

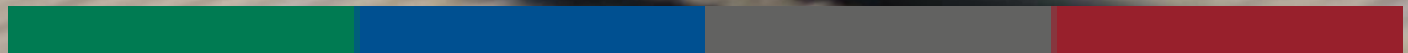
Proton Motor Fuel Cell GmbH Cleantech Power Solutions

Uwe Halbmeier, NOW 4-ter Marktplatz Zulieferer, Berlin, 20.09.2017



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Proton Motor Fuel Cell GmbH is a German manufacturer of fuel cell stacks and fuel cell systems for maritime, stationary and mobile applications

More than 20 years experience in Fuel Cell Technology



- 1994: Start of fuel cell development
- 1998: Founding of Proton Motor Fuel Cell GmbH
- 2006: Stock market launch of Proton Power Systems
- 2015: Cooperation Agreement with DB Bahnbau Gruppe
- 2016: Roll-out of EPS-Systems in BOS application

Provides Solutions for a safe and clean energy supply



CLEANTECH Powersupply



CLEANTECH COMPETENCE



Stack Technology

NT-PEM Stacks
 Power Range
 2..30 kW_{elect}

Products

Batterie – UPS
 Power Range
 1.5 .. 200 kVA

Solar Batterie Storage
 Power Range
 3 .. 10 kW (1-3ph)

PM Module
 S5: 2 .. 6 kW
 S25: 10 .. 25 kW

HyRange®
 Power Range
 9 .. 30 kW

Solutions

- Indoor & Outdoor containerized Solutions for power supply e.g.
- TETRA/BOS Base stations
 - Railway & Transformer Stations
 - Industry, Offices, Residential
- Drive train solutions for
- city busses & light duty vehicles
 - Boats and ships

TriHyBus®



Fuel cell power:	45 kW
Li-Ion battery:	27,4 kWh
Ultracaps:	1 kWh, 200 kW
Propulsion:	120 kW
Hydrogen:	20 kg @ 350bar
Consumption:	8 kg / 100 km

Logistic with HyRange®



Fuel cell power:	8,4 kW
Li-Ion battery:	80 kWh
Charging current:	400 VAC, 32A
Propulsion:	120 kW
Hydrogen:	5 kg @ 350bar
Consumption:	~0,5 kg H ₂ /h

Magna FC REEV



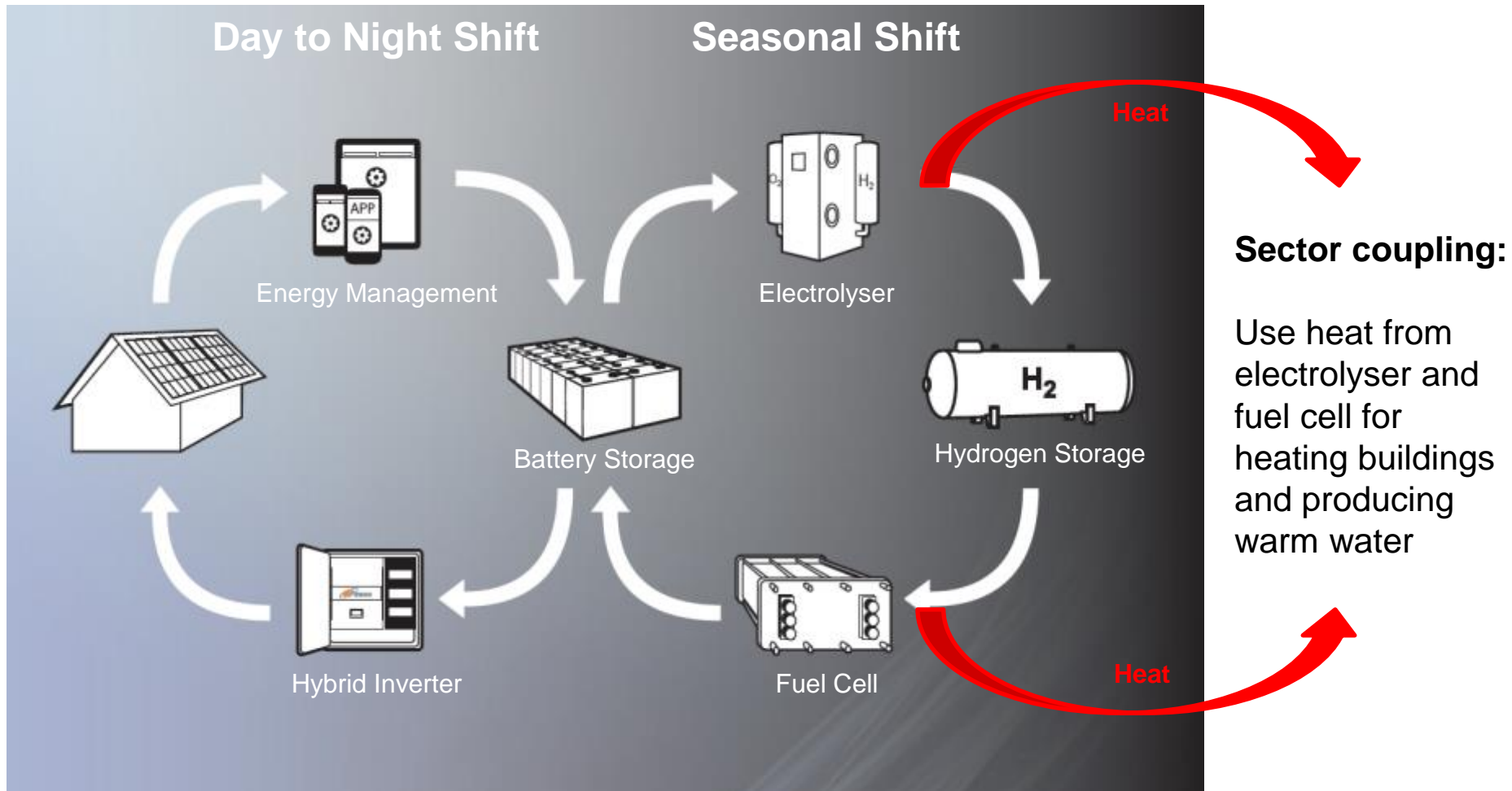
Fuel cell power:	25 kW
Li-Ion battery:	15 kWh
Driving range:	400 km
Propulsion:	Electric 4x4
Acceleration:	< 11 sec (0-100)
Hydrogen:	3 kg @ 700bar
Refueling time:	< 3 min



ZEMSHIPS project, Hamburg

- Zero Emission Fuel Cell Ship.
- Capacity for approx. 100 passengers.
- ZEMSHIPS project partner: ATG, Linde, German Lloyd, Stadt Hamburg, Proton Motor.
- Proton Motor was responsible for the complete propulsion system of the Ship.
- In use since summer 2008. In approx. 4000 operating hours more than 50.000 passengers were transported (01/2014).
- 1,7 kg hydrogen consumption per operation hour.

On Site Storage - Seasonal Energy Storage



FC EPS 4 .. 8 kW



Containerized Emergency Power System

Proton Motor provides a fuel cell based emergency power system, integrated in a special designed outdoor cabinet. In this application, with the following dates:

- | | |
|---------------------------|--------------------|
| Output Voltage: | - 3 x 230VAC; 50Hz |
| Output Power: | - 4 .. 8 kW |
| Bridging time without FC: | - approx. 15 min. |
| Bridging time with FC: | - up to 72 h |

- | | |
|-------------------------------|-------|
| Protection against vandalism: | - RC4 |
| Fire resistance class: | - F30 |

Remote Monitoring available



Bahnbau Gruppe

5kW DC-EPS with FC

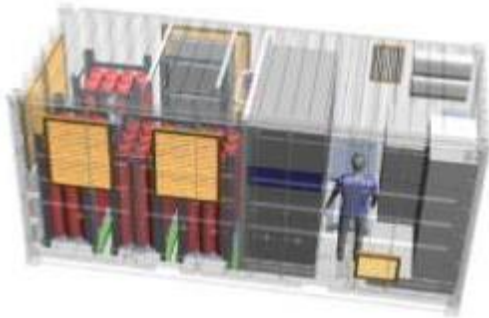


Emergency Power Supply UW Bachhausen

- Pilot project at Bayernwerk (former E.ON Bayern AG) to prove functionality of fuel cell as emergency power supply for switching stations instead of huge batteries.
- Technical Data:
 - Electrical Output Power: 5 kW
 - PM Module S5 inside
 - Output Voltage: 220 VDC
 - Direct DC coupling
 - Bridging time: > 10 h
- In operation since 05th of November 2012

bayernwerk

50 kVA FC EPS



General opportunities:

- AC or DC
- 5kVA up to 250kVA
- Internal gas storage up to 50kVA
- Back synchronization to mains without interruption

Containerized Emergency Power System

Proton Motor provides a 50kVA fuel cell based emergency power system, integrated in a 20 feet HC sea container. In this application, with the following dates:

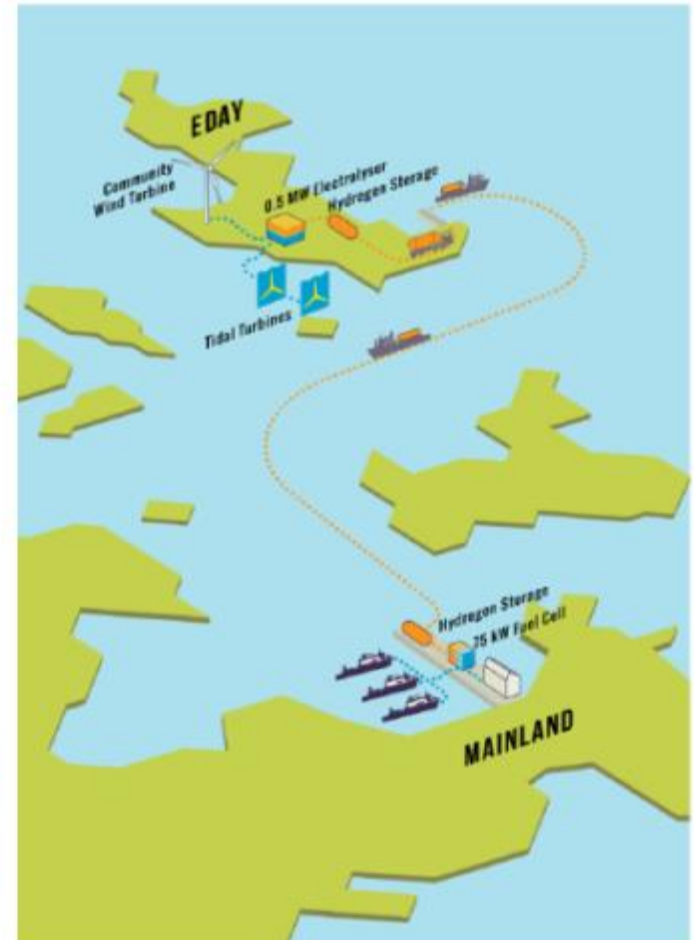
- | | |
|---------------------------|-----------------------------|
| Output Voltage: | - 230/400VAC; 50Hz |
| Output Power: | - 50kVA nominal |
| | - 60kVA short time (15 min) |
| | - 90kVA peak (1s) |
| Bridging time without FC: | - approx. 10min. |
| Bridging time with FC: | - approx. 12h (200bar) |
| | - approx. 17h (300bar) |

(additional external gas-storage possible / exchange of internal storage during running system possible)

Protection against vandalism: - RC2

Surf n Turf:

- Infrastructure linking wind and tidal turbines to electrolyser
- 3x bespoke tube trailers to transfer hydrogen
- Permission from Marine and Coastguard Agency to use ferries
- 75kW fuel cell at harbour



Thank you for your attention!



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