



HYDROG(E)NICS

SHIFT POWER | ENERGIZE YOUR WORLD

Ervaringen en Plannen

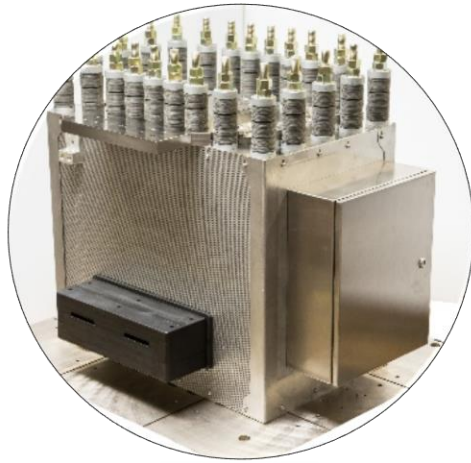
Filip SMEETS
Managing Director
Hydrogenics Europe

Hydrogenics in a nutshell



Hydrogenics manufactures zero emission hydrogen technologies

Electrolyzers



Fuel Cells



WATER (H₂O) + **POWER**

Electrolyzer

Fuel Cell

HYDROGEN (H₂) + OXYGEN (O₂)

Hydrogenics, a daughter company of Cummins and Air Liquide

Cummins takes over fuel cell maker Hydrogenics

AIR LIQUIDE CANADA CUMMINS FUEL CELL HYDROGEN HYDROGENICS CORPORATION USA



The US engine manufacturer Cummins has taken over the Canadian fuel cell manufacturer Hydrogenics Corporation. However, Air Liquide will remain on board as an investor in Hydrogenics.

Cummins announced that the company will acquire all shares of the Canadian fuel cell and hydrogen technology developer and manufacturer, with the exception of the shares [Air Liquide acquired](#) in Hydrogenics earlier this year. Cummins will pay \$15 per share, equivalent to \$290 million in shareholder value.

Further details on the deal and its impact on both companies will be announced by Cummins CEO Tom Linebarger later this year: “Upon closing, we will share more details about the acquisition and our strategy to offer a broad portfolio of power solutions to meet our customers’ needs.” According to the announcement, Cummins expects the transaction to close in the third quarter of 2019.

The US manufacturer Cummins was previously known for its diesel engines, but over the last two years has already made a number of significant and decisive acquisitions in the field of electrically powered vehicles. After presenting the prototype of an electric truck in 2017, Cummins acquired the former electric motorcycle manufacturer and current battery specialist Brammo, followed in February 2018 by the [acquisition of Johnson Matthey’s](#) UK division specialising in electric and hybrid vehicles. Just a few months later in July of 2018, Cummins also [acquired Efficient Drivetrains](#), as well as joining the Hydrogen Council. Now, with the acquisition of Hydrogenics, the US firm is setting itself up for rapidly growing markets in zero-emission technologies.

Author: [Carrie Hampel](#) 

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Source: <https://www.electrive.com/2019/07/01/cummins-takes-over-fuel-cell-maker-hydrogenics/>



Hydrogenics' locations

Hydrogenics Corporation



- **Headquarters**
- Mississauga, Ontario
- 180+ employees worldwide
- Fuel Cells, PEM electrolyser stacks, Power-to-Gas, H₂ refueling and and mobility products / projects

Hydrogenics Europe



- Oevel, Belgium
- Since 1987
- Power-to-X, industrial onsite hydrogen production, and H₂ refueling station projects

Hydrogenics GmbH



- Gladbeck, Germany
- Since 2002
- Fuel Cell power module integration

Hydrogenics USA

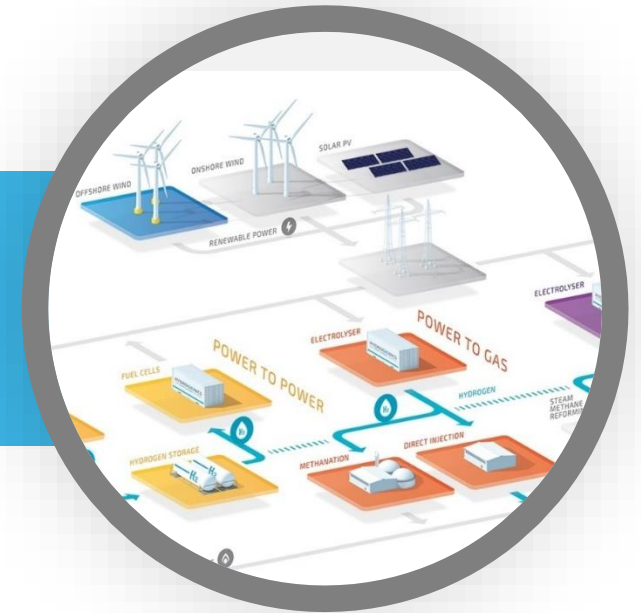


- Carlsbad, California
- Since 2018
- Fuel Cell power module integration

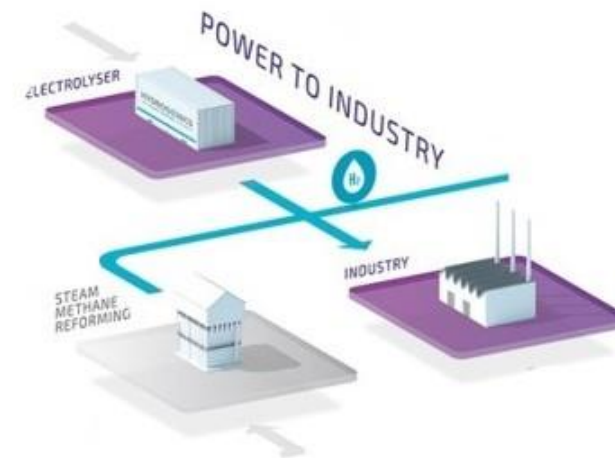


- Production Facility
- Sales Office

Market transformation

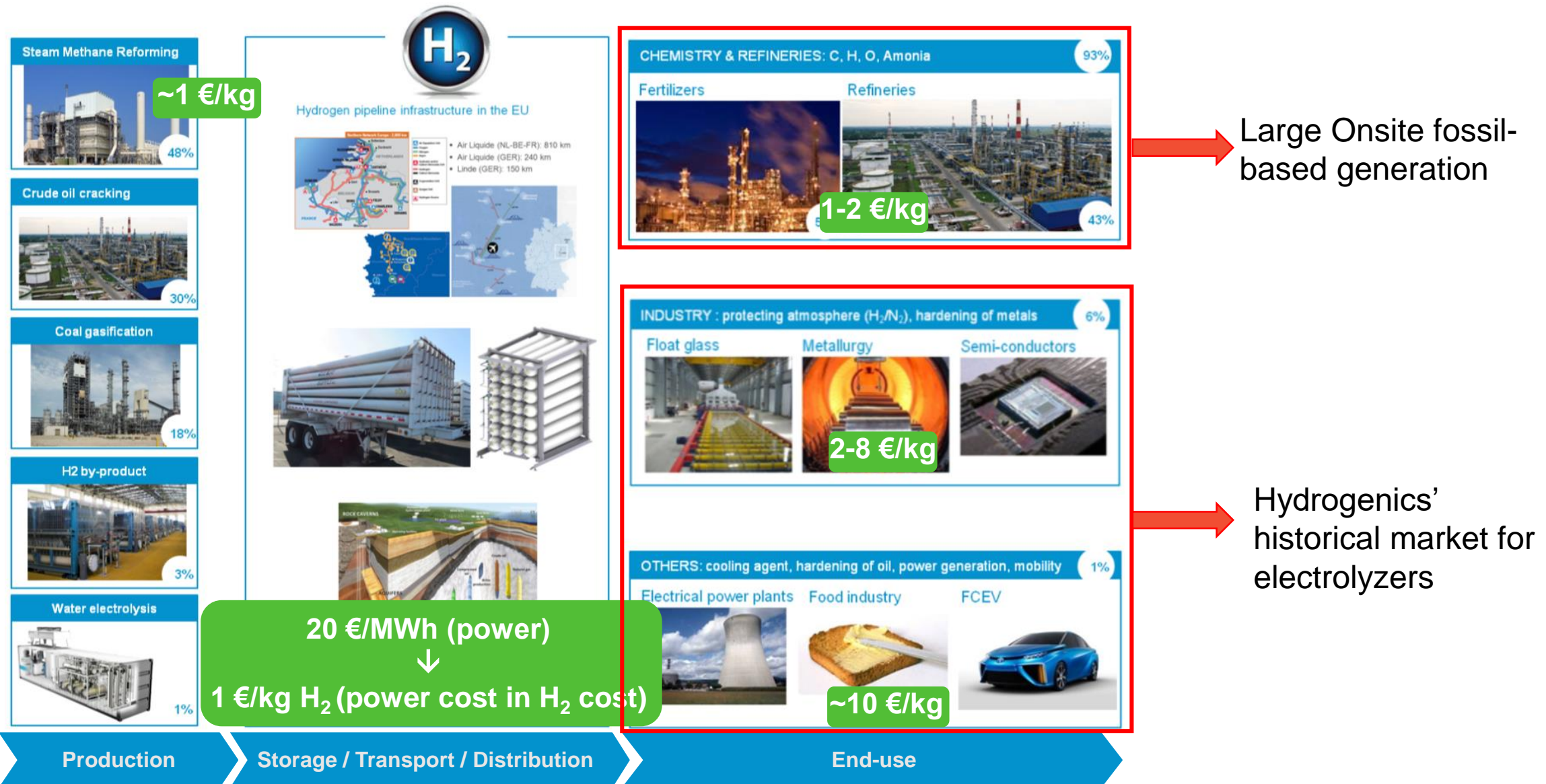


From industrial Hydrogen market ...



Chemical feedstock

World hydrogen market: 70 MMT/year



+ 350 Industrial projects delivered



Nations Unies

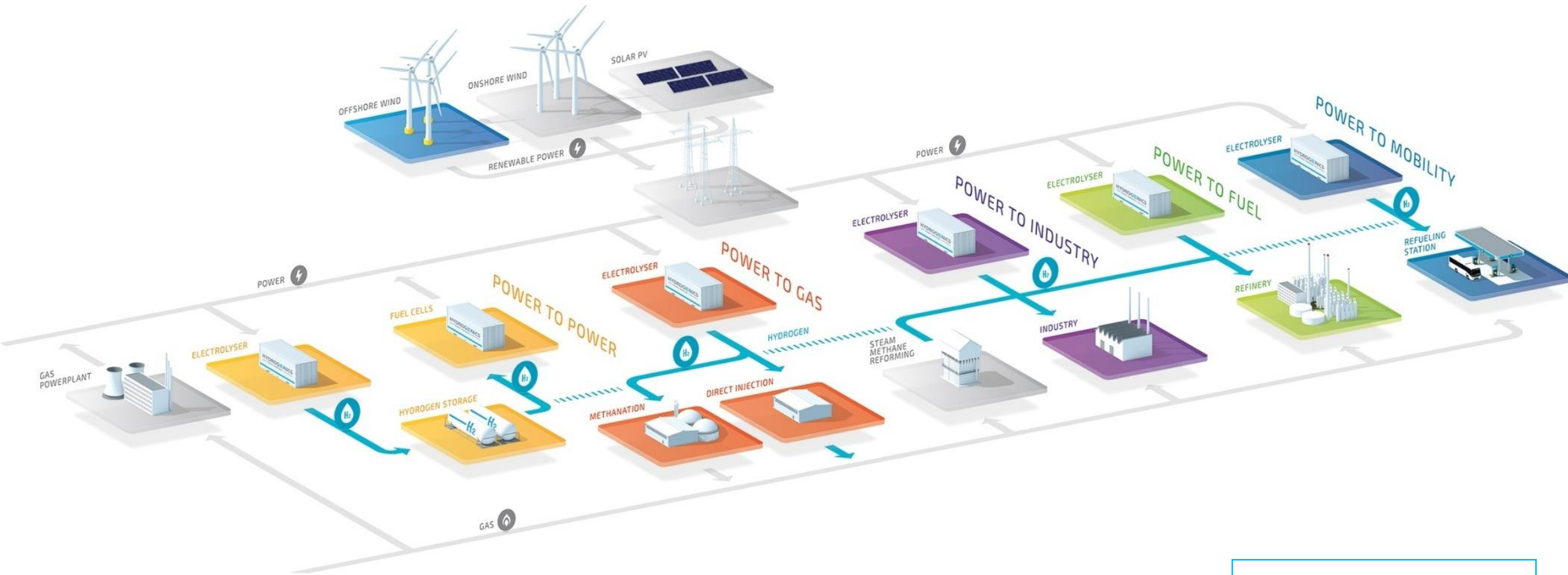
Conférence sur les Changements Climatiques 2015

COP21/CMP11

Paris France

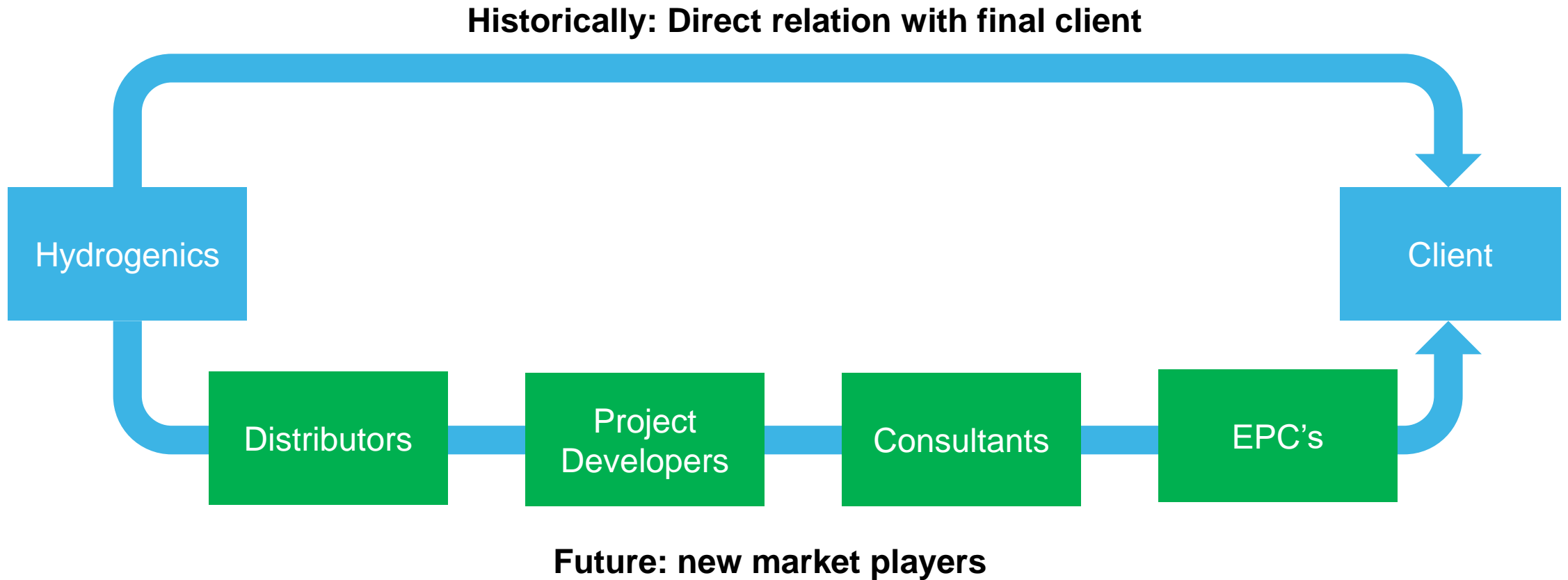


... to Renewable Hydrogen

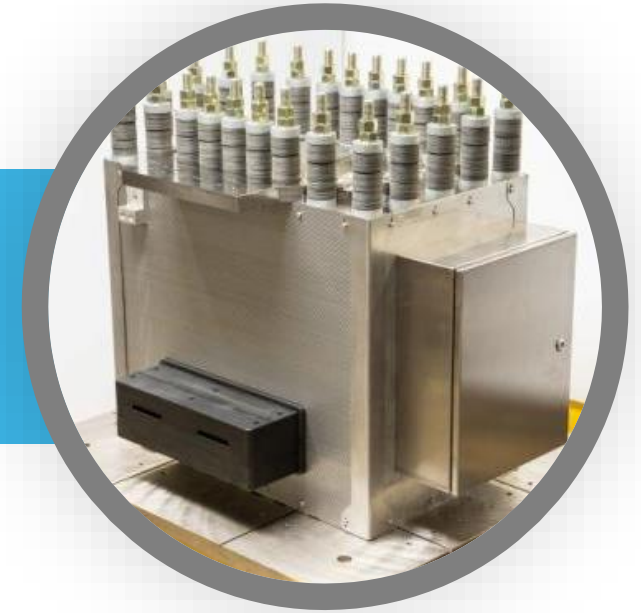


Energy carrier

New Market Players

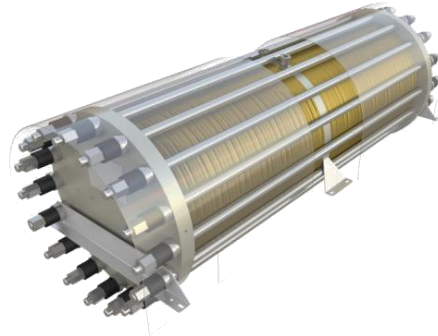


Technology tranformation



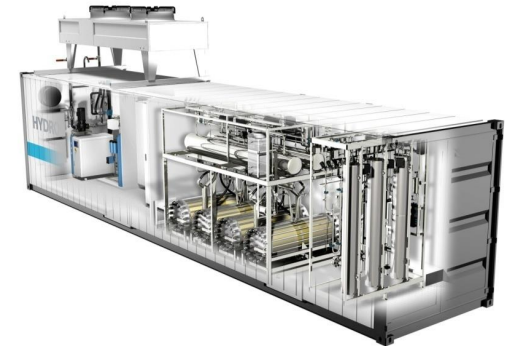
Technology evolution: from kW to MW scale

Alkaline



80 kW
15 Nm³/h

x6



HySTAT®100-10 (500 kW)
100 Nm³/h

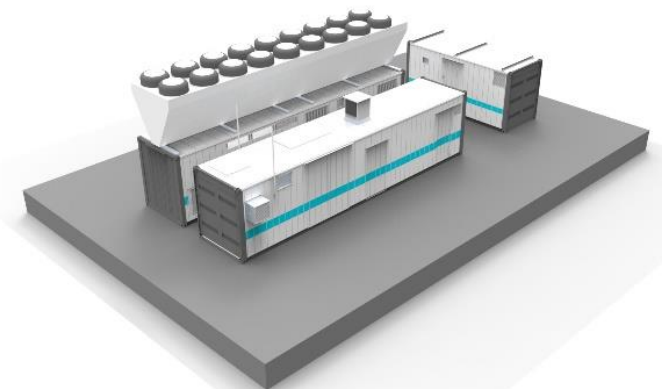
PEM

(Proton Exchange
Membrane)



2.5 MW
500 Nm³/h

x2



HyLYZER®1000-30 (5MW)
1000 Nm³/h

New Benchmark in PEM Water Electrolysis, 3MW 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



2019

2014

Power Input: 3.0 MW
Hydrogen Output: 1,330 kgpd
620 Nm³/h
Design Pressure: 40 bar

Power Input: 1.5 MW
Hydrogen Output: 670 kgpd
310 Nm³/h
Design Pressure: 40 bar

4

Fast Response and Dynamic Operation

Key requirement established

5

Very compact

Smallest footprint on the market

6

Reduced Maintenance

Limited and optimized

Electrolysers : product's line

Alkaline

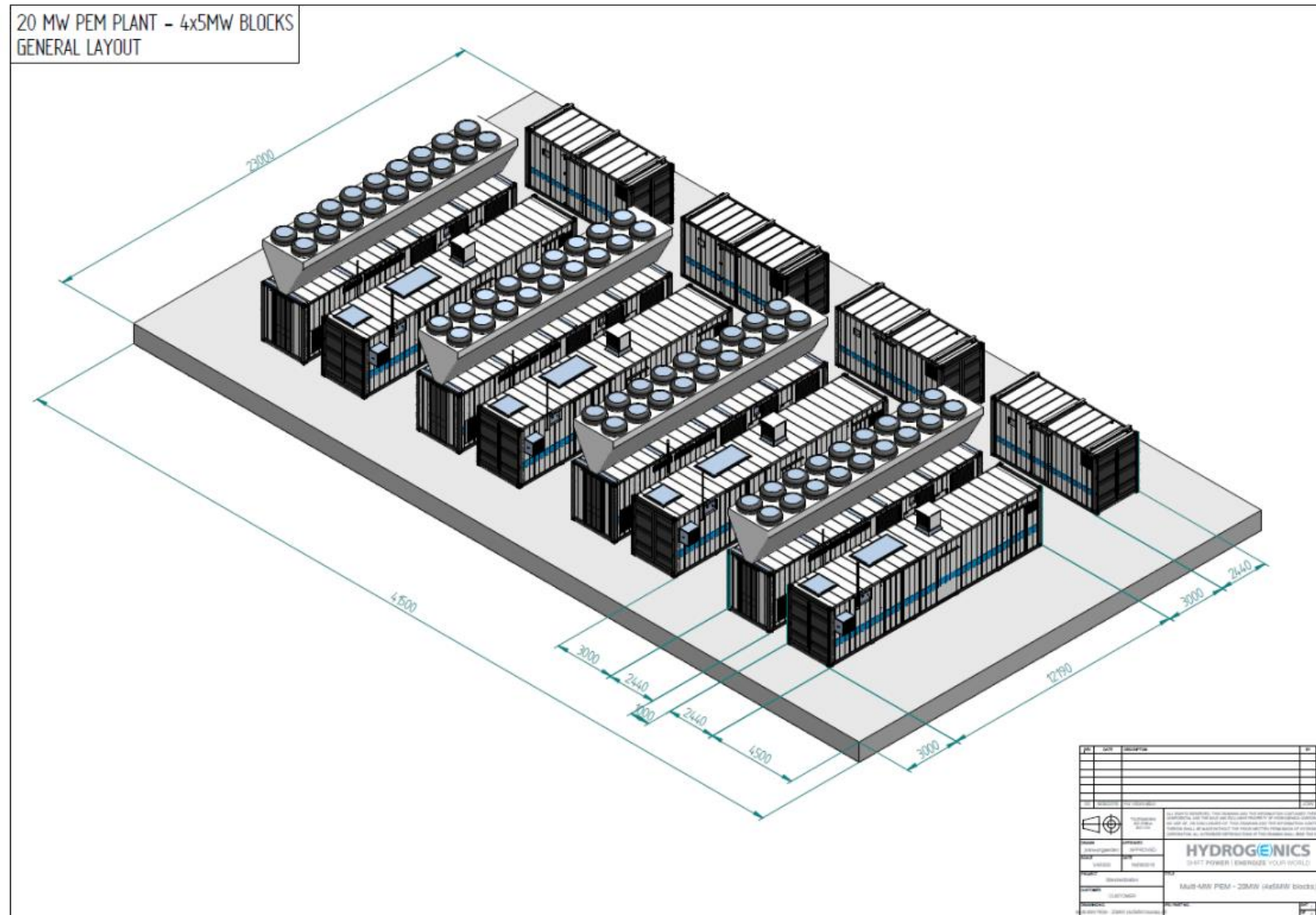


PEM (Proton Exchange Membrane)



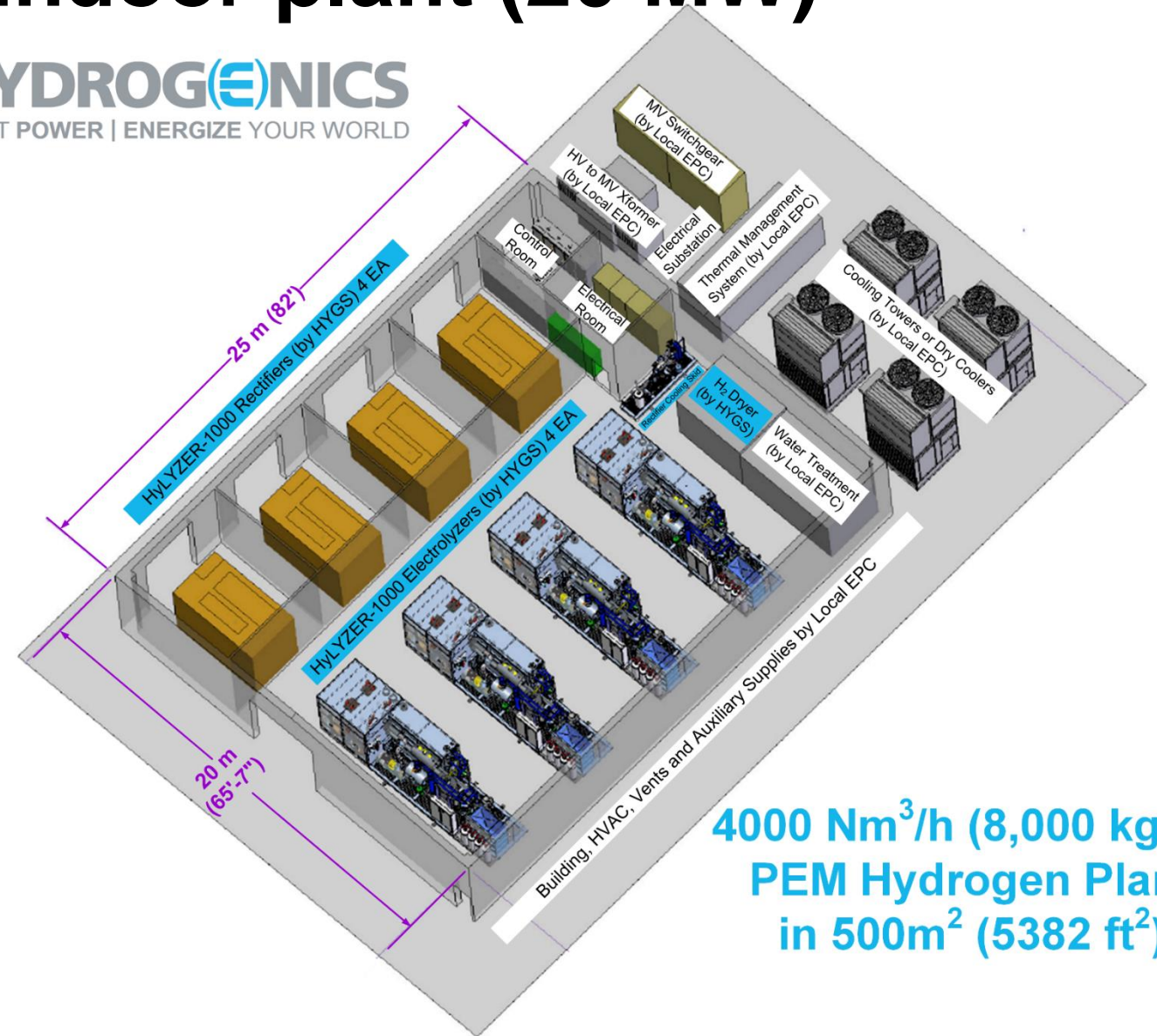
	HySTAT®-15-10	HySTAT®-60-10	HySTAT®-100-10	HyLYZER® -300-30	HyLYZER® -1.000-30	HyLYZER® -5.000-30
Output pressure	10 barg (27 barg optional)			30 barg		
Number of cell stacks	1	4	6	1	2	10
Nominal Hydrogen Flow	15 Nm ³ /h	60 Nm ³ /h	100 Nm ³ /h	300 Nm ³ /h	1.000 Nm ³ /h	5.000 Nm ³ /h
Nominal input power	80 kW	300 kW	500 kW	1.5 MW	5 MW	25 MW
AC power consumption (utilities included, at nominal capacity)	5.0 to 5.4 kWh/Nm ³			4.4 to 4.8 kWh/Nm ³		
Hydrogen flow range	40-100%	10-100%	5-100%	1-100%		
Hydrogen purity	99.998% O ₂ < 2 ppm, N ₂ < 12 ppm (higher purities optional)			99.998% O ₂ < 2 ppm, N ₂ < 12 ppm (higher purities optional)		
Tap water consumption	<1.4 liters / Nm ³ H ₂			<1.4 liters / Nm ³ H ₂		
Footprint (in containers)	1 x 20 ft	1 x 40 ft	1 x 40 ft	1 x 40 ft	2 x 40 ft	10 x 40 ft
Footprint utilities (optional)	Incl.	Incl.	Incl.	1 x 20 ft	1 x 20 ft	5 x 20 ft

Layout for 4000 Nm³/h outdoor plant (20 MW)



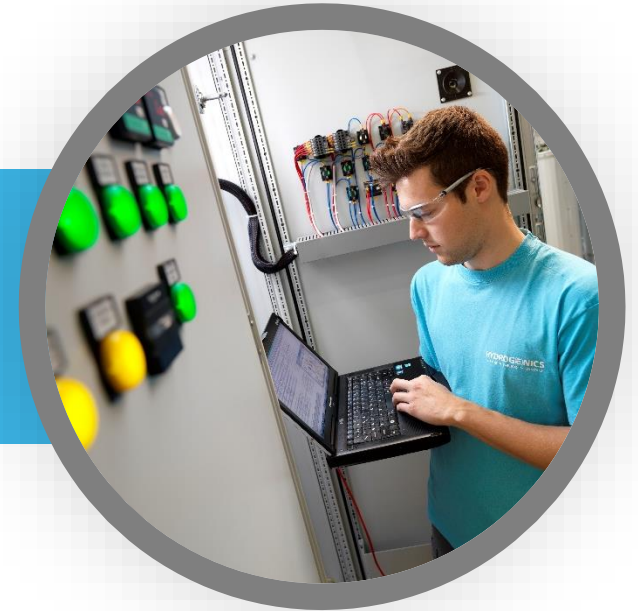
Layout for 4000 Nm³/h indoor plant (20 MW)

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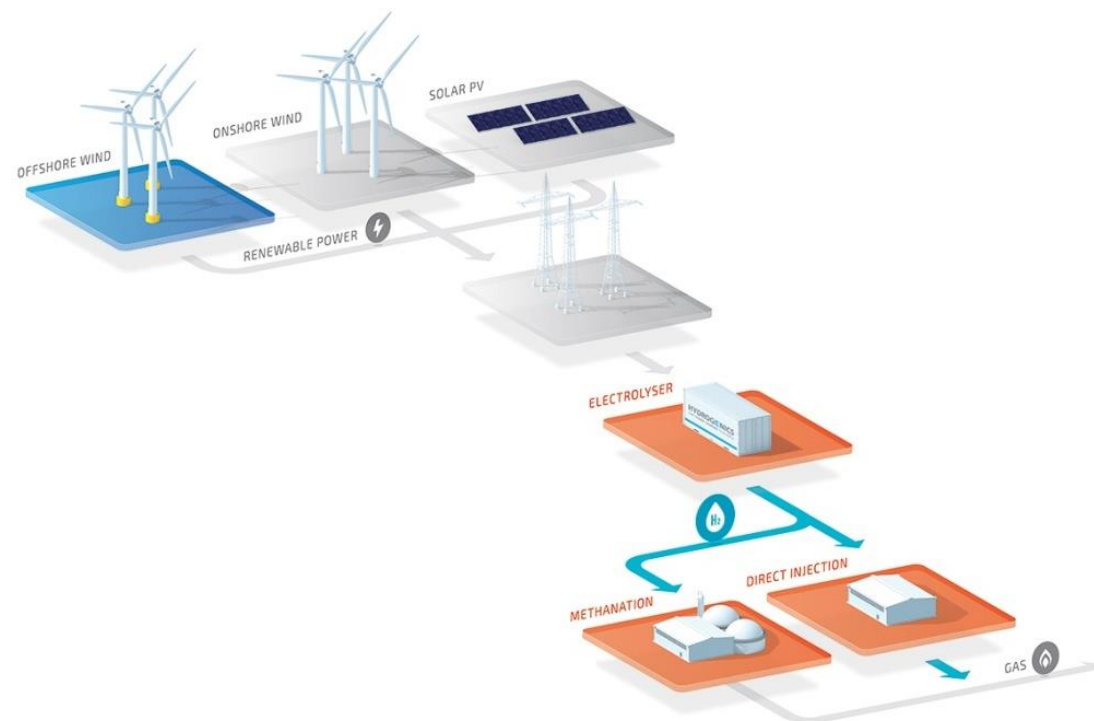


4000 Nm³/h (8,000 kgpd)
PEM Hydrogen Plant
in 500m² (5382 ft²)

Latest Power-to-X references



Wind-to-Gas Südermarsch in Brunsbüttel, Germany (2018)



wind2gas
energy

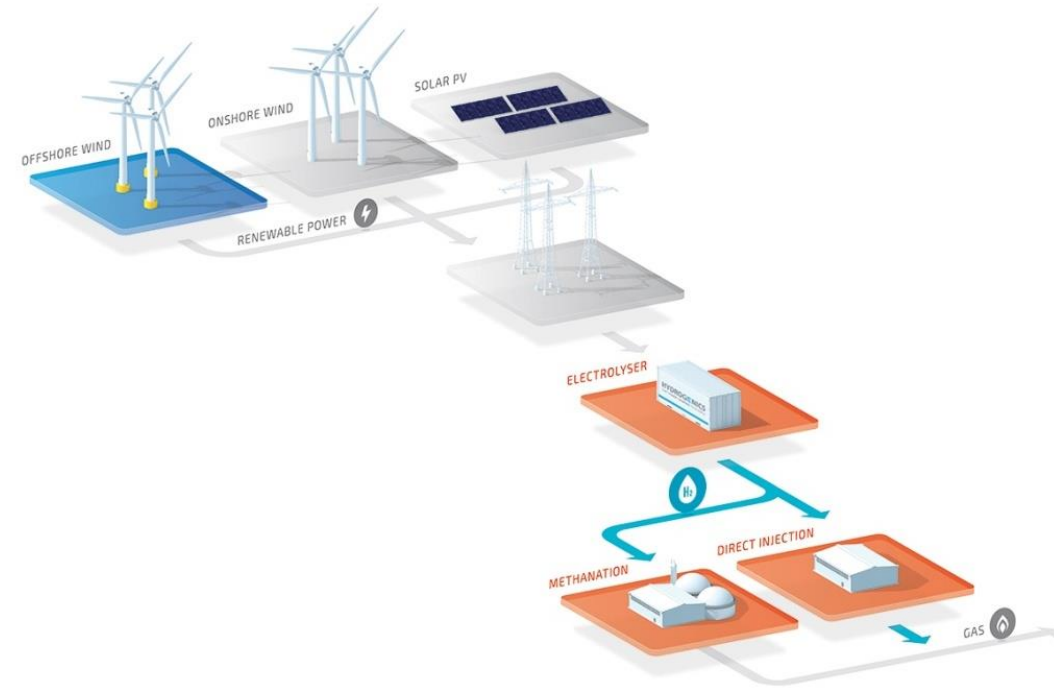
More information: www.w2g-energy.de



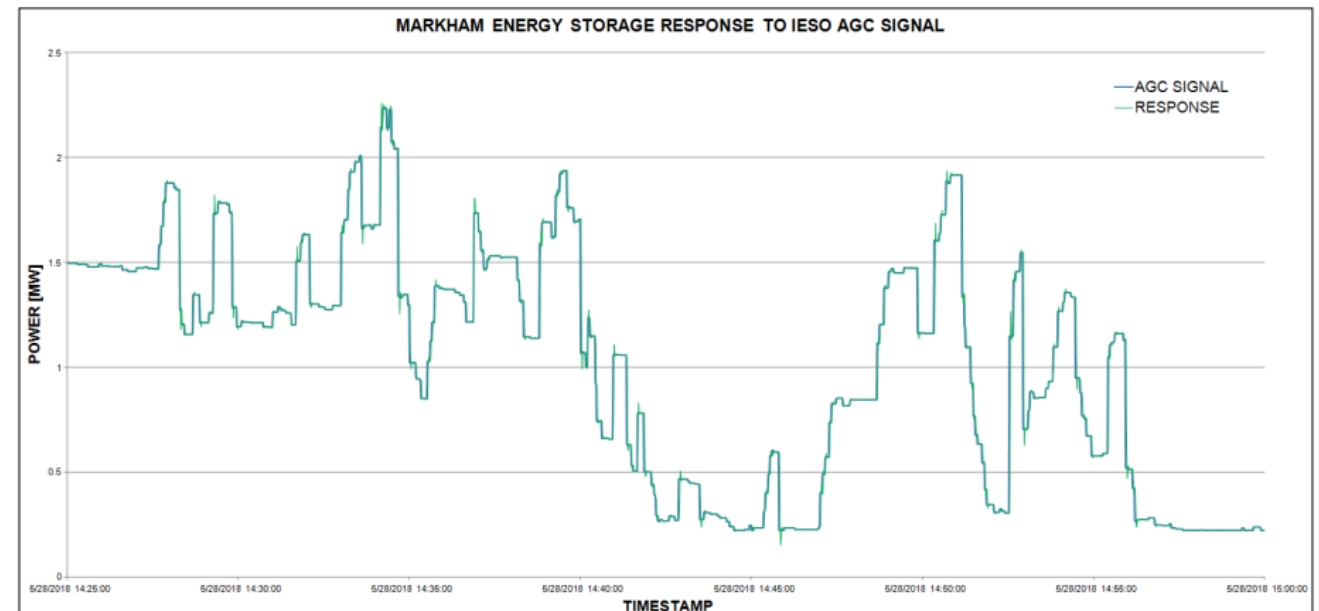
Secondary Frequency Control for IESO in Markham, Canada (2018)

Power-to-Gas

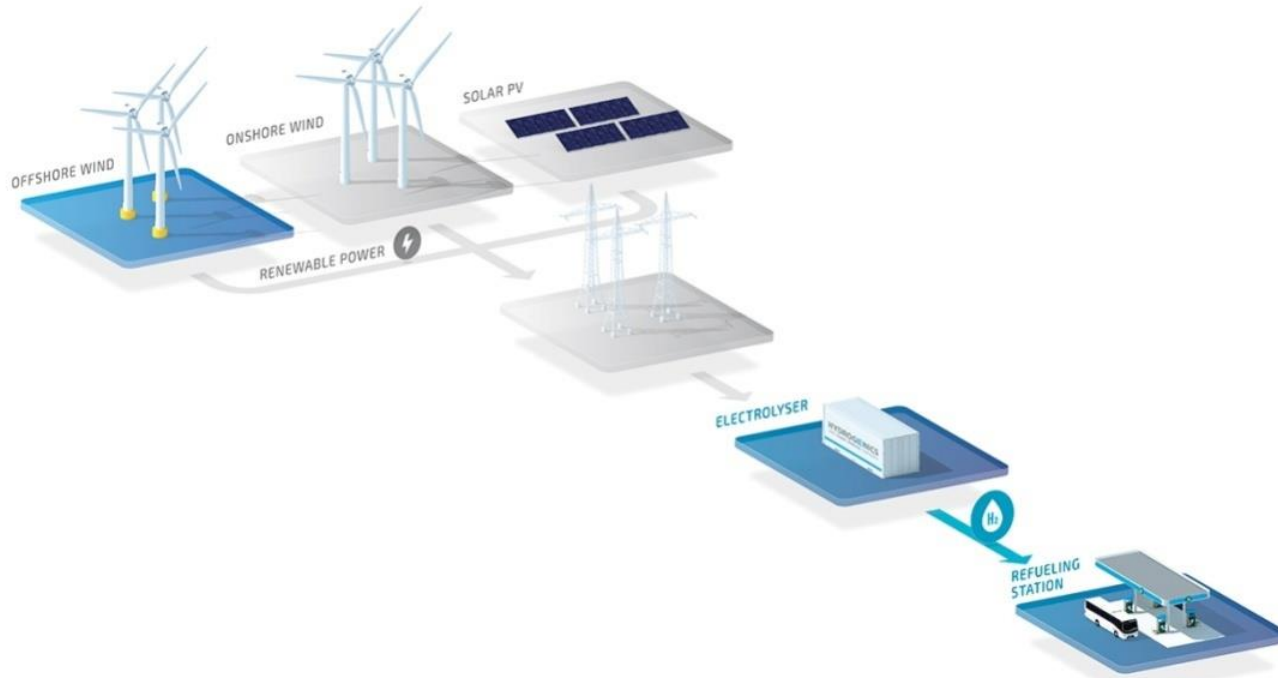
2,5 MW
Direct injection
PEM



More information: www.enbridge.com

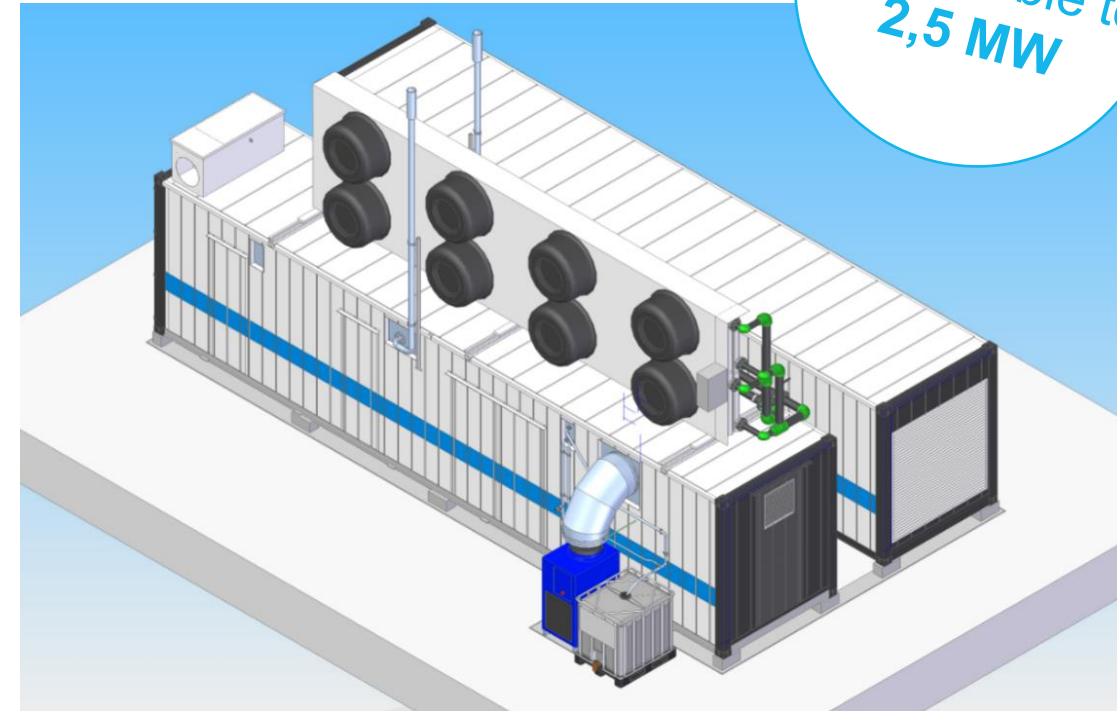


Maximator Refuelling station in Wuppertal, Germany (2019)



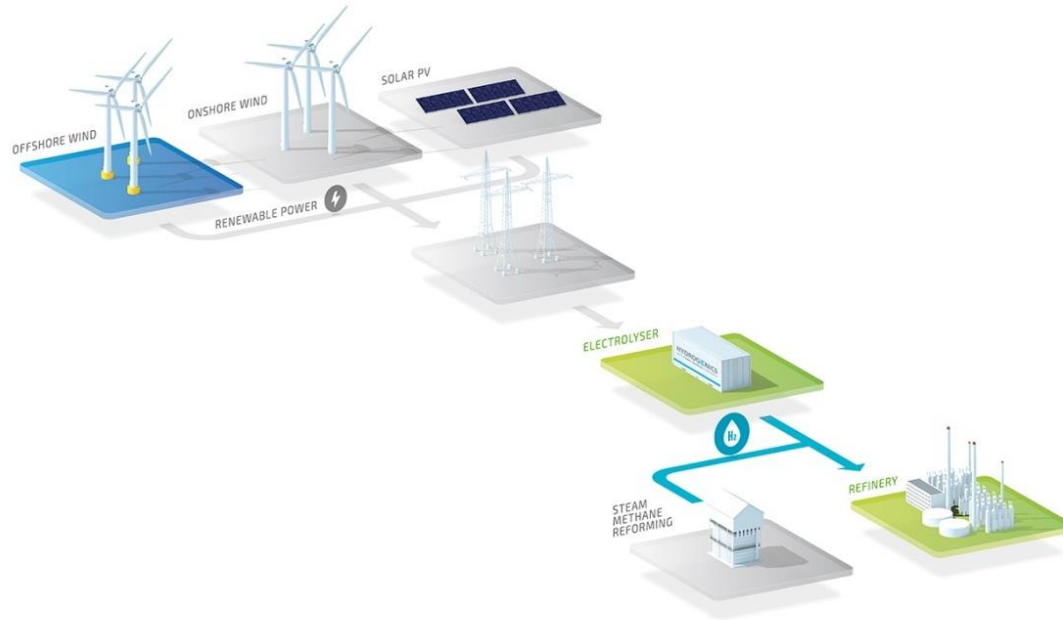
MAXIMATOR®
Maximum Pressure.

More information: <https://www.maximator.de/flycms/en/web/10/>



MEFCO₂: Power-to-Methanol in Niederaußem, Germany (2018)

Power-to-Fuels



HYDROGENICS



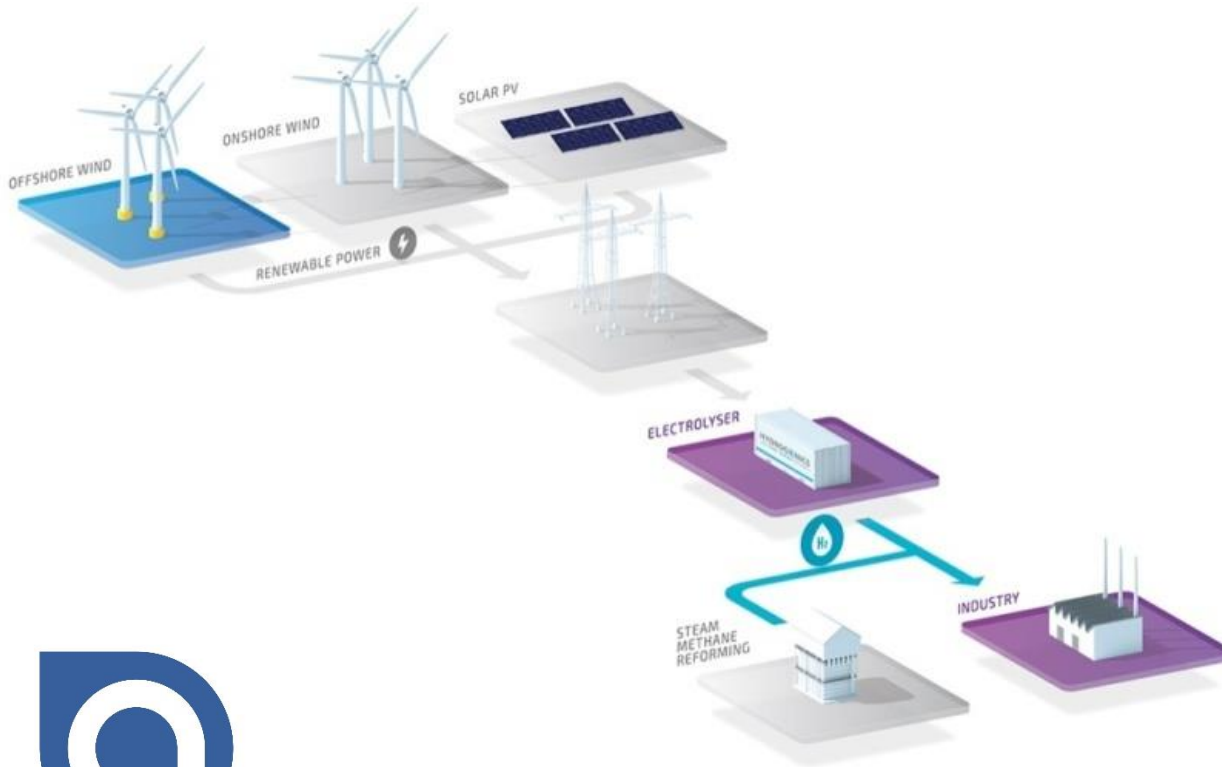
RWE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (No 637016).

More information: www.mefco2.eu



Air Liquide: Power-to-Industry in Becancour, Canada (2020)



Air Liquide

More information: <https://industry.airliquide.ca/air-liquide-invests-worlds-largest-membrane-based-electrolyzer-develop-its-carbon-free-hydrogen>



**20 MW
PEM**

**LARGEST PEM ELECTROLYZER
IN THE WORLD**

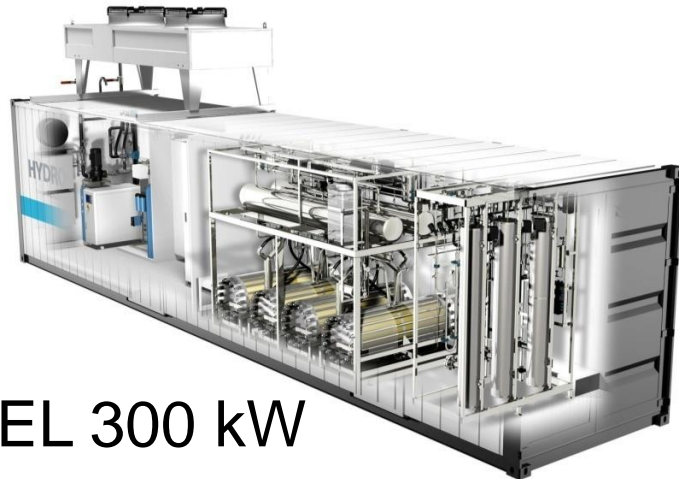
Lessons learnt



Lessons learnt from last P2X projects

Lessons from industry

- Strong experience in H2 safety
- Global standards
- Permitting/regulation
- Technology maturity
- Customized project manufacturing

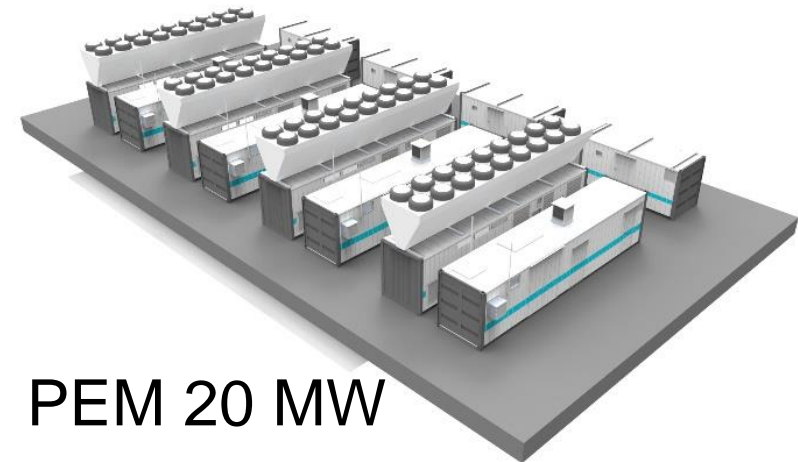


AEL 300 kW



Challenges for scale-up

- Size increase
- Production capabilities
- Cost reduction
- Maturity of supply chain
- Regulations / policy support



PEM 20 MW

Competitive Advantages PEM vs. Alkaline

Reduced CAPEX

- Competitive equipment CAPEX → prices will continue to decrease with volume
- Non-classified process room → can use normal equipment for auxiliary systems
- Compact equipment → less land costs, smaller buildings, lower EPC costs for customer
- Simple interfaces → reduced installation costs
- Overdrive feature → design with N-1 redundancy in guaranteed flow applications
- Stacks will be refurbished → Do not need to buy new stacks

Reduced OPEX

- Highest efficiency stacks → less electricity usage
- Highly efficient Balance of Stack → no compressors required for H₂ liquefaction or NG injection
- No KOH → easier for onsite works and maintenance
- No compressors → No risk of oil contamination, no added maintenance
- Very few moving parts → low maintenance costs (~0.5 to 1% of CAPEX per annum for onshore projects)
- Very low degradation → Many years between stack overhauls
- Future improvements → Refurbished stacks will have even better efficiency than today

Our PEM technology provides the best TCO for water electrolysis on the market

Tipping point for the hydrogen industry

From niche

- First products and demo projects
- kW market
- Workshop mode
- Immature supply chain
- Only small Industrial market is commercial

"Hydrogen is a hype"

Upscaling

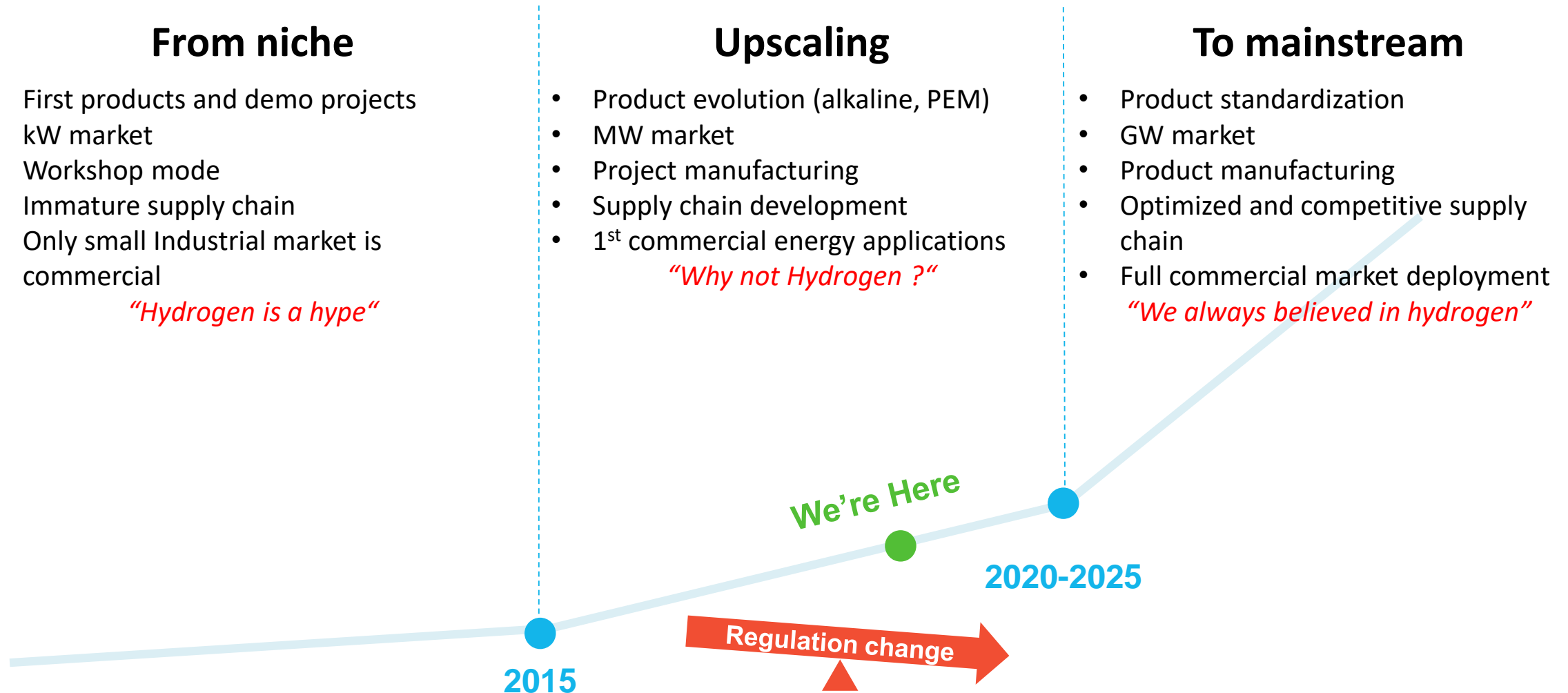
- Product evolution (alkaline, PEM)
- MW market
- Project manufacturing
- Supply chain development
- 1st commercial energy applications

"Why not Hydrogen ?"

To mainstream

- Product standardization
- GW market
- Product manufacturing
- Optimized and competitive supply chain
- Full commercial market deployment

"We always believed in hydrogen"



— Thank you for your attention



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