INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update December 2015: Germany

The IPHE Secretariat requests each IPHE member submit a one-page narrative update on hydrogen and fuel cell (HFC) activities. Please only report actions and developments since the last Country Update and leave Sections blank if there have been no new developments.

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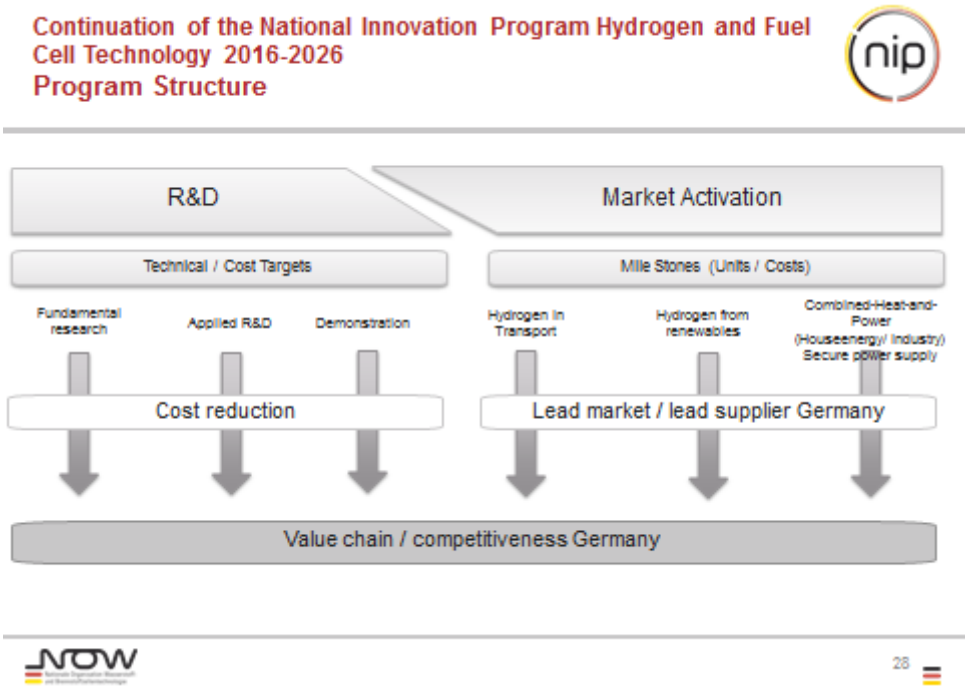
1. New Policy Initiatives on Hydrogen and Fuel Cell

The continuation of the National Innovation Program for Hydrogen and Fuel Cells (NIP2) and of the respective implementation organization NOW for another 10 years is currently discussed within the ministries and a decision is expected by the end of 2015.
The suggested NIP2 program would consist of two main pillars.

- Pillar 1: Continued R&D
- Pillar 2: Market activation

The focus of pillar 1 is on technical improvement and technical based cost reductions. Pillar 2 focuses on the early commercialization of products in transport, hydrogen production and the combined-heat-and-power market for house energy and industrial processes.



Furthermore, NOW was contracted by the federal Ministry of Transport and Digital Infrastructure to develop the national strategy frameworks, which are required in the context of the European Directive 2014/94/EU on the deployment of alternative fuels infrastructure (AFI).

Since September 15th 2015 the European Directive 2015/1513 for amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources came into effect. These directives for the first time consider renewable electricity and renewable hydrogen as fuels for the transportation sector. Accordingly, these new renewable fuels and especially their contribution to greenhouse gas-reduction have to be implemented into national law within the next years.

2. Hydrogen and Fuel Cell R&D Update

The Callux practical test for fuel cell heating systems in the home, which commenced in September 2008 as part of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP), is now successfully completed and has culminated in the market introduction of the innovative systems. The participating manufacturers, Baxi Innotech, Hexis and Vaillant, jointly tested almost 500 such fuel cell heating systems for their efficiency together with companies from the energy sector including EnBW Energie Baden-Württemberg, E.ON, EWE, MVV Energie and VNG – Verbundnetz Gas.

On October 15th the operation of the world's most efficient and compact power-to-gas system on the HanseWerk research site in Hamburg-Reitbrook was launched. The project facilitates the supply of hydrogen which has been generated by wind electricity into the Hamburg gas network. The aim of the joint project of E.ON and HanseWerk is to increase the use of renewable energies in terms of the set objectives over the course of the energy transition. Operating for the first time, a PEM electrolyser facilitates the optimization of the power-to-gas technology both technically and economically. With a nominal 1.5 megawatt power-input, the PEM system achieves a more dynamic operation as well as less energy losses compared to incumbent technologies. With its dimensions of 50 x 50 x 50cm, this stack is the most compact unit in the world.

Furthermore, the process to extend the activities within the Clean Energy Partnership (CEP) is currently ongoing. In the context of a NIP2 all partners showed their interest to continue this joint research, development and demonstration platform for hydrogen and fuels in road transport.

Regarding the use of hydrogen and fuel cells in rail transport, a study on the issue of "Hydrogen rail infrastructure" has been launched. Coordinating with the relevant stakeholders (e.g. railway companies, Alstom Deutschland AG) and regional actors (e.g. state agencies, commissioning authorities of the regional rail services), the study will develop appropriate action plans including different provision options for hydrogen, legal framework conditions and the anticipated investment costs in infrastructure and operation. Synergies with other transportation modes will have to be identified.

3. Demonstration and Deployments Update

A continuation of the lighthouse project "e4Ships" is currently under discussion. Two major aspects in the future might be market analysis for fuels and infrastructure for maritime

applications and global alignment of the regulative environment for the use of fuel cell systems on ships. This would facilitate the early commercialization of these applications.

The federal Ministry for Economics and Energy has announced plans to support the market introduction of residential fuel cell systems starting 2016.

4. Events and Solicitations

International:

- 25th – 29th April 2016 — Industry Fair, Hanover
- 10th – 12th October 2016 — World of Energy Solutions, Stuttgart

National:

- 10th April 2016 — Symposium "Hydrogen rail infrastructure ", Berlin
- 10th March — Suppliers Market Place, Berlin

For more information https://www.now-gmbh.de/en/aktuelles/veranstaltungen

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

Public funding of hydrogen technology will continue

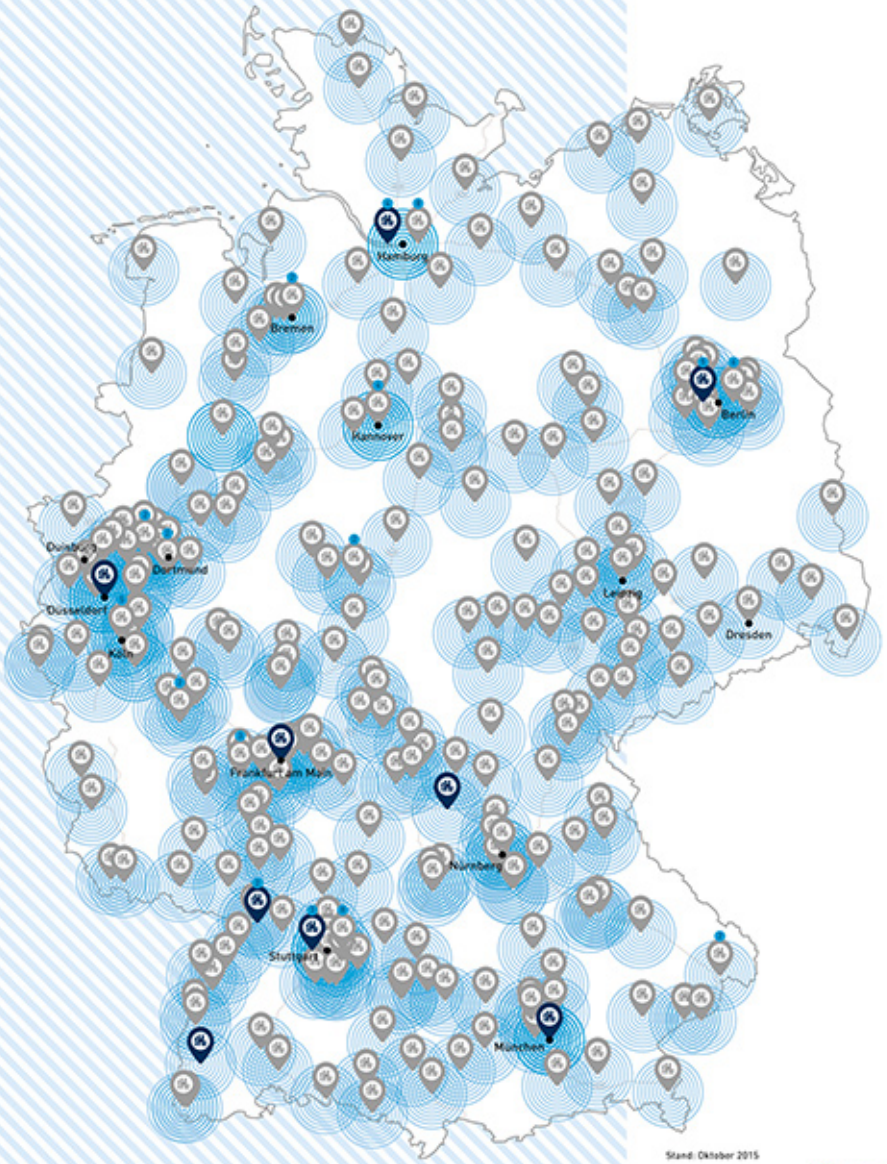
The Ministries of the federal Government participating in the NIP are currently discussion to continue the NIP until 2026. The BMVI will continue to fund hydrogen and fuel cell technology and has secured 161 million euro until 2018. Aside from the continuation of research and development as well as everyday demonstration of the technology, in future the focus will be on market introduction of the technology

Based on the cross-sectoral joint initiative H2 MOBILITY in Germany, six industry partners have founded a joint venture, the H2 Mobility Deutschland GmbH & Co. KG (H2M), to further develop a nationwide hydrogen refueling station network. In a first step up to 100 refueling stations will be built as a base coverage followed by a synchronized network development depending on fuel cell car sales of up to 400 stations by 2023. Germany would thus become the first country to have a cross-regional network for refuelling fuel cell vehicles with hydrogen. Representatives of H2M partners affirmed these plans on October 13th 2015 at the meeting with Transport Minister Alexander Dobrindt.

2023/~400 H_2

MISSION:
WASSERSTOFF
INFRASTRUKTUR

H_2 MOBILITY
WASSERSTOFF TANKEN



H_2-STATIONEN
IN DEUTSCHLAND

IN BETRIEB

GEPLANT

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Summary Country Update December 2015: Germany

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Policy Support
Fuel Cell Vehicles[1]	Targets for NIP2 are currently under discussion	103	• CEP	• NIP
FC Bus	Targets for NIP2 are currently under discussion	14	• CEP	• NIP
Fuel Cell Trucks[2]	Targets for NIP2 are currently under discussion	---	---	---
Forklifts (Floor-borne vehicles)	Targets for NIP2 are currently under discussion	16	---	• NIP
H_2 Refueling Stations	**Target Number**	**Current Status**	**Partnerships, Strategic Approach**	**Policy Support**
70 MPa On-Site Production	Overall total of 400 HRS by 2023	5	• CEP,H2 Mobility Deutschland GmbH & Co. KG	• R&D funds for operation and installation (NIP)
70 MPa Delivered	Included in the Above	11	• CEP, H2 Mobility Deutschland GmbH & Co. KG	• R&D funds for operation and installation (NIP)
35 MPa On-Site Production	Tbd	2	• CEP	• R&D funds for operation and installation

[1] Includes Fuel Cell Electric Vehicles with Range Extenders
[2] As above

35 MPa Delivered	Tbd	4	• CEP	• R&D funds for operation and installation (NIP)
Stationary	**Target Number[3]**	**Current Status**	**Partnerships, Strategic Approach**	**Policy Support**
Small[4]	Targets for NIP2 are currently under discussion	~1000	• Callux; ENE-Field; other field tests	• NIP, state funding and FCH-JU
Medium[5]	Targets for NIP2 are currently under discussion	0	---	---
Large[6]	Targets for NIP2 are currently under discussion	0	---	---
District Grid[7]	---	0	---	---
Regional Grid[8]	---	0	---	---
Telecom backup	Targets for NIP2 are currently under discussion	~200	---	• NIP
H_2 Production	**Target[9]**	**Current Status**	**Partnerships, Strategic Approach**	**Policy Support**

[3] Targets can be units installed and/or total installed capacity in the size range indicated
[4] <5 kW (e.g., Residential Use)
[5] 5kW – 400 kW (e.g., Distributed Residential Use)
[6] 0.3MW – 10 MW (e.g., Industrial Use)
[7] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)
[8] 30MW plus (e.g., Grid Storage and Systems Management)

Fossil Fuels[10]	---	---	---	---
Water Electrolysis[11] (PEM, Alkaline, SOEC)	Targets for NIP2 are currently under discussion	21	www.performingenergy.de www.powertogas.info	• NIP and others
By-product H_2	---	2	---	• NIP
Energy Storage from Renewables	**Target[12]**	**Current Status**	**Partnership, Strategic Approach**	**Policy Support**
Power to Power[13] Capacity	Targets for NIP2 are currently under discussion	2	www.performingenergy.de www.powertogas.info	• NIP and other federal funding
Power to Gas[14] Capacity	Targets for NIP2 are currently under discussion	2	www.performingenergy.de www.powertogas.info	• NIP and other federal funding

[9] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target
[10] Hydrogen produced by reforming processes
[11] Please indicate if targets relate to a specific technology (PEM, Alkiline, SOEC)
[12] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity
[13] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity
[14] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)