



HYDRO(€)NICS

SHIFT POWER | ENERGIZE YOUR WORLD

The Energy Shift is Underway

Mark Kammerer
Business Development Manager

Florø, Norway, September 18, 2019

Hydrogenics' Markets

Fuel Cells



Transit Bus



Railway



Commercial Vehicle



Marine

Electrolyzers



Industrial Hydrogen



Energy Storage, especially for Transportation Fuels

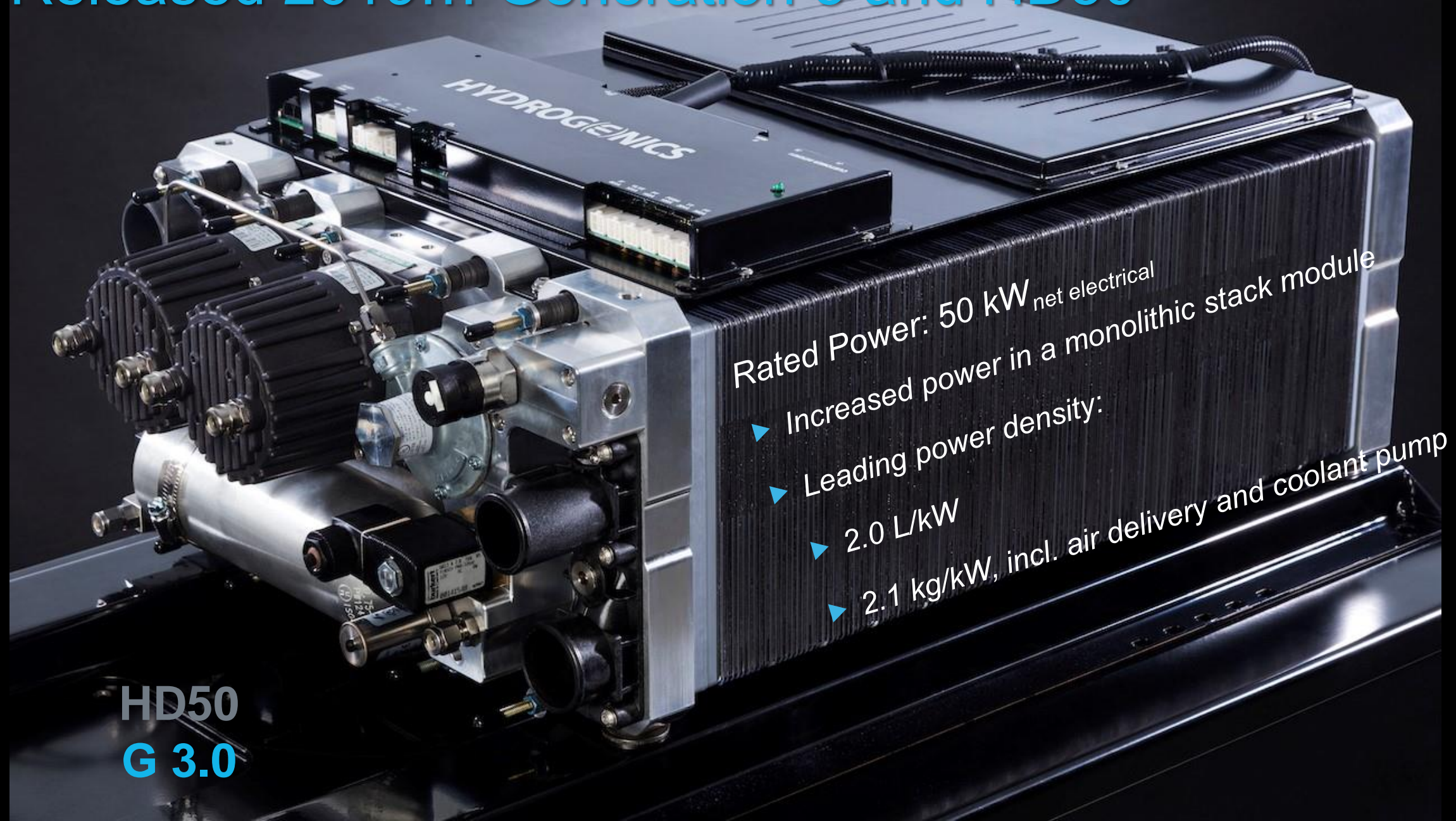


Green Chemicals, Methanol, Ammonia, etc.



H2 Refueling Stations

Released 2019... Generation 3 and HD50

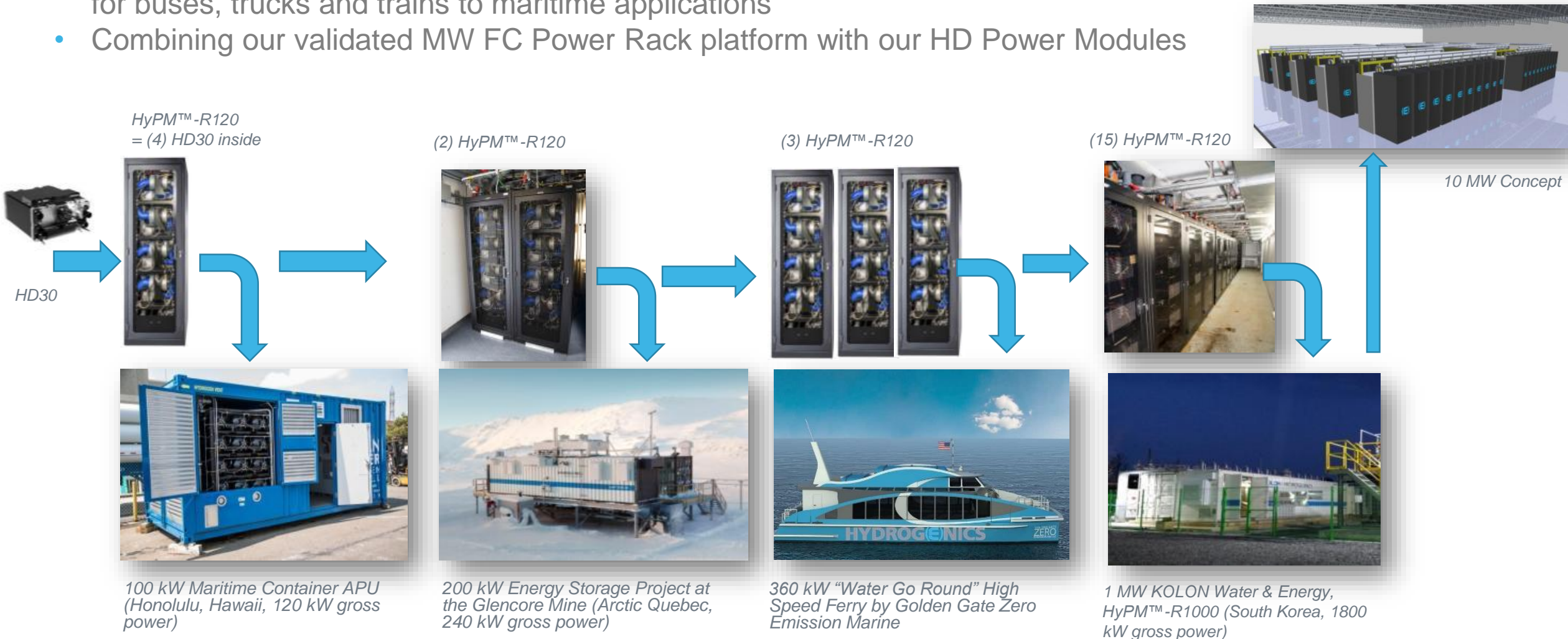


- Rated Power: 50 kW_{net electrical}
- ▶ Increased power in a monolithic stack module
- ▶ Leading power density:
 - ▶ 2.0 L/kW
 - ▶ 2.1 kg/kW, incl. air delivery and coolant pump

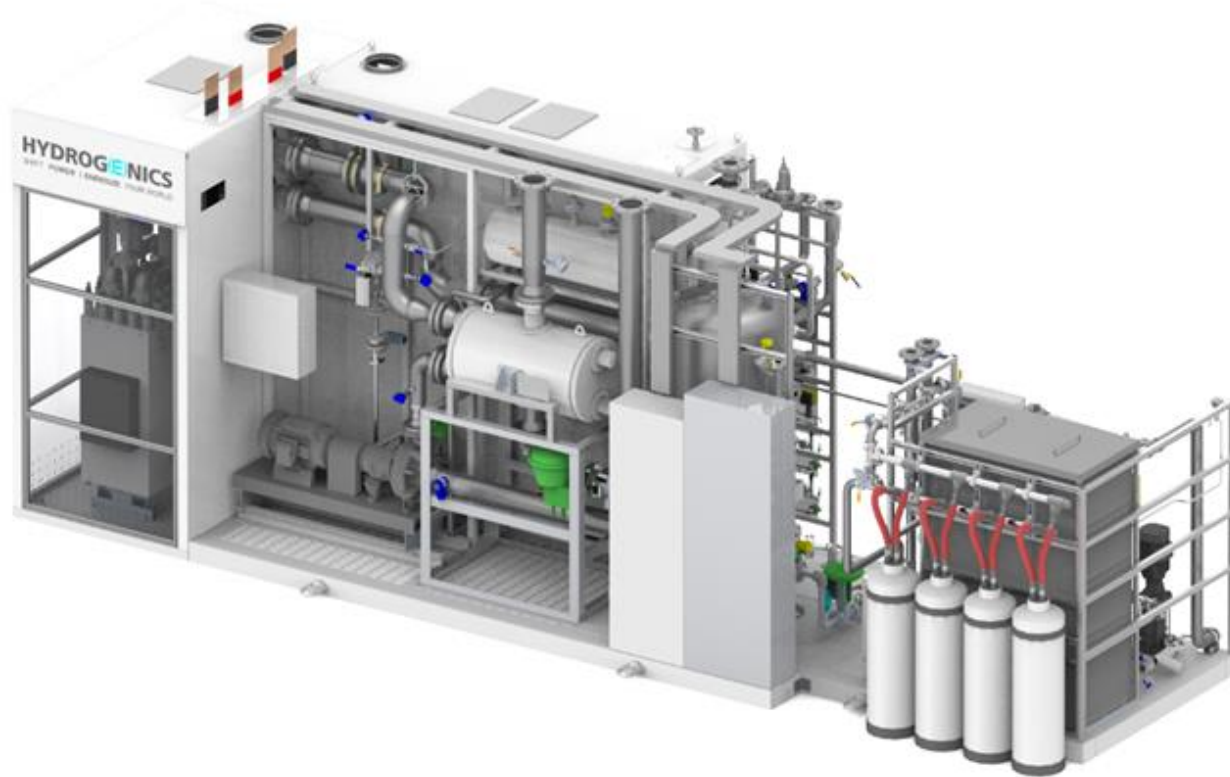
HD50
G 3.0

Hydrogenics' capabilities to deploy multi MWs in large ships

- Hydrogenics is applying fuel cell technology, system and certification know-how developed and validated for buses, trucks and trains to maritime applications
- Combining our validated MW FC Power Rack platform with our HD Power Modules



The HyLYZER®-1000 PEM Electrolyzer



The HyLYZER®-1000 Electrolyzer Skid

- 2160 kg of H₂ per day per skid
- Low cost of installation:
 - no special lifting tools
 - small footprint (~20 m² skid)
- No chemicals
- High Efficiency
PEM Stack : 40 to 47 kWh/kg
Plant: < 50 kWh/kg
- 30 bar(g) pressurized H₂ without a compressor

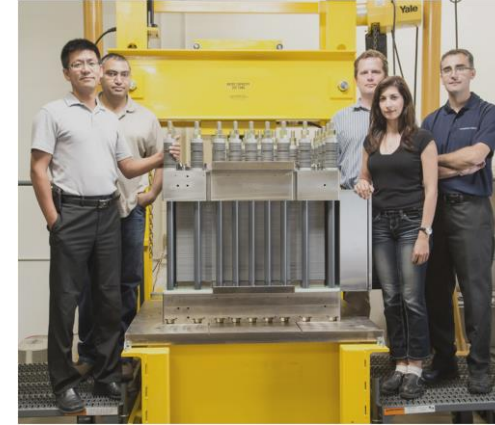
Relative Scale of Alkaline verses PEM Electrolyzer Stacks

Alkaline



33 each x 75 kW Stacks of 33 kg/day

PEM

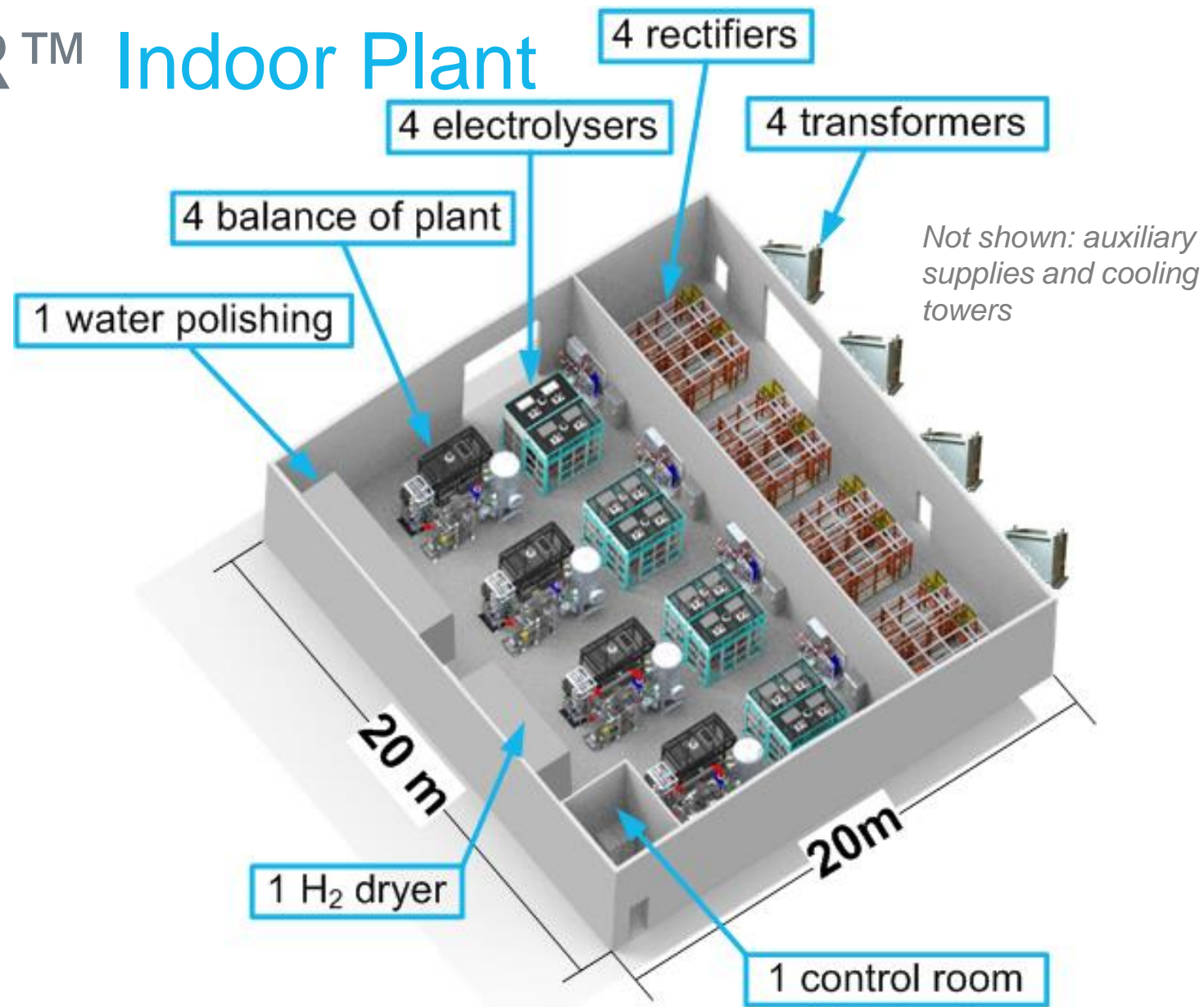


1 each 2.5 MW Stack of 1080 kg/day

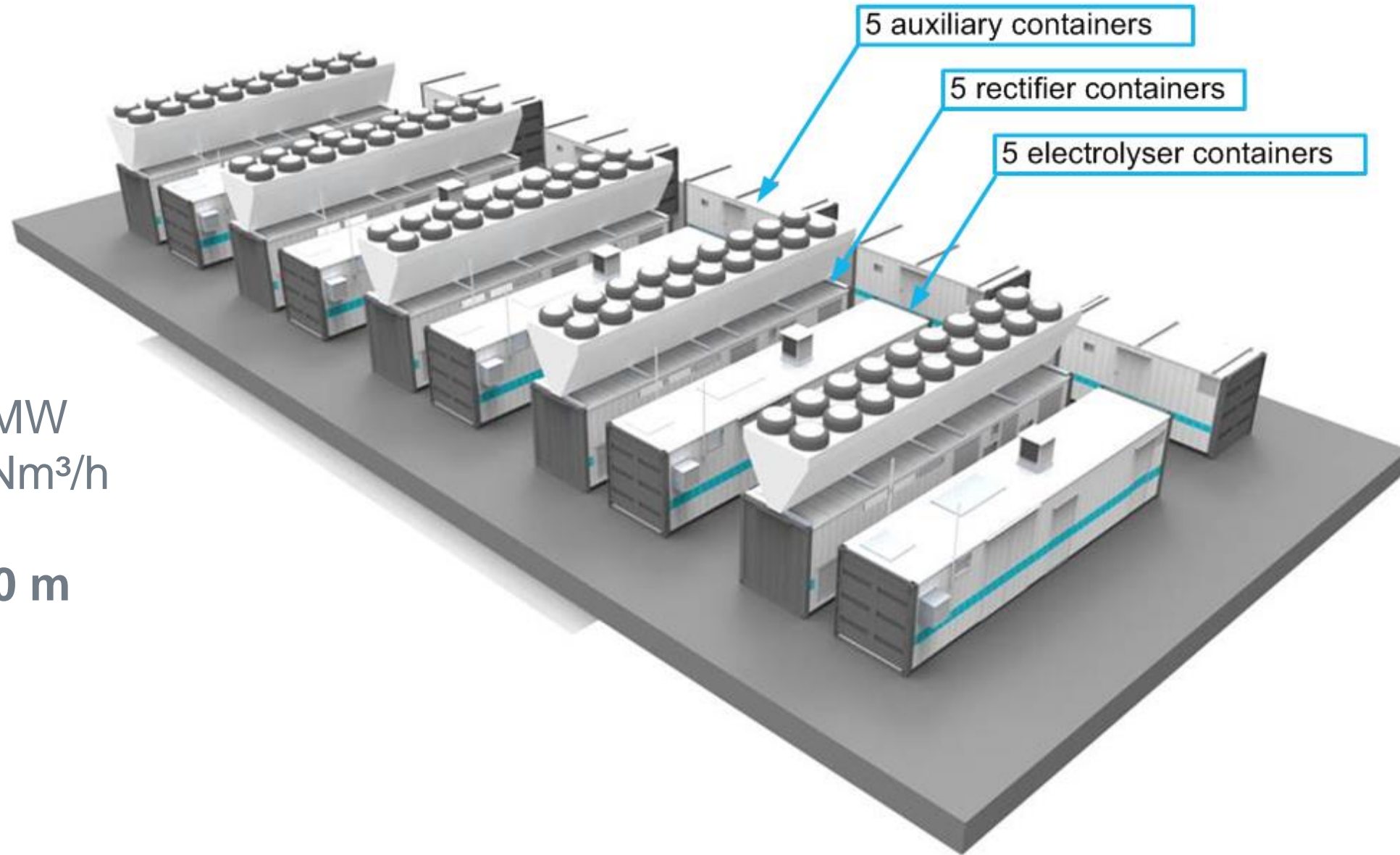
Relative scale

20 MW PEM HyLYZER™ Indoor Plant

Input Power: 20 MW
Capacity: 5,000 Nm³/h
10,000 kg/day
Footprint: **Compact 20 X 20 m**



25 MW PEM HyLYZER™ Outdoor Plant



Input Power: 25 MW
Capacity: 6,000 Nm³/h
13,000 kg/day
Footprint: 40 X 20 m

Berlevåg, Norway, Highly flexible electrolyzers balancing the energy output inside the fence of a wind park

OBJECTIVES

- Direct connection to 45 MW wind park
- Enhanced wind integration through hydrogen
- Demonstrate multiple control systems and applications for electricity storage, mini-grid and fuel production
- Remote operation (difficult access)
- Techno-economic analysis and regulatory aspects of wind-to-hydrogen

SOLUTION

- 1x HyLYZER®-500-30 (PEM) with all peripherals to produce 400 Nm³/h H₂ (power: 2,5 MW)

PROJECT

- This project receives financial support FCH-JU funding: 4,9 M€, GA No 779469, duration: 2018-2021)



2,5 MW
PEM



PARTNERS



VARANGER KRAFT

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SINTEF



tecnalia



Markham Energy Storage Facility: 5MW +/- 1.05 MW Grid Balancing Services for IESO – North America's 1st Multi MW P2G Facility



2 @ 2.5 MW Stacks

Our success is the
result of one
essential ingredient:
– the **human** one.

HYDROG(E)NICS
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The **human** factor.

Experience / Leadership / Technology

We're Ready.

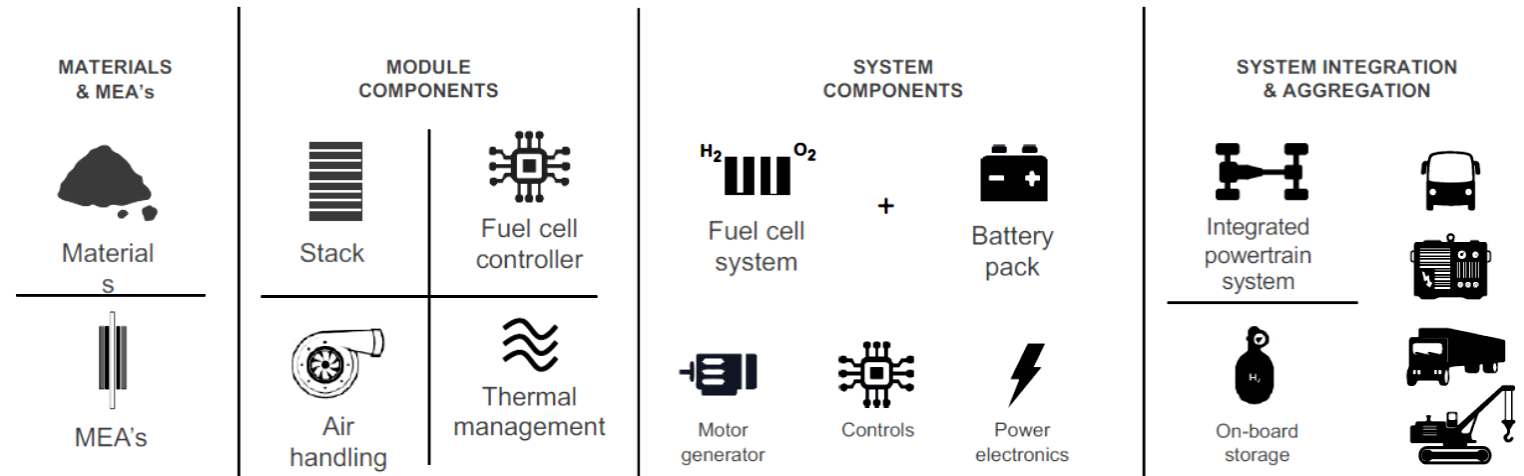
Cummins · Air Liquide Transaction



- **September 9, 2019** - The transaction for Cummins to acquire Hydrogenics for a value of just under \$300 million USD is now completed.
- In the deal, Air Liquide agreed with Cummins to increase their holding of Hydrogenics to 19%
- Cummins holds the balance 81%
- The acquisition of Hydrogenics, with Air Liquide's support, accelerates Cummins' ability to innovate and scale hydrogen fuel cell technologies across a range of commercial markets.
- Owning both fuel cell and hydrogen generation from electrolysis capabilities will enable the company to offer a full, differentiated hydrogen solution, from start to finish, seamlessly integrated for customers.

Cummins is expanding its capabilities across the electrification value chain...

Source: Cummins Perspective on Fuel Cells, Nishchay Bharati, September 10, 2018



"Air Liquide and Cummins have a shared vision of the key role that hydrogen plays in the energy transition. As a shareholder, and more widely as a company, Air Liquide is highly supportive of a hydrogen-based society," said Pierre Etienne Franc, CEO, The Hydrogen Company. "The two global companies, leaders in their sector, have complementary expertise in the development of hydrogen energy. Thanks to Cummins' investment, we believe Hydrogenics technologies will be able to accelerate significantly their development."