



Sales presentation, as of 01.2025

Bosch Manufacturing Solutions | BMG

Bosch | Who we are

Bosch Industrial Technology (BBI)



Drive and Control Technology

- Mobile Hydraulics
- Machinery Applications
- Factory Automation



Bosch Manufacturing Solutions

- Production equipment & automation: special purpose machinery
- Individual assembly and testing systems
- advanced manufacturing processes and technologies
- digital & intelligent solutions and services along entire product lifecycle



Bosch Connected Industry

- Production & logistics software from a single source

BMG | who we are

Bosch Manufacturing Solutions | BMG –

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



> 30 years of experience as special machinery supplier



> 4.000 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



1.900

Employees



~680

TNS m€



BMG | our purpose statement

The difference in manufacturing



For us, **‘Invented for life’** means to build a **more sustainable future** through production equipment by Bosch Manufacturing Solutions.

We create a difference in our customers’ products by offering **“the difference in manufacturing”**

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**

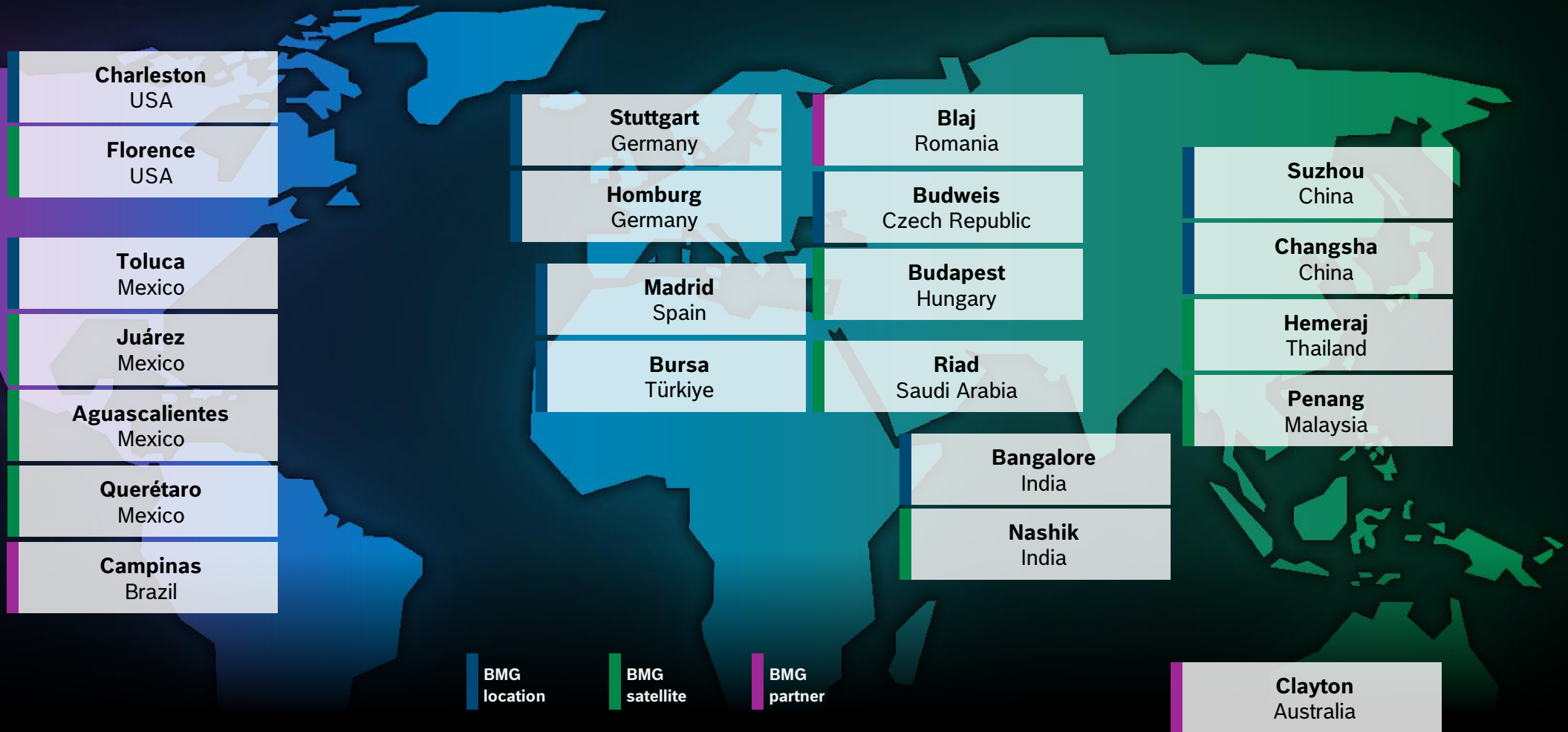


**Digital & Intelligent
Solutions**



**Services along the entire
product lifecycle**

BMG | global strength in network & partners



BMG | focus industries & product areas

Focus industries



eMobility



Automotive (ICE)



Energy



Consumer Goods

Focus product areas



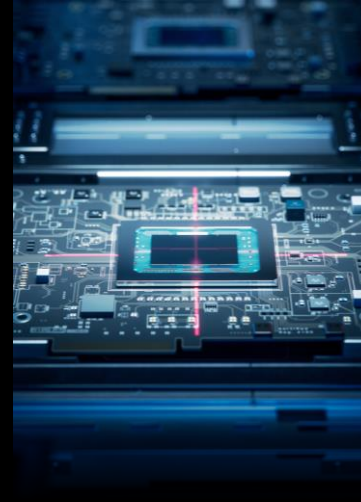
Battery



H2 Solutions / Fuel Cell



eDrive



Sensors & Electronics



Chassis & Steering



Combustion Engine

Stay charged

with battery production equipment from Bosch Manufacturing Solutions | BMG. Our expertise reaches from cell production technologies up to fully automated and intelligent Cell to X assembly and testing systems.



Cell Manufacturing

Dry Electrode Manufacturing

Smart Battery Formation

Cell to X Manufacturing

Cell Supply

Cell Cleaning

Begin & End of Line Testing

Dispensing

Resistance Welding

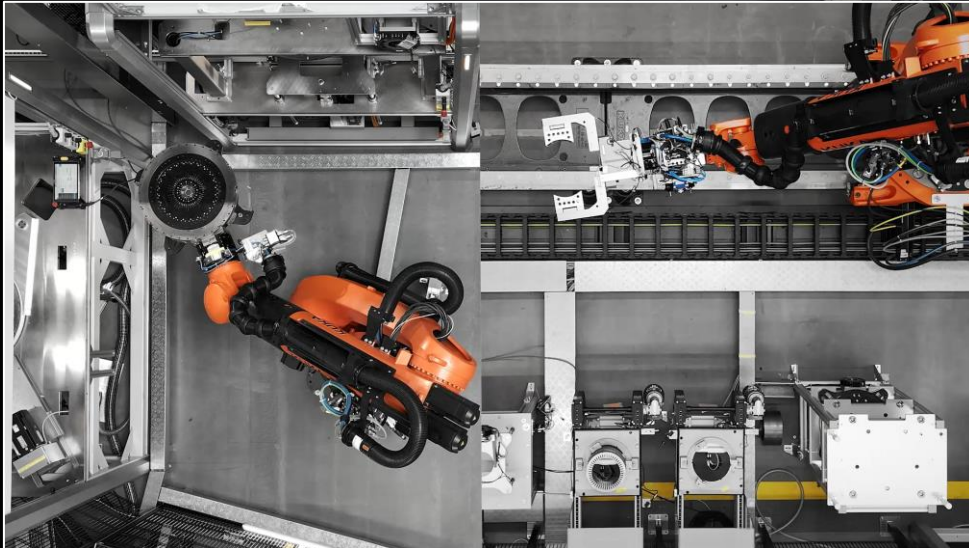
Laser Welding

Machine Vision

Leakage Testing

Driving mobility

with innovative eDrive production equipment from Bosch Manufacturing Solutions | BMG. Our expertise ranges from various winding technologies such as Hair-Pin, I-Pin, X-Pin, for all vehicle classes, to individual line concepts from semi to fully automated, including AI based solutions for increased efficiency.



eDrive – some process highlights

Pin Manufacturing

Handling & Robotics

Twisting

Laser Welding

Separating & Cutting

Trickling

Clamping

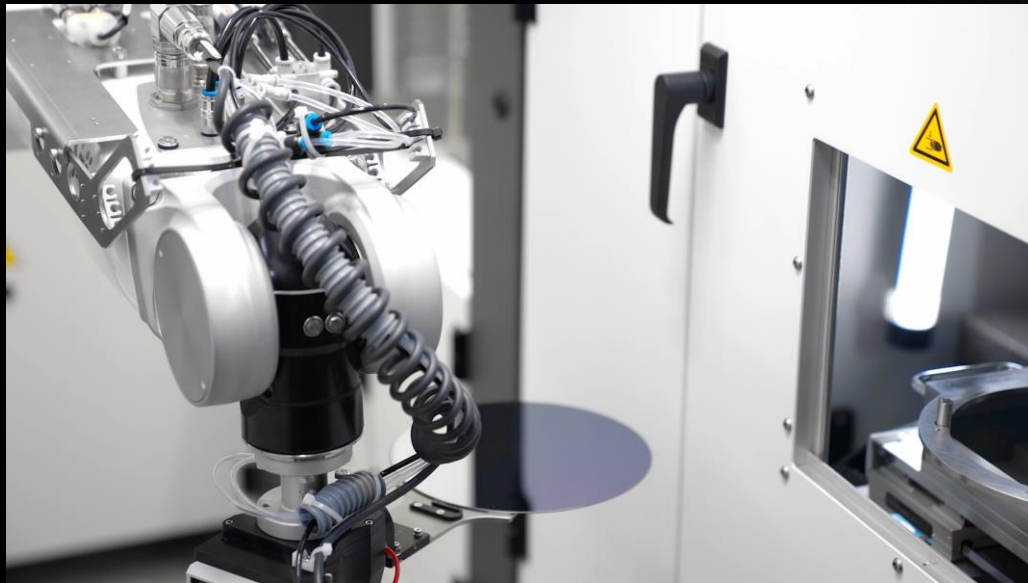
Optical Inspection: Post Vision

Parameter Identification (PI) Testing

Further ...

Unleash power

with sensors & electronics production equipment from Bosch Manufacturing Solutions | BMG. We provide flexible assembly technology for ECUs, power electronics, and sensors, mainly in eMobility. Our scalable solutions optimize investments and adapt to variable production volumes.



Sensors & Electronics – some insights

Flexfoil Handling

Laser Welding of Electrical Connections

Laser Micro Structuring

Laser Cleaning

Dispensing

Screwing

Pressfit & Single Pin Insertion

Optical Inspection

Magnetic Conveyor System

From Water to Energy –

empower your sustainable future with H₂ 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

» PEMFC – Hydrogen Gas Injection

BMG | focus industries & product areas

Chassis & Steering

As a technology and process expert for the automotive industry, we offer you the optimum manufacturing equipment for various components in the field of chassis and steering.

From hydraulic to electric steering and driving systems: New Braking Systems like the Integrated Power Brake (IPB) and the electronic stability program (ESP) are just some examples of components manufactured with equipment from Bosch Manufacturing Solutions | BMG.

BMG | focus industries & product areas

Combustion Engine

Our high-precision production and testing equipment for diesel and gasoline injection systems, e.g. including high-pressure injectors, diesel pumps, and exhaust gas systems, are backed by the expertise of Bosch Manufacturing Solutions | BMG.

As the ICE sector matures, our services are crucial in maximizing performance and extending the lifetime of your systems. From cycle time improvements and modernizations to relocation projects, we ensure peak efficiency throughout your equipment's lifecycle.



From Water to Energy –

empower your sustainable future with H₂ 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**

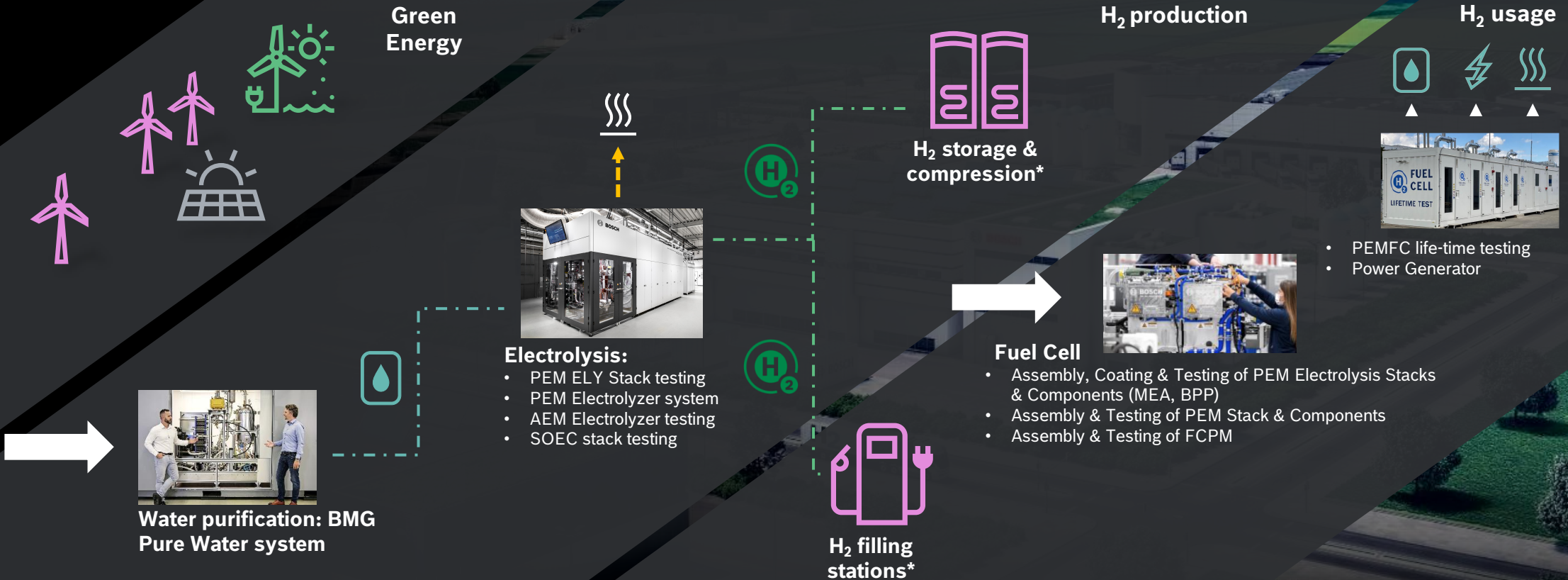
Electrolysis – from water to hydrogen

- » **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**

BMG portfolio & system integrator



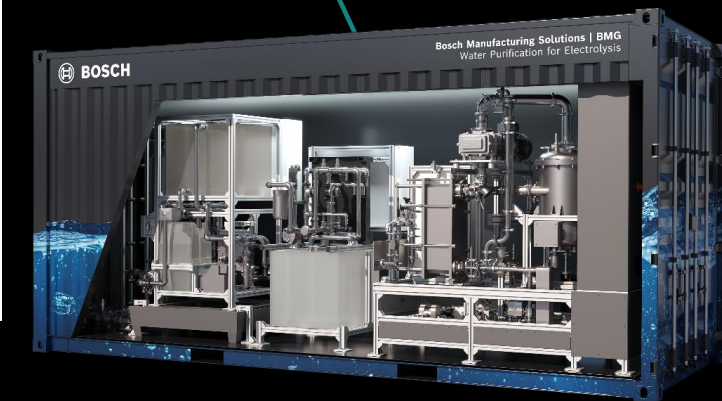
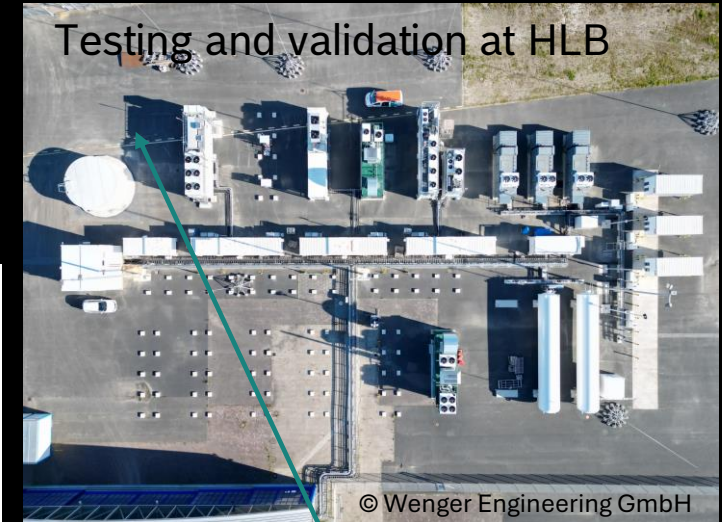
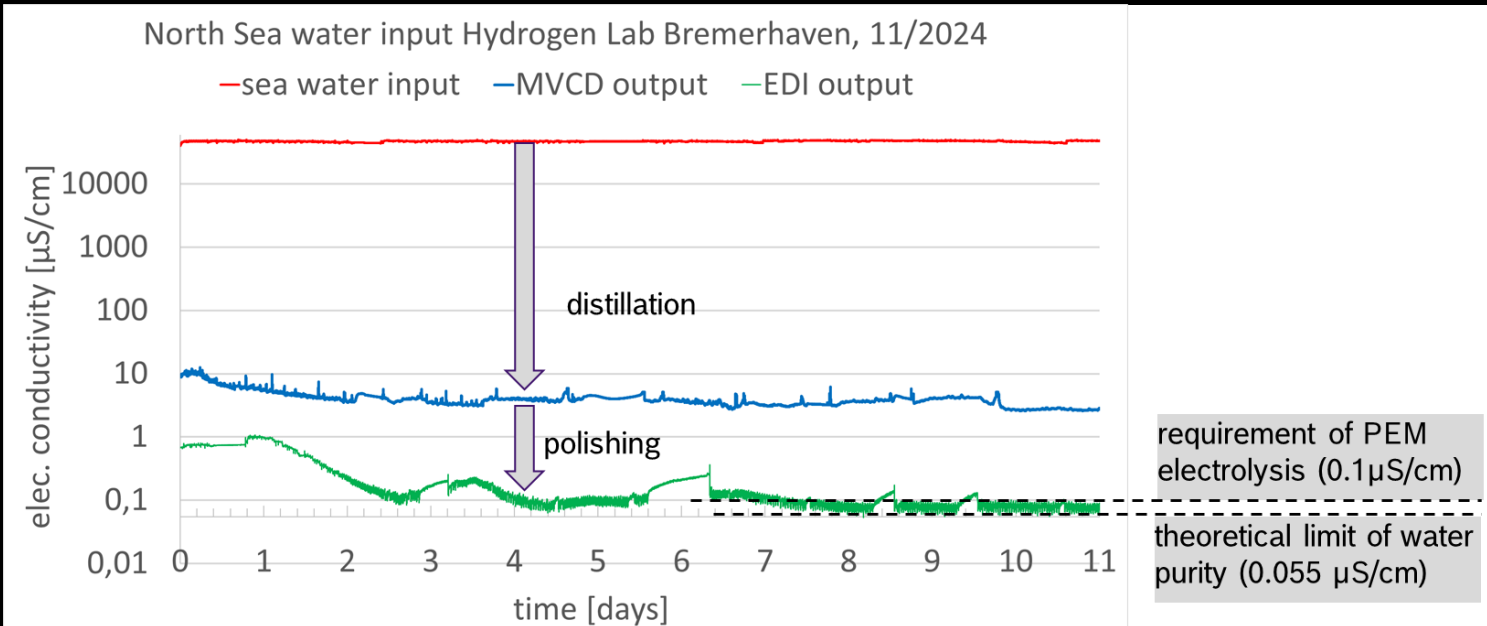
Bosch / DC portfolio*

BMG | H2 Solutions | Reference projects

Fraunhofer IWES Hydrogen Lab Bremerhaven (HLB)

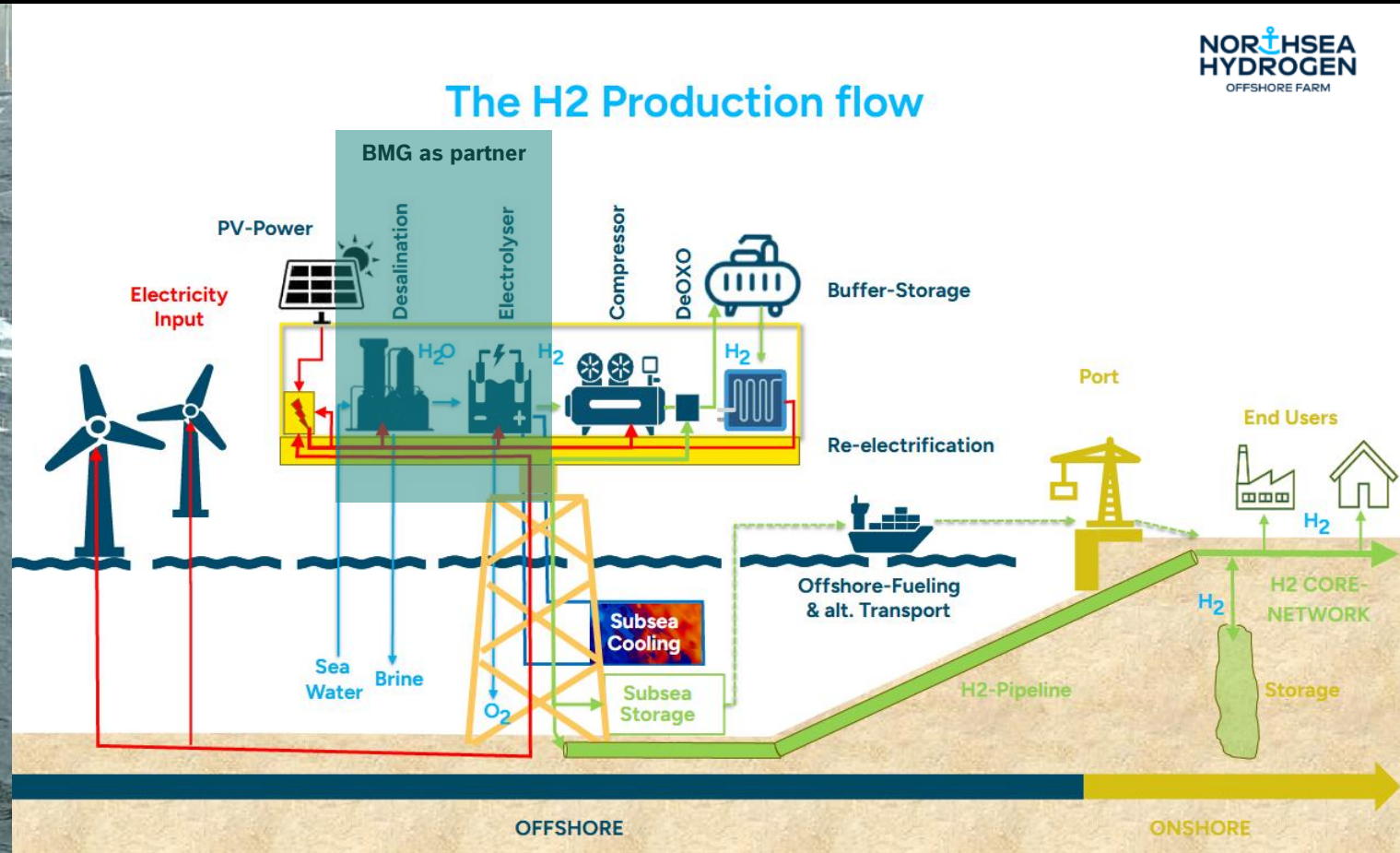
Testing completed with offshore-like conditions

- Process water settles safely into required window of conductivity
- No abnormalities in the analyzed water samples, brine and ultrapure water



BMG | H2 Solutions | Reference projects

Partner of NorthH2



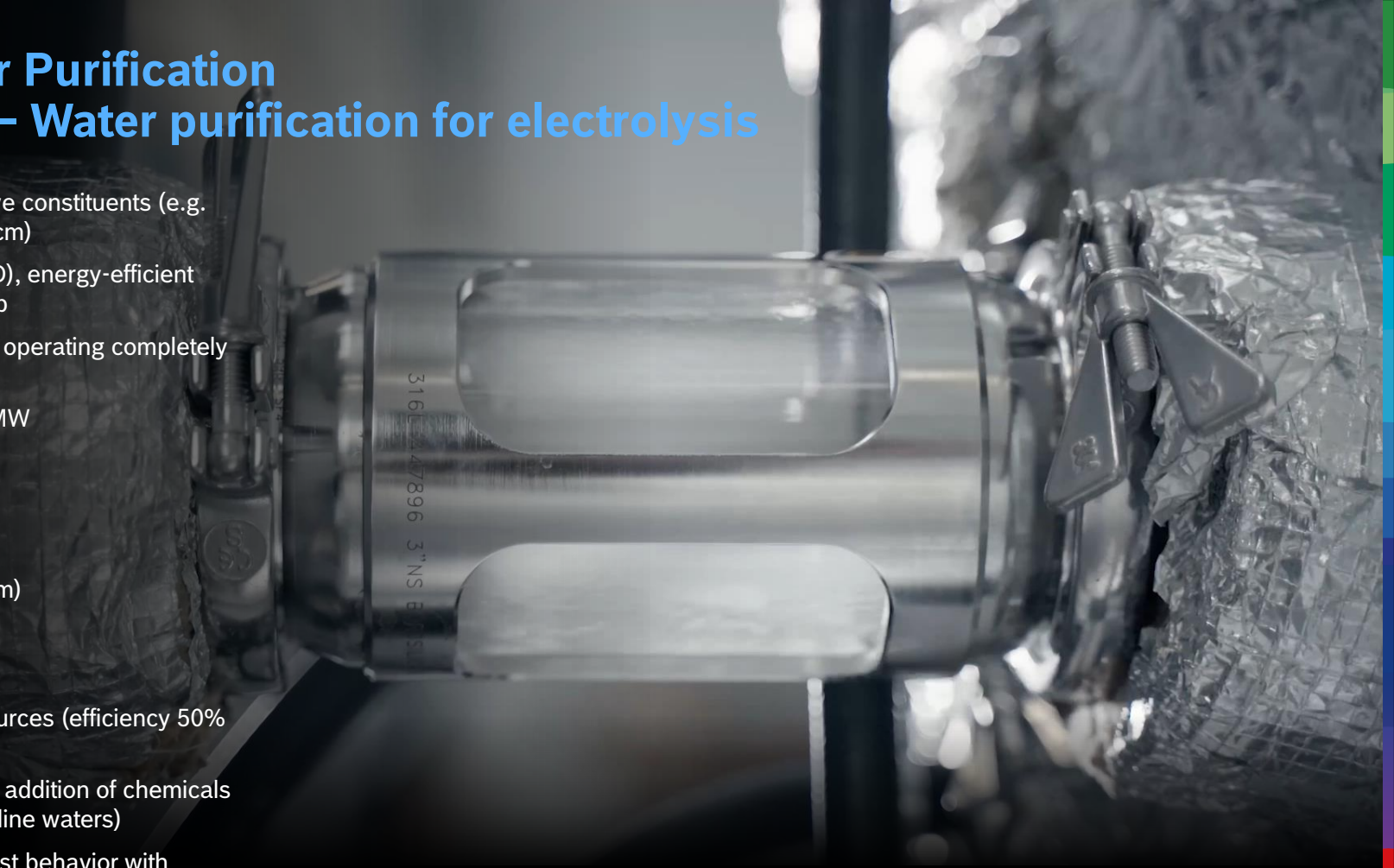
BMG | H2 Solutions | Water Purification

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-pure water (0.1 uS/cm)

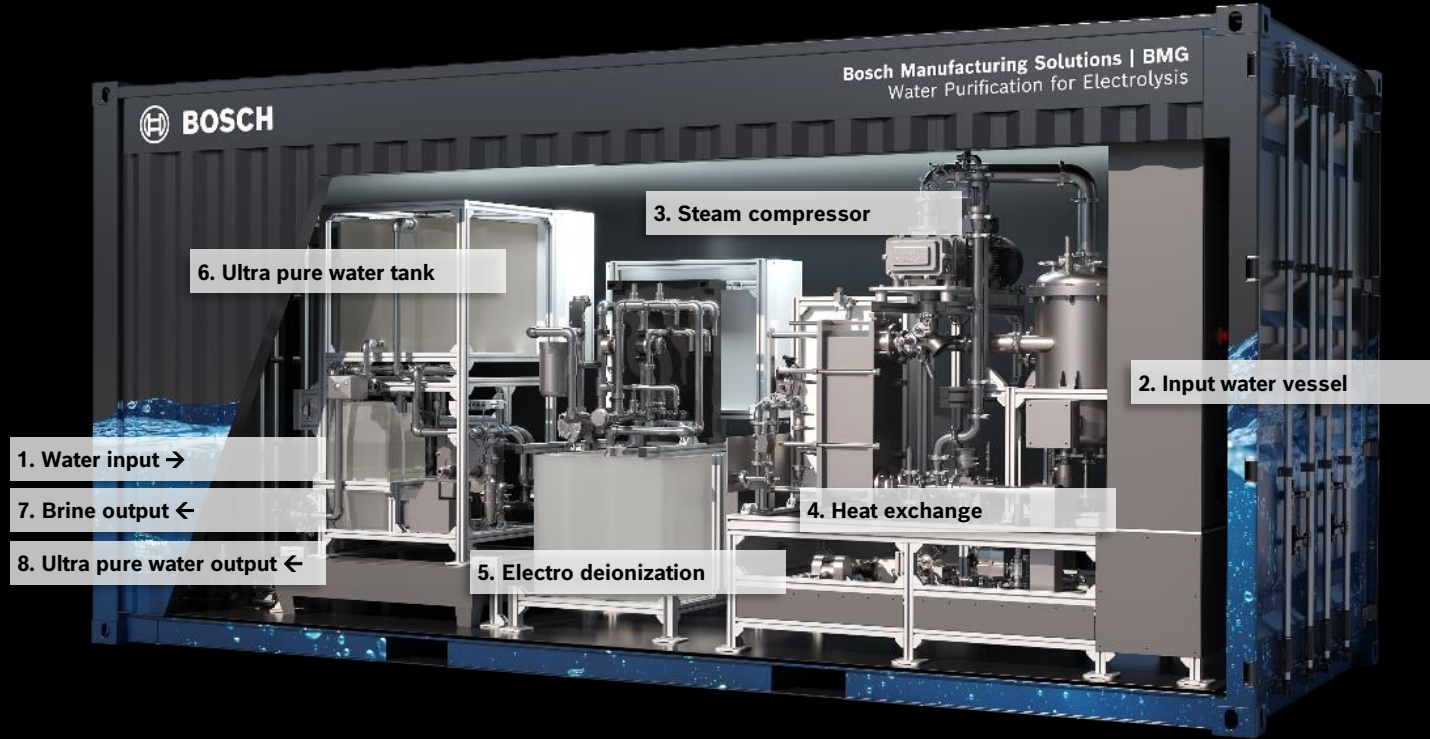
Benefits

- 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 behavior 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)



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 $\mu\text{S}/\text{cm}$)
- **output:** up to 3m³/h of ultra-pure water (0.1 $\mu\text{S}/\text{cm}$)
- Reference project: North H2, Fraunhofer LAB



robust
low-cost
maintenance



save water
preserve drinking
water resources



sustainability
tailored to
environment



dynamic
using fluctuating
energy sources

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			

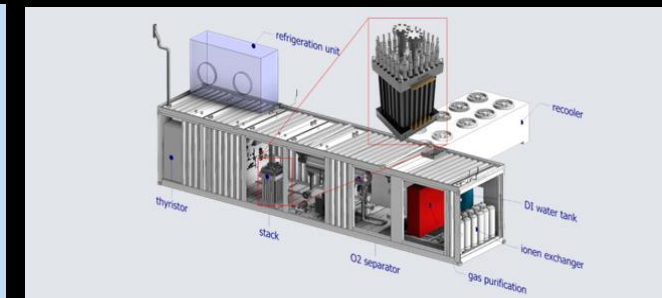
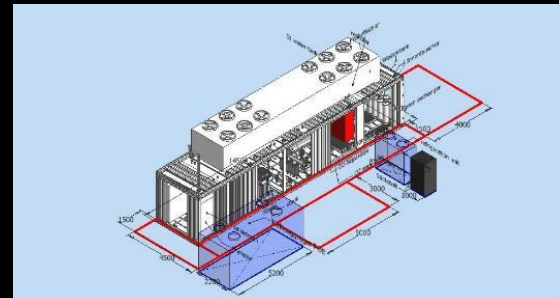
BMG | H2 Solutions | **Electrolysis**

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

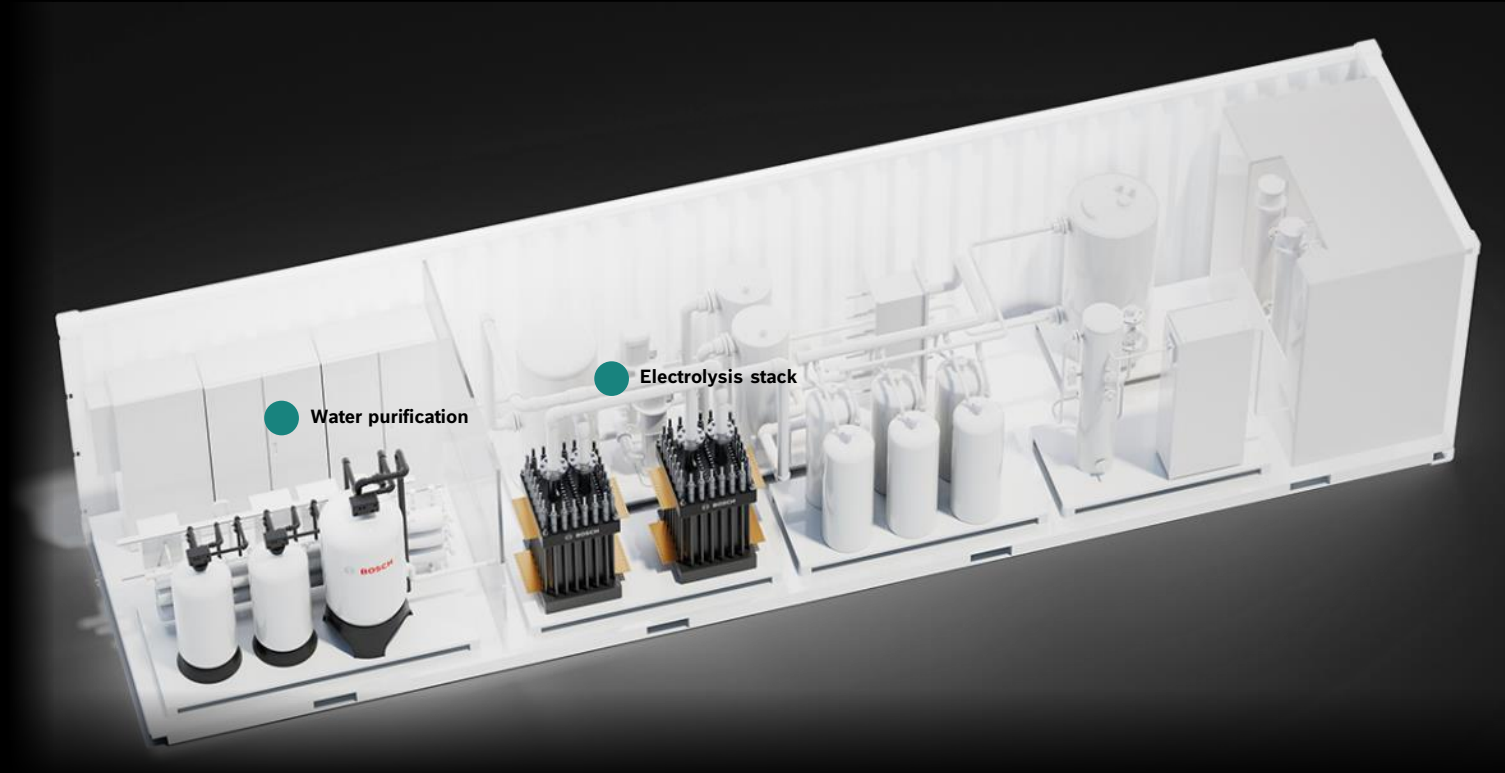


BMG | H2 Solutions | **Electrolysis**

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

Capacity	Approx. 2.100 twin boxes per year
Cycle time	133 minutes
Operators	13,5 per shift



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			

BMG | H2 Solutions | Electrolysis SOEC Stack Testing

- Stack testing in an individual portfolio from 50 W up to 15 kW
- Solution for Short & Full Stack testing GEN1 & GEN2
- Key processes: stack testing from 50 W up to 15 kW
- Integrated ELA, high accurate cell voltage measurement
- Temperature range up to 850°C
- Hot Box development & build

Benefits

- All kinds of different anode gas compositions can be implemented
- Operation with natural gas is possible due to integrated reformer
- Flexible test bench software with freely configurable test cycles
- High overall efficiency due to substantial heat



Power range	50 W to 700 W	5 kW to 15 kW
Max. anode flow range / slm	30	300
Max. cathode flow range/ slm	100	3000
Gas temperature	Up to 700°C	
Gas temperature control accuracy	+/- 1°C	
DI-water flow range/ g/h	300	600
Air temperature range	Up to 850°C	
Load power range kW (easy expandable)	1 bidirectional	15 bidirectional
Air temperature control accuracy	+/- 1°C	

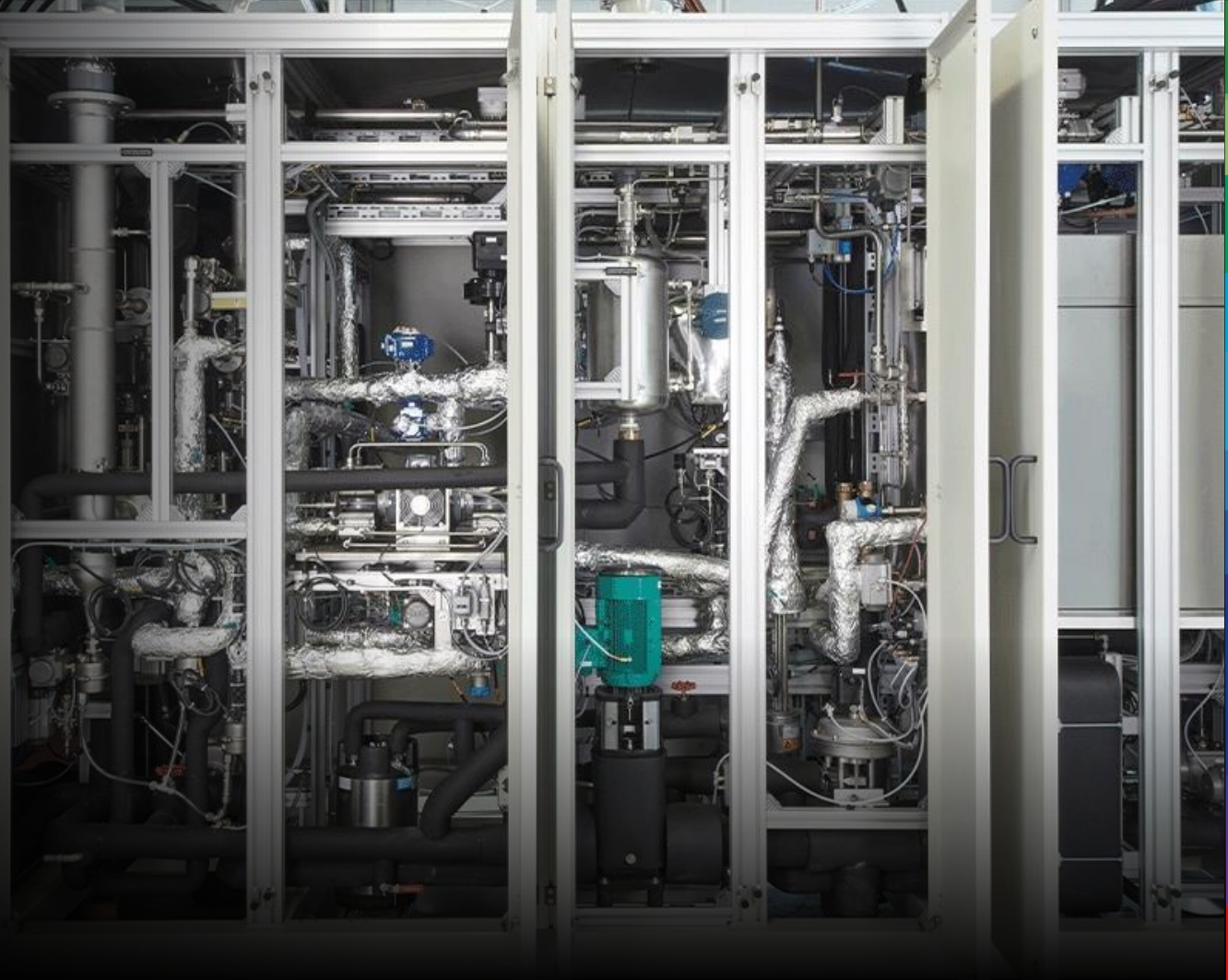
BMG | H2 Solutions | PEMFC

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

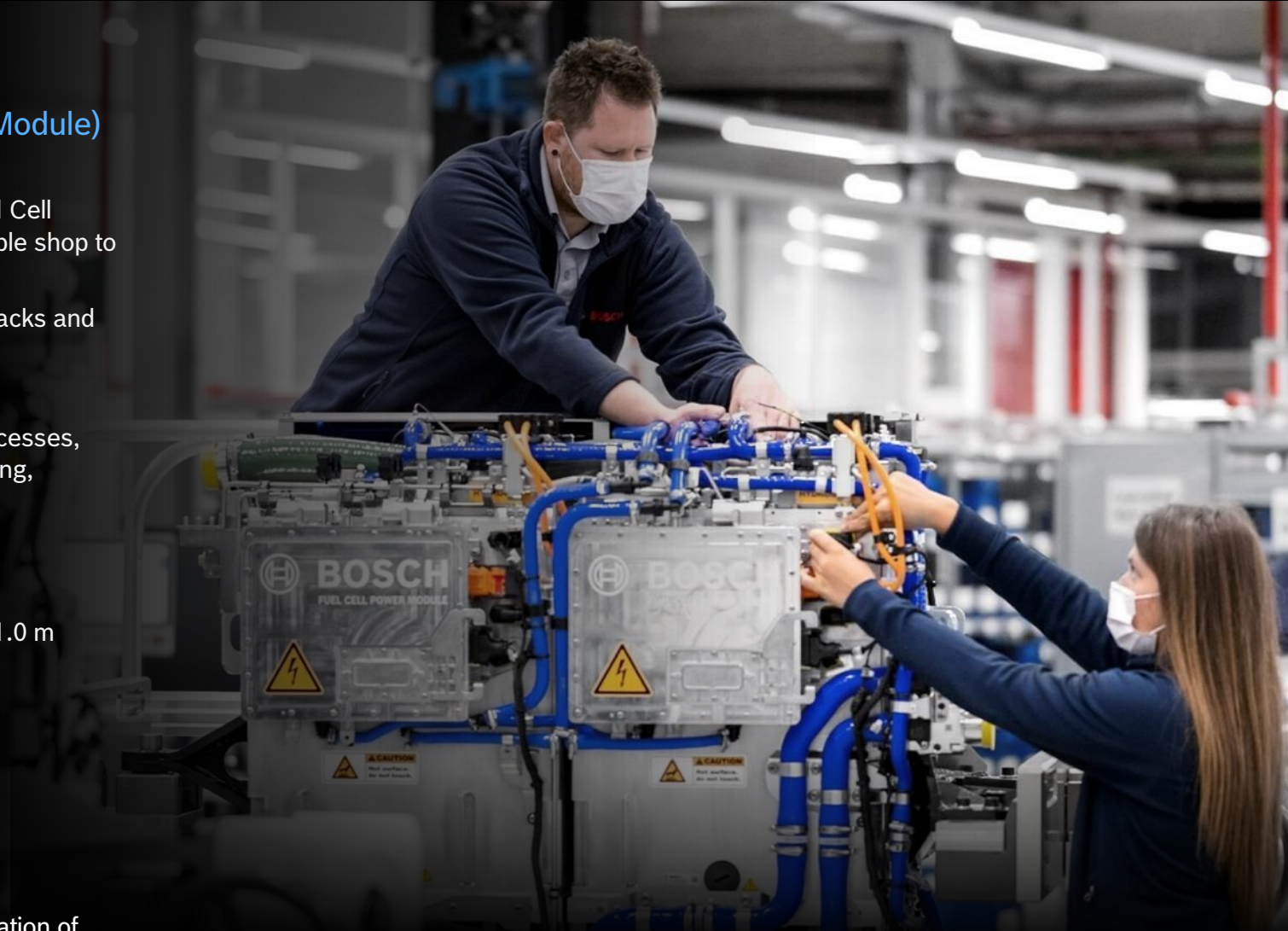


BMG | H2 Solutions | **PEMFC** **FCEM Assembly** (Fuel Cell Power Module)

- Scalable and flexible solution for the assembly of Fuel Cell Power Modules (FCEM) 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 automated 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



BMG | H2 Solutions | PEMFC

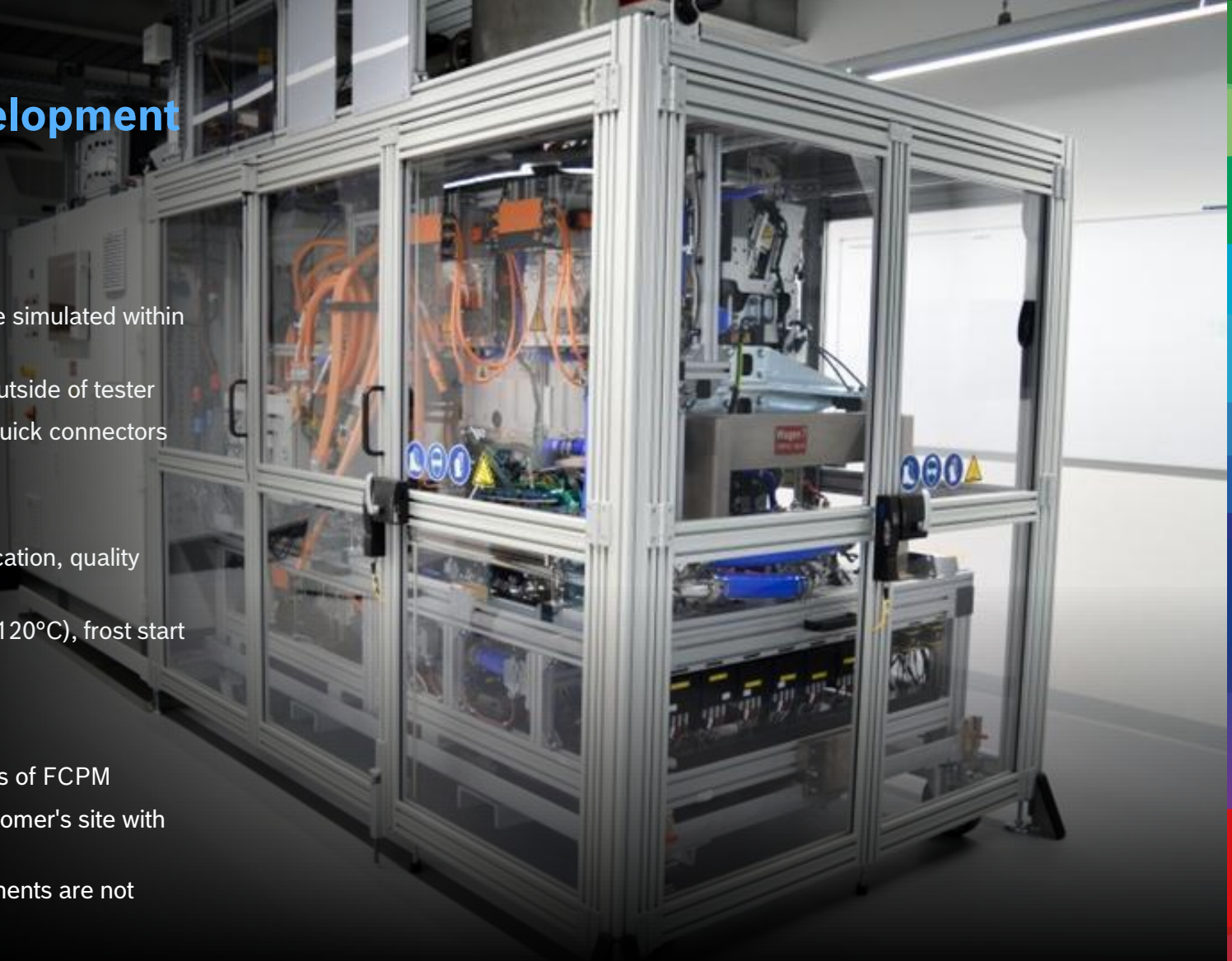
FCPM System testing for development

(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



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

Key Data

H2-consumption (up to)	846 kg/d
DI-water production (up to)	7.6 t/d
Air throughput (up to)	57 t/d
Dimensions	14.5 x 3.2 x 3.1m
Weight	25 to

BMG | H2 Solutions | PEMFC FCPM Power Generator



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, transformer	IPC, DC/AC, transformer
Additional attachments	<ul style="list-style-type: none"> – Cooler: on the roof – Bundle of nitrogen vessels – Bundle of hydrogen vessels – Compressor of pressurized air (tbc) 	<ul style="list-style-type: none"> – Cooler: on the roof – Bundle of nitrogen vessels – Bundle of hydrogen vessels – Compressor of pressurized air (tbc)

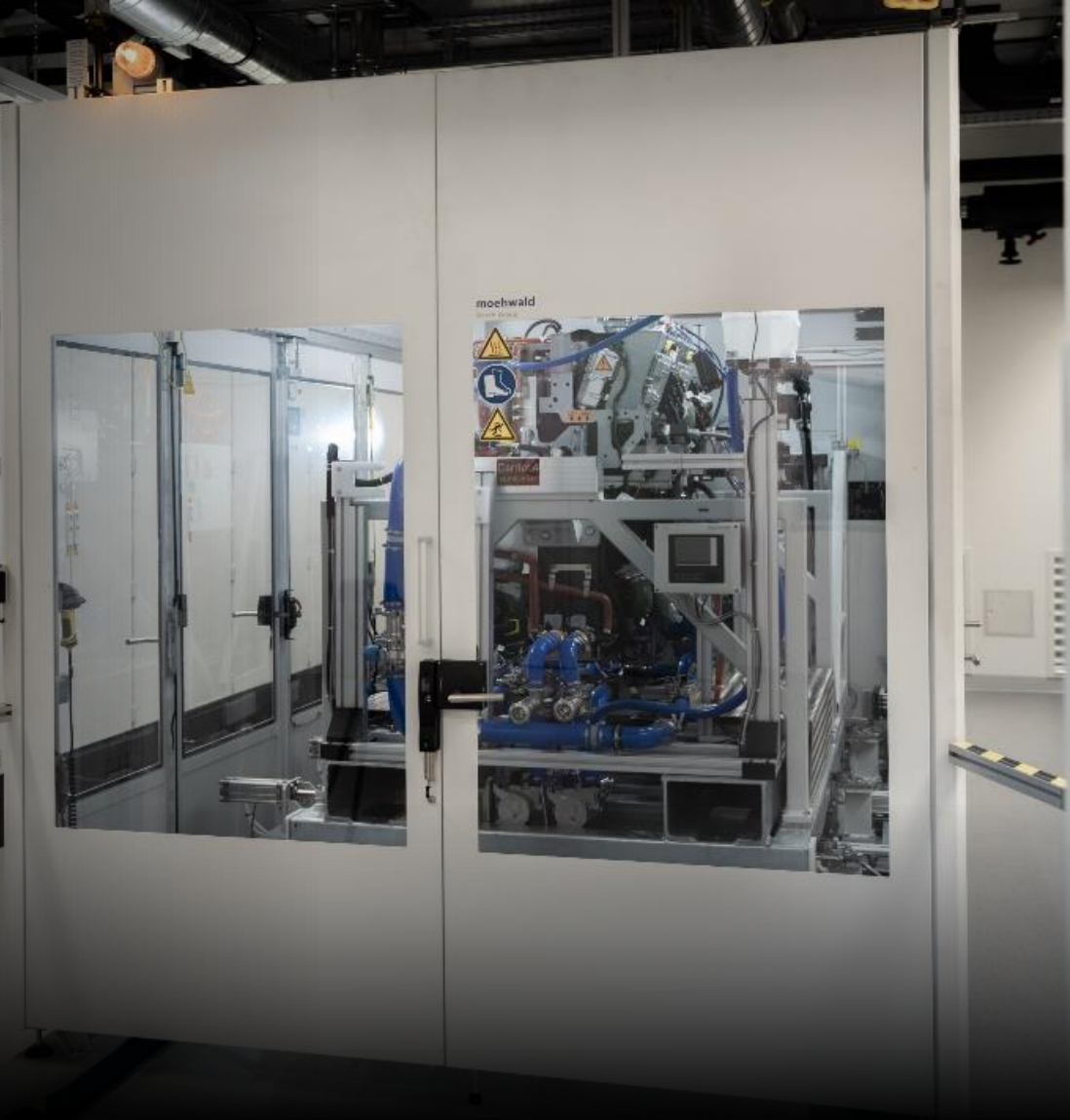
BMG | H2 Solutions | PEMFC

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



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: 1 E-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



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

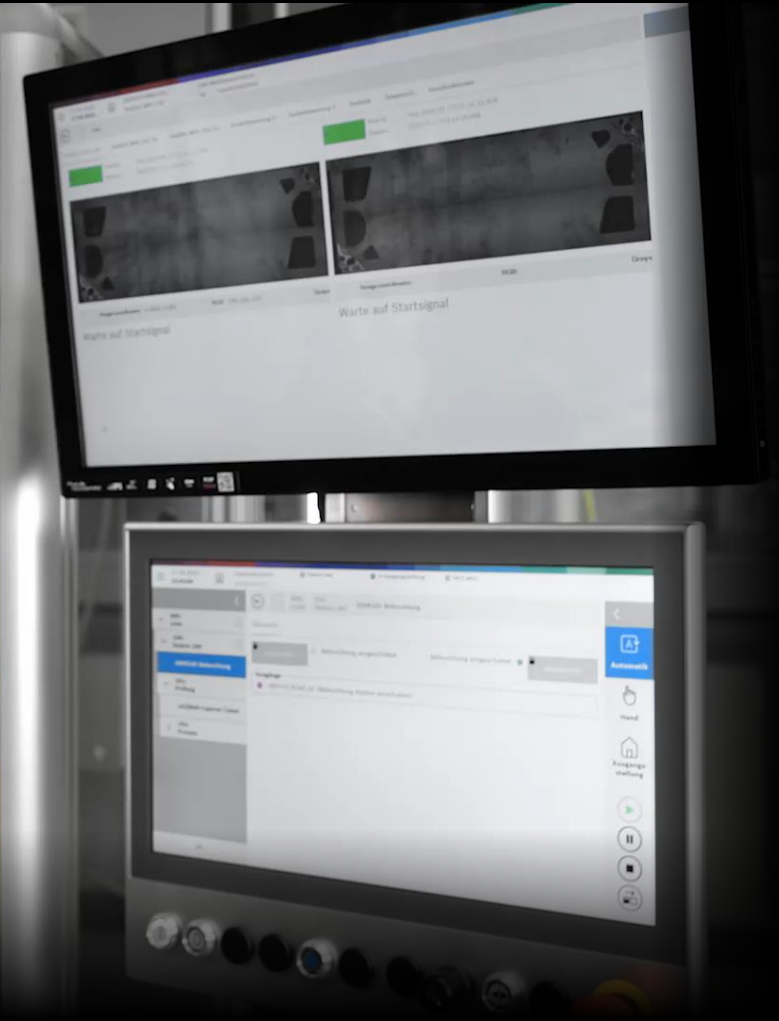
BMG | H2 Solutions | PEMFC

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

- Highspeed, 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



BMG | H2 Solutions | PEMFC

Coating – 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
- Test temperature capability up to 250°C
- Sample geometry:
 - Circular blank
 - Diameter: 33mm
 - Thickness: 0,5mm

Benefits

- Minimized floor space required
- In-house testing system and expertise for rapid job measurements & accelerated time to market
- Easy integration into common lab environments with no special requirements needed
- Increased test temperature allows for accelerated measurements in less than 3 hours (depending on sample) → suitable for materials with lower permeability, e.g. metals
- No corrosion effects that can influence the results



BMG | H2 Solutions | 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 $\pm 5\%$



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 ...



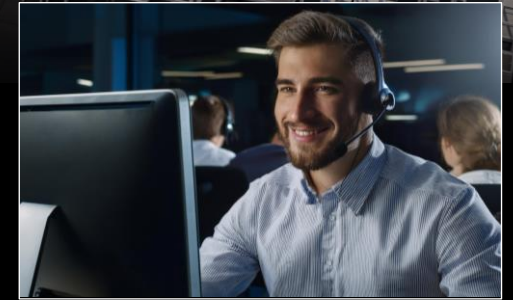
**Engineering Consulting
& Digital Engineering**



**Advanced Manufacturing
Processes & Technologies**



**Digital & Intelligent
Solutions**



**Services along the entire
product lifecycle**

Engineering Consulting & Digital Engineering



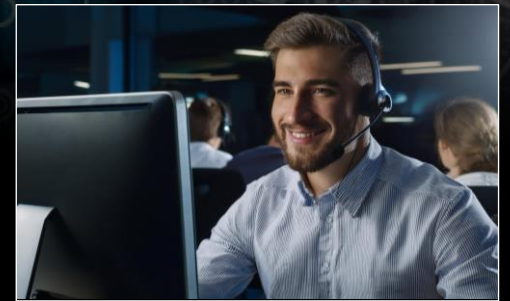
Engineering Consulting
& Digital Engineering



Advanced Manufacturing
Processes & Technologies



Digital & Intelligent
Solutions



Services along the entire
product lifecycle

BMG | our portfolio

Engineering Consulting & Digital Engineering

We support you with our experience already in **your SE work** - for **sustainable product design** that leads to **simpler and more cost-effective manufacturing equipment concepts**. Thanks to our **digital engineering**, we are able to simulate even before realization and thus check everything for feasibility and technical requirements.



Seamless Digital Toolchain

- Automation of engineering tasks
- Bi-directional change management
- Highly efficient global collaboration



Model-Based Engineering

- Line concept & material flow
- Kinematic sequences
- PLC software & MES connection



Functional Machine Structure

- Structured requirement engineering
- One perspective for all domains
- Parallelized work



Mechatronic Modular Standards

- Effective reuse in engineering
- Creators are provided right content at right time
- Exchange of standards across organizations



Field Data Leverage

- Digital machine twins
- Product understanding and improvements
- Custom-tailored services



Digital Solutions & Application on the Edge

- Real-time data processing
- Data aggregation & enrichment
- Powerful (AI) algorithms on the edge

BMG | our portfolio

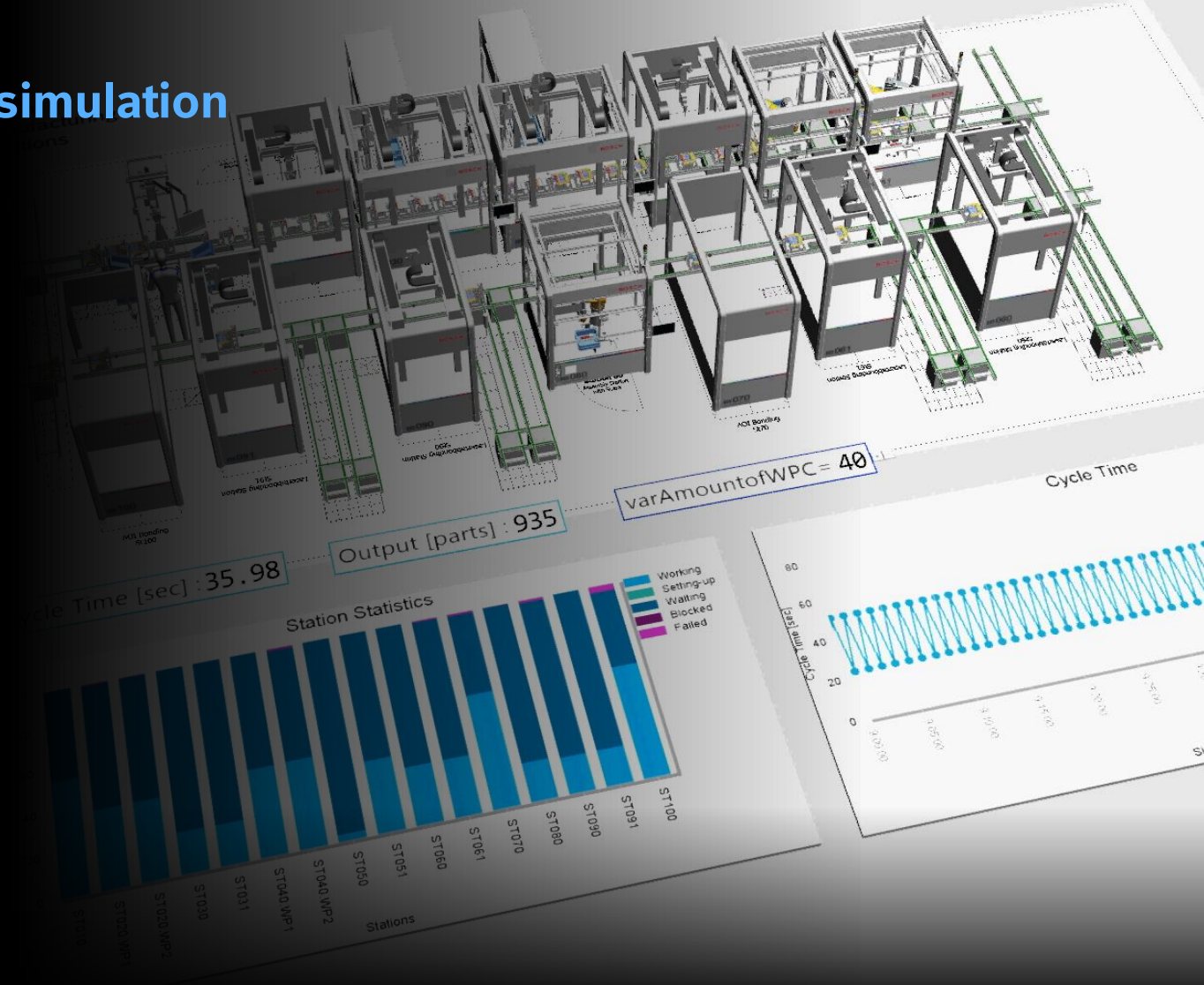
Digital Engineering | material flow simulation

Validated line concepts lead to a considerable risk reduction, even before the equipment is fully designed

- Analysis of cycle time to reach target of xx s
- Standard and custom-tailored line & logistics KPIs, e.g. cycle time, utilization, throughput-time etc.
- Decoupling analysis within and between segments
- Bottleneck identification and optimization analysis considering technical availabilities & additional losses

Benefits

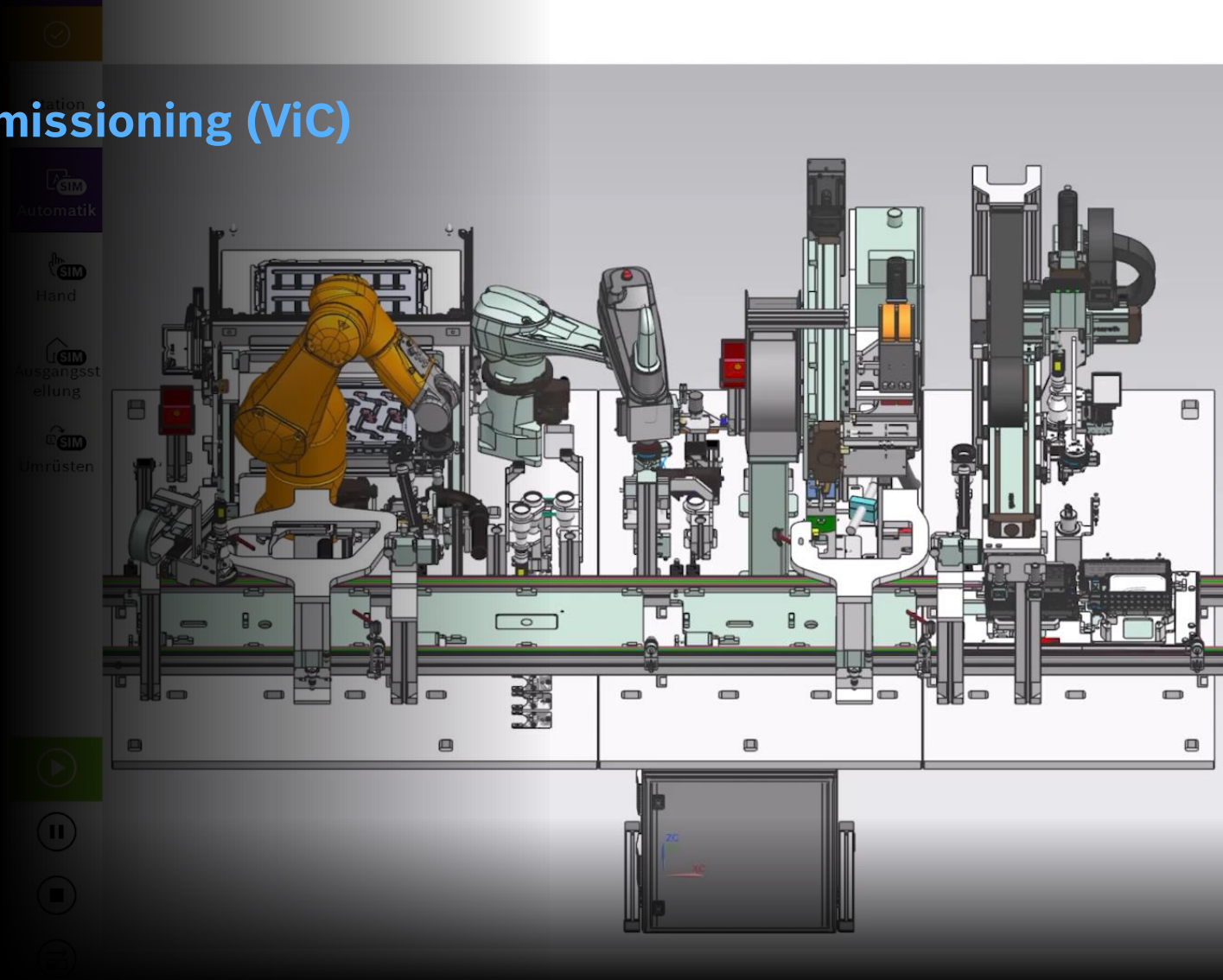
- Overall concept verification including external MAE
- Optimized number of WPCs → Reduction of up to 25 %
- Optimized station concepts e.g. additional buffer position
- Optimized decoupling concept regarding buffer type, size and position



BMG | our portfolio

Digital Engineering | virtual commissioning (ViC)

- Kinematic 3D simulation
- Risk & failure cost reduction
- Reduction of commissioning time & time to market
- Parallel mechatronic engineering in early project phases
- Basis for further optimizations & services during the machine life cycle
- >20 stations worldwide



Manufacturing Processes & Technologies



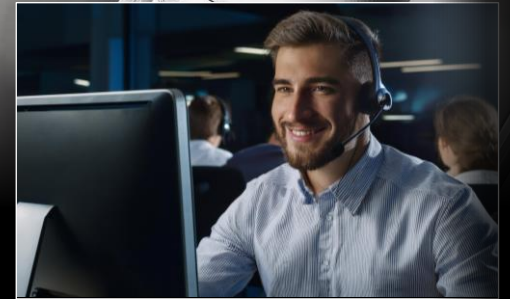
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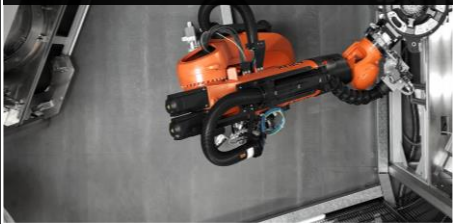
BMG | our portfolio

Manufacturing Processes & Technologies

Manufacturing Processes – innovative & intelligent.

Efficient solutions for demanding & customized applications

Handling, Robotic & Automation



Machine Vision



Separating



Joining



Measurement & Testing



Laser Technology



Forming



Surface Technology



BMG | our portfolio

Manufacturing Processes & Technologies

Manufacturing Processes – innovative & intelligent.

Efficient solutions for demanding & customized applications

Handling, Robotic & Automation

- Handling & Positioning
- Transfer, Transport & AGVs
- Robotics & Gripping
- Feeding, Clamping, Palletizing

Machine Vision

- Assembly Guiding
- Process Control
- Quality Check End of Line / Inline

Separating

- Stripping / Skinning
- Cutting with undefined Edge (Internal Grinding & External Grinding)
- Balancing

Joining

- Resistance & keep welding
- Friction welding
- Ultrasonic welding
- Dispensing & gluing
- Tightening & screwing

Measurement & Testing

- Electrical Testing & Characterization
- Leakage, Gas & Pneumatic Testing

Laser Technology

- Laser Welding (on-the-fly)
- Laser Cutting
- Laser Drilling
- Laser Micro Structuring

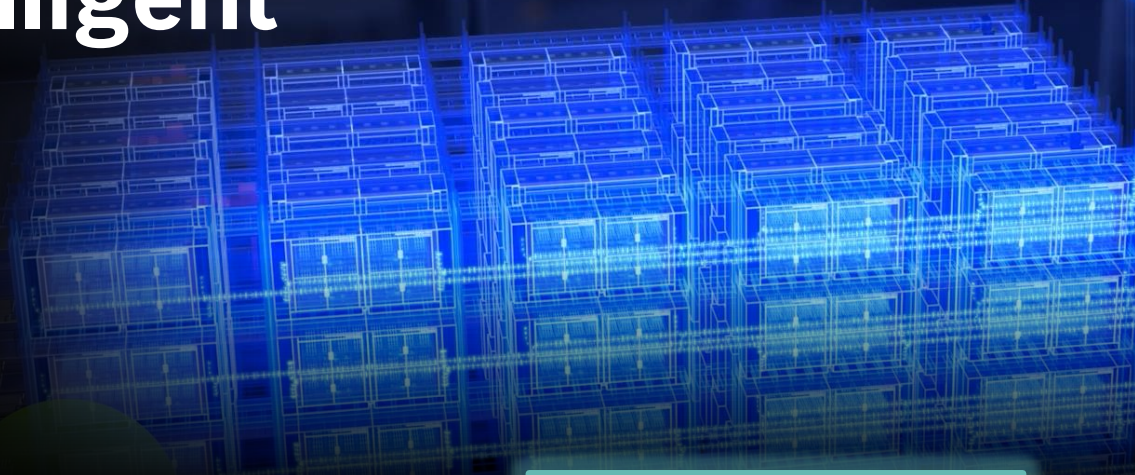
Forming

- Twisting
- Bending
- Winding
- 3D Forming

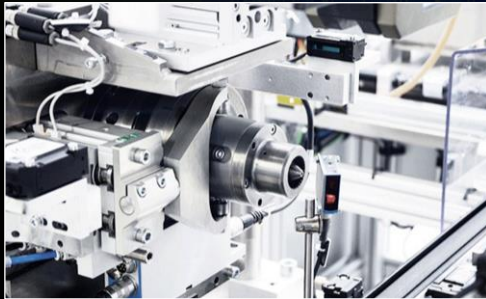
Surface Technology

- Electro plating
- PVD coating
- Functional printing

Digital & Intelligent Solutions



**Engineering Consulting
& Digital Engineering**



**Advanced Manufacturing
Processes & Technologies**



**Digital & Intelligent
Solutions**



**Services along the entire
product lifecycle**

BMG | our portfolio

Digital & Intelligent Solutions | IP Suite environment

Factory Network OS

Plant OS: e.g. Bosch Nexeed MES / IAS

BMG intelligent production suite (IP Suite)



Condition Monitoring
& Alerting



Data Analysis



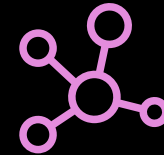
Prediction



Intelligent Process
Optimization



Line & Shopfloor
Solutions



System
Connectivity

Hardware, Security, Documentation

Line, Machine, Process

Nexeed

Beckhoff

Mitsubishi

Siemens

Fanuc

CtrlX

...

Bosch Edge Layer

BMG Consulting & Services

BMG | our portfolio

Digital & Intelligent Solutions | IP Suite modules overview

BMG intelligent production suite (IP Suite)



Condition Monitoring & Alerting

Process Monitoring

Health Report

Cycle Time Assist

Cycle Time Analysis

uHMI (universal HMI)

Dolphin



Data Analysis

AI-based Anomaly Detection

AI-based Root Cause Analysis

MathEngine



Prediction

MathEngine



Intelligent Process Optimization

PPO (Process Parameter Optimization)

MathEngine



Line & Shopfloor Solutions

DashCam (Event-based Video Monitoring)

KPI-Views / Digital Twin

MTS (Maintenance Ticket System)



System Connectivity

UMC (Universal Machine Connector)

Hardware, Security, Services & Documentation

Experience Share System (ESS)

EFA (Embedded Field Application)

Digital Manuals

Services along the entire product lifecycle



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**Digital & Intelligent
Solutions**



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Bosch Manufacturing Solutions | BMG

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