Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

HRS Infrastructure in Germany and Europe - Current activities

June 19th, 2014 | Washington D.C.

Dr. Hanno Butsch | Head of International Cooperation
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

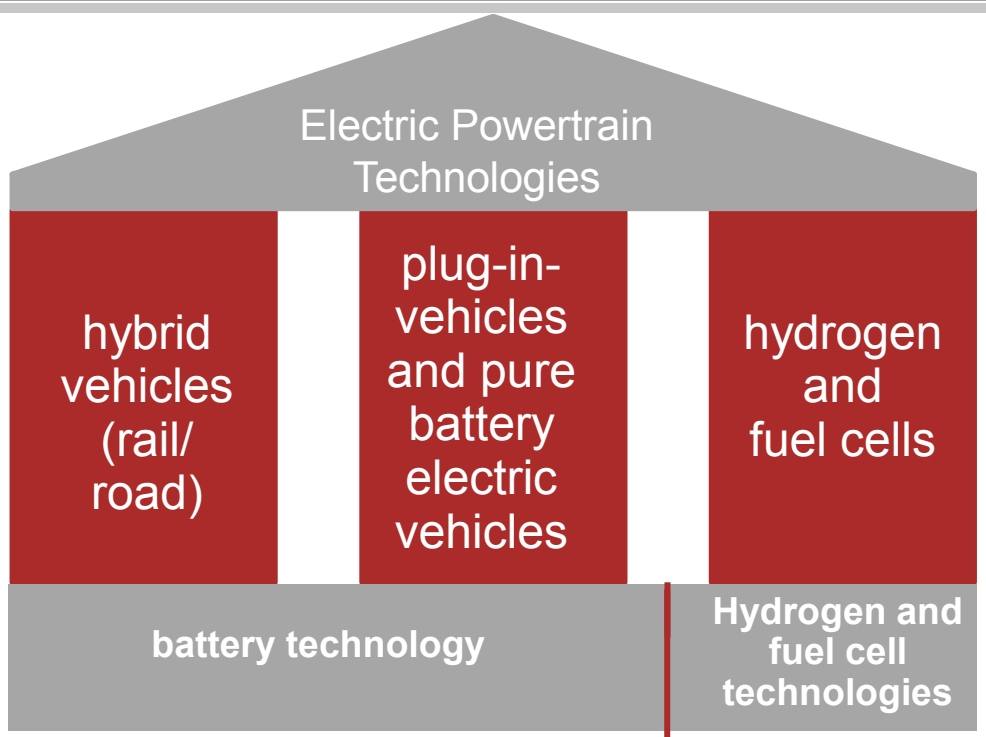
NOW
Program Management / International cooperation / Communication

NIP Preparing hydrogen and fuel cell markets	**BMVBS Electric Mobility** Electric Mobility with Battery-Technologies
Lighthouse projects	**Model regions**

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

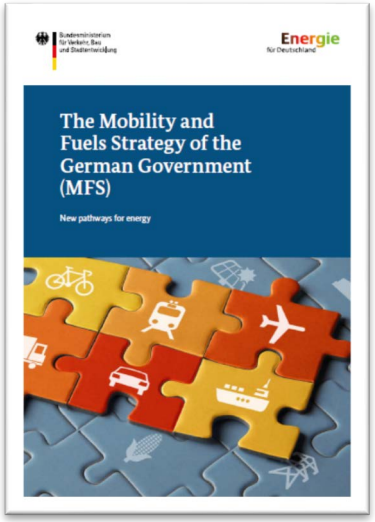
key technologies for a sustainable mobility

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.

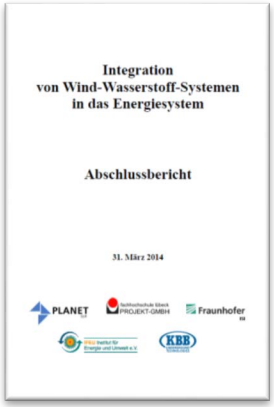


➔**Electrification of the drive train (BEV's and FCEV's) is an key issue to reach the targets!**

➔**Targets only achievable with renewable power to gaseous fuels.**

➔**Further increase of RE mandatory to achieve the targets.**

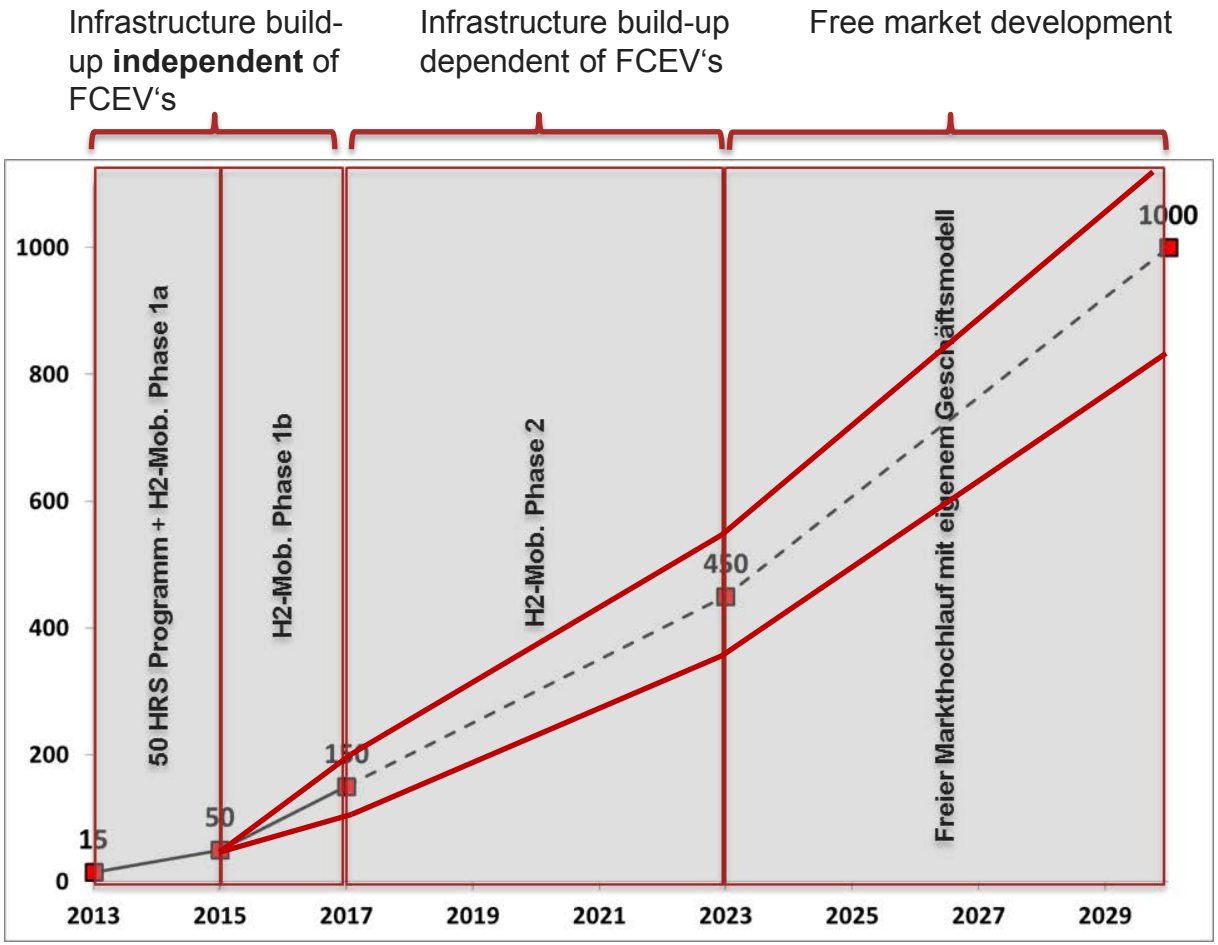
➔**Large scale storage for Hydrogen is inevitable.**



Phased approach to a profitable commercial infrastructure ramp-up

	R&D and demonstration	Market preparation and validation	Commercial ramp-up
When? Who?	▪ Since 2006 ▪ NOW / CEP	▪ For the next 5 - 10 years ▪ H_2 Mobility and NOW / CEP	▪ Around 2020 ▪ 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

Clean Energy Partnership CEP

AIR LIQUIDE | BMW Group | BVG
DAIMLER | EnBW | Ford
GM | OPEL | HOCHBAHN | HONDA The Power of Dreams
HYUNDAI | THE LINDE GROUP Linde | SIEMENS
Shell | TOTAL | TOYOTA
SSB | VATTENFALL | VOLKSWAGEN AKTIENGESELLSCHAFT

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

Hamburg, Bramfelder Chaussee Shell

Hamburg, HafenCity Vattenfall/ Shell

Hamburg, Cuxhavener Str. Total *(location change ongoing)*

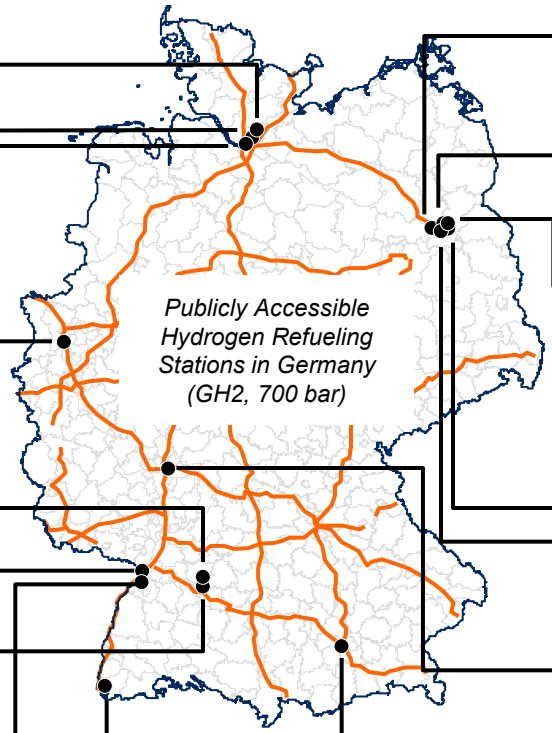
Düsseldorf, Air Liquide

Stuttgart, EnBW

Stuttgart, Airport OMV

Karlsruhe, EnBW

Karlsruhe, KIT *(only 350 bar; upgrade planned)*



Freiburg, FhG ISE

Berlin, Heidestraße Linde/Total

Berlin, Heerstraße Total *(location change ongoing)*

Berlin, BER Total *(under construction)*

Berlin, Holzmarktstraße Linde/Total (rebuild ongoing)

Berlin, Sachsendamm Shell

Frankfurt (Höchst), Infraserv/AGIP

Munich, Detmoldstraße Total *(only LH2, rebuild ongoing)*

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

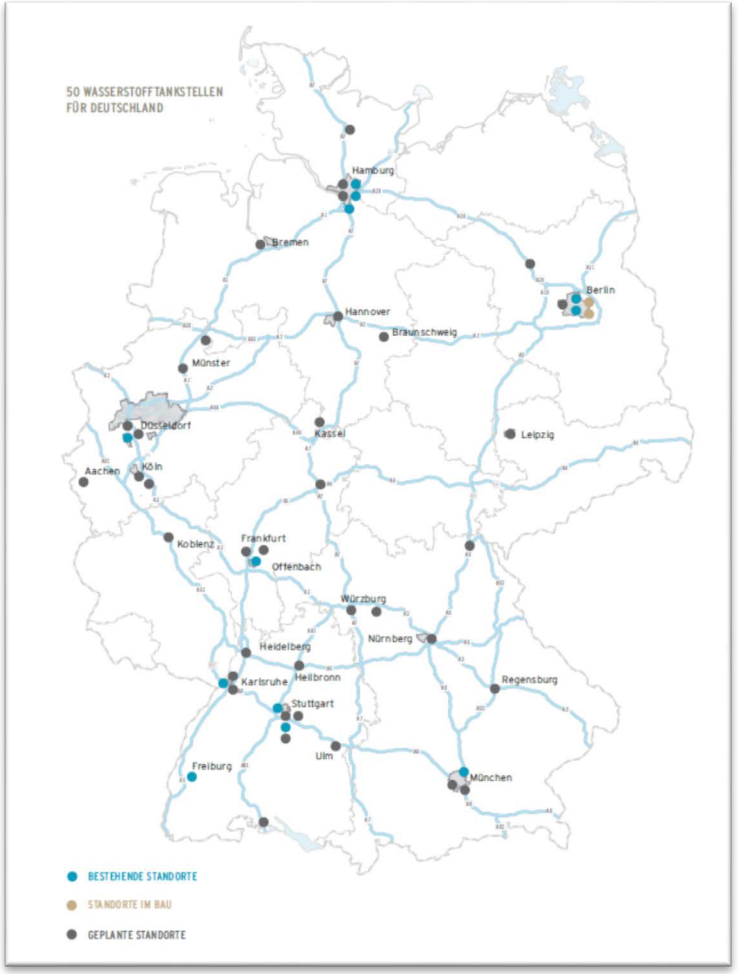
- **joint Letter of Intent to expand the network of hydrogen filling stations in Germany**
  - signed by the German Ministry of Transport, Building and Urban Development (BMVBS) and several industrial companies
  - part of the National Innovation Programmed for Hydrogen and Fuel Cell Technology (NIP)
  - 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, Opel, BMW Group, DAIMLER, VATTENFALL, EnBW	AIR LIQUIDE, Shell, BMW Group, Linde, DAIMLER, HONDA The Power of Dreams	VATTENFALL, GM, Opel, 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

CEP	German States	H_2 Mobility
„Getting the job done!“	*(accociate CEP partners North Rhine-Westphalia, Baden-Württemberg, Hesse and others)*	*„The big picture“*
Continuously build-up of H2-stations, vehicle fleets, standards	***promote the expansion of the hydrogen infrastructure***	***Framework requirements for the economic build-up of a nationwide H_2-Infrastructure***

Nationwide H_2-Infrastructure in Germany. Standardised, safe, comfortable fuelling!

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

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			H_2 Mobility coalition objectives	
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	Negotiate joint entity agreement	Start HRS rollout in Germany via the CEP
		Business case calculated and implementation plan outlined	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:

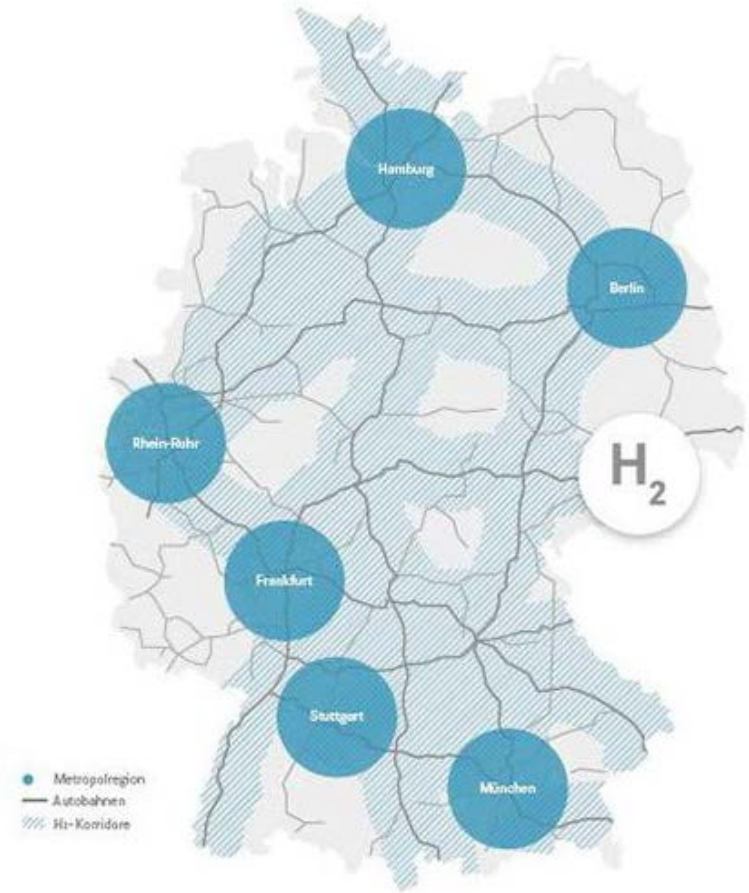
NISSAN, BMW GROUP, HYUNDAI, KIA MOTORS, VW, TOYOTA, HONDA The Power of Dreams, Intelligent Energy, NOW Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

H2-Mobility action plan through 2023

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.



Developing Commercial Hydrogen-Infrastructure

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

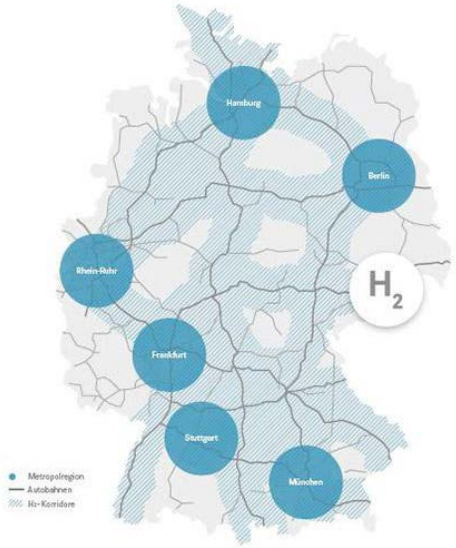
Success factors
- Synchronized ramp-up of hydrogen stations and vehicle deployment
- Risk sharing mechanisms (across industries / the role of public)

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!

Dr. Hanno Butsch
Head of International Cooperation

NOW GmbH
National Organization Hydrogen and Fuel Cell Technology

Fasanenstrasse 5, 10623 Berlin, Germany

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