

SolydEra

High efficiency electrolysis

presented by Bernard Turi

Italian Hydrogen Expo

Piacenza, Italy - 12 September 2024



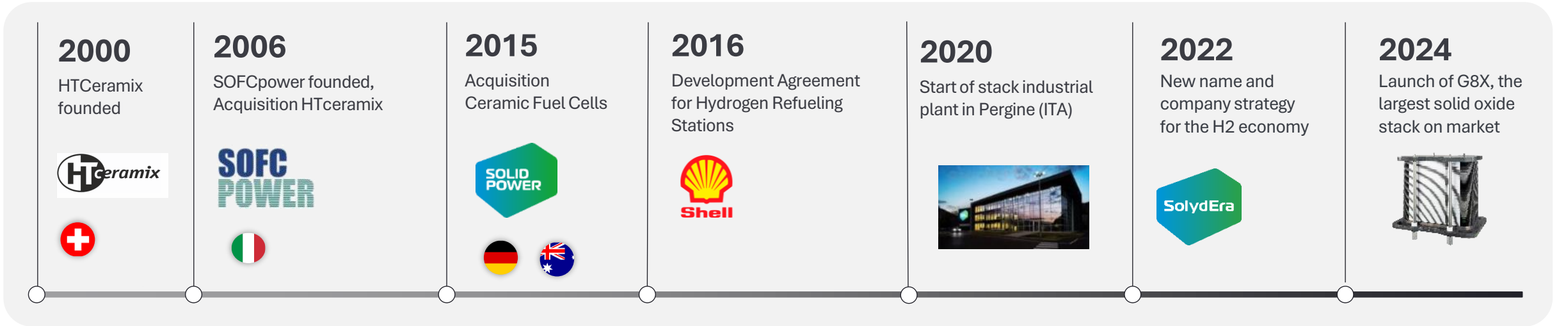
We stack it.

Mission statement



SolydEra aims to become the world's premier **solid oxide stack and stack module** supplier for high temperature electrolysis and power generation applications, providing **standardized stacks and sub-systems** into both markets and contributing as a core technology provider to industrial decarbonization solutions. The company's USP consists of stack efficiency, reversibility, and flexibility along with decades of core system knowhow.

From startup to scale-up to industrialization



Research and Innovation Centers



Mezzolombardo (TN)
ITALY



Yverdon-les-Bains
SWITZERLAND



Melbourne
AUSTRALIA



Head Quarters and 75MW Industrial plant



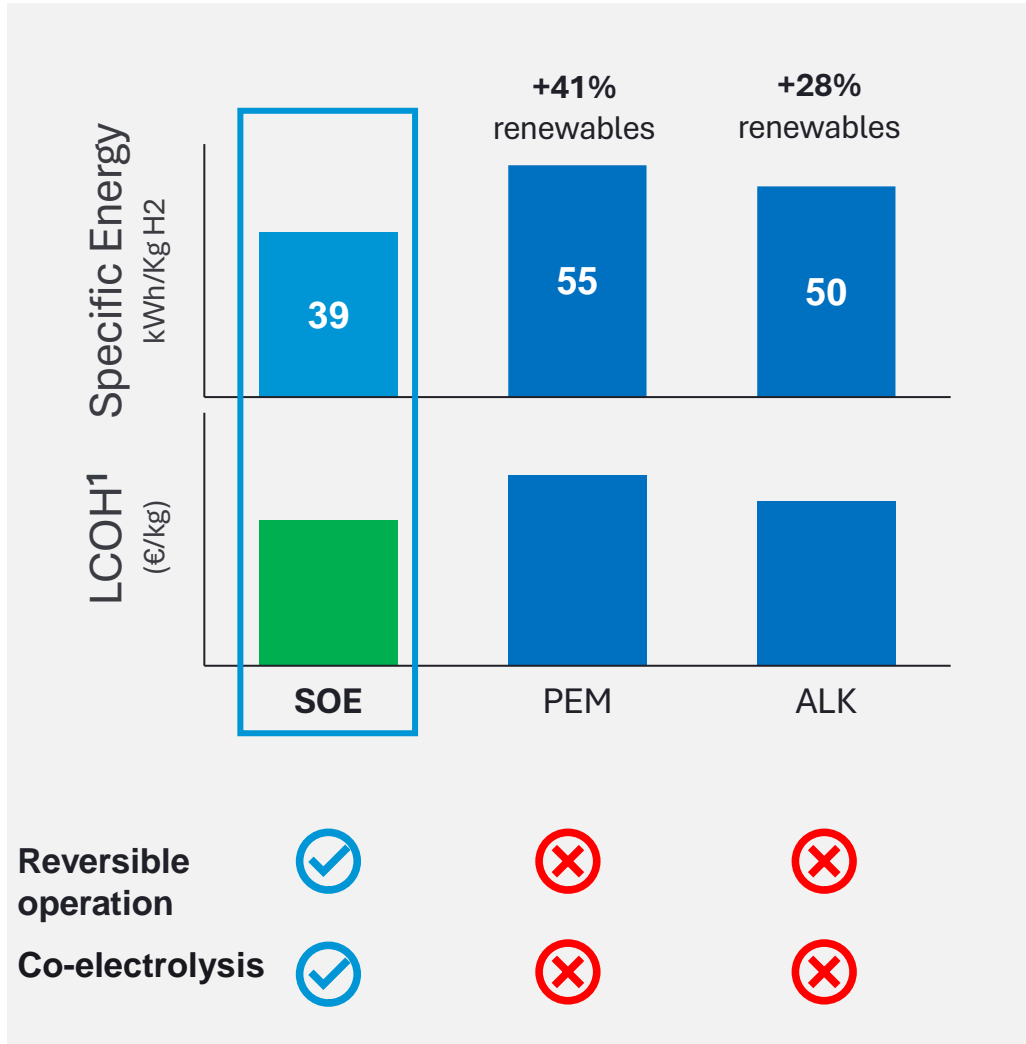
25/75 MW
SOFC / SOE
capacity

1mn
cells/year

60
stacks/day

Pergine Valsugana (TN)
ITALY

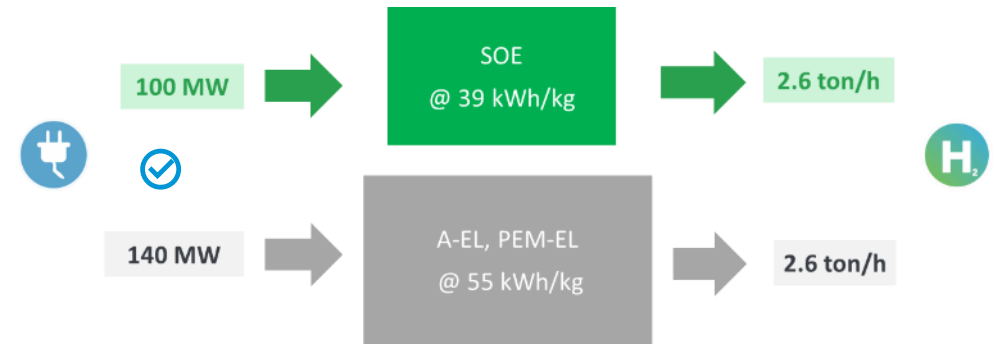
Competitive advantage in green hydrogen and derivatives



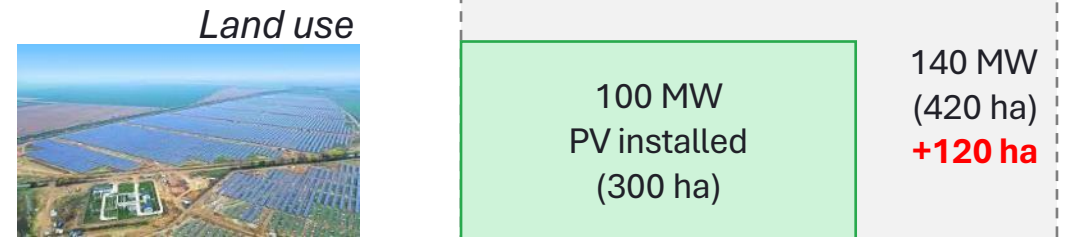
Not only Opex savings..



- >30% larger electrolyzer installed capacity required with ALK/PEM electrolyzer for the same H₂ production

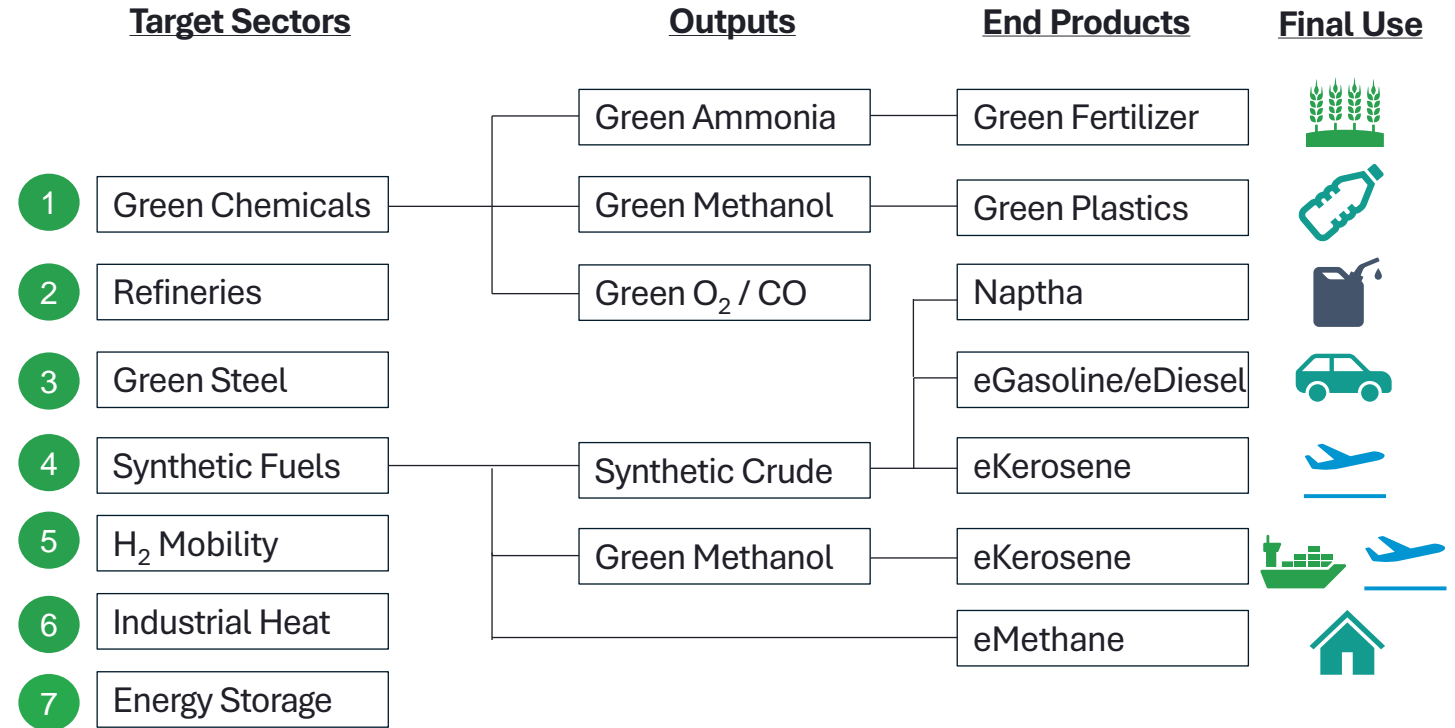
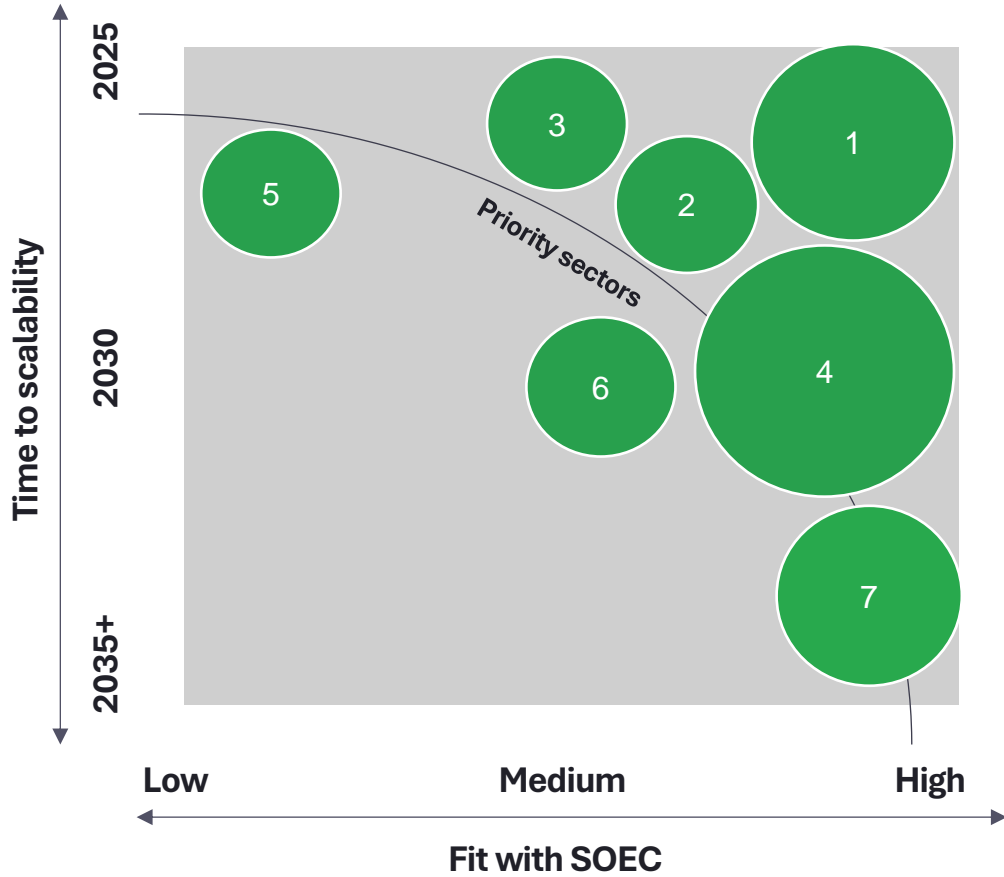


- >30% more CapEx and land required for RES (eg PV)




- Significant savings on battery storage with rSOC system

Target applications for SOEC




Efficiency, reversibility, & flexibility position SOEC ahead




High conversion efficiency
Up to **90%** both in steam electrolysis and cogeneration mode from gas; similar efficiencies with co-electrolysis

Long-term advantage in Green H₂ production

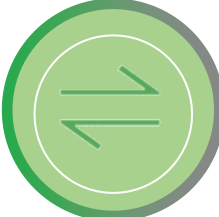


Low cost based on **proprietary design** and use of materials & processes from well-developed industries




No use of noble metals or other rare materials, therefore **no risk for shortage nor limitation for capacity ramp up**

Long-term advantage in Storage / P2P

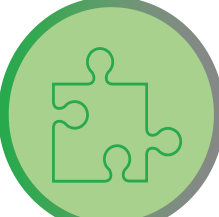


Reversible operation using the same stack makes it ideal for large scale off-grid production & storage projects




No polluting emissions
(NO_x, SO_x, VOC)
CO₂ reduction between 50%-100%


Strategic advantage in Green Fuels production



Feedstock flexibility
Steam, CO₂, biogas, off-gas, and co-electrolysis abilities offers strategic advantage over other technologies



Proven **fuel cell operation with 70M+ hours** in the field



Proprietary core technology (**11 patent families**)

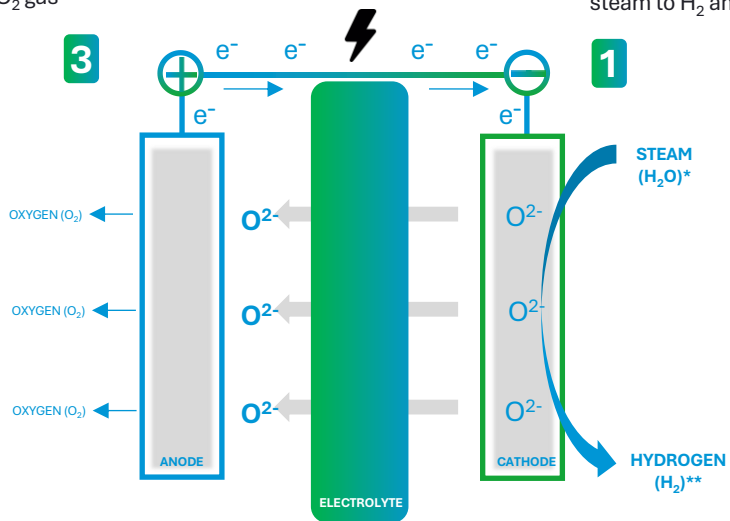
Reversible technology for Power AND Hydrogen(+) production



Producing Hydrogen (& Syngas) in SOE Mode

At anode, O^{2-} ions are oxidized to pure O_2 gas

Cathode voltage reduces steam to H_2 and O^{2-} ions



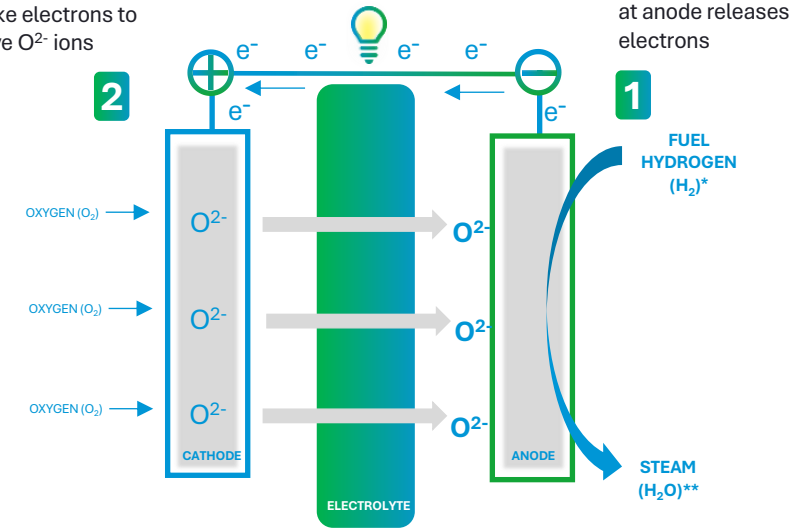
Cathode-produced O^{2-} ions passing through the electrolyte

* H_2O/CO_2 mixture can be also used;
**In case of H_2O/CO_2 input, syngas is produced

Producing power & heat in SOFC Mode

Oxygen molecules take electrons to give O^{2-} ions

Hydrogen oxidation at anode releases electrons



O^{2-} ions pass through the electrolyte, react with hydrogen ions (H^+), through an exothermic reaction, steam and heat

*At system level, wide range of fuels can be used (NG, biomethane, H_2 NG blends, Ammonia, H_2 , biogas);
**Also CO_2 in case of hydrocarbon fuels, or N_2 in case of Ammonia

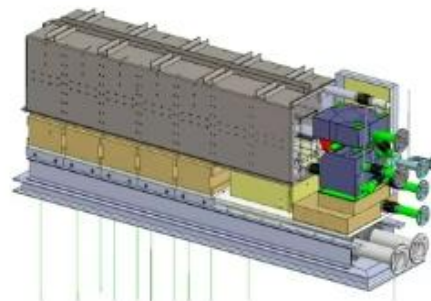
G8X Stack (25kW) is the world's largest solid oxide stack



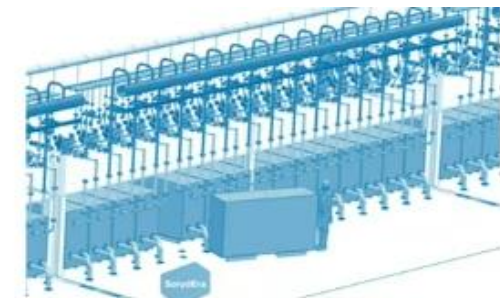
Number of cells	80 repeating elements, 320 cells
Size (w-h-d)	306mm – 379mm – 424mm (excluding compression system)
Weight	130kg
Fuels	Hydrogen, reformat of natural gas, biogas, reformat of LPG, ammonia
Electrolysis	Steam, CO ₂
Features	Electrolysis: >95% el. efficiency Power: >60% el. efficiency Reversible Operation: Power and H ₂ production Low degradation



G8X Stack



EMX module



Reversible Multi-MW array

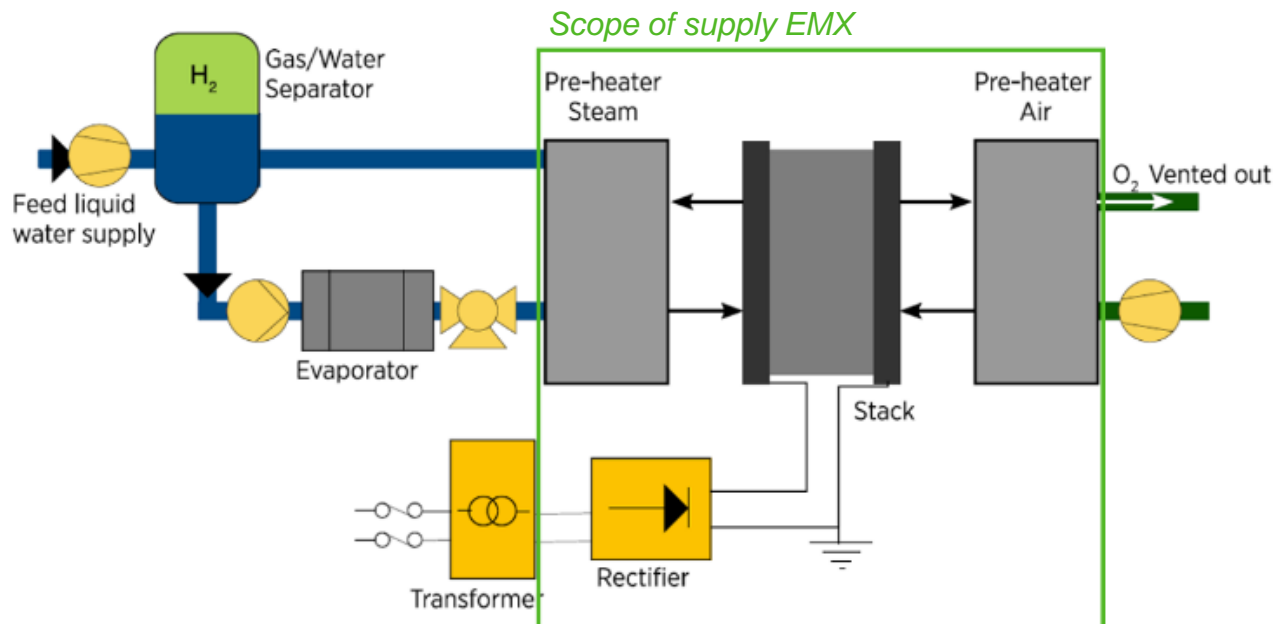
SolydEra's electrolyser module solution: EMX (125kW)



The **EMX** is a stand alone subsystem

The scope of supply is:

- Five G8X stacks (125kW)
- One hot BoP for easy thermal integration
- Safety functions
- Flow controll
- Defined hard- and software interface
- One housing for easy integration and maintenance
- Rectifier



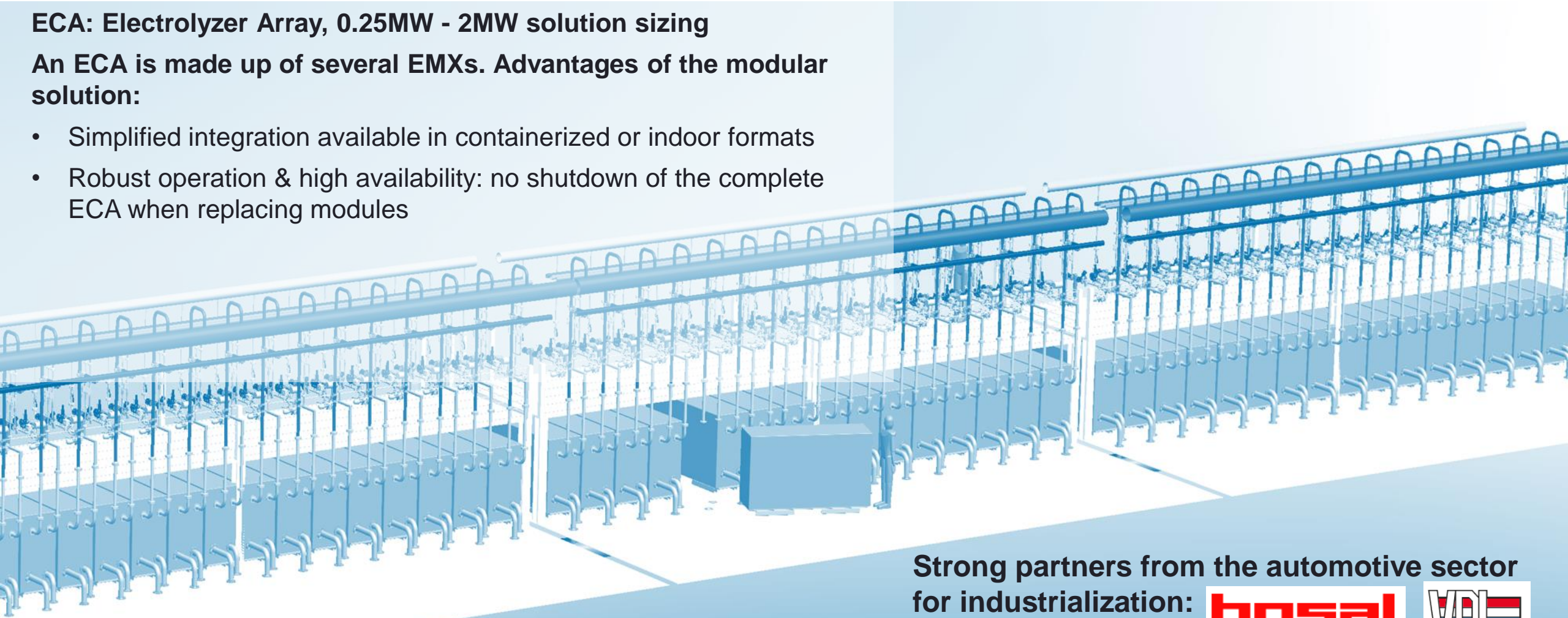
SolydEra Electrolyser Plant Solution: ECA



ECA: Electrolyzer Array, 0.25MW - 2MW solution sizing

An ECA is made up of several EMXs. Advantages of the modular solution:

- Simplified integration available in containerized or indoor formats
- Robust operation & high availability: no shutdown of the complete ECA when replacing modules



Strong partners from the automotive sector for industrialization:



Summarizing SolydEra's position in the SOEC value chain



G8X Stack
25kW Stack



EMX Module
125kW Stack Module

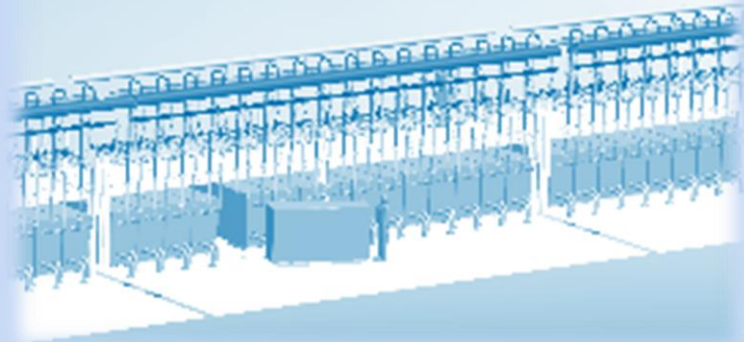
- HotModule
- Instrumentation
- PLC/SPLC
- Flow control
- Recirculation Module

ECA Array
2MW Electrolyzer Array

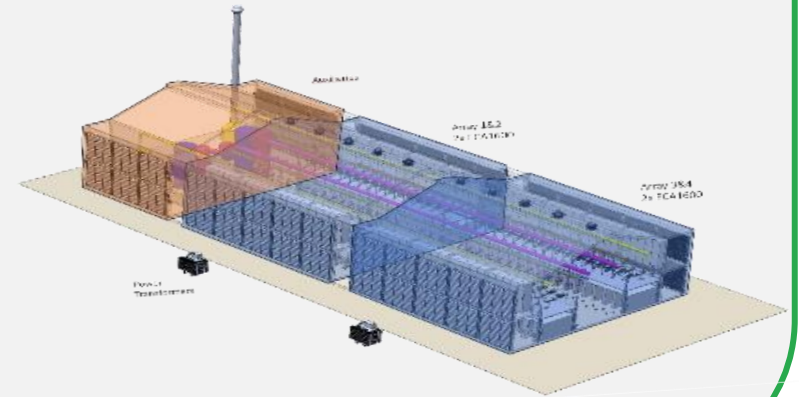
- PLC/SPLC Master
- Power Electronic
- Gas headers
- Optional
- Array recirculation
- Array condensers
- Array Ventilation

Electrolyzer
EPC & Balance of Plant

- | | |
|---------------------------|-----------------------|
| Building/Container | Room Ventilation |
| Auxiliary systems | Downstream processing |
| Water preparation | Condensation |
| Steam supply/purification | Compression |
| Auxiliary gases | Recirculation systems |
| Gas farms | |



SolydEra



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Thank you!