Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

HRS Infrastructure in Germany and Europe - Current activities

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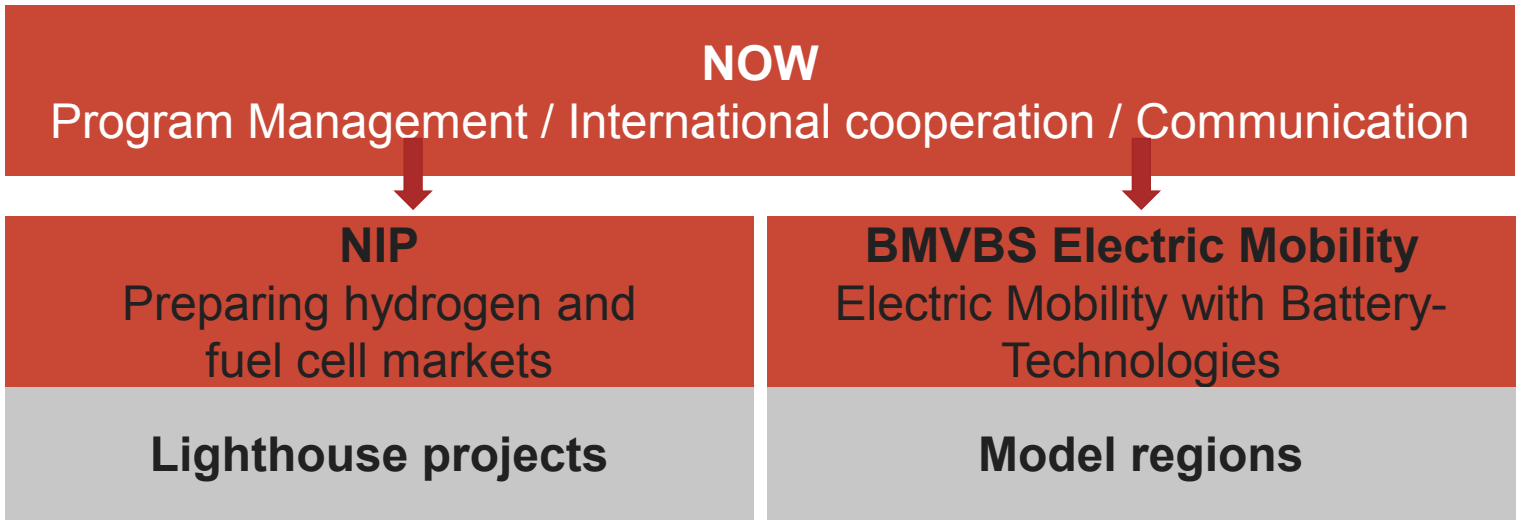
NOW GmbH National Organization Hydrogen and Fuel Cell Technology

NOW GmbH
National Organization Hydrogen and Fuel Cell Technology

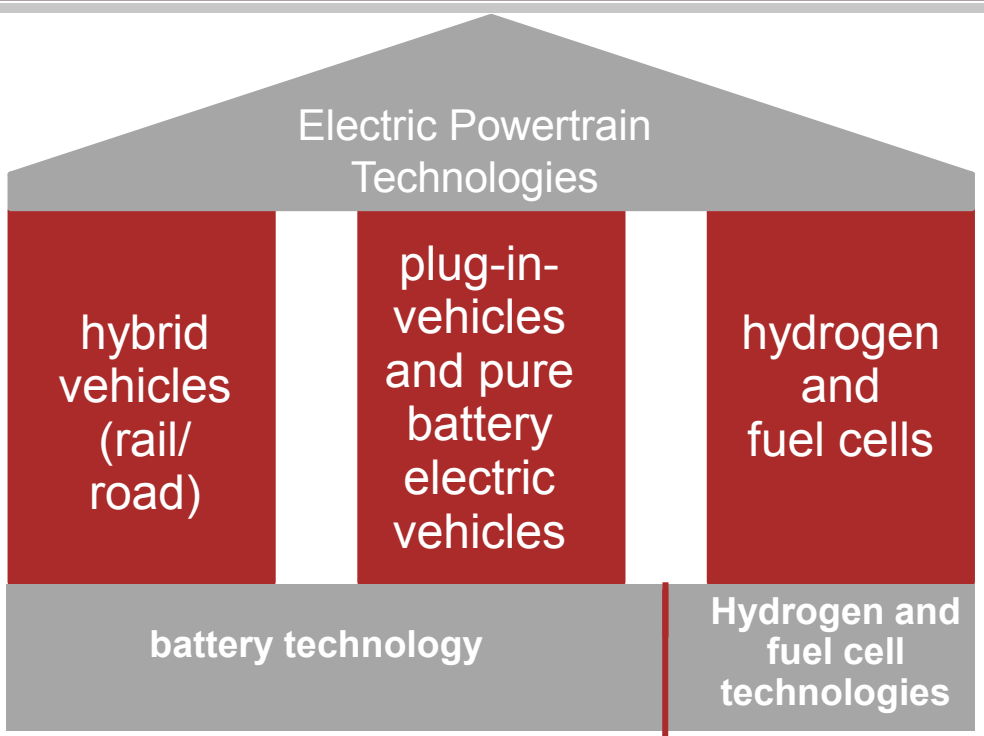
- Government-owned company (100 %) funded in 2008
- Co-financing by industry (project overheads)
- Supervisory board: BMVBS (Chair), BMWi, BMBF, BMU
- Advisory board: strategic controlling and development of programs



programs addressing market preparation

Market Preparation for Eletro-Mobility

Three pillars of electrifying the powertrain



Modellregionen Elektromobilität

500 mio. € budget (2009-2014);
- Incl. 150 mio. € BMVBS (2009-2011)
- ~ 100 mio. € (2011-2014)

nip

1,4 bn. € budget (2007-2016)
- incl. 700 mio. € federal funding: BMVBS (500 mio. €) and BMWi (200 mio. €)

batteries

and

hydrogen / fuel cells

are

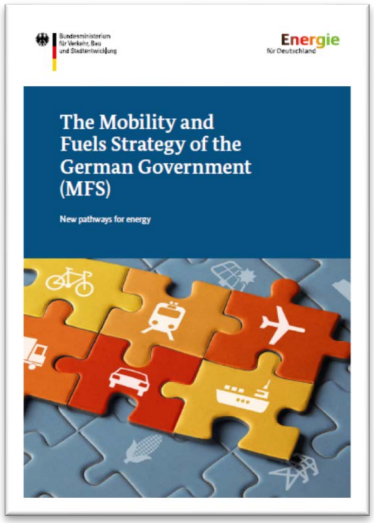
key technologies for a sustainable mobility

Political Framework for the Transport Sector

- Share of transport in final energy consumption nearly 30%
- Tripling of energy consumption in transport since 1960, even five-fold increase in road traffic

- Goals of the German Energy Concept (2010) for Transport:
  - about -10 % until 2020 of energy consumption
  - about -40 % until 2050 of energy consumption (vs. 2005)

➔The Mobility and Fuels Strategy of the German Government[2] outlines the way how to achieve these objectives.



➔Electrification of the drive train (BEV's and FCEV's) is an key issue to reach the targets!

➔Targets only achievable with renewable power to gaseous fuels.

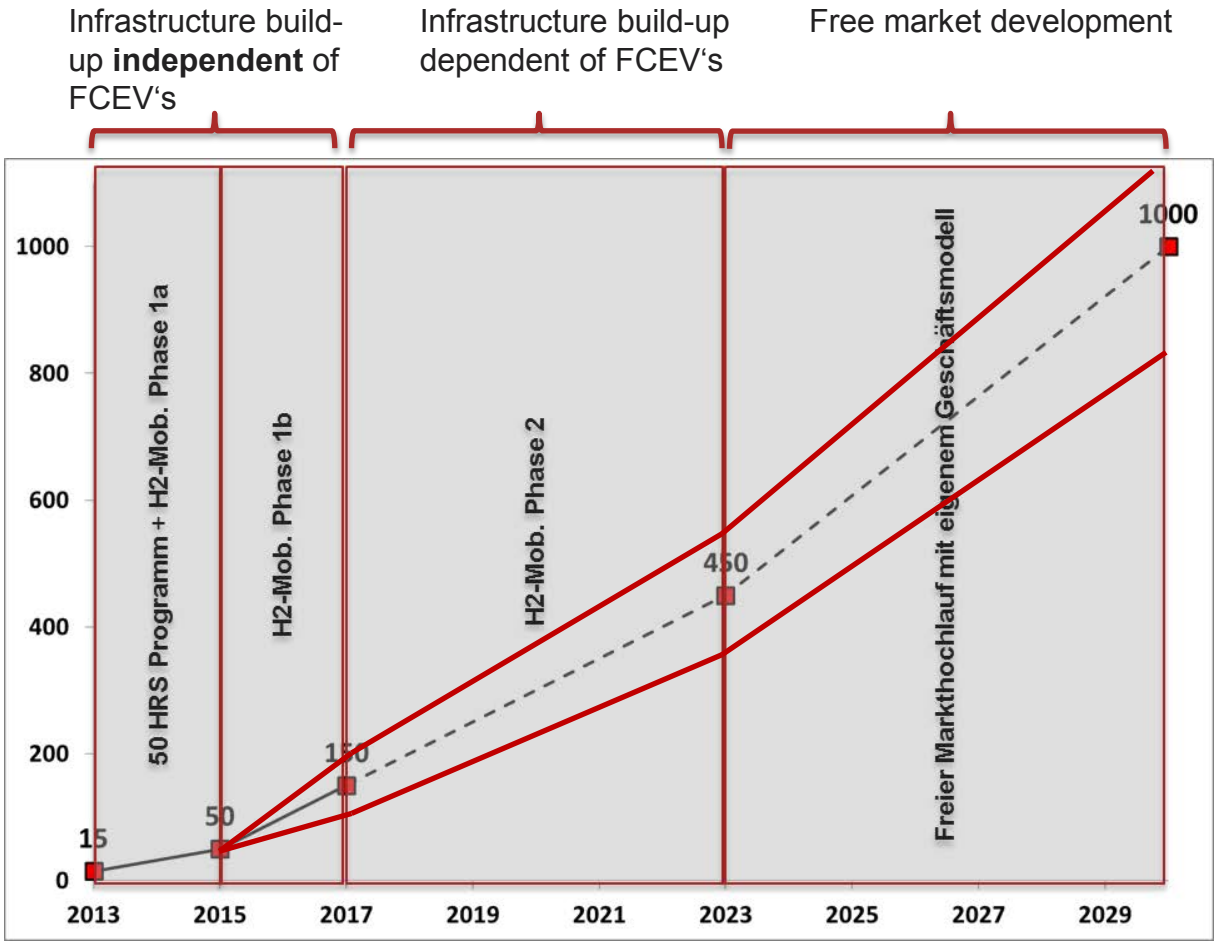
➔Further increase of RE mandatory to achieve the targets.

➔Large scale storage for Hydrogen is inevitable.

Phased approach to a profitable commercial infrastructure ramp-up

	R&D and demonstration	Market preparation and validation	Commercial ramp-up
When?	▪ Since 2006	▪ For the next 5 - 10 years	▪ Around 2020
Who?	▪ NOW / CEP	▪ H_2 Mobility and NOW / CEP	▪ H_2 Mobility and free market
Goals	▪ HRS technology up and running ▪ Costs significantly reduced	▪ Proof of HRS, FCEV technology, and H_2 supply chain ▪ Customer acceptance of FCEVs ▪ Attractive business case for next phase	▪ Scaled nationwide HRS network to enable FCEV mass take-up ▪ Profitable, high-growth business

Timeline HRS infrastructure build-up H2-Mobility including 50 HRS Program



Until 2015:

- 50 HRS are securely financed by NIP.

2015 - 2017:

- Build-up of a preliminary overcapacity of HRS as basis for an independent market development by H2 Mobility
- Build up is not related to (certified) FCEV numbers

2017 - 2023:

- Roll-out of HRS network will depend on (certified) FCEV numbers (internal H2-Mobility allocation key)

The Clean Energy Partnership

Fields of Activities:

- Hydrogen Production

  Technical improvement of electrolyzers, compressors and storage technologies.

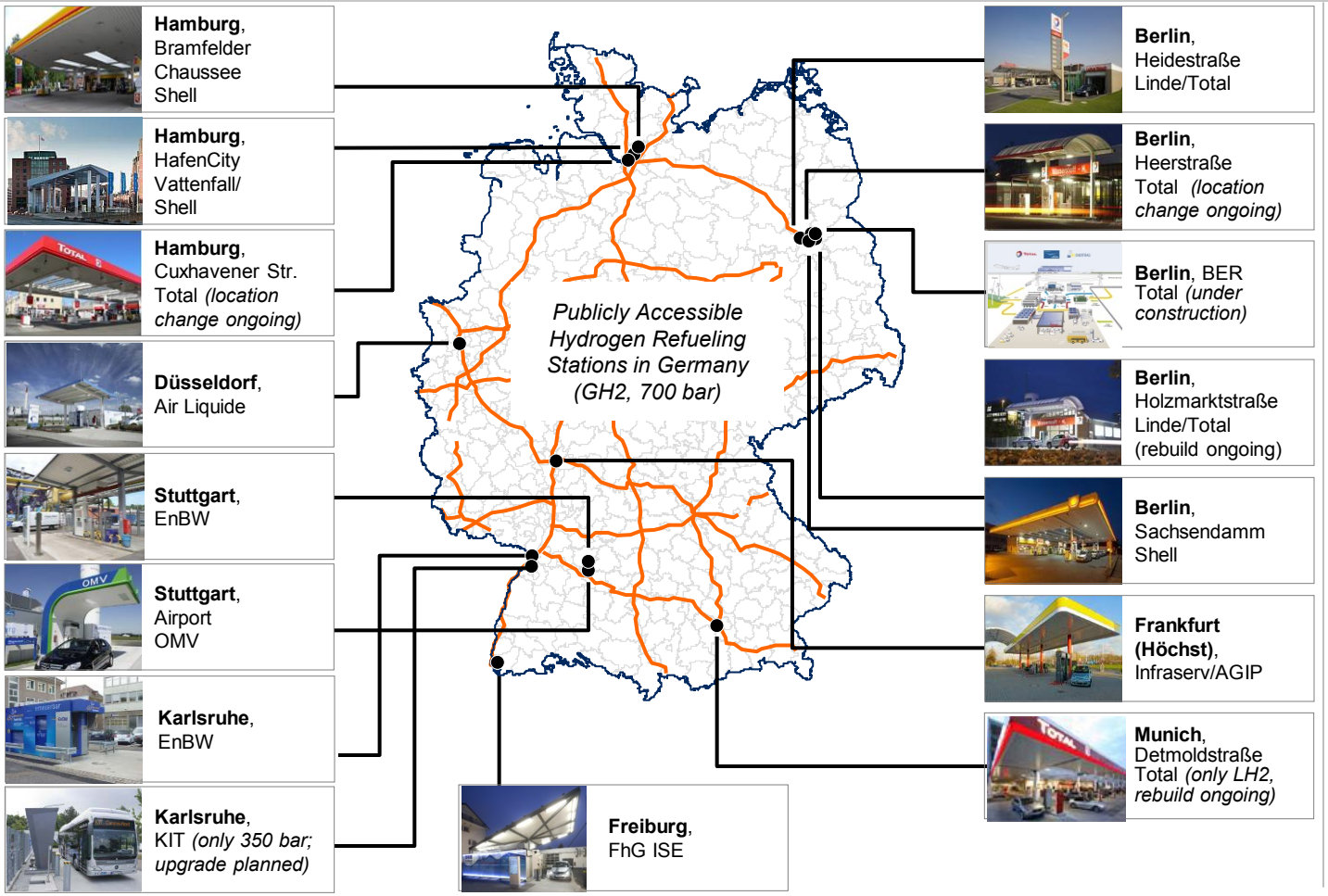
- Infrastructure

  Technical improvement of refueling technology and deployment of an initial HRS infrastructure.

- Mobility (Cars and Busses)

  Technical improvement of the FC System and running demonstration fleets.

Current Hydrogen Refueling Stations (HRS) in Germany



Key achievements

- Safety of stations proven
- Refueling standards agreed
- Storage and compressor technology tested
- H_2 supply chain tested
- Bugs of station technology eliminated

50 HRS for Germany

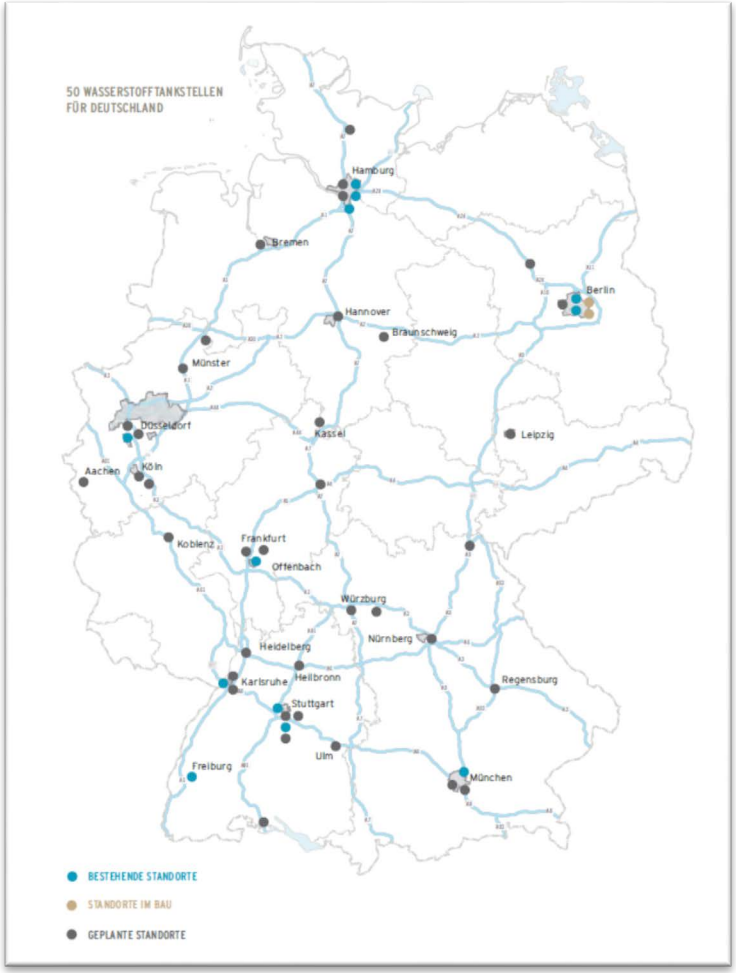
- **joint Letter of Intent to expand the network of hydrogen filling stations in Germany**
  - signed by the German Ministry of Transport, Building and Urban Development (BMVBS) and several industrial companies
  - part of the National Innovation Programmed for Hydrogen and Fuel Cell Technology (NIP)
  - overall investment more than €40 million (US$51 million)
- **coordination by NOW GmbH in the frame of the Clean Energy Partnership (CEP)**

Federal Ministry of Transport, Building and Urban Development

Ein Projekt im Nationalen Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie

Current Status:

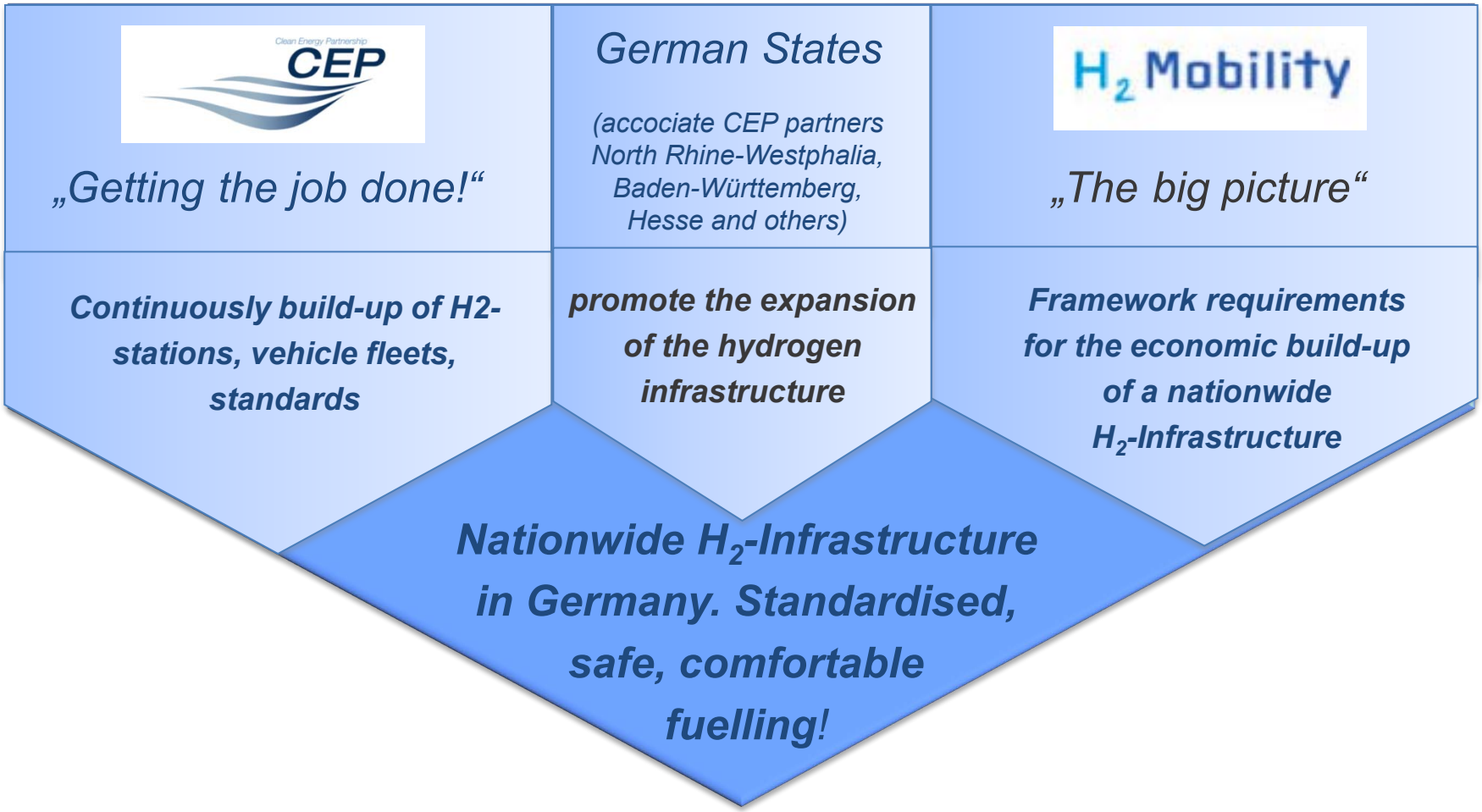
- Location planning of the 50 HRS has been finalized.
- Currently there are application for funding for 23 HRS, the remaining 12 HRS are in the planning phase.
- The majority of the HRS will be operated by H2-Mobility after the funded project time frame has ended.
- About ~110 FCEV's are currently on the road.



Work groups for inspecting filling stations

	H_2 filling	H_2 quality	Leak test filling system	H_2 flow measurement
Goal	*Inspect filling stations with regard to refuelling (pressure and temperature)*	*Take samples of hydrogen at filling stations and subject them to analysis/testing*	*Leak test of nozzle, hose and tear-away coupling*	*calibration of the hydrogen flow measurement*
Work group Participants ***[Management]***	TOTAL, GM, BMW Group, DAIMLER, VATTENFALL, EnBW	AIR LIQUIDE, Shell, BMW Group, Linde, DAIMLER, HONDA	VATTENFALL, GM, BMW Group, AIR LIQUIDE, Linde	Linde, Shell, DAIMLER, TOTAL, Ford, VOLKSWAGEN
Modelled on	• *SAE 2601 / CSA 4.3*	• *SAE 2719 / ASTM*	• *SAE 2600*	

CEP & H2 Mobility – Expansion of the filling station network in Germany



In-depth analysis investigating the potential development of a hydrogen infrastructure in Germany

H_2 Mobility

H_2 Mobility setup	H_2 Mobility business case (joint study)	H2 Mobility business and implementation plan (joint study)	Negotiations for founding joint entity	Market preparation and validation

Main achievements

Memorandum of understanding for H_2 Mobility signed Sep 10, 2009 in Berlin	Consistent HRS and FCEV ramp-up scenarios for Germany agreed	Design of joint entity structure outlined
		Business case calculated and implementation plan outlined

H_2 Mobility coalition objectives

Negotiate joint entity agreement	Start HRS rollout in Germany via the CEP
Win (new) H_2 Mobility members as investors	Synchronize HRS rollout with FCEV ramp-up

Partner:

DAIMLER, TOTAL, AIR LIQUIDE, OMV, Linde, Shell

Associated Partner:

NISSAN, BMW GROUP, HYUNDAI, KIA MOTORS, Volkswagen, TOYOTA, HONDA The Power of Dreams, Intelligent Energy, NOW Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

H2-Mobility action plan through 2023

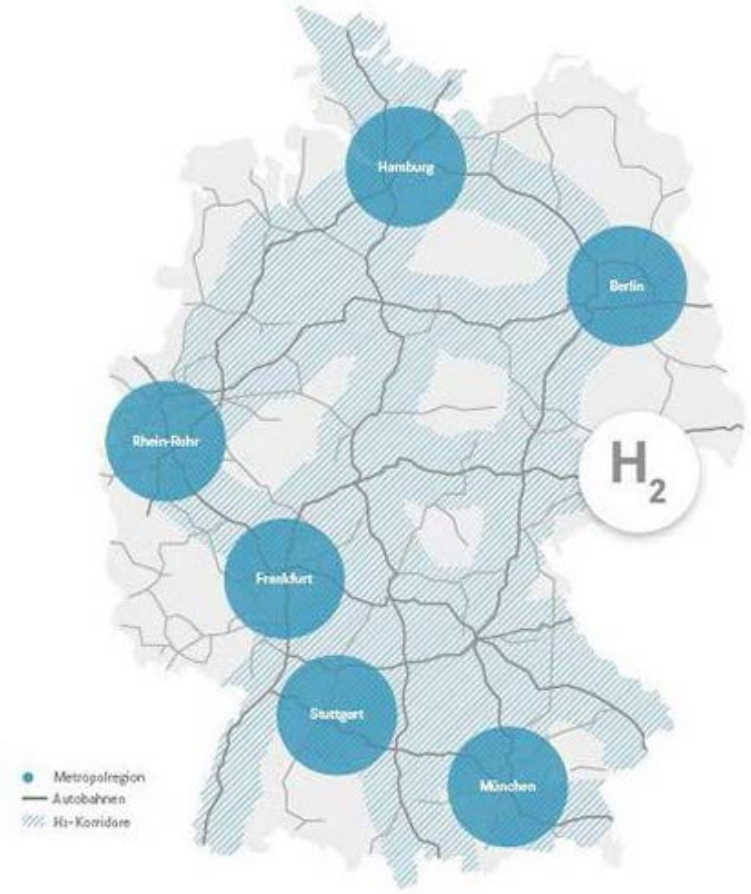
H2 Mobility

DAIMLER TOTAL AIR LIQUIDE OMV Linde

Air Liquide, Daimler, Linde, OMV, Shell and Total agree on an action plan for the construction of a hydrogen refueling network in Germany.

Targets:

- **400 HRS** until **2023** (100 HRS until 2017).
- **350 mio. €** investment.
- Max**. 90 km** distance between two HRS at the motorway.
- **10 HRS** in each metropolitan area.



H2 Mobility

Developing Commercial Hydrogen-Infrastructure

Key aspects of Public-Private-Partnerships / Learnings from H2-Mobility Germany

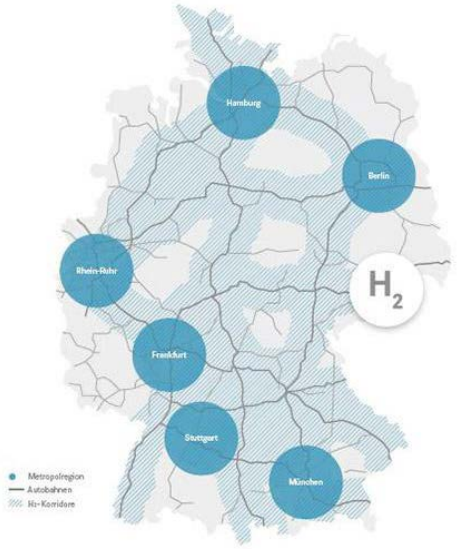
Success factors
- Synchronized ramp-up of hydrogen stations and vehicle deployment
- Risk sharing mechanisms (across industries / the role of public)

Key Elements of public-private deployment roadmaps
- Policy framework (e.g.: EU - CPT Directive, D – Mobility and Fuels Strategy)
- Implementation of standards (e.g. J2601, …)
- Continued R&D as a basis for increased performance and cost reduction
- Joint network planning in phases (based on defined milestones)
- Financing (from loss making business to positive ROI)

Investment decision of Infrastructure-Industry requires
- Active participation/involvement of OEMs to build trust between industry sectors
- Robust commitment from public stakeholders

Clean Energy Partnership CEP

H_2 Mobility



Current European H2-Infrastructure Initiatives

UK:
- 4 existing
- 1 planned in 2014
- UK H2 Mobility:
  - 65 HRS until 2020
  - 330 HRS until 2025

Netherlands:
- 1 existing
- 3 planned until 2015
- HIT-I and HIT-II
- H2 Mobility NL:
  - 30 HRS until 2017

France:
- HIT-I Partner
- France H2 Mobility:
  - ~150 HRS until 2020 (estimation)

Germany:
- 50 HRS until 2015
- H2 Mobility:
  - 400 HRS until 2023

Sweden:
- 1 existing
- 5 planned until 2016
- HIT-I and HIT-II

Norway:
- 6 Existing

Denmark:
- 2 existing
- 4 planned in 2014
- HIT-I and HIT-II

Scandinavia:
- SHHP
  - 45 HRS until 2015

Clean Power for Transport Directive General

Targets of the directive:

- Solve the “Chicken-and-Egg-Problem” = Energy/Fuel– Powertrain – Infrastructure, Secure investment in alternative power trains due to availability of infrastructure.
- Establishment of an EU market for alternative fuels and power trains.
- Enforcement of the the EU‘s innovation and competitiveness

CPT-directive covers specific infrastructure requirements for the following fuel options:

- Power for BEV’s as well as charging opportunities for ships in harbors.
- Hydrogen
- Methane (CNG and LNG: for street traffic and maritime applications)

Key elements of the CPT-directive:

- Member states (MS) have to develop national implementation plans (NIP); no specific guidelines for infrastructure by the directive: MS have to decide within their NIP about a “appropriate number” for “Charging/H2/LNG&CNG“-infrastructures
- Establishment of binding technical standards and specifications for the interconnection between “Fuel / Vehicle / Infrastructure”. Motivation/Target: Interoperability and undiscriminatory availability of infrastructure.

Clean Power for Transport Directive
Impact for Hydrogen Technology

- Integration of the directive into national laws: 24 month after empowerment (expected: mid of 2014)

- H2-Infrastructure: 31.12.2025 (just for MS which will use the H2 option)

- Relevant Standards:
  - The **hydrogen purity** dispensed by hydrogen refuelling points shall comply with the technical specifications included in the **ISO 14687-2** standard.
  - Hydrogen refuelling points shall employ **fuelling algorithms** and equipment complying with the **ISO/TS 20100** Gaseous Hydrogen Fuelling specification.
  - **Connectors for motor vehicles** for the refuelling of gaseous hydrogen shall comply with the **ISO 17268** gaseous hydrogen motor vehicle refuelling connection devices standard.

- Transition period for all fuel options: 36 month after empowerment of the directive all new or renewed fuel infrastructure has to follow the mentioned standards.

➔ Council has approved the directive.

Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

Thank you very much!

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download: www.now-gmbh.de