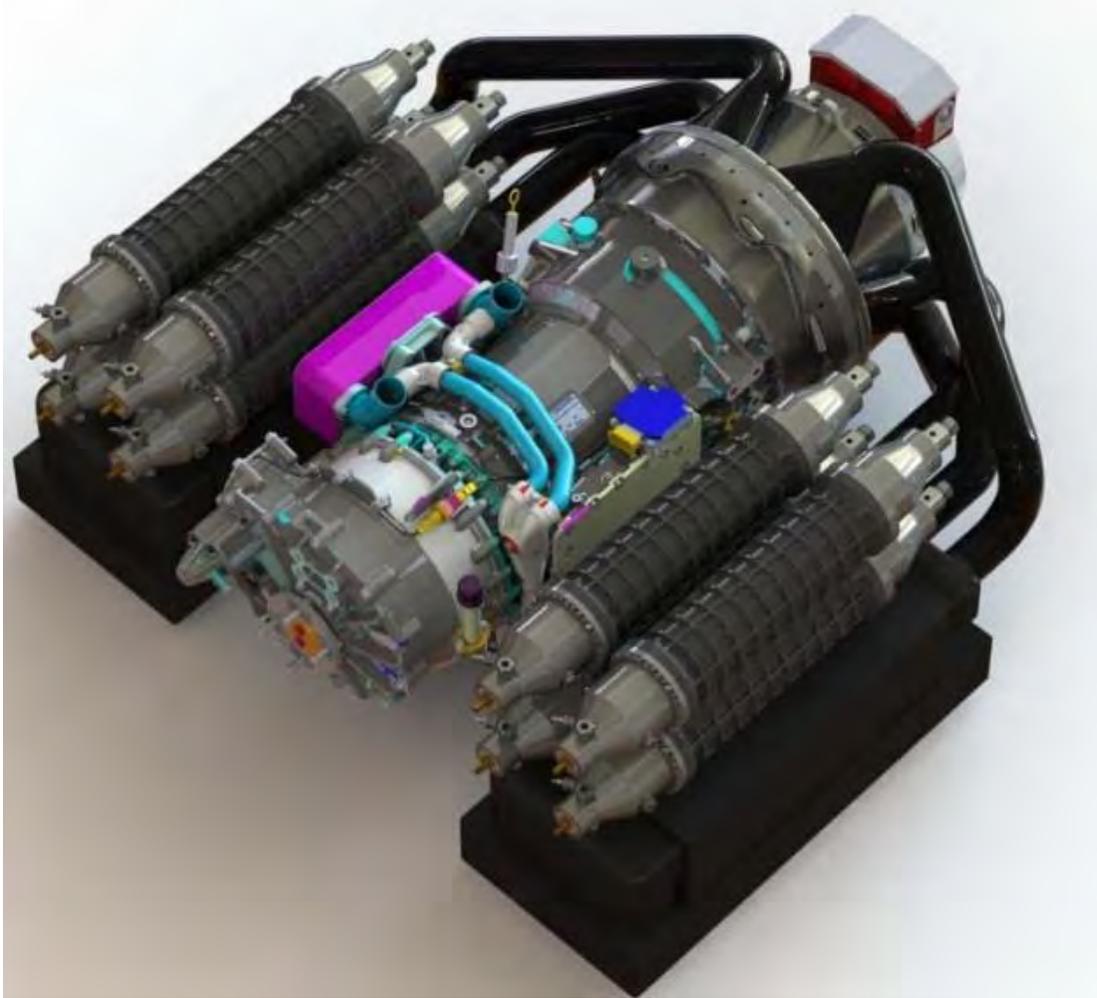
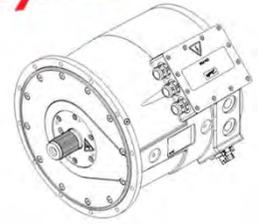
# Passenger Rail Re-tractioning

Zero Emission Diesel Engine Replacement Drive Train

300kW Class 158 Passenger DMU diesel engine replacement



*Danfoss*

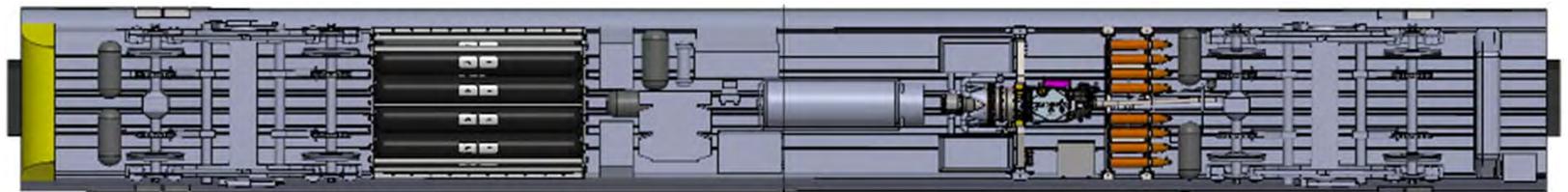
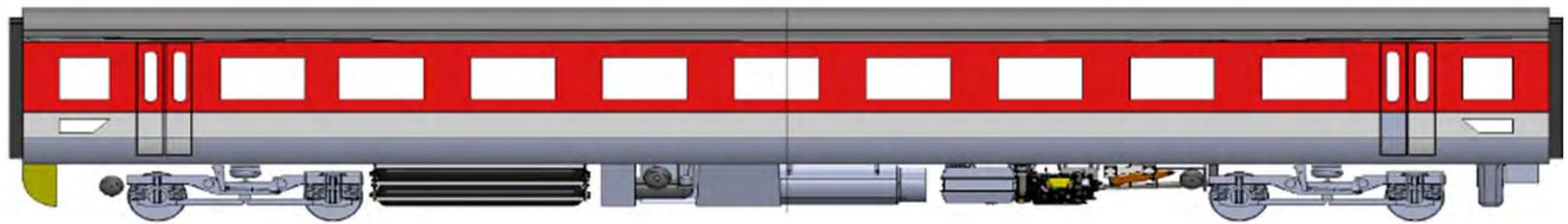
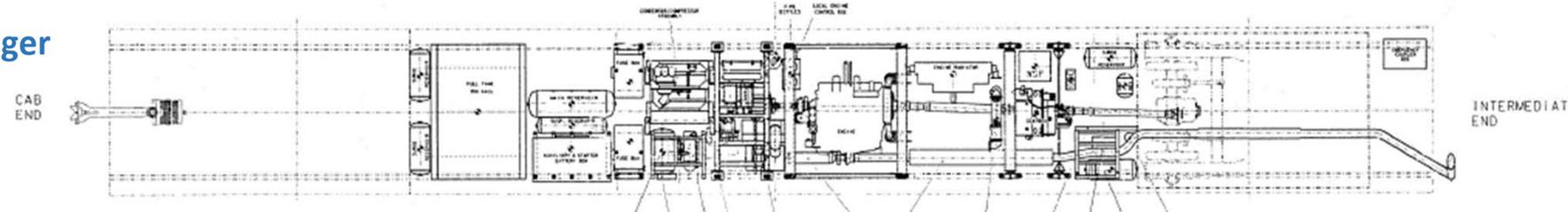
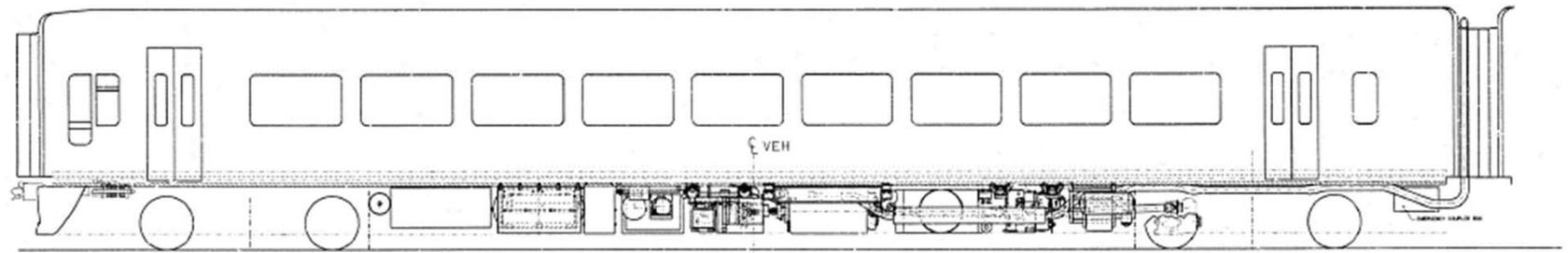




# Direct drive

Zero Emission Diesel  
Engine Replacement Drive  
Train

300kW Class 158 Passenger  
DMU diesel engine  
replacement

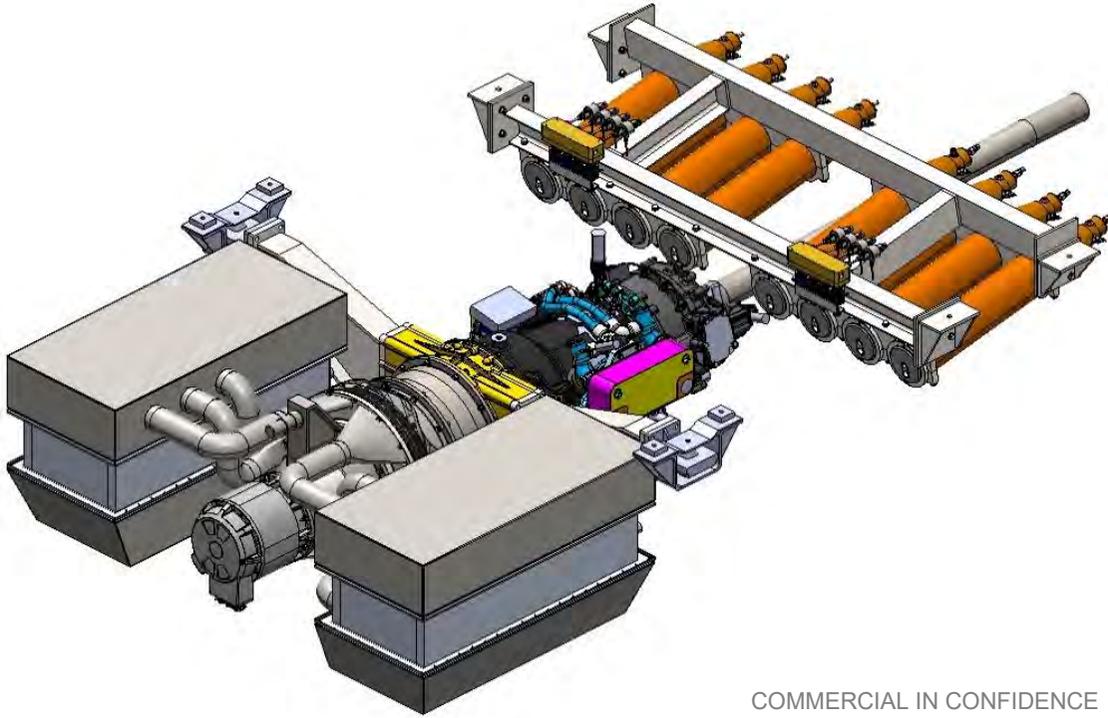
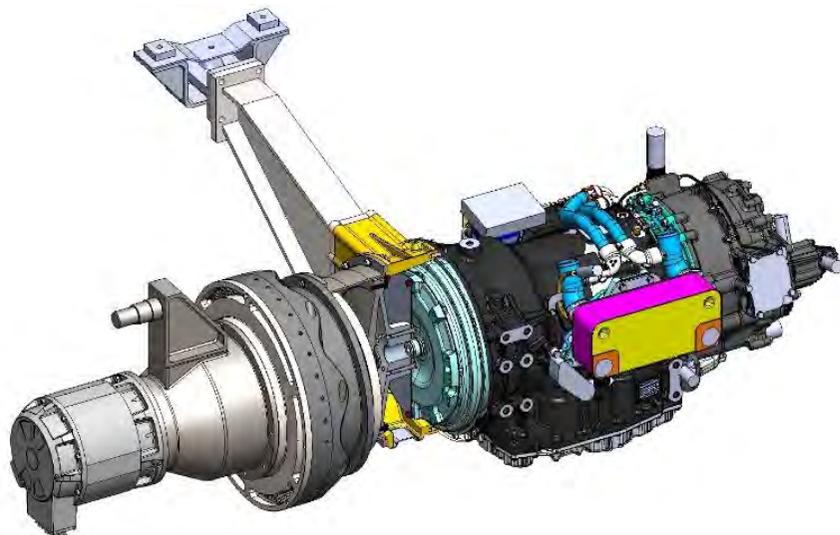




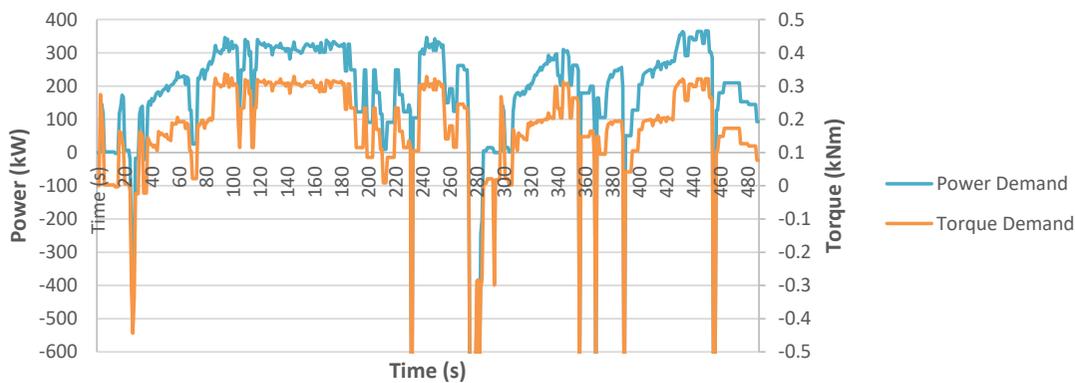
# 300kW Drivetrain

DMU replacement drivetrain with turbine, reduction, ZF EcoWorld transmission, Cardan shaft, condensers, auxiliary motor generator.

Scalable drivetrain to accommodate regenerative energy for passenger rail routes



Power and Torque Demand for Class 158 on Shrewsbury to Aberystwyth route





# Zero emission rail freight power

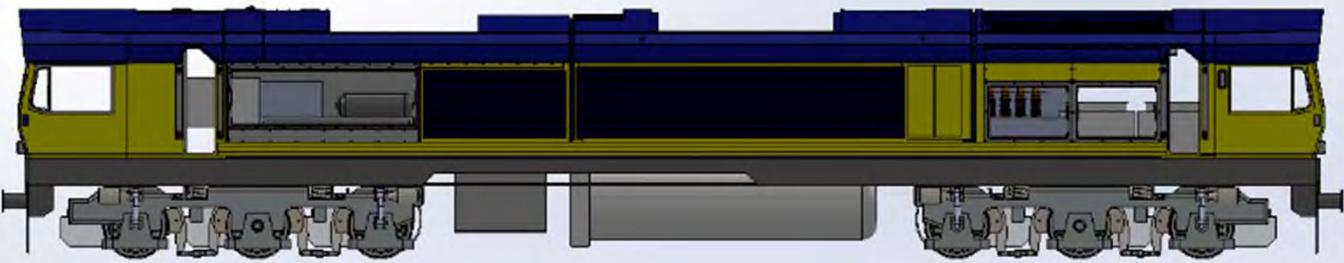
600kW Class 66 Freight steam electric turbine



HM Government



Innovate UK





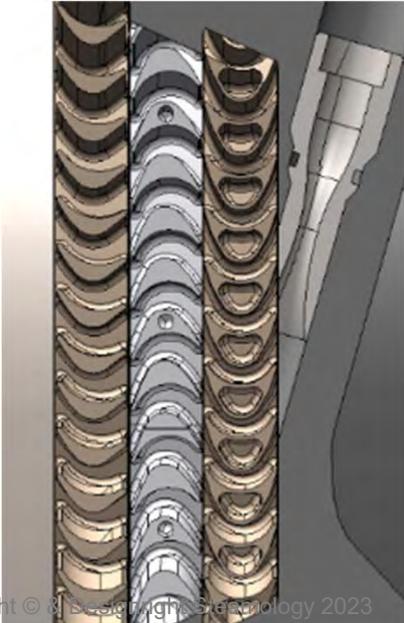
# Turbine

Ø 600mm two stage impulse Curtis wheel turbine

Single component 9,125rpm

Standard materials handle low temperature steam ~110°C

Directly couple to reduction gearbox

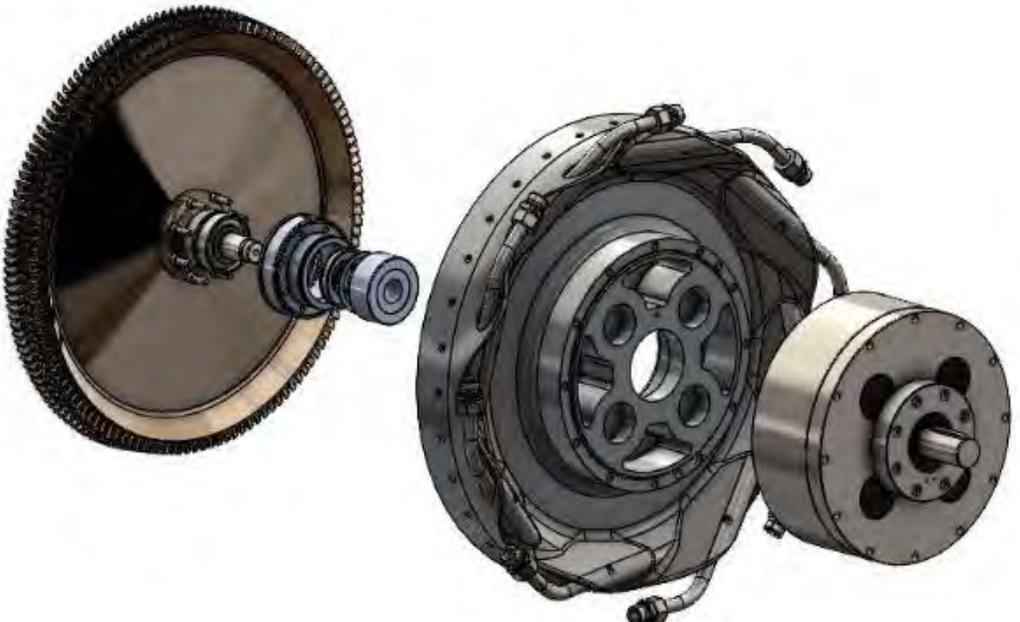




# Turbine reduction

Turbine speed 9,125 rpm can be reduced as appropriate for electrical generators or conventional diesel engine transmissions

Parallel inline gears transmit high torque in simple efficient, compact arrangement



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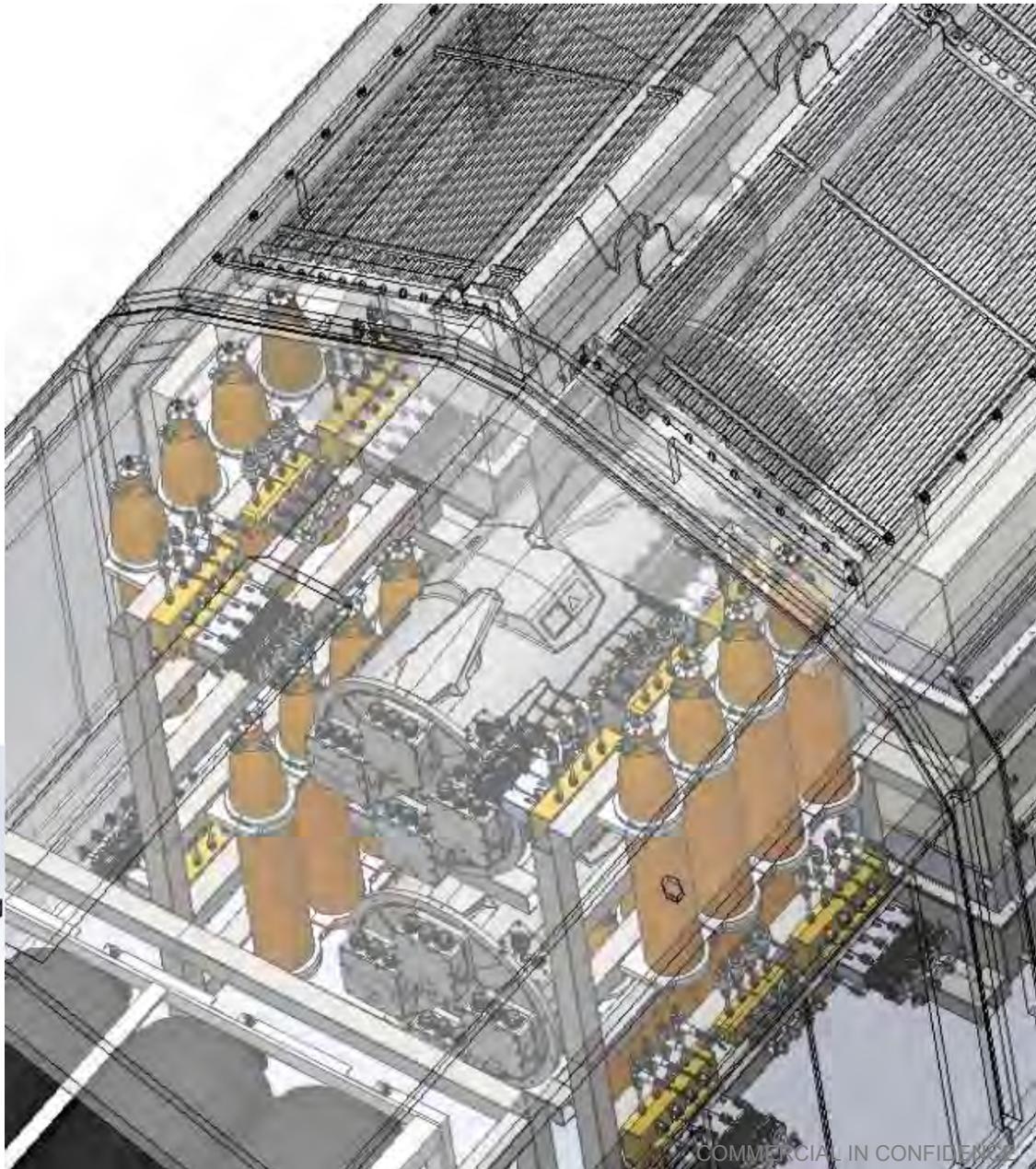
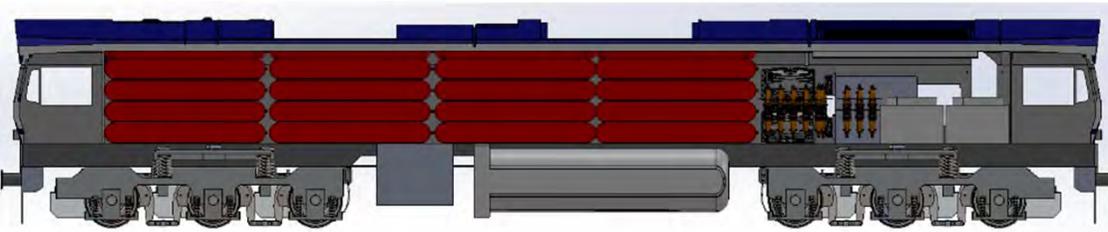
# Zero emission rail freight power

Packaging ~2.4MW steam electric freight re-tractioning

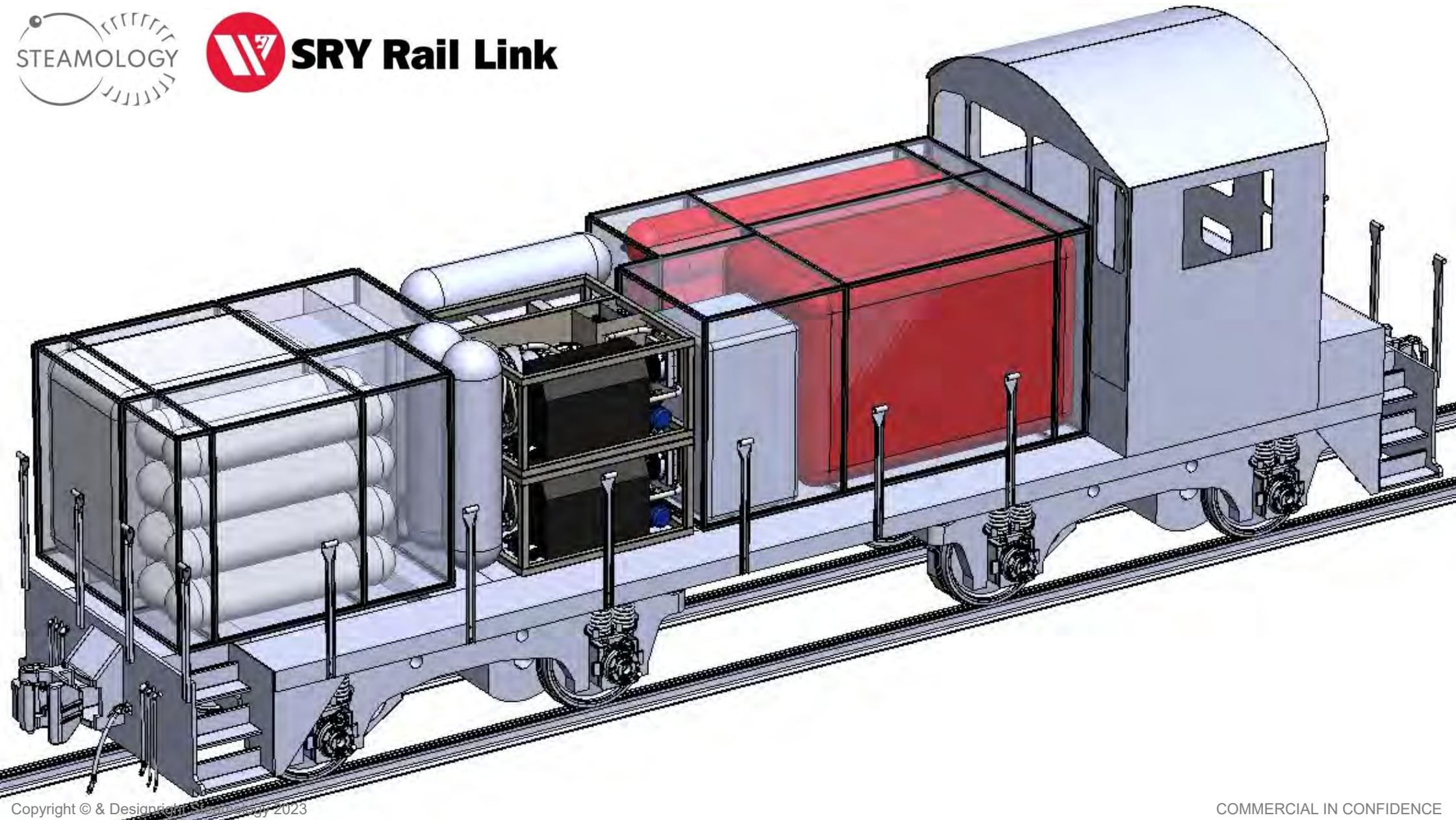
Initial storage models ~13MWhr in single cab configuration

Danfoss Editron range permanent magnet motor generators

Electric compressor Gardner Denver, Atlas Copco



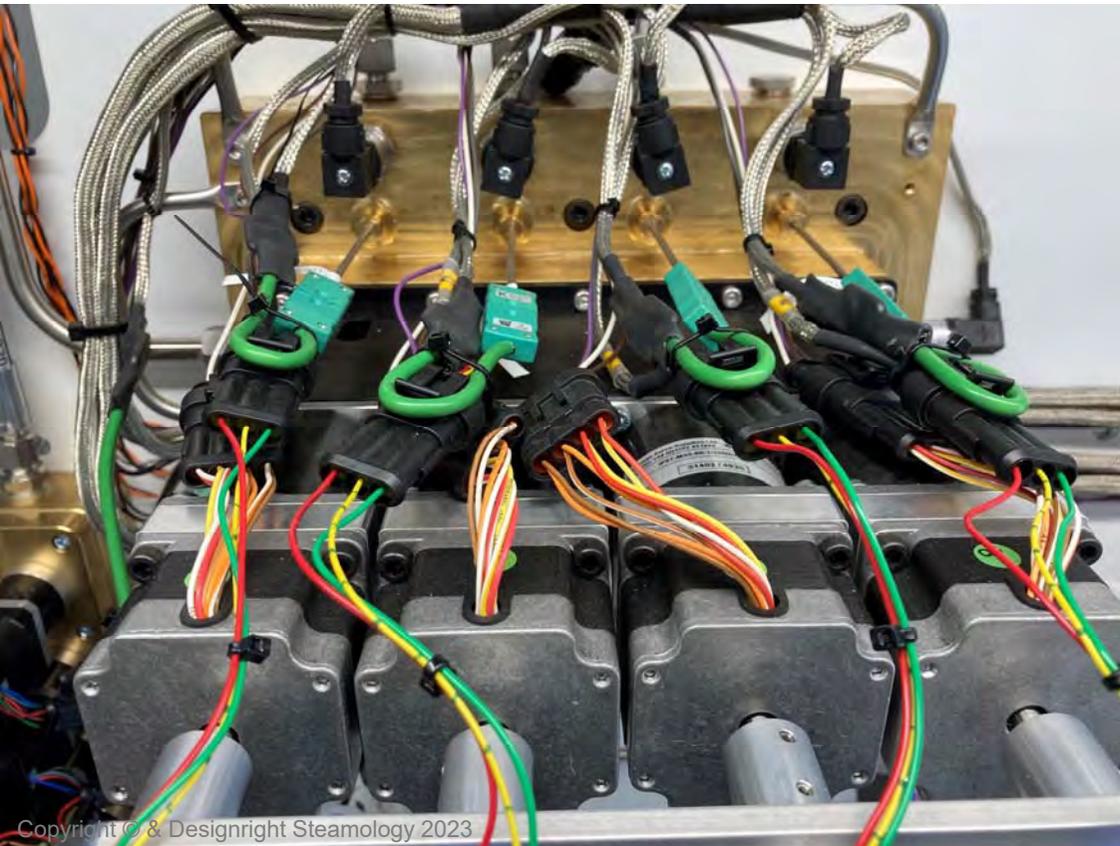
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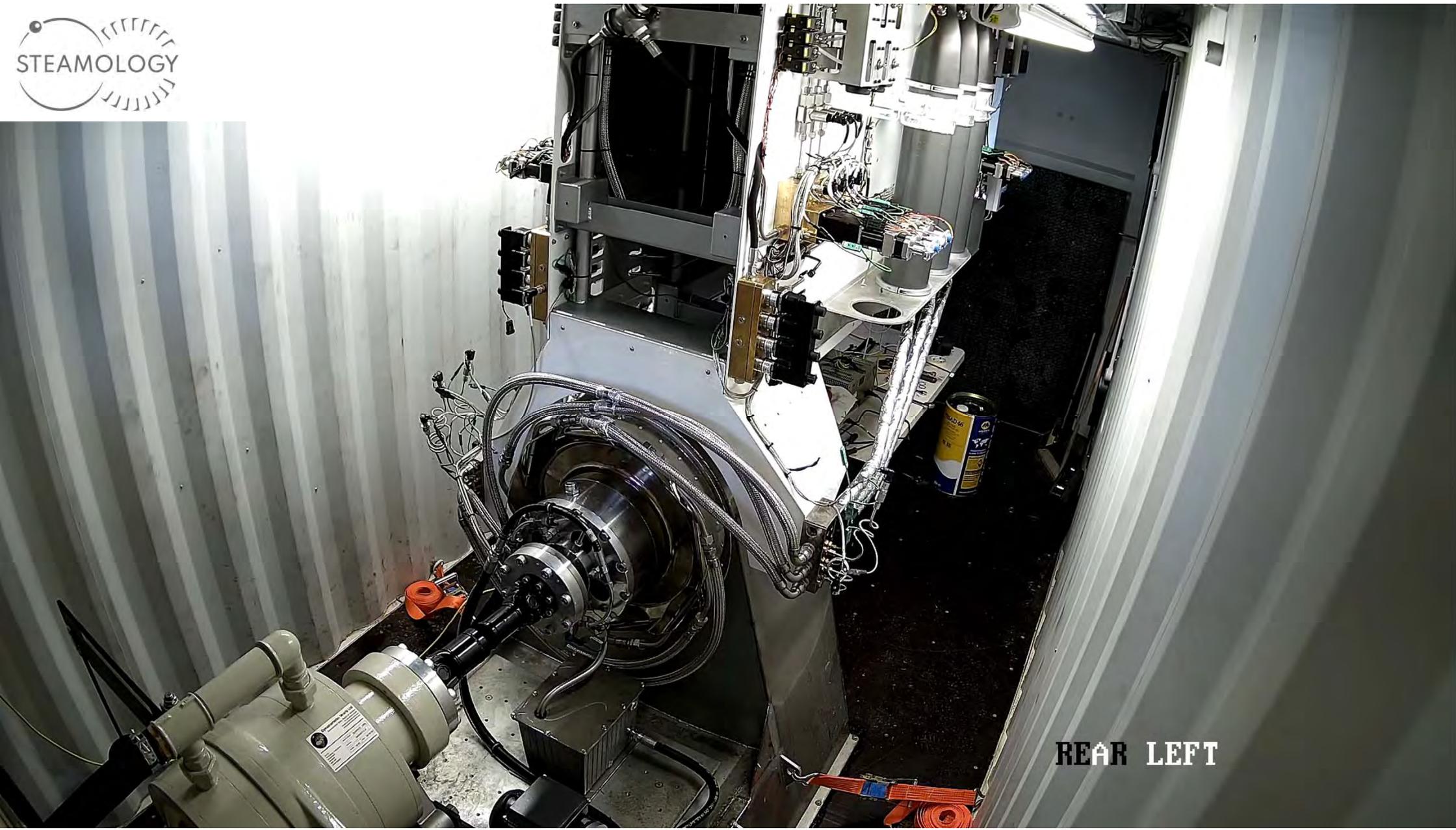






# Test cell



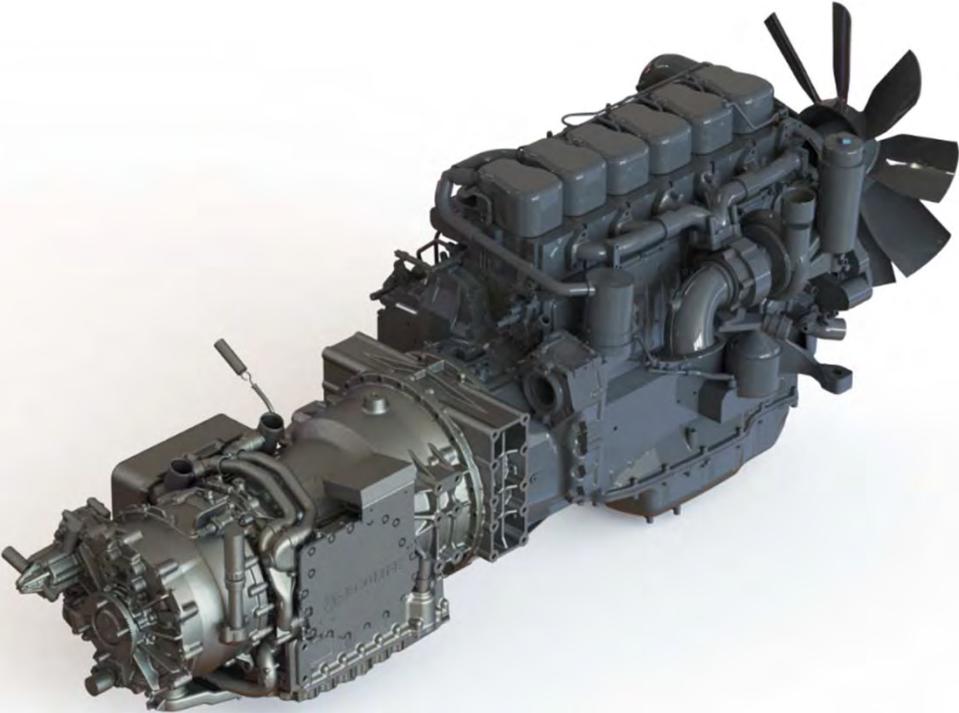


REAR LEFT

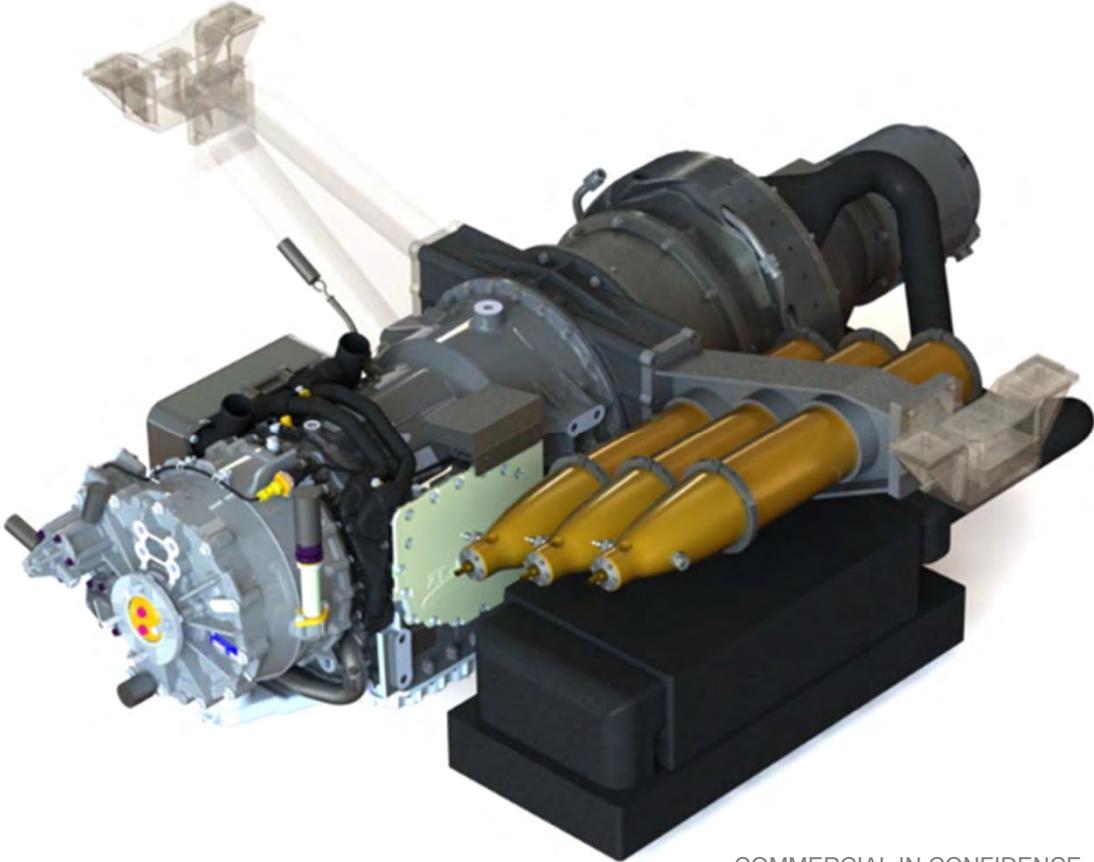


# Diesel engine replacement

Scalable and modular power solutions, embracing the hydrogen economy, eliminating emissions, replacing fossil fuels and fossil fuel engines.



Steamology deliver quiet clean power to MW scale

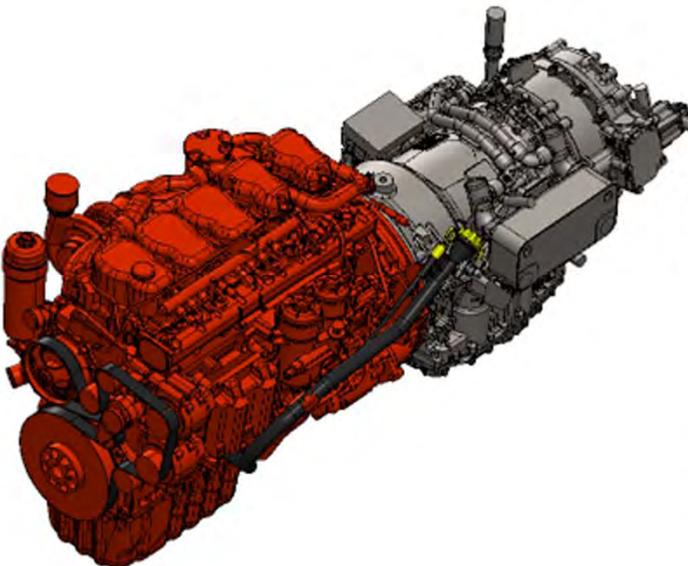




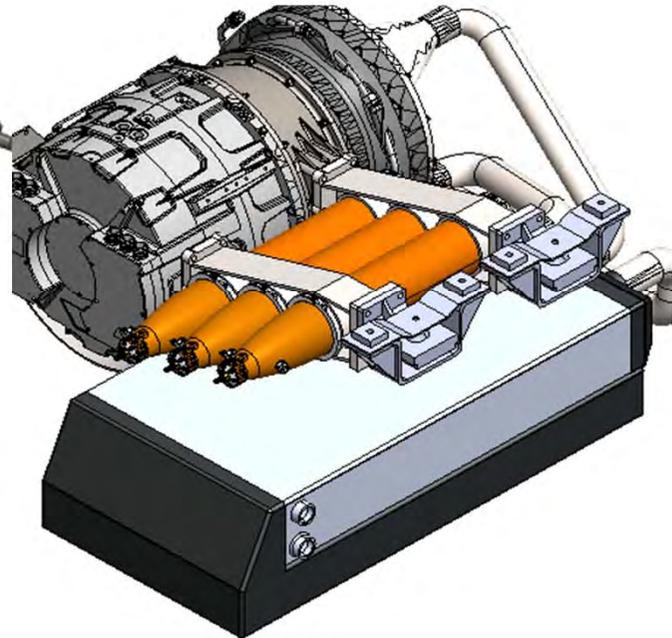
# Size comparison

Comparison of Steamology technology with mechanical and electrical drive with conventional diesel and hydrogen fuel cells

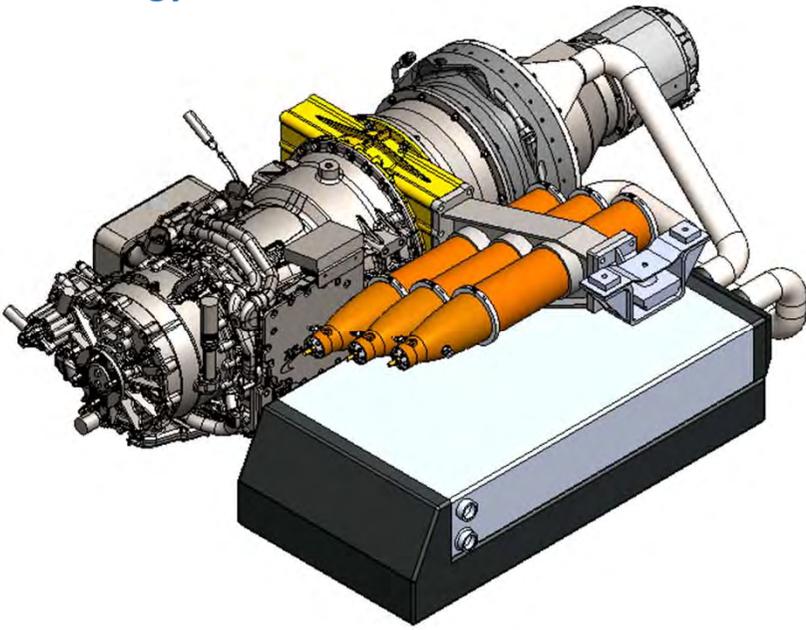
Typical 300kW Diesel



Steamology 300kW electric drive



Steamology 300kW mechanical drive





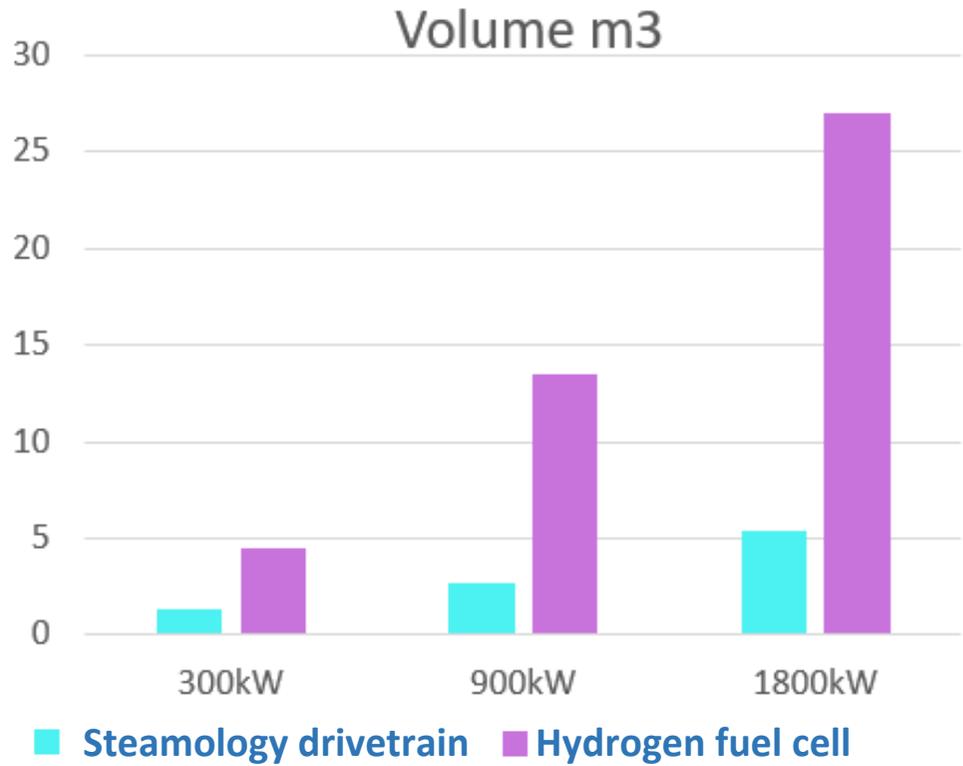
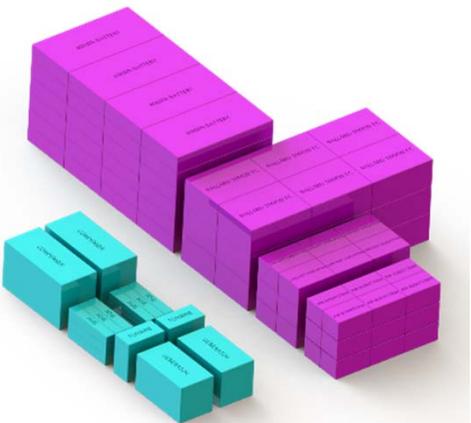
## Size comparison

We have selected 300kW, 900kW and 1800kW to illustrate the increase in Steamology energy density (kW/m<sup>3</sup>) with power output.

Fuel cell and battery systems increase in size and cost indirect proportion to power output

### Energy Density

Fuel cell- 66kW/m<sup>3</sup>    Steamology range 214 to 333kW/m<sup>3</sup>



This volume comparison shows the volume m<sup>3</sup> of drivetrains for typical Steamology and hydrogen fuel cell systems

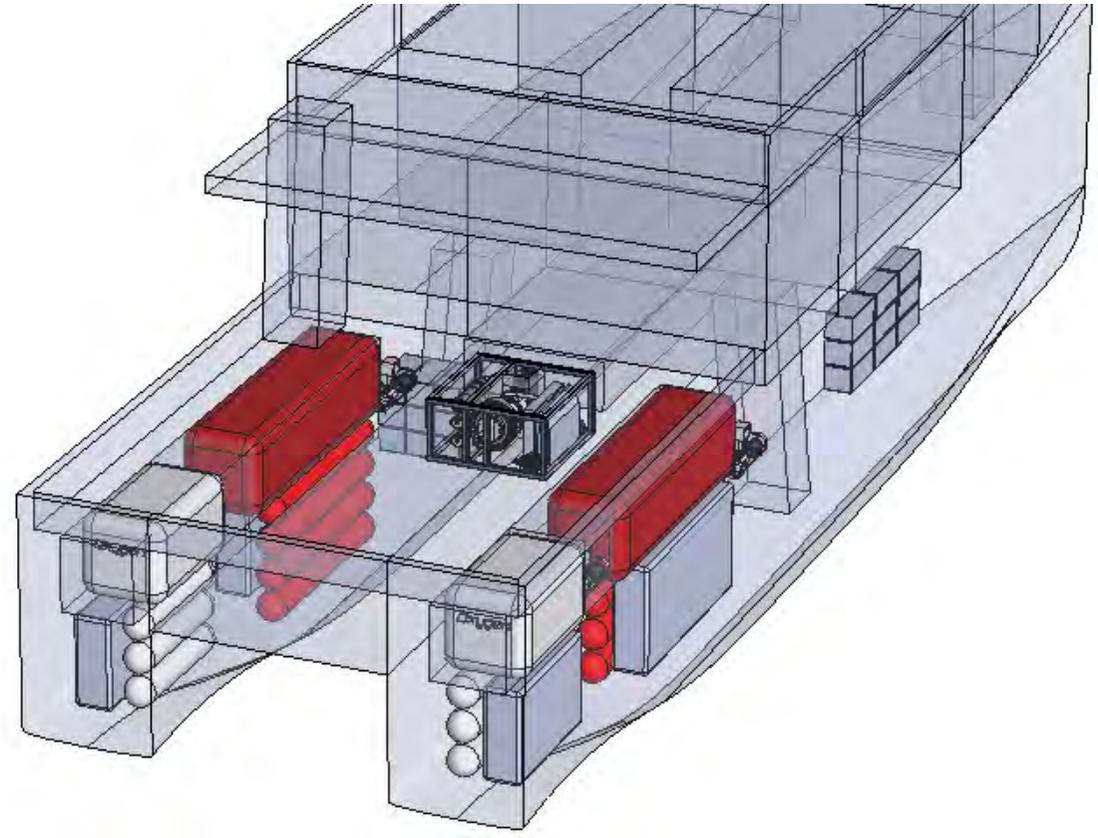




# Clean Maritime Demonstration Competition



QuestZero  
PML | Plymouth Marine Laboratory

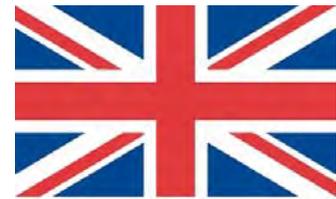


# DNV

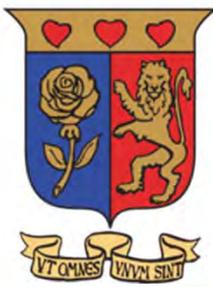
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Innovate UK



UKaid  
from the British people



Strathmore University

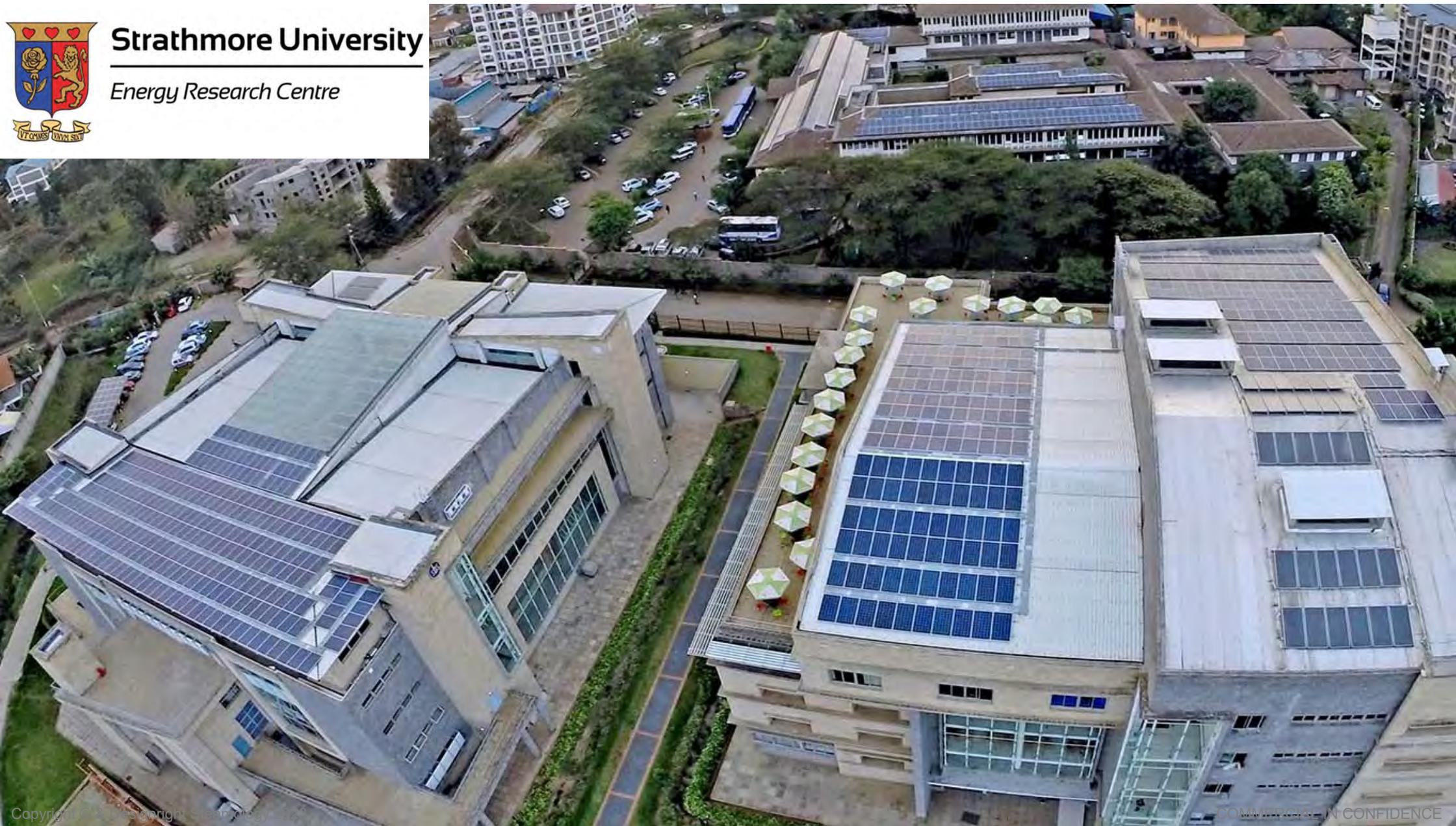
Energy Research Centre





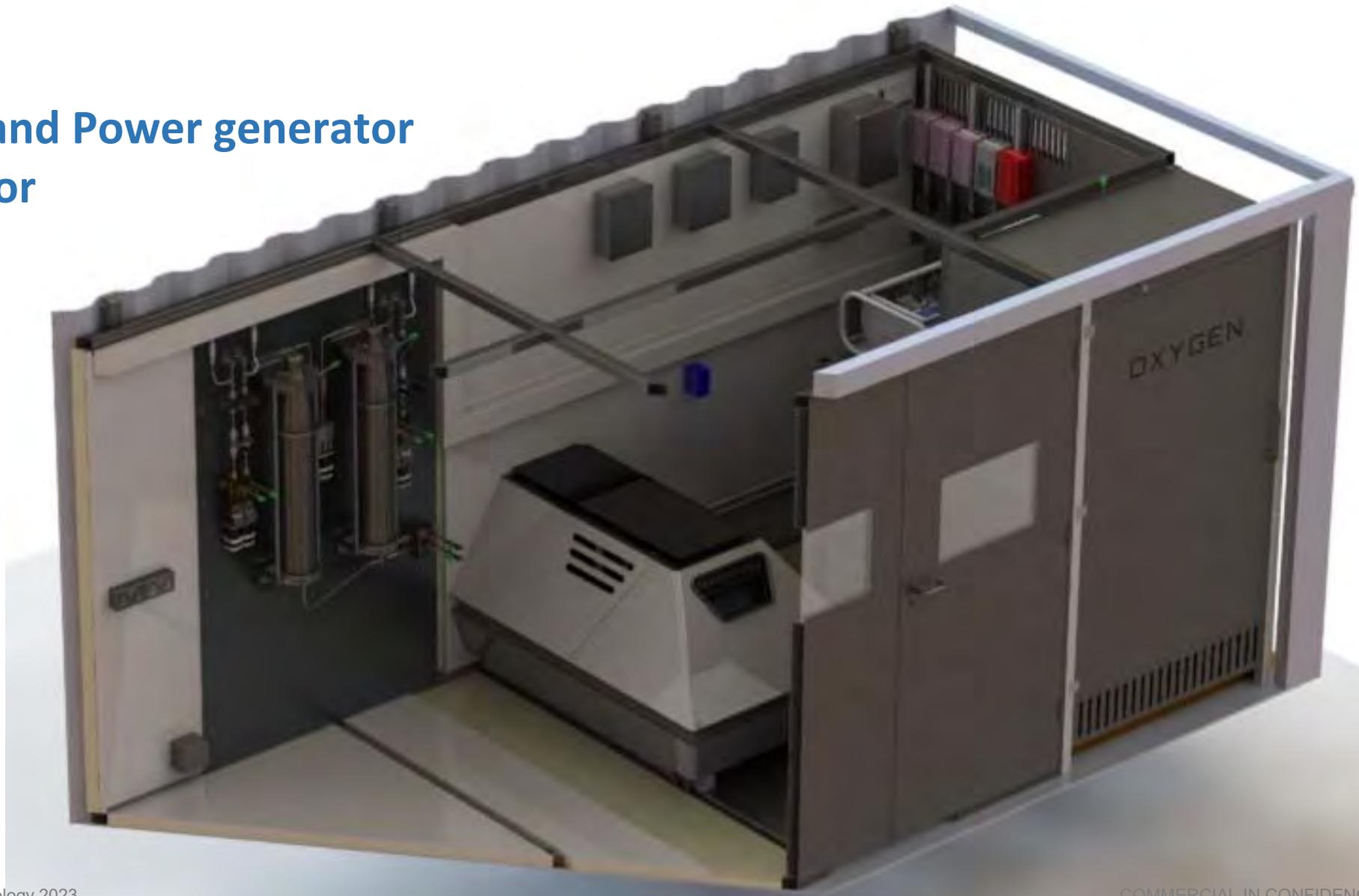
**Strathmore University**

*Energy Research Centre*





# RE Storage and Power generator demonstrator





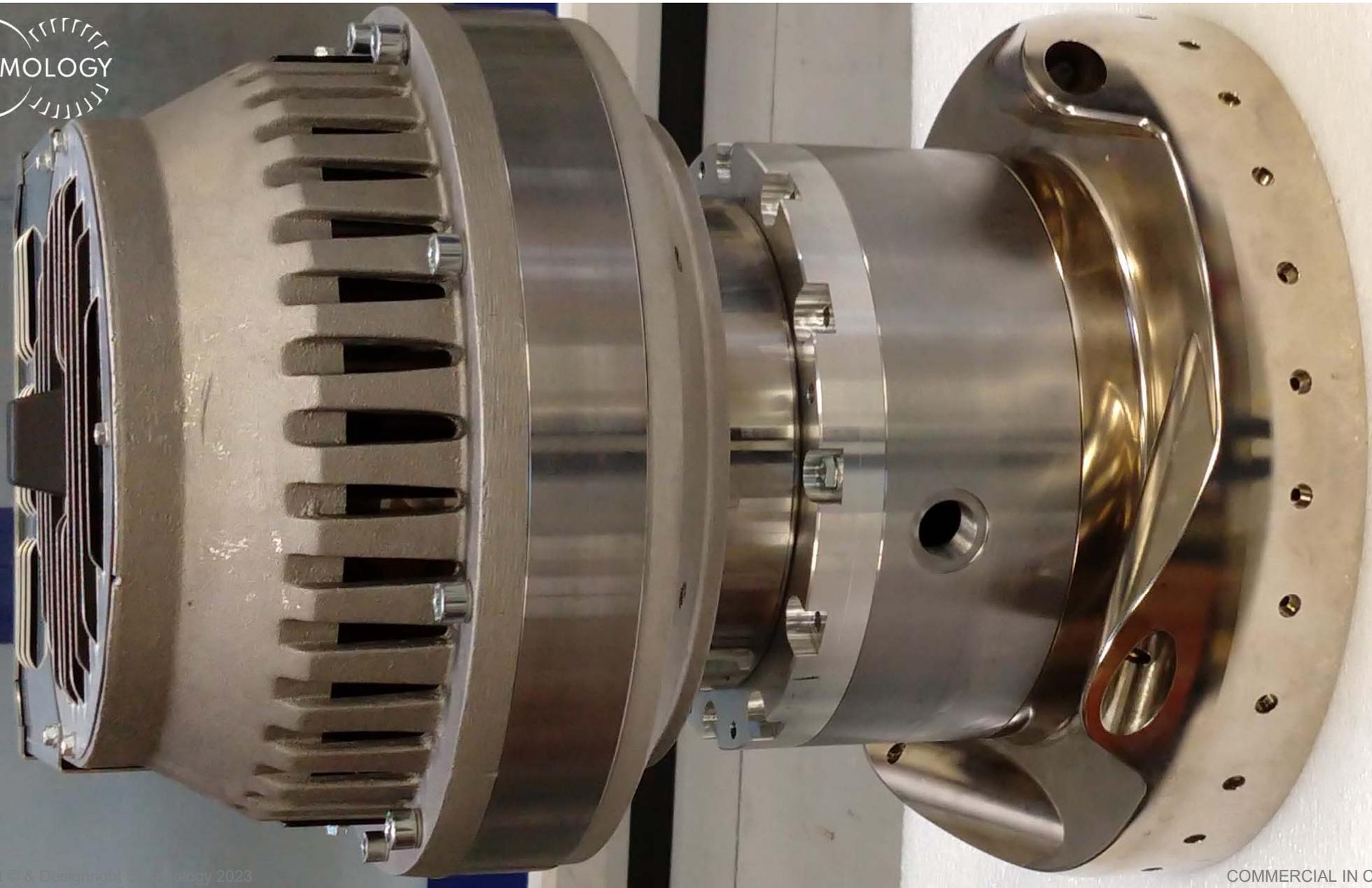
# THE EARTHSHOT PRIZE



# Enapter

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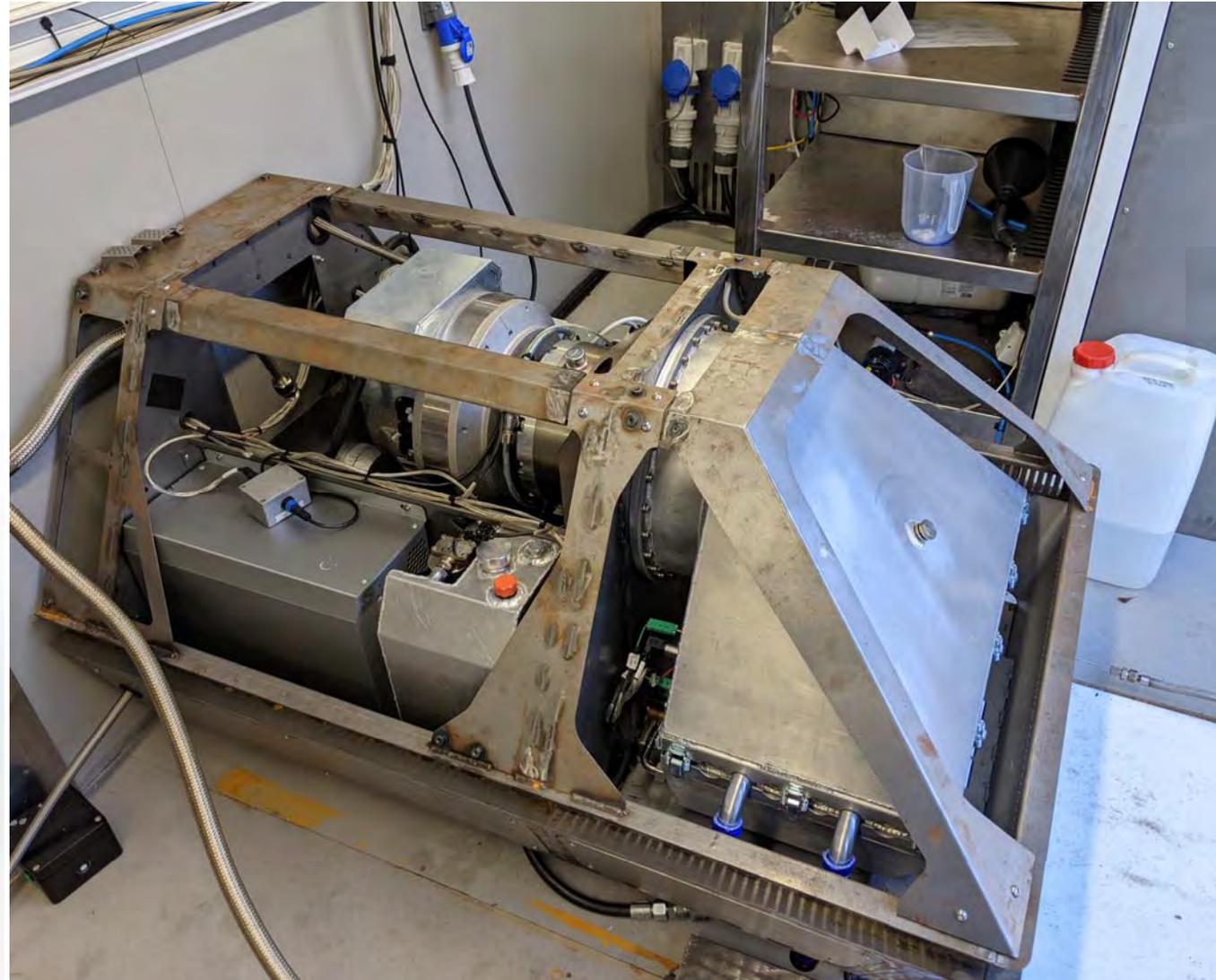
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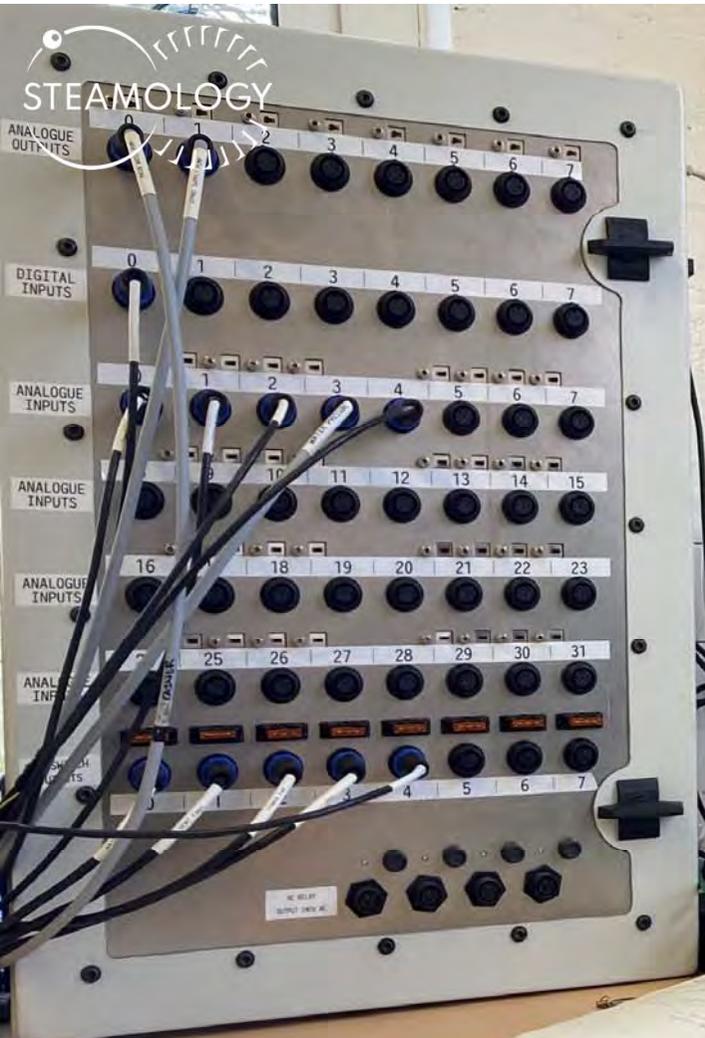


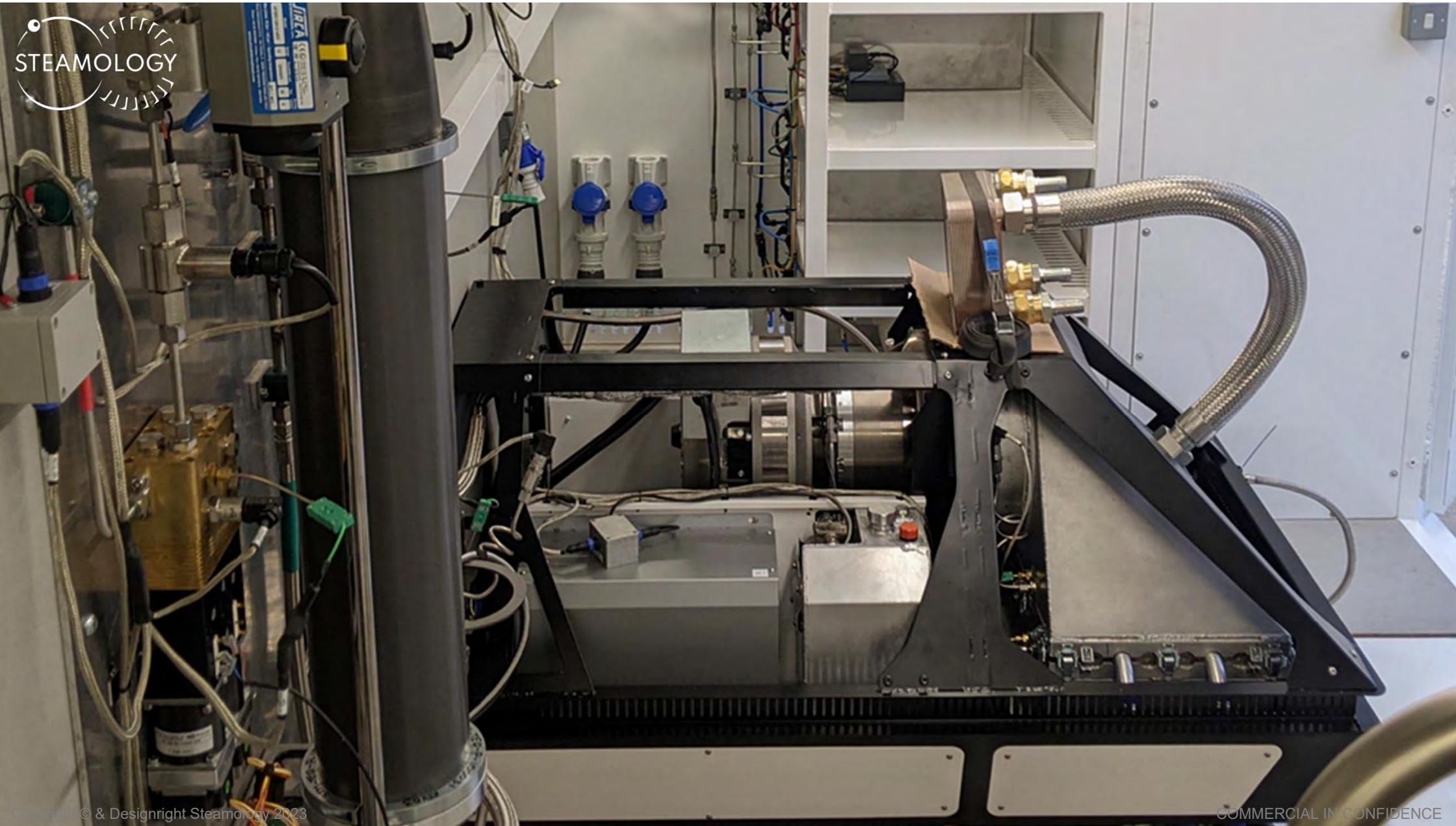




# System build









HYDROGEN

**GAS CYLINDER STORAGE**

- ⚠️ DANGER
- 🚫 No smoking
- 🚫 No open flames
- 🚫 No entry to unauthorized personnel

Compressed hydrogen

OXYGEN

**GAS CYLINDER STORAGE**

**DANGER**

- ⚠️ DANGER
- 🚫 No smoking or open flames
- 🚫 No entry to unauthorized personnel

Compressed oxygen



Department for  
Business, Energy  
& Industrial Strategy

## Red Diesel Replacement

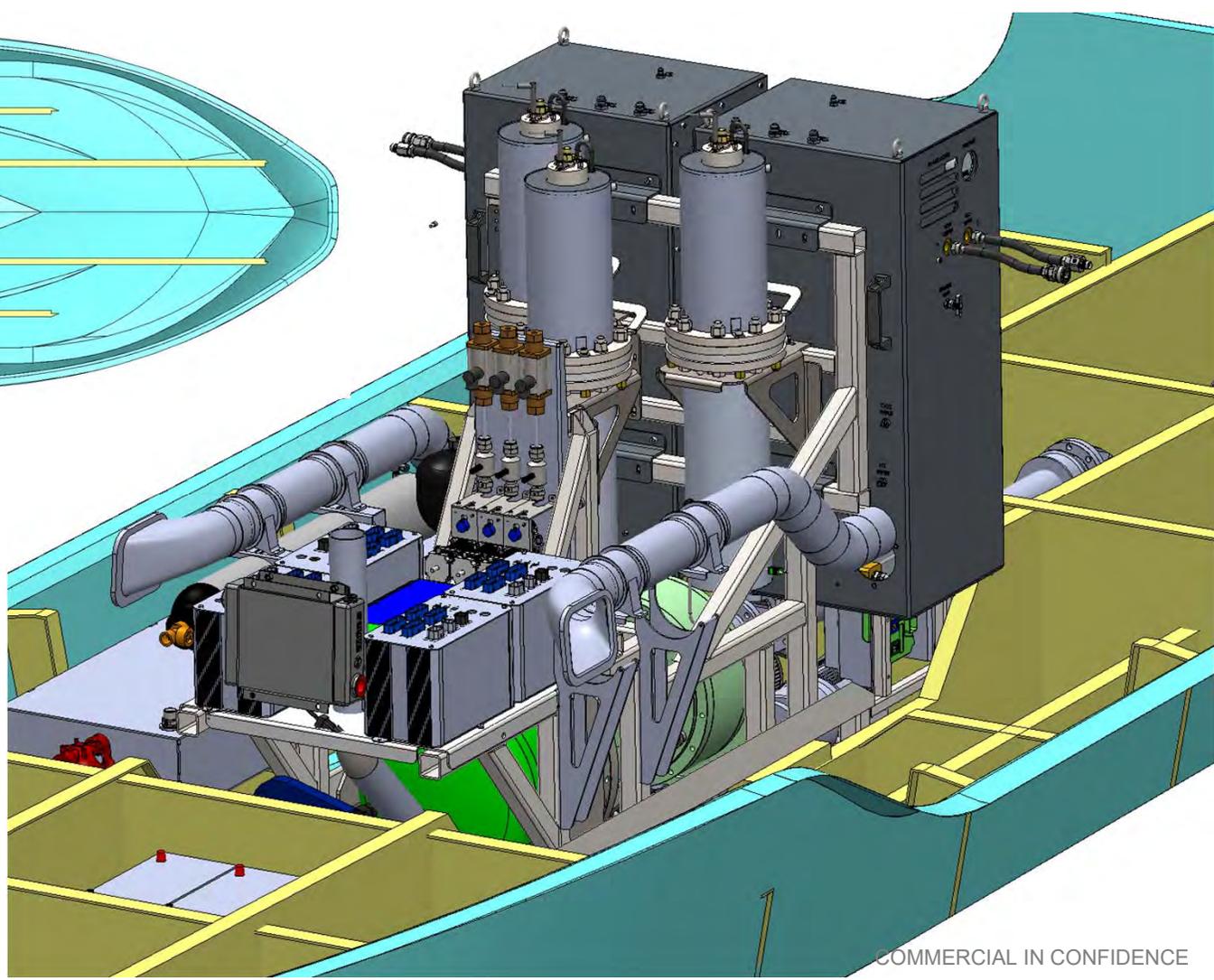
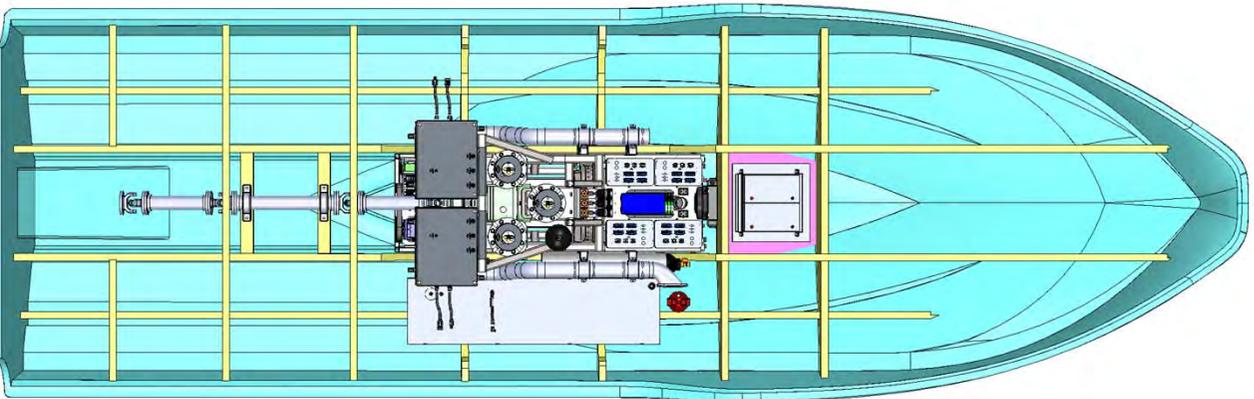




Department  
for Transport

## Clean Maritime Demonstration Competition







Questions...

[matt.candy@steamology.co.uk](mailto:matt.candy@steamology.co.uk)