Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

H2-Mobility

Preparing for a hydrogen infrastructure in Germany

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Nationale Innovationprogramme Hydrogen and Fuel Cell Technologies (NIP)

Suppoerted by

Bundesministerium für Verkehr, Bau und Stadtentwicklung

Bundesministerium für Wirtschaft und Technologie

Bundesministerium für Bildung und Forschung

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

Market preparation for hydrogen- and fuel cell technologies

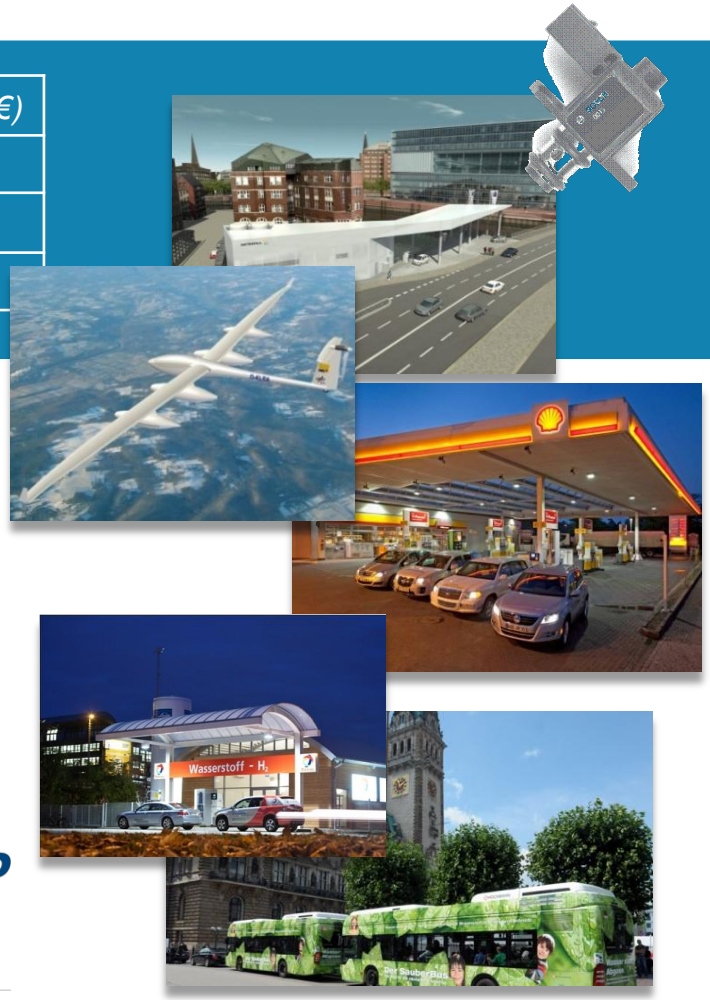
- **200 M€** funding
  focus R&D
  BMWi, NOW, PtJ-Jülich
- **500 M€** funding
  focus demonstration
  BMVBS, NOW, PtJ-Berlin
- **700 M€** industry investment
- **1.400 M€** overall budget

- **10-year-programme (2007-2016)**

The NIP is a strategic alliance combining politics, industry and academia

National Innovation Programme - NIP Transportation Sector (overview)

	# projects	# partners	funding (mio. €)
approved (BMWi)	17	46	52
approved (BMVBS)	50	103	124
LoI BMVBS	8	10	32



Focus areas 2008 – 2011:

- ramp-up of hydrogen vehicle fleets (passenger cars, busses)
- testing of hydrogen refuelling stations in key regions
- development of fuel cell systems and key components (BoP)
- fuel cells in aviation

Aditional areas 2011-2016:

- building an initial hydrogen infrastructure network
- increasing the deployment of fuel cell busses
- developing key components (hydrogen storage/refueling technology)

Lighthouse project:

- Clean Energy Partnership (CEP)
  5 regions,130 passenger cars,11 busses, 15 refueling stations

Clean Energy Partnership CEP

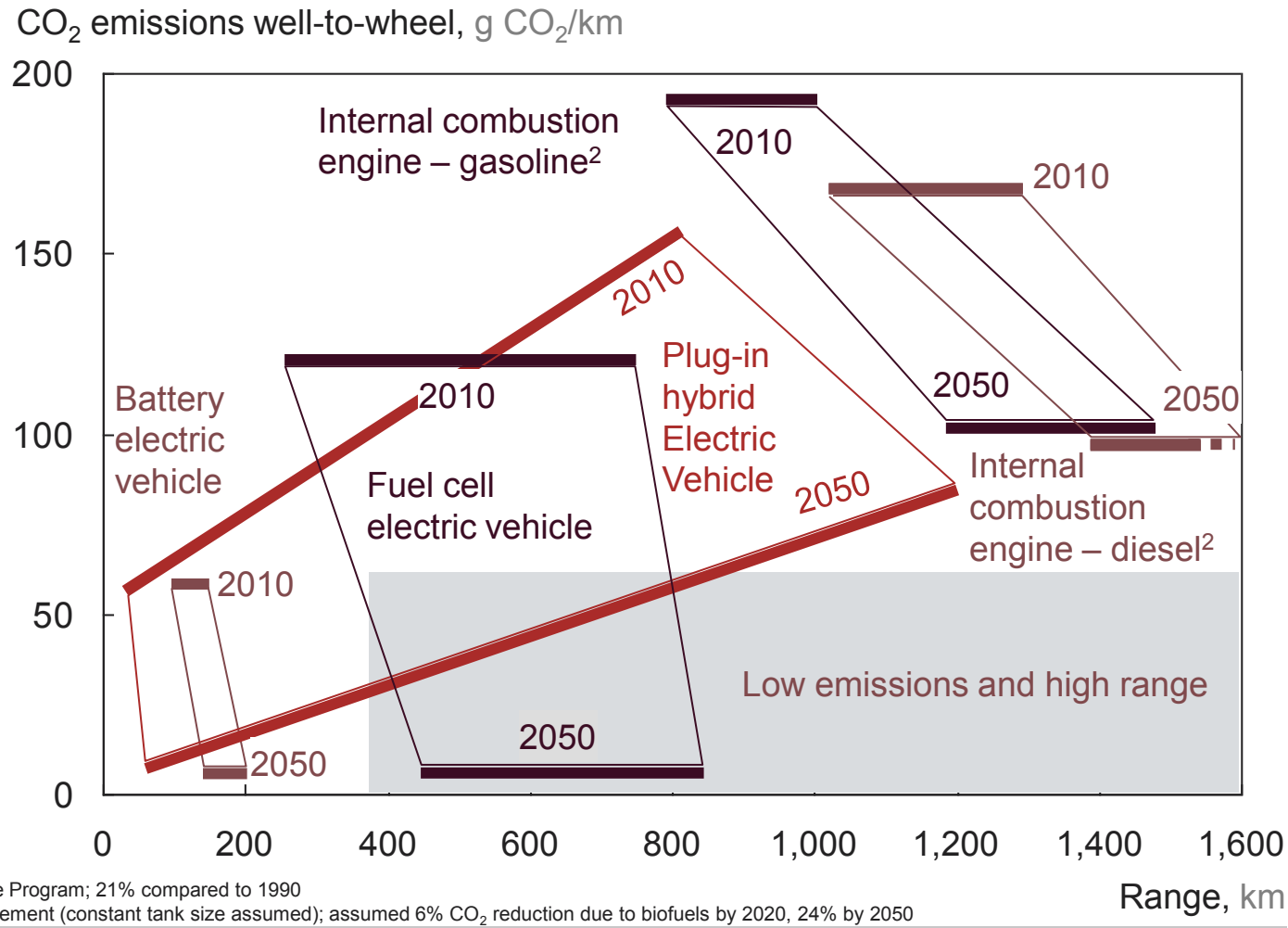
Ein Projekt im Nationalen Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie

Status 11/2011

Key role of FCEV in reaching Germany's target is to fully decarbonize private transport by 2050

Objectives set by German government

- Germany aims to reduce CO_2 emissions by 40/55/80 - 95% until 2020/2030/2050 compared to 1990
- The transport sector accounts for ~ 19% of total German CO_2 emissions in 2009
- Until 2020, Germany aims to reduce transport emissions by 33.6 million tons CO_2[1]



1 According to the Integrated Energy and Climate Program; 21% compared to 1990
2 Range for 2050 based on fuel-economy improvement (constant tank size assumed); assumed 6% CO_2 reduction due to biofuels by 2020, 24% by 2050

Clean Energy Partnership – Hydrogen Refueling Stations (HRS)

Hamburg, Bramfelder Chaussee Shell

Hamburg, HafenCity Vattenfall/ Shell

Hamburg, Cuxhavener Str. Total

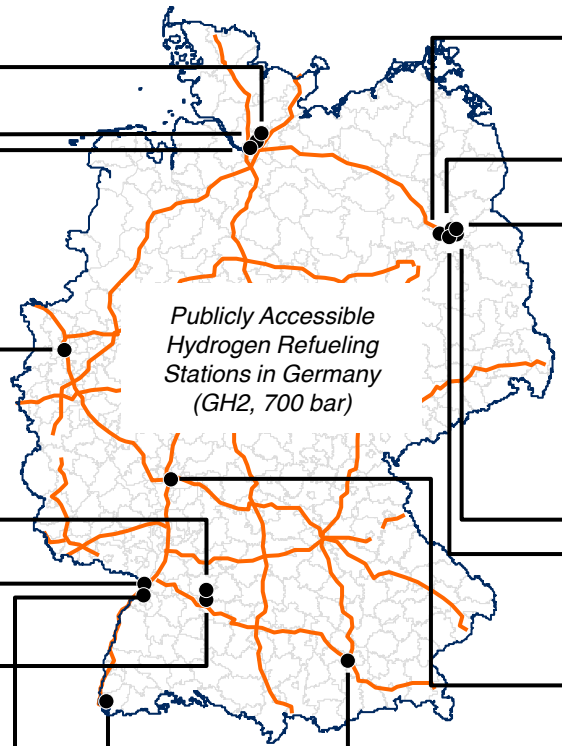
Under construction — **Düsseldorf**, Air Liquide

Under construction — **Stuttgart**, EnBW

Stuttgart, Airport OMV

Karlsruhe, ENBW

Under construction — **Karlsruhe**, KIT



Freiburg, FhG ISE

Berlin, Heidestraße Linde/Total

Berlin, Heerstraße Total

In planning stage — **Berlin**, BBI Total

Berlin, Holzmarktstraße Linde/Total/ Statoil

Berlin, Sachsendamm Shell

Frankfurt (Höchst), AGIP

Munich, Detmoldstraße Total *(only LH2)*

Key achievements

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

- Several additional stations are currently planned
- Daimler and Linde have announced to build 20 HRS within the next years

Toyota confirms commercial hydrogen plans

http://www.enginetechnologyinternational.com/news.php?NewsID=36008

18.01.2012

Having long been a leader in developing new sustainable transportation technologies for the automotive industry, Toyota has confirmed it plans to push ahead with commercial production of hydrogen fuel cell vehicles.

Speaking to the press, Didier Leroy, CEO of Toyota Motor Europe said: “In our quest for sustainable mobility Toyota is investing in a range of environmentally friendly technologies to address key issues such as energy supply and transport emissions. Alongside hybrids, plug-in hybrid electric and pure electric vehicles, we believe that fuel cell vehicles will play an important role in realizing a low carbon society.

“**We plan to commercialize fuel cell vehicles in 2015** and to achieve this goal a hydrogen charging infrastructure will be required. That is why we welcome the establishment of the UK H2 Mobility Group to confirm the potential for hydrogen as a low carbon fuel in the UK.”

Toyota has been researching fuel cell technology and hydrogen storage for almost 20 years and in 2002 its first generation of fuel cell vehicles underwent field tests in Japan and the USA. Most recently it revealed its FCV-R Concept, a vision for a practical sedan-type fuel cell vehicle that is scheduled for launch in 2015.

B-Klasse F-CELL World Drive 2011 – in 125 Tagen um die Welt

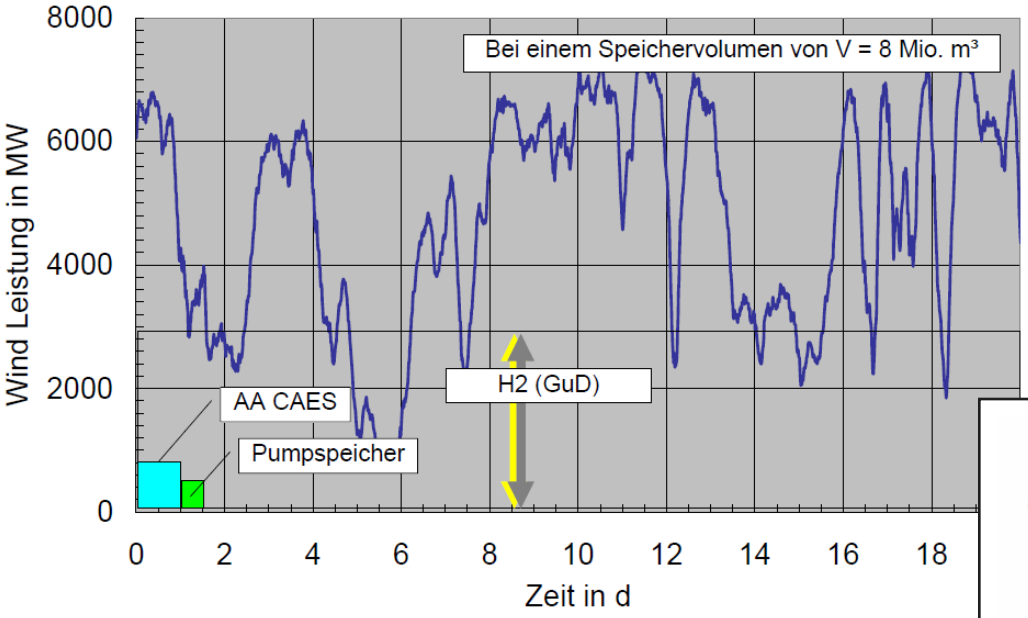
- 125 Tage
- 14 Länder
- 3 Fahrzeuge
- Rund 35.000 km je Fahrzeug

GM's Next Generation Fuel Cell Propulsion Systems

½ Size
½ Weight

GM

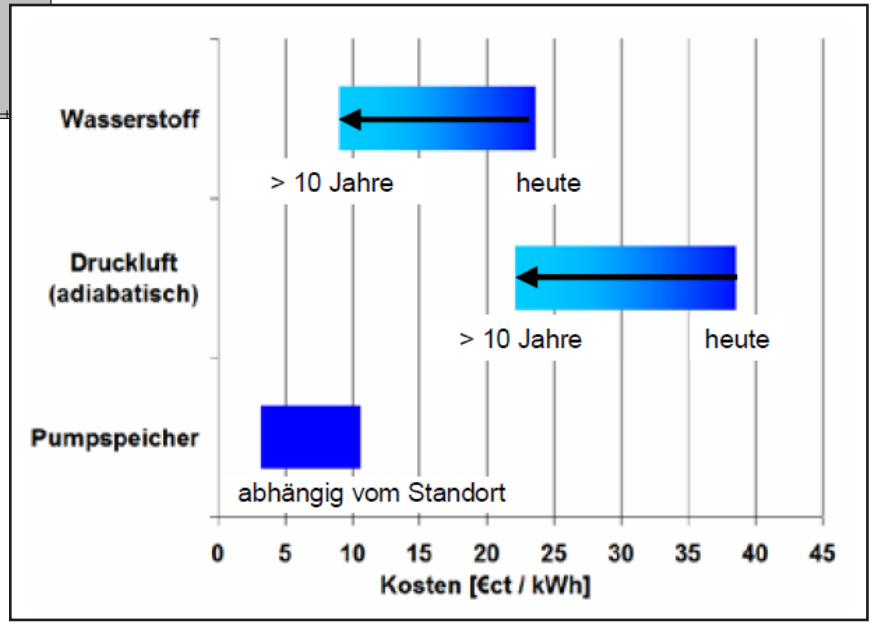
VDE Study Continued:



left: **storage capacity in relation to feed-in wind power in E.ON grid 2007**

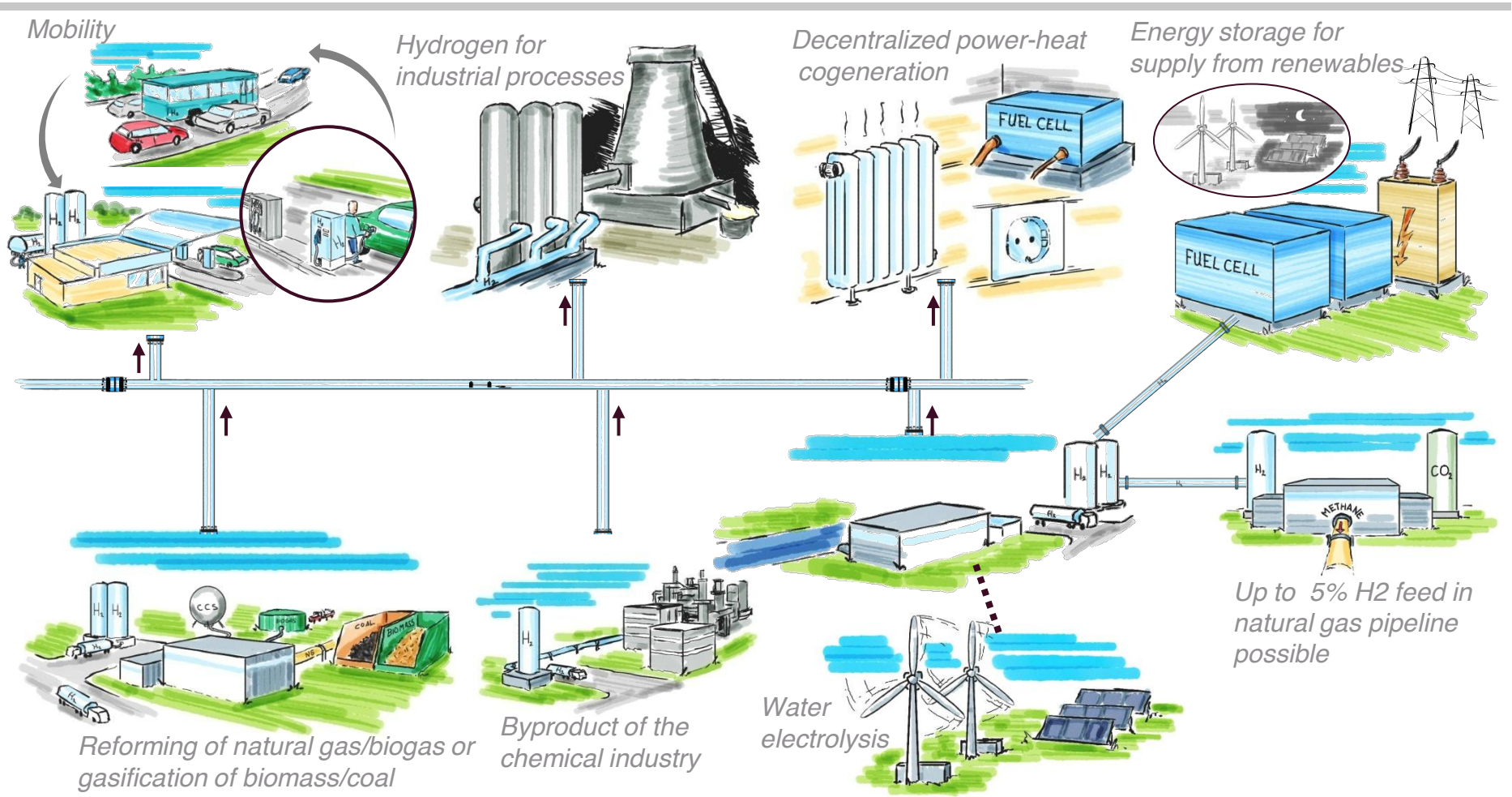
below: **costs of weekly storage**

source : VDE



- almost **no locations** for **pumped hydro available** in Germany
- storage capacity of **H_2 60 times** bigger than **capacity** of **CAES**
- **H_2 most important** option in longer term
- potential **synergies** between H_2 as **energy storage**, **fuel** and **industrial gas** should be exploited

Key role of hydrogen as an energy carrier to facilitate the energy transition in Germany (I)



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

H2 Mobility

H_2 Mobility setup	2010 - 2011 H_2 Mobility business case (joint study)	2011 H_2 Mobility business and implementation plan (joint study)	2012 - ... 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

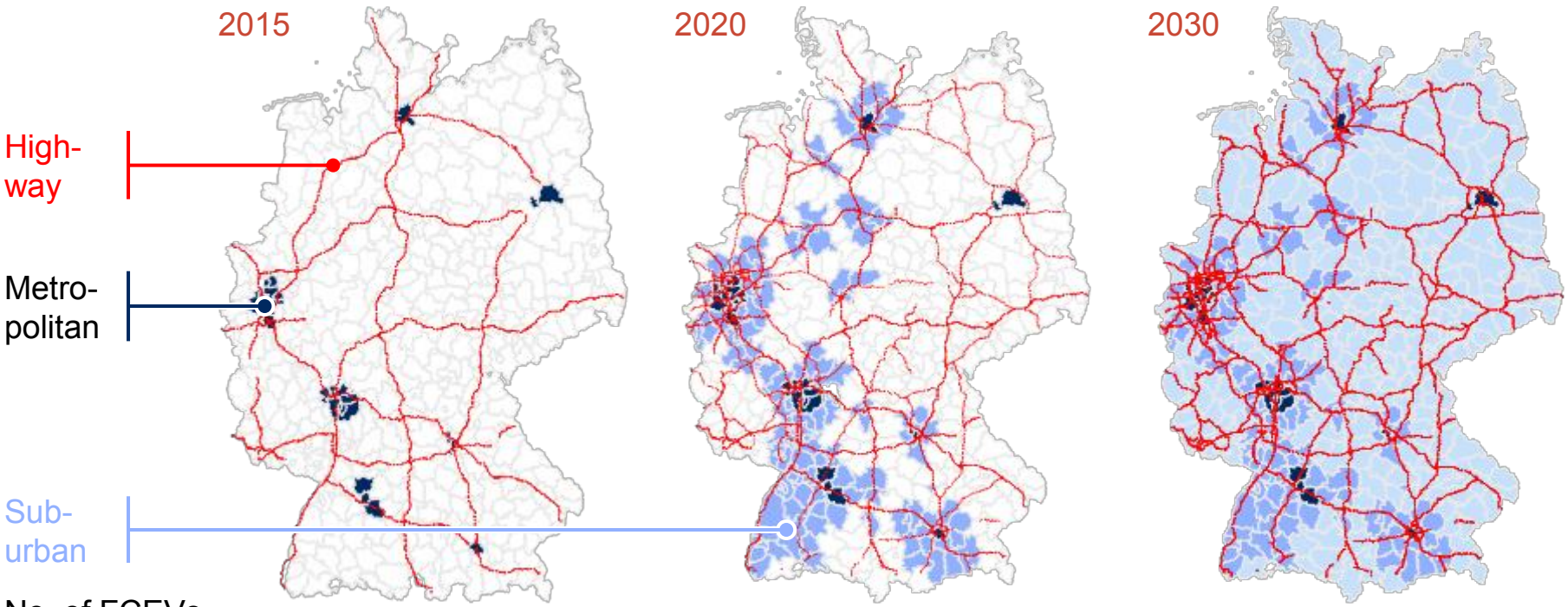
H_2 Mobility analysis participants in 2011

DAIMLER, TOYOTA, NISSAN, GM, BMW GROUP, Intelligent Energy, HYUNDAI, KIA MOTORS, OMV, TOTAL, Linde, NOW Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie, VATTENFALL, EnBW, SIEMENS, AIR LIQUIDE, AIR PRODUCTS

Potential HRS rollout in Germany

H2 Mobility

Tier-1 regions
Tier-2 regions
Tier-3 regions



	2015	2020	2030
No. of FCEVs Thousands	~ 5	~ 150	~ 1.800
No. of HRS	~ 100	~ 400	~ 1.000
Total population covered by HRS Percent	~ 20	~ 60	~ 100

Phased approach to a profitable commercial infrastructure ramp-up

	R&D and demonstration	Market preparation and validation	Commercial ramp-up
When? Who?	▪ Since 2006 ▪ CEP/NIP	▪ For the next 5 - 10 years ▪ H2 Mobility and CEP/NIP	▪ Around 2020 ▪ H2 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

Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

Thank you very much for your attention!

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