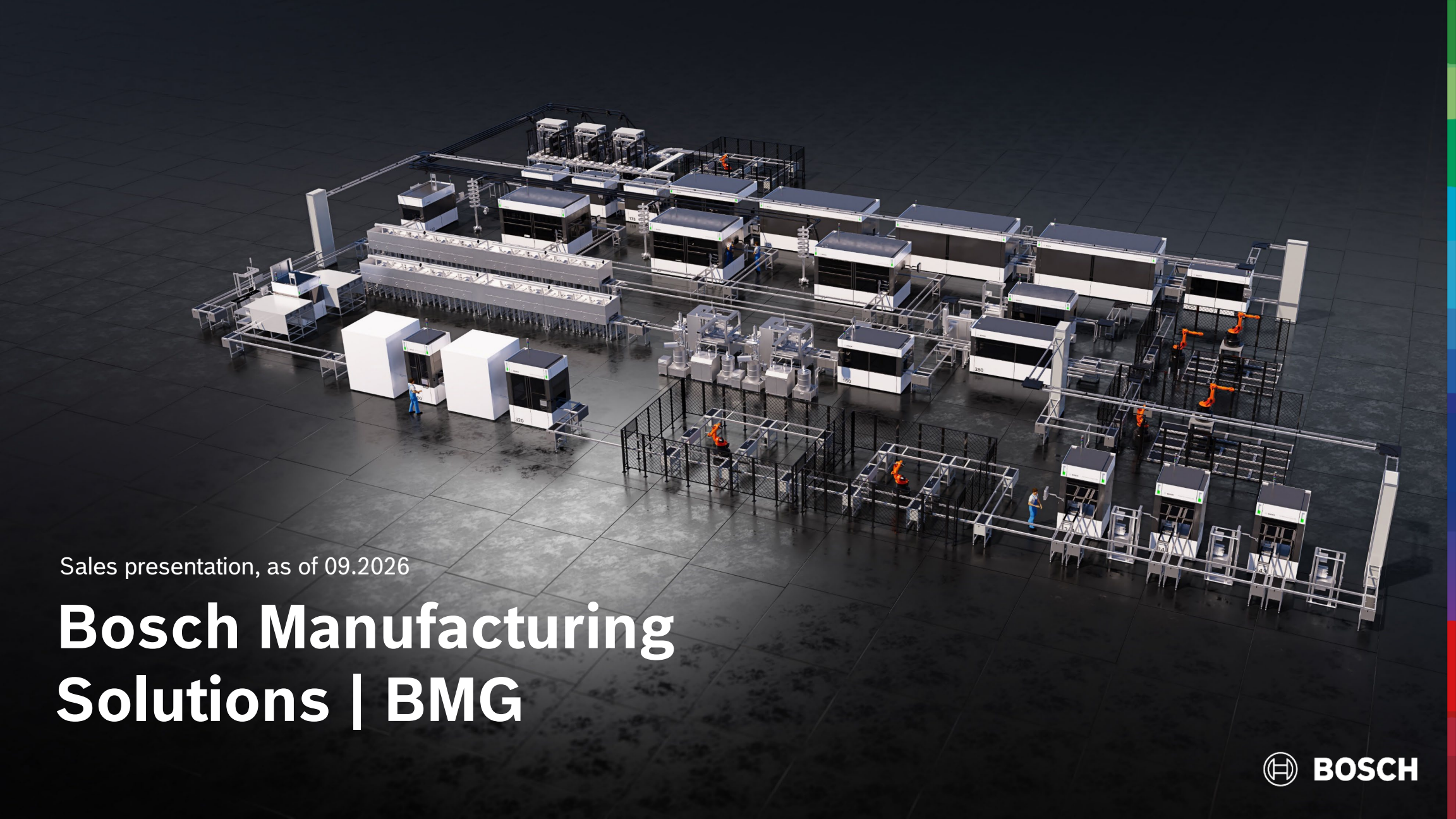


Sales presentation, as of 09.2026

Bosch Manufacturing Solutions | BMG

BOSCH

BMG | **who we are**

Bosch Manufacturing Solutions | BMG – Global industrialization partner & turnkey special machinery provider for

Intelligent Production Equipment & Automation

- > 30 years of experience in systems engineering – from process station to turnkey
- > 5.000 assembly & testing systems
  > 10.000 small & services projects
- Automation level adjustable, semi- to fully automated solutions
- Digital planning & process to digital engineering & i4.0 applications



>17
Locations

Full-liner
portfolio

Several industries & product areas

1.800
Employees

~520
TNS m€

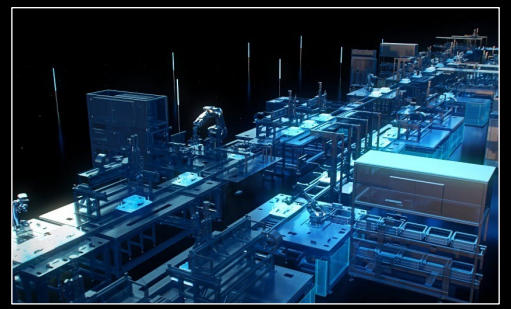
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BMG | **our portfolio**
Customized assembly & testing systems

Global industrialization partner & turnkey special machinery provider for production equipment & automation, offering

Customized assembly & testing systems

empowered by ...



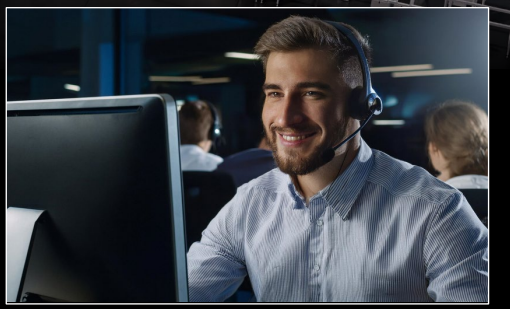
Engineering Consulting & Digital Engineering



Advanced Manufacturing Processes & Technologies



Digital & Intelligent Solutions (IPSuite)

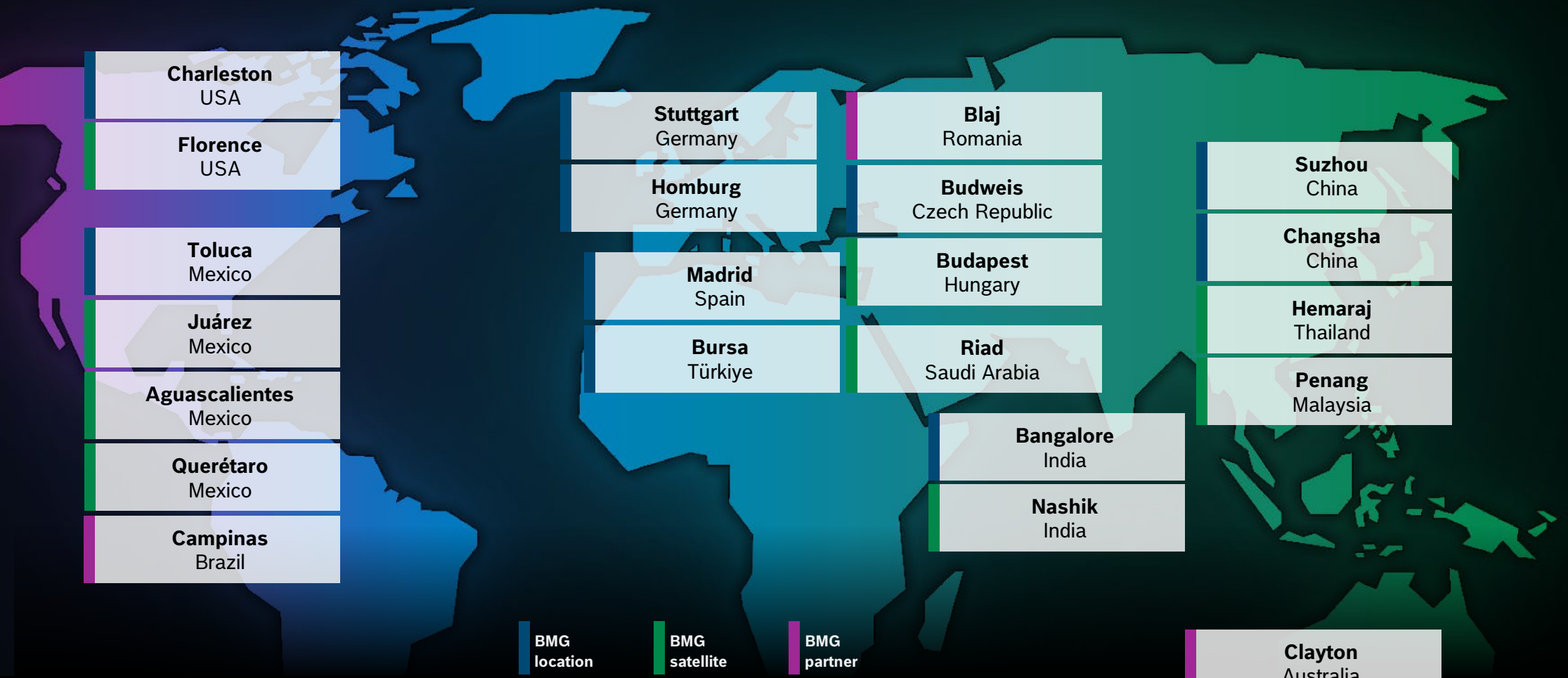


Services along the entire product lifecycle

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BMG | **global strength in network & partners**



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BOSCH

BMG | **references**

Some of our reference customers from 5,000+ systems and 10,000+ projects worldwide:

BOSCH Webasto RIMAC TECHNOLOGY STARK FUTURE

Some of our Ecosystem Partners:

SIEMENS Rexroth ctrlX Schneider Electric KEYENCE COGNEX UNIVERSAL ROBOTS

SICK FESTO BALLUFF FANUC KUKA ABB kassow robots

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BMG | **focus industries & product areas**

Focus industries


eMobility

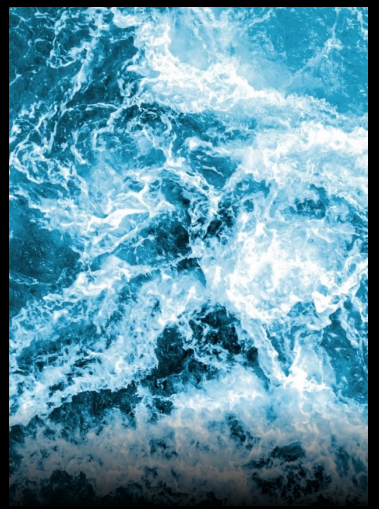

Automotive (ICE)


Energy

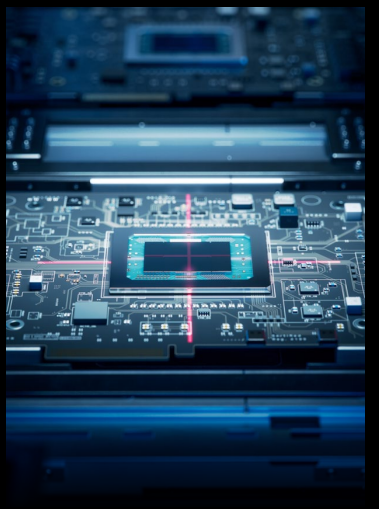

Consumer Goods

Focus product areas

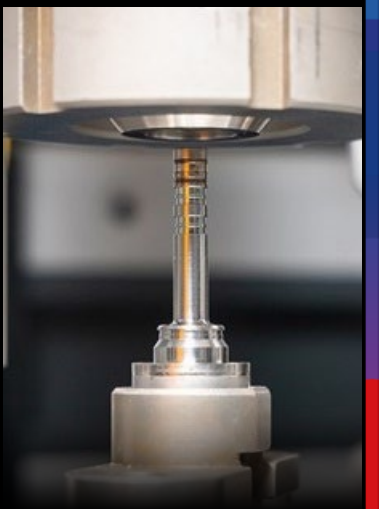

Battery


H2 Solutions / Fuel Cell


eDrive


Sensors & Electronics


Chassis & Steering


Combustion Engine

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BOSCH

BMG | **focus industries & product areas**
H2 Solutions

» **Reference Project NorthH2 & Fraunhofer IWES**

From Water to Energy –

empower your sustainable future with H_2 solutions by Bosch Manufacturing Solutions | BMG, in the area of water purification & electrolysis, fuel cell assembly & testing as well as power generation.



» **H2 circle –**
BMG as system industrialization partner

Water Purification
- » BMG Pure Water System

Electrolysis – from water to hydrogen
- » PEM Ely Stack Testing
- » PEM Electrolyzer System
- » AEM Ely Stack Testing
- » SOEC Stack Testing

Fuel Cell – from hydrogen to energy
- » PEMFC Testing
- » PEMFC – FCPM Assembly & Testing
- » PEMFC – FCPM Power Generator
- » PEMFC – FCPM – Bipolar Plates Processes
- » PEMFC – Coatings

- » Hydrogen Gas Injection
- » GDA – Shot to shot measurements

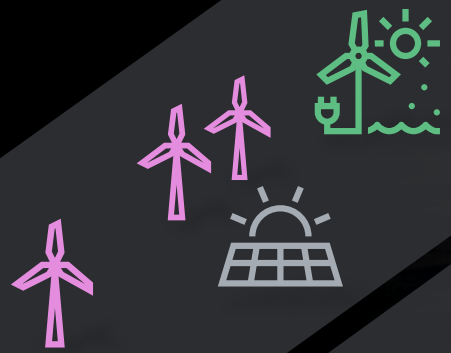
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BOSCH

BMG | H2 Solutions
H2 circle

BMG portfolio & system integrator

Green Energy



Water purification: BMG Pure Water System



Electrolysis:



- Assembly & coating of PEM Electrolysis Stacks & Components
- PEM ELY Stack testing
- PEM Electrolyzer system
- AEM Electrolyzer testing
- SOEC stack testing

H_2 storage & compression*

H_2 filling stations*

H_2 production

Fuel Cell



- Assembly, Coating & Testing of PEM Stacks & Components (MEA, BPP)
- Assembly & Testing of PEM Stack & Components
- Assembly & Testing of Fuel Cell Power Module

H_2 usage



- PEMFC life-time testing
- Power Generator

Bosch portfolio*

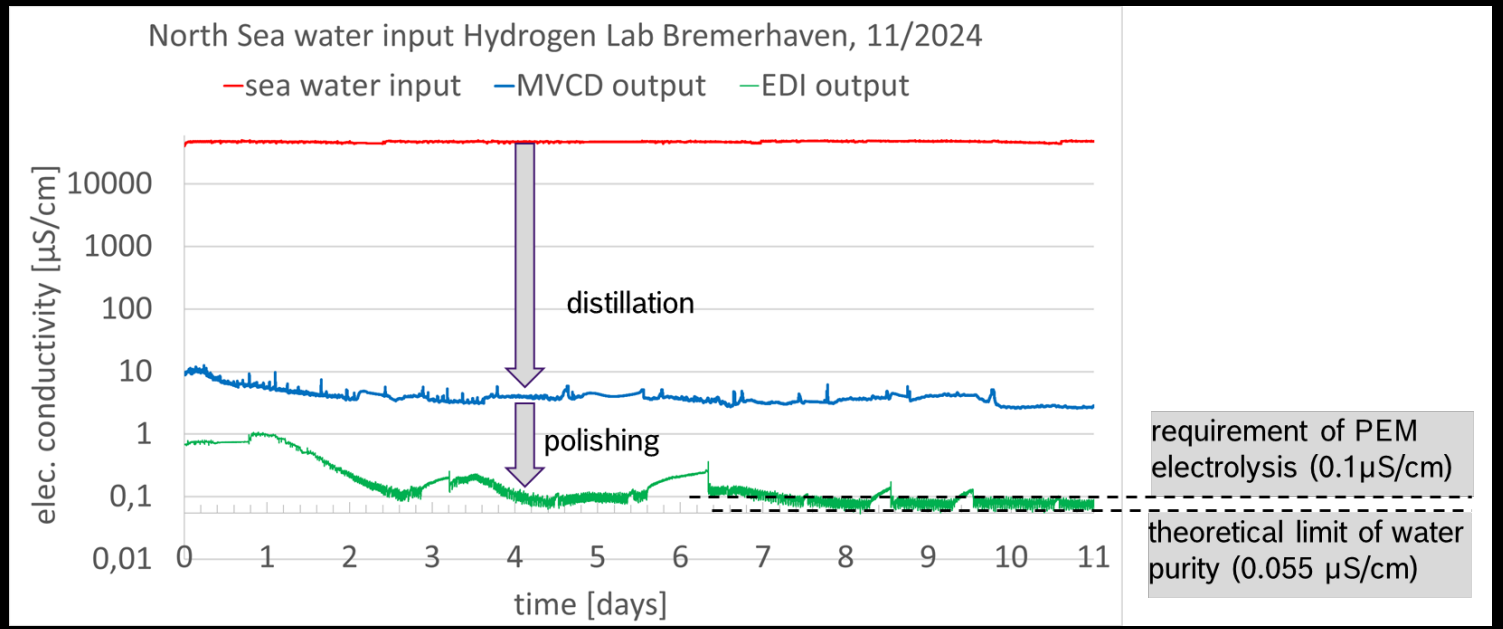
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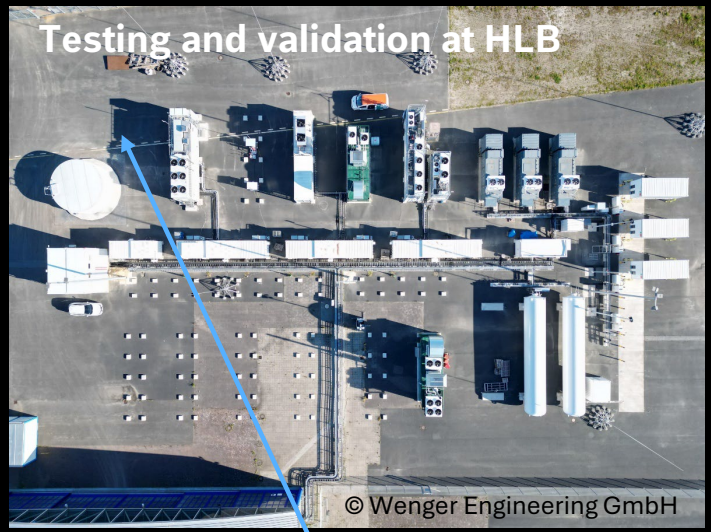
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BMG | H2 Solutions | Reference projects
Fraunhofer IWES Hydrogen Lab Bremerhaven (HLB)

Testing completed with offshore-like conditions

- Process water settles safely into required window of conductivity
- No abnormalities in the analyzed water samples, brine and ultrapure water
- 170,000 liters of seawater (conductivity: 45,000 µS/cm) were treated to obtain ultra-pure water with a conductivity of 0.1 µS/cm





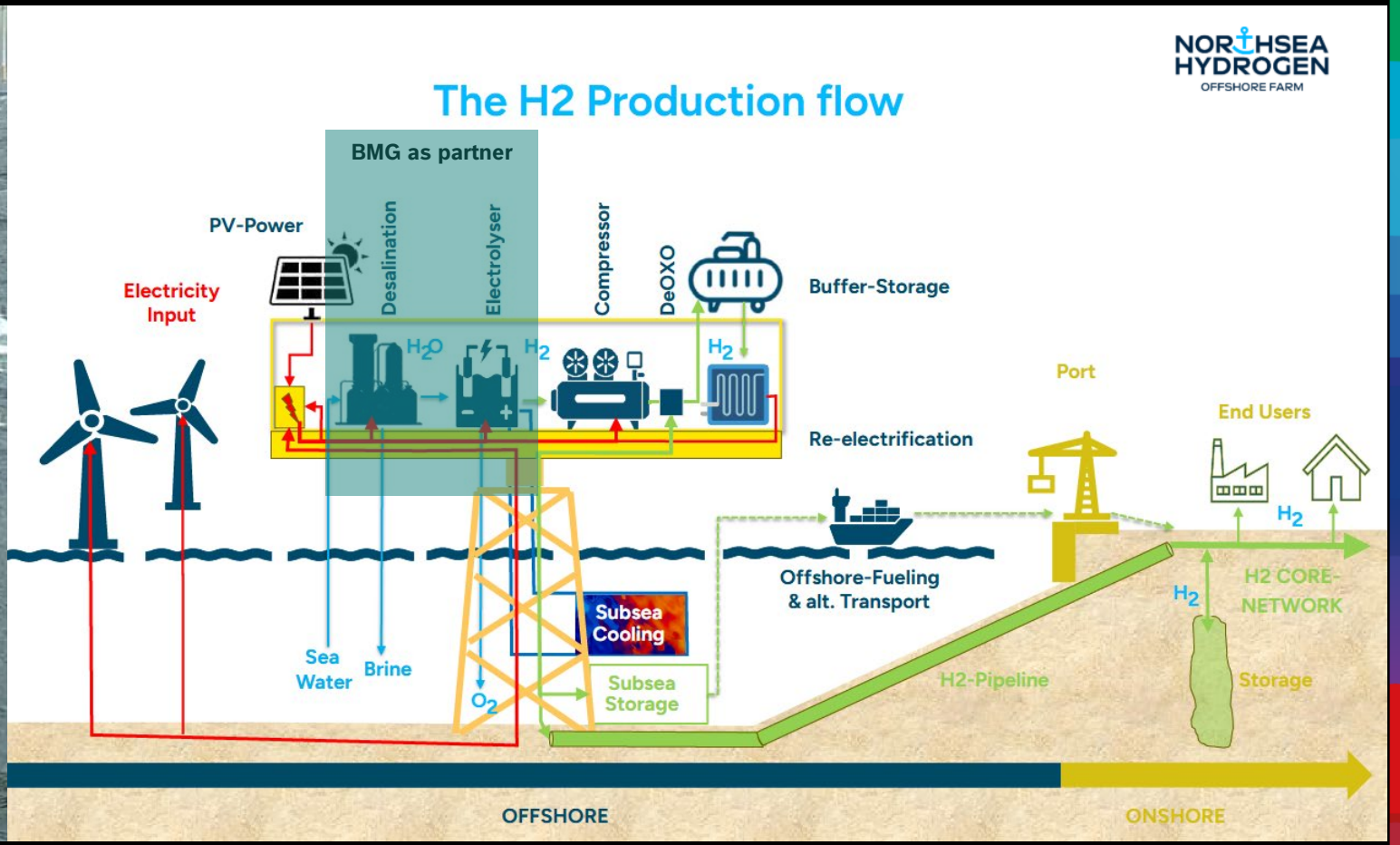


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BMG | H2 Solutions | Reference projects

Partner of NorthH2





Source: Home - Northsea Hydrogen – Offshore Farm

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BOSCH

BMG | H2 Solutions | Water Purification

BMG Pure Water System – Water purification for electrolysis

- Thermal and electrochemical processes to remove constituents (e.g. salts, metals) to obtain high-purity water (0.1 uS/cm)
- Mechanical vapor compression distillation (MVCD), energy-efficient distillation technology, used as first treatment step
- Newly developed for application in remote areas, operating completely without the use of filter media & chemicals
- Compatible with electrolysis capacities up to 15 MW
- Size: 20‘ – 40‘ containers
- Weight: approx. 10 tons
- Input: sea water (50 000 µS/cm)
- Output: up to 3 m³/h of ultra-purewater (0.1 uS/cm)

Benefits

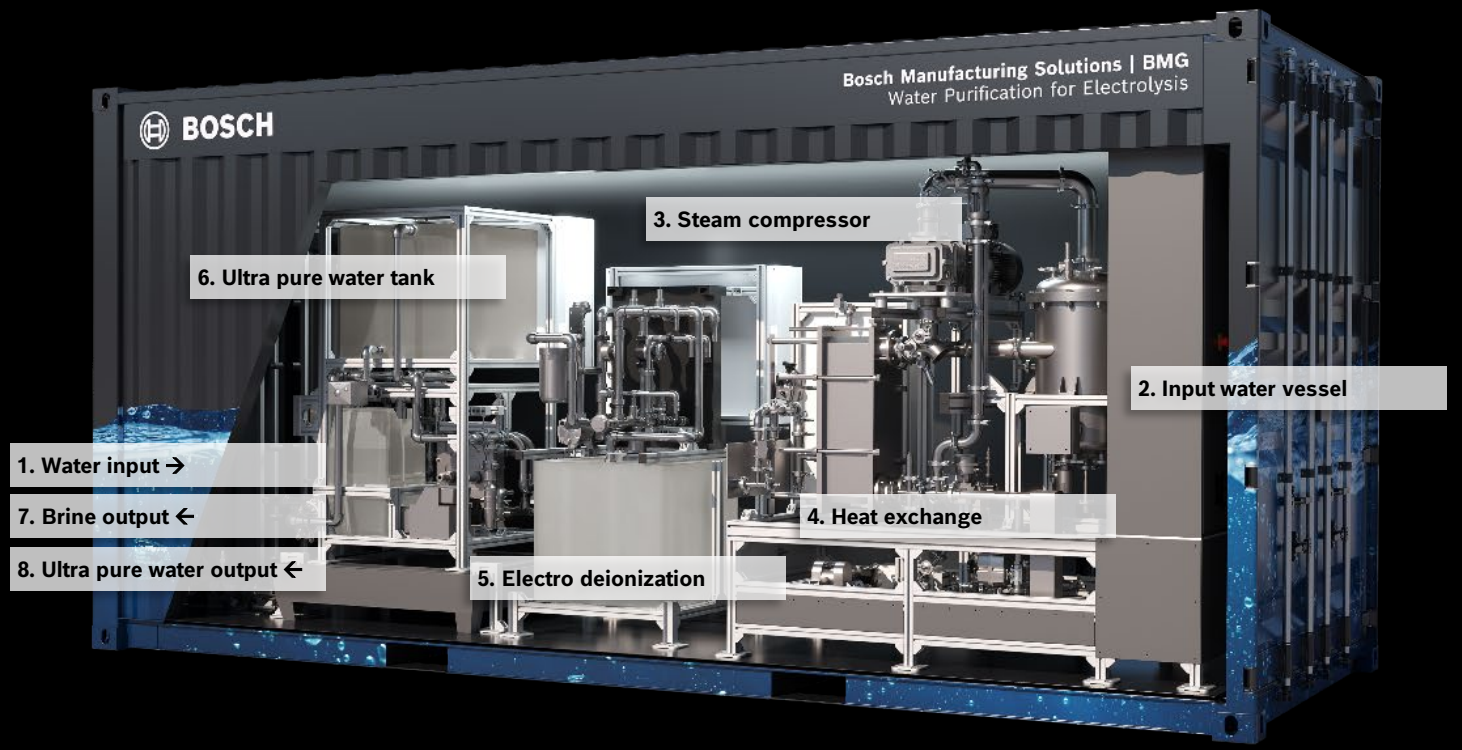
- Saving water and conserving drinking water resources (efficiency 50% to 90%, depending on input water source)
- Minimization of brine disposal & avoidance of the addition of chemicals (zero chemical consumables for purification of saline waters)
- Compatible with renewable energy sources (robust behaviour with frequent start-stop of energy input, dynamics response time with 1 s)
- Cost efficiency due to stable processes and robust technology (< 0.5% of the electrolyzer’s energy consumption)

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BOSCH

BMG | H2 Solutions | Water Purification

BMG Pure Water System – Water purification for electrolysis



Mechanical vapor compression distillation & electro-deionization

- compatible with electrolysis capacities of **up to 15MW**
- **size:** 20‘ – 40’ containers
- **weight:** approx. 10 tons
- **input:** sea water (50 000 µS/cm)
- **output:** up to 3m³/h of ultra-pure water (0.1µS/cm)
- Reference project: North H2, Frauenhofer LAB

robust
low-cost maintenance

save water
preserve drinking water resources

sustainability
tailored to environment

dynamic
using fluctuating energy sources

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BMG | H2 Solutions | Electrolysis
PEM Ely Stack Testing

- Power range stack testing: 10 kW up to 3 MW (up to 5000A) for Short & Full Stack incl. EOL
- Cell voltage measurement up to 200 channels
- Programmable startup- and shutdown procedures with Node RED; Data visualization with Dashboard
- Automatic contacting, conditioning and leakage test

Benefits

- Fully automated, unsupervised operation of the test system via one control
- Automated purging processes with nitrogen or flushing with deionized water
- Pre-pressurization of defined circuits (anode/cathode)
- Level controlled automated gas – liquid separation
- Pre-heating of system and stack with electrical heater
- Precision power measurement (up to 800 V/ 5000 A)
- Customized MES implementation



Power range	Single cell test – up to 10 kW	50 to 100 kW	100 to 400 kW	400 kW to 1.5 MW	1.5 to 3 MW
Min. anode flow range [m³/ h]	0.05	0.1	1	3	11
Max. anode flow range [m³/ h]	1.5	6	21	105	185
Active electrode area [cm2]	Up to 1350	Up to 500	Up to 500	Up to 1550	Up to 1550
Number of cells	1	1 to 30	30 to 100	25 to 160	100 to 320
Max. stack current [A]	4050	Up to 1500	Up to 1500	Up to 5000	Up to 5000
Max. stack voltage [V]	2,3	75	250	400	800
Electrolyte temperature		30°C to 95°C (203°F)			
Water temperature control accuracy [K]		+/- 1			
Delta temperature over stack		5 K (common value, variable but effecting other parameters)			
Heating rate [K/ min]		1 up to 5			

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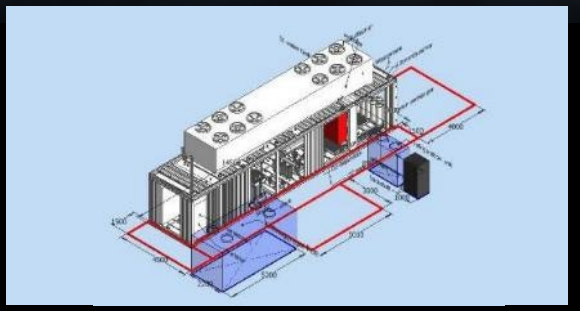
BMG | H2 Solutions | Electrolysis
Electrolyzer Systems – customizable

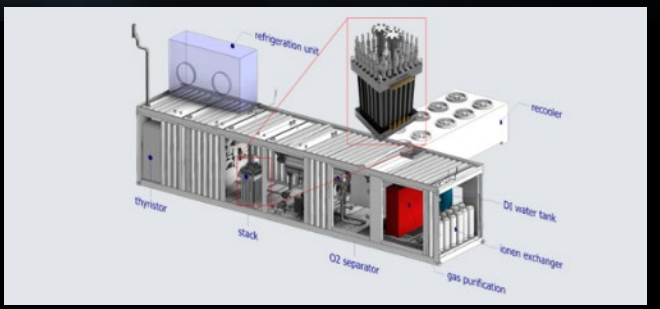
PEM ELY 5MW

- Implementation of larger stacks/systems in container
- Development and realization of process engineering, power supply, control system and safety concept.
- Process controlling and visualization via Dashboard
- Documentation and certification of the complete system
- Reference project: North H2



Key Parameters	1250 PEM Electrolyzer	2500 PEM Electrolyzer
H2 Production Nominal	23 kg/h | 257 Nm3/h	46 kg/h | 514 Nm3/h
H2 Purity	5.0 (ISO 14687-2:2012)	5.0 (ISO 14687-2:2012)
H2 Output Pressure	28 - 32 bar	28 - 32 bar
Required Water Quality	0.1 µS/cm, < 30 ppb	0.1 µS/cm, < 30 ppb
Water Consumption	35-320 kg/h	70-640 kg/h
Electr. conn. PoE	3 x 400 V / 50 Hz, 1500 kW	not transistor incl.
Electr. conn. Peripherals	3 x 400 V / 50 Hz, ca. 150-180 kW	3 x 400 V / 50 Hz, ca. 320 kW
Weight	ca. 45 t	ca. 45 t
Size	40` container (incl. transistor, electrolyzer, gas purification)	40` container (electrolyzer, gas purification)
Additional attachments:	Cooler: ca. 8 m x 2,5 m; ca. 2,5 t	Cooler
	Bundle of nitrogen vessels	Bundle of nitrogen vessels





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BMG | H2 Solutions | Electrolysis
Assembly of PEM Ely Stacks & Components

- Scalable manufacturing & assembly solutions from sample shop to mass production for large and heavy products
- Loads up to 2.5 t
- Simultaneous engineering
- Handling of high loads
- Precise automated solutions for stacking
- Digital closed-loop control
- Key processes: Adjusting, Screwing, Pressing, Leakage Testing



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BMG | H2 Solutions | Electrolysis
AEM Stack Testing

- Covers both single-cell and whole-stack tests, supports dual-side alkali circulation and independent cathode & anode liquid supply schemes
- Power range from 100W to 200kW
- Low-power: Precise material performance measurement, faster screening, and data-driven system optimization
- High-power: Safe and accurate electrolyzer performance testing, validating hydrogen production efficiency

Modular Testing Solutions

- Single-Cell Testing (10W – 1kW)
  - Multi-channel design for parallel material screening & durability testing
  - Automated alkali concentration adjustment (0%-10%) for optimized conditions
  - Precise measurement of electro-osmotic drag & diffusion coefficients
- Stack Testing (10kW – 200kW)
  - Evaluates full-system performance (pressure, temperature, flow rate)
  - IEC 62061 safety design: equal-pressure venting, oxygen-hydrogen detection
  - Comparable to PEM test benches in efficiency and safety



Power range	10 W to 1 kW	1 to 10 kW	10 to 50 kW	50 to 200 kW
Min. anode flow range [NL/min]	0.2	1	6	24
Max. anode flow range [NL/min]	4	50	300	1200
Anode and Cathode pressure [barg]	0-16 (Wider pressure range is optional)			
Alkali circulation mode	Anode / Cathode / Both sides			
Alkali concentration control range [wt%]	0~10% KOH			
Alkali concentration control accuracy	0.2wt%			
Electrolyte temperature	30°C to 80°C (203°F)			
Water temperature control accuracy [K]	+/- 1			
Heating rate [K/ min]	1 up to 5			

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BMG | H2 Solutions | Electrolysis & Fuel Cell
SOEC & SOFC Stack Testing



- Stack testing in an individual portfolio from 50 W up to 15 kW and beyond
- Solution for Short & Tall Stack testing
- Key processes:
  - Functional testing at a wide range of conditions
  - Validation of yield and consumption
- Integrated bidirectional ELA, high accurate cell voltage measurement
- Temperature range up to 850°C
- Hot Box development & build to individual requirement

Benefits

- All kinds of different gas compositions can be implemented (e.g. co-electrolysis, supported electrolysis)
- Operation with natural gas is possible due to integrated reformer
- Flexible test bench software with easy and freely configurable test cycles
- High efficiency due to substantial heat recovery and recirculation

Power range	50 W to 1,5 kW	2 kW to > 15 kW
Gas temperature	Up to 700°C	
Gas temperature control accuracy	+/- 1°C	
DI-water / steam flow range / g/h	300	20000
Air temperature range	Up to 850°C	
Electrical power range kW (easy expandable)	1,5 bidirectional	> 15 bidirectional
Air temperature control accuracy	+/- 1°C	

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BMG | H2 Solutions | **PEMFC**

PEMFC Stack Testing

- Stack testing in a range up to 600 kW
- Cell voltage measurement up to 1000 channels
- Programmable startup- and shutdown procedures
- Automatic leakage test before each test
- Flexible testing procedures
- Power ranges: 5 kW, 10 kW, 30 kW, 100 kW, 150 kW, 200 kW, 250 kW, 600 kW
- Applications: Engineering
- Adaptation: Manual and semi-automatic
- Options: Climate chamber (-40°C to +120°C), hot/cold start, recirculation, back pressure control, high dynamic humidification



Benefits

- Recirculation saves up to 50% of hydrogen during test
- High dynamic change of operation point within 2 seconds

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BMG | H2 Solutions | **PEMFC**
FCPM Assembly (Fuel Cell Power Module)

- Scalable and flexible solution for the assembly of Fuel Cell Power Modules (FCPM) and other systems from sample shop to series production
- Handling of large and heavy products (e.g. fuel cell stacks and other system parts)
- Accurate leakage test of big fuel cell systems
- Key processes: manual assembly with automized processes, screwing, leakage testing, electrical testing, SW flashing, operator guiding system, data traceability
- 650 process steps
- Weight of product: 560 kg
- Dimensions (width x height x depth): 1.2 m x 0.7 m x 1.0 m
- 1500 single parts
- 200 kW electrical power



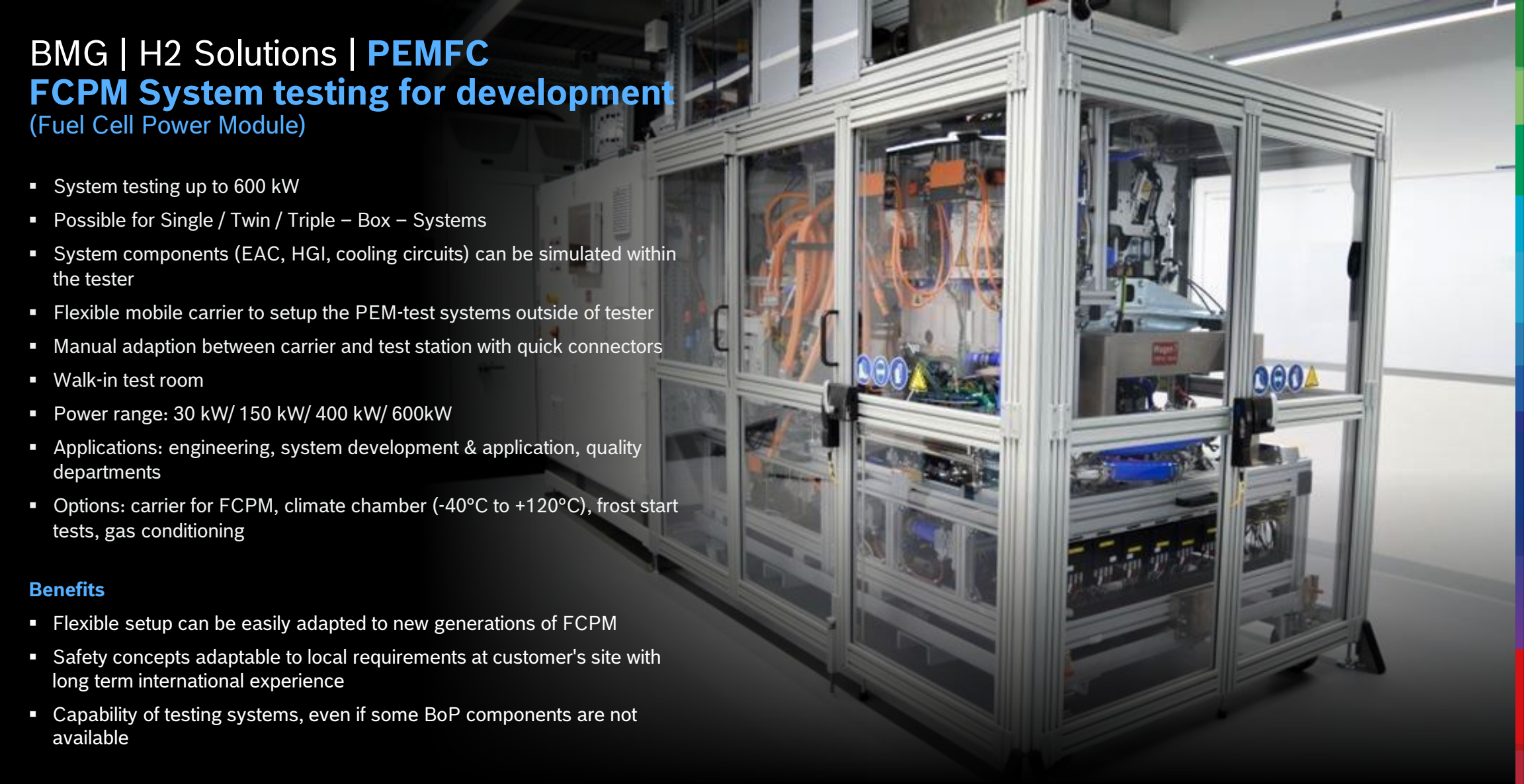
Benefits

- High ergonomic standards
- Guidance system for operator for each working step
- Intelligent data analysis and quality-controlled optimization of manufacturing & production processes

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BMG | H2 Solutions | PEMFC
FCPM System testing for development
(Fuel Cell Power Module)

- System testing up to 600 kW
- Possible for Single / Twin / Triple – Box – Systems
- System components (EAC, HGI, cooling circuits) can be simulated within the tester
- Flexible mobile carrier to setup the PEM-test systems outside of tester
- Manual adaption between carrier and test station with quick connectors
- Walk-in test room
- Power range: 30 kW/ 150 kW/ 400 kW/ 600kW
- Applications: engineering, system development & application, quality departments
- Options: carrier for FCPM, climate chamber (-40°C to +120°C), frost start tests, gas conditioning



Benefits

- Flexible setup can be easily adapted to new generations of FCPM
- Safety concepts adaptable to local requirements at customer's site with long term international experience
- Capability of testing systems, even if some BoP components are not available

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BMG | H2 Solutions | **PEMFC**
FCPM Life-time-Container (Fuel Cell Power Module)





Endurance test for fuel cell power module (FCPM)

- Endurance tests for up to 4 x 300kW FCPM under real conditions with hydrogen
- The electrical power up to 1.2 MW produced during the tests can be fed back into the grid
- Each test cell can be entered and run individually

Power range	200 kW to 800 kW	300 kW to 1200 kW
H2-consumption (up to)	Up to 850 kg/d	Up to 1300 kg/d
DI-water production (up to)	7.6 t/d	11.5 t/d
Air throughput (up to)	57 t/d	86 t/d
Max electrical power	0.8 MW	1.2 MW
Net electrical energy	7 GWh/a	10.5 GWh/a
Dimensions	14.5 x 3.2 x 3.1m	14.5 x 3.2 x 3.1m

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BMG | H2 Solutions | PEMFC
FCPM Power Generator



Various Fuel Cell Power Modules are possible

BMG Power Generator

- Fully automatic, CO2-neutral, unattended & safe electrical energy – whether as an emergency power generator or as a continuous runner
- Customizable for range from 200 kW to 1 MW with approx. 64 kg of hydrogen per hour (extendable to 1.7 MW)

Key parameters	PowerGen 450	PowerGen 1000
Normal power	200 – 450 kW prospective 850 kW 1 – 4 fuel cells	600kW – 1 MW prospective 1,7 MW 5 – 8 fuel cells
Peak efficiency fuel cell	58%	58%
Operating temperature	~ 30 – 45 °C	~ 30 – 45 °C
Max altitude	2000 m	2000 m
Starting temperature	> -30 °C	> -30 °C
Starting time at ambient temperature	< 28 sec	< 28 sec
Startup time at low temperature	< 200 sec	< 200 sec
Nominal hydrogen inlet working pressure	14,5 – 17,5 bara	14,5 – 17,5 bara
Weight	ca. 30 t	ca. 45 t
Size	9 m x 3 m x 3,1 m	14,5 m x 3 m x 3,1 m
Includes components	IPC, DC/AC, transformator	IPC, DC/AC, transformator
Additional attachments	– Cooler: on the roof – Bundle of nitrogen vessels – Bundle of hydrogen vessels – Compressor of pressurized air (tbc)	– Cooler: on the roof – Bundle of nitrogen vessels – Bundle of hydrogen vessels – Compressor of pressurized air (tbc)

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BMG | H2 Solutions | PEMFC
FCPM End of Line System Testing

- System testing up to 600 kW
- Tests with Single/ Twin/ Triple – Box – Systems possible
- Used for test of complete customer system before delivery
- Quick connection system to minimize cycle time
- Mobile carrier to setup and pretest the FCPM in other stations prior to connect to tester
- Automated quick connection system for all interfaces between carrier and tester to minimize cycle time
- Flexible testing procedures to assure test of specified FCPM key parameters
- Power range: 150 kW – 600 kW
- Applications: Manufacturing, End of line testing of FCPM systems
- Adaptation: Automated quick connection system for all interfaces
- Options: Carrier, moving system for carrier, calibration equipment, integration or simulation of DC/DC-converters in tester

Benefits

- Flexible setup can be easily adapted to new generations of FCPM
- Load point profiles can be created based on end user's requirements
- Multi coupling system with leakage free connections for all media connects FCPM within 5 minutes
- Safety concepts adaptable to local requirements at customer's site with long term international experience



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BMG | H2 Solutions | PEMFC
FCPM Leakage Testing

- Enhanced leakage testing with the appropriate technology depending on your requirement: pressure drop, massflow, helium-in-air or hydrogen testing
- Ready to test and scalable / expandable solution
- Seamless transferability from development to serial production for leak testing solutions
- Smallest leak rates: 1E-6 mbar*l/s
- Leakage detection example: 1 µm defect/leak
- Testing chamber: up to 10.000 liters
- Testing specimens up to 2 m³



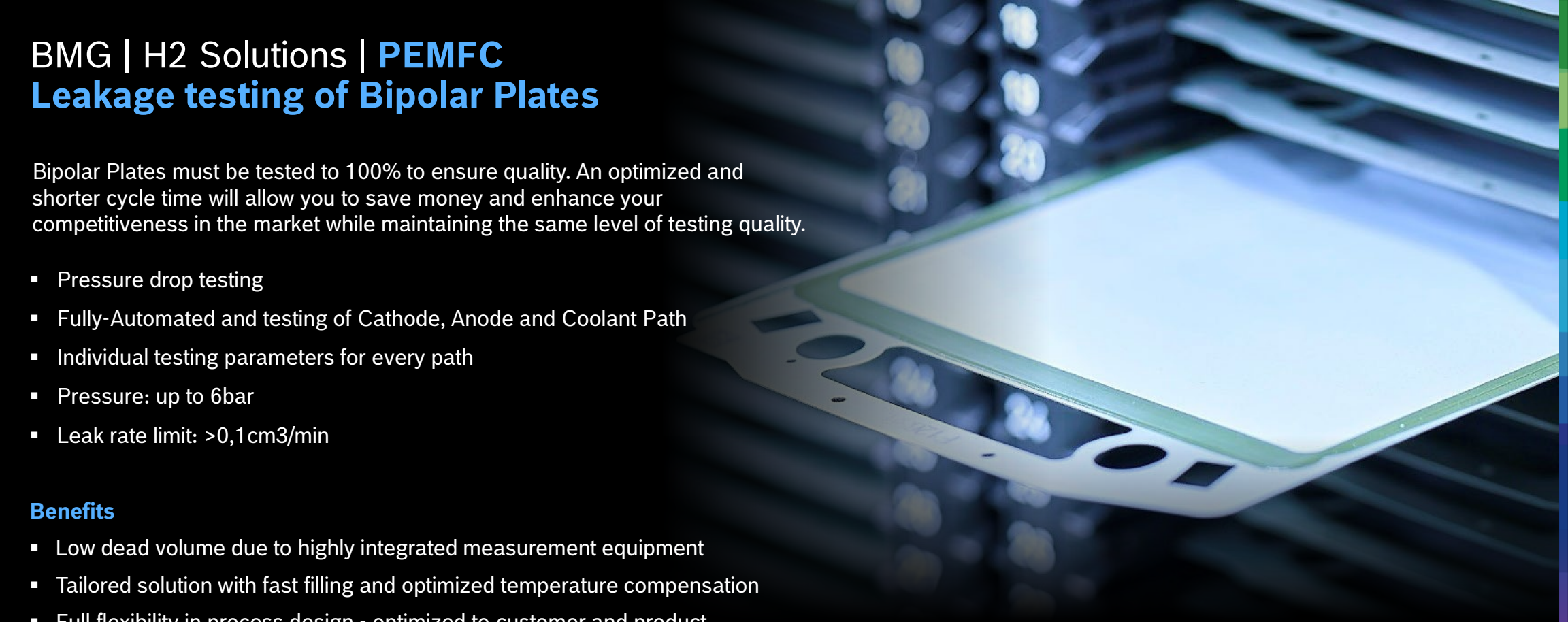
Benefits

- Process optimization through preliminary experiments with cycle time reduction up to 35%
- A configurable standardized software for all applications, providing flexibility and ease of use across diverse operational needs
- Evacuation of the chamber is not necessary leading to reduction of costs by 10%
- Unique optimized He-in-Air technology which enables the detection of smallest leak rates of huge components

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BOSCH

BMG | H2 Solutions | PEMFC
Leakage testing of Bipolar Plates



Bipolar Plates must be tested to 100% to ensure quality. An optimized and shorter cycle time will allow you to save money and enhance your competitiveness in the market while maintaining the same level of testing quality.

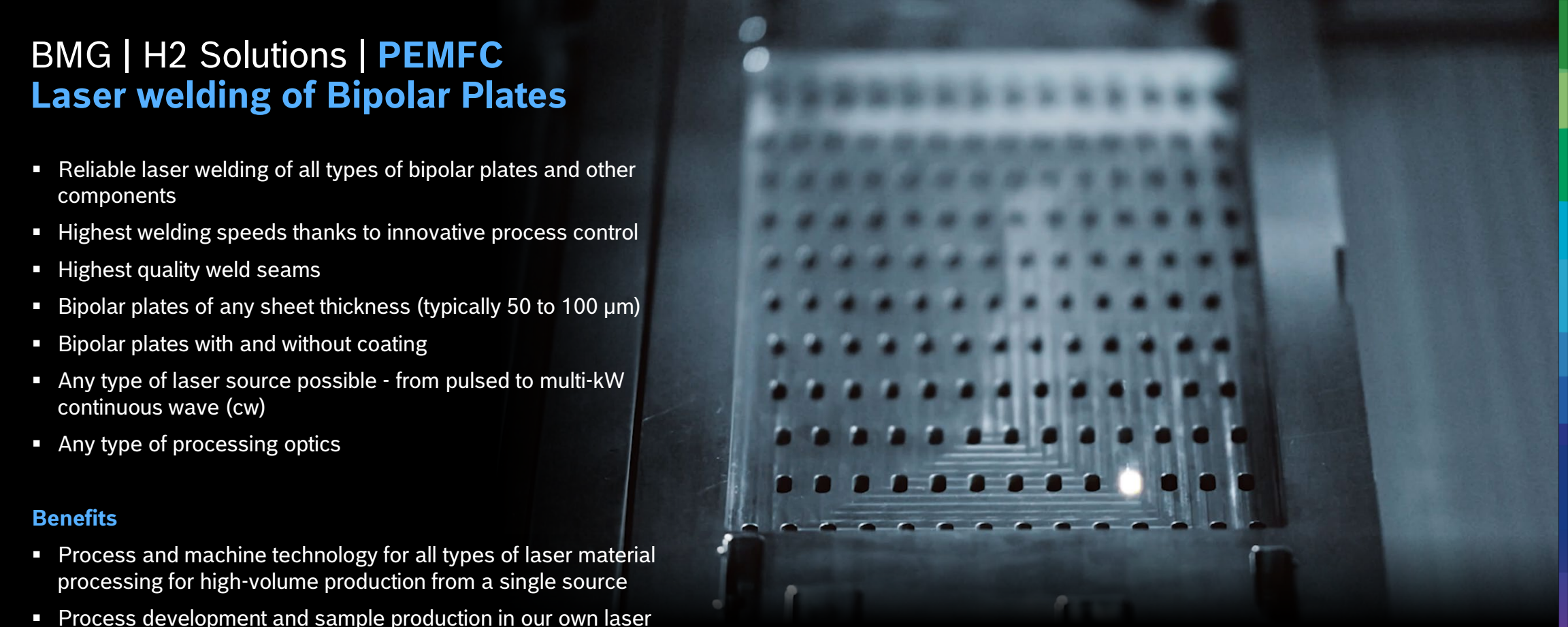
- Pressure drop testing
- Fully-Automated and testing of Cathode, Anode and Coolant Path
- Individual testing parameters for every path
- Pressure: up to 6bar
- Leak rate limit: >0,1cm3/min

Benefits

- Low dead volume due to highly integrated measurement equipment
- Tailored solution with fast filling and optimized temperature compensation
- Full flexibility in process design - optimized to customer and product requirements
- < 15 s cycle time for all 3 tests
- 35% better than state of the art

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BMG | H2 Solutions | PEMFC
Laser welding of Bipolar Plates



- Reliable laser welding of all types of bipolar plates and other components
- Highest welding speeds thanks to innovative process control
- Highest quality weld seams
- Bipolar plates of any sheet thickness (typically 50 to 100 µm)
- Bipolar plates with and without coating
- Any type of laser source possible - from pulsed to multi-kW continuous wave (cw)
- Any type of processing optics

Benefits

- Process and machine technology for all types of laser material processing for high-volume production from a single source
- Process development and sample production in our own laser laboratory
- Decades of experience in the field of laser material processing

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BOSCH

BMG | H2 Solutions | PEMFC
Stack Leakage Testing

One important leakage test for the Stack is the permeation between the anode and cooling path. With our unique accumulation method **“He-in-pressure”** smallest leakages in a pressurized volume (coolant) can be detected. Another important test is the leakrate of each single path: Anode – Cathode – Coolant.

Permeation test:

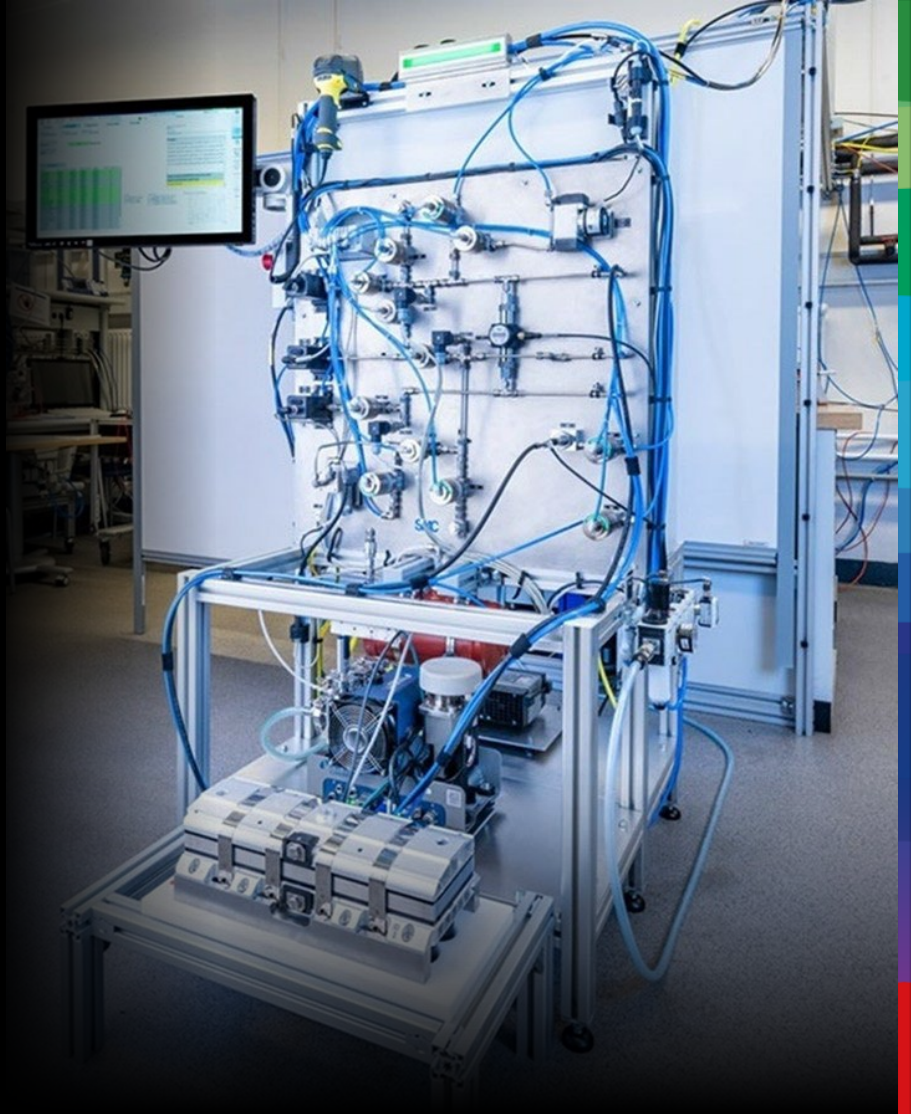
- Pressure Anode/Cathode: 0,5 - 2,5 bar He/N
- Pressure: up to 6 bar
- Leakage: >1 ml/min

Leakage test of Coolant/ Anode/ Cathode:

- Cathode: < 4 cm³/min
- Anode: < 4 cm³/min
- Coolant: < 2 cm³/min

Benefits

- Accumulation technology without separate chamber by developing new technologies which can test the permeation in a pressurized volume
- Tailored massflow set up
- Cycle time < 120s



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BOSCH

BMG | H2 Solutions | PEMFC
Optical Inspection for Bipolar Plates



- High quality optical inspection machines and solutions for all kinds of fuel cell stack components and other parts
- Closed process control-loop of image processing to maintain process tolerances
- Powerful software framework for processing of large amount of data in short cycle time
- Variety of handling processes from pick-and-place to roll-to-roll
- Wide variety of proven high speed 2D and 3D image acquisition sensor systems
- Lateral resolutions down to few µm
- Hight measurements with µm precision in-line
- Short cycle times of seconds

Benefits

- High speed, high resolution sensor systems to guarantee short cycle time, maximum cost-effectiveness and best inspection quality
- Highly capable measurement systems according to quality guidelines
- 30 years of experience in close integration of machine vision systems for inspection and process guiding into handling technology
- Full-equipped machine vision lab for development of innovative applications

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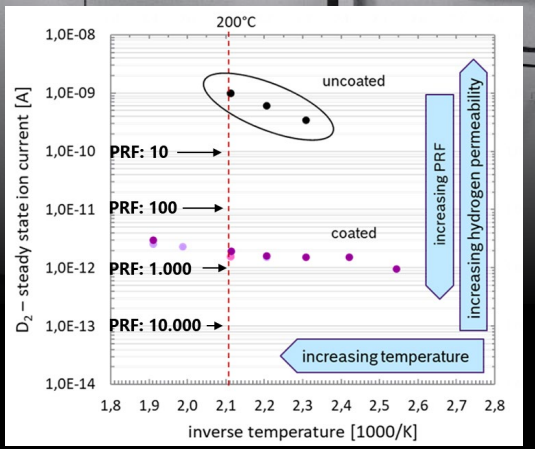
BOSCH

BMG | H2 Solutions | PEMFC
Hydrogen Permeation Testing

- Hydrogen permeation measurement in a gas atmosphere
- Two vacuum chambers separated by a sample membrane
- Deuterium used as hydrogen carrier and permeation gas
- Mass spectrometer for precise gas analysis
- Testing temperature up to 250°C
- Sample geometry:
  - Circular blank
  - Diameter: 33 mm
  - Thickness: 0,5 mm

Benefits

- Measurement result corresponds to the established evaluation parameters (permeation reduction factor (PRF), diffusion coefficient)
- No corrosion effects that can influence the results
- Easy integration into common lab environments with no special requirements needed: 1,2 m x 2,2 m x 0,7 m (W x H x D)
- In-house testing system for rapid job measurements & fast time to market
- Increased test temperature allows for accelerated measurements in less than 3 hours (depending on sample) → suitable for materials with lower permeability, e.g. metals



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BMG | H2 Solutions | **Electrolysis**
PEMFC / PEM Ely Plasma Coating

- Increase of performance and strengthening resistance to corrosion
- PVD technology: coat ELY components with precious metals in an extremely resource-saving manner
- PVD & PA-CVD technology: coat FC components with price competitive protective and functional layers (e.g. carbon-based coatings)
- Single- and double-sided coating
- Horizontal & vertical machine layout
- Inline coating systems for flat substrates
- High speed - approx. 1 sqm/min for standard layers
- Coating materials options: DLC, GLC, Cr, Ti, Au, Ag, Pt and many others

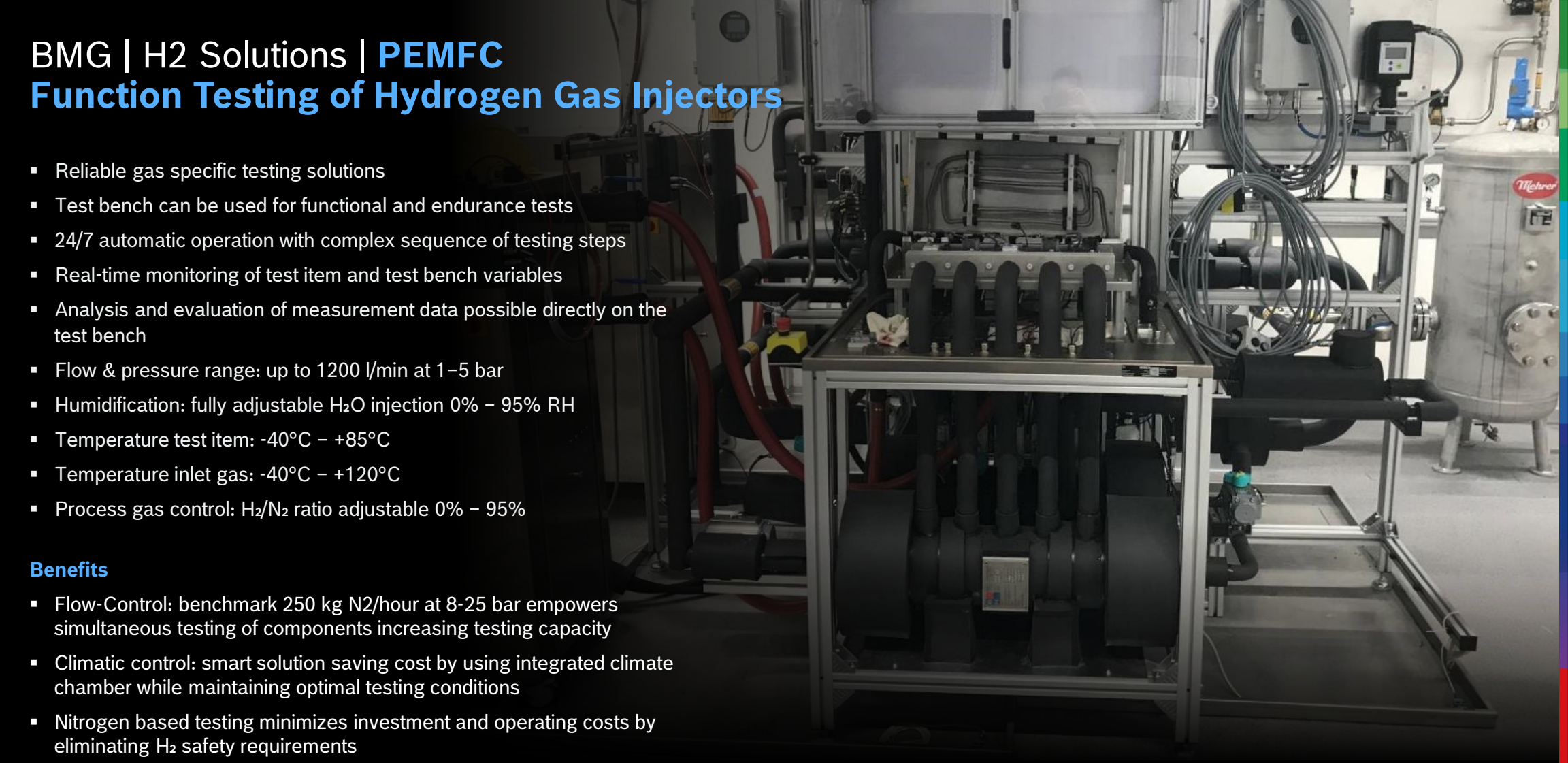


Benefits

- Own inline coating system and well-equipped laboratory enables samples at short notice and accelerated time to market
- Inline concepts results in very homogeneous coating thickness of ± 5%

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BMG | H2 Solutions | PEMFC
Function Testing of Hydrogen Gas Injectors



- Reliable gas specific testing solutions
- Test bench can be used for functional and endurance tests
- 24/7 automatic operation with complex sequence of testing steps
- Real-time monitoring of test item and test bench variables
- Analysis and evaluation of measurement data possible directly on the test bench
- Flow & pressure range: up to 1200 l/min at 1–5 bar
- Humidification: fully adjustable H_2O injection 0% – 95% RH
- Temperature test item: -40°C – +85°C
- Temperature inlet gas: -40°C – +120°C
- Process gas control: H_2/N_2 ratio adjustable 0% – 95%

Benefits

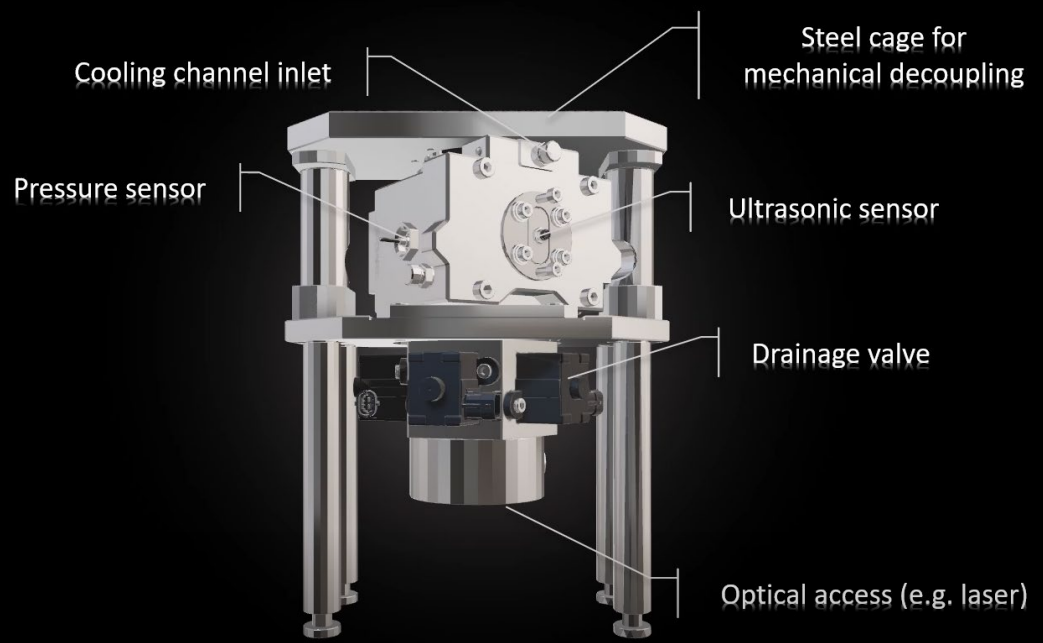
- Flow-Control: benchmark 250 kg N2/hour at 8-25 bar empowers simultaneous testing of components increasing testing capacity
- Climatic control: smart solution saving cost by using integrated climate chamber while maintaining optimal testing conditions
- Nitrogen based testing minimizes investment and operating costs by eliminating H_2 safety requirements

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BOSCH

BMG | H2 Solutions
GDA – Shot to Shot Measurement Systems

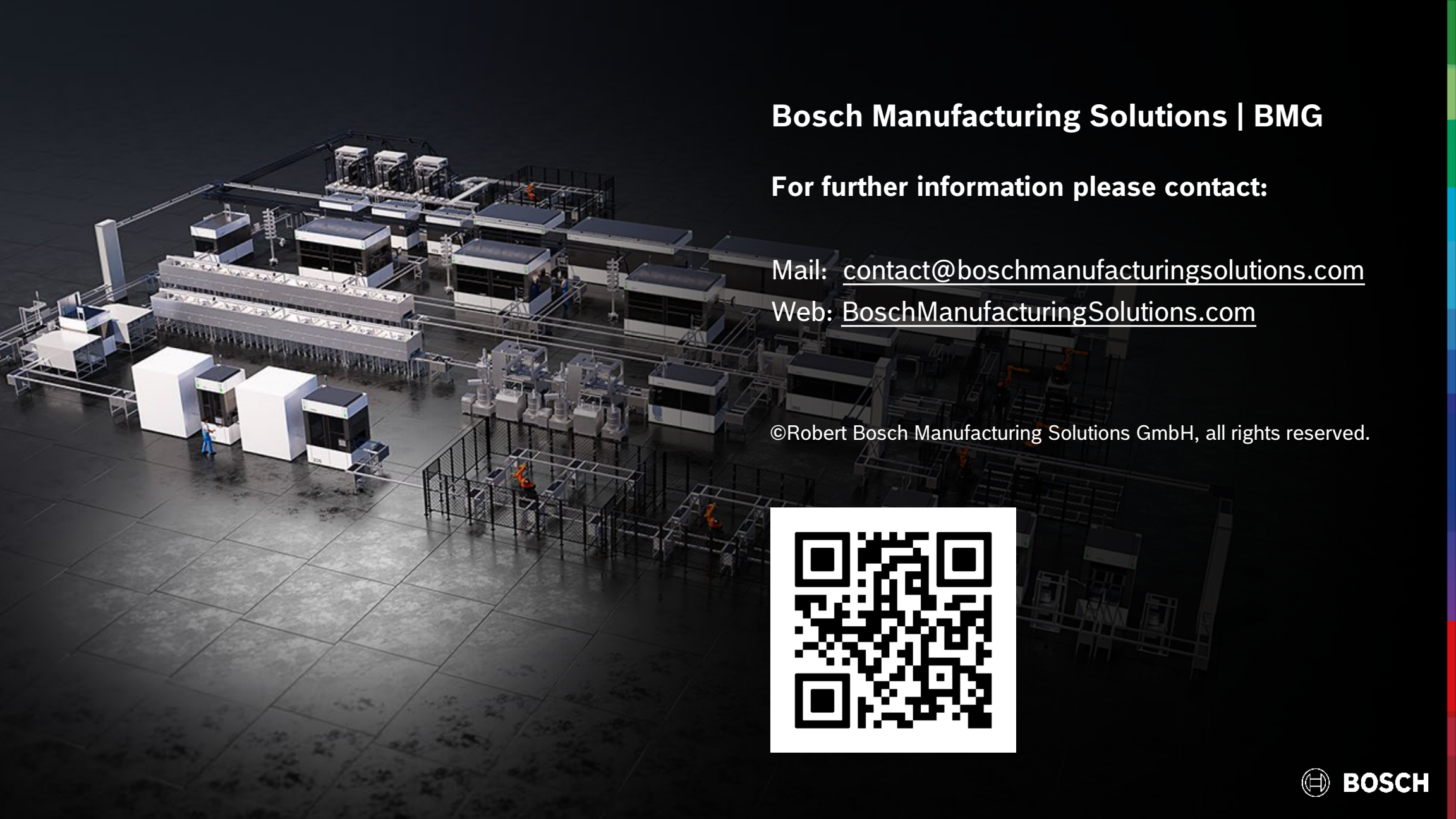
- Real Shot-to-Shot measurements
- Precise determination of mass rate and injection timing across a large measurement range
- Measurements with low back pressure possible (1,5bara)
- One measuring system for multiple gases (N_2, Air, future: Forming gas and H_2)
- Optical access (e.g., laser) for advanced diagnostics such as injector lift measurement
- No cooling required Optional tempering of the measuring chamber
- Standard measurement range up to 2000 mg N_2 per cycle
- No additional nitrogen supply required - back pressure is generated by test sample itself



Benefits

- Increased measurement efficiency through synchronized multi-parameter acquisition, reducing test cycle times
- One universal device covering multiple gas types, lowering investment & equipment costs
- No external nitrogen supply needed, leading to reduced operating expenses and simplified setup
- Flexible and quick adaptation to different injector types, increasing lab and test bench utilization

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Bosch Manufacturing Solutions | BMG

For further information please contact:

Mail: contact@boschmanufacturingsolutions.com
Web: BoschManufacturingSolutions.com

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BOSCH

Bosch Electrolyzer Solutions

BOSCH

Our technology is...

1. low-emission
2. reliable & of highest quality
3. powerful & built to scale
4. constantly optimized
5. service-enriched



Partner community

BOSCH

A centerpiece

of the new



BOSCH

A low-emission centerpiece of the new energy now



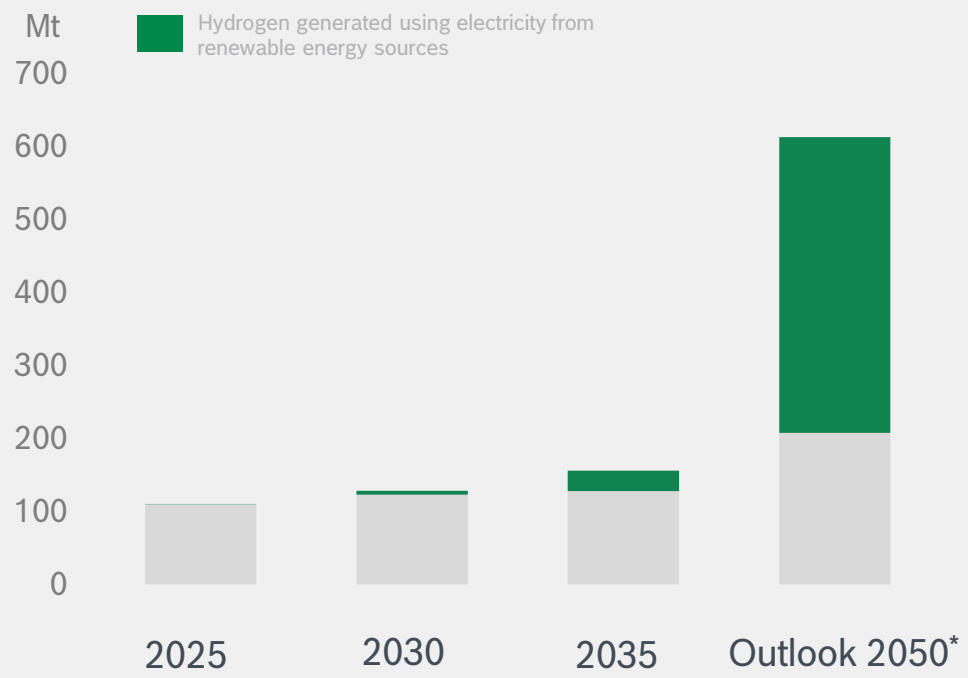


- PEM electrolysis for fluctuating loads
- Reduced CO_2 emission

BOSCH

Clean H2 is a major part of
Our energy future

Worldwide development of H_2 demand [Mt]



*International Renewable Energy Agency (Irena) 1.5° scenario

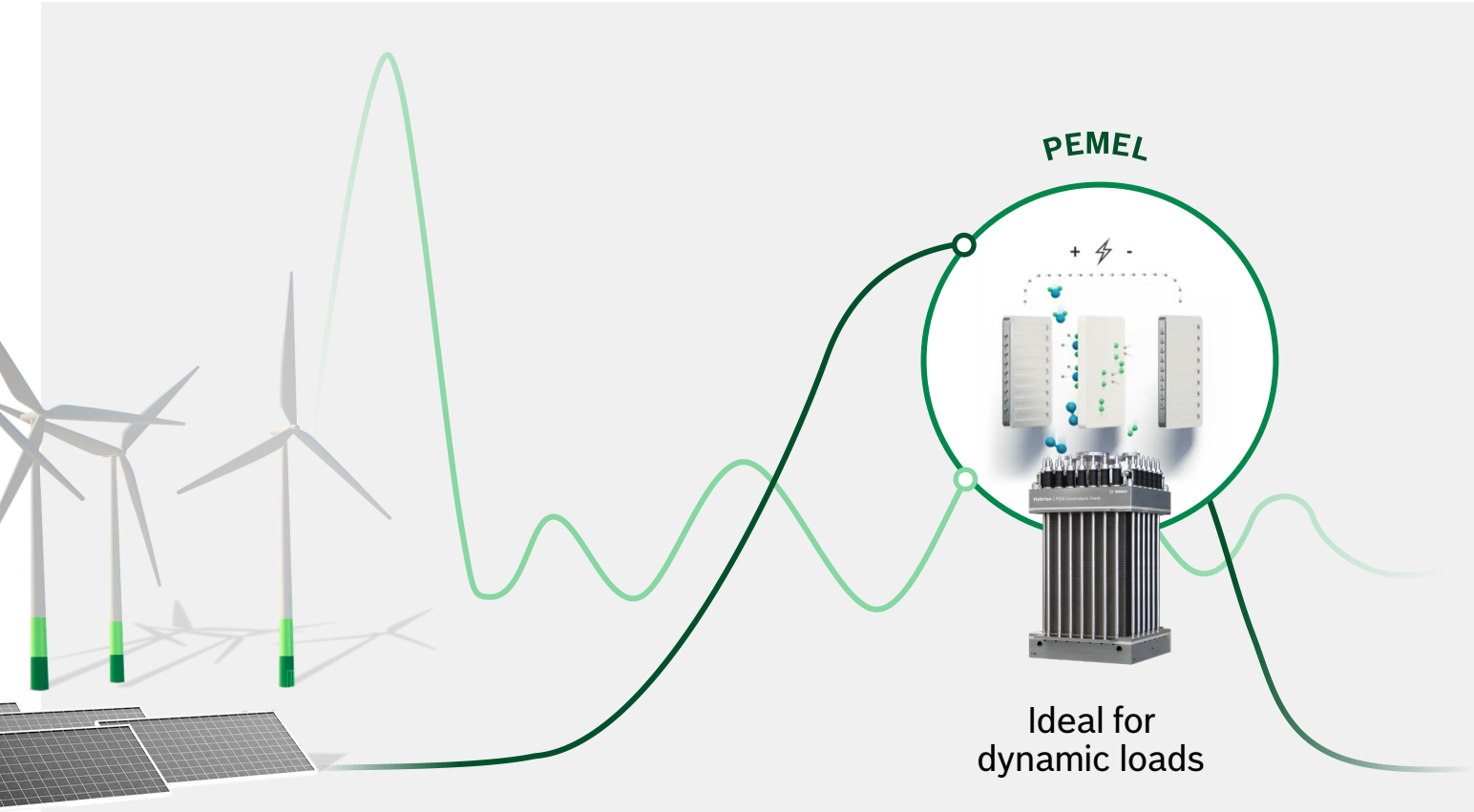
5.5 Mt green hydrogen by 2030 equals**

- Fueling 69 Mio fuel cell trucks
- Producing 31 Mt green Ammonia
- Producing 91 TWh electricity

** Assumptions: 1) H_2 truck w/ 80kg H_2 tank; 2) w/o losses; 3) Fuel cell efficiency of 50%

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Proton Exchange Membrane Electrolysis
Best choice for renewable energy



- \+ Optimizing Renewable Energy Use, e.g. by using overcapacities
- \+ Compact and modular design
- \+ Technology longevity
- \+ High H_2 purity and operating pressure
- \+ Low OPEX
- \+ Fast modulation and wide operating range

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Where we want to go
Hydrogen at Bosch

“Hydrogen plays a central role in a climate-neutral world (...) It can be produced, stored, and transported almost anywhere, and in a climate-neutral way.
For Bosch, hydrogen continues to be a strategically important business.”

Dr. Markus Heyn,
Member of the Bosch board of management

Source: Bosch media service LINK, retrieved March 25, 2026

BOSCH

Climate-neutral production
Four levers of climate action activities

Energy efficiency

New clean power

Green electricity

where necessary
Carbon offset







The Bosch Group with its 450 locations worldwide has been carbon neutral (scopes 1 and 2) since 2020.
We also work to reduce scope 3 emissions, e.g., at suppliers, in logistics, and during product use.

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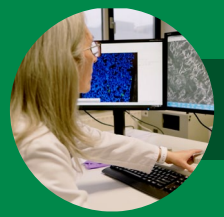
low-emission

A reliable & of highest quality centerpiece

powerful & built to scale

constant

of the new energy now



>30 years of
fuel cell research



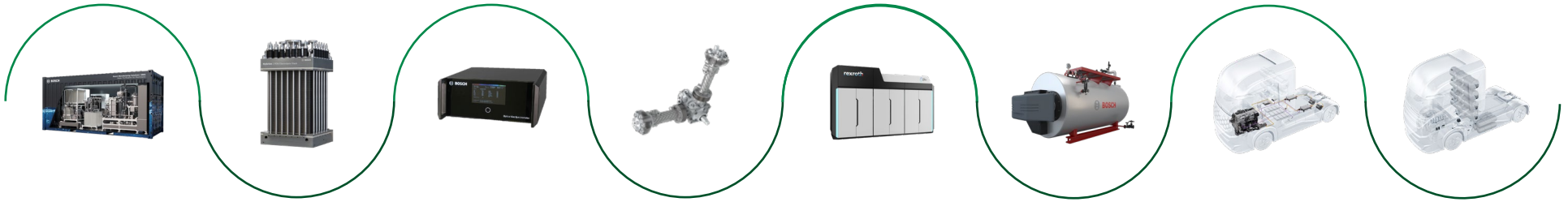
Automotive
standards & grade



BOSCH

Bosch H_2 portfolio
brings in the maximum knowledge span

Production | **Storage & Distribution** | **Usage**



Pure water System

PEM electrolysis stack

Optical gas spectrometer

Compact gas compressor

CryoPump station

Universal steam boiler

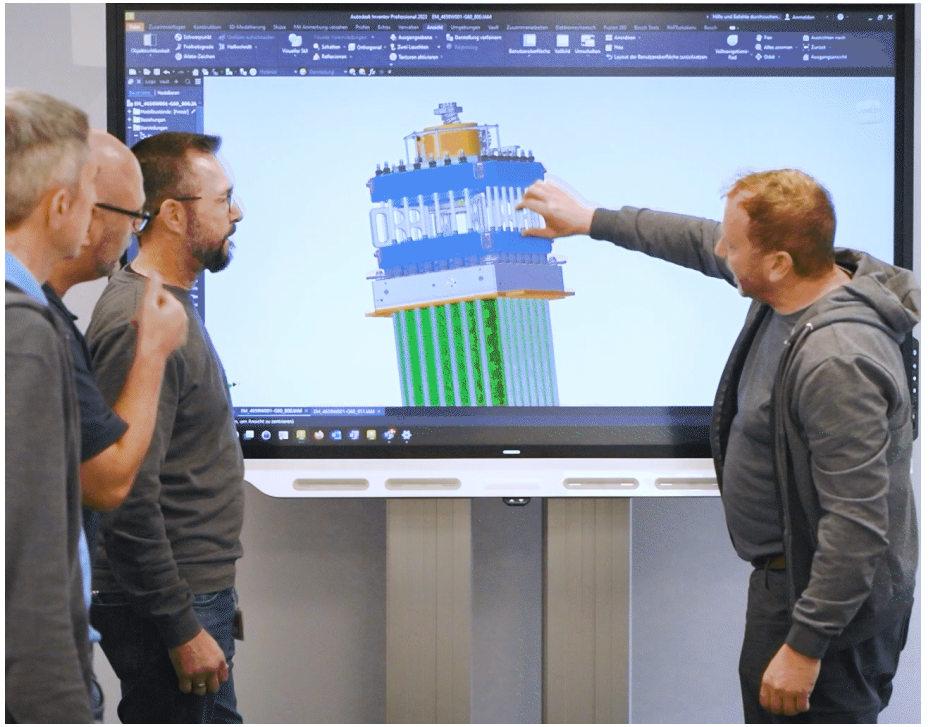
Fuel cell engine

H_2 combustion engine

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From our know-how
in mobile fuel cells ...

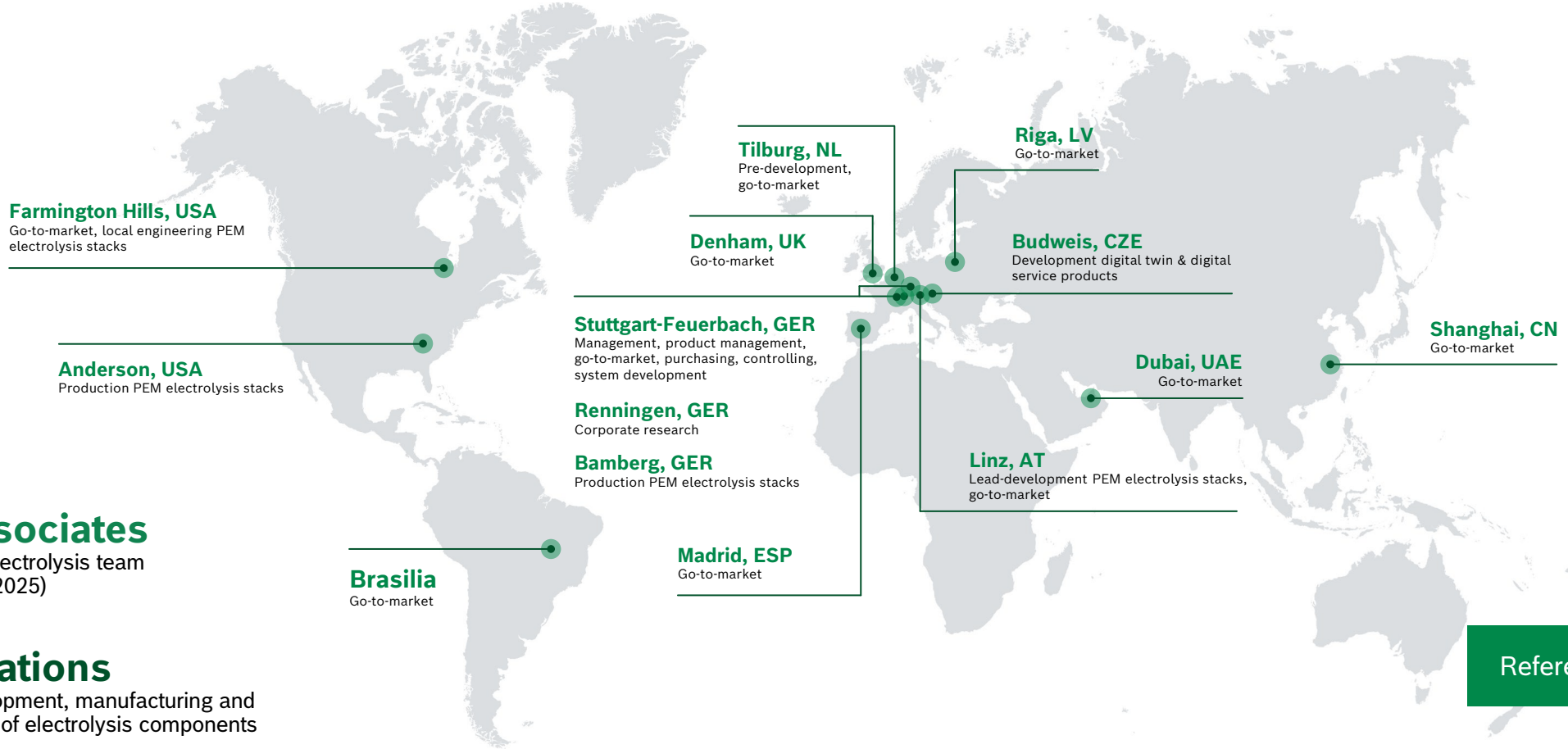




... to electrolysis
stack expertise

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Local for local
With a global infrastructure



350 associates
work in the electrolysis team
(status Feb. 2025)

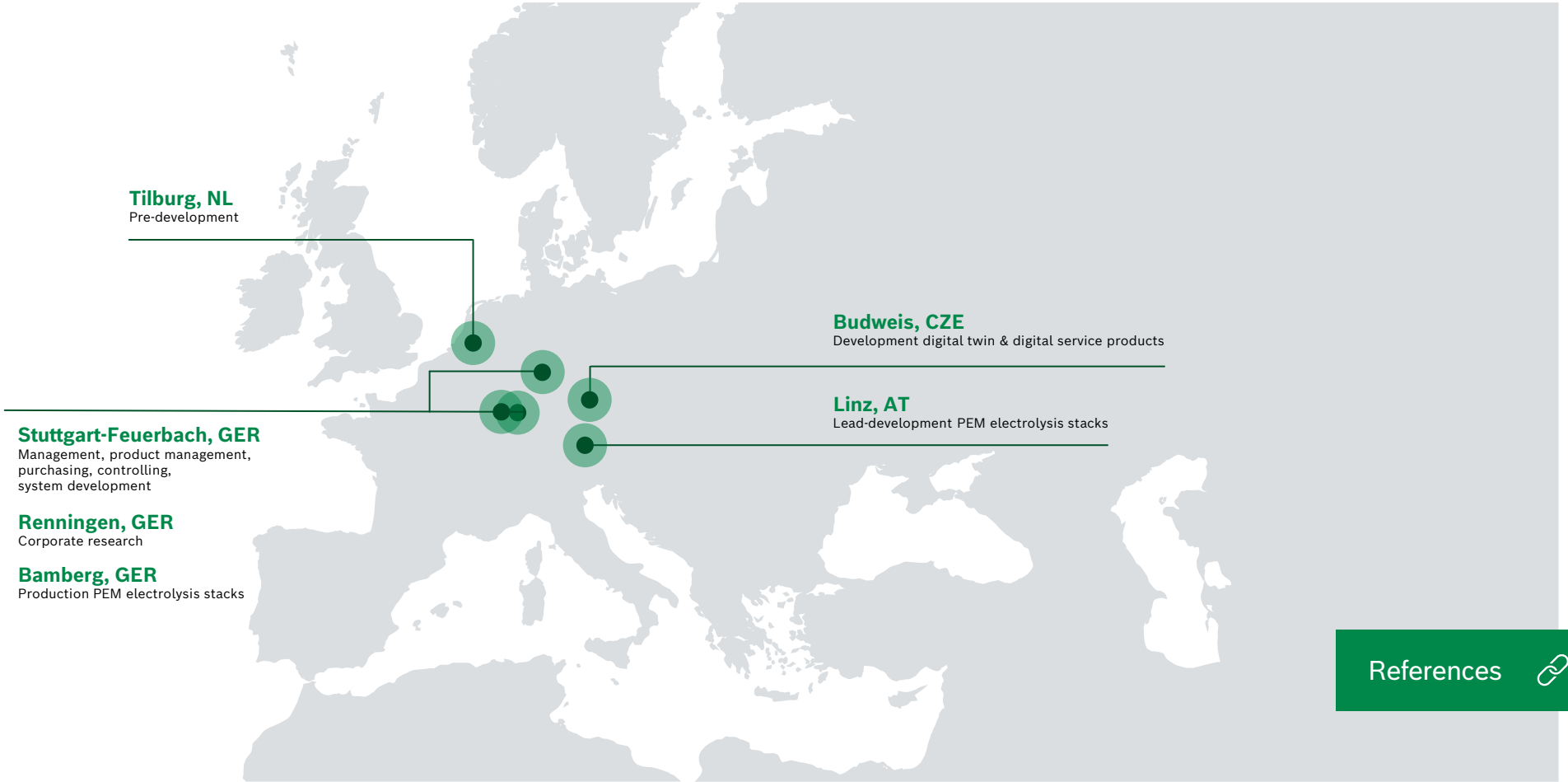
14 Locations
for the development, manufacturing and go-to-market of electrolysis components

References

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BOSCH

Local for local
Focus on engineering excellence



References

BOSCH

Projects worldwide
Hybrion PEM Electrolysis Stacks by Bosch



>175 MW

order entry



Canada
1.25 MW
COD: Q4/2027

USA
1.25 MW
COD: Q1/2026

1.25 MW
COD: Q2/2027

12.5 MW

Brasil
1.25 MW
COD: Q3/2026

Poland
20 MW
COD: Q3/2026

Lithuania
1.25 MW
COD: Q3/2026

Austria
1.25 MW
COD: Q1/2027

1.25 MW
COD: Q1/2027

5 MW
COD: Q4/2027

Spain
1.25 MW

Germany
2.5 MW
COD: Q4/2025

5 MW
COD: Q2/2026

1.25 MW
COD: Q2/2026

62.5 MW

Italy
1.25 MW
COD: Q2/2026

1.25 MW
COD: Q2/2026

1.25 MW
COD: Q2/2026

China
1.25 MW
COD: Q3/2026

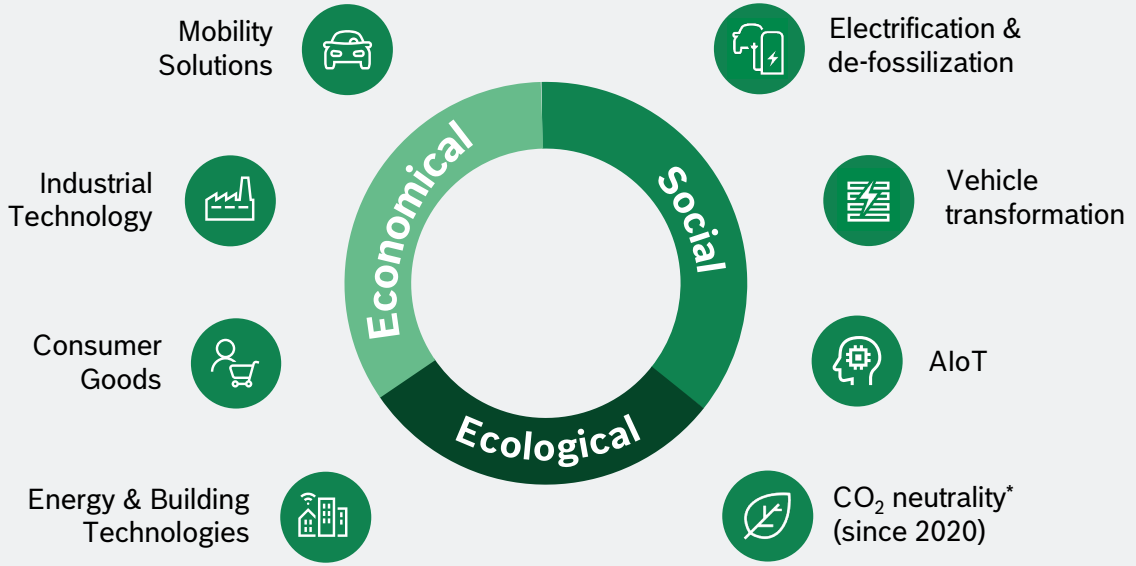
73.75 MW

Operational:	**3.75 MW**
Under Construction/ FID:	**38.75 MW**
Binding offtake agreements:	**153.75 MW**

Status 07/26

BOSCH

Our industry segments & strategic focal areas



* With its more than 450 locations worldwide, the Bosch Group has been carbon neutral overall (scopes 1 & 2 of the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard) since 2020.

This is achieved with four levers:

- improving energy efficiency
- generating energy from renewable sources
- purchasing green electricity
- offsetting residual CO_2 emissions with carbon credits.

Visit sustainability.bosch.com for further information on the Bosch Group's sustainability strategy.

2025 Figures

~91.0
billion euros
sales revenue

~7.9
billion euros research
and development

~1.8
billion euros
EBIT

413,000
Bosch associates worldwide
at year-end (approx.).

500
subsidiaries & regional companies
in more than 60 countries

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Bosch –
a reliable
& powerful
partner
for long-term
projects



low-emission

reliable & of highest quality

A powerful & built to scale centerpiece

constantly optimized

of the new energy now



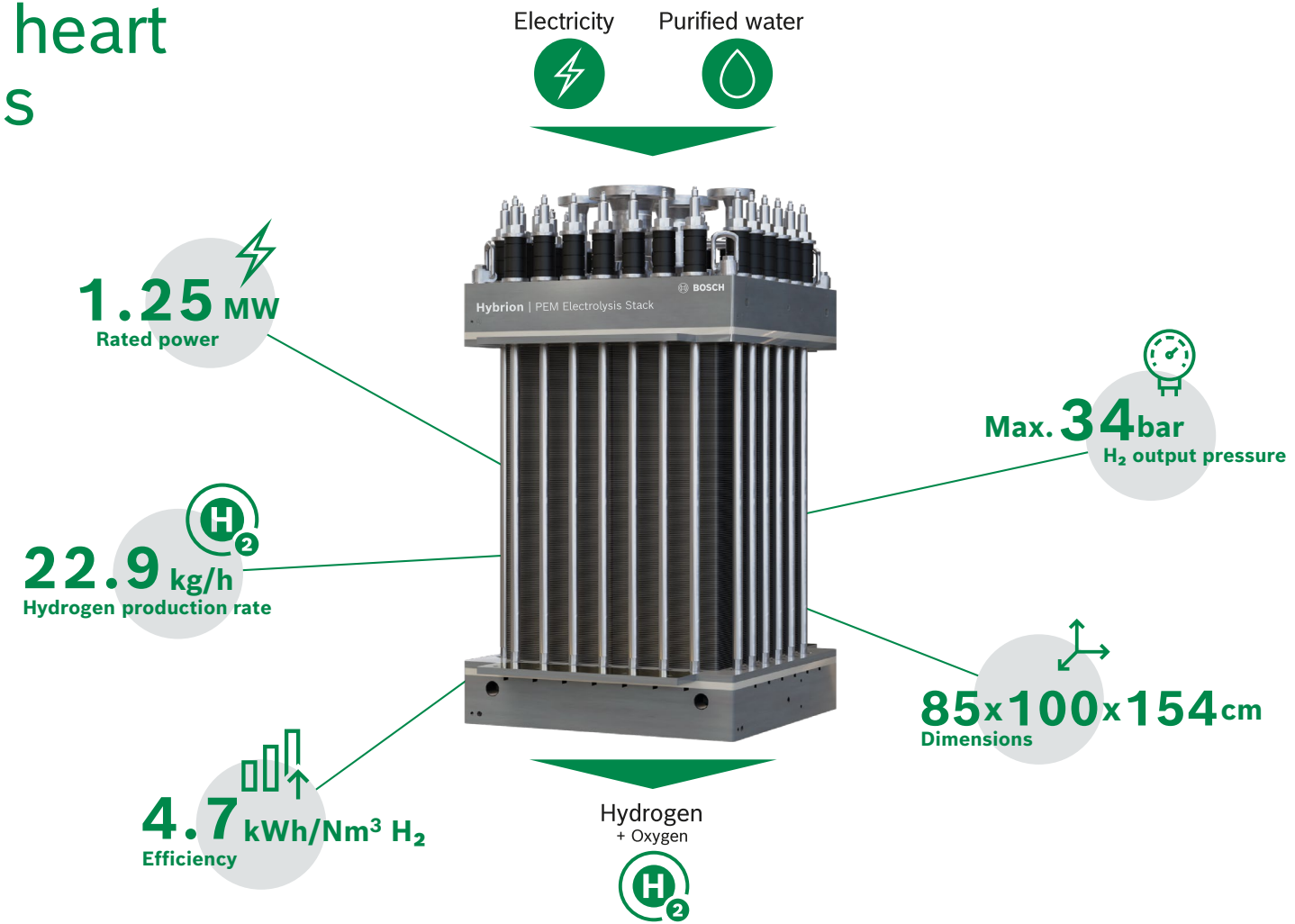
Leading KPIs

Low LCOH

BOSCH

Convincing performance

The efficient heart of electrolysis

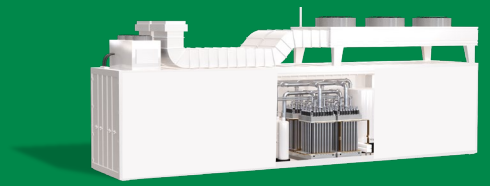


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Maximum scaling effects
by best fit for key applications



Plant solutions
Several hundred MW



Containerized solutions
From 1.25 MW to 5 MW

Ramp-up with our partners

Current — 2027

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Industrialization know-how ensures efficient scaling



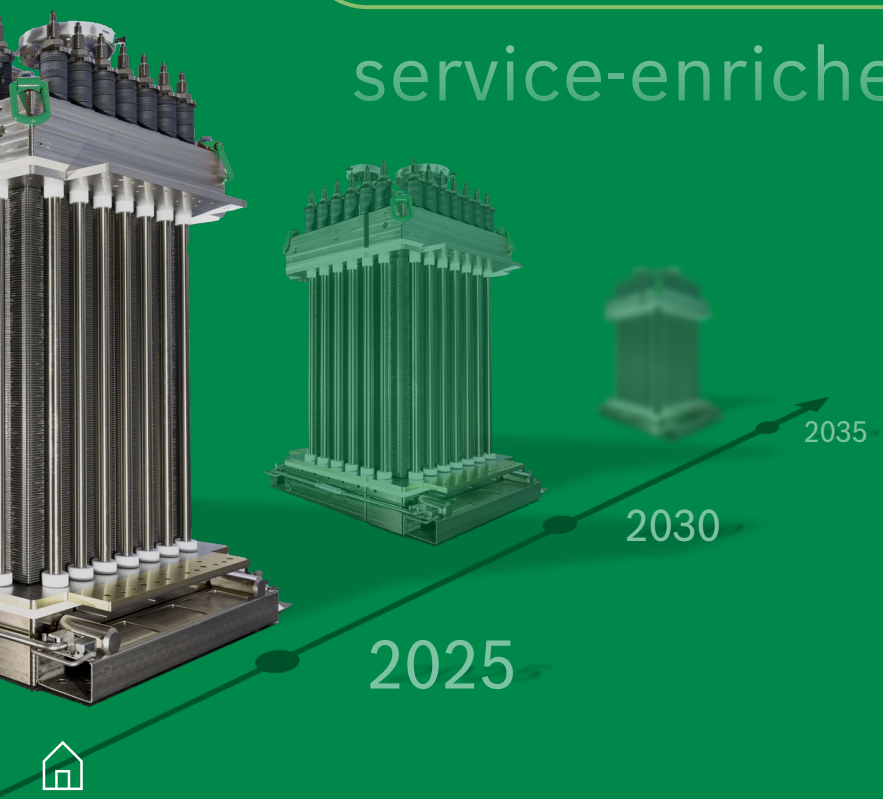
reliable & of highest quality

powerful & built to scale

A constantly optimized centerpiece

service-enriched

of the new energy now



- Next gen in pre-development
- 350 employees, 14 locations
- Simultaneous engineering

BOSCH

Fast-forward development of 1st ELY Stack

Our power to develop and industrialize



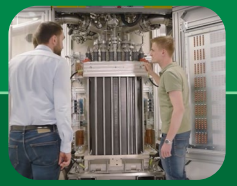
Parallelized development



On different,
specialized Bosch locations



With 350 employees



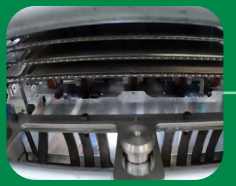
2019

3/2025

Launch Hybrion



Pre-development
of new generations





Material, research and
industrialization know-how
of fuel cells

BOSCH

Resources and abilities

Scale up &
industrialized
production facility

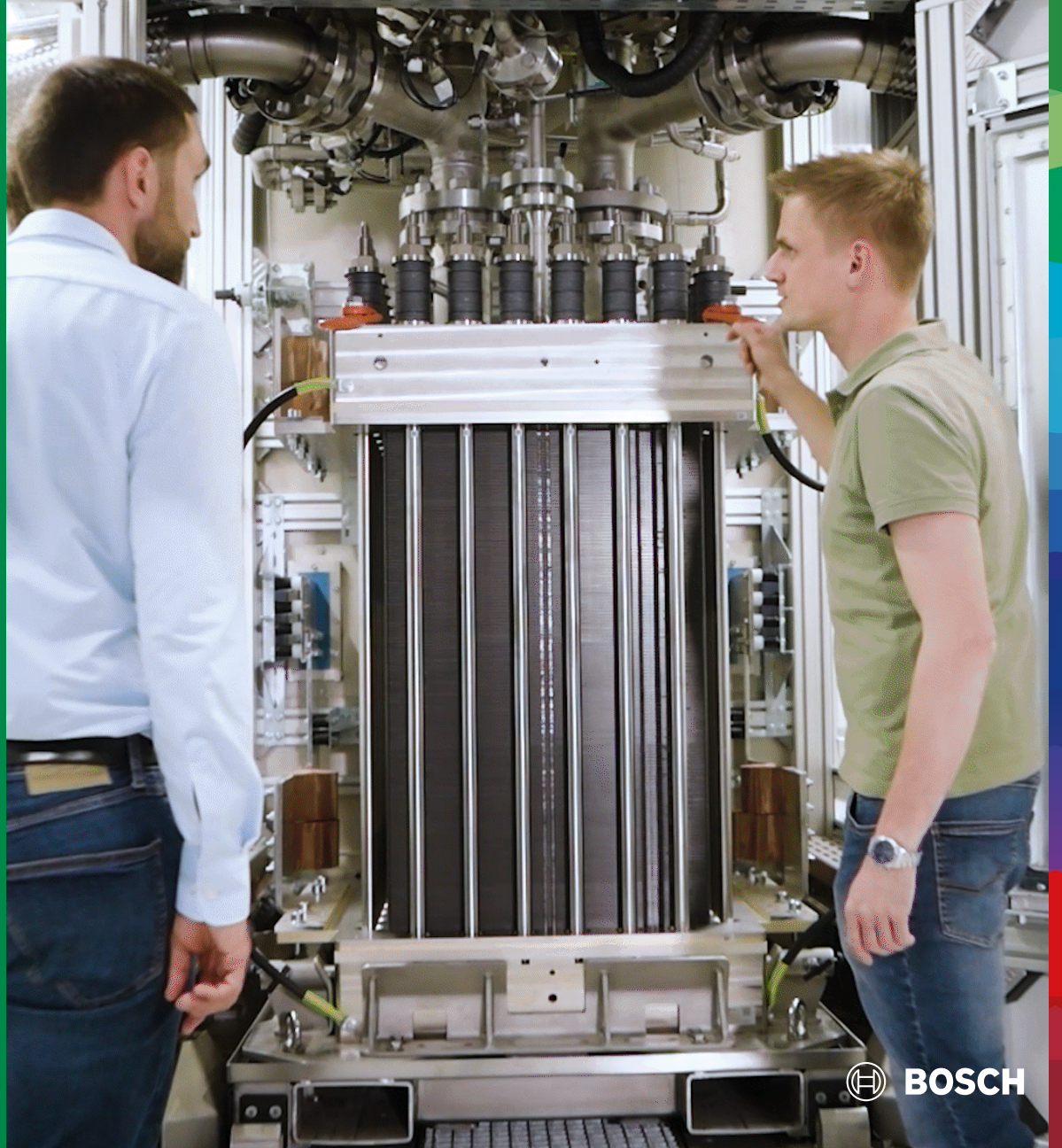
BOSCH

Ongoing development enhances next-gen stacks



Ensuring a secure, reliable product development

- Two inhouse full-size stack testers
- 6 external test centers for stack evaluation
- Complete hydrogen infrastructure:
  - Transformer station
  - Container for cooling pumps
  - Stack testing facilities
  - Soaking station
  - Lab equipment
  - Infrastructure tester
- 21 test benches for single cell, short stack & sub-scale testing
- 2.5 MW demonstrator
- System test lab



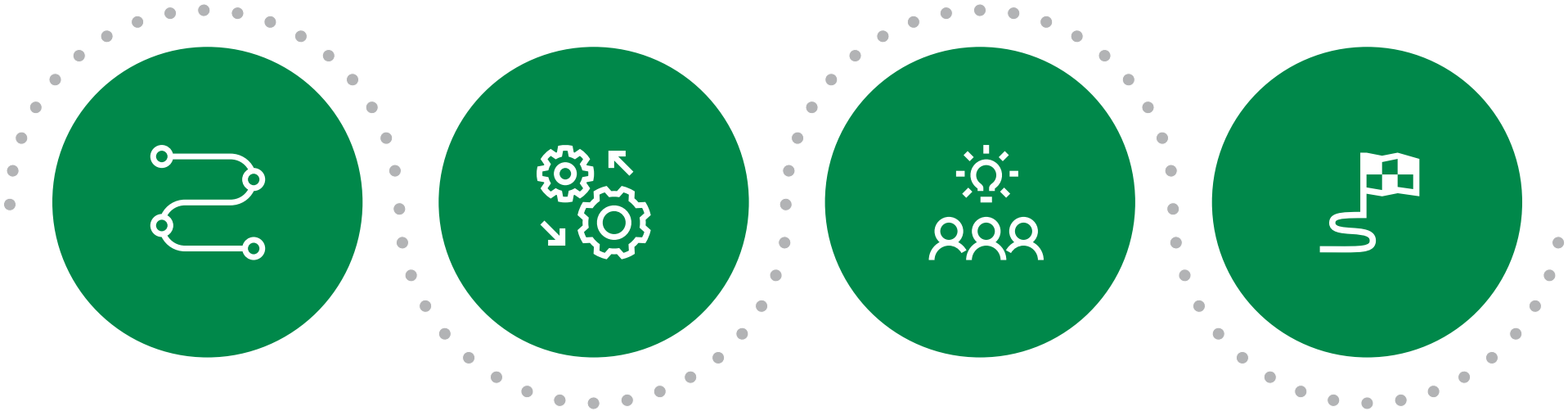


Bringing a safe & secure product to market

- Explosion tests
- Testing shock pressure resistance
- Highest safety standards
- Certifications: ISO9001, ISO/CSA/ANSI (B)22734, CE, ASME/NRTL, CRN

BOSCH

Strong project management
makes the difference



Structured project management processes

Systematic development and testing – with automotive standards

Task force creation to address complex challenges

Consistent, process-driven approach ensuring reliable outcomes

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powerful & built to scale

constantly optimized

A service-enriched centerpiece

of the new energy now



BOSCH

ELY Stack Services
Service add ons complementing stack offering

Customer Support

Engineering support

- Support on mechanical & electrical integration of stack
- Consulting on customer system design, e.g. Piping and Instrumentation Diagram (P&ID*)
- Technical advisory on related requirements on system level and operation modes of the stack

Technical customer support

- Support by stack experts during operations
- Fast communication channel for 2nd and 3rd level support

Commissioning support:

- Supervision of commissioning procedure



Performance Package

- Assurance of specific technical parameters even after standard warranty

Benefit
Assured performance

Premium Supply

- Minimal lead time for the stack
- Replacement** supply with minimal lead time of two weeks
- Professional disposal to close the raw material cycle

Benefit
Reduced plant downtime in case of stack error;
Less redundancies at customer needed and therefore reduction of CAPEX

* P&ID = Piping and Instrumentation Diagram
** Bosch is not responsible for the integration time of the replacement stack

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Partnership serving customer projects

Business scope

Bosch product & services

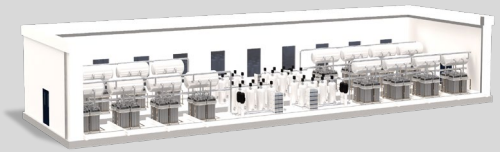


Needed cooperation partner

Balance of stack



Balance of plant



Deployment (plant)



H_2 production

Container or scaled skid mounted modules 2.5 MW, 5 MW or 20 MW

H_2 plant solutions for bigger projects based on mounted modules (e.g., ≥ 20MW)

Stack supplier	Packager / Integrator	Integrator & EPC	Customer

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A committed team
H_2 expertise in every facet













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1 low-emission

PEM as the right technology,
Boschs' carbon neutrality

2 reliable & of highest quality

Know-how, portfolio,
Bosch excellence

3 powerful & built to scale

Hybrion stack KPIs,
Applications, Industrialization

4 constantly optimized

Testing, research, improvement,
quality and security

5 service-enriched

From consulting, remote
monitoring to digital services



H_2EARTBEAT by Bosch

Your Pulse for the Hydrogen Economy.

The exclusive partner program for trailblazers in electrolysis. Innovate, grow, and shape the market together.

Network
Access to key players & events

Grow
Joint marketing & market presence

Innovate
Unlock technical potential & insights

Benefit
Leverage a strong brand & exclusive advantages

Partner with us and power the future.

H_2EARTBEAT members

Since 2025

KYROS

FEST

Hygreen energy™

More to come…

Let's create the H_2EARTBEAT of the hydrogen economy together

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