German Government Perspectives on Hydrogen at Ports and At-Sea Marine Applications

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H2@Ports Workshop

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TOWARDS ZERO EMISSION MOBILITY

Integrated implementation of national funding programs by NOW GmbH

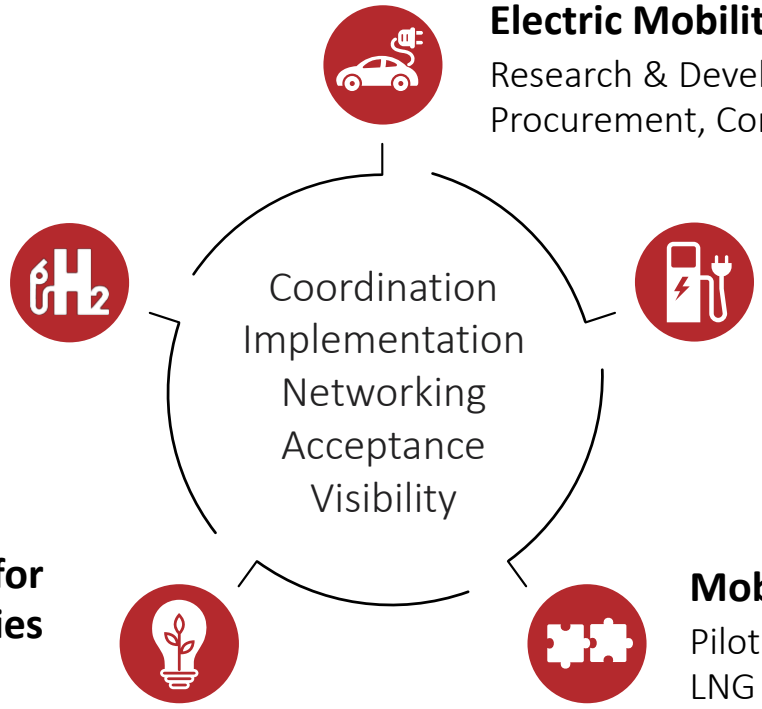
NOW-GMBH.DE

National Innovation Program for Hydrogen and Fuel Cell Technology (NIP)

Research & Development;
Procurement

Electric Mobility on Site

Research & Development,
Procurement, Concepts



Charging Infrastructure for Electric Vehicles

Nationwide Establishment of
Regular- and Fast Charging Points

Export Initiative for Environmental Technologies

Mobility and Fuel Strategy

Pilot Projects
LNG in Shipping

GERMAN GOVERNMENT PERSPEKTIVE

Current German Government´s coalition agreement:

„At national level, we want to strengthen and stabilize our technology-open initiatives for alternative propulsion and energy sources in shipping and in ports (LNG, Hydrogen / fuel cell, methanol, electromobility).”

=> Technology-open, but focus on H_2 & Fuel Cells, Methanol, Electromobility

Current funding initiative:
National **I**nnovation **P**rogram for Hydrogen and Fuel Cell Technology (**NIP**)

FUEL CELLS IN SHIPS - NIP R&D PROJECTS 2009 – TO DATE

e4ships Project Cluster - www.e4ships.de/english-1/

	SchIBZ2	MultiSchIBZ	Pa-X-ell	RiverCell	ELEKTRA	FC Ship Propulsion
Project Management:	ThyssenKrupp Marine Systems	ThyssenKrupp Marine Systems	Meyer Shipyard	Meyer Shipyard	TU Berlin	Humphry Marine
Application Area Focus:	Sea	Sea	Sea	Inland	Inland	Inland
Application Focus:	Multi Purpose Vessels, Yachts	Multi Purpose Vessels, Yachts	Cruise Ship	River Cruise Ship	Tug Boat	Leisure Boat
Usage Focus:	Power Supply	Power Supply	Power Supply	Power Supply & Propulsion	Power Supply & Propulsion	Power Supply & Propulsion
Fuel:	Diesel	Diesel; LNG	Methanol; LNG	Methanol	H_2	H_2

ELEKTRA PROJECT

Example for Ship and Port Operation with Fuel Cells

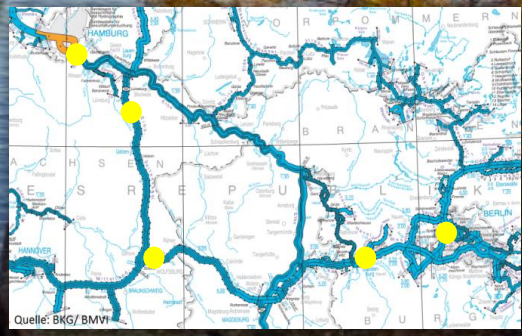
Main Dimensions

Length	20,00 m
Width	8,20 m
Depth	1,25 m
Weight	ca. 150 t

Propulsion

2 x 210 kW
3 x 100 kW Fuel Cell
750 kg H_2 on board
2 x 1025 kWh Battery

Local transport within Berlin



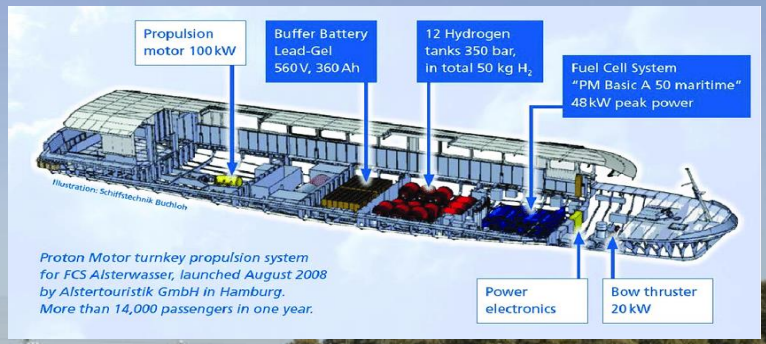
Range extended operation

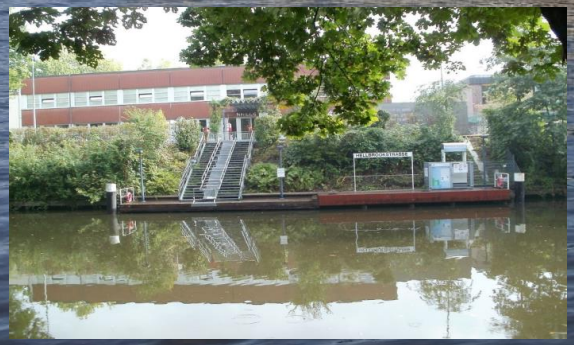
- Berlin <-> Hamburg, Berlin <-> Stettin
- min. range 130 km per day
- 16 h of operation per day
- speed requirement 8,5 km/h, max. 10 km/h

LESSONS LEARNED ON EARLY FUEL CELL MARITIME PROJECTS

„Alsterwasser“ – Sightseeing Passenger Ship in Hamburg

Operational: 2008 – 2013
(no NIP-Project)





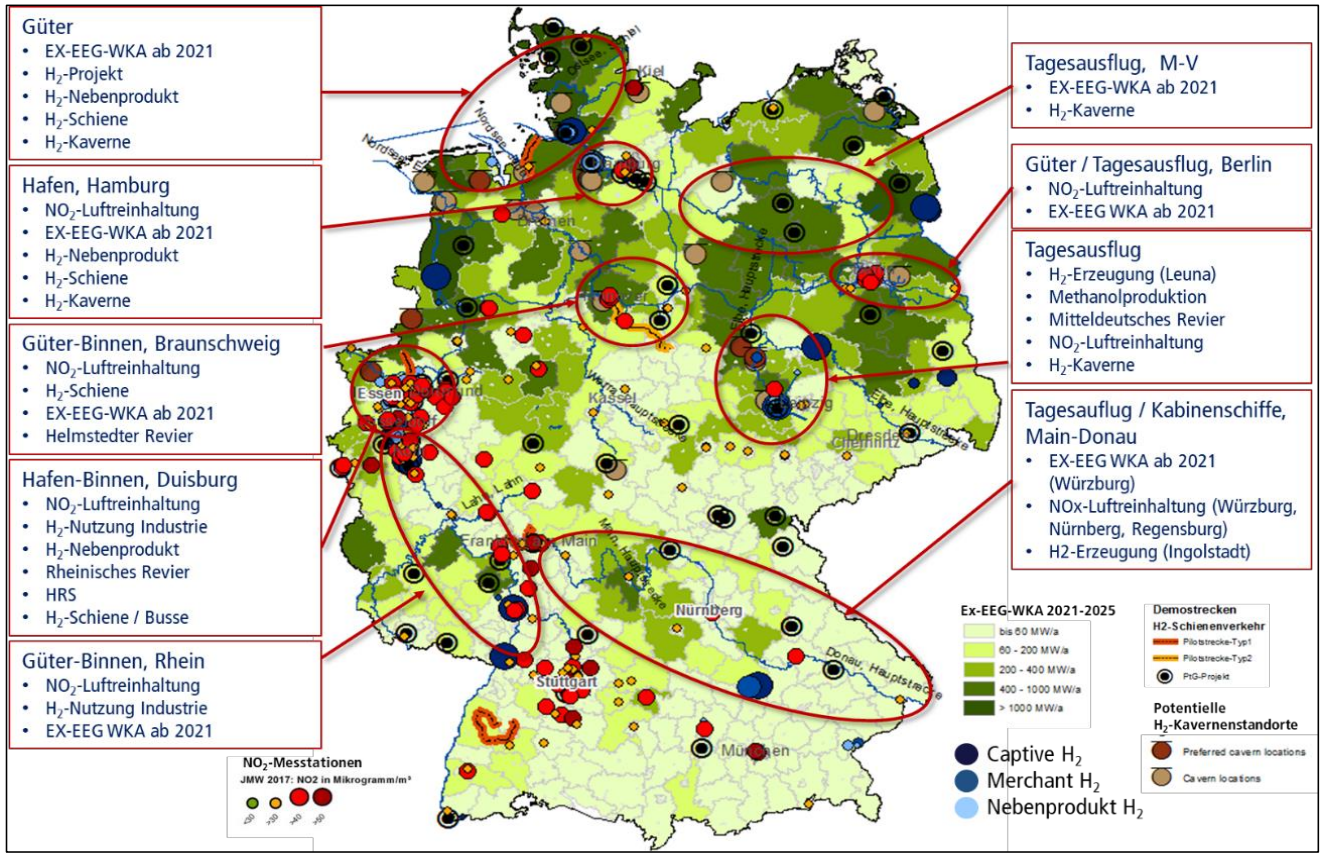
Lessons learned:

- Application and Infrastructure MUST go together
- Cost have to be lowered
- Although the project was a success, it didn´t cause a „rush“ on fuel cells in maritime applications

TO ADDRESS LESSONS LEARNED

Study „Renewable Energy for Fuel Cells in Inland Vessels“ – to be published ~ November 2019

- Identify „germ cells“ for fuel cells in ships by matching:
  - renewable energy sources
  - frequented shipping routes
  - port locations
  - cities with high emissions
- TCO analysis for various ship types and various renewable fuels
- Use study to educate relevant stakeholders about the technology



TECHNOLOGICAL CHALLENGES

Stack & System:

- still R&D needed for SOFC- and HT PEM- fuel cells as well as for reformer technology
- not many technological gaps for H_2 and PEM fuel cells => it works, high TRL

Infrastructure and Fuels:

- local and global availability of H_2 and other alternative fuels
- H_2:
  - pressurized, cryogenic, LOHC?
  - pressure level (350, 500, 700 bar)?
  - interface to refueling station
  - safe and low cost refueling procedure
  - standardization

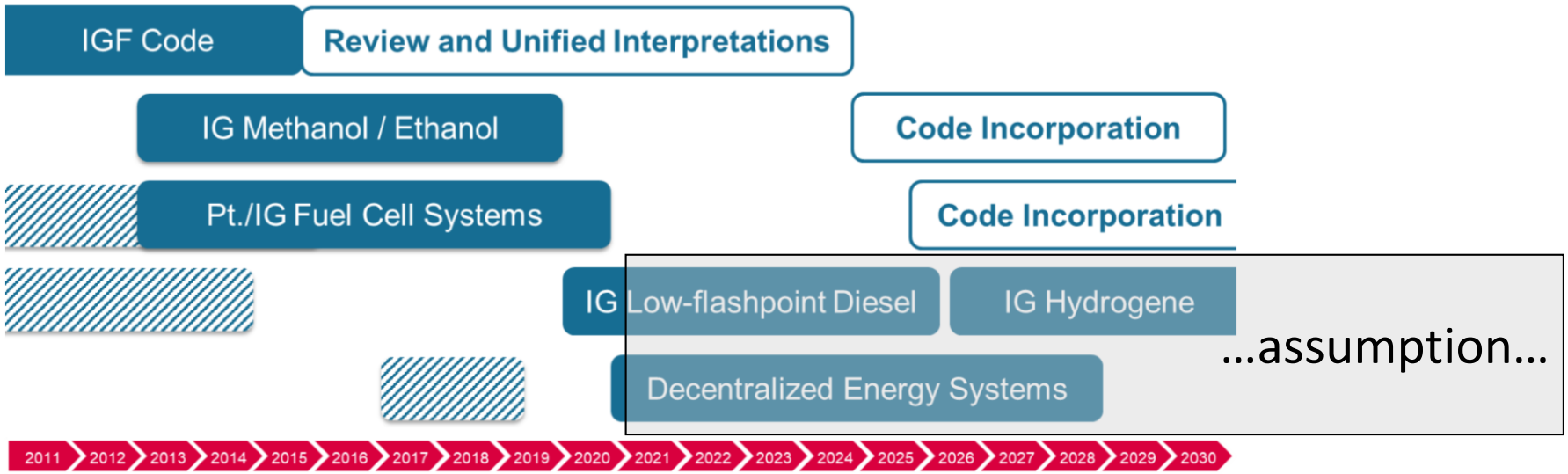
Applications:

- individual design and construction of ships and fuel cell propulsion systems => economies of scale harder to achieve as in other traffic-sectors (i.e. FC cars, busses, heavy duty,…)
- lack of port-specific applications (push-trucks, heavy duty lift trucks,…)

REGULATORY CHALLENGES AND BARRIERS RELATED TO SAFETY, CODES AND STANDARDS

Activities of the e4ships – projects concerning safety, codes and standards are bundled by e4ships-Cluster-Management:

- Development and proposal of regulations for seagoing- and inland- vessels
- Communication with Flagstate



e4ships‘ IMO Roadmap for maritime application of fuel cell

Thank you for your attention!

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