



Exploring large-scale PEM Electrolyzer Technology

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Hydrogen and Fuel Cells – Here and Now,
Birmingham, UK

June 28th, 2022

CUMMINS



Engines



Power generators



Electrification



Hydrogen & Fuel Cells

190
Countries



59.9K
Global Employees



1.3M+
Engines built



10.6K
Distributor & dealer locations



\$1.1B
Invested in research & development



103 YEARS
of industry leadership



*2021 figures

WATER ELECTROLYZER TECHNOLOGIES AT CUMMINS

- **Alkaline electrolysis**

- 30wt% KOH – porous membranes
- Been around for >60 yrs
- Reliable proven technology



Work horse

- **Proton exchange membrane**

- 'Polymer electrolyte membrane'
- Compact / high currents
- Wide working range (low-high power)



Race stallion

Commercial

- **Solid oxide electrolysis**

- Solid ZrxOy steam electrolysis
- High temperature – high efficiency
- Less flexible



Cross country horse

R&D

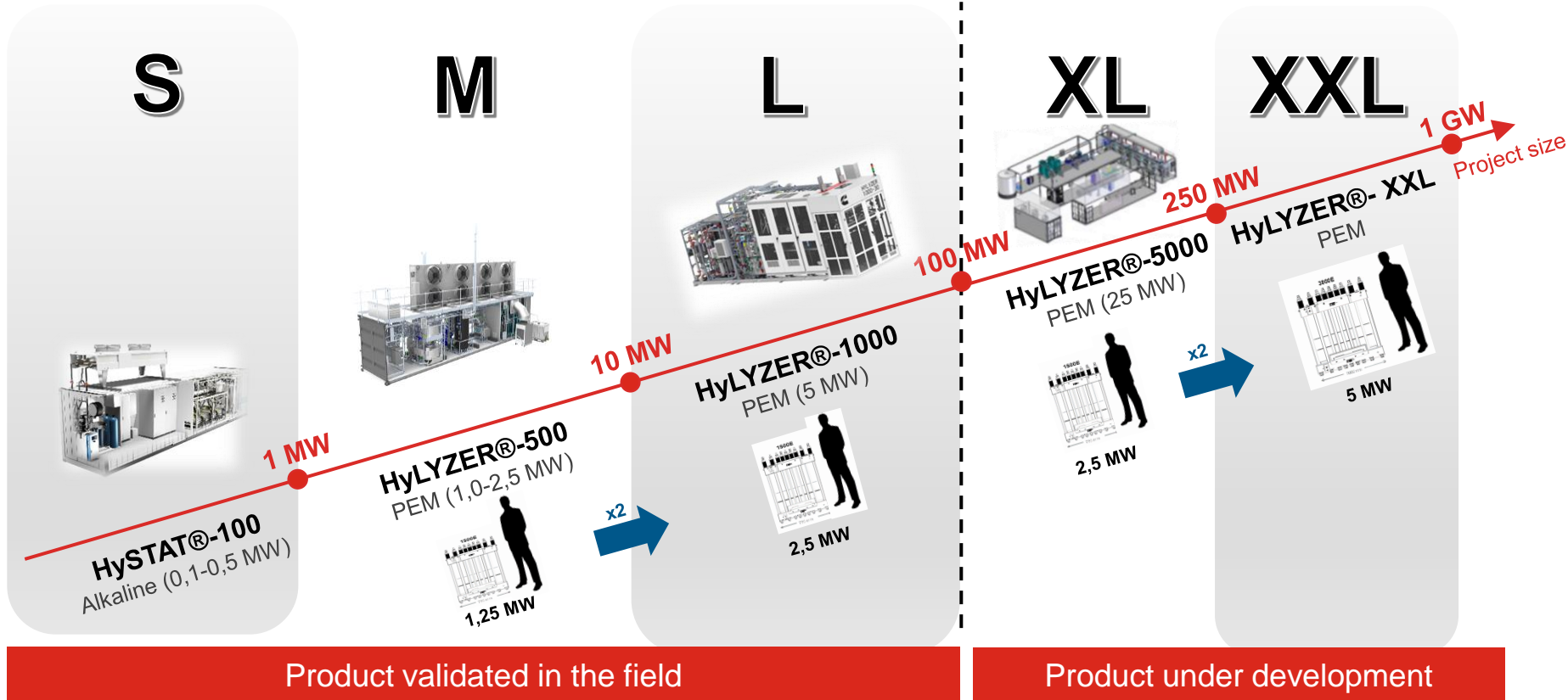
- **Anion exchange membrane**

- Alkaline polymer electrolyte
- Little commercialisation

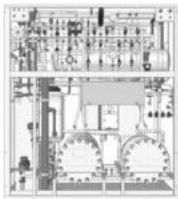
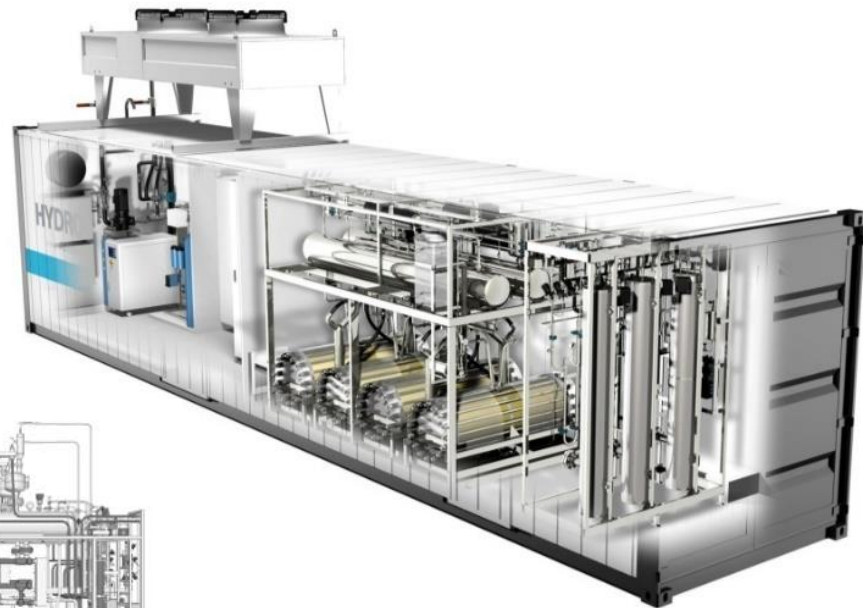


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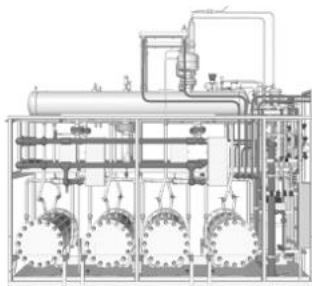
ELECTROLYZER PRODUCT OFFERING



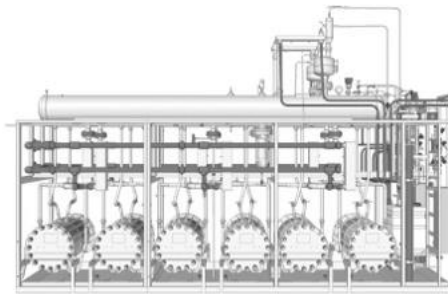
HySTAT[®] SERIES: ALKALINE ELECTROLYZERS



Up to 2 cell stacks
30 Nm³/h



Up to 4 cell stacks
70 Nm³/h

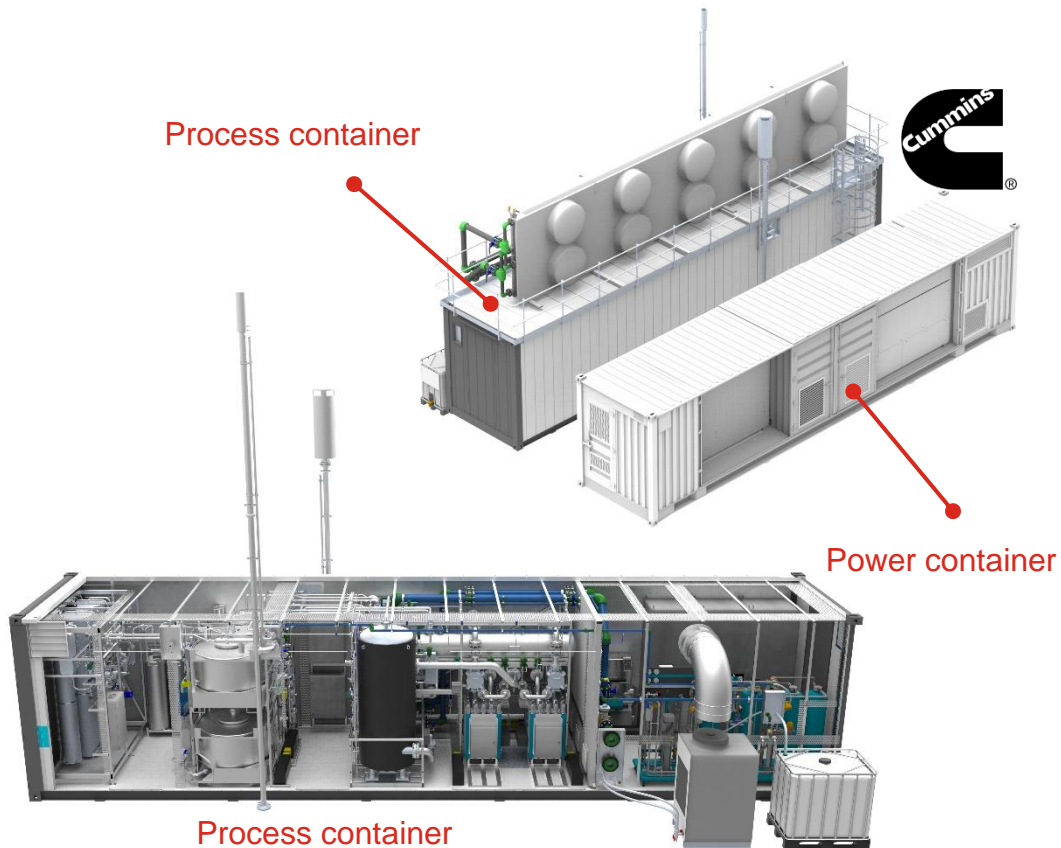


Up to 6 cell stacks
100 Nm³/h

HyLYZER[®]-500 PEM ELECTROLYZER

▪ HyLYZER[®] 200/250/400/500-30

- **Containerized system**
- **Turnkey product (Plug&Play):** including hydrogen gas generation system, power transfo and rectifier AC-DC, water purification (reverse osmosis), cooling (dry cooler)
- **Dual stack platform:** up to 2 cell stacks of 250 Nm³/h (1,25 MW) to reach 500 Nm³/h (2,5 MW)
- **Product versions:**
 - 1,0 MW: 200 Nm³/h (1 stack)
 - 1,25 MW: 250 Nm³/h (1 stack)
 - 2,0 MW: 400 Nm³/h (2 stacks)
 - 2,5 MW: 500 Nm³/h (2 stacks)
- **Output pressure:** 30 barg



HyLYZER[®]-500 PEM ELECTROLYZER



HyLYZER[®]-1000 PEM ELECTROLYZER

▪ HyLYZER[®] 1000-30

- **Indoor system**
- **Modular product (to be integrated):** including hydrogen gas generation system, power transfo and rectifier AC-DC
- **Dual stack platform:** 2 cell stacks of 500 Nm³/h (2,5 MW) to reach 1000 Nm³/h (5 MW)
- **Output pressure:** 30 barg

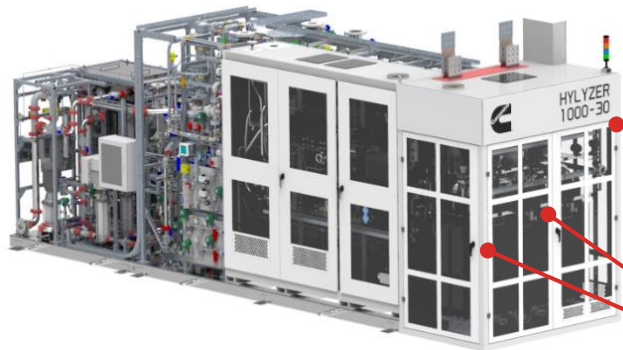
Every hazardous zone of the product is enclosed (ventilated enclosure + hydrogen detection) preventing the building to be classified as ATEX zone → cheaper equipment inside the building + ease of operation & maintenance



HyLYZER[®]-1000 PEM ELECTROLYZER PLANT LAYOUT (4.000 Nm³/h, ~20 MW)

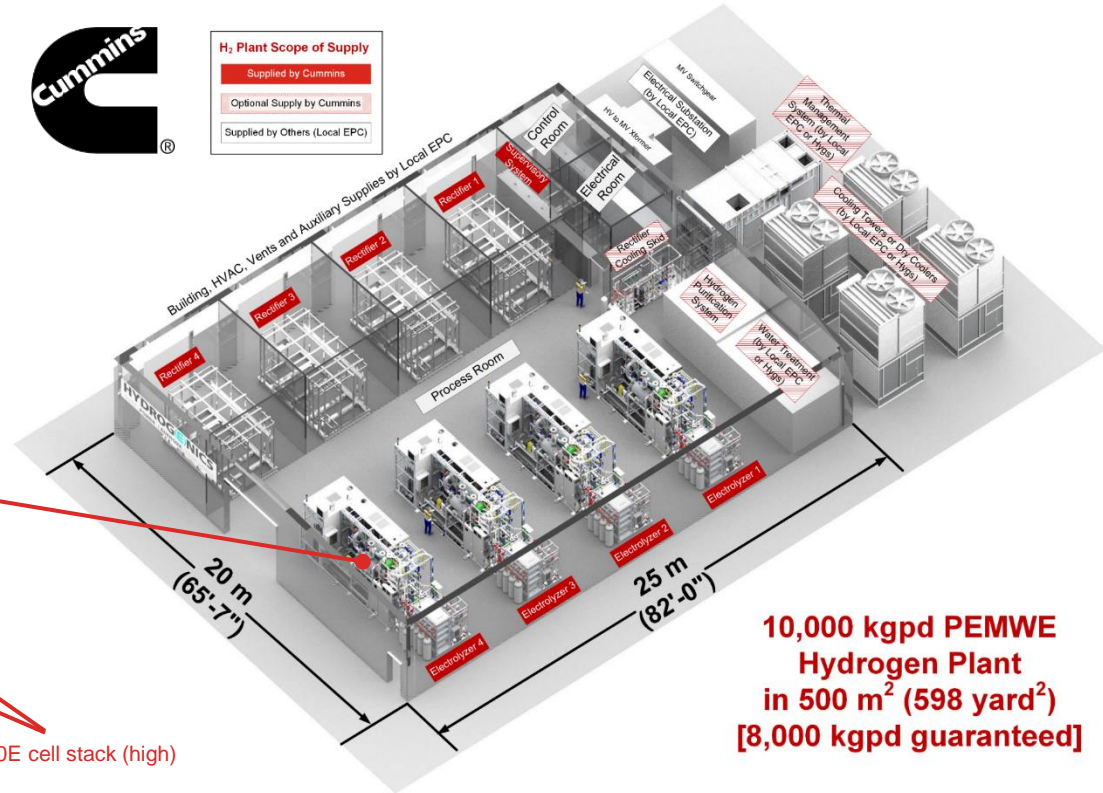


H ₂ Plant Scope of Supply	
Supplied by Cummins	
Optional Supply by Cummins	
Supplied by Others (Local EPC)	



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]**

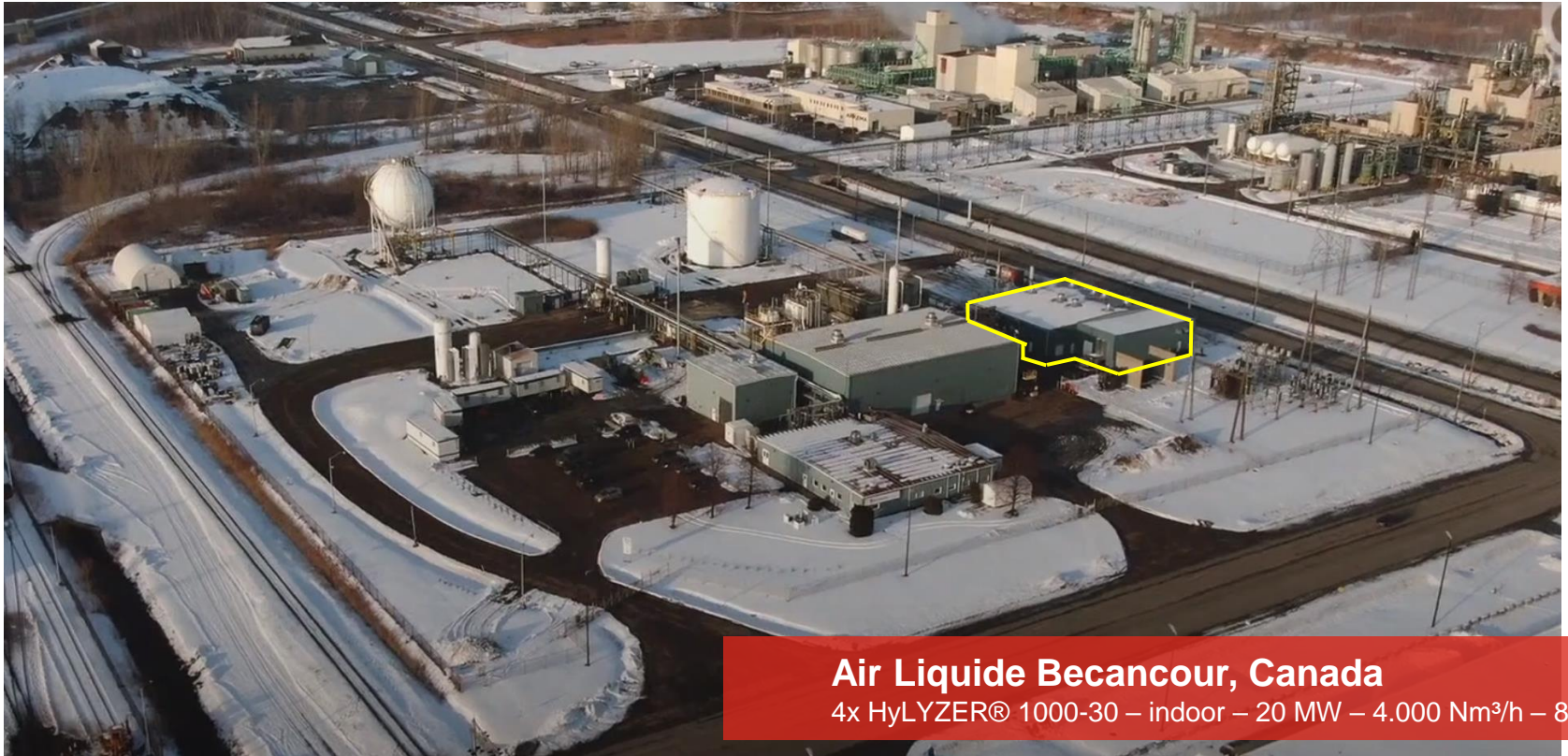
HyLYZER[®]-1000 PEM ELECTROLYZER REFERENCE PLANT (4.000 Nm³/h, ~20 MW)

- Air Liquide Bécancour, Québec, Canada
- Hydrogen is liquefied and distributed by trucks to industrial customers in Québec region
- 3 tons of hydrogen per truck, 6-7 hours to refuel one truck
- 2 great video's about the project:
 - <https://ici.radio-canada.ca/nouvelle/1844495/hydrogene-electricite-strategie-jomathan-julien>
 - <https://www.youtube.com/watch?v=vS5opnwFCUA>



REPLACEMENT OF OLD ATMOSPHERIC ALKALINE ELECTROLYZER (3TPD, 1985) DELIVERED BY STUART*

*Hydrogenics acquired Stuart Energy in 2005



Air Liquide Becancour, Canada

4x HyLYZER® 1000-30 – indoor – 20 MW – 4.000 Nm³/h – 8,6 TPD

World's Largest PEM Electrolyzer 20 MW

More info & video tour:

<https://www.cummins.com/news/2021/10/04/video-case-study-cummins-hylyzerr-pem-electrolyzer-becancour-quebec>

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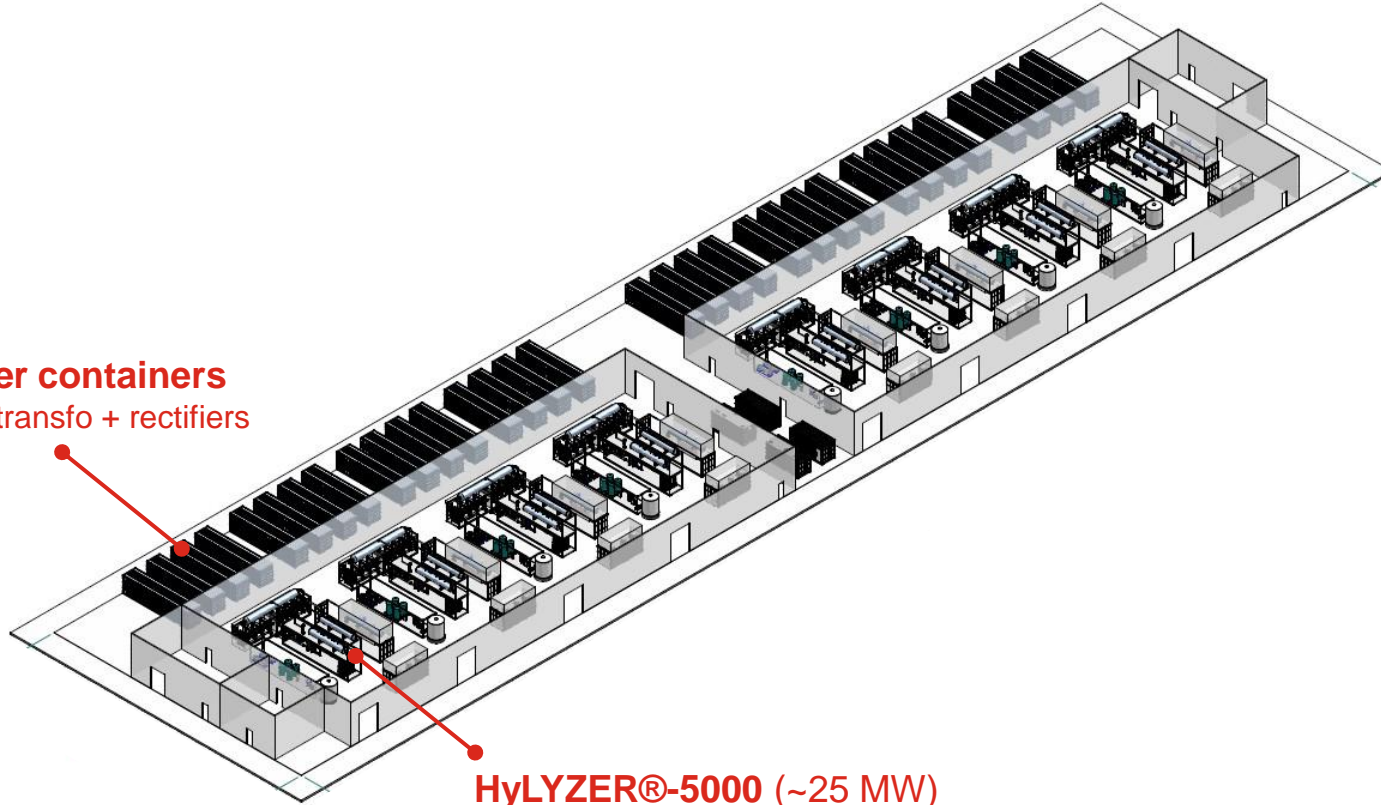


Air Liquide Becancour, Canada

4x HyLYZER® 1000-30 – indoor – 20 MW – 4.000 Nm³/h – 8,6 TPD

HyLYZER®-5000 PEM ELECTROLYZER PLANT LAYOUT 40.000 Nm³/h (~200 MW)

Power containers
MV-LV transfo + rectifiers



HyLYZER®-5000 (~25 MW)

HyLYZER®-XXL PEM ELECTROLYZER PLANT LAYOUT 100.000 Nm³/h (~500 MW)



COST REDUCTION LEVIES (CAPEX & OPEX) FOR PEM ELECTROLYZERS

- **Product standardization** : key technology blocks
- **Innovative product design** : robust & reliable, compact (low footprint), modular (easy to transport), plug&play (reduced installation costs), design to manufacture, design to service, easy to integrate
- **Cell stack upscaling**: more cells, larger active areas, thinner membrane and higher current densities
- **Product upscaling** (towards XXL electrolyzer solutions): “bigger is better”
- **Power** transfo/rectifiers optimization (larger rectifiers powering more stacks)
- **Strategic partnerships** with EPC companies on Balance-of-Plant and with customers
- **Materials and components**: MEA improvements (efficiency, durability), reduction of iridium and platinum loadings
- **Manufacturing upscaling** (see next slide)
- **Vertical integration and supply chain** optimization

WE ARE EXPANDING OUR ELECTROLYZER MANUFACTURING CAPACITY ON 3 CONTINENTS



Country	Belgium	Spain	Canada	China	China
City	Oevel	Guadalajara	Mississauga	Shangai	Foshan
Status	Extension	New	Extension	New	New
HySTAT stacks & systems	●				
HyLYZER PEM cell stacks	●		●	●	
HyLYZER PEM systems	●	●	●		● (in JV with Sinopec)

GLOBAL ANNUAL CAPACITY: 2+ GIGAWATTS IN 2023

OUR FOCUS: PRODUCT,
PARTNERSHIPS, SCALE-UP, PEOPLE

THANK YOU !

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cummins.com/hydrogen



**FOR
A WORLD
THAT'S
ALWAYS ON™**

Cummins

