

HYDROG(E)NICS

SHIFT POWER | ENERGIZE YOUR WORLD

HySTAT® ON SITE HYDROGEN

Infomoment Waterstof 28/06/2017



Roel De Maeyer, Director Sales & Marketing

Hydrogenics Europe NV



- Location : Oevel, **Belgium**
- 75 employees
- +4.500 m² workshop
- ISO 9001 certified since 2001
- ISO 14001 certified since 2004
- OHSAS 18001 certified since 2004



100 % daughter company of Hydrogenics Corporation, Canada (ticker : HYGS)



Hydrogenics Canada: Fuel Cells



mobility



defense



Backup power



Example : 100 kW Racks installed in ISO container



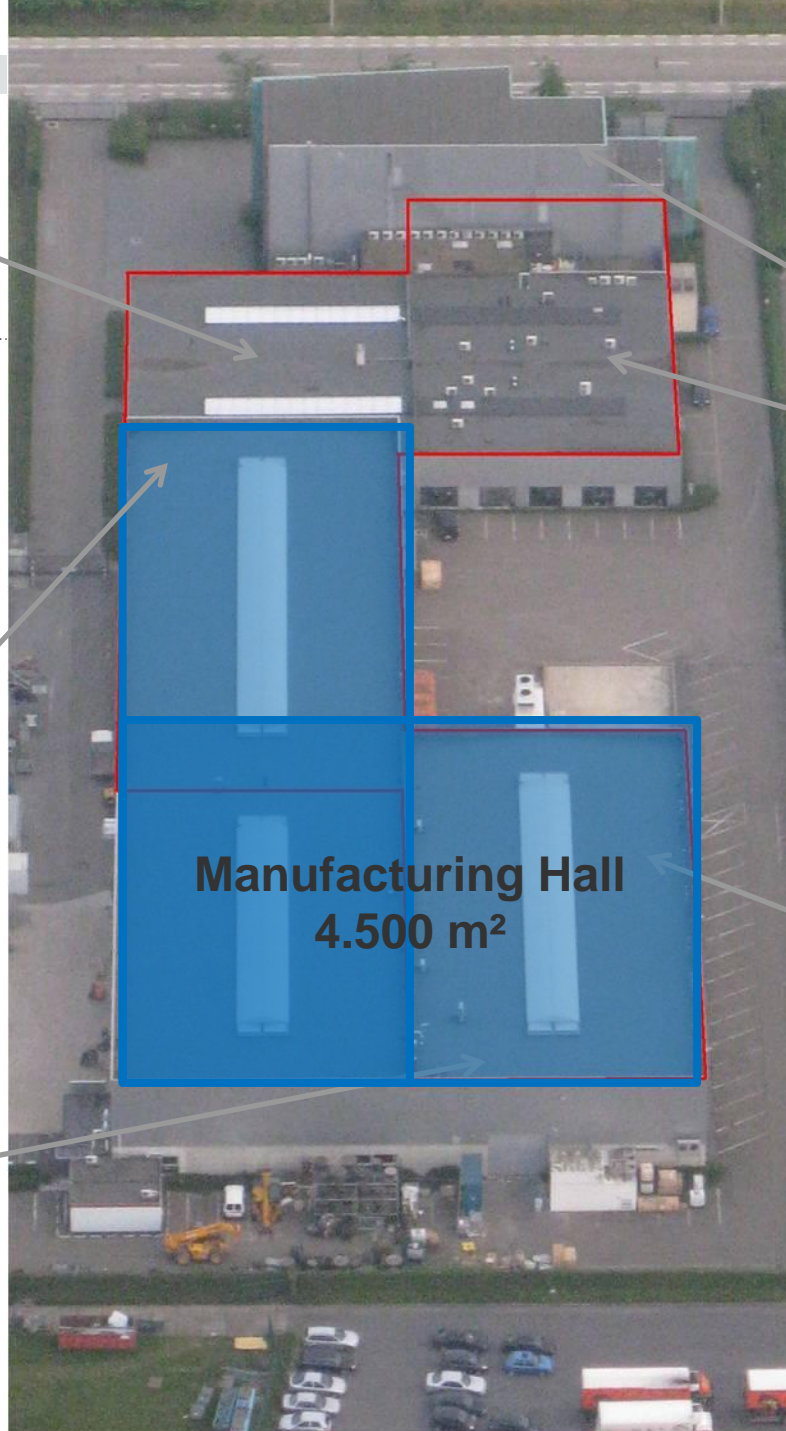
Warehouse & Incoming Inspection



Membrane Production



Cell Stack Assembly & Testing



Offices



Systems Testing







JPSU 2003179

Production Hall

Final Skid & Container Integration

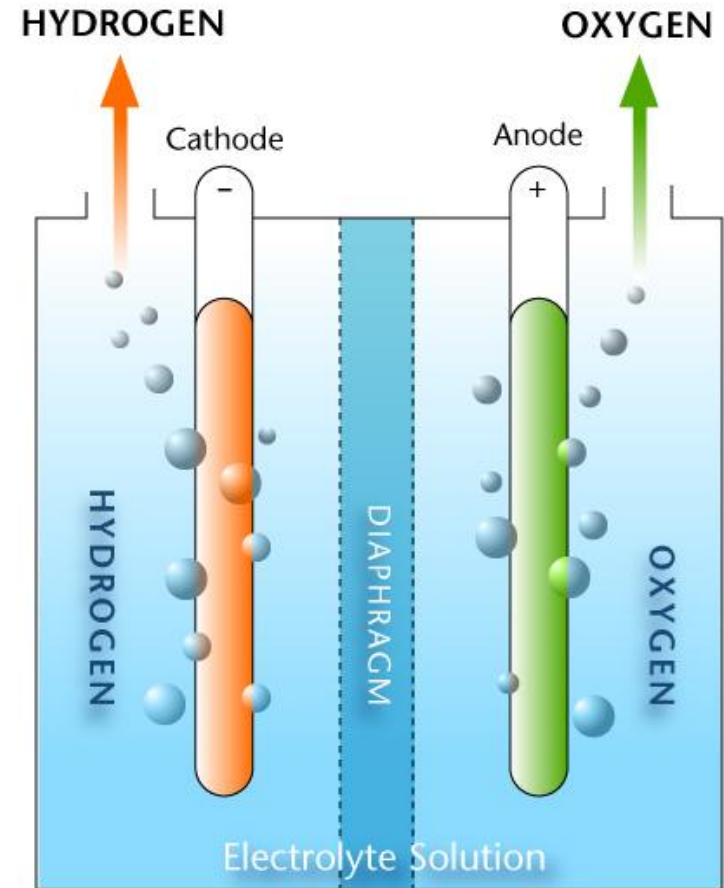
Oxygen cleaning

Welding area (certified)

Skid/System Assembly

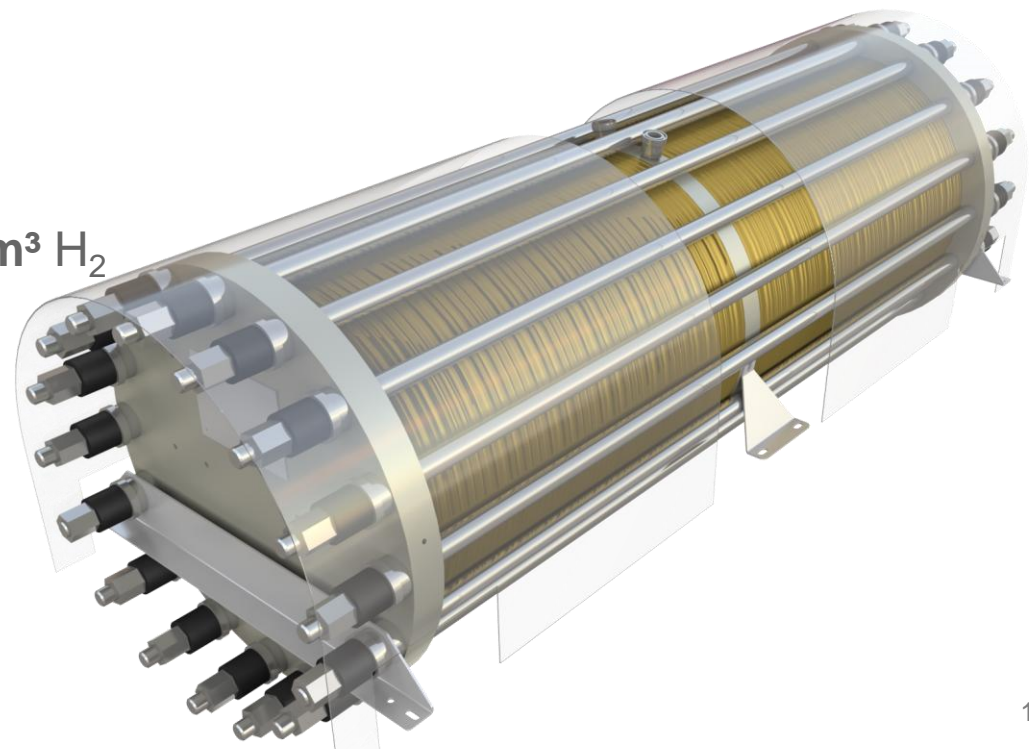


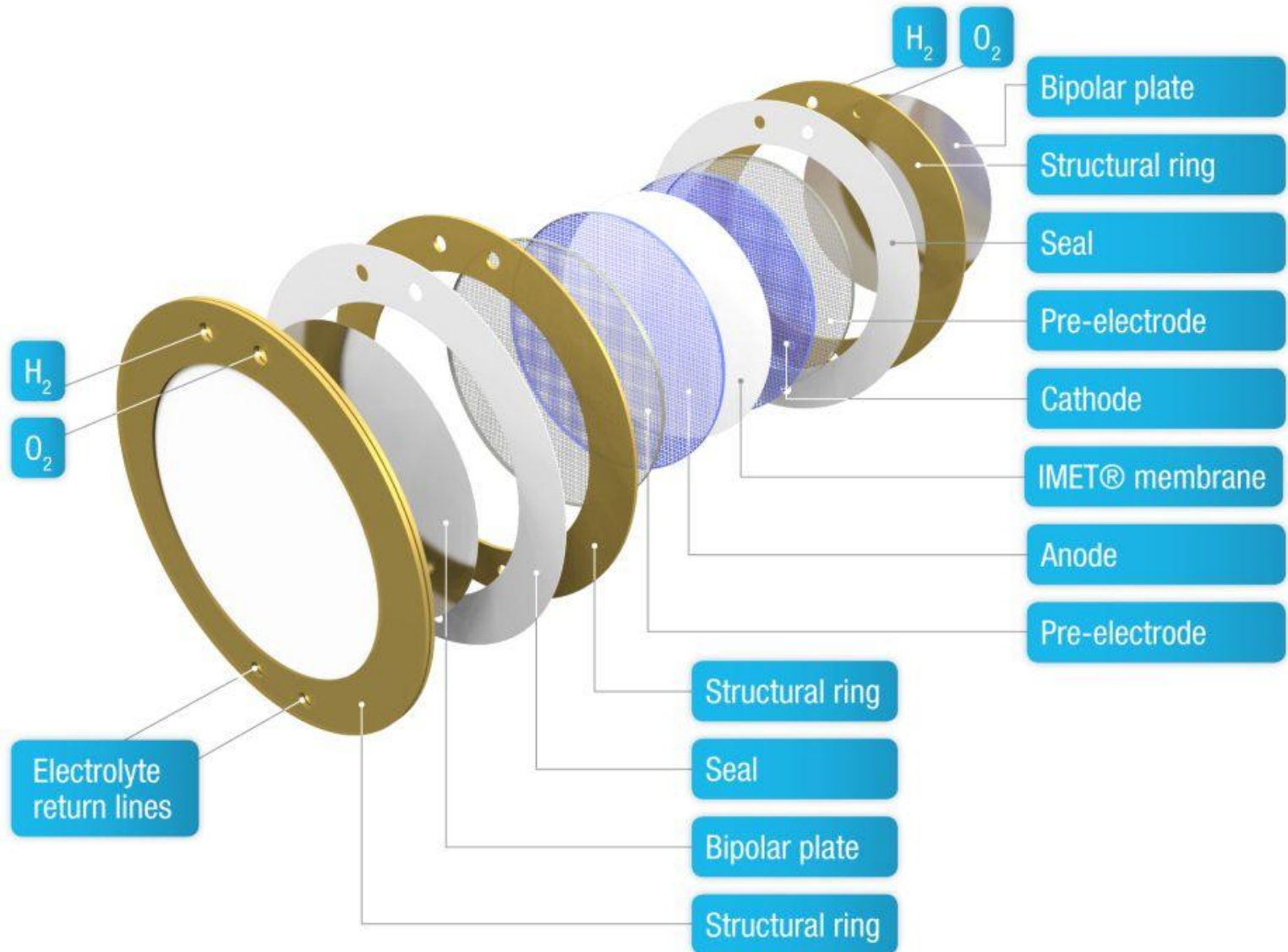
Electrolysis of Water



HySTAT™ Cell Stack

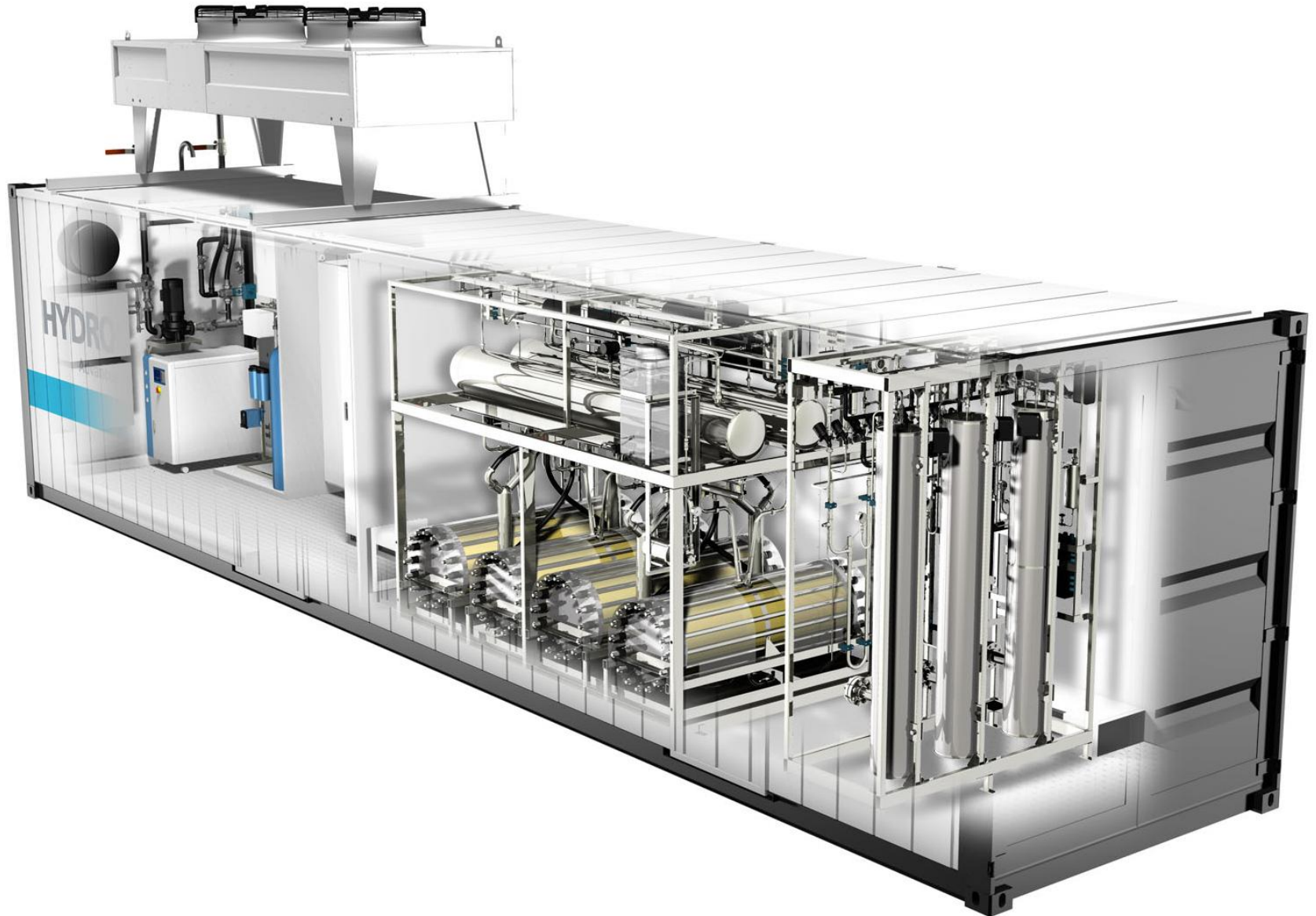
- Designed for continuous use
- ALKALINE electrolysis (30 % vol. KOH)
- Bipolar filter press type
- Nominal capacity **15 Nm³/h H₂**
- Pressure **10 barg**
- Conversion efficiency **4,2 kWh/Nm³ H₂**
- **Hydrogen purity 99,9 %**
 - < 1.000 ppm O₂ in H₂
 - H₂O saturated







'ALL IN' OUTDOOR





'ALL IN' OUTDOOR



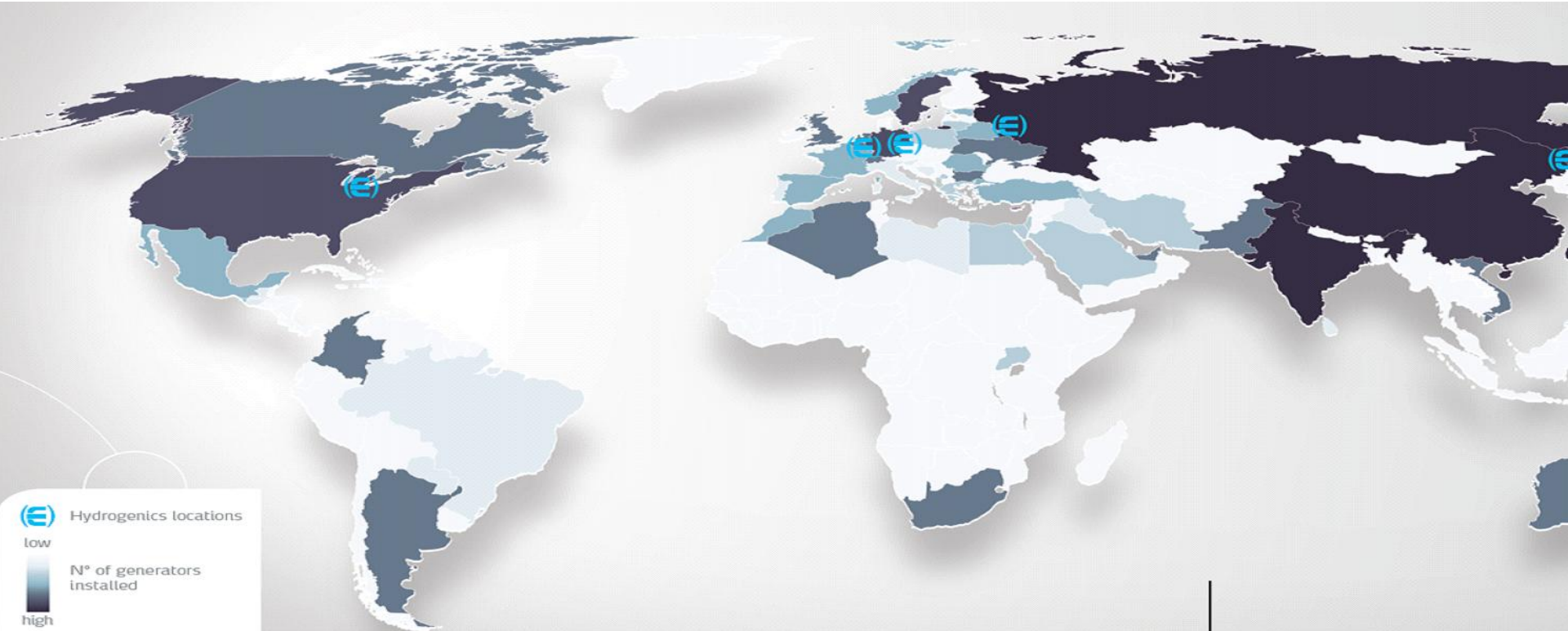
- 6 IMET cell stacks
- Nominal capacity **100 Nm³/h (200 kg/day)**





HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

HySTAT



~ **400** HySTAT™ deployed in the field :

- + **200** Industrial applications
- + **100** Power Plants
- + **50 H2 Fueling**
- + **25 Energy storage ('Renewable')**

Sales offices in :

- Russia
- Indonesia
- 16 Agent offices world wide

Industrial Applications

▪ Glass industry:

- Float glass
- Protective atmosphere (H₂/N₂)
- Typical installed capacity : 60 – 120 Nm³/h



▪ Metallurgy

- Heat treatment of metals
- Protective atmosphere (H₂/N₂)
- Production of stainless steel
- Hardening/sintering of metals
- Typical installed capacity : 60 – 360 Nm³/h

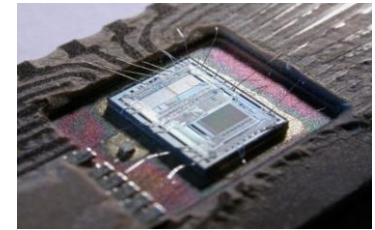


Largest market to date for HySTAT™ products

Industrial Applications

- **Electronic components/ solar panels/flat screens:**

- Protecting atmosphere, pure hydrogen required
- TFT (thin film transistor) - LCD
- Semi-conductors
- Typical installed capacity : 10 – 60 Nm³/h



- **Electrical power plants**

- Cooling of electrical generators
- H₂ is a very efficient cooling agent
- Typical installed capacity 10 Nm³/h



- **Food industry:**

- “hardening of oil” production of margarine
- Typical installed capacity : 120 – 360 Nm³/h



- **Production of nuclear fuel**

- Production of UO₂ in a H₂/Ar mixture



Saudi Arabia – Industrial gas - 2 X 60 Nm³/h



Bulgaria – Varna – Power Plant- 2 X 10 Nm³/h





2 MW – 360 Nm³/h 'Power To Gas'
Hydrogen feed in to HP natural gas line
E.On Falkenhagen



**RUSSIA 8 X 60 Nm³/h
STEEL PROCESSING**

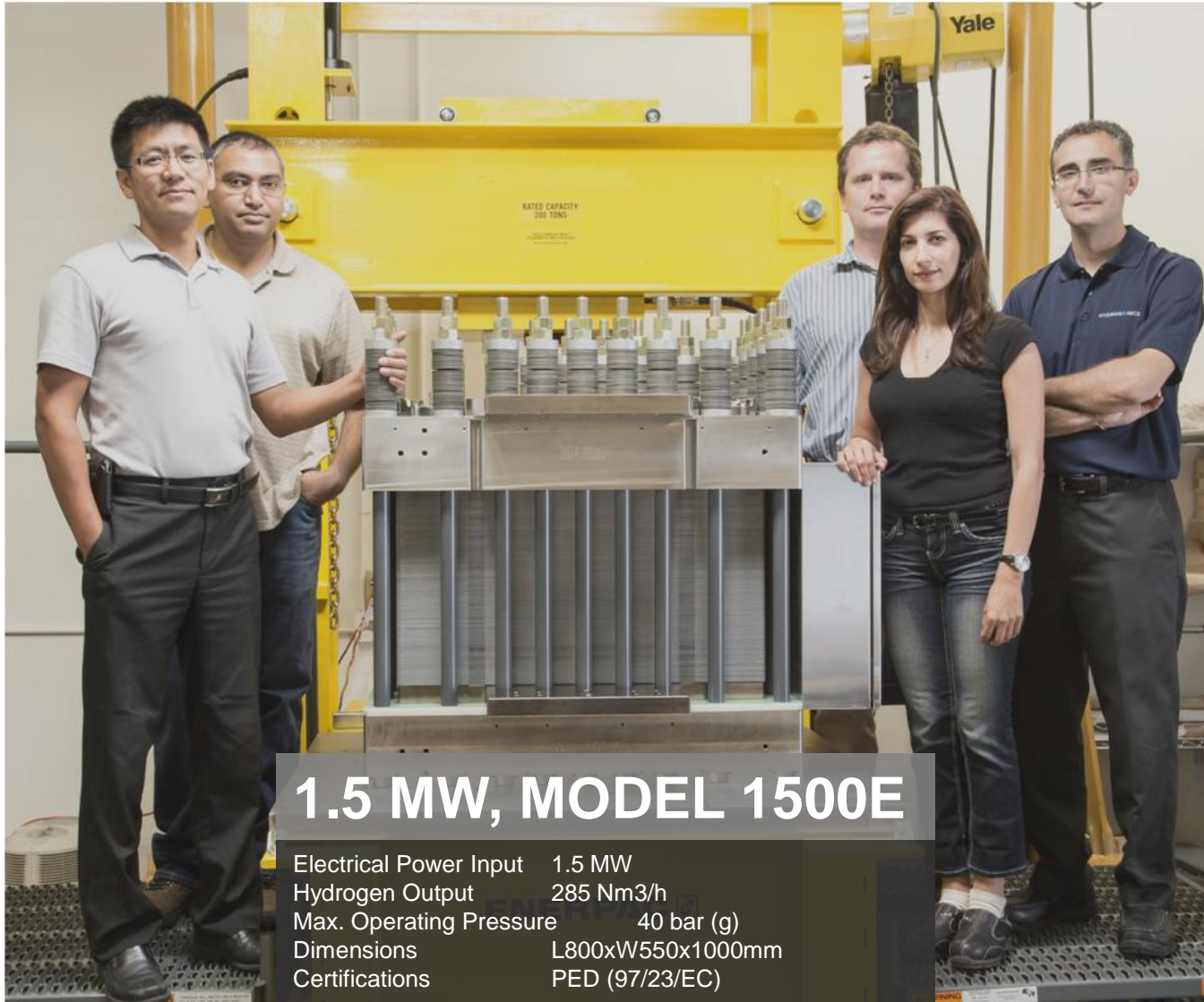


South Africa – 2 X 60 Nm³/h + H₂ and O₂ compression – industrial gas



BRASIL 3 X 60 Nm³/h - STEEL PROCESSING

New Development : Hydrogenics' Proton Exchange Membrane (PEM) cell stack



1

MW Scale Electrolyzer Stack

1.5MW industry benchmark

2

Reduction of Plant Capital Costs

Achieved target system cost

3

Stack Efficiency Improvements

Leading industry performance

4

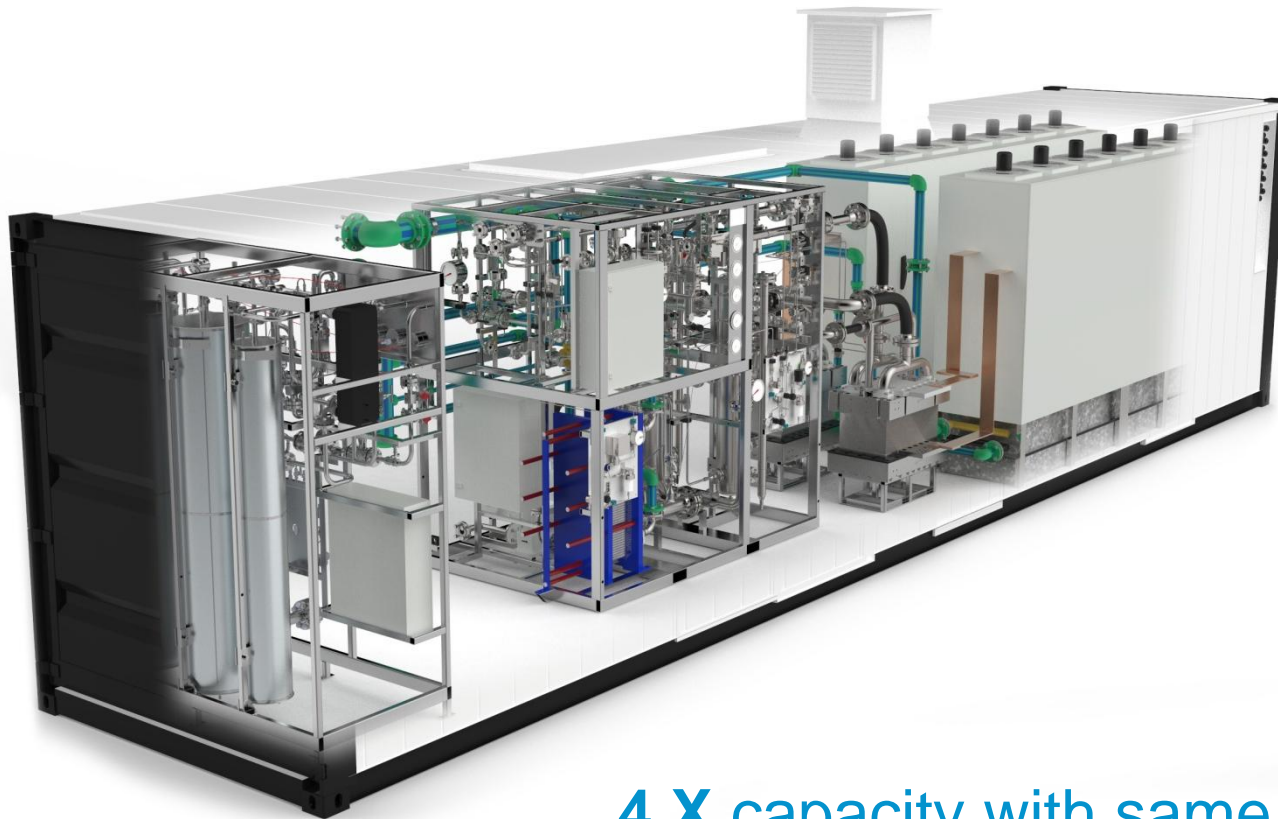
Fast Response and Dynamic Operation

Key IPR established

1.5 MW, MODEL 1500E

Electrical Power Input	1.5 MW
Hydrogen Output	285 Nm ³ /h
Max. Operating Pressure	40 bar (g)
Dimensions	L800xW550x1000mm
Certifications	PED (97/23/EC)

The Benchmark in electrolysis: HyLYZER® 'PEM' water electrolyser 400 Nm³/h

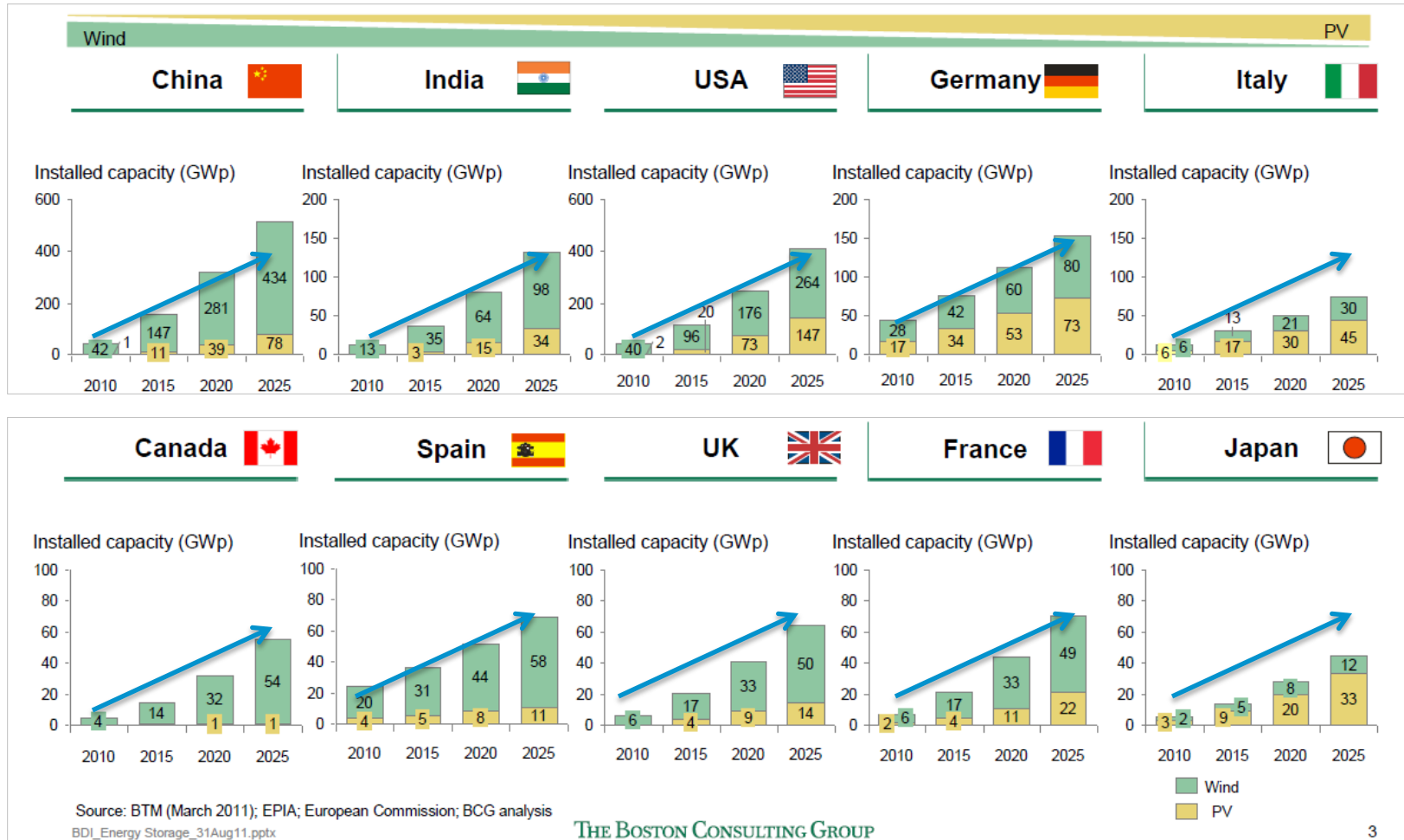


4 X capacity with same footprint

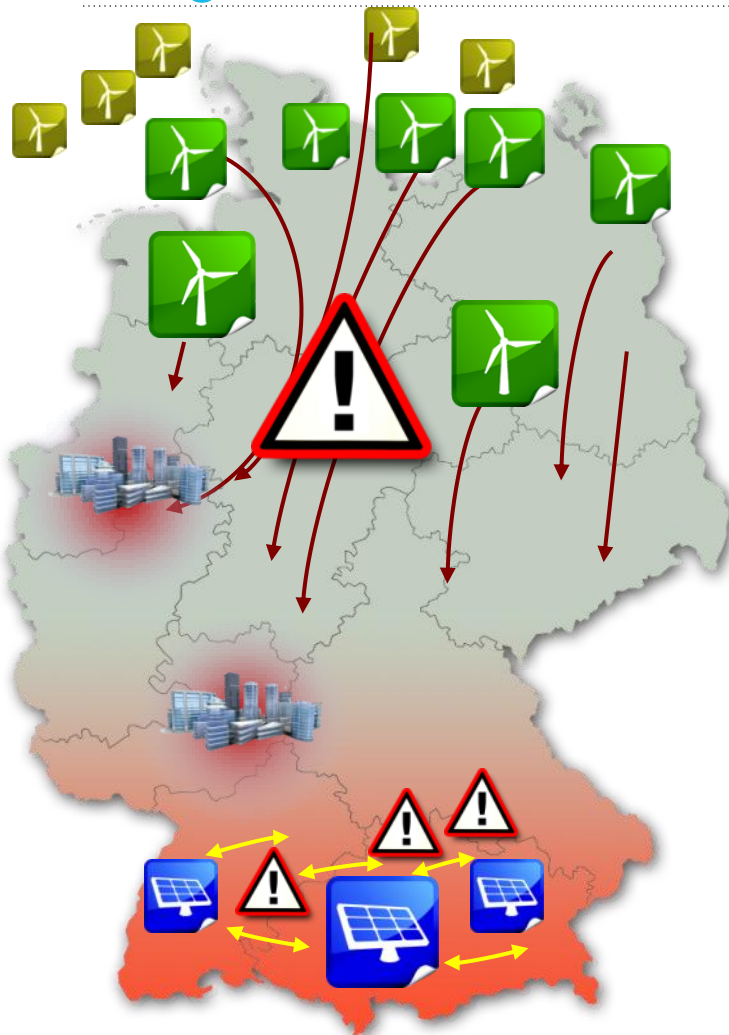


Renewable Energy continues to grow worldwide

Forecast installed capacity wind/PV for key countries



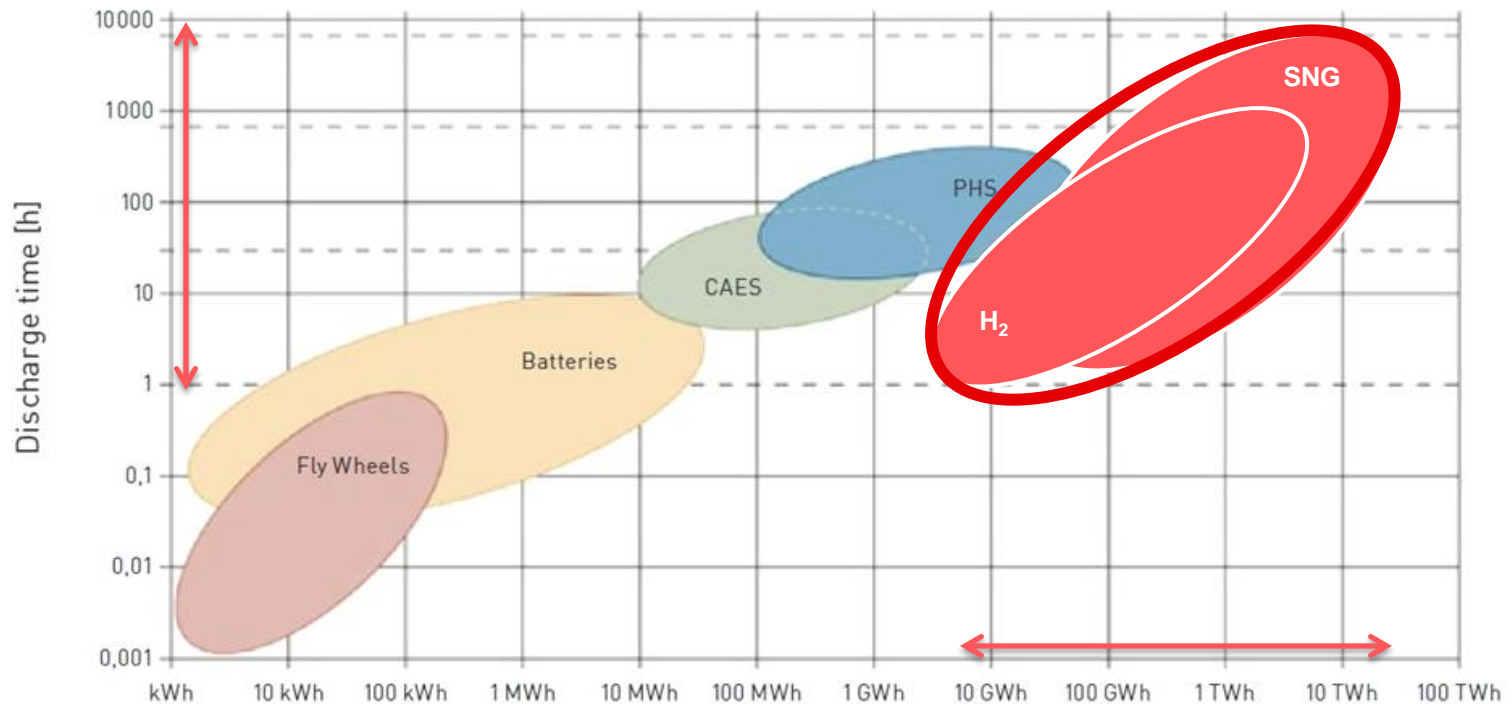
Geographical dependence leads to transportation congestion – German example



4 main solutions for integrating more renewables:

- Transmission and distribution expansion
- Dispatchable generation (hydro, biomass, fossil)
- Demand side management
- Energy storage

Only hydrogen can provide seasonal storage capacity by charging consecutive days or even weeks without needing to discharge



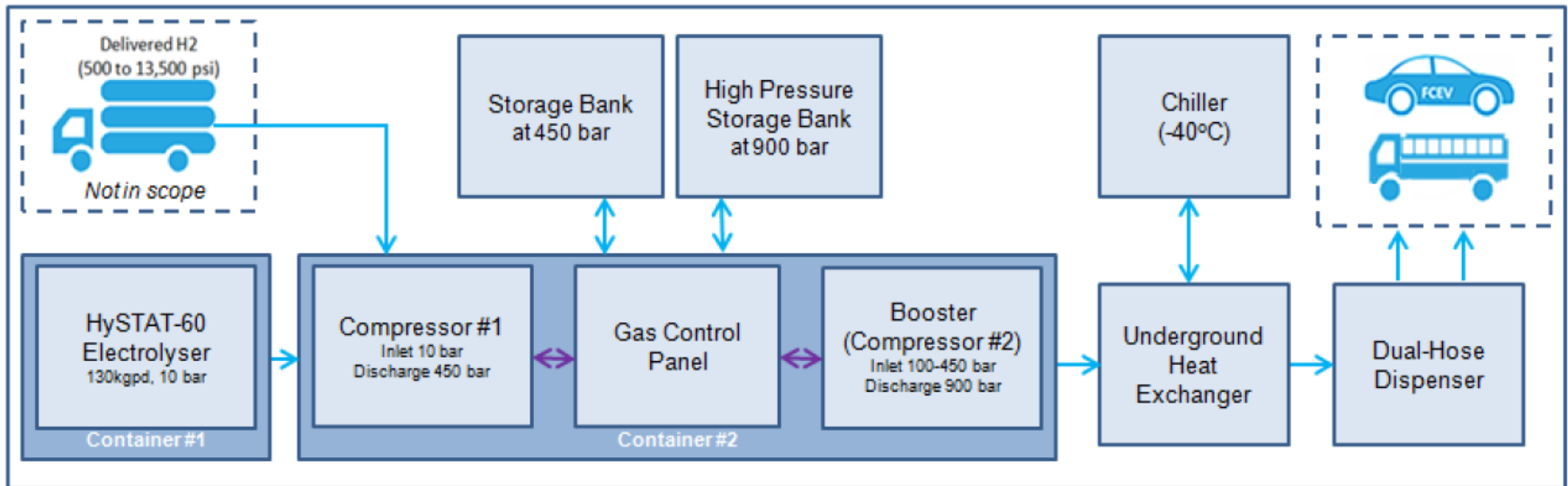
Discharge times and storage capacities. CAES: Compressed Air Energy Storage, PHS: Pumped Hydro Storage, H₂, SNG: Hydrogen, Synthetic Natural Gas.

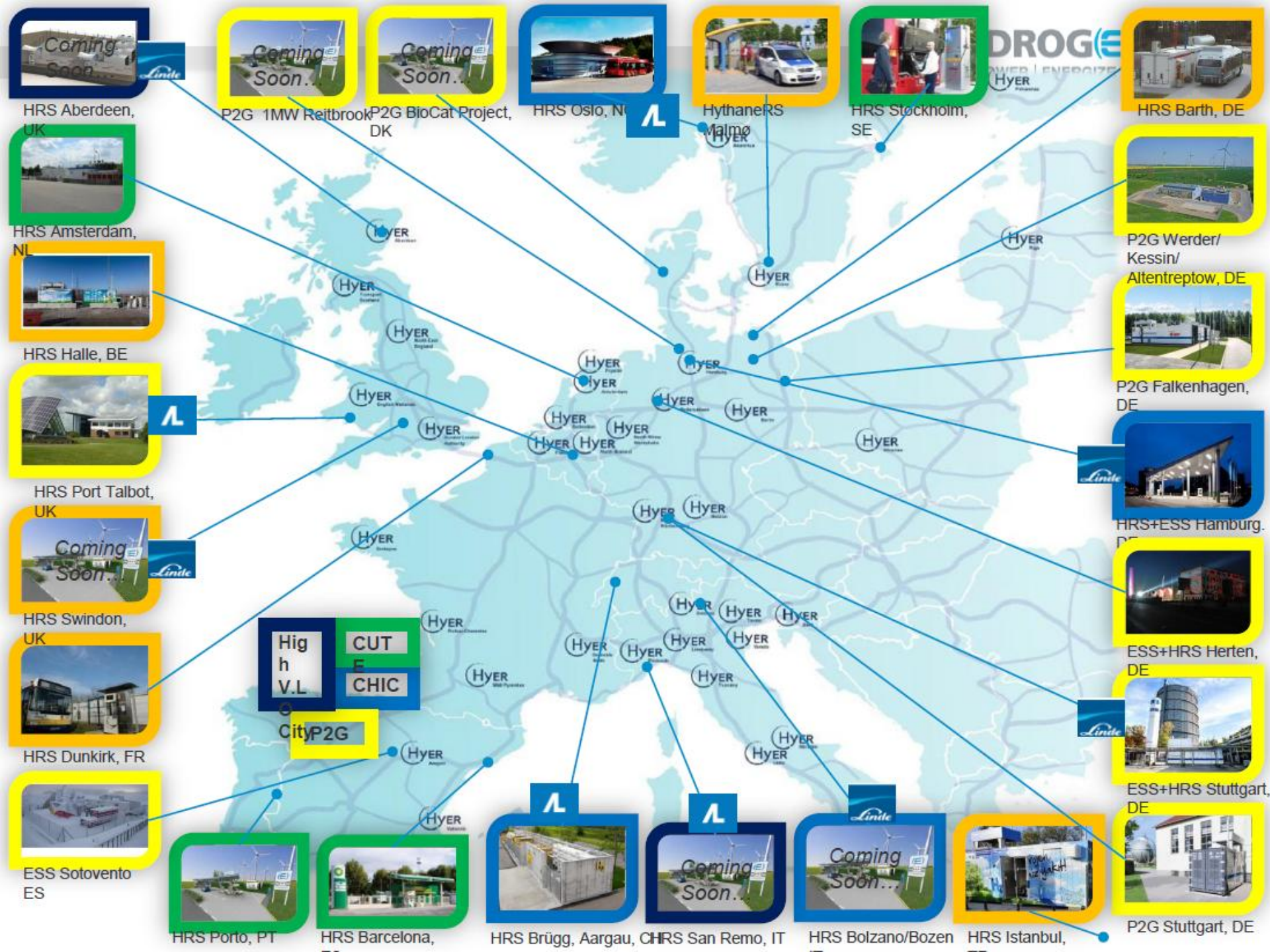
Source: Research Center Jülich

Hydrogen Fueling and 'RE' projects



Hydrogen Fueling





Oslo Norway

- HySTAT-120 350 bar fueling station (Air Liquide)



Oslo, Norway

260kg/day

350bar dispensing

Bolzano, Italy

- HySTAT-180 700 bar fueling station (Linde)





Hamburg, Germany

780kg/day, 350/700 bar dispensing

Located in the center of Hamburg in front of “Der Spiegel” newspaper offices, the station is the biggest worldwide, capable to refill busses and passenger cars. The station has 120Nm³/h electrolyzers, 430kg 45bar storage and 250kg 830bar storage and follows the SAEJ 2601refueling protocol.



Stuttgart, Germany

130kg/day, 700 bar dispensing

Located at the EnBW's offices in Stuttgart, this station provides clean hydrogen to passenger cars. The station has a 60Nm³/h electrolyser, 215kg 45bar storage, 830bar high pressure storage and follows the SAEJ 2601 refueling protocol.

Shell Santa Monica

- HySTAT-15 350 bar fueling station





Brussels, Belgium

65kg/day, 350bar dispensing

Located at one of the warehouse of Colruyt, one of the biggest Belg company, the station is refueling a fleet of forklifts. Additionally, it can also refuel other vehicles. The station has a 30Nm³/h electrolyser, 40kg storage and a -20°C chiller to meet the customer's SAEJ 2601 refueling sequence.

Aberdeen Scotland

Hydrogenics : 3 X HySTAT-60

BOC : CSD for 350 bar fueling station



“Aberdeen II” Scotland

Hydrogenics : 3 X HySTAT-60 350/**700** bar fueling station



"Aberdeen II" Scotland 120 kg a day 350 700 HRS

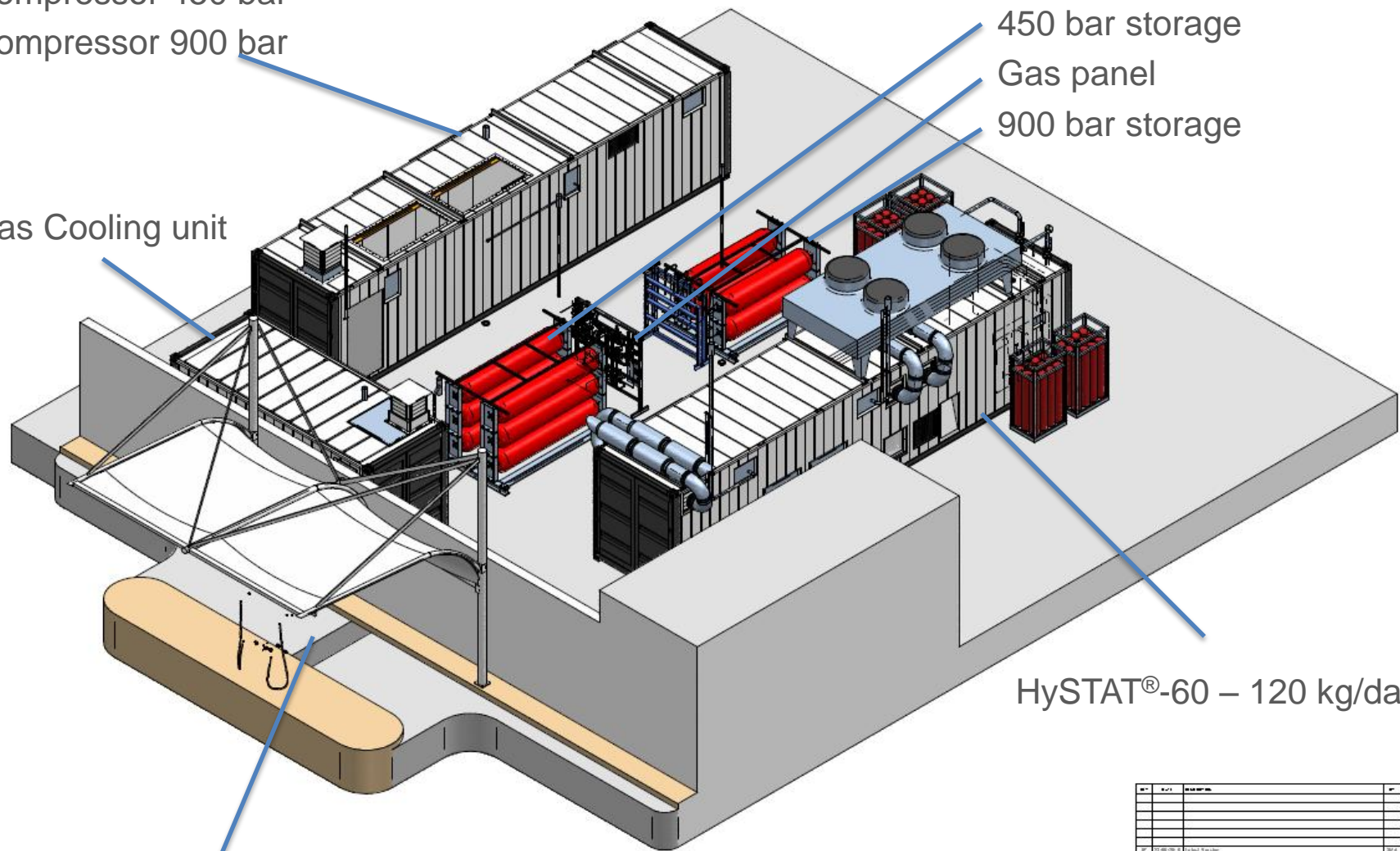
Compressor 450 bar
Compressor 900 bar

450 bar storage
Gas panel
900 bar storage

Gas Cooling unit

HySTAT[®]-60 – 120 kg/day

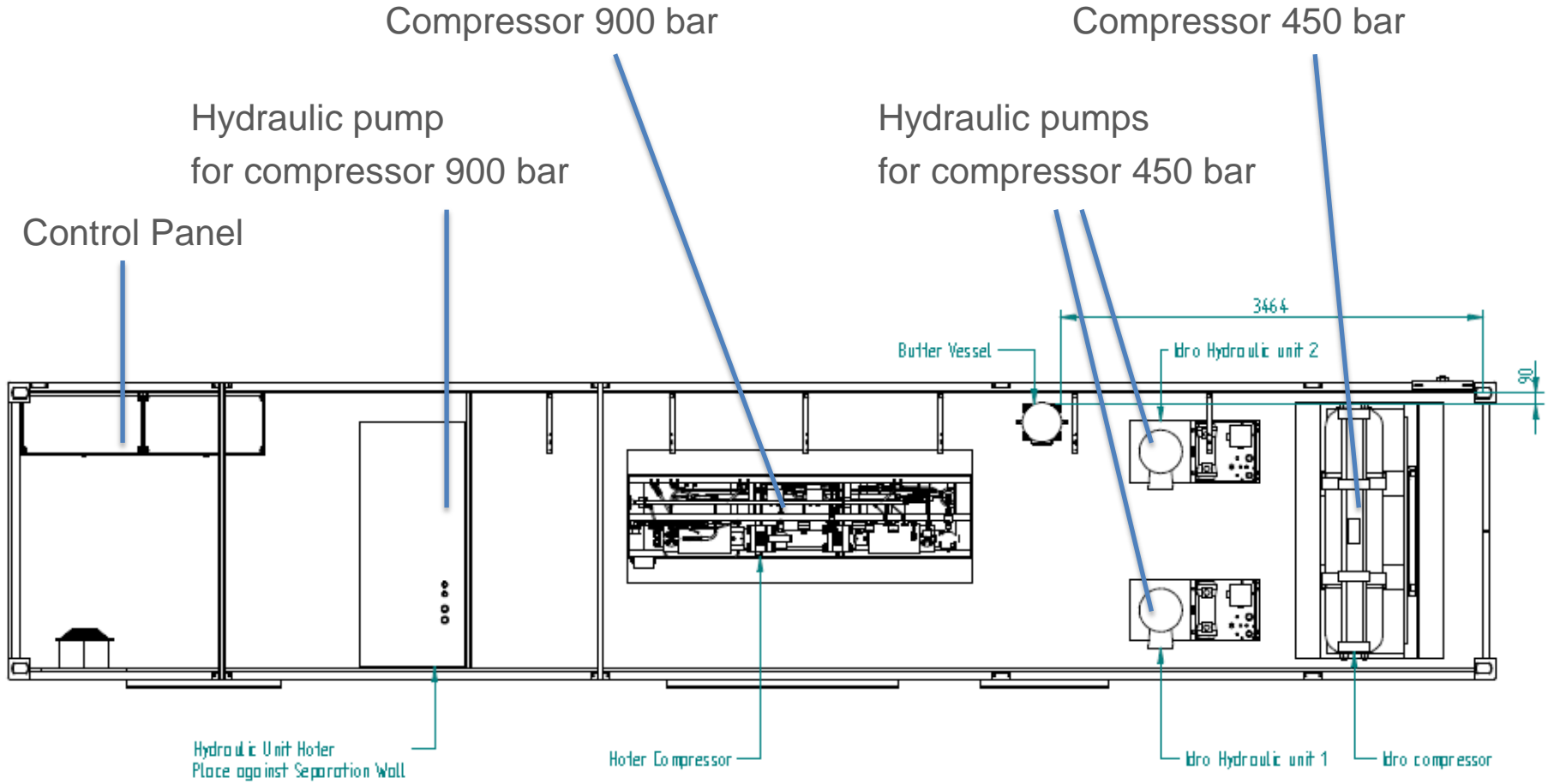
Dispenser 350/700 bar



NO. 101	REVISION	BY	DATE
HYDROGENIC		Advanced Hydrogen Solutions	
FUEL STATION ABERDEEN		FUEL STATION ABERDEEN	
HYDROGENIC		HYDROGENIC	
HYDROGENIC		HYDROGENIC	

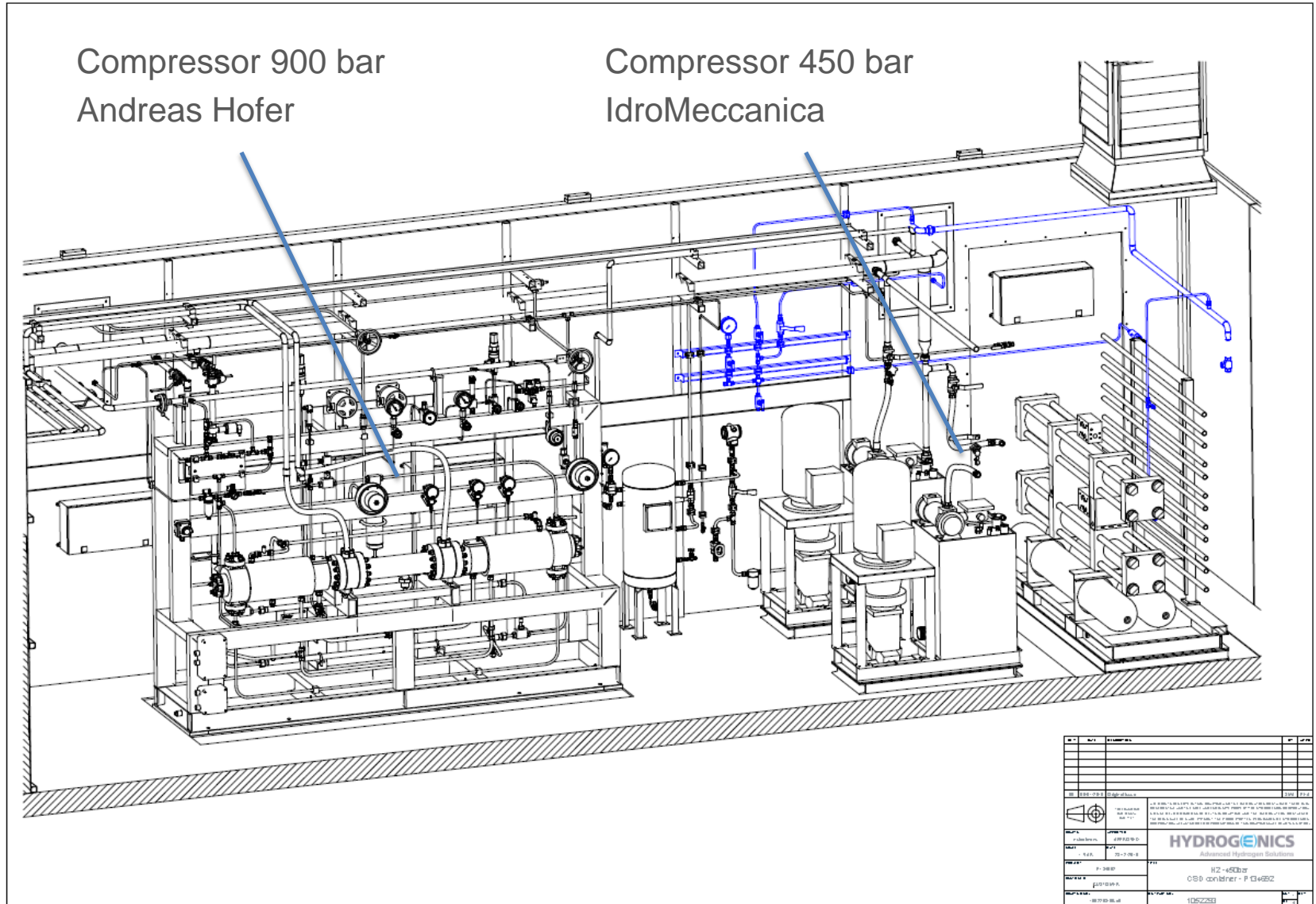
“Aberdeen II” Scotland 120 kg a day 350 700 HRS

Compressor container



“Aberdeen II” Scotland 120 kg a day 350 700 HRS

Compressor container



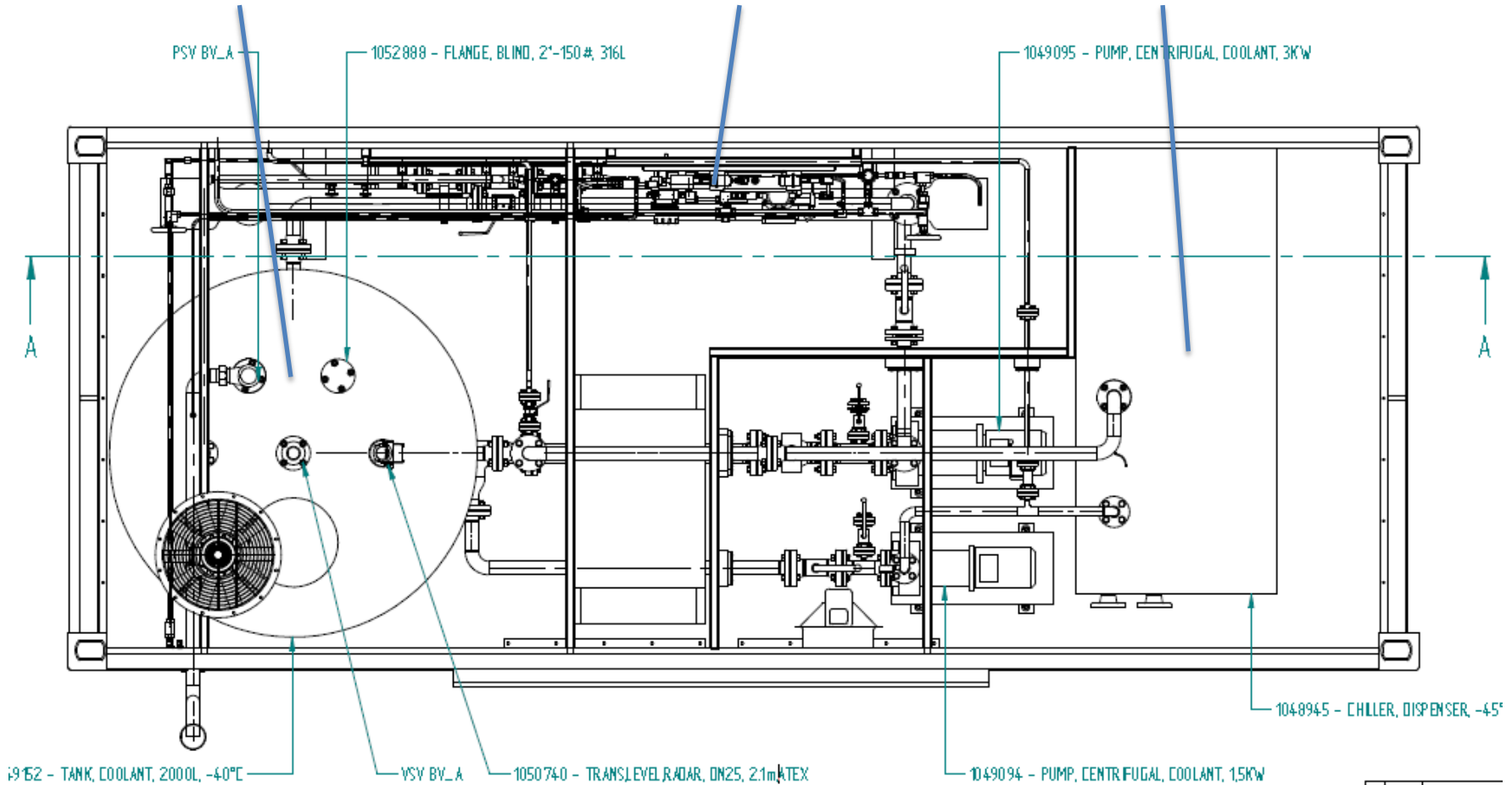
“Aberdeen II” Scotland 120 kg a day 350 700 HRS

Gas cooling container

Buffer reservoir coolant

900 bar heat exchanger

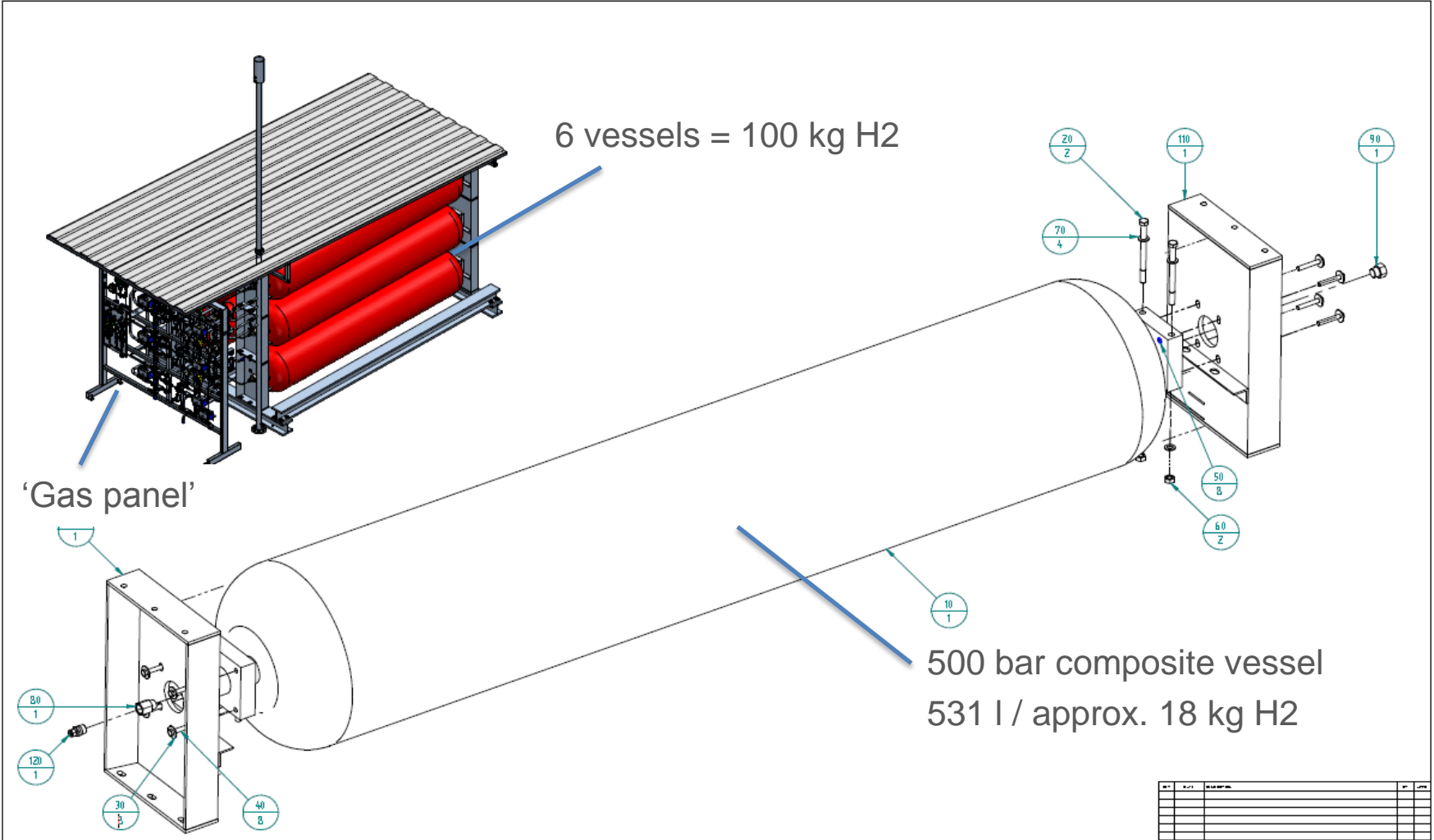
Chiller -45°C



REV	DATE	BY	CHK

“Aberdeen II” Scotland 120 kg a day 350 700 HRS

450 bar storage



Id	Z	N	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q		
50	B																				
40	B																				
30	B																				
20	Z																				
10	I																				

HYDROGENICS
Advanced Hydrogen Solutions

INTERCONNECTED WS
S70 RACE 450 BAR

2007 1717

2008 1717

2009 1717

2010 1717

2011 1717

2012 1717

2013 1717

2014 1717

2015 1717

2016 1717

2017 1717

2018 1717

2019 1717

2020 1717

2021 1717

2022 1717

2023 1717

2024 1717

2025 1717

2026 1717

2027 1717

2028 1717

2029 1717

2030 1717

“Aberdeen II” Scotland 120 kg a day 350 700 HRS

900 bar storage

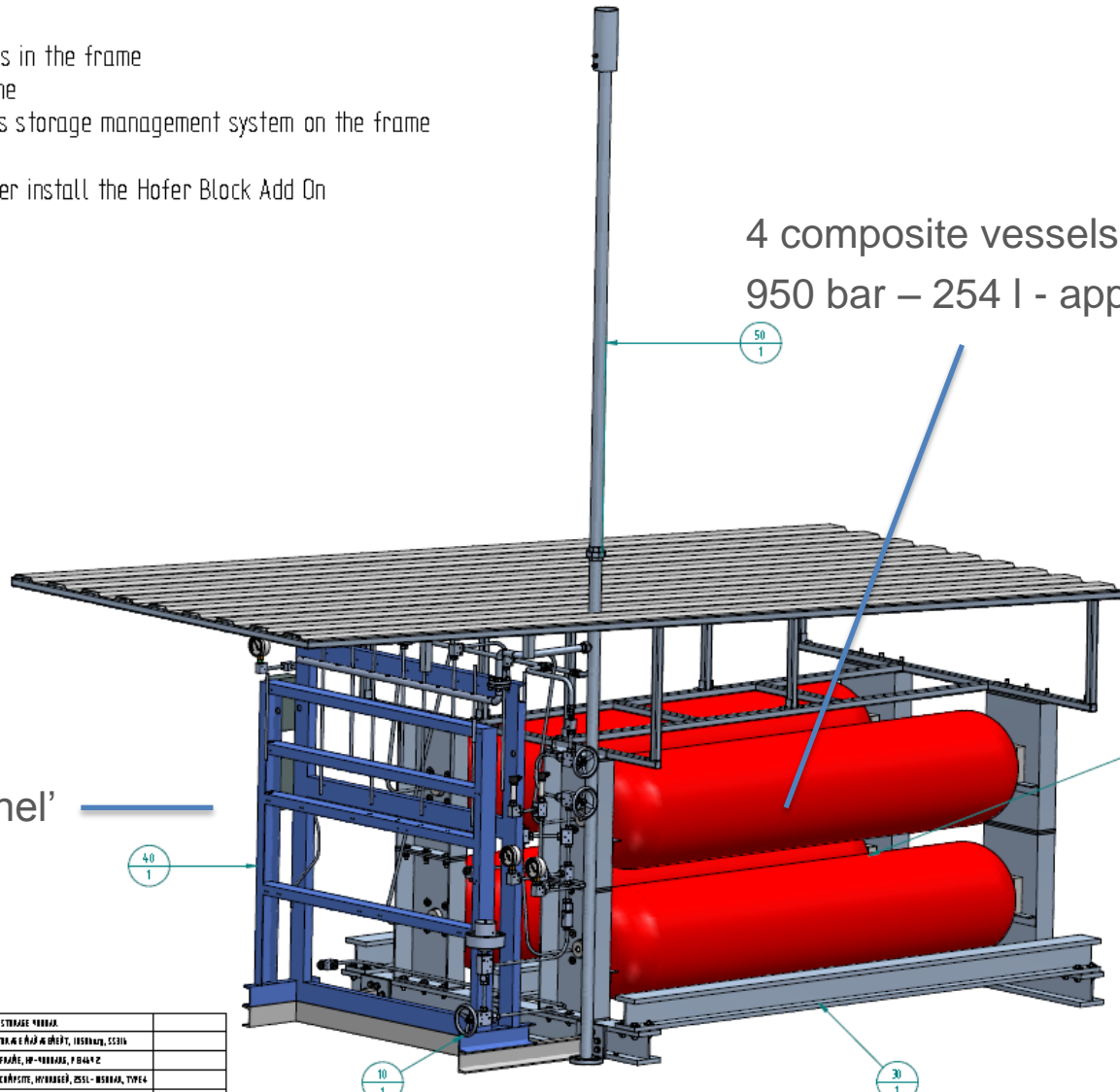
Hydrogenics:

- Place the vessels in the frame
- Make the ventline
- Place the H2 gas storage management system on the frame

Together with Hofer install the Hofer Block Add On

4 composite vessels
950 bar – 254 l - approx. 13 kg each

‘Gas panel’



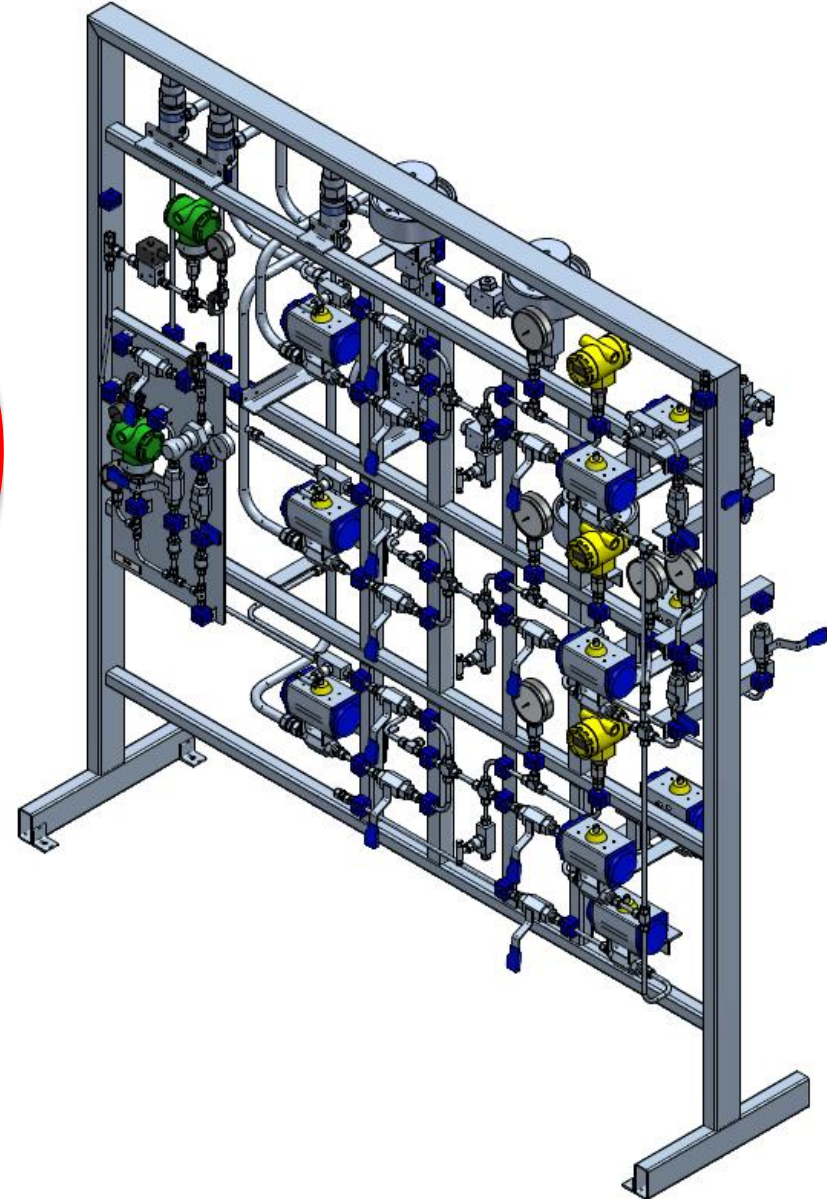
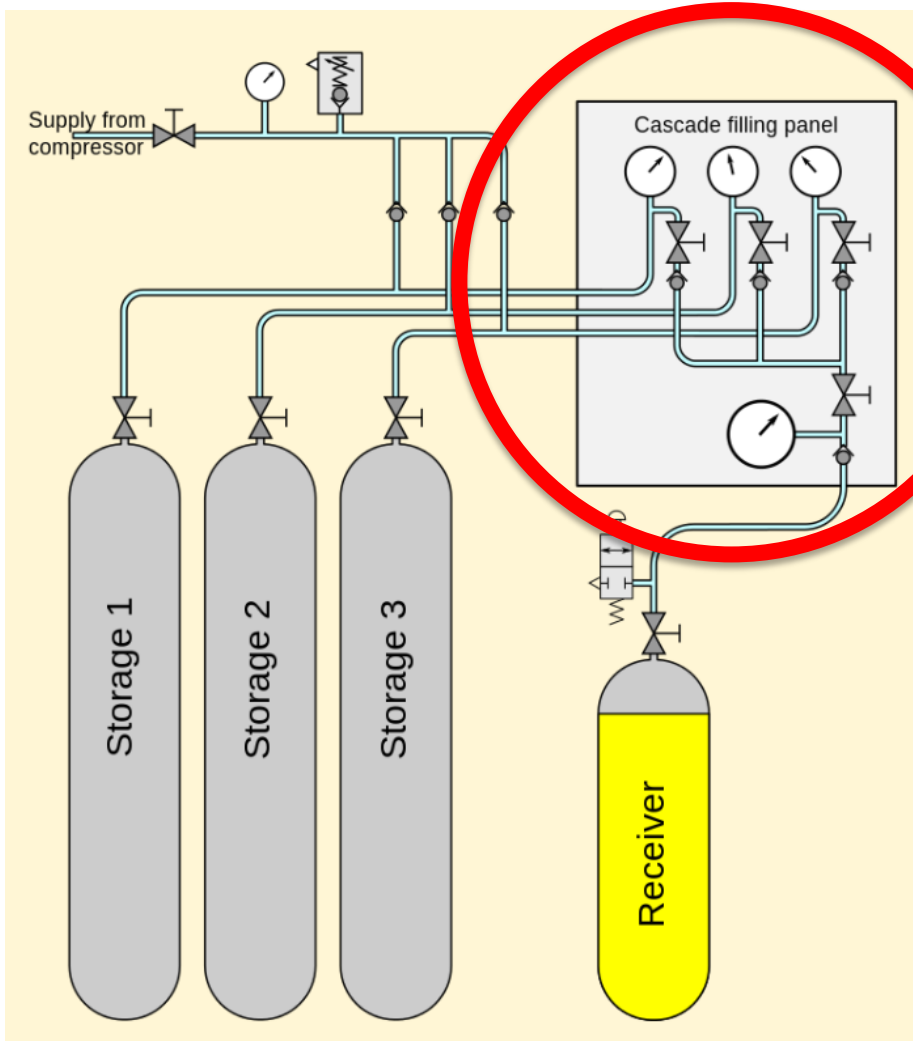
№	QTY	ИПС номер	Техн. Langth	Исчерпываю	Рис. Итого
50	1	И 52720		ВЕРТИКАЛЬ СТОЛБЕ ЧИСТКА	
40	1	И 51944		H2, O2 STORAGE FRAME, 1850MM, SS316	
30	1	И 46793		STORAGE FRAME, H2-CHARGING, P 20447 Z	
20	4	И 46794		CYLINDER, COMPOSITE, HYDROGEN, 255L - 950BAR, TYPE4	
10	1			HOFFER BLOCK ADD ON	

№	QTY	ИПС номер	Техн. Langth	Исчерпываю	Рис. Итого
50	1	И 52720		ВЕРТИКАЛЬ СТОЛБЕ ЧИСТКА	
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20	4	И 46794		CYLINDER, COMPOSITE, HYDROGEN, 255L - 950BAR, TYPE4	
10	1			HOFFER BLOCK ADD ON	

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hydrogenics.com	
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hydrogenics.com	

“Aberdeen II” Scotland 120 kg a day 350 700 HRS

Gas Panel

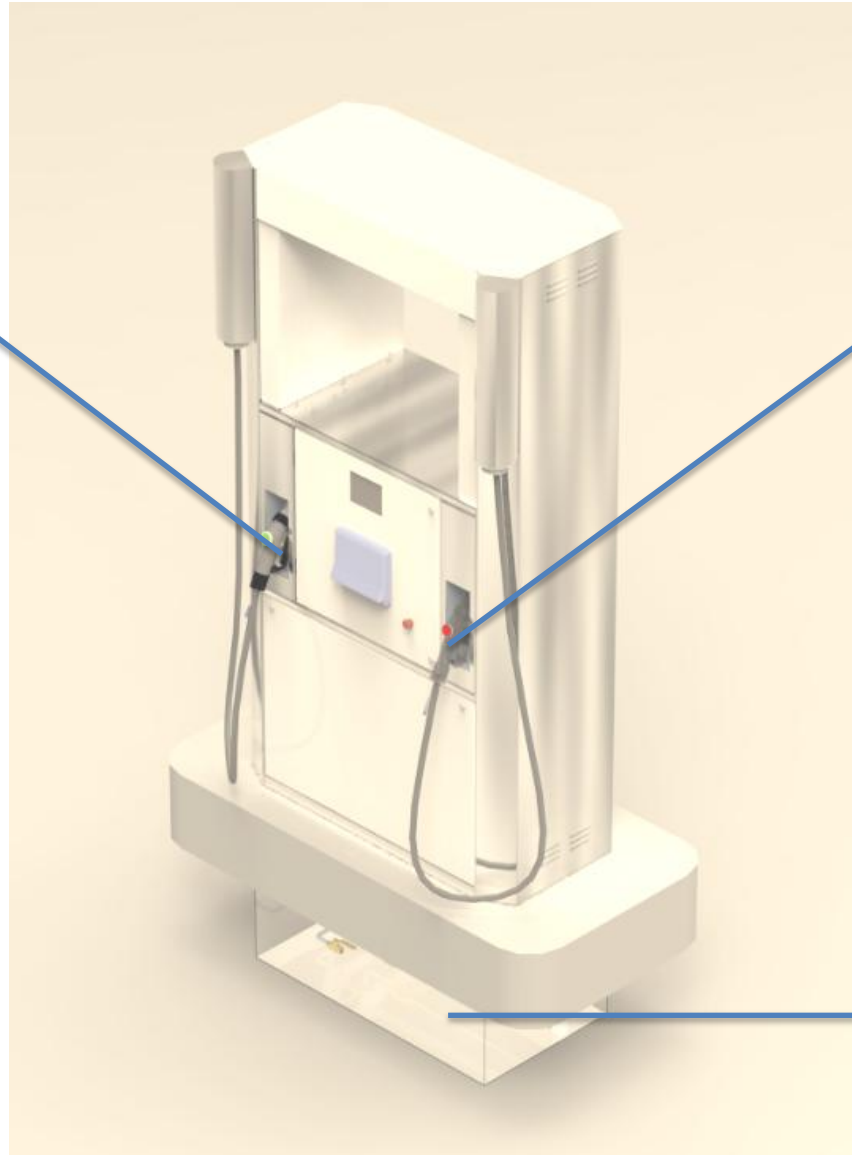


“Aberdeen II” Scotland 120 kg a day 350 700 HRS

Dispenser 350 / 700 bar

700 bar nozzle

350 bar nozzle



connections



MAX
POLY
EAT

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OK

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