AEA Annual Conference

Robust Business Case Leveraging Ceres Low Temperature SOEC Technology

15 November 2023

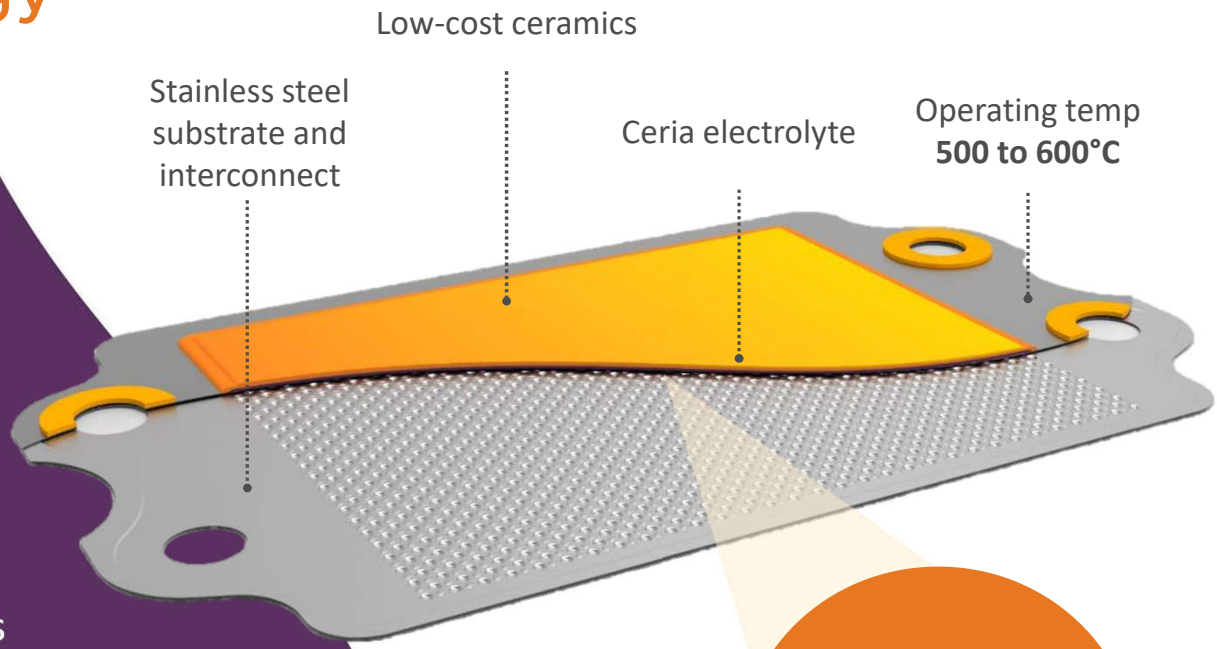
- Leading **Solid Oxide Cell** technology **for power generation and electrolysis** refined for **over 20 years**
- Horsham, **UK** headquartered
- Spun out of **Imperial College London** in **2001**
- **~650 employees**
- Listed on London Stock Exchange **FTSE 250**
- Unique **IP ~100 patent families**
- Focusing on **licensing business model**
- We **collaborate with world-leading companies** to deliver clean energy technology…

…at scale and pace

Highly differentiated Solid Oxide Technology

Ceres **low temperature** solid oxide cell

- Highly efficient
- Fuel flexible
- Steel backbone, robust and scalable
- Made from widely available materials
- Manufacturable at scale and quality
- Cost-efficient
- Suitable for a wide range of applications
- Operates in either fuel cell or electrolysis mode



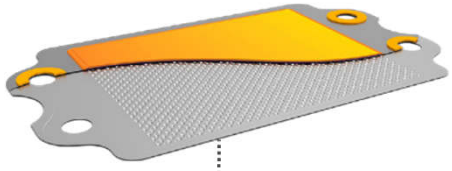
Ceria costs
1/1,000th platinum
1/70,000th iridium
1/10th nickel

ceres power

ceres hydrogen

Bosch + Doosan: 250MW SOFC Manufacturing Capacity in 2024-2025

Ceres technology enables high efficiency energy conversion at low cost



ceres power

- Commercial Power
- Distributed Power
- Marine applications

MIURA BOSCH DOOSAN WEICHAI

Stack

ceres hydrogen

MW-class SOEC system installed at test site in Germany

Shell BOSCH Linde

Demo Targets

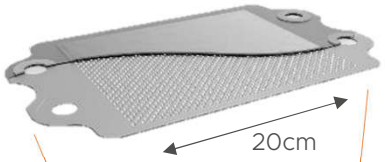
- MW-class SOEC System Demo for 3 years
- System Efficiency: 40kWh/kg
- Hydrogen Production: 500 to 600kg/day

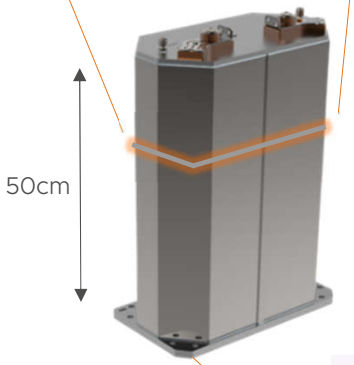
Demo Locations

1. Shell Technology Campus, Bangalore, India
2. Bosch, Stuttgart, Germany

ceres

SOEC Modular scale-up approach





100W
Cell

30kW
Stack

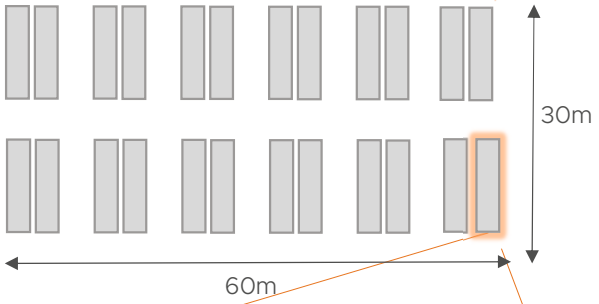
360 kW
Stack Array

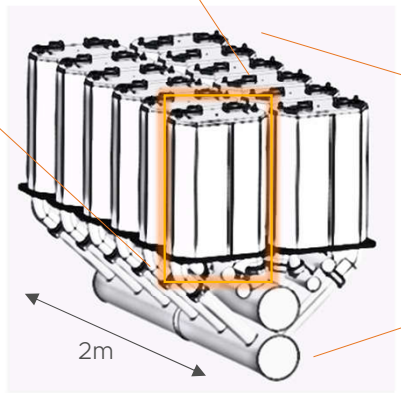
4.3 MW
Module
(1kT/yr)

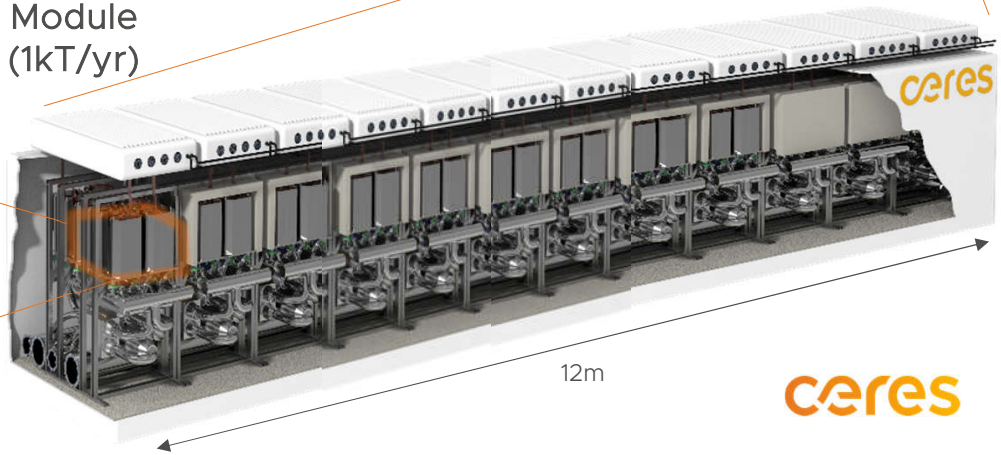
100 MW-class
Module Array
(25kT/yr)

GW-class **Plant**
(0.25MT/yr)

Industrial Decarbonization Applications:
Green Steel
Green Ammonia
E-Fuels
Chemicals
Oil and Gas





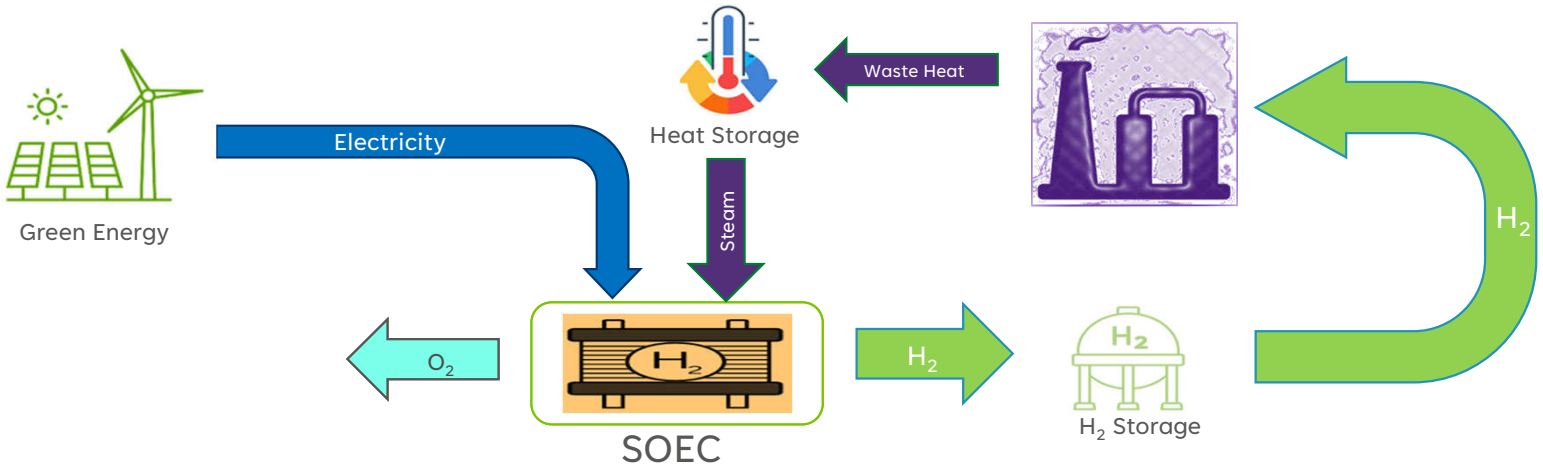


Prototype SOEC modules demonstrated at 38kWh/kg

Specification	Target value
Electrical power input	~100kW
H2 production	65kg/day
Module efficiency	38kWh/kg
Steam input	150°C

SOEC coupled with industrial processes able to supply waste heat

- Water splitting into H2 and O2 requires energy, which can be in the form of either electricity or in the form of heat.
- Low-temperature electrolyzers like AWE (Alkaline Water Electrolysis) and PEM (Proton Exchange Membrane) use energy in the form of electricity only and require cooling to maintain the operating temperature.
- SOEC technology uses a part of the energy in the form of electricity and the other part in the form of heat (e.g., for phase shift from water to steam, which is about 66% of heat energy that could be used).
- The high operating temperature of SOEC creates two main advantages compared to low temperature electrolysis technologies: thermodynamic efficiency and faster kinetics. This gives higher energy efficiency (less kWh/kg H2 produced) even when SOEC starts from water (i.e., use electricity instead of waste heat for phase shift from water to steam).

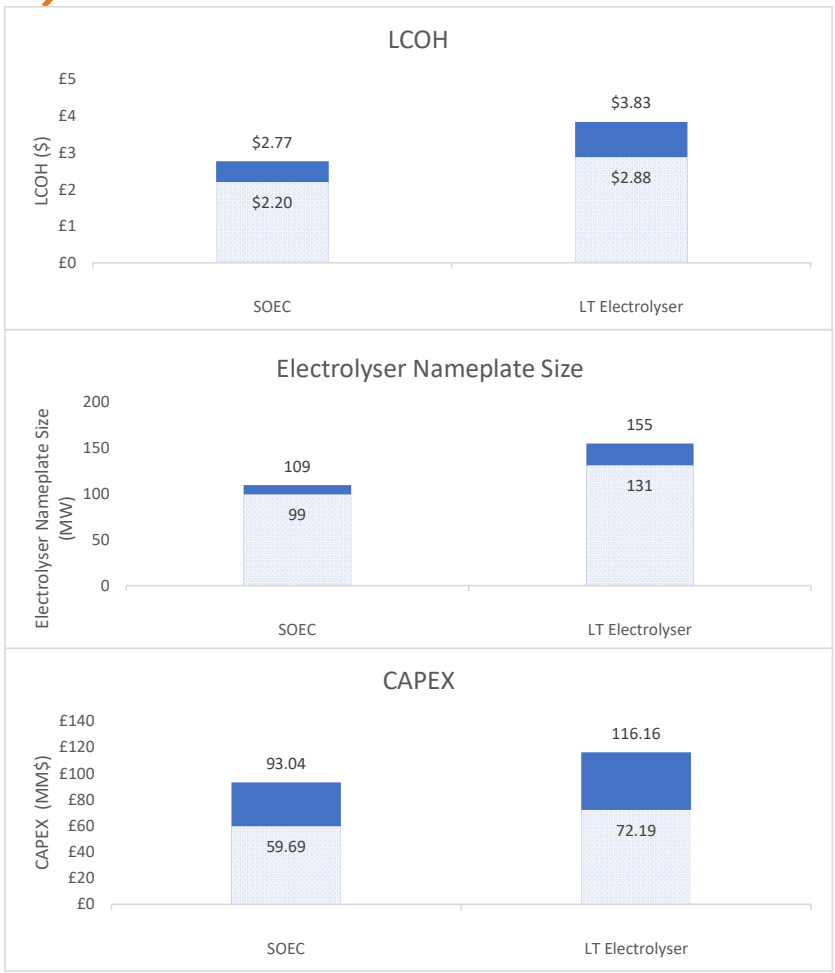


Ceres SOEC maximizes efficiency by using waste heat from other industrial processes

SOEC coupled with HB (Haber-Bosh) Ammonia

- HB Ammonia synthesis is exothermic, theoretically could provide more than 75% of the heat required for Ceres SOEC electrolysis reaction.
- The waste heat from HB Ammonia synthesis can be utilised to generate steam required for the SOEC.
- Alkaline or PEM electrolyzer integrated with Haber Bosch has a specific electricity consumption of 9.5-13.6 kWh/kgNH3
- SOEC electrolyzer integrated with Haber Bosch has a specific electricity consumption of 6.5-7.5 kWh/kg NH3.

SOEC technology platform provides the most efficient electrolysis route to hydrogen and Ceres is the most efficient among SOEC technologies, running at lower temperature.



Ceres SOEC efficiency advantage offers lower CAPEX, OPEX and LCOA

Illustration for 130kT/year green Ammonia production (23KT/year H2 production)

	Lower Electrolyser capacity needed	Lower Electrolyser CAPEX	Lower Electricity consumption	LCOH in $/kg H2 (without considering tax incentives)	LCOA in $/T of NH3 (without considering tax incentives)
ceres hydrogen	100MW	$93MM	$42MM/year	$2.5	$620/T
Low-Temperature Electrolyser: PEM or Alkaline	130MW	$116MM	$56MM/year	$3.4	$782/T

THANK YOU

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