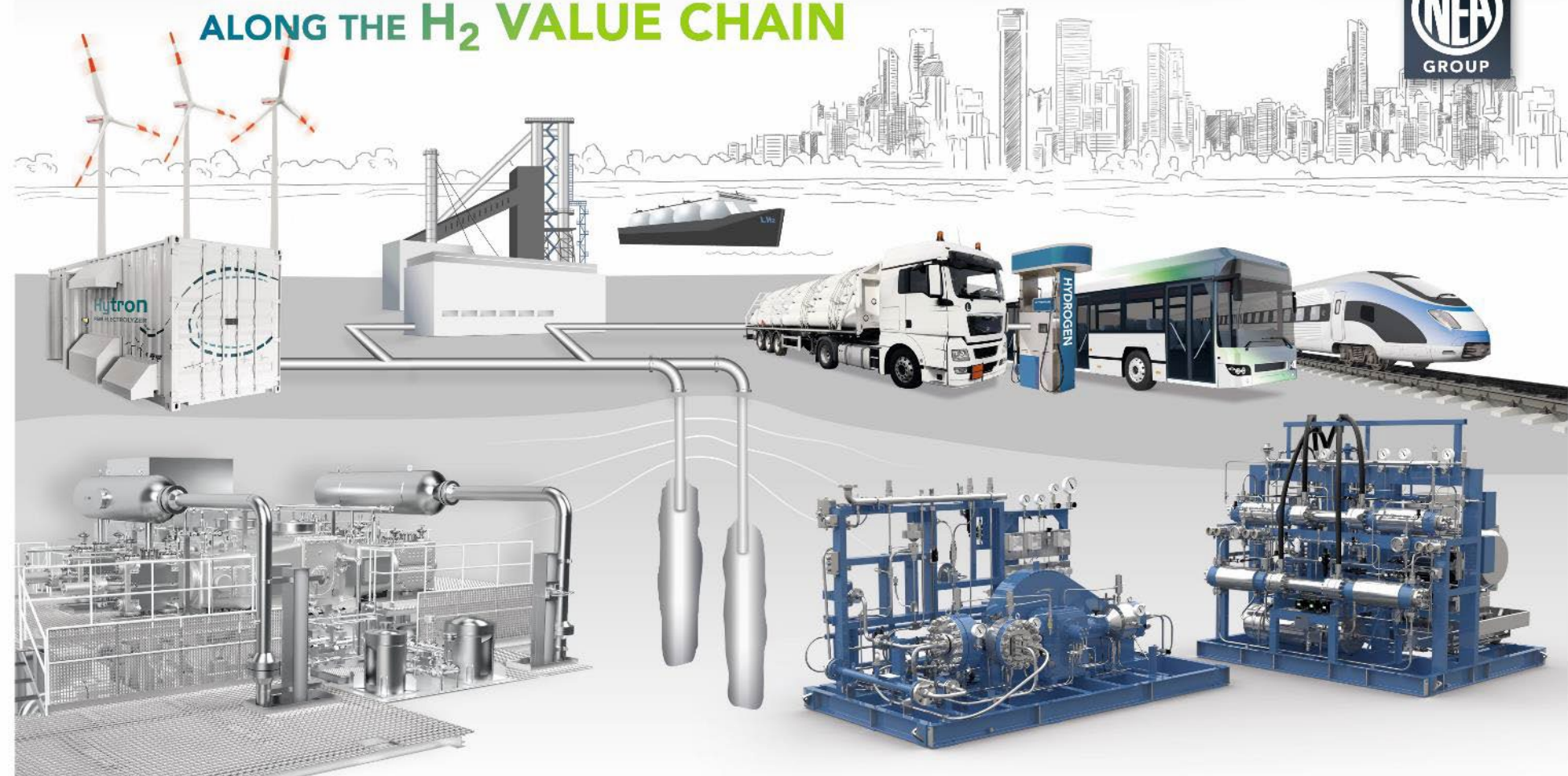


INTEGRATED SOLUTIONS ALONG THE H₂ VALUE CHAIN



NEUMAN & ESSER GROUP

Sequence of Company Owners



1830

Johann L. Neuman



J.L. Neuman & Cie.
Maschinenfabrik in Aachen
am Hirschgraben



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1831

Theodor Esser



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Sequence of Company Owners



1891



Oscar Peters

1930



Wolfgang Peters

1965



Klaus Herbert Peters



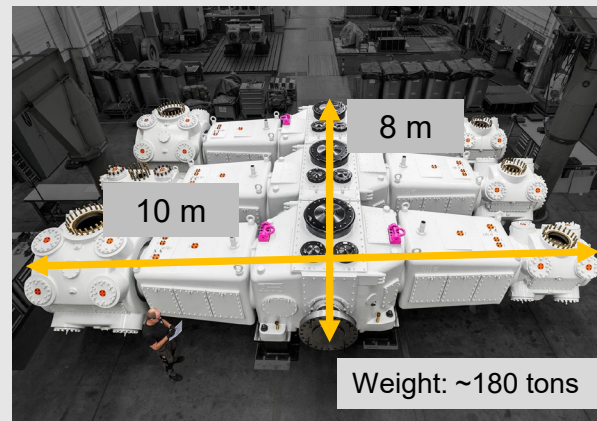
seit 2008 Stefanie & Alexander Peters

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Reciprocating Piston Compressor - Salt Cavern Storage

Typ / Model	2SSL500HD	
Gas	H ₂	
Stage	1	2
Suction pressure bar(a)	40	93
Suction temperature °C	20	30
Pressure ratio	2.34	2.15
Discharge pressure bar(a)	93	200
Outlet temperature °C	105	108
Flow		
Mass flow kg/h	36,400	36,400
Volume flow Nm ³ /h	404,400	404,400
Effective suction flow m ³ /h	11,200	5,110
Power consumption per Stage MW	12.4	11.9
Overall power MW	24.4	
Mechanical efficiency	0.988	
Shaft power MW	24.7	
Electrical efficiency	0.97	
Electrical connection load MW	25.5	



36,4 t/h H₂ = 1,2 GW (LHV)

Sufficient to power a 600 – 700 MW gas power plant

Isothermal efficiency compressor ~80%

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Diaphragm Compressor for H₂ - Size S

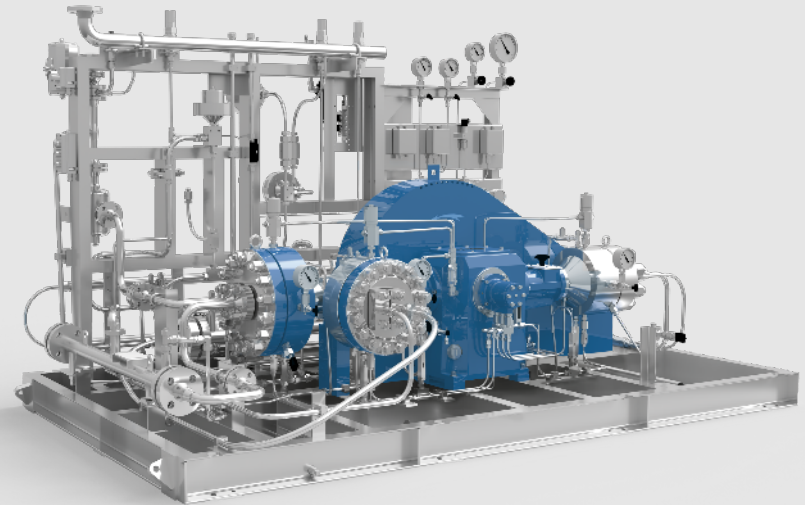


Features

- for more continuous operation
- oil-free, abrasive-free, leakage-free up to 10-6 mbar l/s
- for demands of high purity and gas-tightness
- up to 3,000 bar (45,000 psi), 1 to 4 stages,
- mostly 1000 bar is enough
- ratio per stage 5 to 10
- H₂ -Flow rate: ~110 kg/h from 30-1000 bar.

Applications

- H₂ trailer filling and large refueling station
- Laboratories with highest pressures
- Video of working principle: <https://youtu.be/WvYbKMAHz54>



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TKH – Size XS / S - Piston Compressor with hydraulic drive for H₂

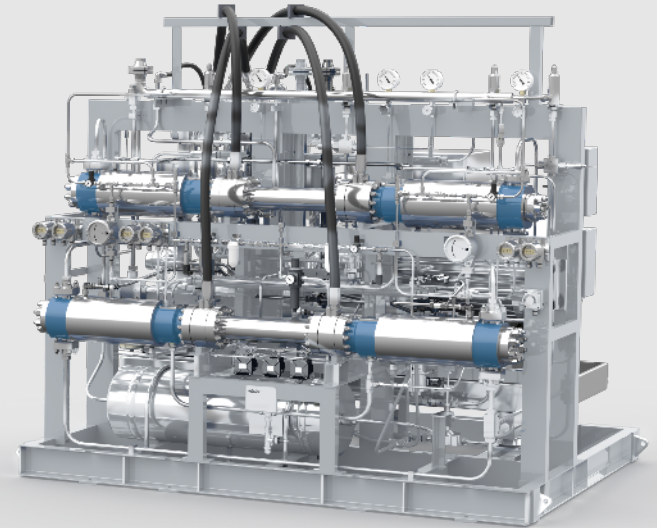


Features

- for frequent start-stop applications
- easy flow control
- small footprint → ideal for container installations
- easy and fast maintenance
- market launch in 1985
- H₂-Flow rate: ~60 kg/h from 30-1000 bar.

Applications

- since 2005 for H₂ services and H₂ filling stations, with more than units 100 installed
- For small and Medium HRS
- As a booster to upgrade existing 350 bar HRS to 700 bar tank pressure



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Hydrogen Refueling Station Compressor



References:

Diaphragm Compressor | H₂-filling station for airport buses

Location:

Airport Munich, Germany

In service:

1997 – 2006

Service conditions:

Suction pressure 15 - 31 bar(a)

Discharge pressure 401 bar(a)

Flow at 30 bar 125 m³N/h at 30 bar



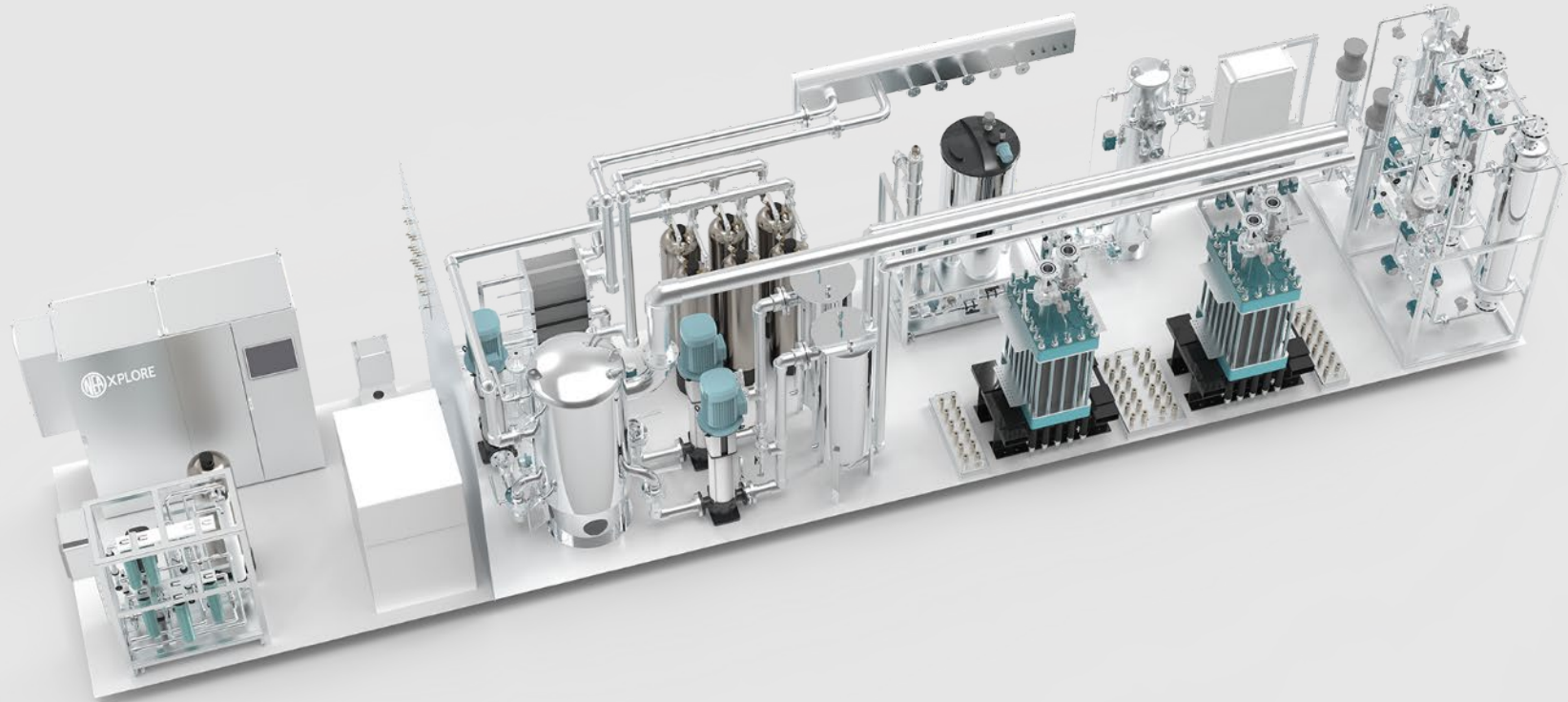
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H2 Generation - Electrolyzer & Reformer



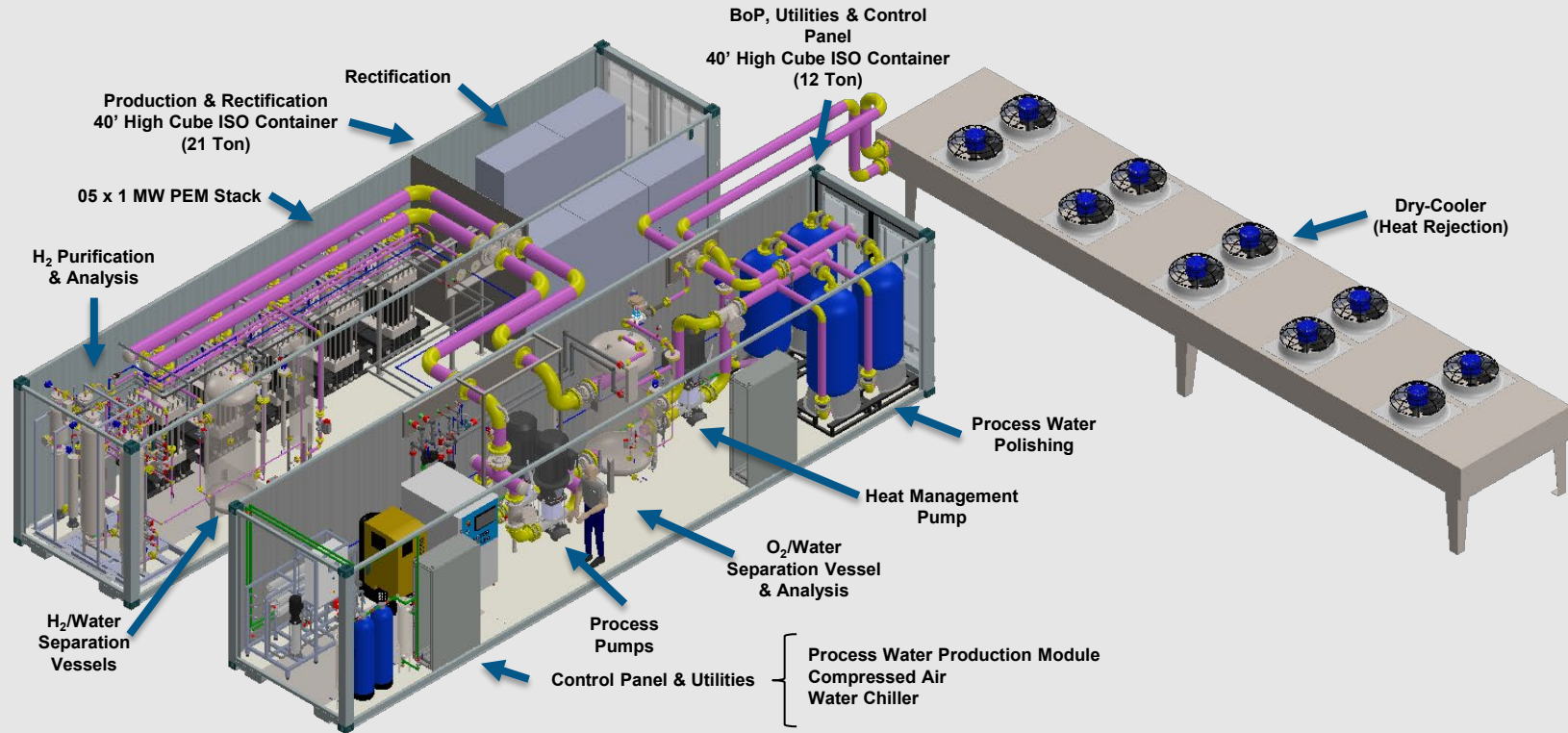
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HyPEM 400-40 Water Electrolysis / 2 MW Plant Design



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HyPEM 1000-40 Water Electrolysis / 5 MW Plant Design



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HRS (Hydrogen Refueling Station) Design Tool



DISPENSER

Dispenser 1

Dispenser 2

Dispenser 3

PASSENGER CAR

BUS-TRUCK-TRAIN MED-P

BUS-TRUCK-TRAIN HIGH-P

▶ START SIMULATION

↶ BACK TO DASHBOARD

Dispenser 3

Busses/Trucks/Train... ▾

Pressure Ramp Setpoint (MPa/min)

− 5 +

Precooling Temperature (°C)

− -20 +

Ave. Precooling COP

− 2 +

Processing Time (s)

− 240 +

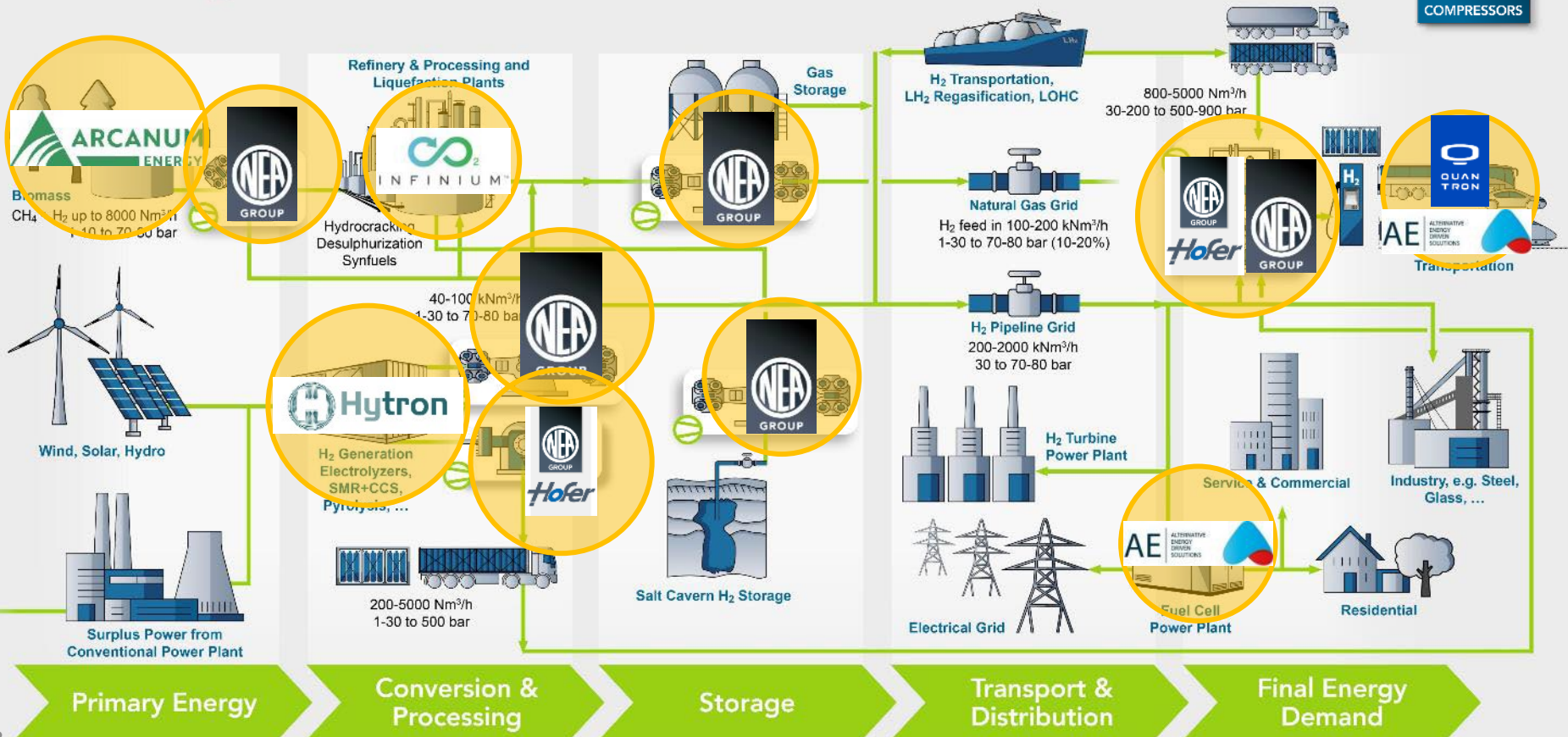
Vehicles per hour

☒ Manual ☐ CSV

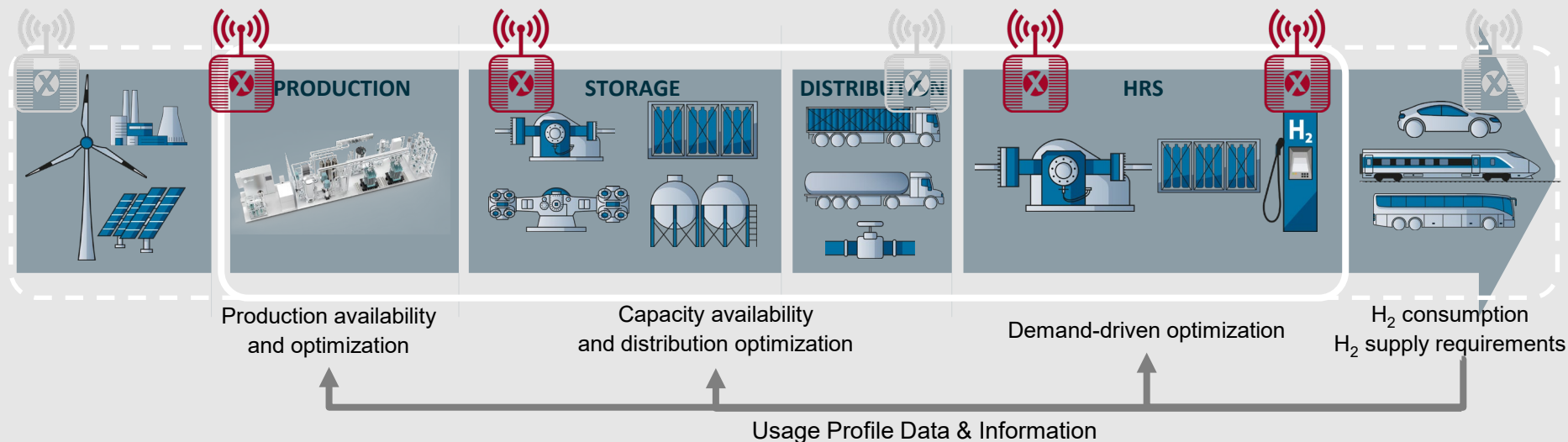
Time [h]	Vehicles Per Hour	Back2Back [-]



The NEA GROUP Portfolio for the H₂ Value Chain

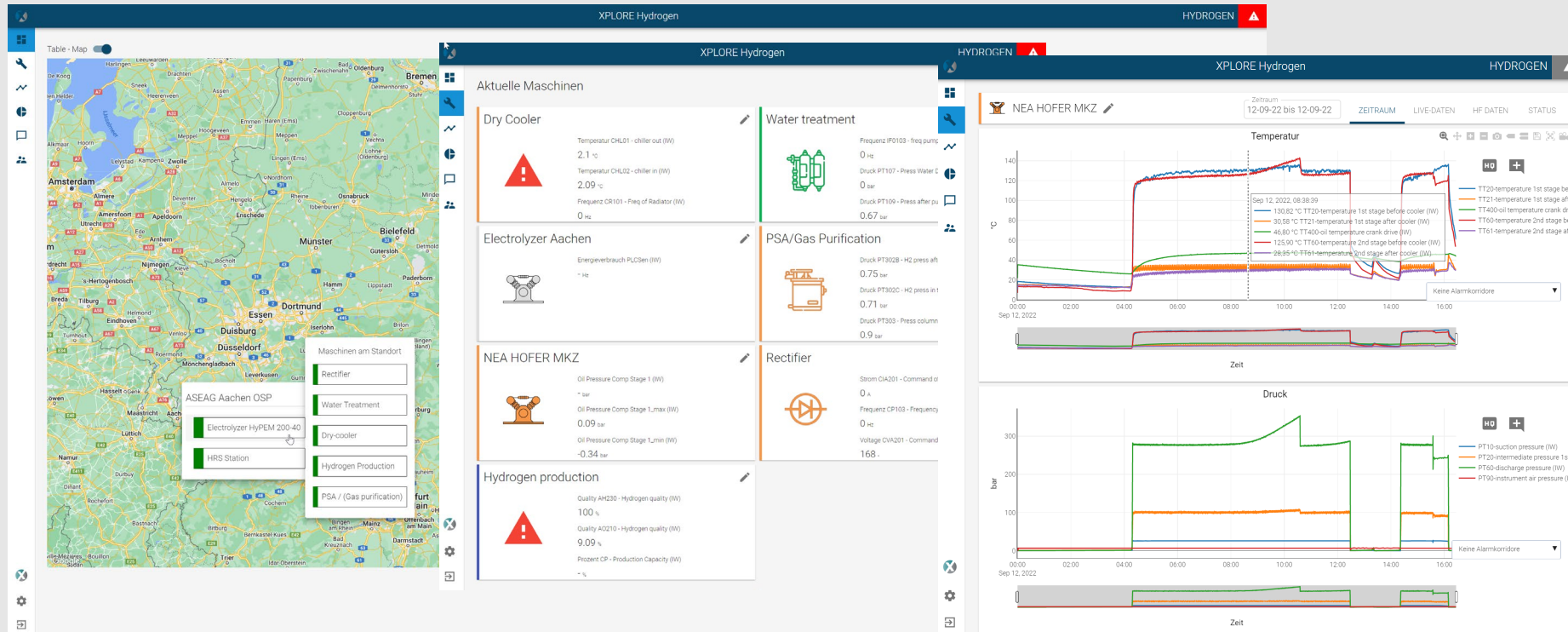


- From monitoring to supervised operation management
- “Smart” control and operation mode according to input variables
- H2 production based on real time and historical data



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...for deep insights into the heart of the H2 value chain



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Challenges with H2 Compression in different applications



- Purity acc. to SAE J2719
 - Dry running compressors without oil contamination
- High pressures up to 1000 barg for mobility applications
 - Diaphragm and hydraulic piston compressor
- High flows for pipeline or storage compression
 - Reciprocating piston compressor
- Purity acc. to SAE J2719 together with high flows (e.g. large HRS)
 - Dry running reciprocating piston compressor up to 500barg

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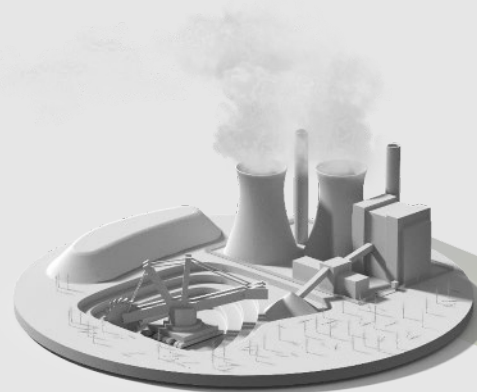
Required Support of Component Suppliers



- Electrolyser
 - Rectifier & transformer
 - Stacks
 - Water purification
 - H2-purification
 - Purity measurement
 - Control Stations
- Hydrogen refueling / Trailer filling stations
 - Mobile (Trailer) and stationary H2 storages
 - Dispenser
 - Filling manifolds
 - Control Stations
 - Chiller

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What we do and need to do



The transition from a fossil...



...to a sustainable &
renewable energy
infrastructure!

Thank You