POWER TO HYDROGEN TO POWER SOLUTION

PEM Water electrolysis

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WHO IS CUMMINS?

Engines

Power generators

Electrification

Hydrogen & Fuel Cells

190
Countries

61.6K
Global Employees

1.4M+
Engines built in 2019

8K
Distributor & dealer locations

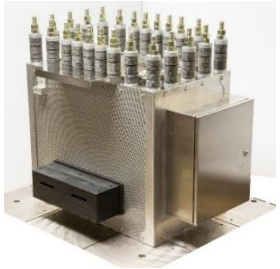
$1B
Invested in research & development in 2019

100 YEARS
of industry leadership

*2019 figures

CUMMINS HYDROGEN ACTIVITIES

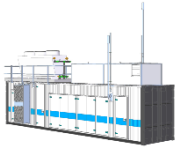
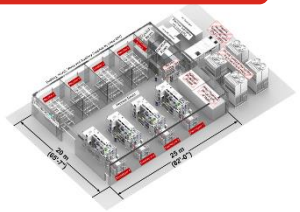
- **Key technologies**
  - Alkaline Electrolysis
  - PEM Electrolysis
  - Solid Oxide Fuel Cells
  - PEM Fuel Cells
  - Hydrogen storage tanks



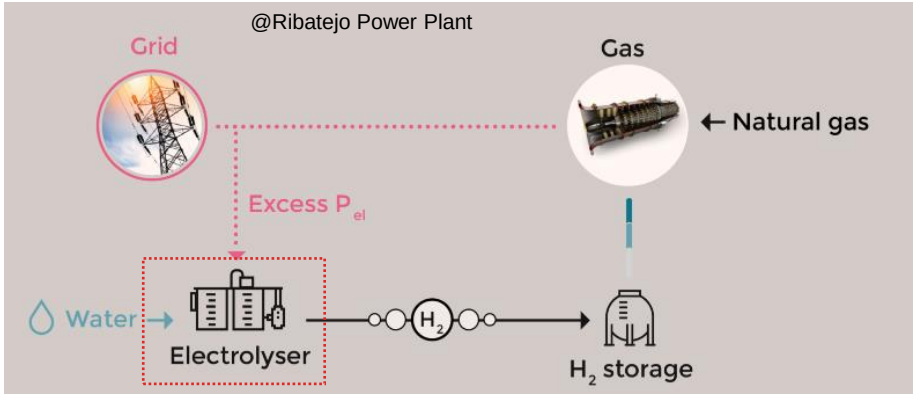
- Recent **acquisitions and partnerships**
  - General Electric (US)
  - Hydrogenics* (Belgium, Germany, Canada)
  - MOU with Hyundai
  - Loop Energy (Canada)
  - JV with NPROXX (Germany)

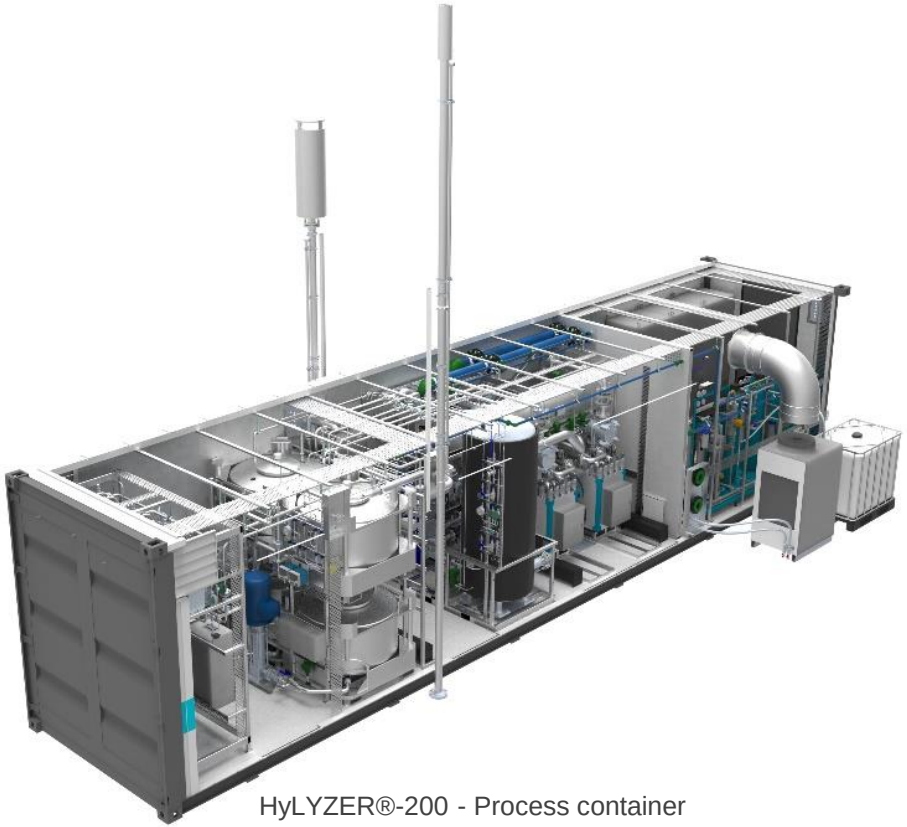
**Air Liquide is still owning 19% of Hydrogenics*

WATER ELECTROLYZERS : PRODUCT LINE

	Alkaline			PEM (Proton Exchange Membrane)		
						
	HySTAT®-15-10	**HySTAT®-60-10**	**HySTAT®-100-10**	**HyLYZER® -500-30**	**HyLYZER® -1.000-30**	**HyLYZER® -4.000-30**
Output pressure	10 barg (27 barg optional)			30 barg		
Design	Indoor/outdoor	Indoor/outdoor	Indoor/outdoor	Indoor/outdoor	Indoor	Indoor
Number of cell stacks	1	4	6	2	2	8
Nominal hydrogen flow	15 Nm³/h	60 Nm³/h	100 Nm³/h	500 Nm³/h	1.000 Nm³/h	4.000 Nm³/h
Nominal input power	80 kW	300 kW	500 kW	2.5 MW	5 MW	20 MW
AC power consumption (utilities included, at nominal capacity)	5.0 to 5.4 kWh/Nm³			≤ 5.1 kWh/Nm³	DC power consumption: 4.3 kWh/Nm³ ± 0.1 (at nameplate hydrogen flow)	
Turndown ratio	40-100%	10-100%	5-100%	5-100%	5-125%	
Hydrogen purity	99.998% O2 < 2 ppm, N2 < 12 ppm (higher purities optional)			99.998% O2 < 2 ppm, N2 < 12 ppm (higher purities optional)		
Tap water consumption	<1.4 liters / Nm³ H2			<1.4 liters / Nm³ H2		
Footprint (in containers)	1 x 20 ft	1 x 40 ft	1 x 40 ft	2 x 40 ft	(LxWxH) 8.4 x 2.3 x 3.0 m	20 x 25 m (500 m²)
Utilities (AC-DC rectifiers, reverse osmosis, cooling, instrument air, H2 dryer)	Incl.	Incl.	Incl.	Incl.	Optional	Optional

CUMMINS ROLE IN FLEXnCONFU:
HYLYZER-200 (1MW) ELECTROLYZER





HyLYZER®-200 - Process container

HyLYZER® 200/300/400/500-30
Dual stack platform (up to 2 cell stacks of 250 Nm³/h)

HyBalance

Air Liquide, HyBalance, Hobro, Denmark

HyLYZER® 230-30 – dual stack

SOME HYLYZER® REFERENCES

Power-to-Gas

1,5 MW, WindGas Reitbrook, Germany

Power-to-Power

1 MW, P2P EGAT, Thailand

Power-to-Fuels

1 MW, MEFCO2, Germany

Power-to-Mobility

Power-to-Industry

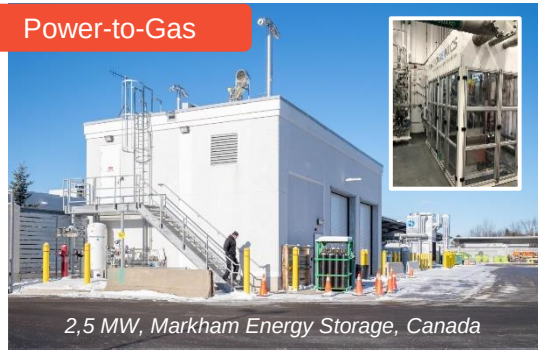
1,2 MW, HyBalance, Denmark

Power-to-Gas

Power-to-Mobility

2,4 MW, Wind to Gas Energy, Germany

Power-to-Gas



2,5 MW, Markham Energy Storage, Canada

CURRENT DEVELOPMENT
2,5 MW PEM CELL STACK

1

MW Scale Electrolyzer Stack

3.0 MW industry benchmark

2

Reduction of Plant Capital Costs

Achieved target system cost

3

Stack Efficiency Improvements

Leading industry performance

	1500E cell stack (high)	1500E cell stack (small)
Nominal input power (Max)	**2,5 MW** (3 MW)	**1,25 MW** (1,5 MW)
Nominal H2 flow (Max)	**500 Nm³/h** (620 Nm³/h)	**250 Nm³/h** (310 Nm³/h)
Operating pressure	30 barg	30 barg

4

Fast Response and Dynamic Operation

Key requirement established

5

Very compact

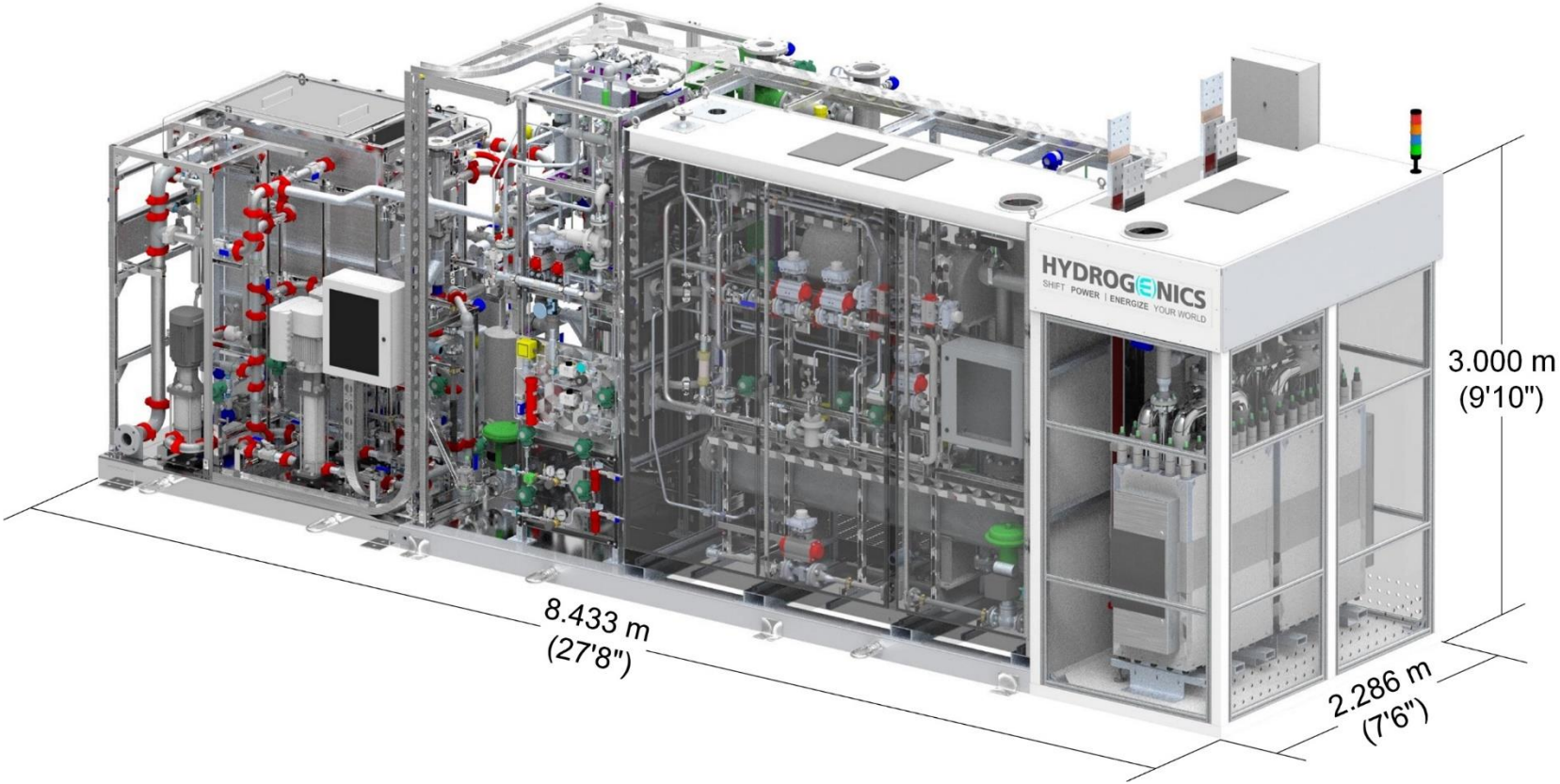
Lowest footprint on the market

6

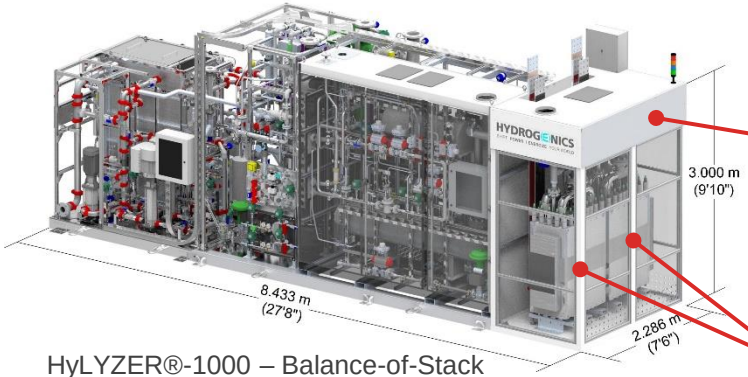
Reduced Maintenance

Limited and optimized

HYLYZER®-1000 ELECTROLYZER

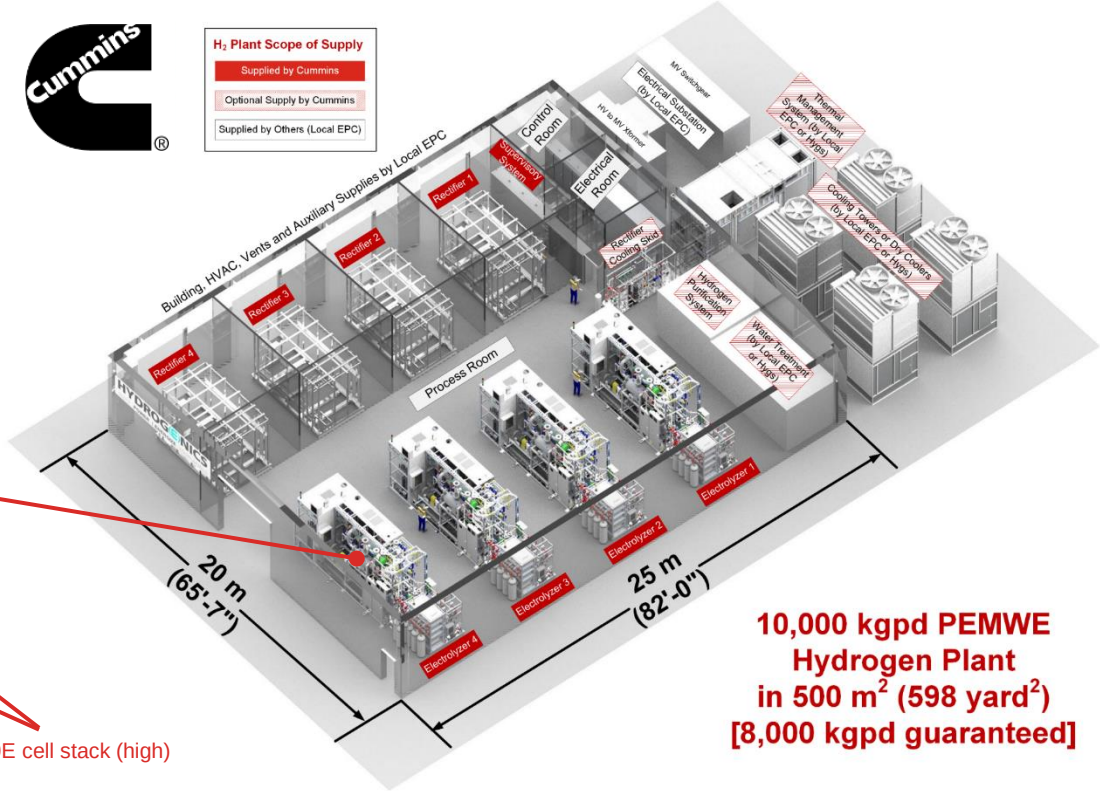


SCALABLE PRODUCT PLATFORM
8,000 KG/DAY / 20MW / 4X HYLYZER®–1000



HyLYZER®-1000 – Balance-of-Stack
1000 Nm³/h (~5 MW) in total

2x 1500E cell stack (high)



10,000 kgpd PEMWE Hydrogen Plant in 500 m² (598 yard²) [8,000 kgpd guaranteed]

THANK YOU

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