



**General Assembly and Third Infrastructure Workshop Oct. 20/21, 2010**

*First steps in regional hydrogen infrastructure buildup*

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## Structure

- **Market and Roll out Hydrogen vehicles**
- **Status and Perspectives Infrastructure**
- **Sources for Hydrogen**
- **Local Concepts**
- **Recommendations**

**HyRaMP**

## Ramp Up Cars



### ■ Growing Commitment of International car manufacturers

- Growing number of vehicle projects in various European regions (Germany, Italy, etc.)
- H2Moves Scandinavia
- Higher quantities and increasing interest of international vehicle manufacturers like Toyota, Honda and Hyundai in Clean Energy Partnership (Berlin, Hamburg, NRW)
- New Vehicle projects in Copenhagen/London

### ■ Expectations for the introduction of hydrogen cars on the market

- Market study on market opportunities and viability of hydrogen vehicles financed by vehicle manufacturers (H2-Coalition)
- Optimistic prognosis for hydrogen vehicles from 2020
- Similar task on buses in 2010 FCH JU call

### ■ Next HyLights project

22.10.2010



# Bus Activities



- **Next generation German federal/regional funding schemes**

- Berlin (4 +), Hamburg (10/20), Karlsruhe (2),
- Cologne/Amsterdam (4 +)
- NRW (> 25 buses)
- Aragon

- **European CHIC project**

- Joint Activities of 5 European partners in the project (Bolzano, London, Milan, Switzerland, Oslo)
- Grant Agreement at all partners
- Funding of 30 buses and refueling infrastructure

- **Other bus projects**

- Partner-consortium for next bus project in formation
- Lead by bus manufacturer van Hool
- At least 3 European regions involved
- 15 – 20 buses



# Co-ordinated Infrastructure Activities



## ▪ H2Mobility

- Network of European partners from automotive, gas-industry and energy utilities
- Objective: installation of up to 1.000 hydrogen refueling stations in Germany until 2020
- Focus on infrastructure for cars in public stations
- Extension or similar project on European level needed

## ▪ Next HyLights project

- Identification of key locations for next vehicle demonstrations and infrastructure ramp up

## ▪ Other Activities

- Dissemination activities from HyRaMP in CHIC and NextHylights
- Submission of topics for MAIP and AIP 2010 and 2011



# Refuelling Infrastructure



## France

Bretagne  
Rhone Alpes  
Midi Pyrénées

## Germany

Baden-Württemberg  
City of Hamburg  
Hessen  
North Rhine-Westphalia

## United Kingdom

British Midlands  
Outer Hybrides  
North East of England  
City of London

## Italy

Abruzzo  
Province of Bolzano  
Lazio  
Lombardy  
Piemonte  
Province of Trento  
Tuscany  
Veneto

## Spain

Andalusia  
Aragon  
Castilla La Mancha  
Catalonia  
Galicia  
Madrid

## Others

Scandinavian Regions (N, SE, DK)  
Flanders (B)  
City of Ljubljana (SLO)  
City of Wroclaw (P)  
City of Torres Vedras (PT)  
DutchHy (NL)  
Pirkanmaa (Finland)



# Existing Refuelling Infrastructure



Infrastructure Informations	Existing Sources of Hydrogen and Quantities	Planned Sources of Hydrogen and Quantities	Existing Infrastructure (Pipeline etc.)	Plans for Building Up of Infrastructure	Existing Refuelling Stations	Number of Planned Stations until 2015
<b>France</b>						
Bretagne						
Rhone Alpes						
Midi Pyrenees	20 Nm3h	100 Nm3/h			1	1
<b>Germany</b>						
Baden-Württemberg	2700 tons/a				1	2
Hamburg	250 kg/d	Electrolysis/Renewables	None	Pipeline /Large Scale Electrolysis	3	another 6 by 2012
Hessen	2.600 t/a		Pipeline			
NRW	30.000 t/a byproduct; 45-80.000 t/a from digester plants	byproduct	Pipeline	byproduct and other industry	1	2012: 5 - 10; 2015: 30; 2020: up to 200
<b>United Kingdom</b>						
British Midlands						
North East of England						
Outer Hebrides	Renewables/electrolysis 5 Nm3/h 240Nm3/h	Wind/Electrolysis		Wind/Electrolysis	1	2
City of London	Delivery	Delivery	None	Delivery	1	5
<b>Italy</b>						
Abruzzo						
Bolzano	Renewables/electrolysis 240Nm3/h	Renewables/Electrolysis		from renewables by electrolysis; 2 more production sites	1	2
Lazio						
Lombardy	Natural Gas/Reformer on site	also bi fuel vehicles and supply			2 (incl. Mix)	6
Piemonte						
Trento						
Tuscany						
Veneto						
<b>Spain</b>						
Andalusia	MaRHeA 40 kg/d					
Aragon	Electrolysis			from elctrolysis	2	2
Castilla La Mancha	diverse				1	1
Catalonia						
Galicia						
Madrid						
<b>Others</b>						
Scandinavian Regions	diverse	Wind/Electrolysis		Renewables	7 in operation; 5 under construction	19 (Hyway)
Flanders	10 MW byproduct	50 Nm3 on site	Pipeline	1 (Amsterdam)	2 moveable hydrogen refuelling stations	
Lubljana						
Wroclaw	2.250 tons/a			from industrial byproduct	1	1
Torres Vedras						
Dutch Hy	2.500 t/d byproduct		240 km Pipeline	SMR plant in Rotterdam		
Pirkanmaa						

# Conclusions refuelling infrastructure



## ■ Constant realisation of refuelling stations

- Already ~ 20 refuelling stations in operation in Europe
- Another 60 – 80 stations in preparation until 2015

## ■ Size of stations and level of realization is very different

- Range from early test applications to semi-professional units
- Installation of refuelling infrastructure mostly driven by automotive
- Approximately more than 50% of the actual stations have no constant purchase of hydrogen
- 90% of the actual stations deliver less than 50 kg hydrogen a day
- Large variety of technology (production as well as storage)
- No technically identical modular systems available
- No standard safety and certification procedures yet
- Already first plans for interlinking regional sites (Italy, Scandinavia, Germany)

## ■ What are the drivers?

- Refuelling stations for buses will increase demand for hydrogen eminently
- Hydrogen production and logistics concepts for larger and constant demand not ready
- Gas industry still limited to conventional production (fragmentation, reformer etc.) and smaller refuelling units



Bolzano



Castilla , La Mancha



Cologne



Hamburg



# Sources for Hydrogen



## Industrial production

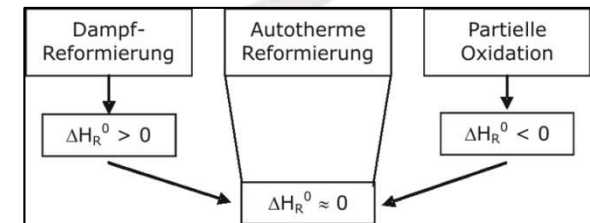
- Usually no relevant reduction in CO<sub>2</sub> emissions compared to conventional fuels
- High tie-up of capital, few, big and centralised production capacities
- Therefore logistic not sufficient for constant supply at great demand

## Industrial Byproduct

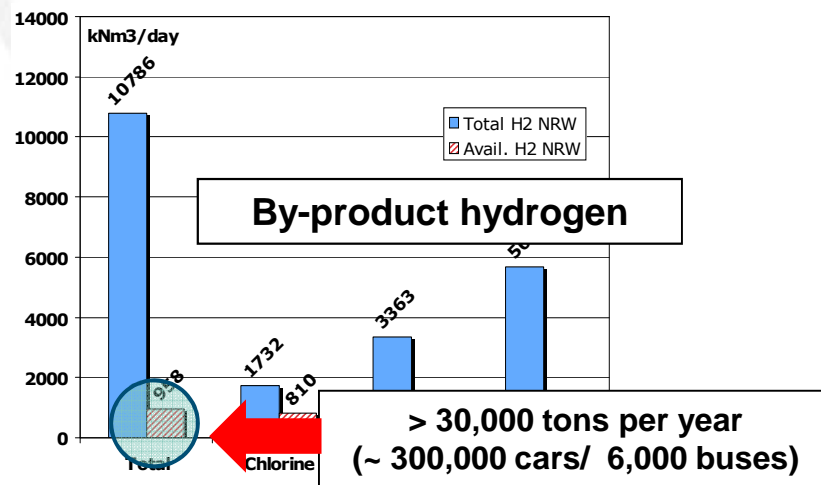
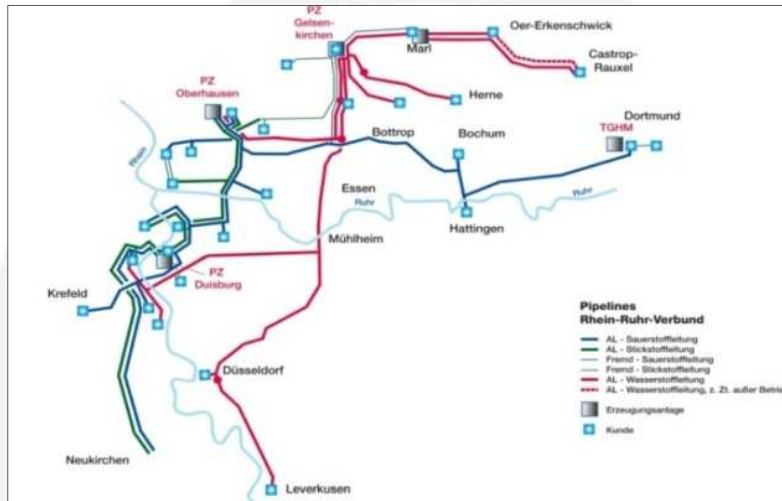
- Sufficient hydrogen for transport applications in Europe available
- Purity can be a problem
- Supply networks need to be installed (if no pipeline available)
- Infrastructure can grow according to demand
- Pipelines induce high fixed costs therefore high volume industrial consumers needed

## Renewable resources

- Biomass (?) and wind have the potential to supply enough energy for the production of hydrogen, according to availability
- Storage of hydrogen as energy vector can help overcome grid obstacles and support peak shaving



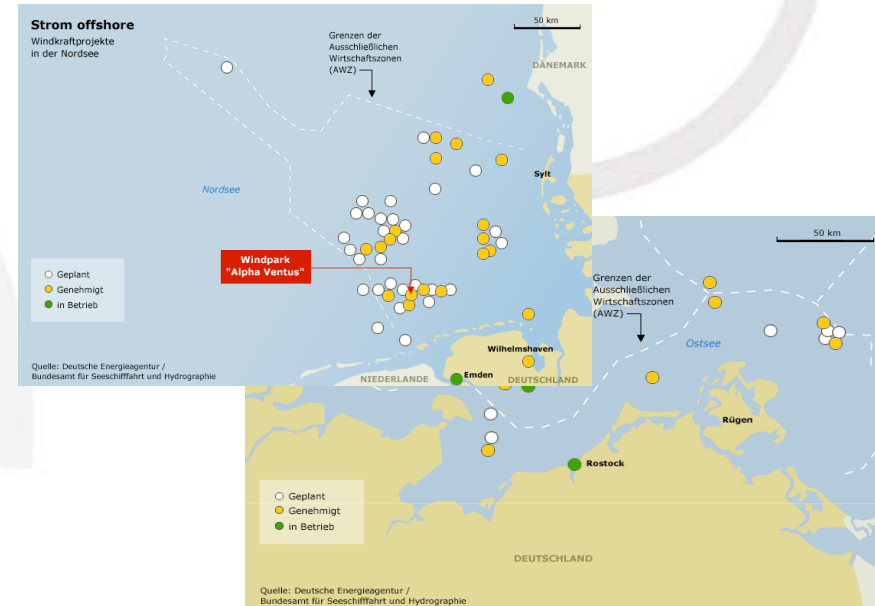
# Local Concepts (1)



- Make use of existing „NRW-H2-Pipeline“ (230 km length in Rhine-Ruhr region)
- Investigate possible options for hydrogen storage within / nearby the pipeline network
- Mapping of **high-priority sites** to start with early infrastructure installations across the state; focus on **public transport depots**:
  - > 5 buses per site ~ 200 kg H<sub>2</sub> /d
- Deployment of **public transport buses** and passenger **cars** (e.g. within **CEP**)

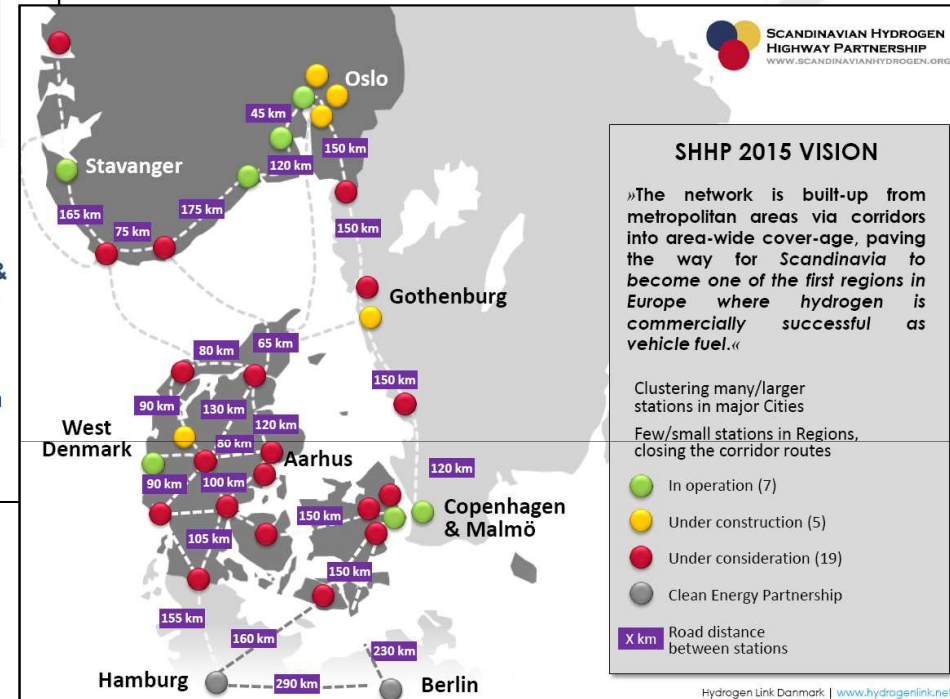
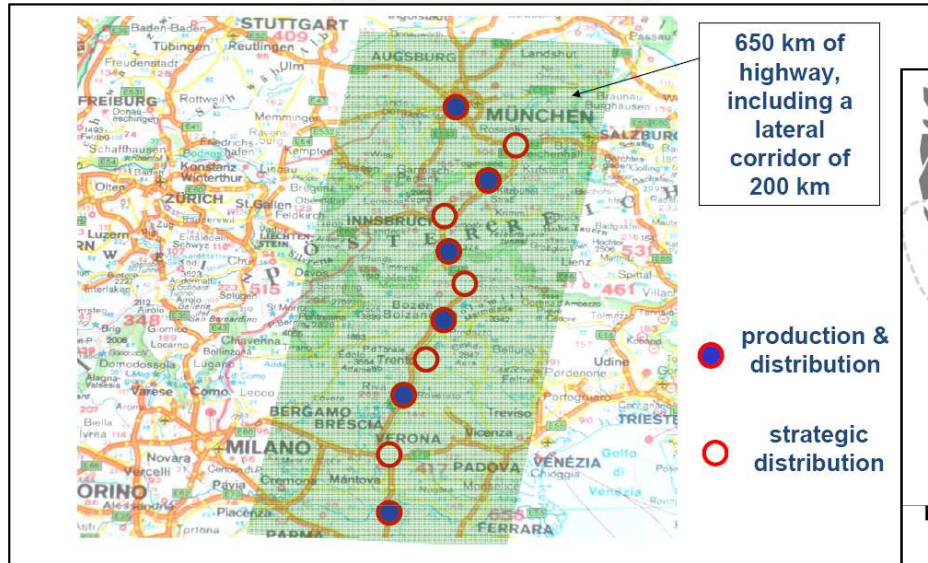
## Local Concepts (2)

- 5 New filling station 2011/2012
- Partners: Vattenfall, Shell and TOTAL
- 2 stations for buses, 4 open to public
- Hydrogen production mostly onsite
- 50 Buses at 2020; 500 cars by 2015

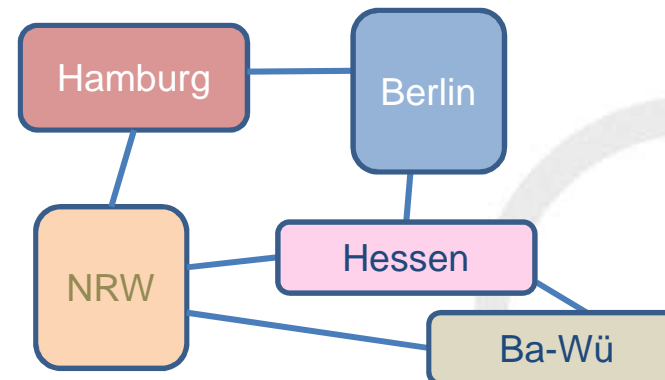


- Capacity in Northern Germany today ca. 20 GW
- 25 GW/70 Windparks currently under planning (mostly offshore)
- Relevant losses due to insufficient grid
- Hydrogen as Energy Storage supports better efficiency of the grid
- Concept for setup of production infrastructure (large scale electrolysis) and logistics under way
- Joint project with industrial consumers for economies of scale

# Hydrogen Hyways



- First backbones for pan-euroean hydrogen highways
- Indication how to bridge the gaps
- Complement to European network in midterm
- Role of industry needs to be defined
- Realisation in parallel to vehicle roll out



## Recommendations (1)

### ■ Organisation HyRaMP

- Detailed compilation of all relevant data on hydrogen infrastructure (today and future plans)
- Deduction of joint interests and activities for a coordinated set up of hydrogen infrastructure
- Integration in MAIP and AIP
- Liaison and assistance in calls and tenders for infrastructure
- Coordinated approach together with H2Mobility and other networks
- Survey (comparable call for bus survey or H2Coalition)

### ■ Support Industry

- Exchange on potential roll out masterplan and demand for infrastructure with industry
- Definition of exemplary refueling systems for specific demand groups
- Transfer into commercially viable standard units
- Extend discussions also to manufacturers of critical components
- Priority for research and demonstration activities on high potential systems and components
- Group purchase of systems, based on frame contracts (supported by Commission action on “grouped purchases of large numbers of clean vehicles”)

## Recommendations (2)



### ■ Production and Resources

- Intensify discussions with regional stakeholders (politics, utilities etc.) on use of hydrogen as energy carrier
- Initiate integrated European survey (supported by EC) on availability of resources and how to forge these for a developing market
- Identify demand in industrial use and marginal costs to help reduce fixed costs on pipelines etc. (costs per unit)

### ■ Strategy

- Coordinate with vehicle roll out (buses, cars)
- Harmonize divergent regional legal framework, building and safety procedures and permissions

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**Thank you for your attention!**

