



NATIONAL INNOVATION PROGRAMME HYDROGEN AND FUEL CELL TECHNOLOGY (NIP)

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NOW

PARTNER OF THE GERMAN GOVERNMENT FOR SUSTAINABLE MOBILITY

Battery Electric Mobility

- Research and Development
- Communal mobility concepts
- Vehicle procurement



National Innovation-Programme Hydrogen and Fuel Cell Technology

- Research and Development
- Market activation

Export Initiative Environmental Technology

- German-Japanese cooperation PtG
- H2/FC technology in developing countries (cooperation with GIZ)



Federal Programme Charging Infrastructure

- Nationwide buildup
- Normal charging
- Fast charging



Mobility and Fuels Strategy

- Alternative fuels (efficient, emission-free)
- LNG as a marine fuel
- Pilot projects



THE NIP I

PHASE 1 (2006 – 2016)



Evaluation of the National Innovation Program Hydrogen and Fuel Cell Technology Phase 1 (2006 bis 2016)

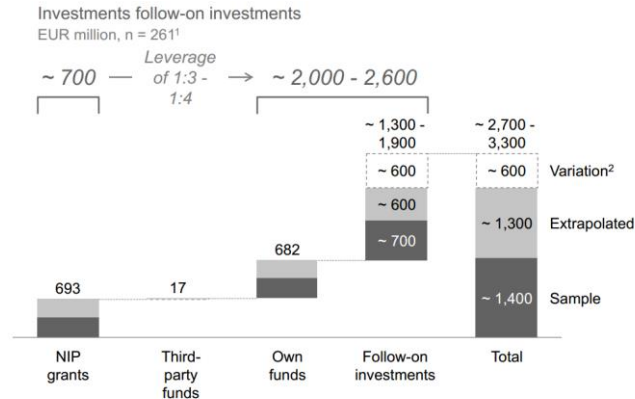
On behalf of

Federal Ministry of Transport and Digital Infrastructure

Federal Ministry for Economic Affairs and Energy

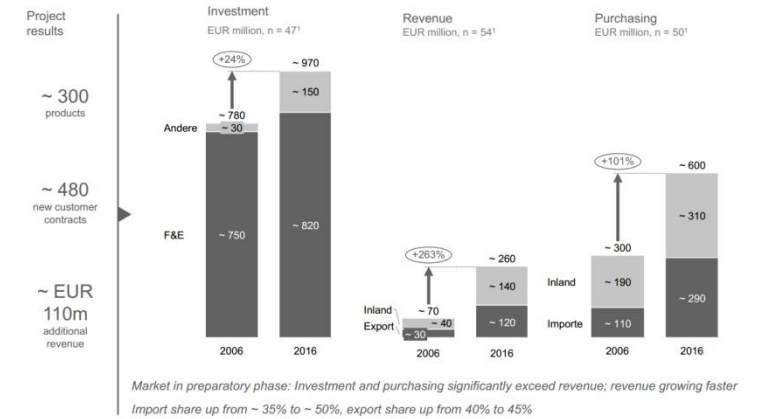
September 2017

...TRIGGERED FOLLOW-ON-INVESTMENTS



¹ 261 responses to question: Have follow-on investments resulted from the project? 110 yes, 151 no. Of the 110 positive answers, 84 included an indication of the volume of follow-on investment. For the remaining 26 positive answers, the average value for the 84 responses was assumed.
² The upper boundary of the leverage was calculated directly from the raw data, the lower boundary from a version adjusted for potential double-counting. The double-counting adjustment was made for volumes in excess of EUR 10 million at organizations with multiple projects.
SOURCE: Survey of NIP Grant Recipients 2017

...ACCELERATED MARKET DEVELOPMENT



Question: Please indicate your investments in and revenue from H₂FC technologies; investments in H₂FC/thereof R&D; revenue from H₂FC/thereof exports; purchases from suppliers in H₂FC/thereof from suppliers outside Germany
¹ Average values were extrapolated to 205 companies (large corporations and SMEs) that received the survey
SOURCE: Survey of NIP Grant Recipients 2017

...€710 MILLION PUBLIC R&D FUNDING

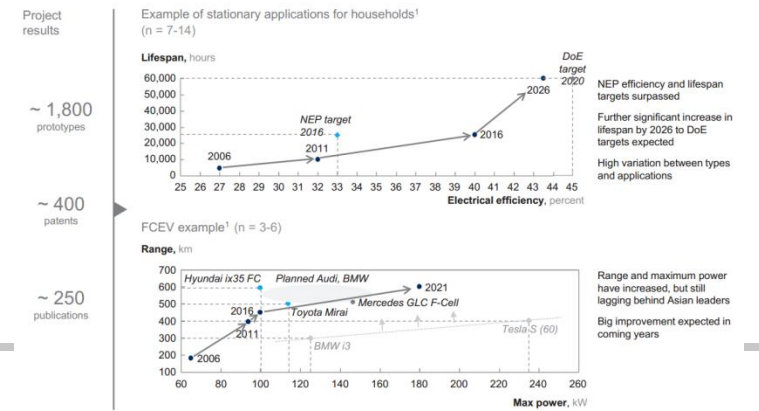
Scale, EUR m: 10 50 100 150 200 250 300 350 400

Total volume and grant proportion

	Basic research ¹	Applied R&D ¹	Demonstration projects ¹	Market activation ²	Support activities ¹	Total
Transport	44 (46%)	471 (49%)	238 (49%)	-	0 (41%)	754
Household power	4 (49%)	165 (48%)	33 (49%)	13 (39%)	9 (48%)	223
Special markets	4 (46%)	109 (53%)	40 (48%)	3 (45%)	-	152
Industry	8 (46%)	32 (60%)	76 (46%)	-	1 (46%)	120
Transversal topics	6 (88%)	67 (60%)	1 (43%)	-	8 (43%)	83
H ₂ production	5 (86%)	18 (59%)	30 (50%)	-	2 (100%)	55
Total	71	863	418	16	21	1,415³

¹ Estimate of innovation stage based on self-assessment of grant recipients
² NIP grant guidelines
³ Contains 18 additional BMW programs subsequently designated to NIP but not designated within this matrix – see appendix 8.5
SOURCE: Database NOW GmbH NIP I (professional excerpt, as of February 2017); Survey of NIP Grant Recipients 2017

...SAFEGUARDED GERMANY'S POSITION AS TECHNOLOGY LEADER



¹ Median of survey responses per area of application
SOURCE: Survey of NIP Grant Recipients 2017; National Development Plan for NIP, Version 3.0, 2011; McKinsey

National innovation programme hydrogen and fuel cell technology 2016 to 2026 (€1.4 bn.)

Measures by the BMVI within the scope of NIP II (€250 million until 2019)

Funding guidelines of the BMVI in the course of NIP II

Measures of research, development and innovation

Measures of market activation

- Funding rates of up to 100%, depending on the respective TRL
- Constantly open to submissions



- Funding rates of 40-45% of the extra costs compared to a conventional technology
- Regular calls addressing different applications

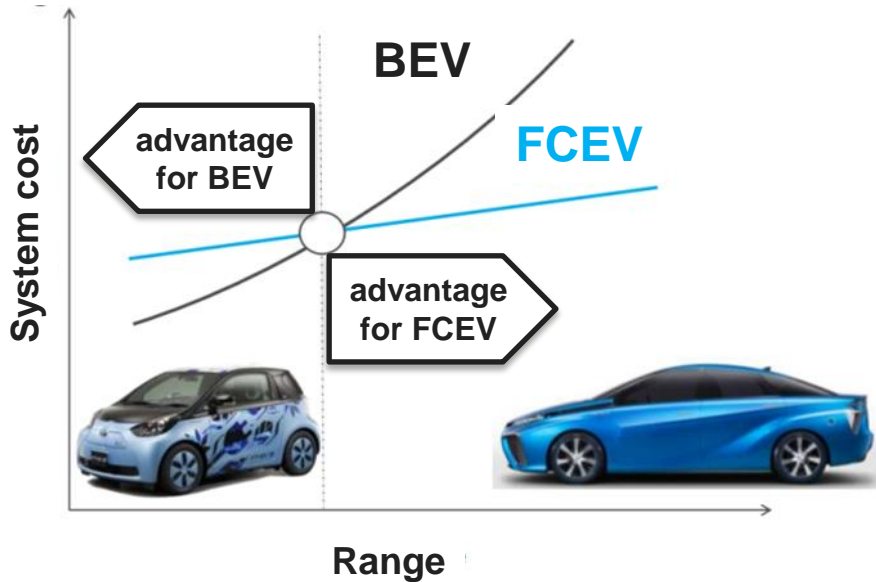


MOBILITY WITH BATTERIES AND FUEL CELLS

COMPLIMENTARY ZERO EMISSION SOLUTIONS COVERING ALL MARKET REQUIREMENTS

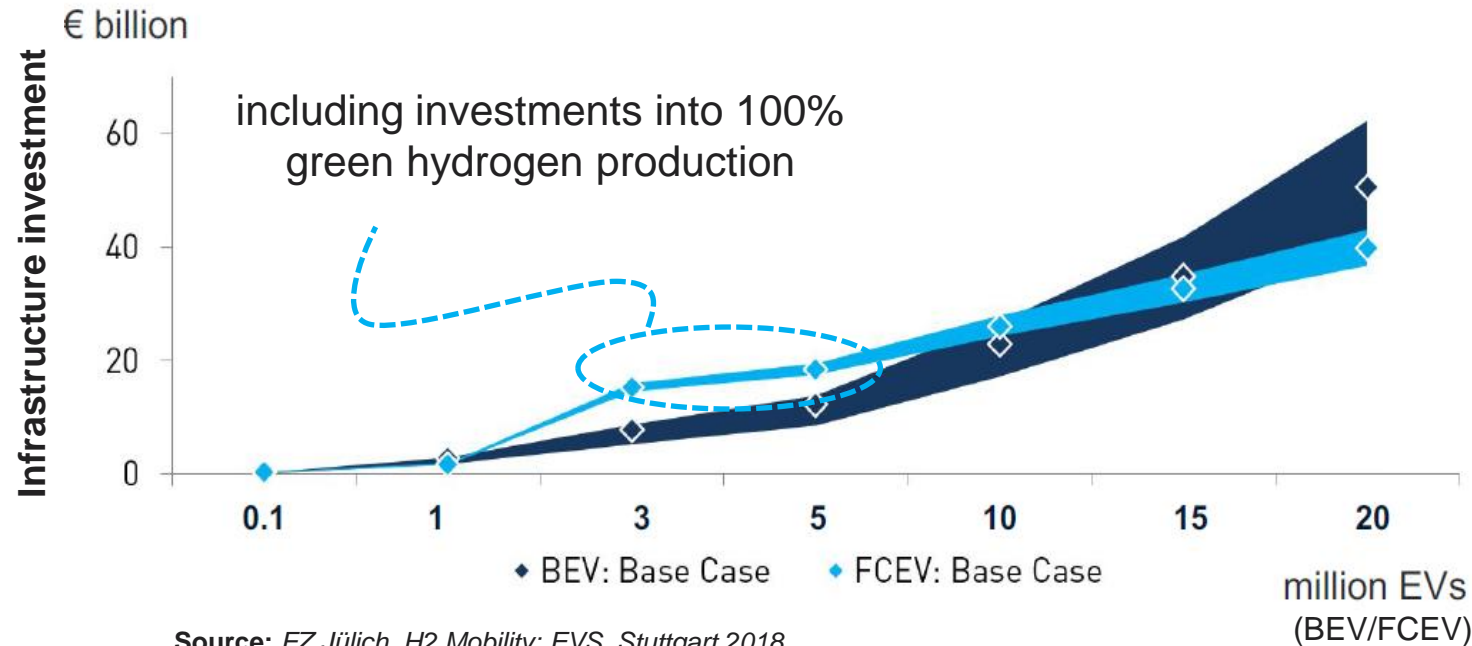


System cost comparison between BEV and FCEV



Source: Toyota

Infrastructure investment costs comparison for BEVs and FCEVs in mass market



Source: FZ Jülich, H2 Mobility; EVS, Stuttgart 2018

HYDROGEN REFUELING INFRASTRUCTURE

NETWORK OF 700 BAR RETAIL STATIONS



2006-2016

until 2020

TASKS

Secure technological basis, meet conditions for ramp up

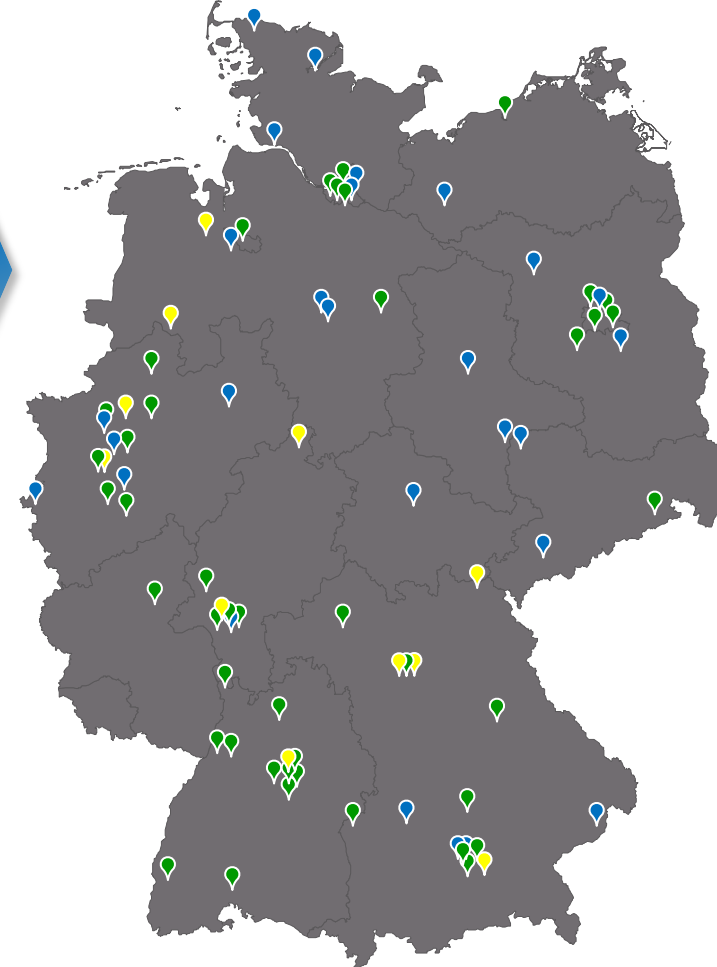
Basic coverage for Germany

GOAL

50 stations

100 stations

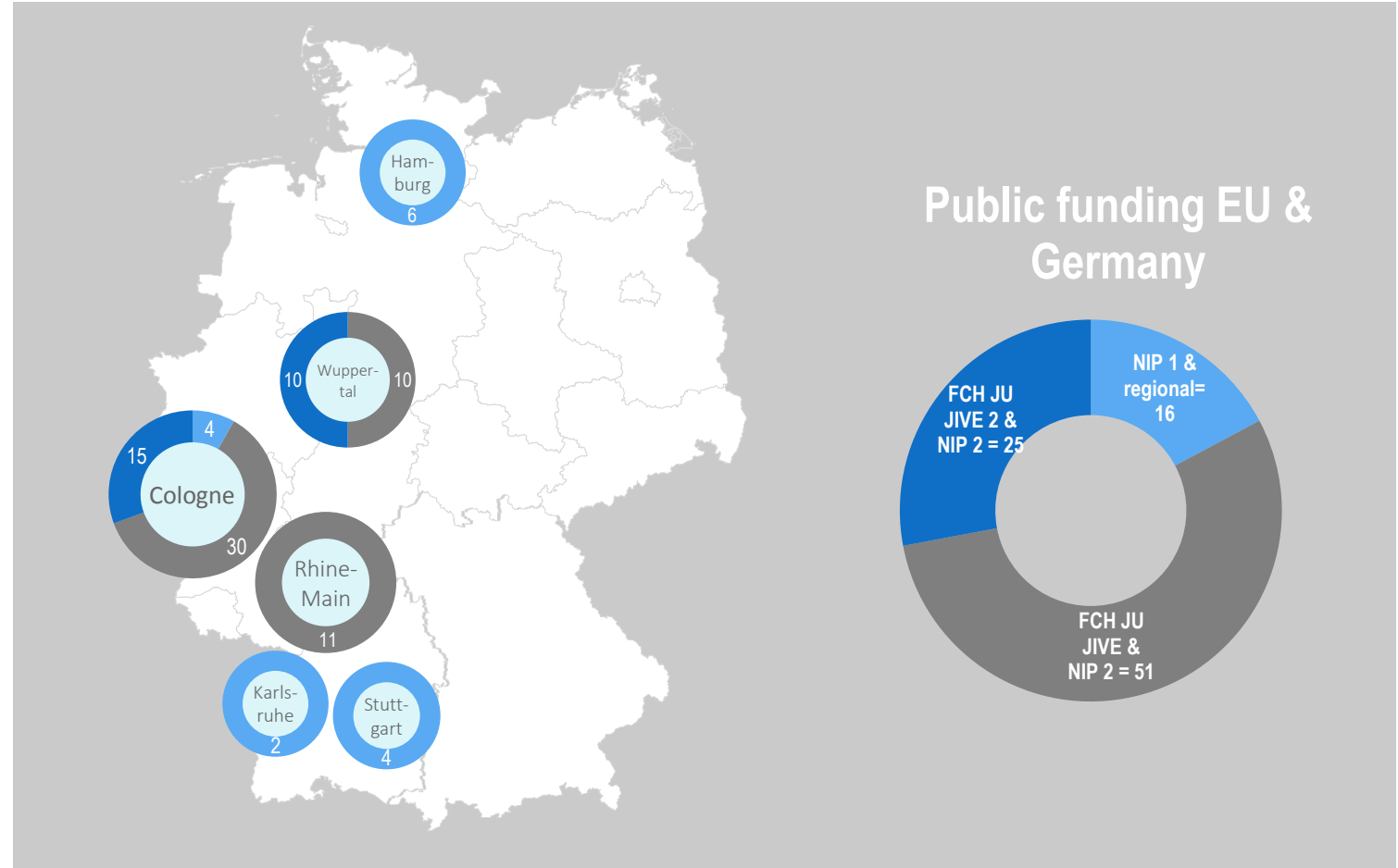
INDEPENDENT OF NUMBER OF VEHICLES



- In operation 51
- Under construction 23
- In planning 11

FUEL CELL BUSES IN GERMANY

ELECTRIFYING PUBLIC TRANSPORT



DEPLOYMENT OF FUEL CELL RAILWAY VEHICLES

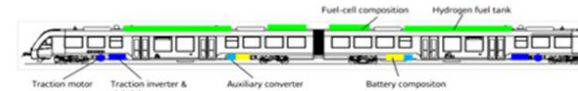
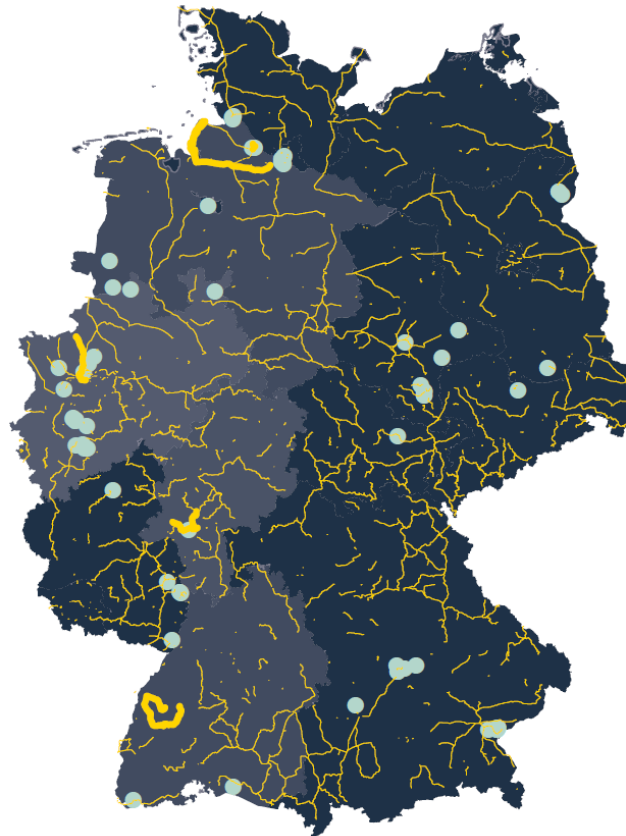
INDISPENSABLE OPTION FOR ELECTRIFYING THE GERMAN GRID



Merely ~54 % of the German railway network is electrified

~30 % less energy demand per travelled distance by fuel cell train

- H2 sources/use
- Not electrified
- H2 pilot routes

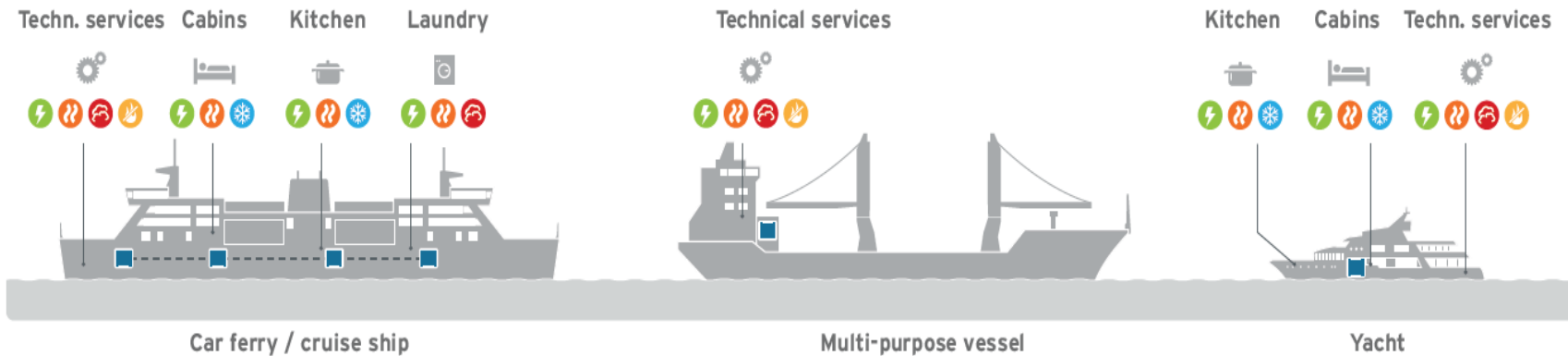
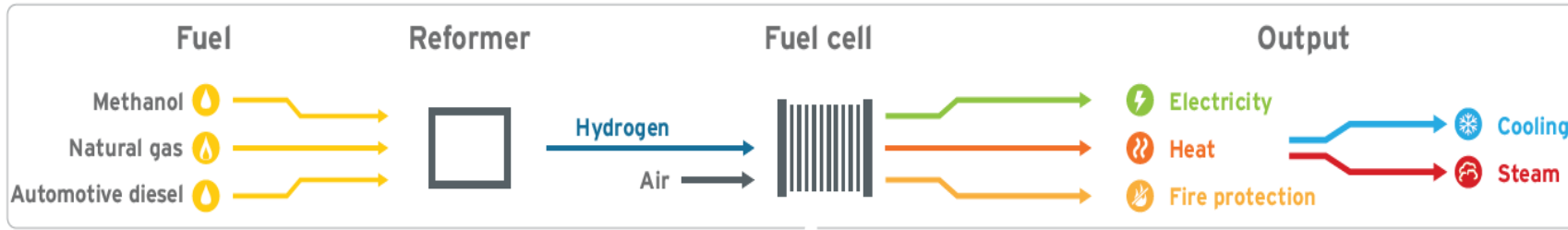


Reference route	Comparative data				Fuel cell energy requirements compared with diesel drive
	Route length per round	Number of stations	Consumption figures		
	km	—	Diesel l/km (kWh/km)	Hydrogen kg/km (kWh/km)	
Buxtehude – Bremerhaven – Bremervörde – Cuxhaven – Buxtehude	240	44	1.08 (10.8)	0.23 (7.7)	-29%
Frankfurt – Königstein – Frankfurt	50.2	18	1.82 (18.2)	0.34 (11.3)	-38%



E4SHIPS: FUEL CELLS IN MARITIME APPLICATIONS

MULTIFUNCTIONAL & FLEXIBLE



Improved air quality
by reducing pollutants such as nitrous oxides (NO_x) and sulphur dioxides (SO₂)

+

Reduction of CO₂ emissions
by 25 to 30 %, as a contribution to climate protection and in response to stricter emission regulations

+

Economic viability
by being independent from finite fossil resources

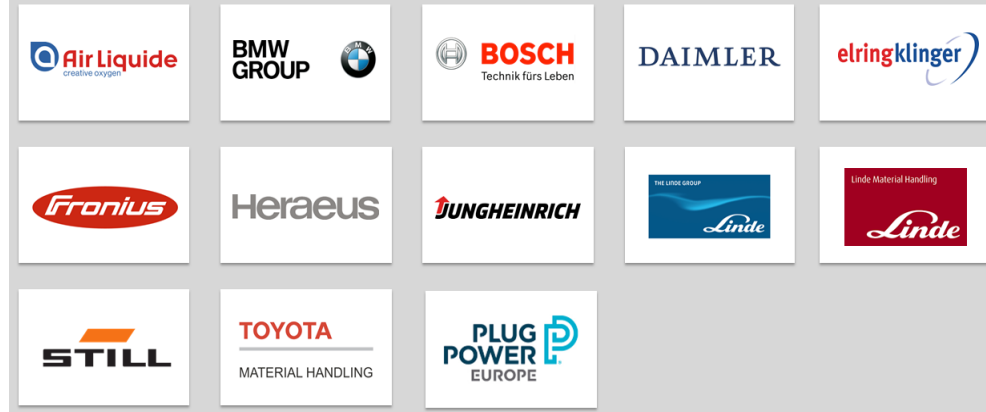
Common Tasks for the shipping Industry:

- Technology **demonstrators**
- Definition of functional **safety requirements** for fuel cell applications
- **HAZID/FMEA: design evaluation** by DNV GL for failure modes according to class rules and IGF code
- Derive of **IGF Code** requirements for fuel cells and conveyance of proposals for regulations to **IMO** by German Federal Ministry of Traffic and CESA
- Further development of **class rules**

<http://www.e4ships.de/>

LOGISTICS AND SPECIAL APPLICATIONS

GREEN MATERIAL HANDLING



Market-Pull from automotive industry in the EU
→ Users of fuel cells recognize **environmental impact** and **structural benefit** in production lines
→ In the medium term **TCO-benefits** predicted
→ www.cleanintralogistics.net (in English)

FUEL CELLS IN INDUSTRY AND BUSINESS

BACKUP POWER SUPPLY TO CRITICAL INFRASTRUCTURE



Brennstoffzellen in Industrie und Business



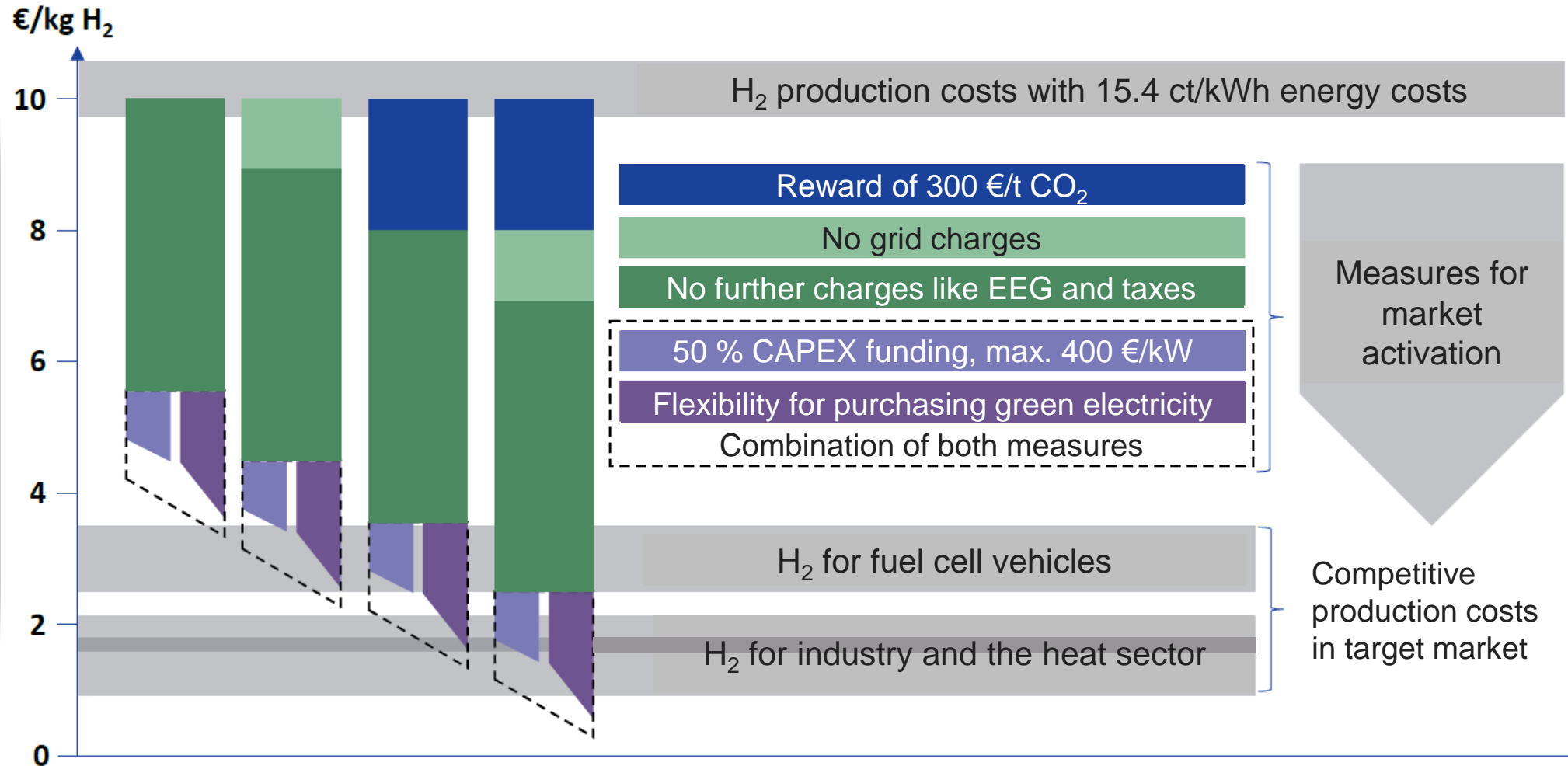
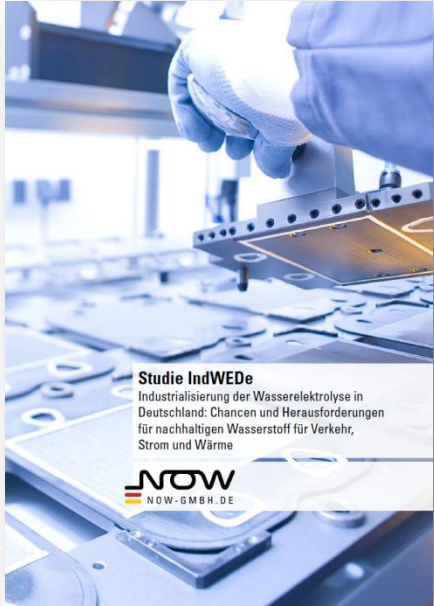
Clean Power Net (CPN):

- Uninterruptible power supply, backup power supply, network backup systems, etc.
- 22 partners - manufacturers, users, research
- **5 Mio € funding** by the German Ministry of Transport and Digital Infrastructure in 2018
- BOS Digital radio network < 20 kW
- www.cleanpowernet.de (in English)



INDUSTRIALIZATION OF WATER ELECTROLYSIS

MEASURES TO REDUCE THE COSTS OF GREEN HYDROGEN



INTERNATIONAL COLLABORATION

EXAMPLES FOR ONGOING ACTIVITIES



- Fuel Cell Technology Office (FCTO) of the DoE
- California Fuel Cell Partnership (CaFCP), California Air Resources Board (CARB)



- GSG, STF, AFI committee
- FCH JU
- Fr.-Ger. WG E-Mobility



- NEDO & METI
- Bilateral PtG-Project



- CATARC & MOST
- SGECC & 5 bilateral Projects: (MetropoLIS, Networked Mobility, RCS Cooperation, DeH2MLeak, CHIG)



GOVERNMENT SUPPORT GROUP



MISSION INNOVATION



giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



22 October 2018

Wolfgang Axthammer | Managing Director

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Thank you very much for your attention!

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