

Hydrogen in Germany

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Introduction



- Energy supply in Germany is based on fossil fuels (~85%)
 - at present: ~ 60 % of fossil fuels imported
 - in future: ~ ?? % of renewables imported
- Germany is part of the global energy scenario
- Not all statements in this presentation are Germany-specific

25 years of H₂ ...



Activities for energetic use of hydrogen since
the 1970ies

theoretical
practical



25 years of H₂ ...



1st Phase

(after 1st Oil Crisis)

- Search for national self-sufficiency based on
 - Domestic resources: coal, lignite (gasification, liquif.)
 - Nuclear energy: fission (HTR, breeder), fusion
 - Renewables: solar (PV, wind, ...), maritime (tidal,..)
- No particular importance of hydrogen
 - System sufficiently flexible by itself
 - Liquid fuels from coal

25 years of H₂ ...



2nd Phase

- Search for sustainability based on
 - Renewables: solar energy in hot geographic regions
 - Large scale underground coal gasification
 - Geothermic sources
- Hydrogen as medium for storage and transport
 - Primary energy carrier: electricity (PV, ThDyCy)
 - Trans- and intercontinental hydrogen pipelines
 - “Hydrogen Economy”: H₂ as universal energy carrier, replacing widely electricity and conventional fuels

25 years of H₂ ...



3rd phase

- Impact of awareness of ecological problems
 - Trend to clean energy systems
 - “Hydrogen economy” is “clean energy economy”
- Hydrogen as clean energy carrier
 - First hydrogen car projects: Daimler B., DFVLR, BMW
 - Supported by first producers of H₂ on-board storage tanks
 - Mannesmann for metal hydrides
 - Messer Griesheim for liquid
 - H₂ related Research Institutes founded

25 years of H₂ ...



4th phase

- Relaxation Phase
 - Cheap oil available
 - Abundant natural gas imports
 - Anti-eco coalition of petrol companies
 - Unlikelihood of pure hydrogen economy
- Decrease of public H₂ funding in Germany
 - “Hydrogen is for far future”
 - “H₂ related problems are solved”
 - “Conservation (hibernation) of results obtained”

25 years of H₂ ...



5th phase

- **European-Canadian Initiative EQHHPP**
 - Merit of a few far-sighted people in the Brussels Administr.
 - Reality-near study on far distance energy transport by H₂
 - Demonstr. of various mobile and stationary energetic use
 - Cooperation of German and other EU companies concerned by energetic application of hydrogen, even in aviation
- **Big step in advance**
 - Important gain of German know-how in H₂ technology
 - Promotion of further projects (still in operation)
 - Bavarian Hydrogen Initiative WIBA
 - Hamburg Van Fleet
 - European Integrated Hydrogen Project EIHP

Wasserstoff-Führer Deutschland (Hydrogen Guide Germany)

Subscription at the DWV booth

Present



A German national strategy for hydrogen is missing!



Present



Trends

- Perception of the role of hydrogen is growing.
 - Rapid development of fuel cells is boosting the application of hydrogen technology.
 - Mobile and stationary applications are forthcoming.
 - Various prototype tests (producers and users)
 - Hydrogen is the most important fuel option for fuel cells.
- >> Important role of hydrogen in the fossil energy system

Mobile Applications

- Electric driven vehicles with a fuel cell as power source will need hydrogen as fuel.
- Hydrogen is a fuel for Internal Combustion Engines.
- Applications will take place in niche markets in the very near future.
- VES/TES tends to hydrogen as one of major future fuels.

Stationary Applications

- Fuel cells as combined heating & power (CHP) unit of different sizes will need hydrogen as fuel.
- In a first stage, the fuel option for CHPs will be natural gas transformed to hydrogen in a separate reformer unit.
- Implementation on a mid to long term scale is expected to begin in the next few years.

Present



Major Players

– Industry:

- Car manufacturers
- Fuel cell developers and producers
- Utilities and oil industry
- Heating system manufacturers and suppliers

Some of the companies are globally engaged.

- Various service companies demand for clean vehicles for their fleets, due to legislation.

Present



Social/Political Situation

- Society gets more and more open to technology, technology hostility is decreasing. Tendency to support H₂!
- Safety related acceptance of H₂: much better than expected
- Environmental organizations: a bundle of opinions !
- Political support:
 - Hydrogen is on its move to appear on the “radar screen” of the German political parties
 - financial (funding): federal decreasing and weak, but good in some states
 - goodwill commitments concerning vision and necessity: still weak
- State governments (BY, HH, BW) and the EC: much more committed than German federal government

A Vision of the Role of Hydrogen

- The energy supply will be based on
 - various sources (growing share of renewables)
 - various carriers, electricity and hydrogen being the main ones
- Energy conversion will be minimized, e.g.
 - Electricity will be used as electricity wherever possible.
 - Hydrogen from biomass will be used as a fuel, if there is demand for fuel.
- Hydrogen as a buffer will assure the flexibility of the system, due to its ability to provide storage and transportation.
- Hydrogen facilitates decentralized power and fuel supply.
- Hydrogen will be traded and utilized world-wide, as one of various energy carriers.
- A pure “Hydrogen Economy” will not develop.

Implementation of H₂ to Market

- Accelerated by fuel cell development (mobile and stationary), primarily based on fossil fuels (mainly natural gas)
- Favoured by niche markets, necessary before approaching a large scale utilization, e.g.:
 - Mobile: fleet operators, like public transit, delivery services, taxis
 - Stationary: island systems, weak grid areas

Measures to accelerate the process (1)

Political

- Clear proactive statements (vision) are required because the early market needs political support.
- Financial support (funding, tax incentives,...) and social-political commitments are mandatory.
- Clear and reliable legal framework for environmental issues (e.g. traffic restrictions in inner cities) will enhance new applications and lower investment risks.
- Investors, producers and users need encouragement !

Measures to accelerate the process (2)

Economical

R&D as well as projects for demonstration and gain of experience under technical and cost aspects are necessary in the areas:

- refuelling infrastructure
 - electrolysis
 - small scale steam reforming
 - dispenser
- on-board storage

Future



Measures to accelerate the process (3)

Social

- Society needs a constant process of information to maintain and further increase the acceptance.
- The public is aware of environmental problems
- **But:** Only a few people are willing to pay extra money for environmentally beneficial technologies.
- Legislation should create incentives.

Measures to accelerate the process (4)

- Technical Development
 - Infrastructure and hydrogen end-use technologies (like fuel cells, cars)
 - Cost reduction
 - Improvement of reliability and availability
 - Standards and safety codes
 - Standardize codes and safety issues

Future



Special Contribution of Germany

- Experience and competence in H₂ technologies
- The economy is in the position to subsidize the introduction of new technologies
- The society becomes aware of weaknesses of the present energy system and demands a (smooth) change
- Good basis to push the implementation of H₂ technologies in Germany, and abroad in co-operation with international partners
- Pay-back of Hydrogen investments: Hydrogen technologies and systems (including fuel cells) are a huge market and offer new business opportunities.

Conclusion



- FCs as efficient energy transformers will enter the market soon.
- FCs require reliable hydrogen related technologies.
- In a future energy system dominated by renewable energies H₂ will be an important energy carrier.
- Hydrogen technologies for FCs will serve as footstep for the renewables.
- Renewable energies have to be developed with more emphasis.
- Germany is fairly well prepared to follow this development and to cooperate with other countries.
- **But: Acceleration of the development by political support is considered mandatory, in order to take advantage of it as early as possible.**