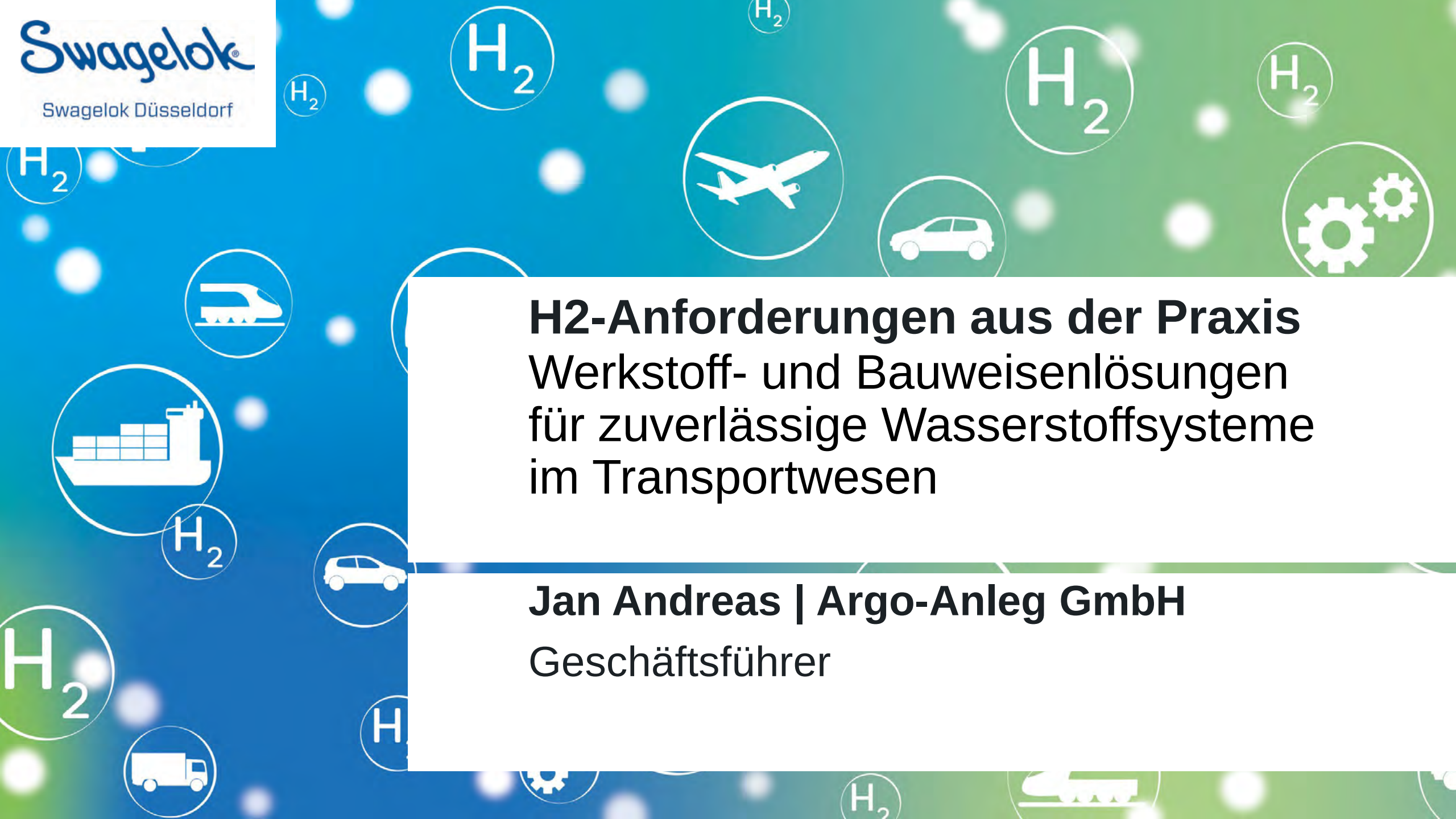


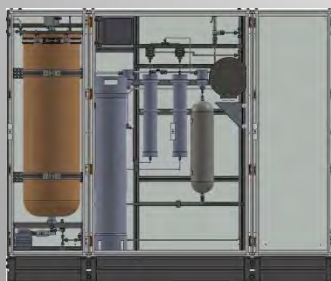
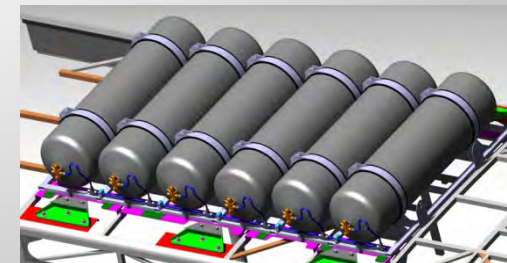
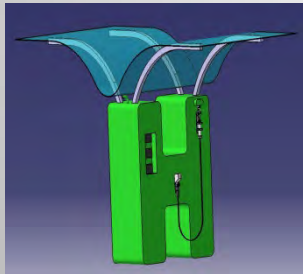
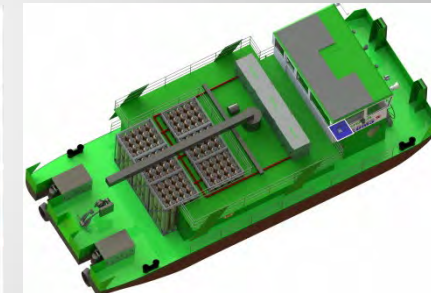
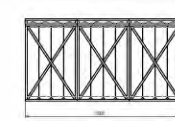
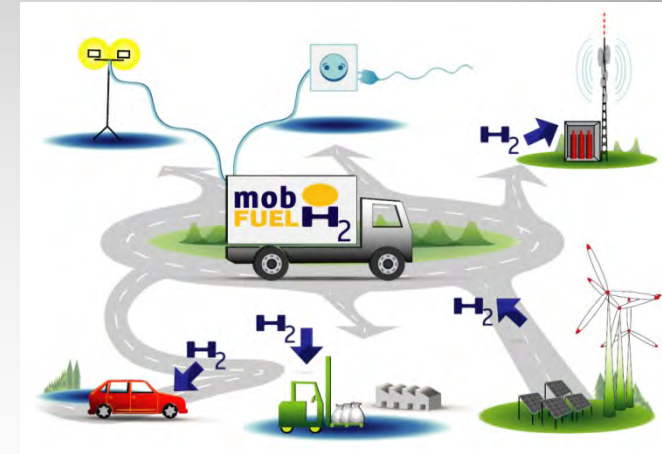
The background of the slide is a gradient of blue and green. It is decorated with various white icons: hydrogen molecules (H<sub>2</sub>) in circles, a high-speed train, a cargo ship, a car, a truck, an airplane, and gears. These icons are scattered across the slide, with a higher concentration on the left side.

# **H<sub>2</sub>-Anforderungen aus der Praxis**

## **Werkstoff- und Bauweisenlösungen für zuverlässige Wasserstoffsysteme im Transportwesen**

**Jan Andreas | Argo-Anleg GmbH**  
Geschäftsführer

# Product Portfolio



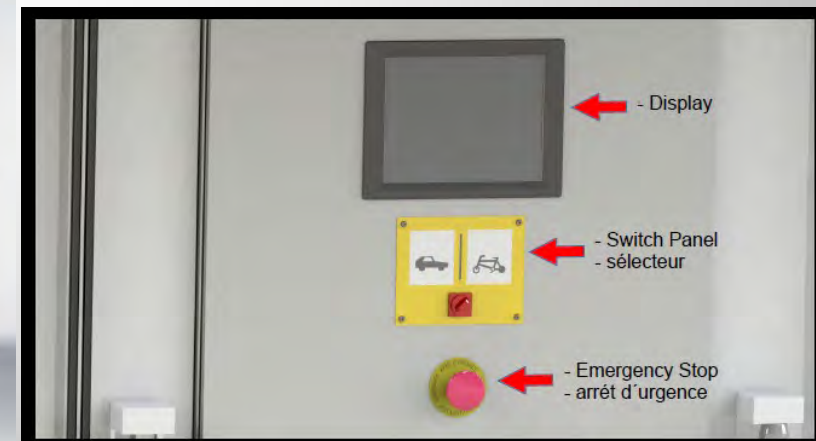
# Bus Refuelling Stations: 200 to 600 kg/day



# Small Refuelling Stations: 5 to 10 kg/day



With on site H<sub>2</sub> production  
refuelling with SAE J 2601 protocol  
refuelling of cars and bikes  
refuelling per day: 2 – 100 kg/day  
scalable



# Project Mobfuel H2

Mobile H2 refuelling and mobile electrical power supply





## Enaq-Project

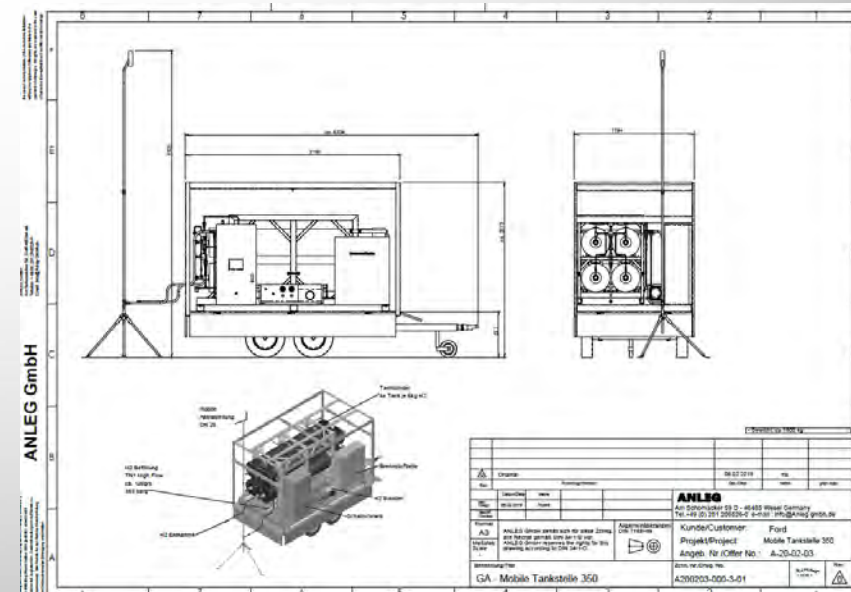
Mobile H2 refuelling solution (350 bar  
700 bar) with on bord compressor

4, 6 oder 8 x 214 Lx400 bar = 26,8 kg

H2, 40,2 kg H2 or 53,6 kg H2

Mobile energy supply, 2 KW, 5 KW, 10  
KW

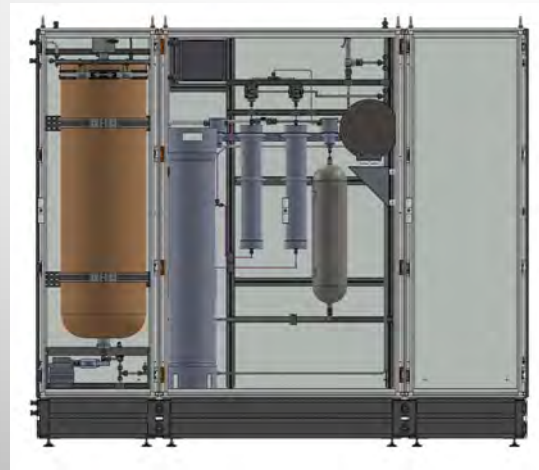
H2 rack can be separated from trailer



# Anleg's PEM Electrolyser 6 to 100 kW

## Features:

|                     |                                  |
|---------------------|----------------------------------|
| Production-rate:    | 2.5 Nm <sup>3</sup> - 100 kg/day |
| Output pressure:    | 30/40 bar                        |
| Power Supply:       | 400 VAC 3Ph                      |
| Input Power:        | 5 to 100 kW                      |
| Operation:          | Indoor/Outdoor                   |
| Dimensions:         | 2,4m x 2,2m x 0.6m for 15 kW     |
| Weight:             | 350 kg (empty)                   |
| Water Storage:      | 140 L                            |
| Control-System:     | PLC-Siemens                      |
| Operating Panel:    | Touchscreen                      |
| Water purification: |                                  |



# Racing Car2: Tanksystem for GreenGT





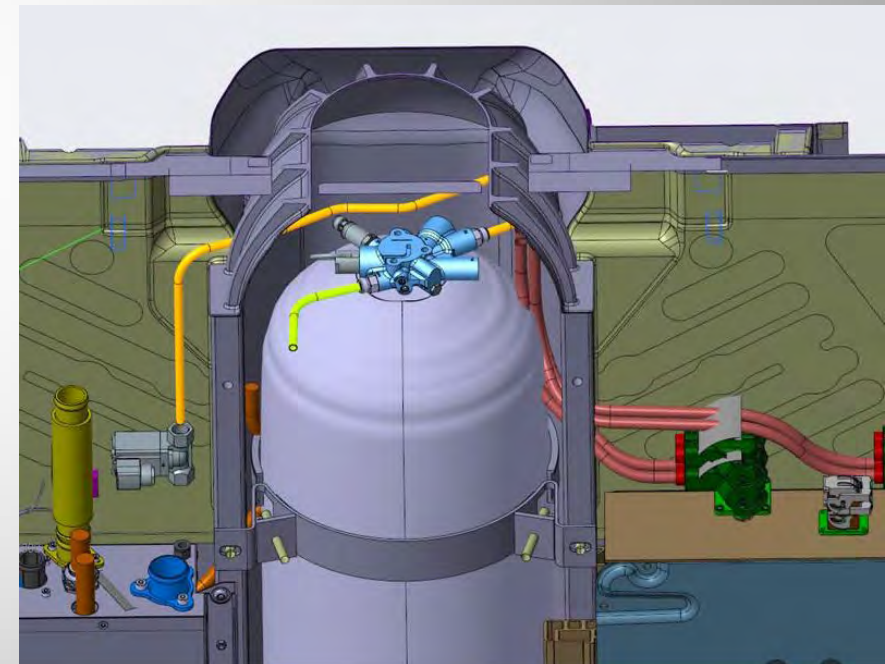
## Achievements:

- Large scale solutions for automotive car tank-systems

--> Reduction of components by development of a GHU (Gas Handling Unit instead of installing single components)

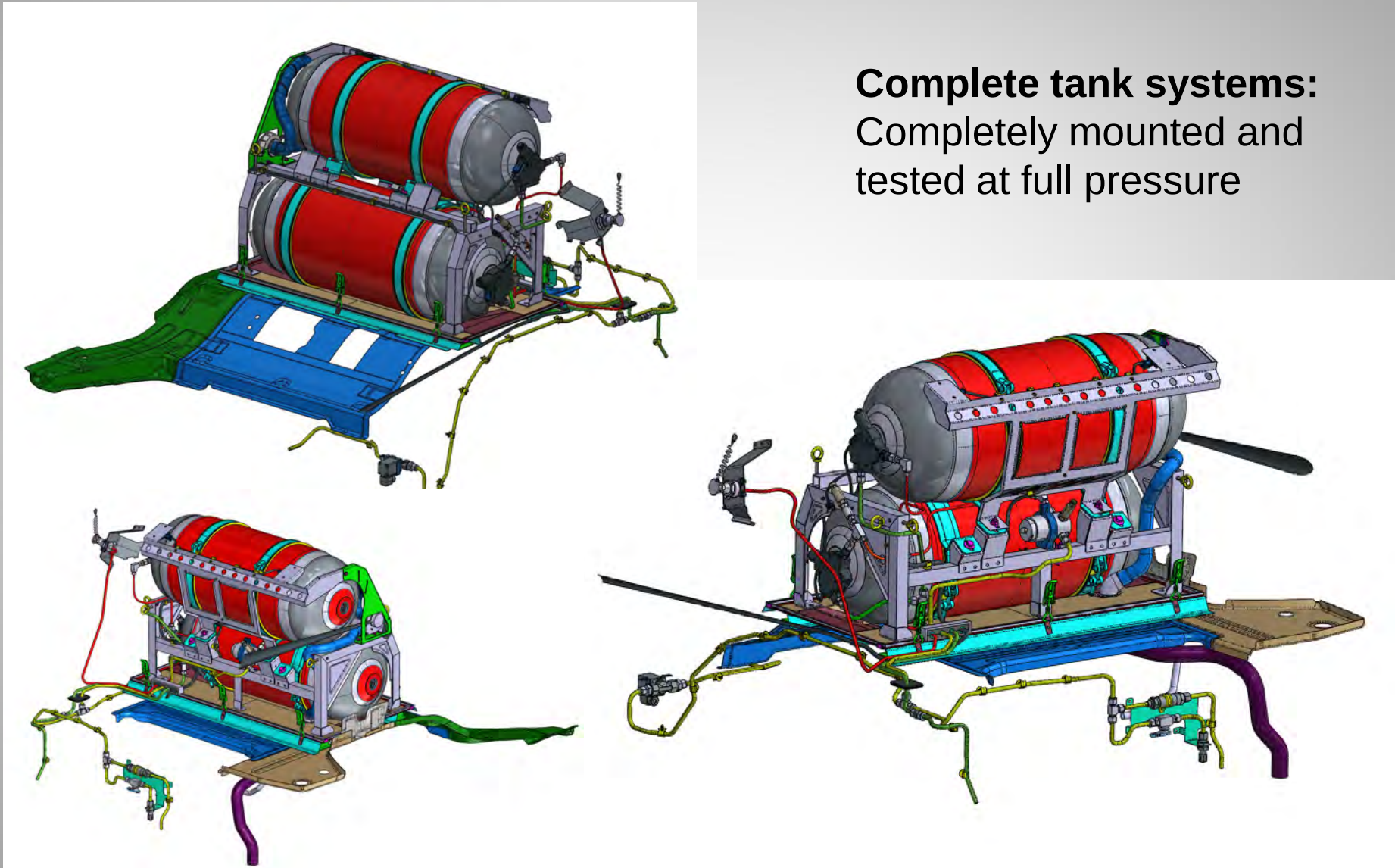
## Next steps:

- Realisation on test tank-system in cooperation with VW



# Integration of tank systems into vehicles

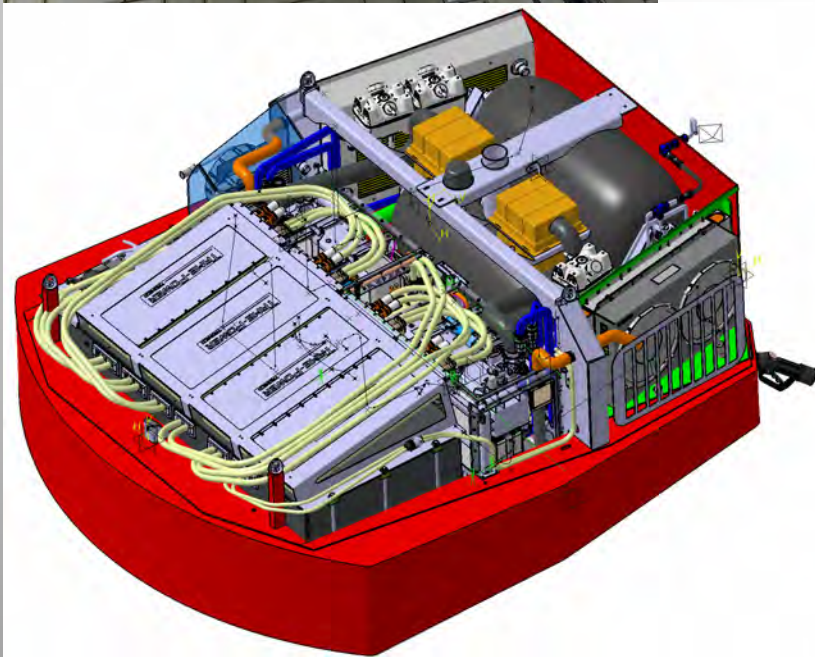
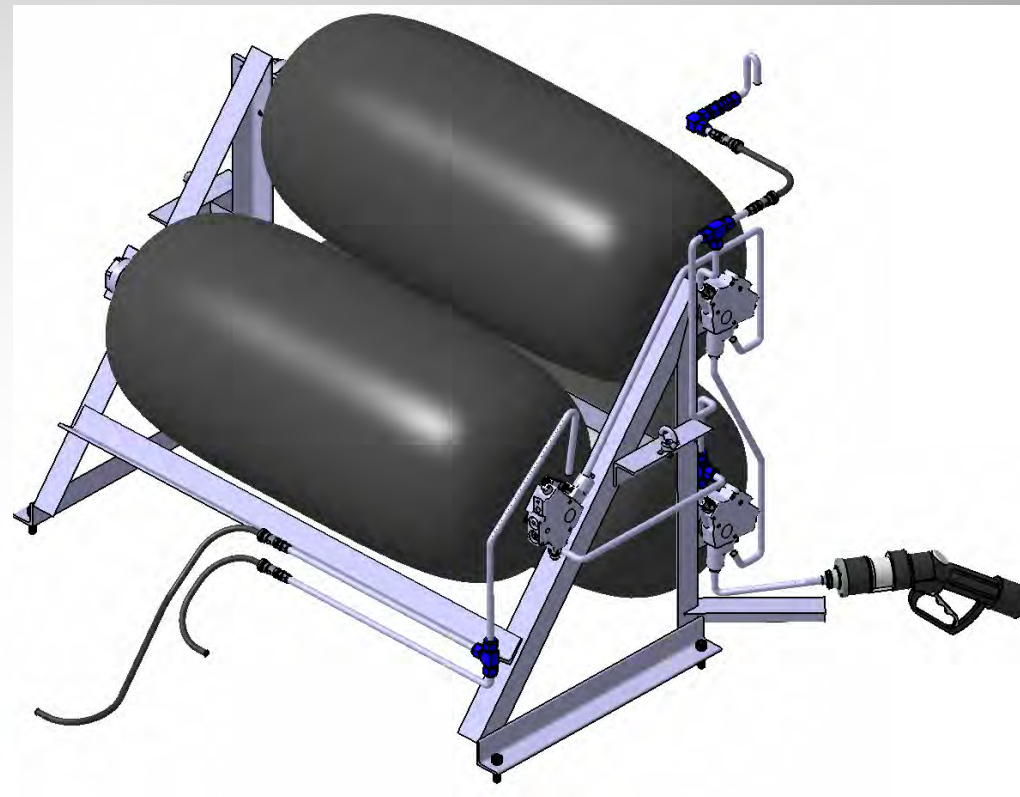
**Complete tank systems:**  
Completely mounted and  
tested at full pressure



# Bus Tank Solution



# Tank System for Fork Lift





## **Moduline.**

Modular embedded  
Electronic Control Unit  
for industrial and  
automotive applications

## **MAN Truck Tank System**

Development of Tank System

Gas Handling Unit

**Energy Management of  
3 x Fuel Cells, including the  
Recharge Strategy of the Batteries**

On Tank Valve

Fire Safety-Solutions

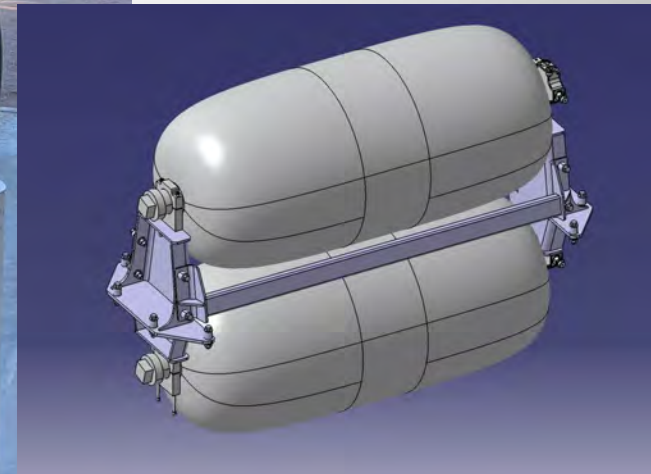
Increase of security of the H<sub>2</sub>-supply

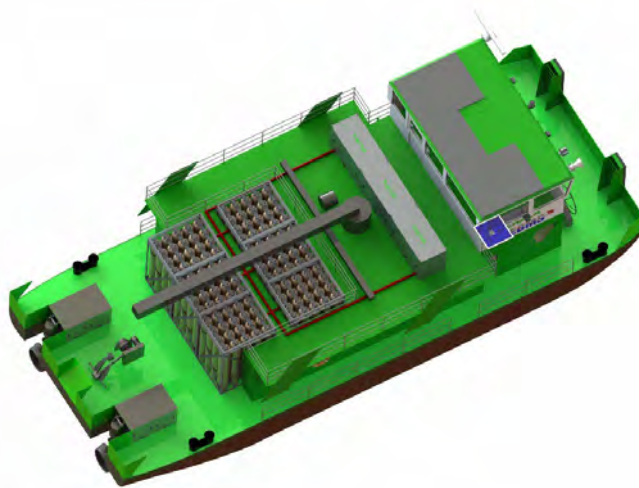
New communication with  
the refuelling station

# Integration of Tank System into a Vehicle

## Neck mounted tank system for heavy duty vehicles

Complete integration of H<sub>2</sub> tank system into an existing vehicle, including control system





## Tank System

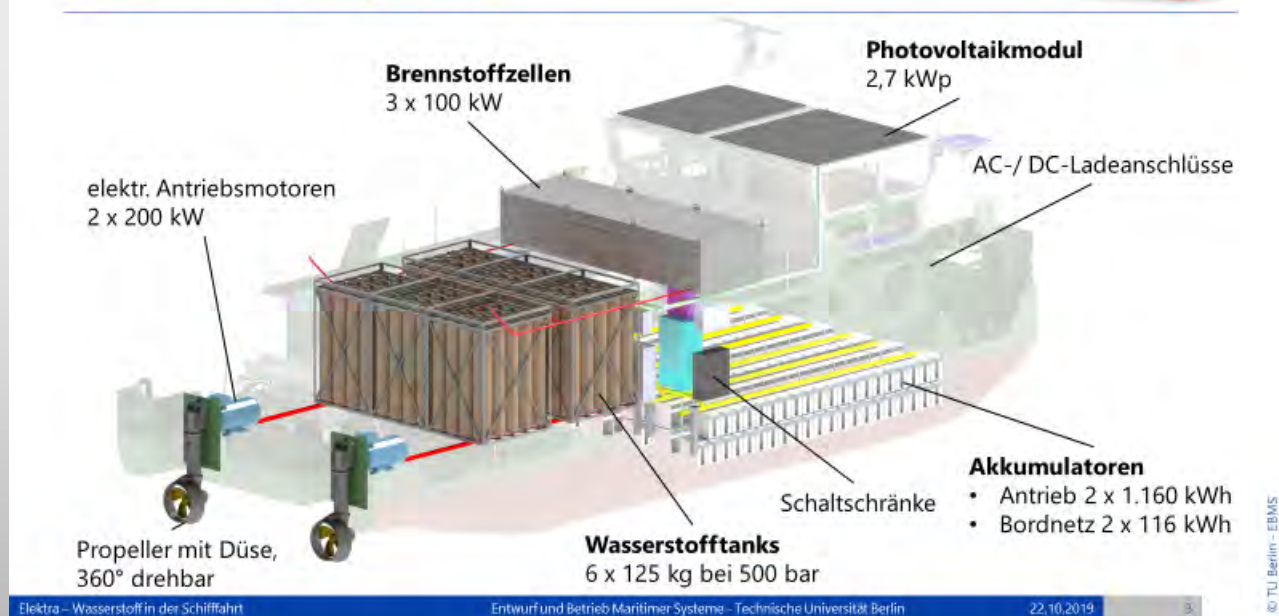
Modular: 700 kg on board

Module: 125 kg H2 PN 500 Module

Modules creatable and changable

One refuelling station can supply different harbors

## Das innovative Energiekonzept



# Complete range extender concepts

from 0,5 KW to 400 KW  
5 KW energy pack with  
5 KW PEM fuel cell



H<sub>2</sub> geeignet, Wasserstoff-Korrosion

Temperatur: - 40 ° C ... + 110 ° C

Temperatur Luftfahrt : - 55° C

Drücke: 0 .. 700/875 bar

Temperaturgradienten: von Umgebungstemperatur auf – 40 °C  
in wenigen Minuten an der H<sub>2</sub> Tankstelle

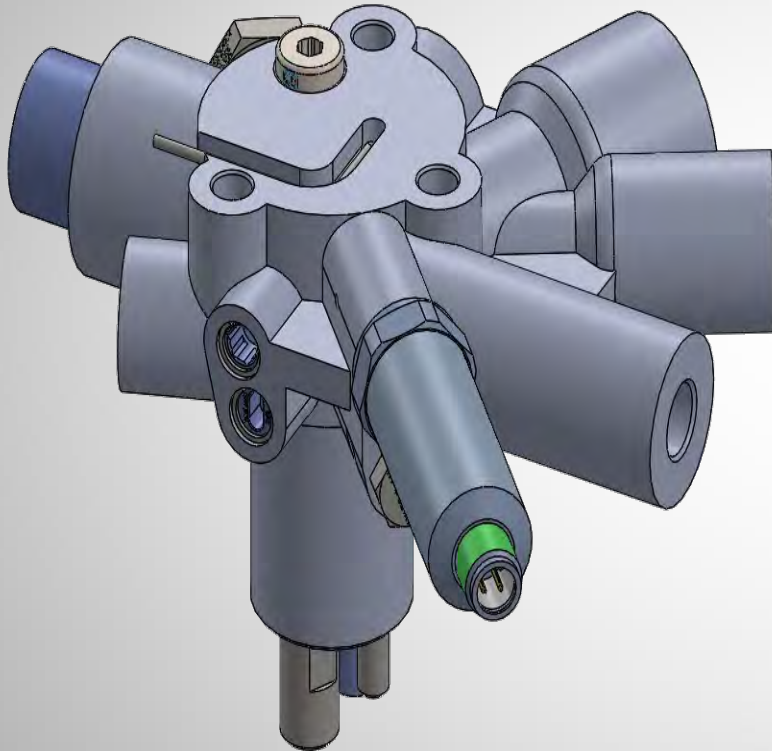
Salznebel Sprühtest

Materialpaarungen: Aluminium, Edelstahl in Salzhaltiger  
Umgebung (Schiffsanwendungen)

Bei Elektrolyse: H<sub>2</sub> + demineralisiertes Wasser

Zyklen - Festigkeit der Komponenten 100.0000 und mehr

**=> Extreme Belastungen für Material in zum Teil  
schwieriger Umgebung**



## OTV / OTV-R

PN 350 / PN 700

ATEX Solenoid Valve ON/OFF

Inlet & Outlet Filter

Excess Flow Valve

Integrated Pressure Regulator

P2 = 10 – 14 bar

Height < 39 mm

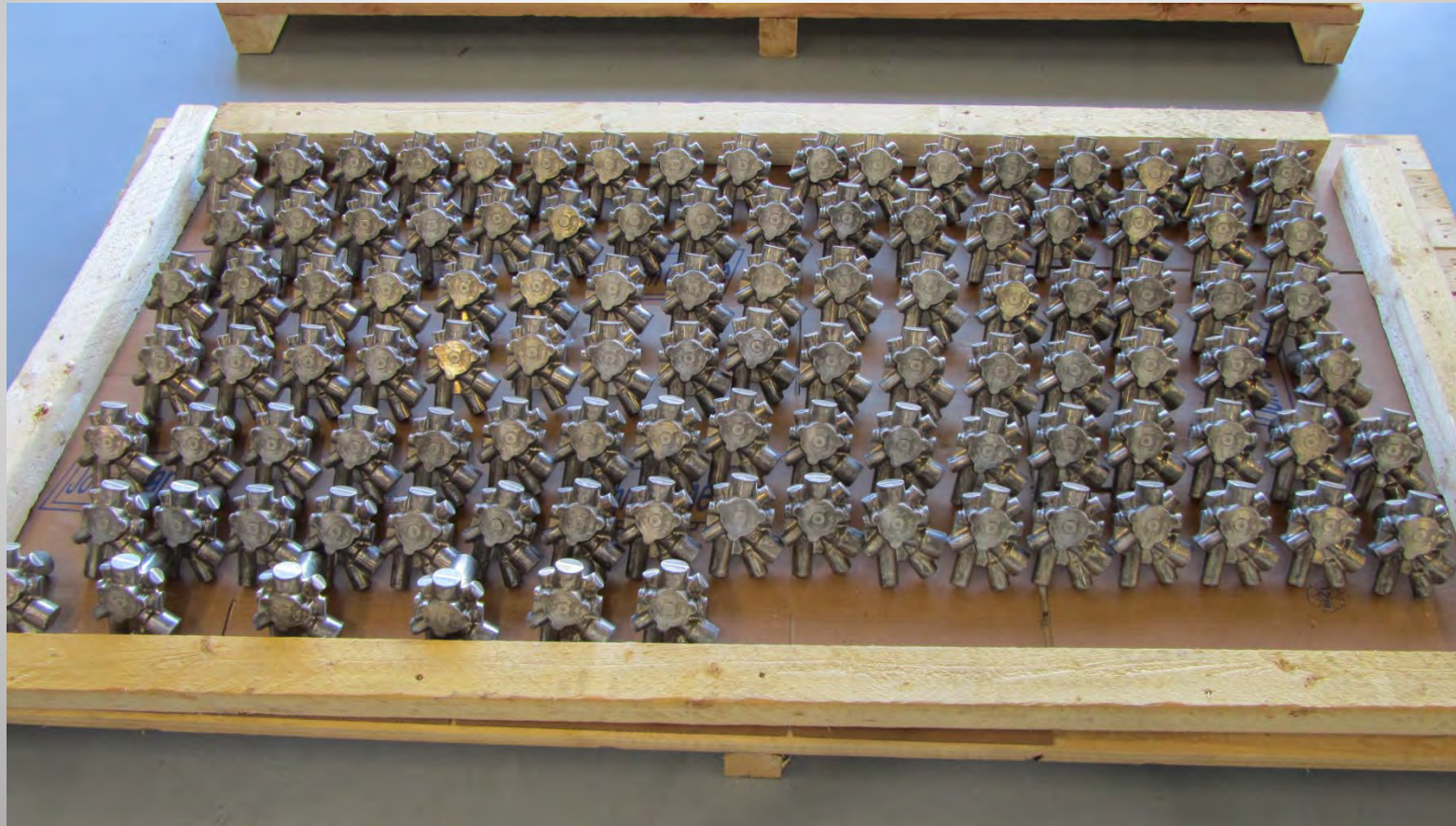
Weight : < 1 kg

Material 6061 T6 beschichtet, oder

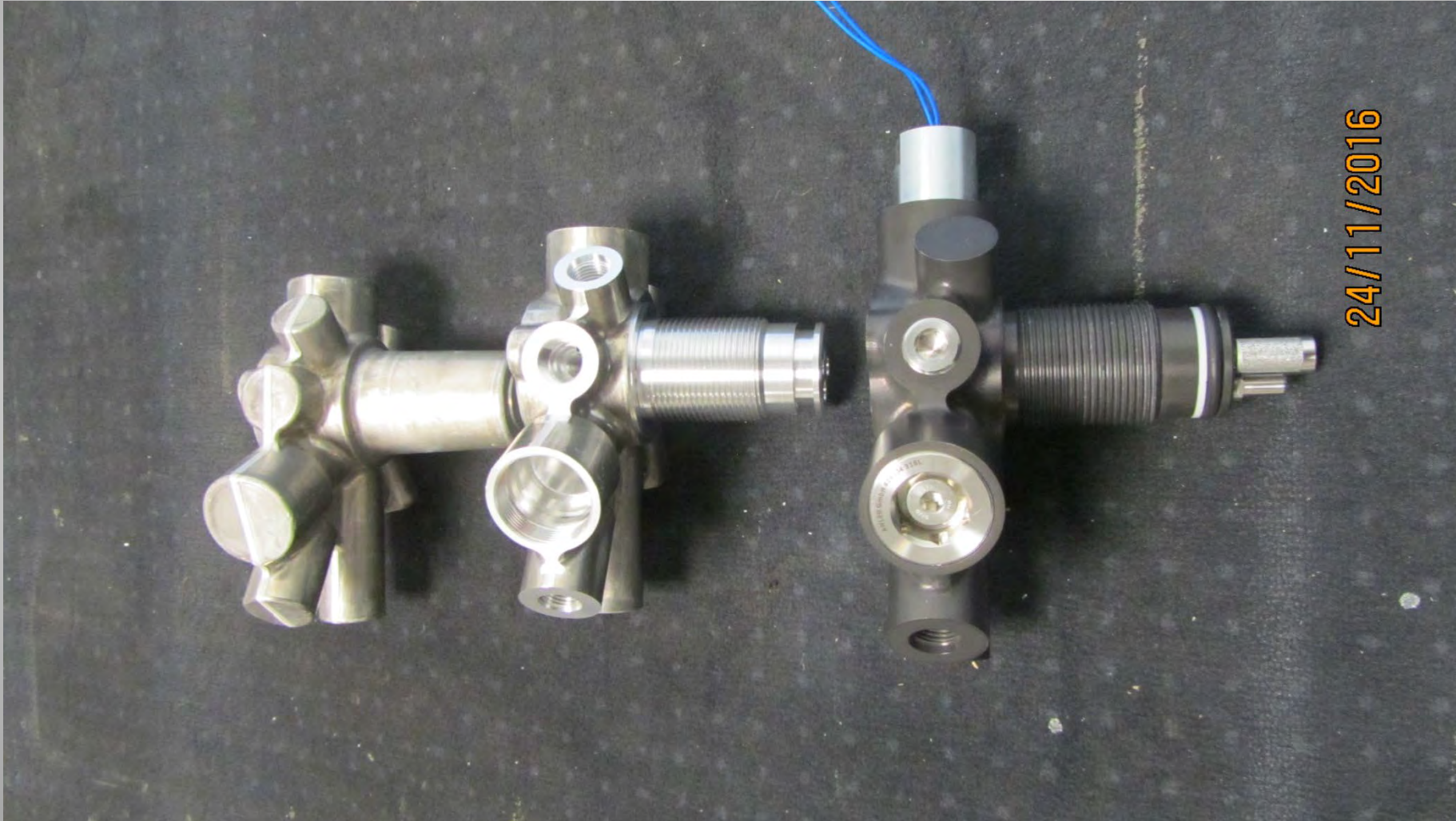
Edelstahl: 1.4435, 1.4404, 1.4475

Einschraubverschraubungen Edelstahl

## Gehäuse geschmiedet-Aluminium: 6061 T6



Beschichtungen: Hartcoating, Eloxieren oder Gehäuse aus Edelstahl  
Was ist am besten geeignet?



24/11/2016

Ventile für Dispenser:  
60 g/sec and 120 g/sec  
180 g/sec für Truckbetankung

Temperaturschock beim Betanken von  
Fahrzeugen  
Probleme für die Dichtungen  
Extreme Belastung für das Material

Edelstahl 1.4435, 1.4571

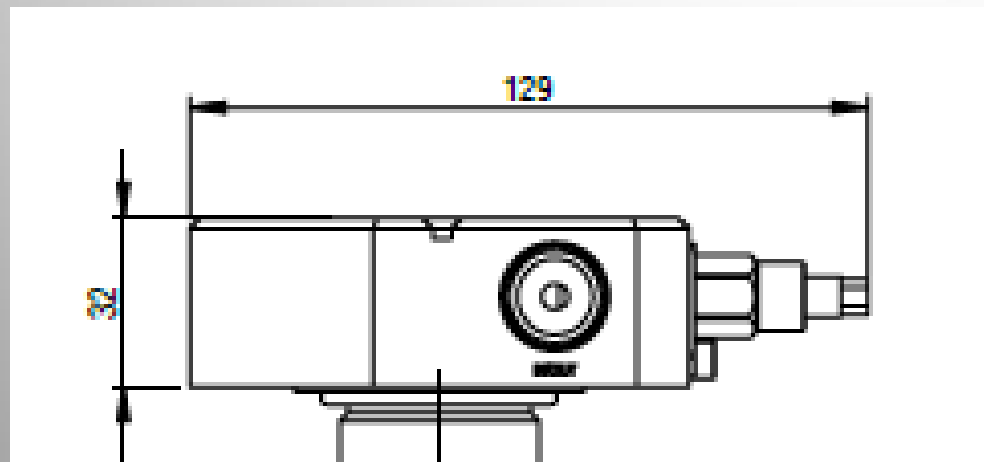
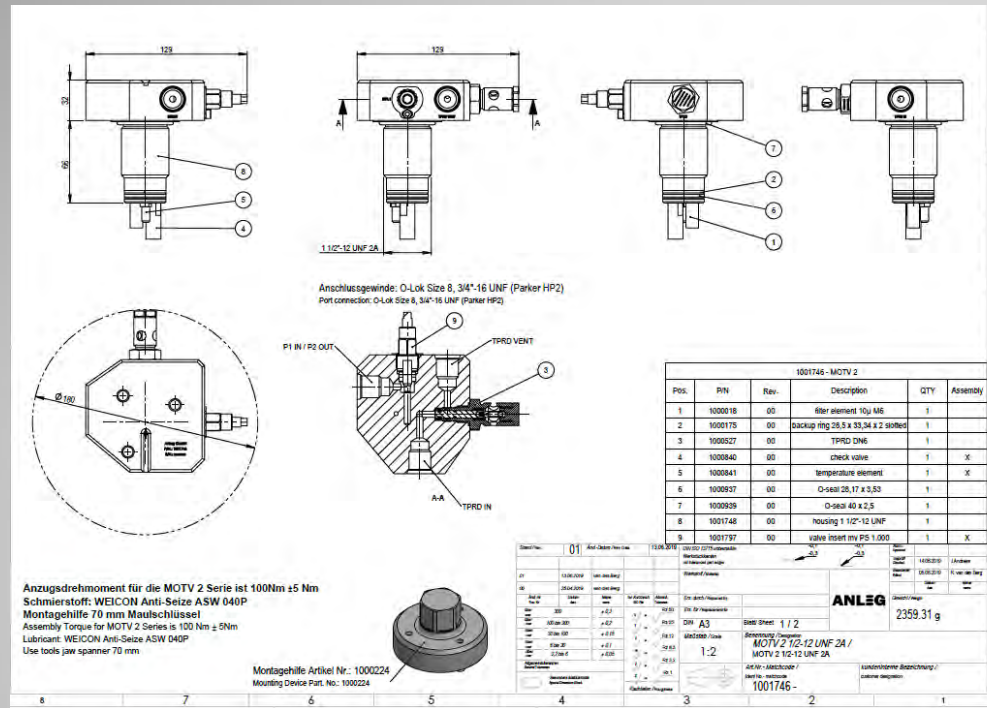


- Reduzierung von Schnittstellen
- Verwendung von hochwertigen Materialien
- Validierung der ausgewählten Materialien
- Dauerlastversuche bei unterschiedlichen Betriebsbedingungen

## bei unterschiedlichen Betriebsbedingungen

- Endurance Test Gesamtventil OTV 700 bar  
Zyklenfestigkeit: 50.000 Zyklen
- Zyklenzahl:  $1,5 * \text{Duty Cycles} = 75.000$
- 72.000 Zyklen: 20 °C, H<sub>2</sub>, < 350 ... 700 bar<sub>ü</sub>, max. 6/Min.
- Ext. & int. Dichtheitsprüfung
- 1.500 Zyklen: -40 °C, H<sub>2</sub>, < 350 ... 700 bar<sub>ü</sub>, max. 6/Min.
- Ext. & int. Dichtheitsprüfung
- 1.500 Zyklen: 85 °C, H<sub>2</sub>, < 350 ... 875 bar<sub>ü</sub>, max. 6/Min. Ext. & int. Dichtheitsprüfung

# Flaschenköpfe mit erhöhter Sicherheit



## Anleg MOTV

Edelstahl 1.4435

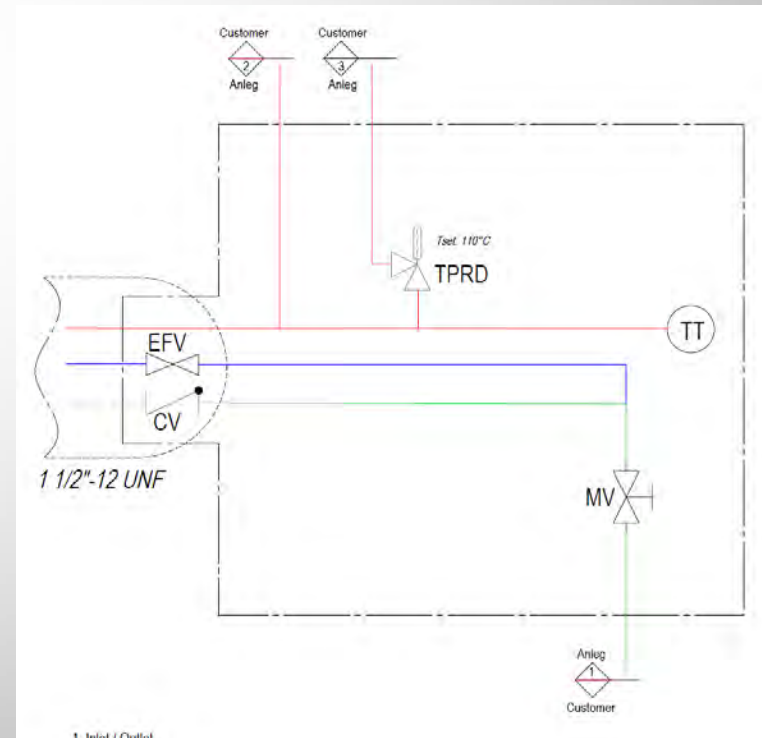
PN 350 / PN 500 / PN 900

Inlet & Outlet Filter

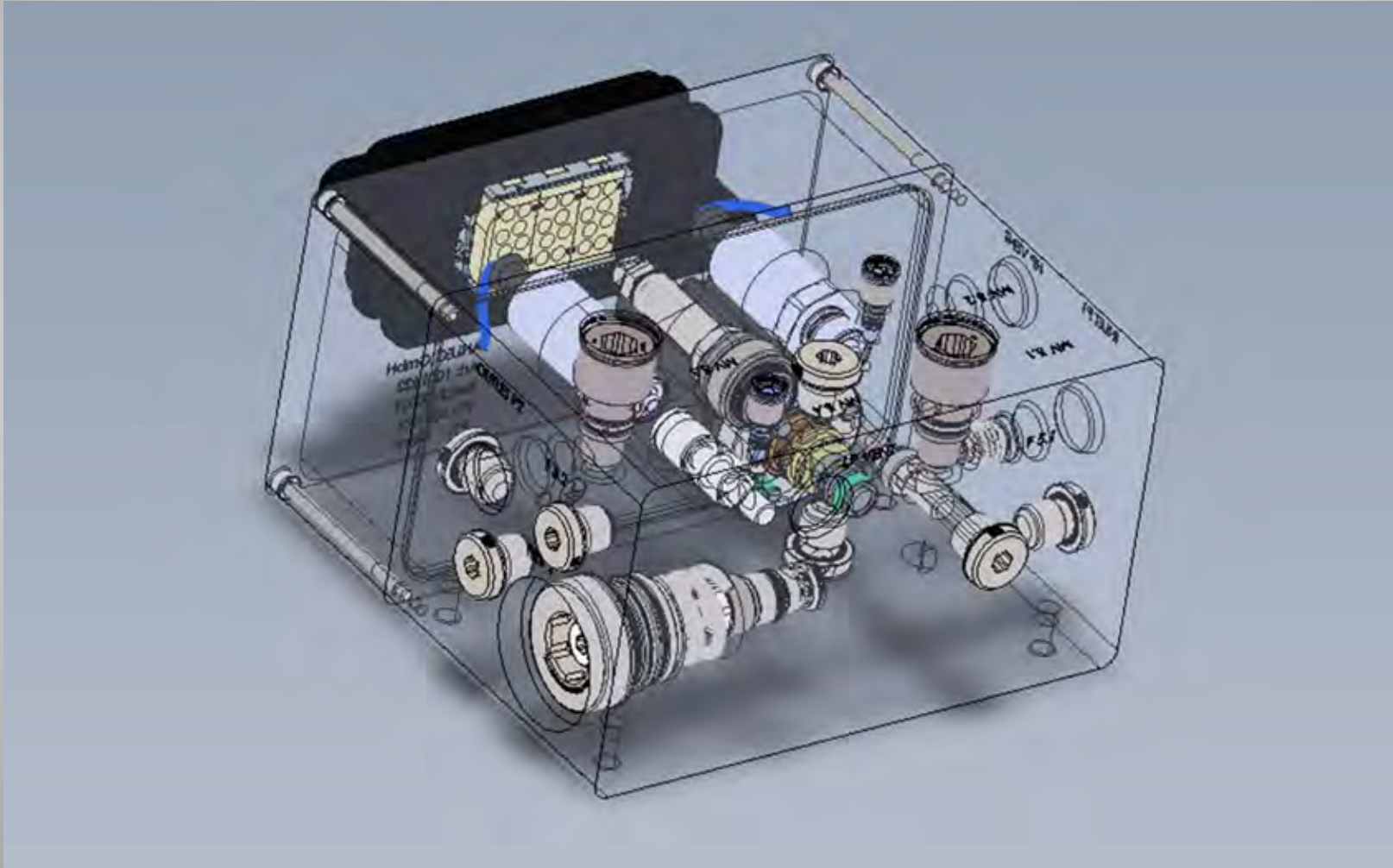
Excess Flow Valve

TPRD high flow

More safety-functions:  
confidential



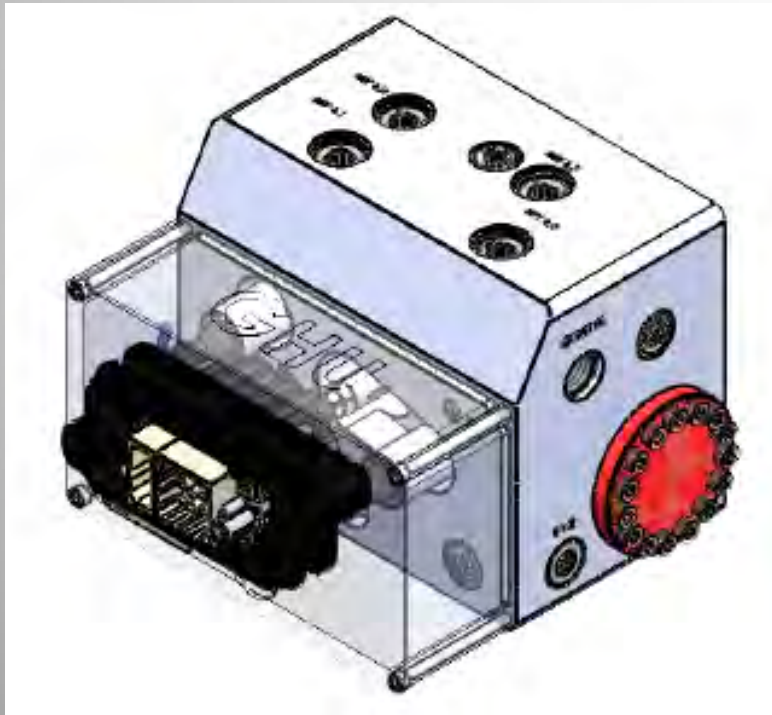
Ventilbaugruppen versus Einzelkomponenten =>  
Reduzierung von Leckage-Möglichkeiten



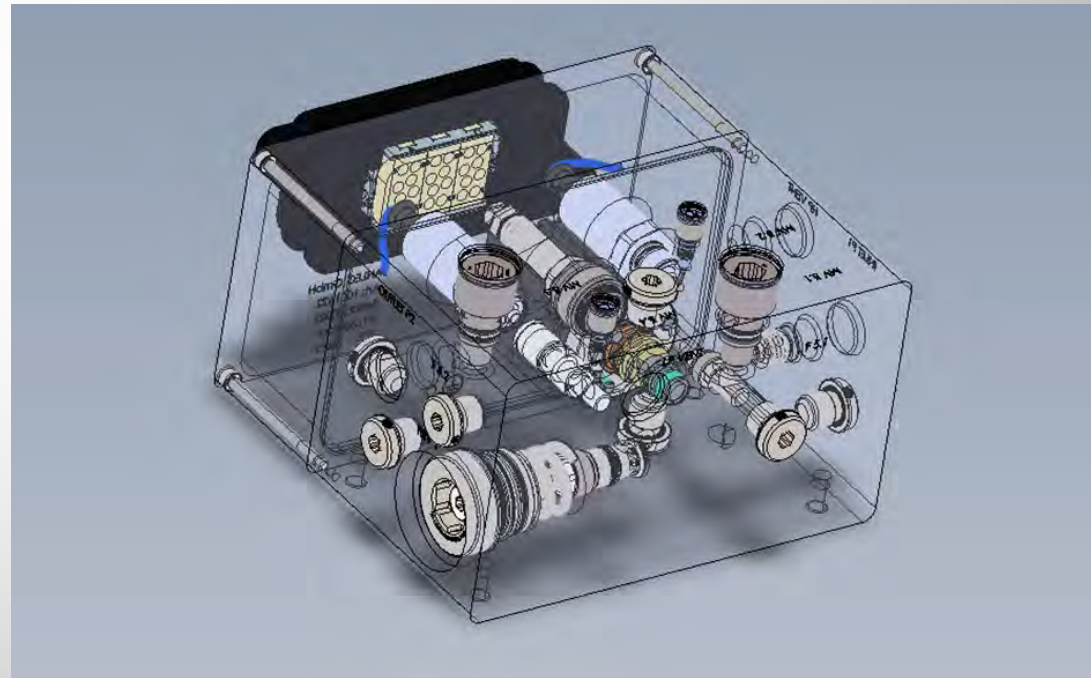
# System design high pressure GHU

- Gas Handling Unit development: Compact Valve block
- Small compact high safety, leakage possibility reduction
- 500 bar and 700 bar
- $Q = 10$  to  $30$  kg/h
- $P2 = 8 - 16$  bar,  $20 \dots 30$  bar

700 bar



500 bar



T-TPRD's for very long tanks



## Thermal-Pressure-Relief-Device

**ANLEG**  
Advanced Technologie

*Rotatable*



### Technical features:

|                        |                                |
|------------------------|--------------------------------|
| ▶ Working Pressure     | PN 700 (Pproof 1000 bar)       |
| ▶ Material             | 316 L                          |
| ▶ Process connection   | 1 1/2"-20 UNF                  |
| ▶ Connections          | M25 x 2 or 1 1/8"-12 UNF       |
| ▶ Weight               | 920 g                          |
| ▶ Reaction temperature | 110 °C, 68 °C                  |
| ▶ Vent Port Connection | 9/16" SAE-18UNF-2B, SAE size 6 |
| ▶ Flow Passage         | d = 2.5 mm                     |

This TPRD valve is designed to protect tanks and vessels against overtemperature. A glass bulb will be destroyed if the reaction temperature will be reached.

Then the medium / gas can flow into a safety vent and will minimize possible danger.

A special feature of this TPRD is the rotatable installation possibility. The valve can be aligned exactly according to the necessary piping.

Typically this type of TPRD is used to be installed on tanksystems with more than 1 tank in parallel. It is intrinsic that the threads of the tank-bosses could not be exactly manufactured in an adjusted location. Therefore this kind of TPRD can be aligned proper to the necessary position of the foreseen piping.

- Several years of experience in hydrogen applications
- We are manufacturer of valves, filters, solenoid valves, but we can also deliver complete solutions
- Customized solutions

## **Project list of the last years:**

- HDW: H2 Submarine, ATI-Küste: Deep Sea-submarine
- Magna Steyr: Tank system B-Class
- GM On Tank valve and Gas Handling Unit
- Mobile Filling Station 350 / 700 bar
- Filling Station for hydride storage tanks
- BZ-NRW: 700 bar J99
- Proton Motor: Tank system for H2 Bus, H2 supply for Linde Fork Lifter
- Hydrogenics: Fuel Cell Bus Components
- MAN Truck, Ursus-Bus, Daimler
- DLR: Test Rigg components for Ariane Espace engine test rig
- ZBT Testbenches for H2 projects:
- ZSW-Ulm, Special differential pressure regulator for H2 of APU
- Air Liquide, Air Products, Linde
- OPEL solutions for fuel cell driven cars: GHU / OTV
- Symbio Fcell, Green GT, AUDI, VW, Volco Car, Volvo Truck
- Siemens Train: H2 tank-system
- FutureE
- Amsterdam Ship
- Military Projects
- MUV-Range Extender

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