JUTTA STROHBECK, RAINER HOFFMANN

Green hydrogen and Power-to-X

Energy business trip to Namibia and South Africa

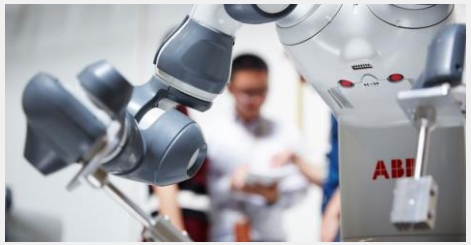
About ABB

Well positioned on the world markets

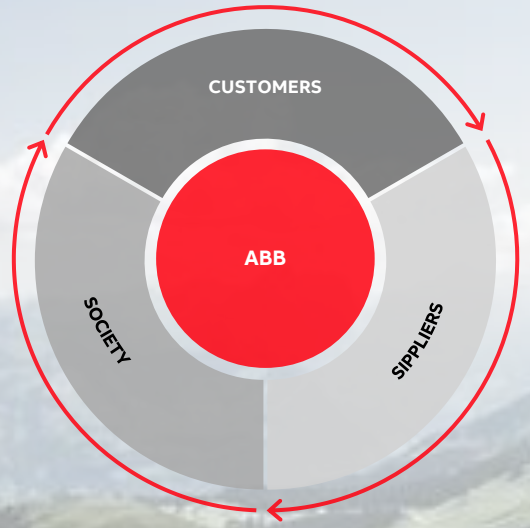
ABB is a leading technology company that is vigorously driving the transformation of society and industry worldwide into a more productive and sustainable future.

By combining its portfolio in **electrification**, **drives**, **process automation**, **robotics** and **factory automation** with software, ABB defines the boundaries of what is technologically possible, enabling new levels of excellence

Fully decentralized business model with 21 divisions

BUSINESS AREAS	electrification	drives	process automation	robotic & factory automation
				
DIVISIONS	Distribution Solutions	IEC LV Motors	Energy Industries	Robotics
	Smart Power	Large Motors & Generators	Process Industries	Machine Automation
	Smart Buildings	NEMA Motors	Marine & Ports	
	Installation Products	Drive Products	Turbocharging	
	Power Conversion	Systems Drives	Measurement & Analytics	
	E-mobility	Service		
		Traction		
		Mechanical Power Transmission		

Key sustainability goals
Achieve by 2030



Sustainability value chain

We enable a
low-emission society

- **Climate neutrality** in our own company
- Supporting our customers in reducing annual CO2 emissions by **> 100 megaton**[1]
- Emissions reduction in the supply chain

We preserve
resources

- **80%** of ABB's products and solutions are covered by the recycling approach
- Zero waste to landfill[2]
- Sustainability concept for suppliers

We promote
social progress

- **No harm** to our employees and contractors
- Comprehensive D&I frameworkt[3]; **25% female representation** among ABB executives
- **Top score** for employee engagement in our industry
- Effective support for community-building initiatives

INTEGRITY AND TRANSPARENCY ALONG OUR VALUE CHAIN

1. savings in 2030 through solutions for our customers 2021-30
2. wherever local conditions permit
3. diversity and inclusion framework concept

Hydrogen – ABB Offering

ABB’s Hydrogen areas

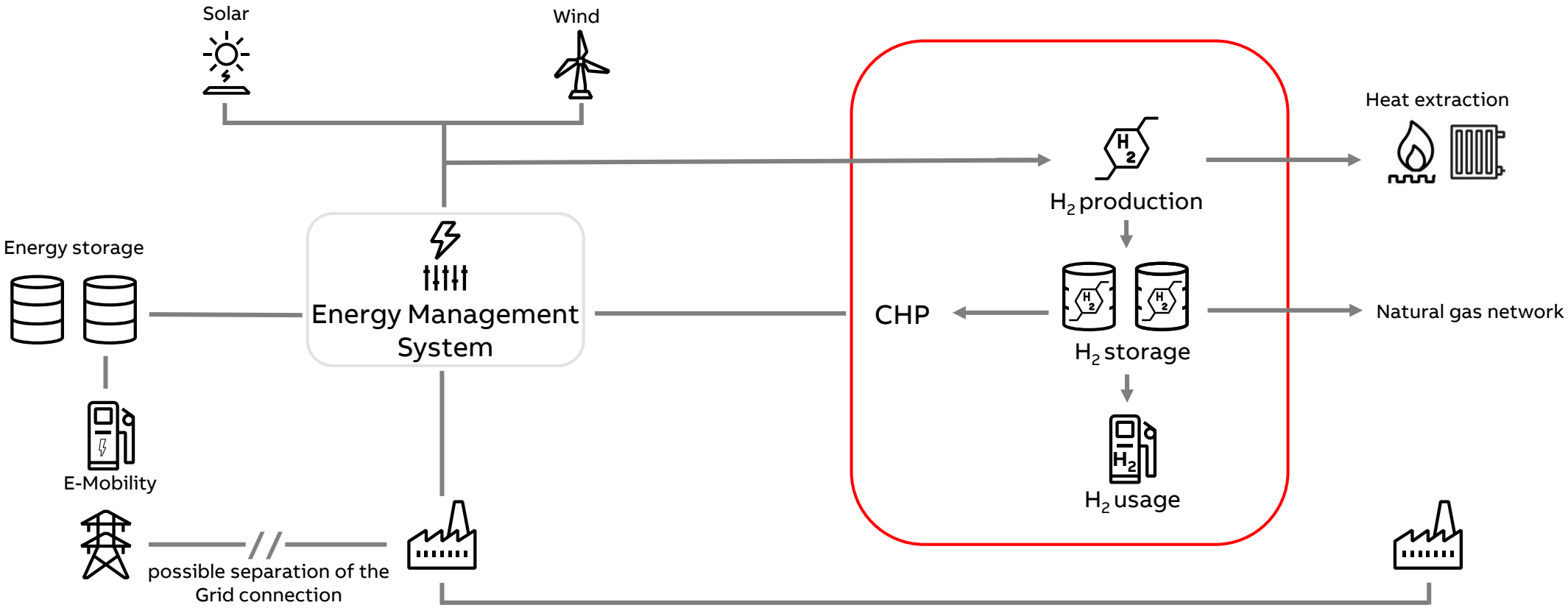
Hydrogen production

Transport and Storage

Consumption

ABB supports within the different hydrogen-sectors

A hydrogen-based energy concept – an example



We can develop an overall concept - and thus a carefree entry into the hydrogen variety

ABB Opportunities

Hydrogen

ABB offering

- Energy Management Systems
- Asset Performance Management and Digital Twin

- Safety and Automation Systems
- Remote Control & Autonomous Operation
- Analysers & Instrumentation

- Power distribution solutions (MV, LV, HV) and - studies
- Power rectifiers

- Partnerships with key technology providers (electrolysers, fuel cells, compressor stations) for a complete solution

Power-to-X

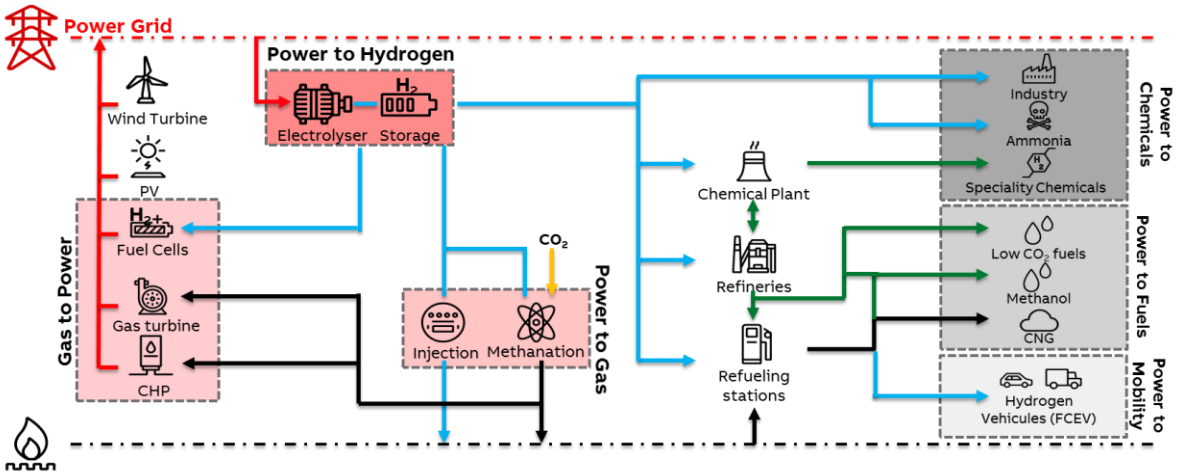
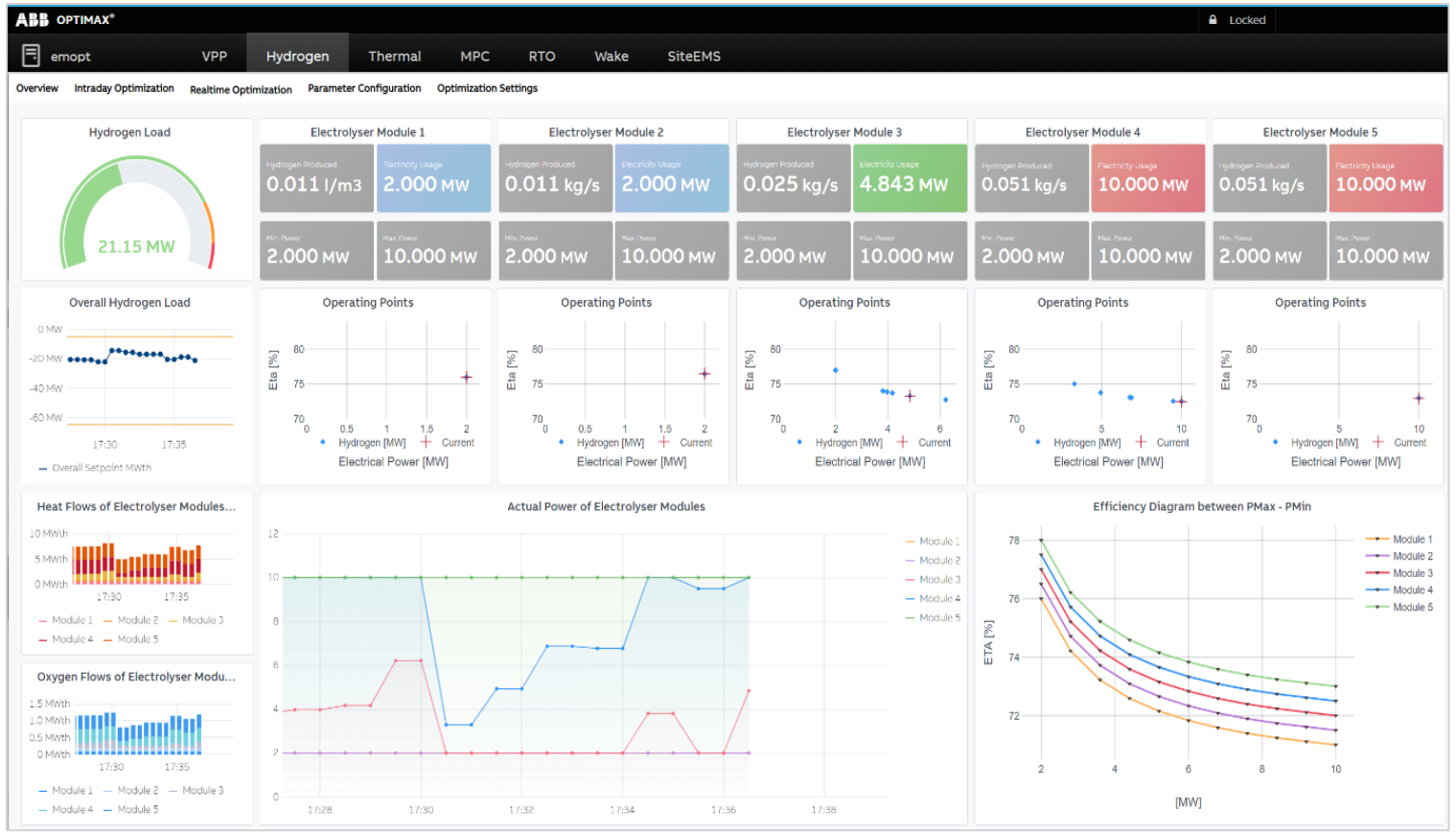


ABB Ability™ Energy management OPTIMAX®

Optimization of multiple el.-modules for efficiency and degradation

OPTIMAX® for Hydrogen Energy Management

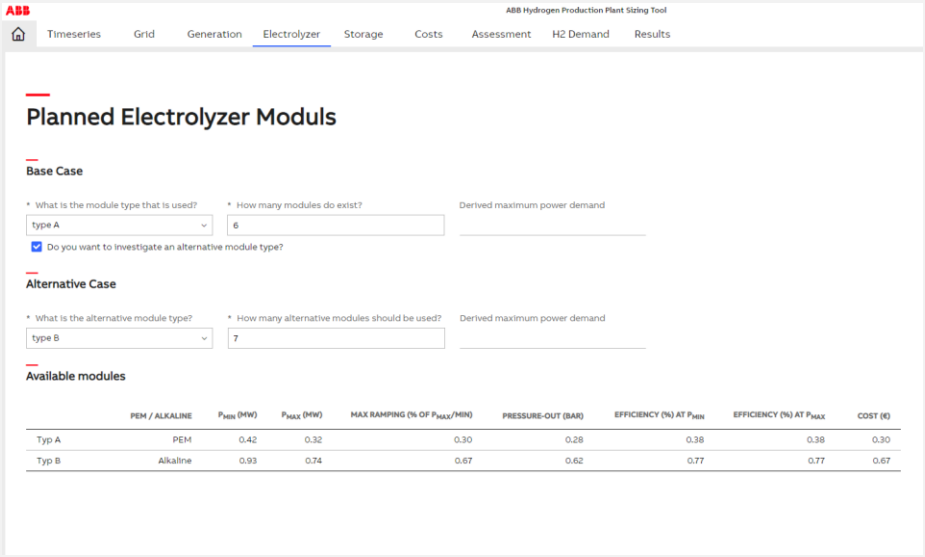


- individual efficiency curve for each electrolyser module
- Operation of the plant in optimal condition for different set points
- Enables predictive maintenance of modules
- Monitoring and optimization of electrolyzers and coordinated real-time optimization of multiple electrolyzer modules

HPP (Hydrogen Production Plant) Sizing Tool

Consulting and analysis in the conception phase, FEED and design

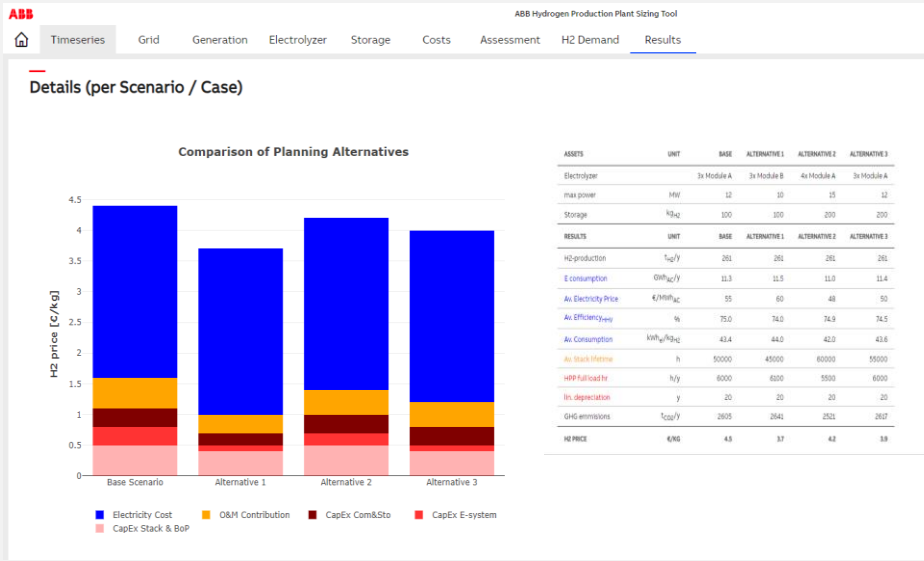
System Design and Scenarios



Planning parameters:

- **Network:** technical limit, prices, GHG mix
- **Generators (PV, wind, diesel, waste2energy):** timetables, GHG
- **Electrolyzer:** module type, number of modules, efficiencies, limit values
- **Storage:** Size, Pressure, Compression
- **Costs:** depreciation, operating hours

Consulting and analysis



Results:

- **Scenarios:** Optimized, non-optimized, electrolyzer module types
- **Cost per scenario divided:** Capex, O&M, Power
- **Greenhouse gas emissions per scenario**

Slide 12

References

Auxerre / FR

Pilotanlage zur H2-Produktion

Pilot plant Auxerre – H2 for transport
Thyristor bridge with 12 pulses
- Power factor correction and harmonic filtering
- Electrolyser including drying and cleaning unit
- H2 buffer tanks, compressors and medium-pressure accumulators
- H2 filling station

OPTIMAX®
- Monitoring of the plant
- Real-time optimization of the electrolyzer
- Predictive optimization of H2 production

Outlook
- Multiple such facilities managed through a hybrid cloud

H2 in FR

Customer: Hynamics Edf Group **Location**: Auxerre, FR
Delivery: OPTIMAX®

Production site

Mission to Zero – Busch Jaeger

Customer need
- Optimization of: solar, EV, battery, co-generation, backup generator
- Optimal use of own production
- Participation in the energy market

ABB solution
- Software-as-a-Service with minimal upfront costs
- Minimal costs for technology and local hardware
- Aggregate multiple site EMSs

Customer benefit
- Reduced energy costs
- Increased transparency and internal consumption
- 745t /p.a. CO2 saving
- 360-degree service package

Customer: Busch-Jaeger Elektro GmbH
Location: Lüdenscheid **Delivery**: OPTIMAX®

6,8%
Electricity costs savings

Offshore – Connection

Kriegers Flak

Customer need

- 2 countries interconnect their onshore transmission systems
- Via 4 offshore wind farms platforms

ABB solution

- Real-time data processing and evaluating of P/V references to control power flow
- Optimal powerflow calculation based on grid model
- Predictive and forecast functions

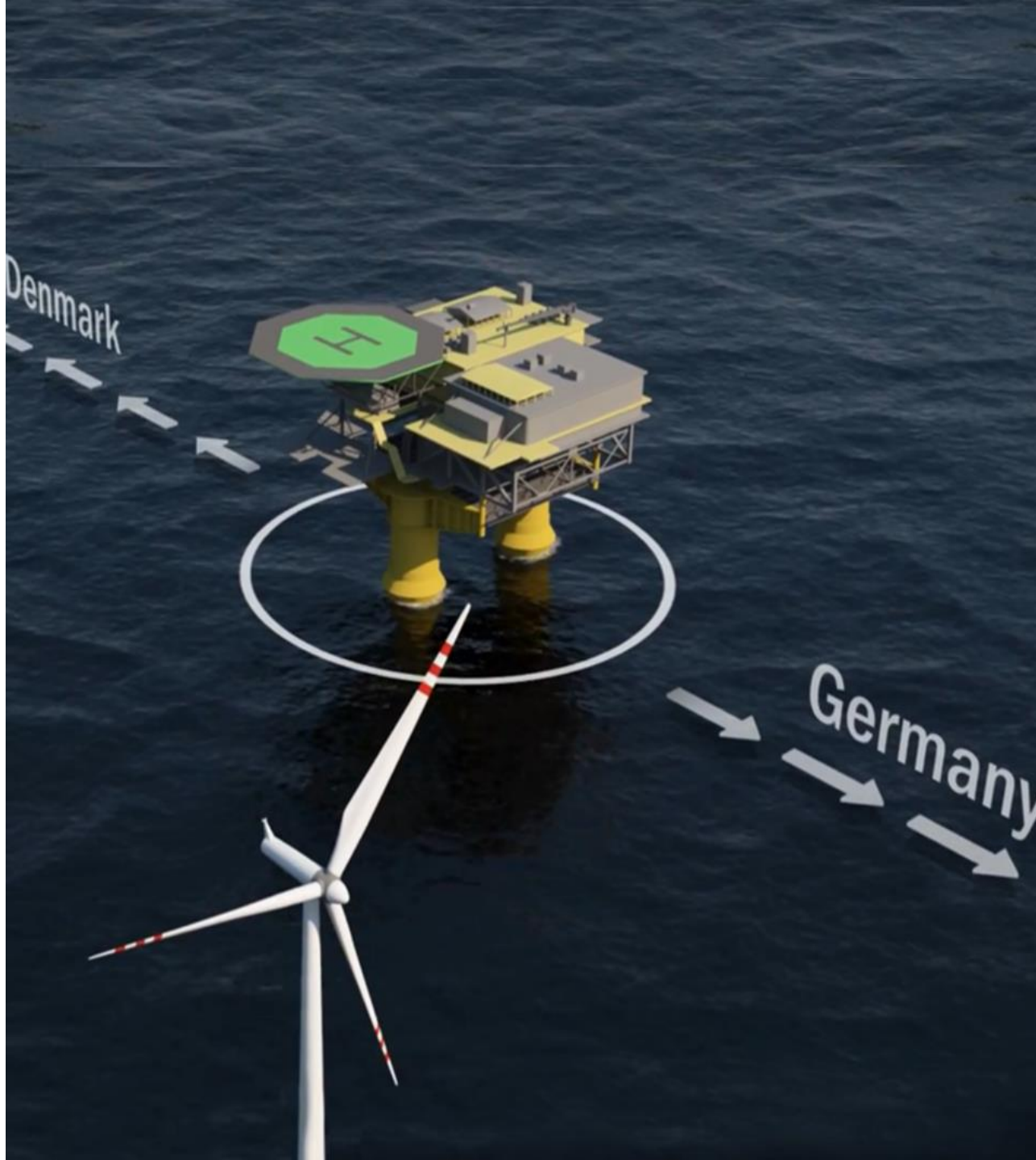
Customer benefit

Cutting-edge technology to manage and control the Combined Grid Solution:

- Power flow (active, reactive)
- Incorporating the HVDC-Link

Customer: 50Hertz & Energinet DK
Location: Baltic Sea **Delivery:** OPTIMAX® for VPPs

1 GW
Wind power

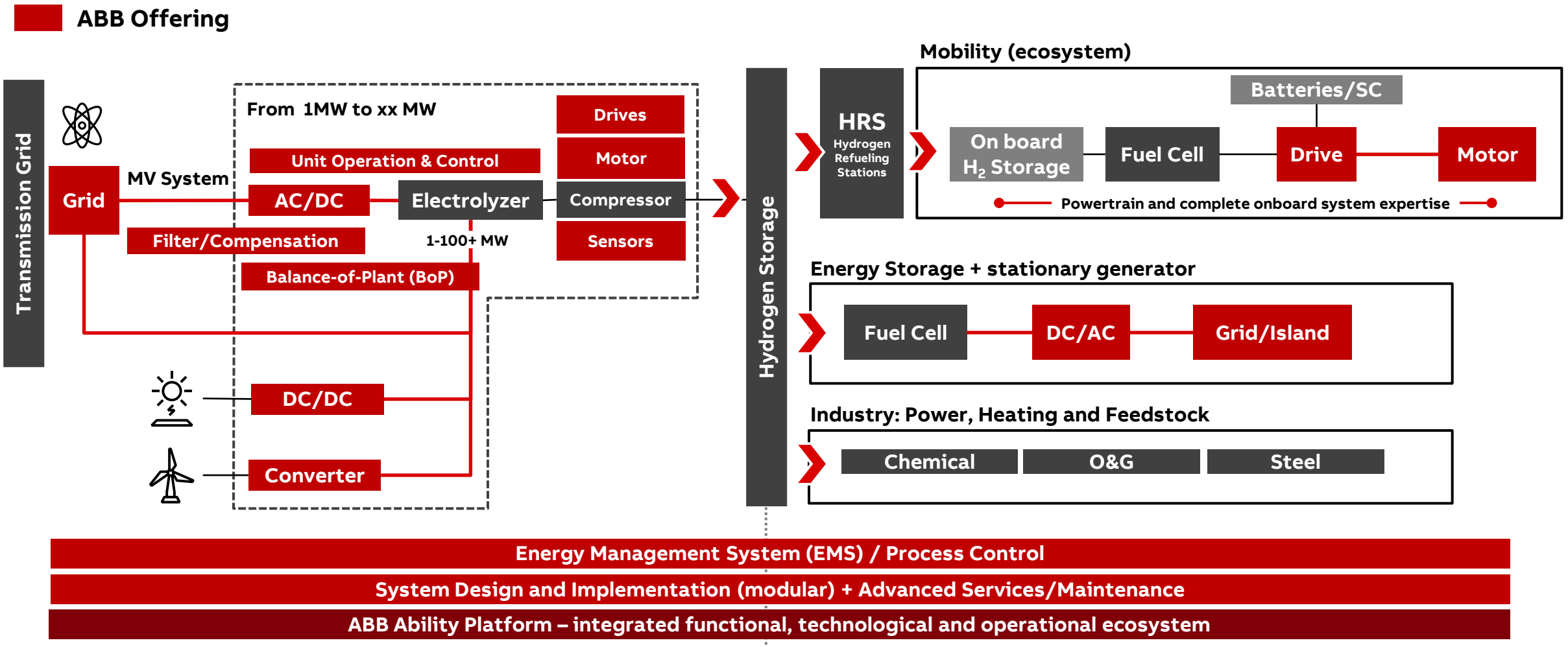


Read the web story on abb.com

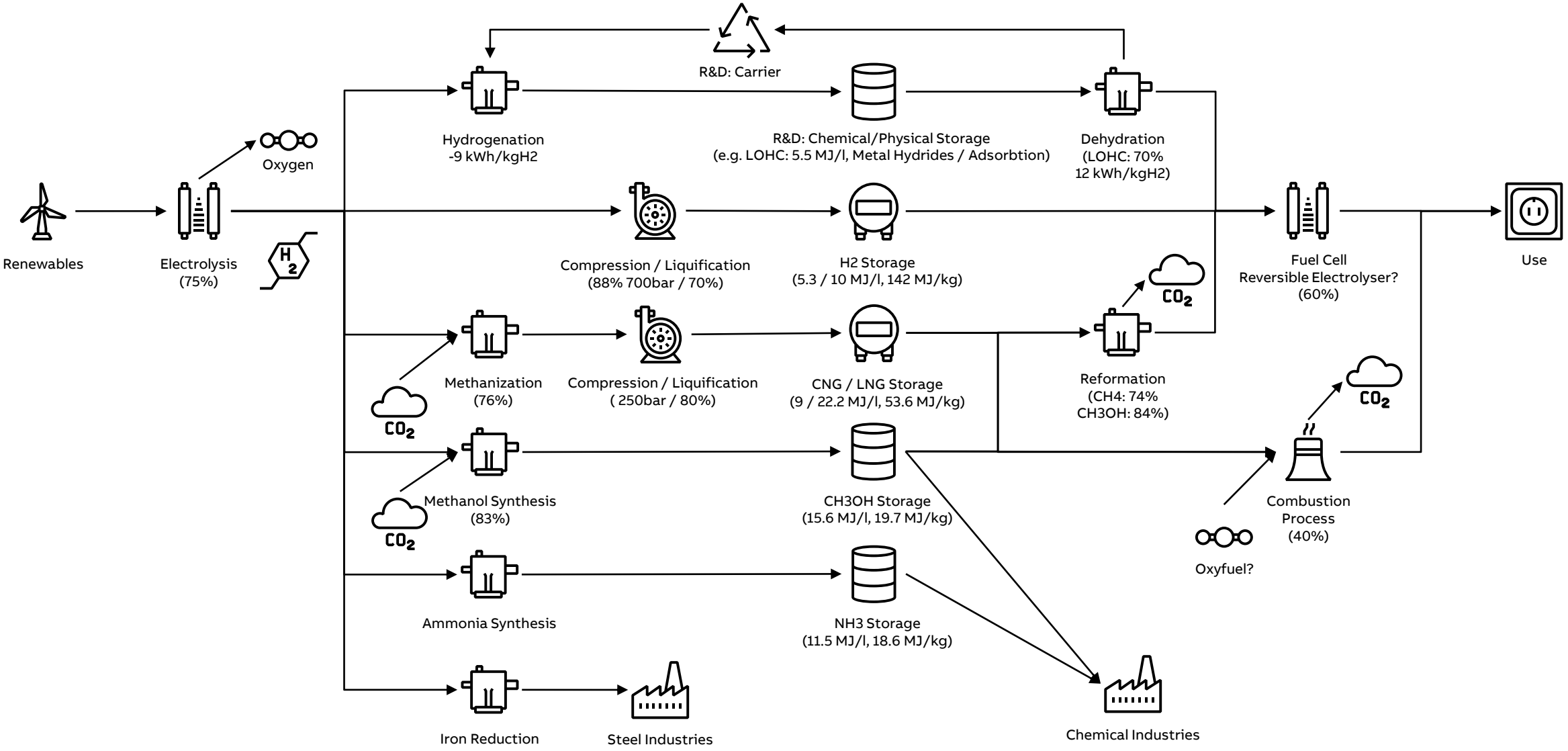

ABB

Backup Slides

ABB's contributions to the value chain



Pathways of green Hydrogen



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