Energy concepts for GW scale hydrogen production

Dr. Klaus Bonhoff | Managing Director, NOW GmbH
Deep-dive Workshop Innovation Challenge | Berlin | October 17th, 2018
Implementation of the Paris Climate Agreement – CO₂ reduction in all sectors

- Energy (Target: -92.5%)
- Industry (Target: -92.5%)
- Homes (Target: -92.5%)
- Transport (Target: -92.5%)
- Agriculture (Target: -60%)

Programs for decarbonisation of transport – Task and programs of the NOW GmbH

Battery Electric Mobility
- Research and Development
- Communal mobility concepts
- Vehicle procurement

Federal Programme Charging Infrastructure
- Nationwide buildup
- Normal charging
- Fast charging

Mobility and Fuels Strategy
- Alternative fuels (efficient, emission-free)
- LNG as a marine fuel
- Pilot projects

National Innovation-Programme Hydrogen and Fuel Cell Technology
- Research and Development
- Market activation

Export Initiative Environmental Technology
- German-Japanese cooperation PtG
- H2/FC technology in developing countries (cooperation with GIZ)

Coordination
Implementation
Strategy
Networking
Visibility

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Establishing a hydrogen and fuel cell market – The NIP II (2016 – 2026)

**MEASURES OF R&D AND INNOVATION**
- Road transport
- Aviation
- Rail transport
- Shipping
- Logistics and special applications
- Electricity-based Fuels ($H_2$-production)

**MEASURES OF MARKET ACTIVATION**
- Vehicles (road, rail, water) and aircraft with fuel cell drives/engines
- Electrolysis installations if operated with renewable power
- Special vehicles in logistics equipped with fuel cells and $H_2$ refuelling stations
- Fuel cell cogeneration installations for on-board power supply on ships, vehicles and aircrafts
- Fuel cell based independent power supply for critical or off-grid infrastructures

**Funding guideline; open call**
- € 250 million
- 2017 - 2019

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Integrated energy system – Renewable, flexible and connected across all sectors

Renewable Energies

Power-to-liquid

Smart grids

Base load

Integrated energy system

Trade and industry

Domestic energy

Logistic and mobility

Off-grid supply

Storage

Power grid

Gas grid

Electricity

Hydrogen

Fuel Cells

Gas

Heating

Vapour

Cooling

Power-to-liquid

Fire safety

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Integrated energy system – PtX-technology enables flexibility

Potentials for PtX-technologies:

- Substitution of fossil energy carriers
- Decarbonizes end use applications
- Enables the increase of renewables in the energy system
- Creates new jobs
- Fits to different

Electricity procurement options

- **Electricity market**
  - High burden on procurement by tariffs and fees

- **System services**
- **Power curtailment**
  - Limited utilization options

**Power-to-Gas facilities**
Industrialization with potential of cost reduction and efficiency optimization

**Creation of goods**
Low revenue possibilities for PtG products

- **Products for heat sector**
- **Products for transport sector**
- **Products for industry sector**
- **Products for electricity sector**

Power-to-Gas roadmap, Deutsche Energie-Agentur GmbH (dena), Nov. 2017
Integrated energy system –
Water electrolysis as key technology

- Emission-free production of hydrogen with water electrolysis technology
- Hydrogen as feedstock for the production of synthetic fuels (i.e. Kerosene, syn. Diesel)
Industrialization water electrolysis – Development of installed water electrolysis capacity

Feasible market development in Germany [MW/a]

Program for market activation for projectable capital investments

Market activation for cost reduction

Established supply market

Development to GW industry

< 20 MW/a additions
< 100 MW installed

250-500 MW/a additions
1- 2 GW installed

1-5 GW/a additions
> 10 GW installed

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Hydrogen as energy carrier – GW scale needed for the demand of all sectors

Hydrogen has significant potential across energy and industry sectors.
Hydrogen as energy carrier – Demand in the transportation sector

Renewable hydrogen production – National perspective

Potential of PtX for energy transition by facilitating implementation of RE

- Long term storage needed and possible (salt caverns)
- Grid expansion very demanding, highly developed gas grid available

System size is depending on boundary conditions

- Development of regional concepts in small scale
- Large scale plants for chemical industry and power based fuels
Renewable hydrogen production – Global perspective

- Due to location boundaries, Germany will have the demand for energy import.
- High potentials for RE offer the opportunity for green PtX with competitive prizes.
- Enable regions to be self-sufficient in energy and potentially chemical feedstocks.
- Global transport infrastructure.
- PtX offers the opportunity of versatile, scalable, intelligent and flexible system integration with high shares of RE.

Renewable hydrogen production – Challenges for a GW scale production

Central challenges are:

• Production capacities for water electrolysis systems on the GW scale
• Integration of large scale hydrogen production in existing energy systems
• Identification of suitable energy carriers for a global renewable energy market
• Establishing a global market for green hydrogen and other synthetic energy carriers
Renewable hydrogen production – Collaboration needed on a global scale

- Fuel Cell Technology Office (FCTO) of the DoE
- California Fuel Cell Partnership (CaFCP), California Air Resources Board (CARB)
- GSG, STF, committee
- FCH JU
- Ger.-fra. AG E-Mobility
- NEDO & METI
  - Bilateral PtG-Project
- CATARC & MOST
- SGEC & 5 bilateral Projects: (MetropoLIS, Networked Mobility, RCS Cooperation, DeH2MLeak, CHIG)
- GSG, STF, committee
- FCH JU
- Ger.-fra. AG E-Mobility
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Thank you!

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