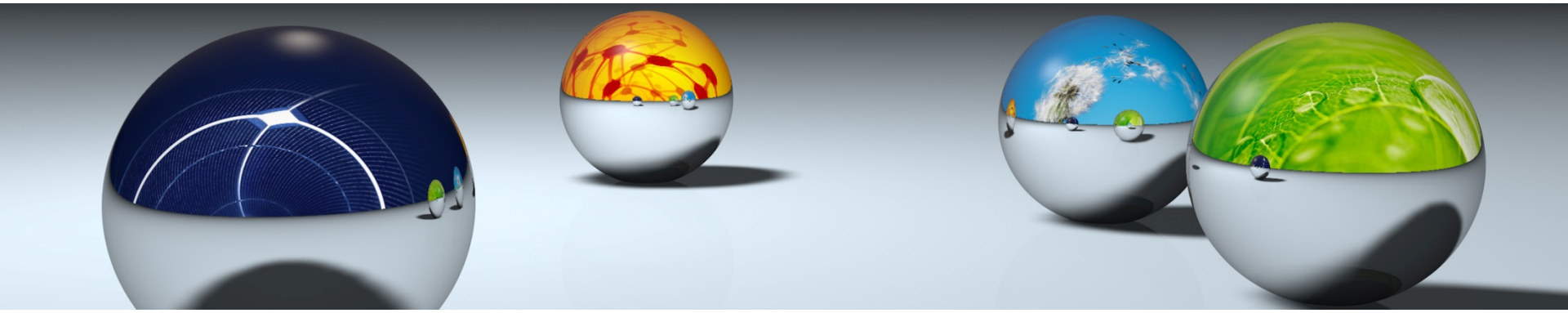
Projektträger Jülich
Forschungszentrum Jülich

Federal Ministry
for Economic Affairs
and Energy



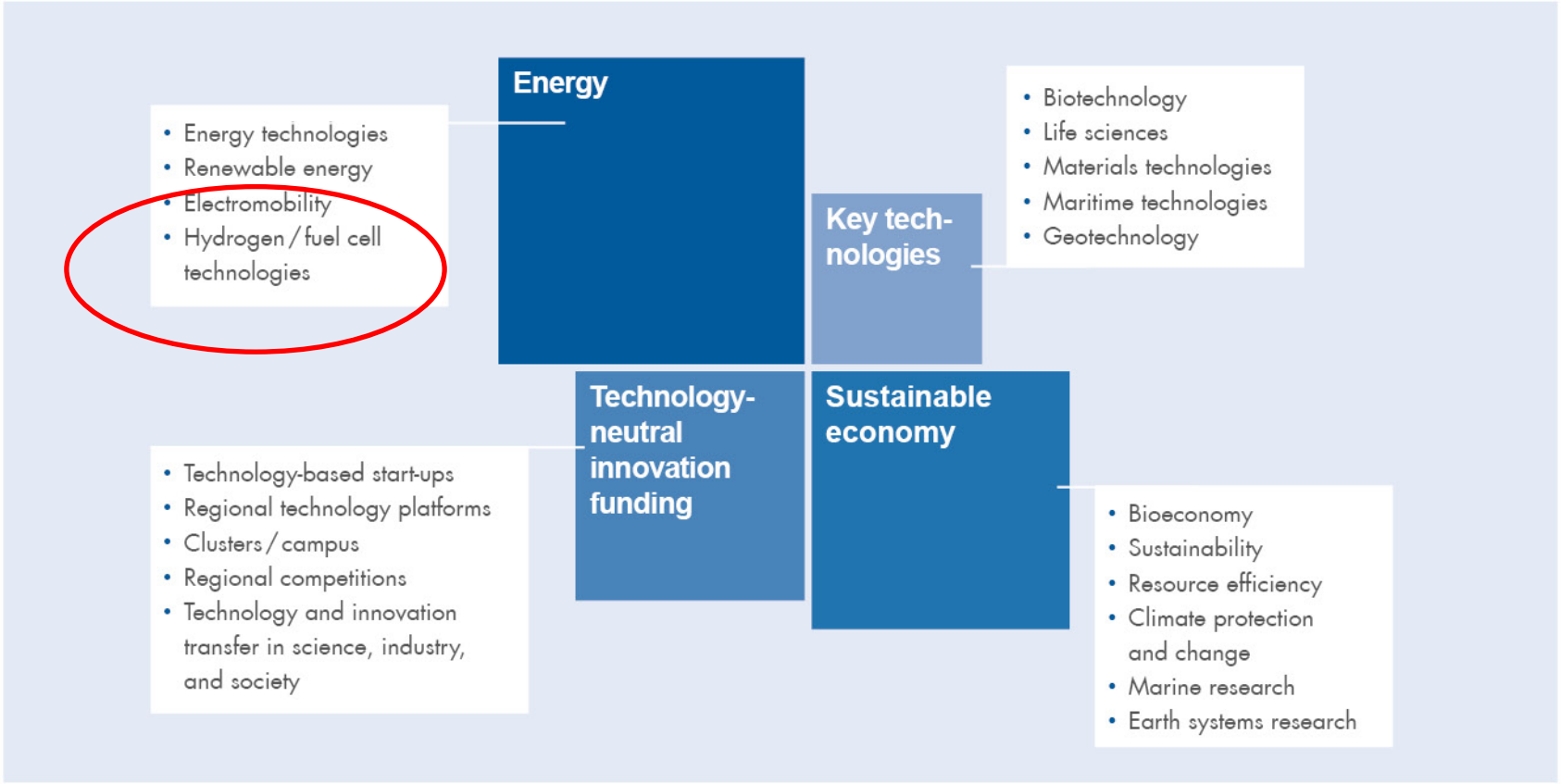
National Innovation Program on Hydrogen and Fuel Cell Technology in Germany

From Research and Development to Market Launch Support

IEA EGRD Workshop, Washington DC, 26.10.2016

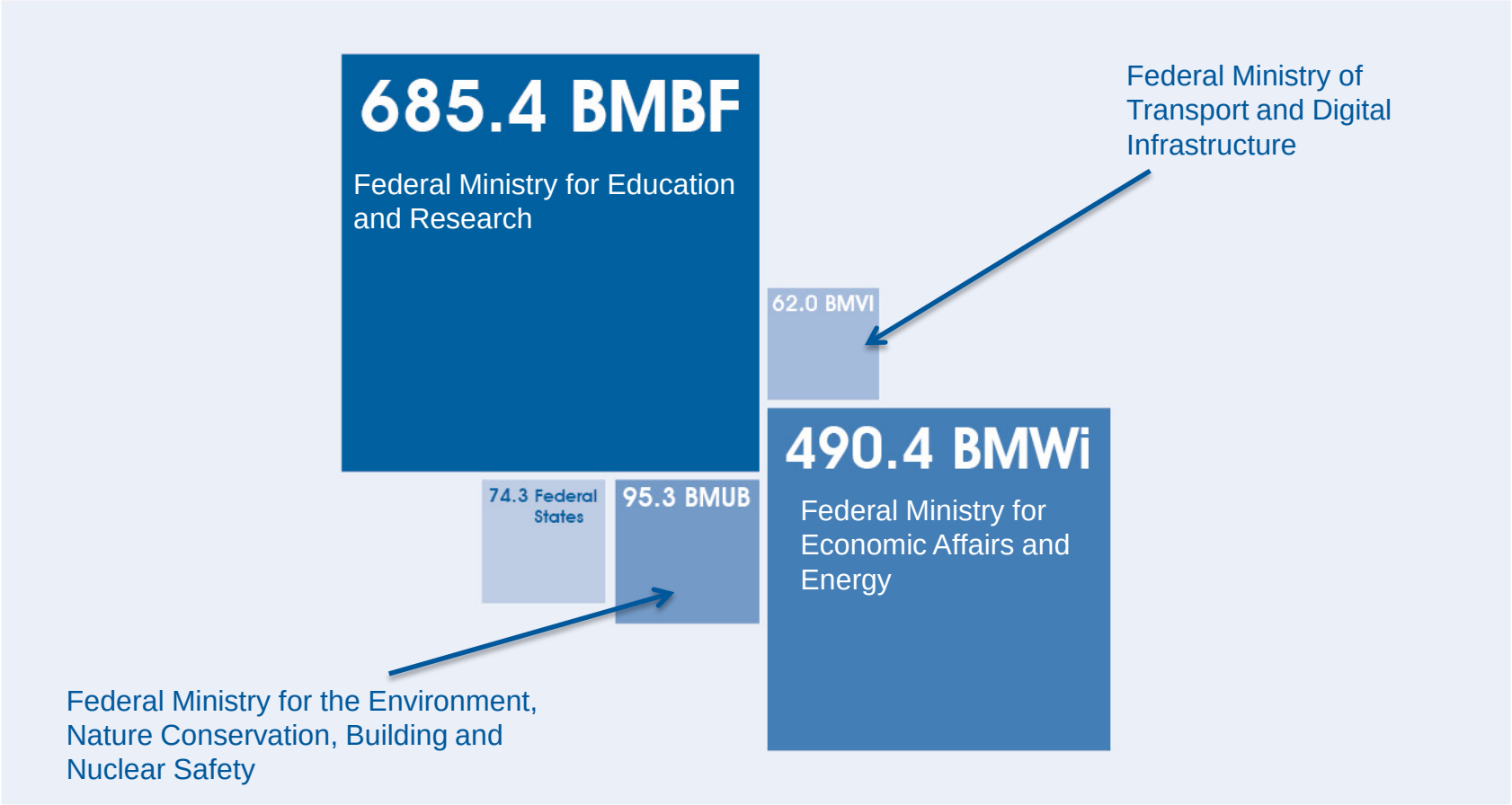
Johannes Tambornino – Project Management Jülich

Project Management Jülich - Our business areas



Project Management Jülich - Funding Volume 2015

(Volume € million)



R&D in Applied Energy Research by the Ministry of Economic Affairs and Energy

Power Generation	Energy System Integration	Energy Efficiency
PV	Storage	Smart Cities
Wind	Smart Grids	Energy Efficient Buildings
Geothermal Energy	Integration of RES	Industrial Production
Solarthermal Energy	Systems Analysis	Electromobility
Hydro		Hydrogen / Fuel Cells
Efficient Fossil Plants / CCS		

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National Innovation Program on Hydrogen and Fuel Cell Technologies

- Joint research program funded by the Federal Ministries of *Economic Affairs and Energy* (BMWi) and *Transport and Digital Infrastructure (BMVI)*
  - *In Coordination with the Ministry for Education and Research (BMBF) & Ministry for Ministry for the Environment (BMUB)*
- 2006 – 2016
- Total volume (government & industry): approx.1.4 billion €
- Goal: R&D, Demonstration and Market Integration of Fuel Cell and Hydrogen Technology
- Applications: Mobility, Home Energy Systems, Hydrogen Production, Industrial Applications, Hydrogen Infrastructure, Special Markets

Responsibilities

- Ministry of Economic Affairs and Energy
  - Applied R&D in Hydrogen Production and Fuel Cell Technologies
  - Electrolysers, PEM, SOFC, MCFC
  - Funding Volume (2006 – 2016): 232 M€
  - Number of Projects (2006 – 2016): 293
- Ministry of Transport and Digital Infrastructure
  - Demonstration and Market Launch Support
  - Hydrogen Mobililty, Hydrogen Infrastructure, Hydrogen CHP for Home Applications, Special Markets (Vessels, UPS,…)
  - Funding Volume (2006 -2016): 450 M€
  - Number of Projects (2006 – 2016): 405
  - Coordinated by National Organisation Hydrogen and Fuel Cell Technology (NOW)

Some Numbers

Provided by: Dr. Darja Markova, PtJ

	BMWi		BMVI	
	# Projects	*Funding*	*# Projects*	*Funding*
Mobility	87	91 M €	207	291 M €
Home Energy	37	42 M €	62	52 M €
Hydrogen Production	25	18 M €	7	10 M €
Industrial Applications	20	24 M €	43	35 M €
Special Markets	70	26 M €	72	58 M €
Others	54	32 M €	14	5 M €
Total	**293**	**232 M €**	**405**	**450 M €**

Partners from Industry and Academia

* Clean Energy Partnership mit 19 Industriepartnern: Air Liquide, BMW, Bohlen & Doyen, Daimler, EnBW, Ford, GM/Opel, Hamburger Hochbahn, Honda, Hyundai, Linde, Shell, Siemens, die Stuttgarter Straßenbahnen SSB, Total, Toyota, OMV, Volkswagen und Westfalen

Some Examples

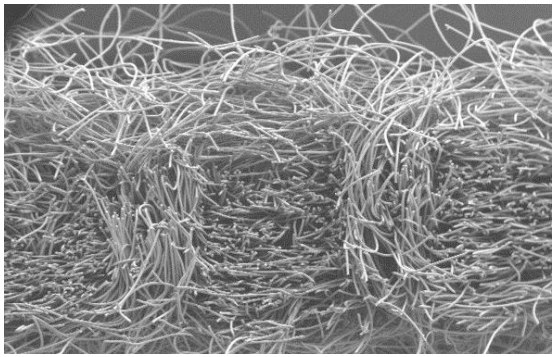
From Applied R&D to Market Launch Support

Optigaa2

Optimizing the Gas Diffusion Layer For Applications in Fuel Cell Vehicels

- Goal: Increasing Power density of GDL up to 1.8 W/cm² to reduce the overall cost of fuel cell stacks
- Partners
  - Freudenberg Vliesstoffe, Daimler, ZSW

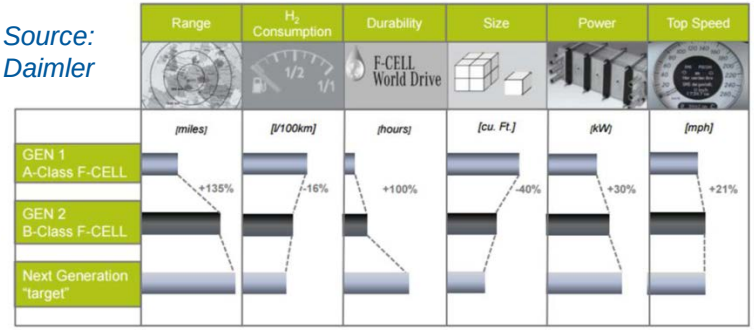
  Fraunhofer ITWM, Technical University Munich, Math2Market
- New Materials, Simulation of Diffusion Processes, Optimized Production Processes,…



Fuel Cell Vehicles

Research and Development lead to substantial performance increase and cost reduction

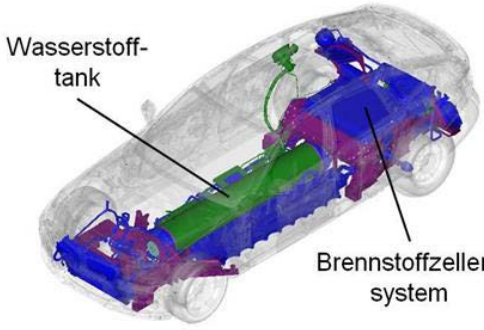
Source: Daimler



HyMotion4 (Volkswagen) day-to-day testing of FCV

Source: Volkswagen

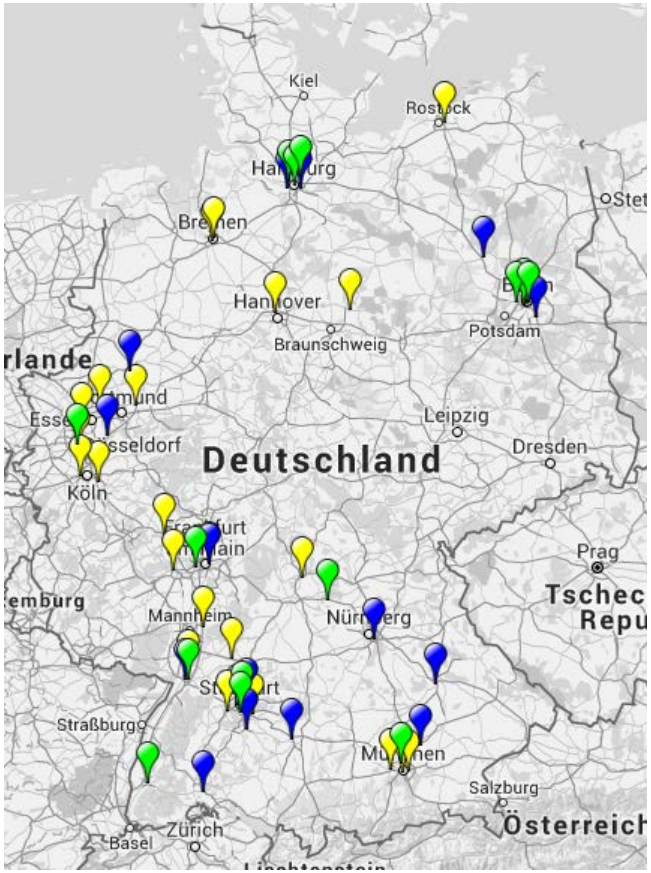
Source:BMW



- **component and system development and testing**
- **vehicle concepts**
- **vehicle testing and demonstration**
- **involving supply industry**
- **production technologies and processes**

50 Station Program

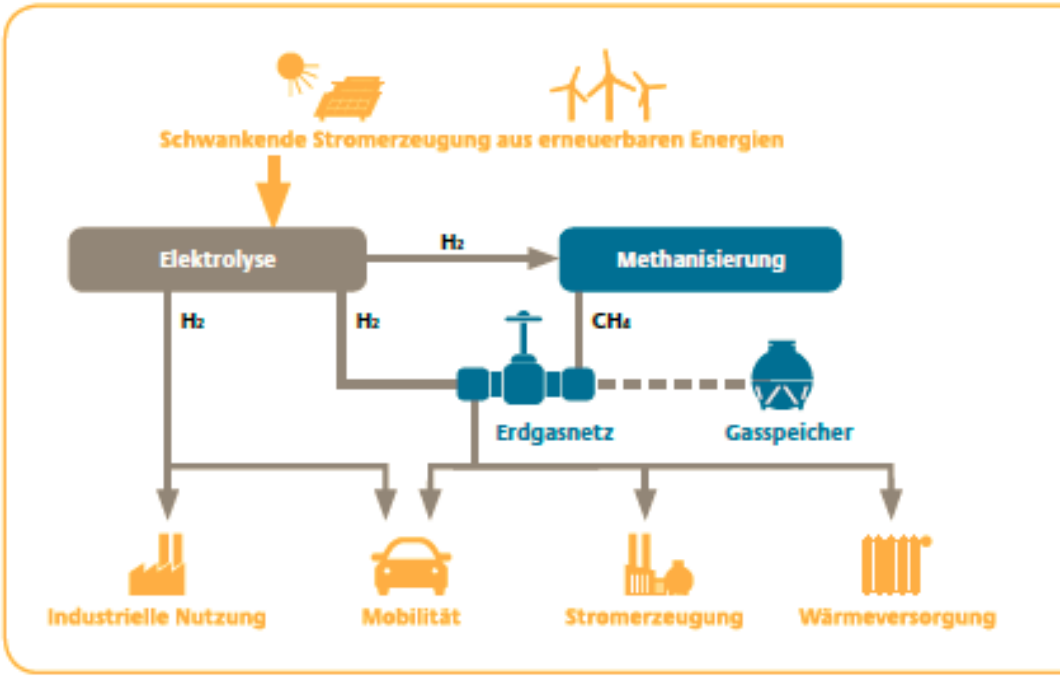
Research and Development for hydrogen refuelling stations and building an initial network in Germany



Power-to-Gas

Production of hydrogen from renewable power sources to achieve targets for a sustainable mobility system

- providing a renewable energy source for the transportation sector (power based fuels)
- managing the increase of fluctuating renewable energy sources in the power sector
- decarbonizing the energy system
- linking the energy sectors



Power-to-Gas Projects in Germany

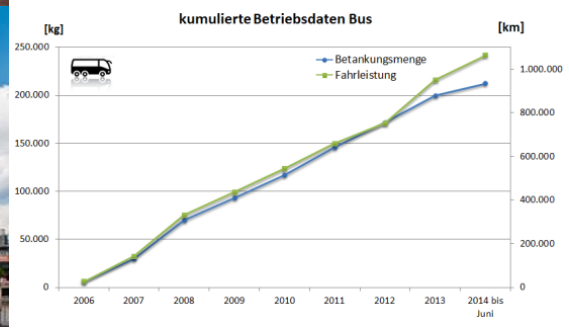
Preparing the *Energiewende* for transportation

- currently > 30 PtG projects / activities
- designed to run on renewable energies
- including 16 operating plants with a total capacity of 16 MW (9 AEL and 6 PEMEL)
- Audi Werlte project: 6 MW AEL (3x2MW)
- 5 hydrogen retail stations with onsite electrolyzers provide fuel for vehicles
- 8 projects re-electrify hydrogen for stationary power supply
- 9 plants feed hydrogen into the natural gas grid
- 5 plants produce and ship hydrogen, by trailer and / or pipeline, for further use
- 18 plants boast electrolyzers ranging from 1 to 7 MW
- 5 plants are equipped with electrolyzers of less than 1 MW

source: Ludwig-Bölkow-Systemtechnik GmbH, Begleitforschung 50-Wasserstoff-Tankstellen-Programm

Clean Energy Partnership

Technology validation with more than 100 fuel cell vehicles (passenger cars and busses) including hydrogen infrastructure



- **Vehicle Performance**
  - efficiency, cold start, range
- **Fast Refueling**
  - 700 bar technology
- **Safety**
  - standards defined and tested
- **Sustainable**
  - >50% green hydrogen
- **Customer Acceptance**

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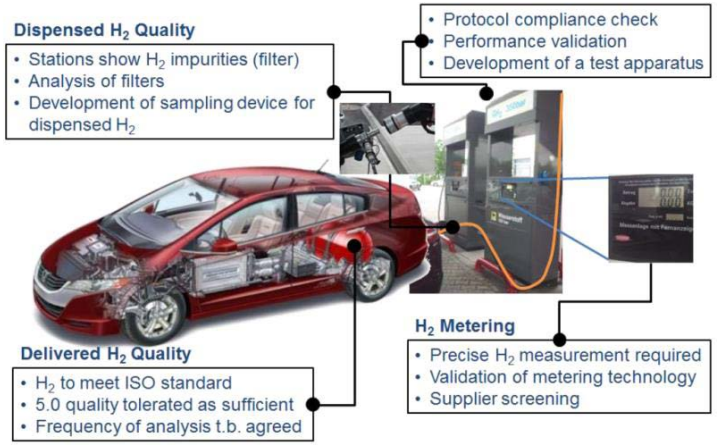
Joint Testing of Infrastructure Equipment

Interdisciplinary working groups address infrastructure issues



H2 filling → H2 quality → H2 leak proof → H2 flow measurement → H2 backup

What has been accomplished so far?

- Improvement on components and whole fuel cell stacks
- Proof of concept for the feasibility of a hydrogen infrastructure
- Outstanding commitment from industry: automotive, utilities, component suppliers, gas distributors, …

- Detailed evaluation of the program is in progress
  - Responsible at PtJ: Dr. Darja Markova, PtJ

Next Steps

- BMVI published NIP II in September 2016
  - BMVI will provide 250 M € for 2016 – 2019
  - Goal: Making hydrogen technology in the mobility sector competetive within 10 years
  - Focus on Demonstration, Innovation and Market Launch Support for Hydrogen and Fuel Cell Technology in the Mobility Sector
  - Focus on TRL 5 to 8
  - Support Innovation and Research to build up H2- & FC-Industry in Germany

Next Steps II

- BMWi will continue to fund FC-R&D with approx. 25 M € / y
- New call on (non-fuel cell) „Mobility and Energy“ in preparation
  - Power to Gas/ Fuels/ Chemicals
  - New engine concepts for synthetic fuels
  - Alternative (gas and synthetic fuels) motor concepts for ships and industrial motors
  - Will be published soon.

Thank you for your attention!

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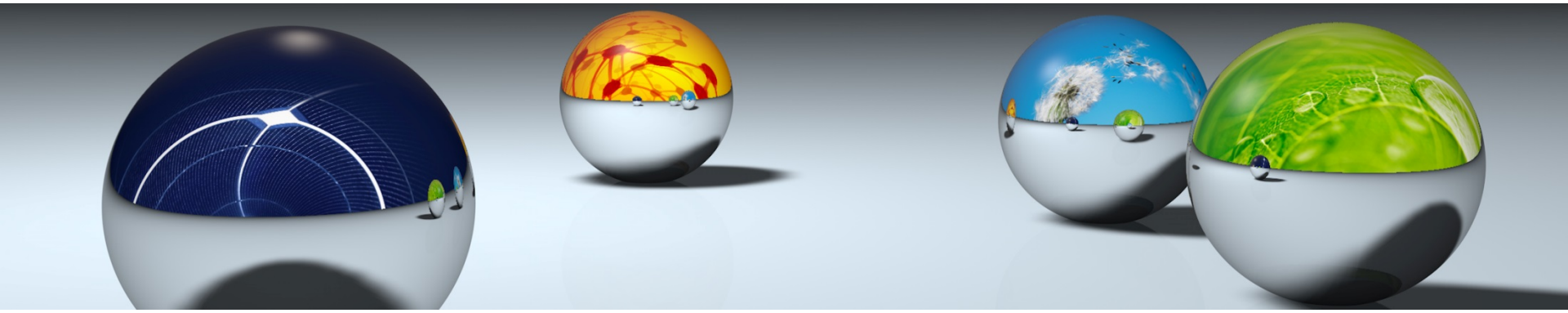

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