



**SOLUTIONS FOR HYDROGEN
PRODUCTION & PURIFICATION**

Sumaré – SP – Brazil - 2021 - Version 1

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Hytron

Company's History



- Technology company founded in 2003
 - Spin-off from Hydrogen Laboratory (DAP - IFGW), Unicamp
 - Strong R&D activities, focused on innovative applied solutions
- Expertise in Hydrogen Production and Alternative Energy Systems
 - Multidisciplinary team of specialists, inc. PhD's and MSc's
 - Technology development
 - System design, integration and supervision
- 2015: New Headquarters (Sumare, SP - Brazil)
 - Facility dedicated to R&D (current and future portfolio), fabrication and testing („cold“ and „hot“ runs)

HYTRON

A NEA GROUP COMPANY



Press Release

NEA GROUP acquired HYTRON Energy & Gas

Machinery and Plant Manufacturer strengthens leading position in hydrogen solutions

The NEUMAN & ESSER (NEA) GROUP from Übach-Palenberg acquired HYTRON Energy & Gas (HYTRON)
Nov 19, 2020



28 Companies in 10 Strategic Countries



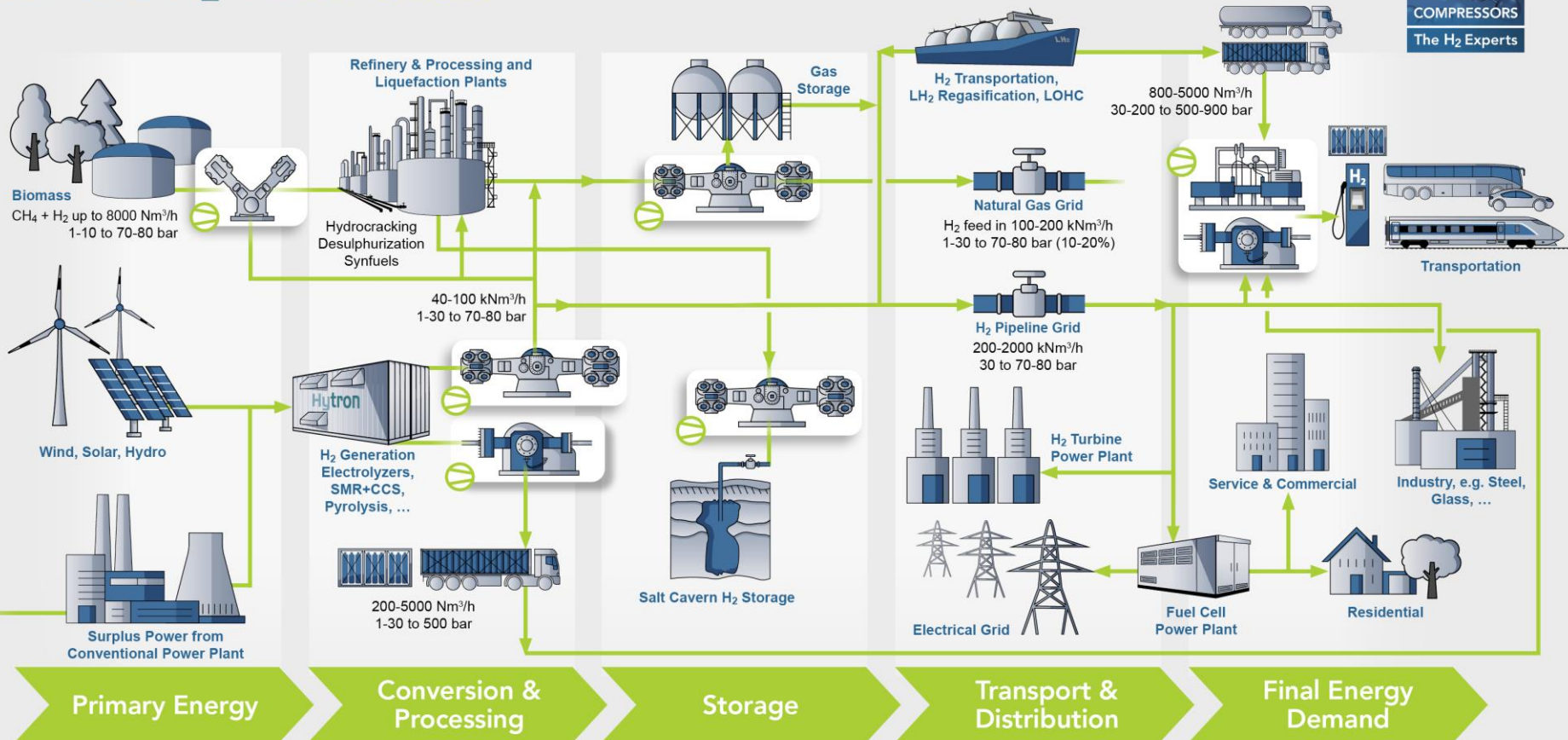
Employees:

1,230

Consolidated Sales 2020:

230 Mio. EUR

The NEA GROUP Portfolio for the H₂ Value Chain



HyPEM
ELECTROLYSER

HyALK
ELECTROLYSER

Electrolyser

Use of renewable sources
H₂ and O₂ production
Green H₂ applications
Higher electrical consumption compared to reformers
Higher global demand for modular applications

HyREF
NG REFORMER

HyREF
EtOH REFORMER

Steam Reforming

Use of local feedstocks
Pure H₂ or H₂ + CO production
Continuous production (no intermittence)
Interest of the NG industry
Green Solutions:
(Biomethane end ethanol)

HyPSA
Gas Purification System

Pressure Swing Adsorption

H₂ Purification
Methane Purification (others)
It may be included in our equipment, or sold separately



HyPEM

ELECTROLYSER

<https://www.youtube.com/watch?v=FTJaI93xHKA>

HyPEM Water Electrolysis

System Attributes



Rated productions up to **1,000 Nm³ H₂/h** or **5 MW** (per module)

Integrated and autonomous solutions (“**Turn-Key**”):

- H₂ and O₂ production module
- Gas purification & Purity supervision
- Thermal management & Utilities:
 - Heat rejection, Instrument air provision, Process water production, Chilled water
- Power electronics, Controls & Cabinet (outdoor installation)

Proprietary control software & Supervisory platform (**SCADA**)

Hydrogen purity up to 99.9999% (**6.0**)

Maximum operating pressure: **40 bar_g**

HyPEM Water Electrolysis

Plant Sizes

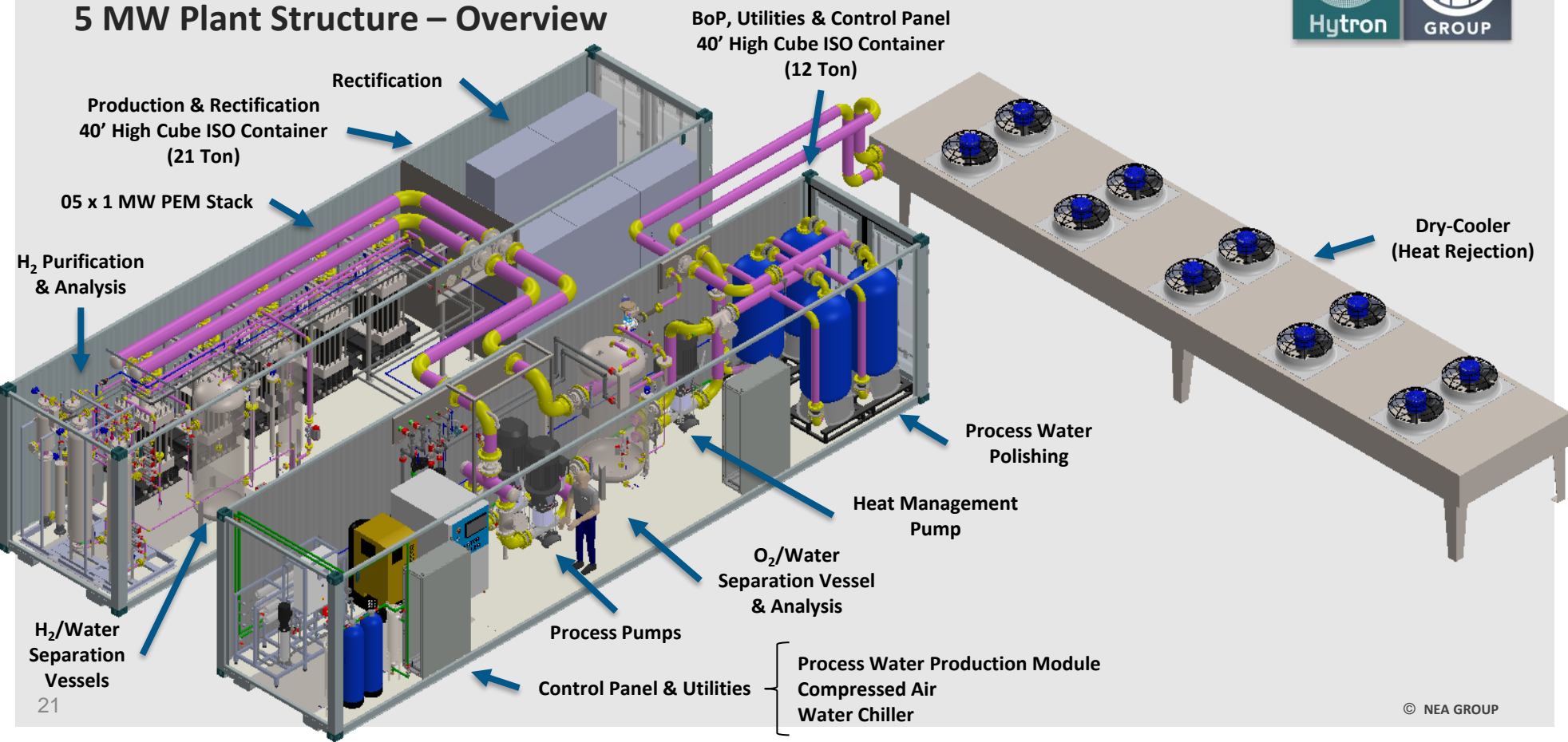


“Small-Scale”		Industry / Energy	
HyPEM 10-40	10 Nm ³ H ₂ /h; 40 bar _g (50 kW Plant)	HyPEM 60-40	60 Nm ³ H ₂ /h; 40 bar _g (300 kW Plant)
HyPEM 20-40	20 Nm ³ H ₂ /h; 40 bar _g (100 kW Plant)	HyPEM 100-40	100 Nm ³ H ₂ /h; 40 bar _g (0.5 MW Plant)
HyPEM 30-40	30 Nm ³ H ₂ /h; 40 bar _g (150 kW Plant)	HyPEM 200-40	200 Nm ³ H ₂ /h; 40 bar _g (1 MW Plant)
		HyPEM 400-40	400 Nm ³ H ₂ /h; 40 bar _g (2 MW Plant)
		HyPEM 600-40	600 Nm ³ H ₂ /h; 40 bar _g (3 MW Plant)
		HyPEM 800-40	800 Nm ³ H ₂ /h; 40 bar _g (4 MW Plant)
		HyPEM 1,000-40	1,000 Nm ³ H ₂ /h; 40 bar _g (5 MW Plant)

PS: the association of HyPEM 1,000-40 systems creates Multi-MW solutions

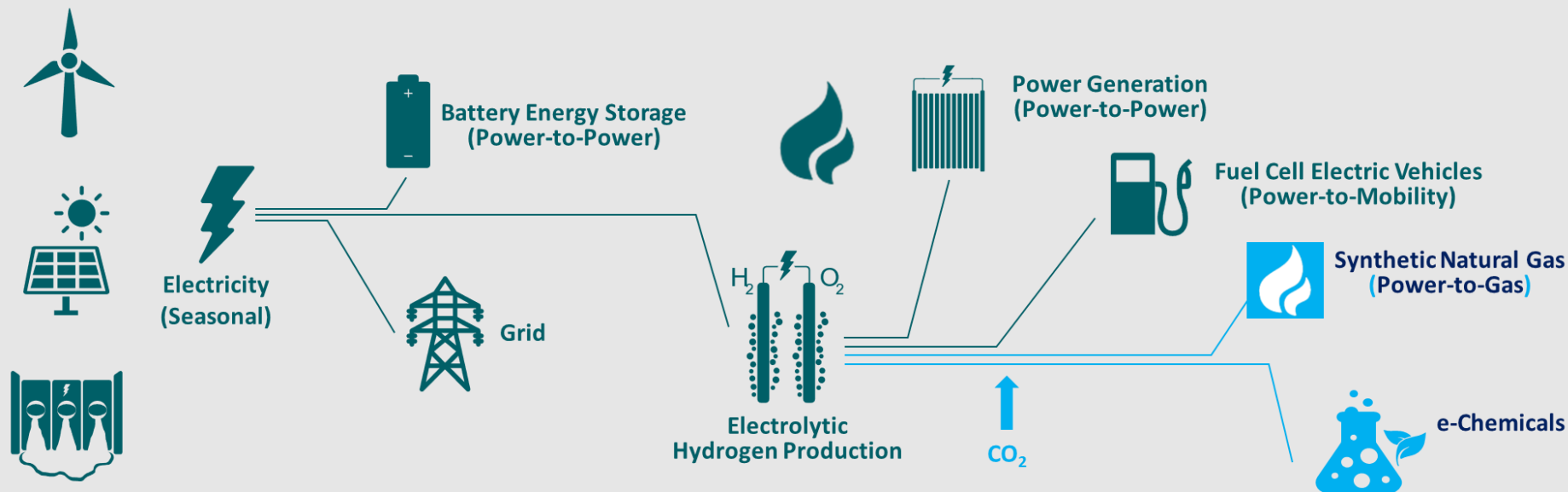
HyPEM Water Electrolysis

5 MW Plant Structure – Overview



H₂ FROM ELECTROLYSIS

Power to X

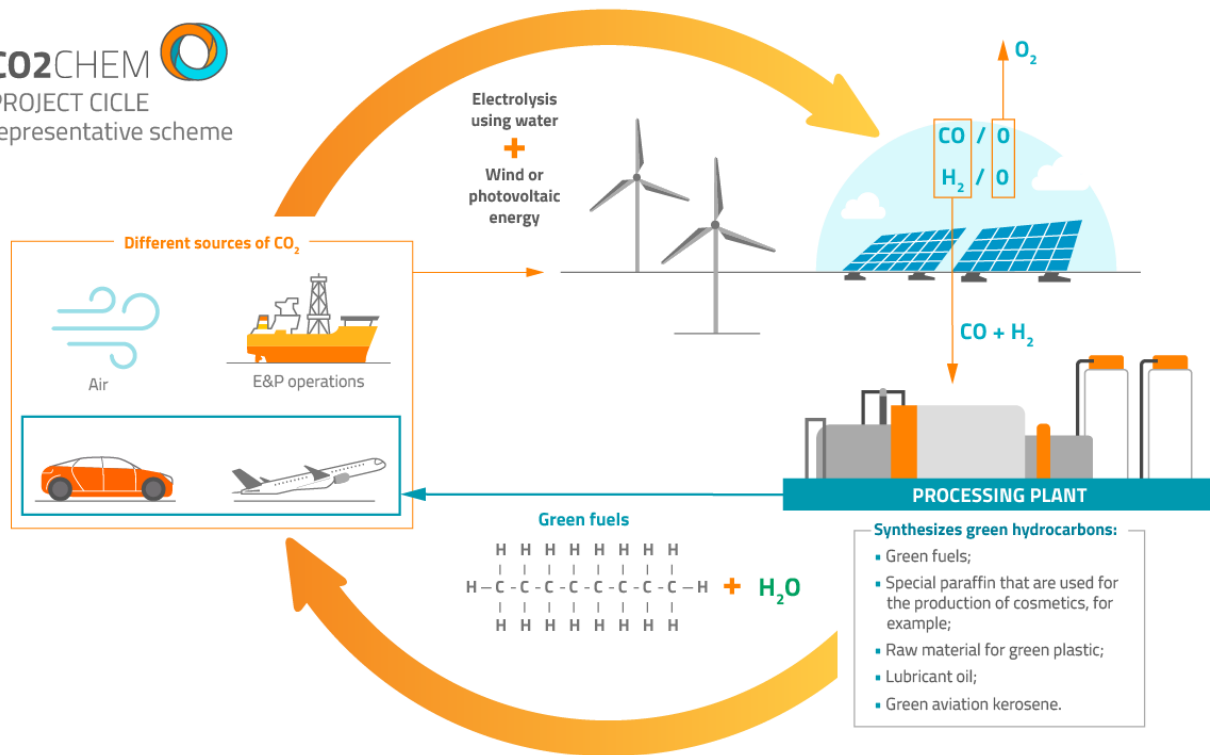


<https://www.youtube.com/watch?v=MfZpdNxxCUM>

CO2CHEM

Power to X

CO2CHEM
PROJECT CICLE
representative scheme



Repsol Sinopec Brasil

Hytron

INSTITUTO SENAI
DE INOVAÇÃO BIOSYNTHETIC AND FIBERS

USP

HyREF
EtOH REFORMER

HyREF
NG REFORMER



Solutions Portfolio

FUEL REFORMING

Fuel Reformers

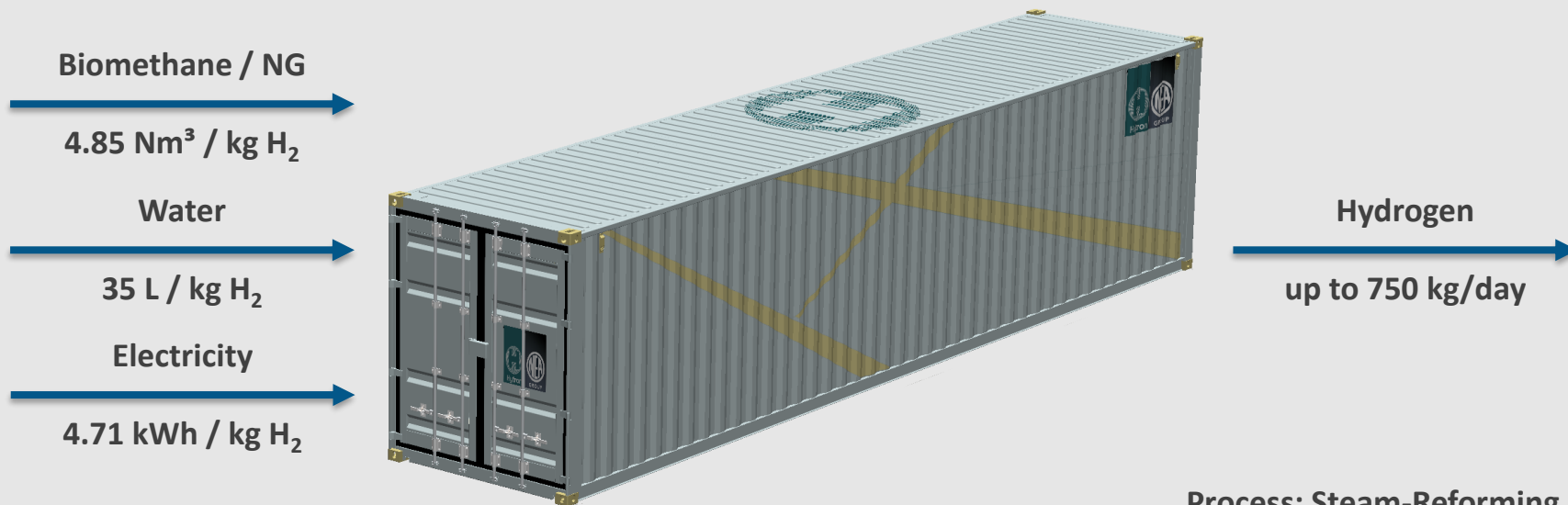
System Attributes

- Rated productions up to **350 Nm³ H₂/h** (per module)
- Integrated and autonomous solutions (“**Turn-Key**”):
 - Feed treatment, Reforming & Shift conversion
 - PSA gas purification & Purity supervision
 - Thermal management & Utilities:
 - Heat recovery, Instrument air provision, Process water production
 - Controls & Cabinet (outdoor installation)
- Proprietary control software & Supervisory platform (**SCADA**)
- Hydrogen purity up to 99.9999% (**6.0**)
- Operating pressure: **10 bar_g**



Fuel Reformers

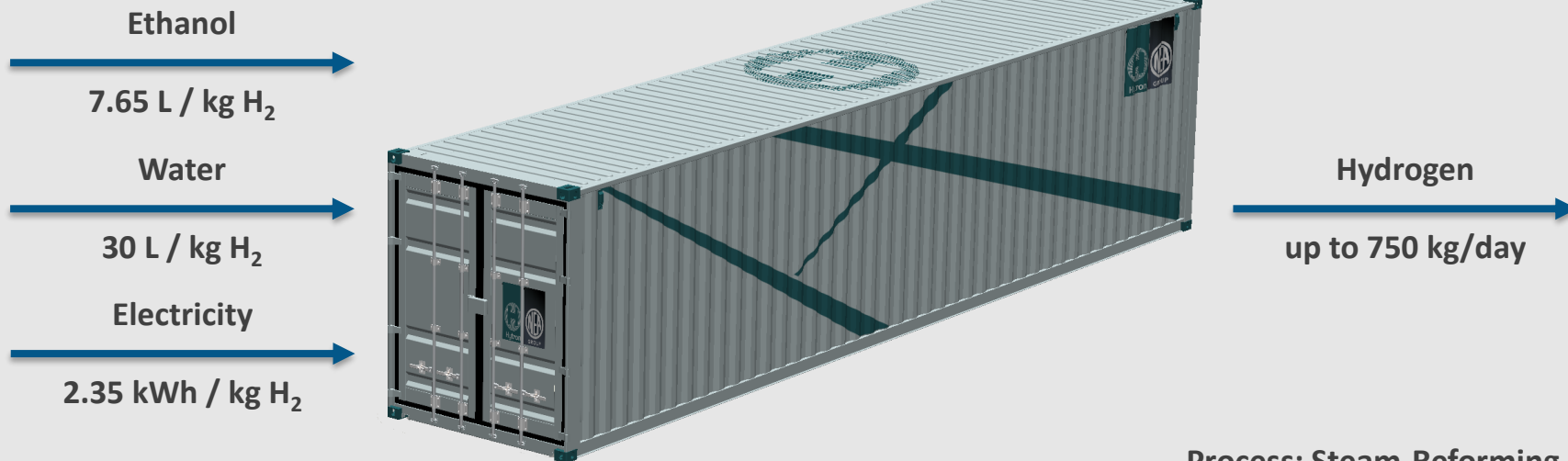
Product Performance – Biomethane



Process: Steam-Reforming
H₂ Purification: PSA (Pressure Swing Adsorption)
H₂ Purity: up to 99.9999% (SAE J2719 / DIN EN 17124 compliant)
H₂ Pressure: 10 bar_g (typical)

Fuel Reformers

Product to Come – Ethanol



Process: Steam-Reforming
H₂ Purification: PSA (Pressure Swing Adsorption)
H₂ Purity: up to 99.9999% (SAE J2719 / DIN EN 17124 compliant)
H₂ Pressure: 10 bar_g (typical)

Advantages of Using Ethanol for H₂ Production

Ethanol as Green Hydrogen Carrier



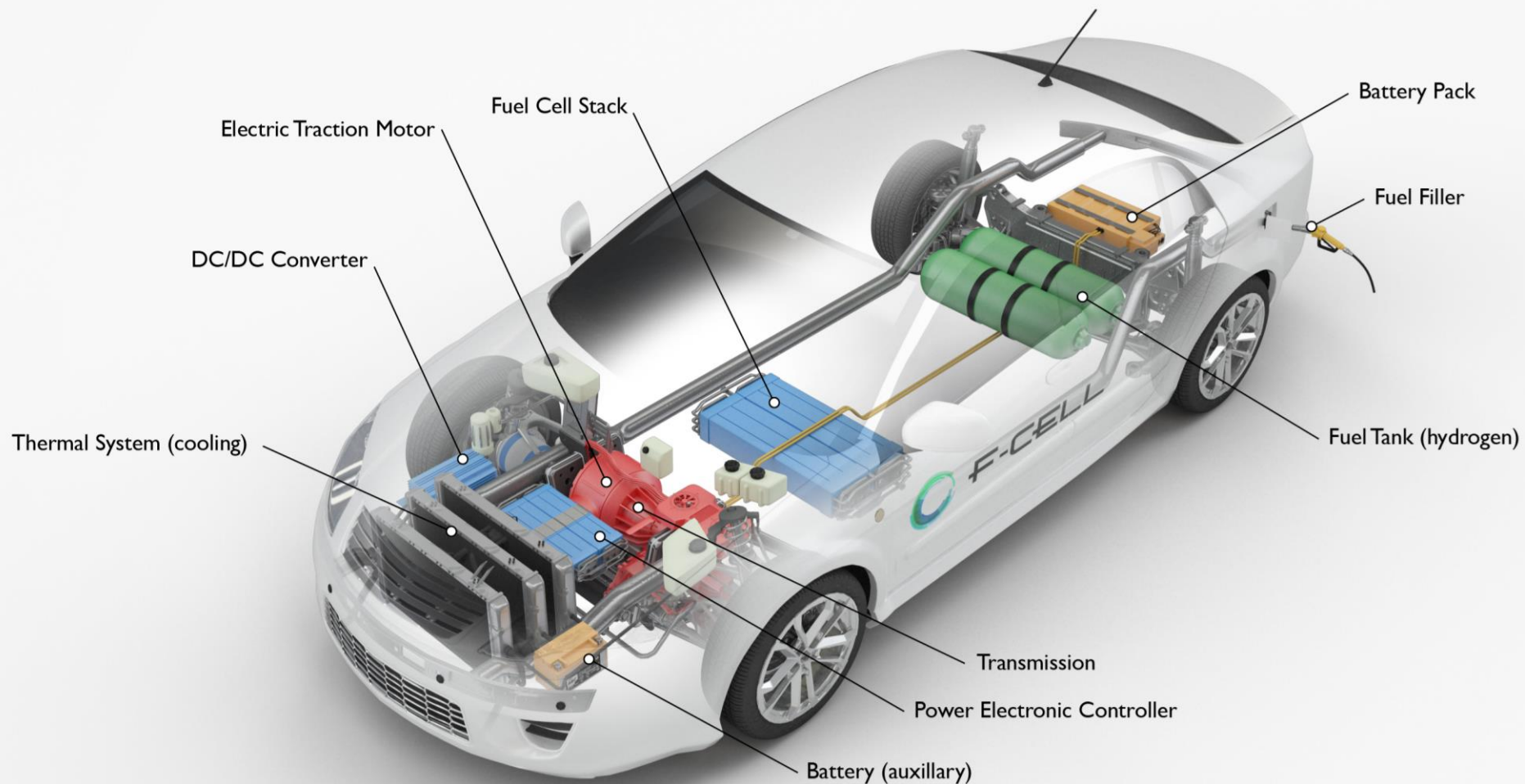
- Fact of being a renewable fuel
- Ease of transportation (usual for the Brazilian case)
- Brazil's potential as an important global player
- There is already an entire value chain established
- It is not a toxic fuel
- Enables the flat production of Green H₂ (without intermittence)
- Easy to store
- Enables local production of H₂ close to consumption

Some Numbers from Ethanol Industry

Ethanol as Green Hydrogen Carrier

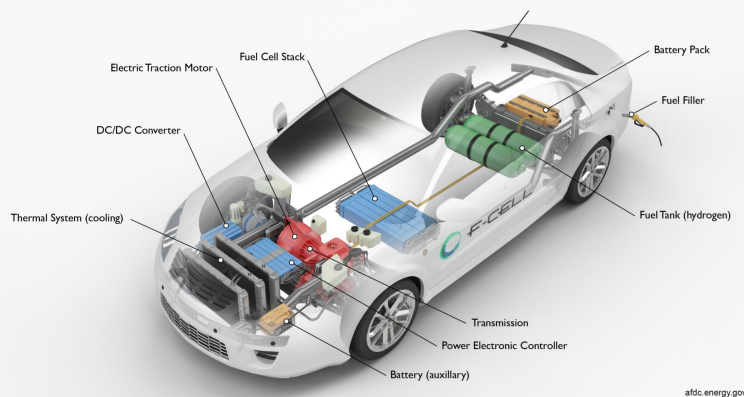
INPUT	QUANTITY	UNITS
Ethanol 1G	80	L / t (sugar cane)
Ethanol 2G	32	L / t (sugar cane)
Biogas	8,9	Nm ³ CH ₄ / t (sugar cane)
E. Energy	49	kW / t (sugar cane)
<hr/>		
Ethanol 1G + 2G	15	kg H₂ / t (sugar cane)
Biogas	1,84	kg H₂ / t (sugar cane)
E. Energy	0,92	kg H₂ / t (sugar cane)
Total	17,76	kg H₂ / t (sugar cane)
	198,91	Nm³ H₂ / t (sugar cane)

Hydrogen Fuel Cell Electric Vehicle



CHARACTERISTICS WITH THE USE OF ETHANOL

Hydrogen Fuel Cell Electric Vehicle



- ✓ 7.6 liters of ethanol produces 1 kg of H_2 (Hytron Reformer)
- ✓ H_2 storage in the car ranges from 5 kg to 7.5 kg H_2
- ✓ BOSCH Fuel Cell: 1 kg $H_2 \rightarrow 150$ km
- ✓ Autonomy: 750 km to 1,125 km
- ✓ ETHANOL Consumption: 38 liters to 57 liters
- ✓ 57 liters of Ethanol $\rightarrow 1,125$ km (~20 Km/L)
- ✓ Refueling time: 3 min

THIS IS JUST THE BEGINNING!

NEUMAN & ESSER GROUP

AGILE. SOLUTION. EXPERTS.



COMPRESSORS

The H₂ Experts



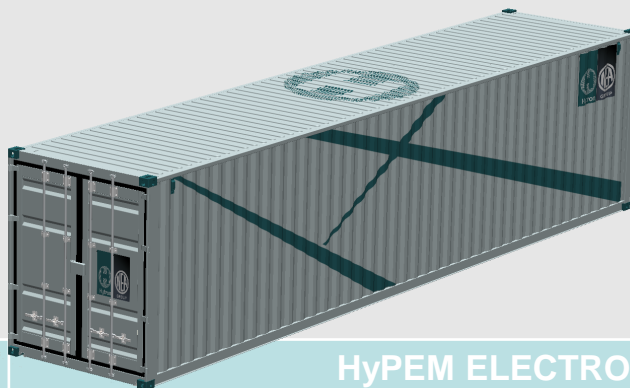
HYDROGEN GENERATION PLANTS

HRS PROJECT REFERENCE

- **Electrolyzer Unit**
 - One 20" standard container for Electrolysis system
- **Compressor Unit & Storage Unit**
 - One 20" standard container for Compressor system

These dimensions are only for reference. NEUMAN & ESSER solutions for Hydrogen plants are tailor made for each customer and application. Actual plant dimensions are defined during Technical discussions and Engineering phase.





HyPEM 20-40

EQUIPMENT	HyPEM ELECTROLYSER
Cabinet	20' container, including process and controls
Ambient Conditions	up to +50°C
Rated Production (H ₂)	20 Nm ³ /h (1.8 kg/h)
Installed Power	120 kW
Raw Water Consumption *	34 L/h (may vary depending on the quality of water available locally)
H ₂ Purity (higher purities also available)	99.999% (5.0) → SAE J2719 / DIN EN 17124 compliant
Maximum H ₂ Delivery Pressure	40 bar _g
Operating Range	10 to 100%
Nitrogen	Only for maintenances
Compressed Air	5 – 7 bar _g (ISO 8573.1, 2010, class 2.4.1; Included and only used for piloting purposes)
Electrical Standard (typical)**	380 Vac / 3 / 60 Hz (Different power supply standards can be provided)

HYDROGEN GENERATION PLANTS

Compressor Units



HOER Diaphragm Compressors



HOER Hydraulic Driven Compressors

HYDROGEN GENERATION PLANTS

Storage



- High pressure hydrogen storage for both stationary and mobile applications
- Storage solutions for pressures of 200 bar up to 1,000 bar
- Type II or IV pressure vessels

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THANK YOU!