ECN

Energy research Centre of the Netherlands

Hydrogen: missing link for a sustainable energy system

Marcel Weeda, ECN Policy Studies

Energy Storage 2012, Luxembourg, 29 Feb - 1 March 2012

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International Energy Agency


Germany


Australia


Austria


Belgium


Canada


Korea


Denmark


Spain


United States


Finland


EC


France


Greece


Netherlands


Hungary


Ireland


Italy


Japan

Autonomous body within the Organization of Economic Cooperation and Development (OECD), founded in 1974 to carry out energy cooperation among member countries.


Luxembourg


Norway


New Zealand


Portugal


United Kingdom


Czech Republic


Sweden


Switzerland


Turkey

IEA Hydrogen Implementing Agreement

- A collaborative research and development (RD&D) program, created in 1977 on a task-shared, "bottom-up" basis

Strategic Framework: 2009 - 2015

- **Vision:**

A hydrogen future based on a clean sustainable energy supply of global proportions that plays a key role in all sectors of the economy

- **Mission:**

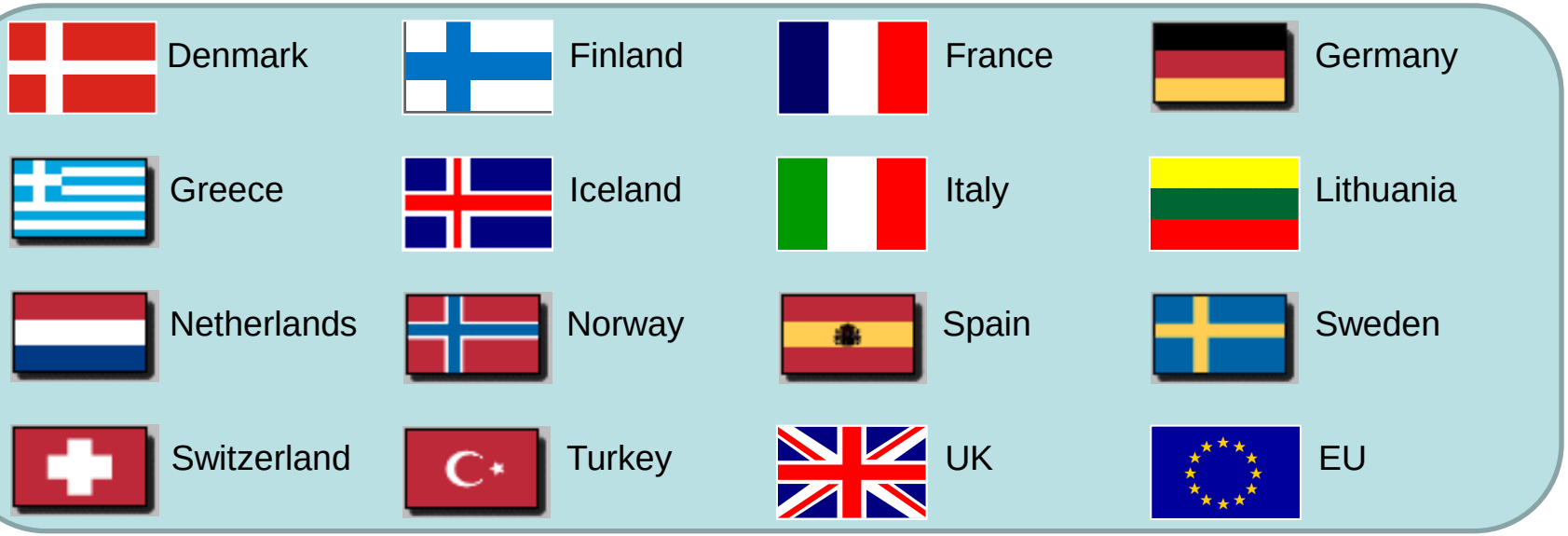
To accelerate hydrogen implementation and widespread utilization to optimize environmental protection, improve energy security and promote economic development internationally, while establishing the HIA as a premier global resource for expertise in hydrogen

- **Strategy:**

To facilitate, coordinate and maintain innovative research, development and demonstration (RD&D) activities through international cooperation and information exchange

IEA HIA Members

- 23 Contracting Partners



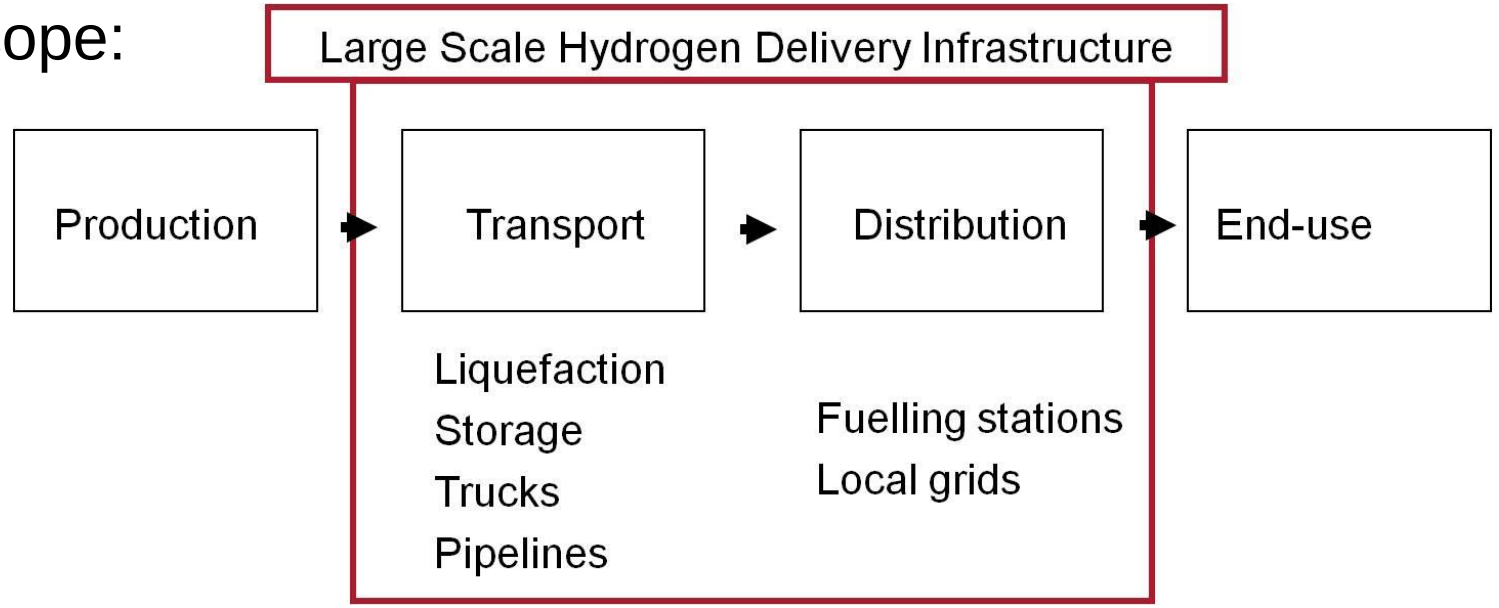
IEA HIA Research & Analysis

- Current Task Portfolio

21. BioHydrogen - II
22. Fundamental & Applied H_2 Storage Materials Development
23. Small-Scale Reformers for On-Site H_2 Supply
24. Wind Energy and H_2 Integration
25. High Temperature Processes for H_2 Production
26. Advanced Materials for H_2 from Waterphotolysis
27. Near-Market Routes to H_2 by co-utilization of biomass with fossil fuel
28. Large Scale Hydrogen Delivery Infrastructure
29. Distributed and Community H_2
30. Global Hydrogen Systems Analysis
31. Hydrogen Safety

IEA HIA Task 28

- Scope:



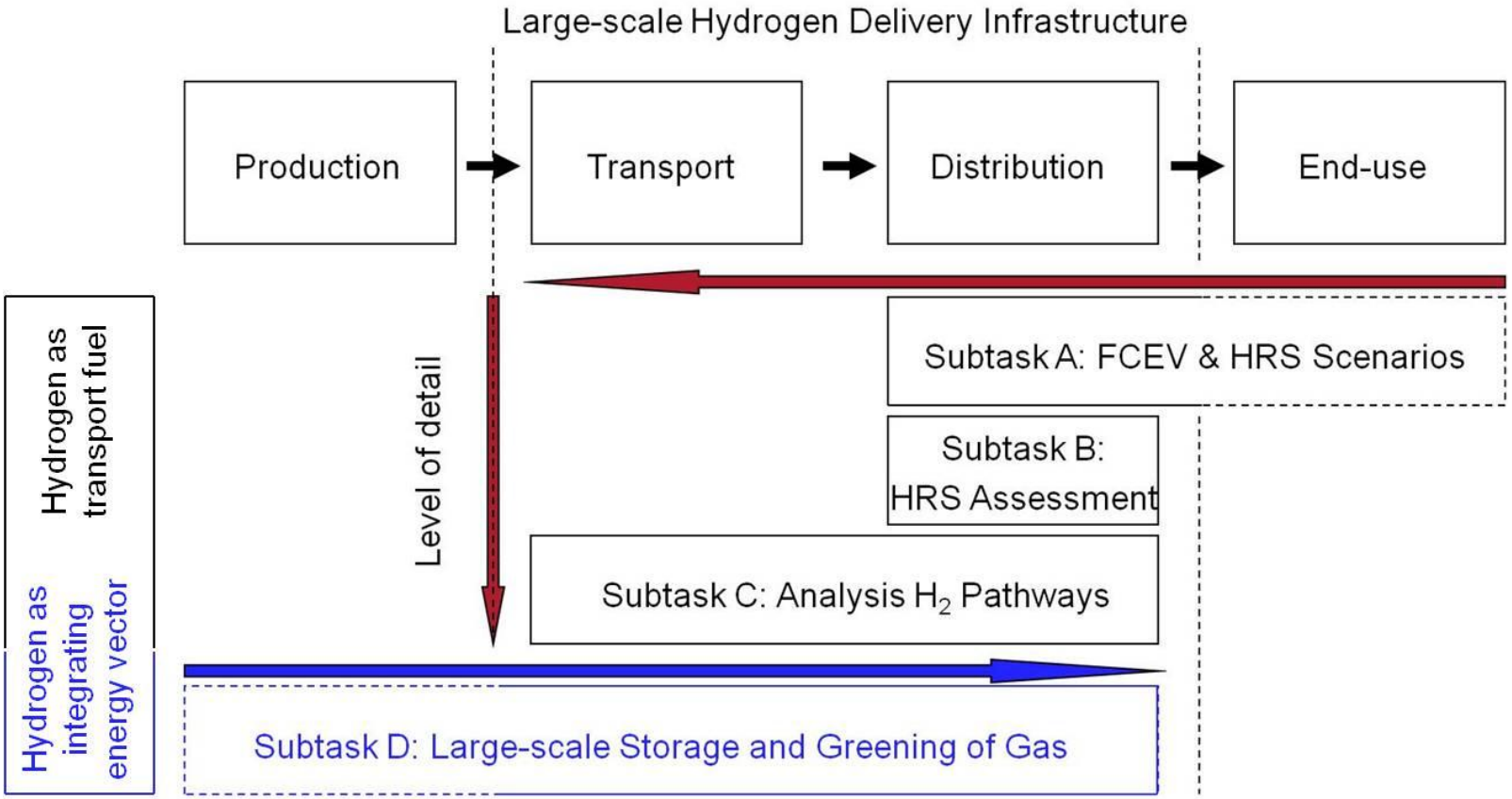
- Mass market applications: cars, busses, light duty trucks
- Infra needed beyond current demonstration phase
- Scenarios with large scale intermittent sources; storage of hydrogen and greening of natural gas

IEA HIA Task 28

- Objectives
  - Improve understanding of infrastructure needed to deliver projected hydrogen demands by sharing latest information, experiences/insights and lessons learned
  - Develop a common state-of-the-art knowledge base on concepts and components for delivery of hydrogen
  - Improve understanding of available tools for modeling and analysis of hydrogen delivery infrastructure (rollout) using case studies; approach, assumptions, …
  - Identify knowledge gaps regarding components and concepts for hydrogen delivery and delivery infrastructure deployment strategies

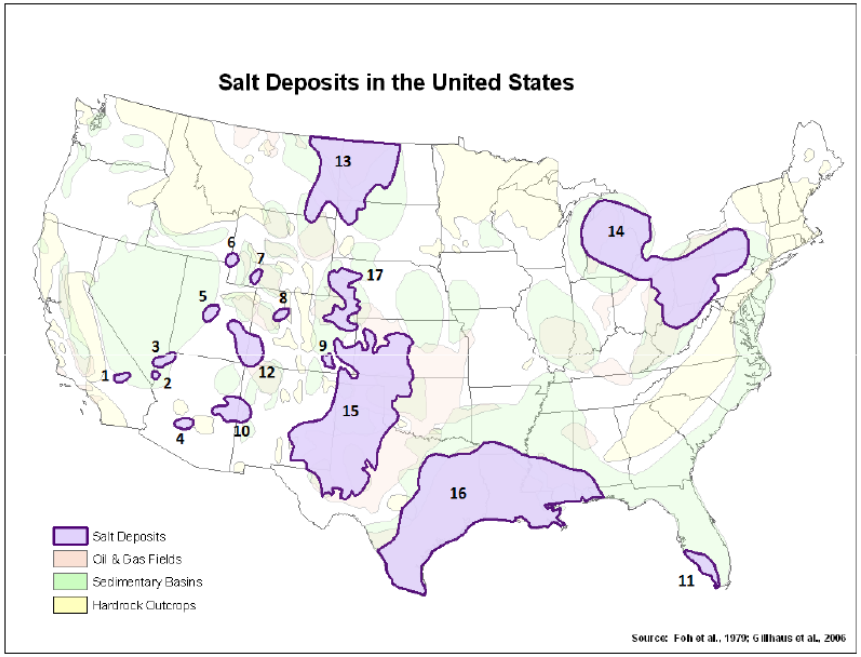
IEA HIA Task 28

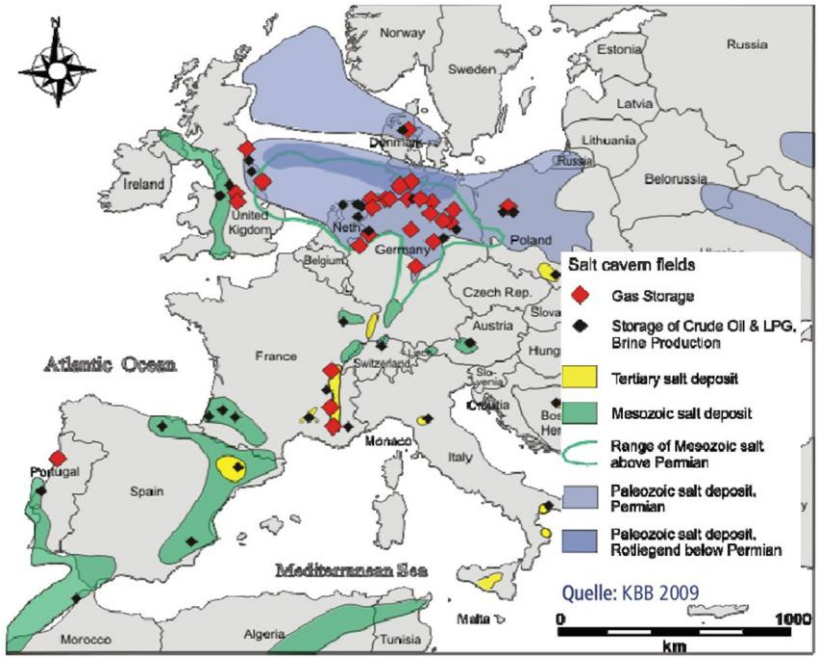
- Task structure



IEA HIA Task 28 Subtask D: Large-scale Storage and Greening gas

- Map studies, demo's and initiatives about use of H_2 for buffering energy from intermittent sources and mixing of H_2 into the natural gas grid
- Evaluate data and results
- Identify knowledge gaps/research questions



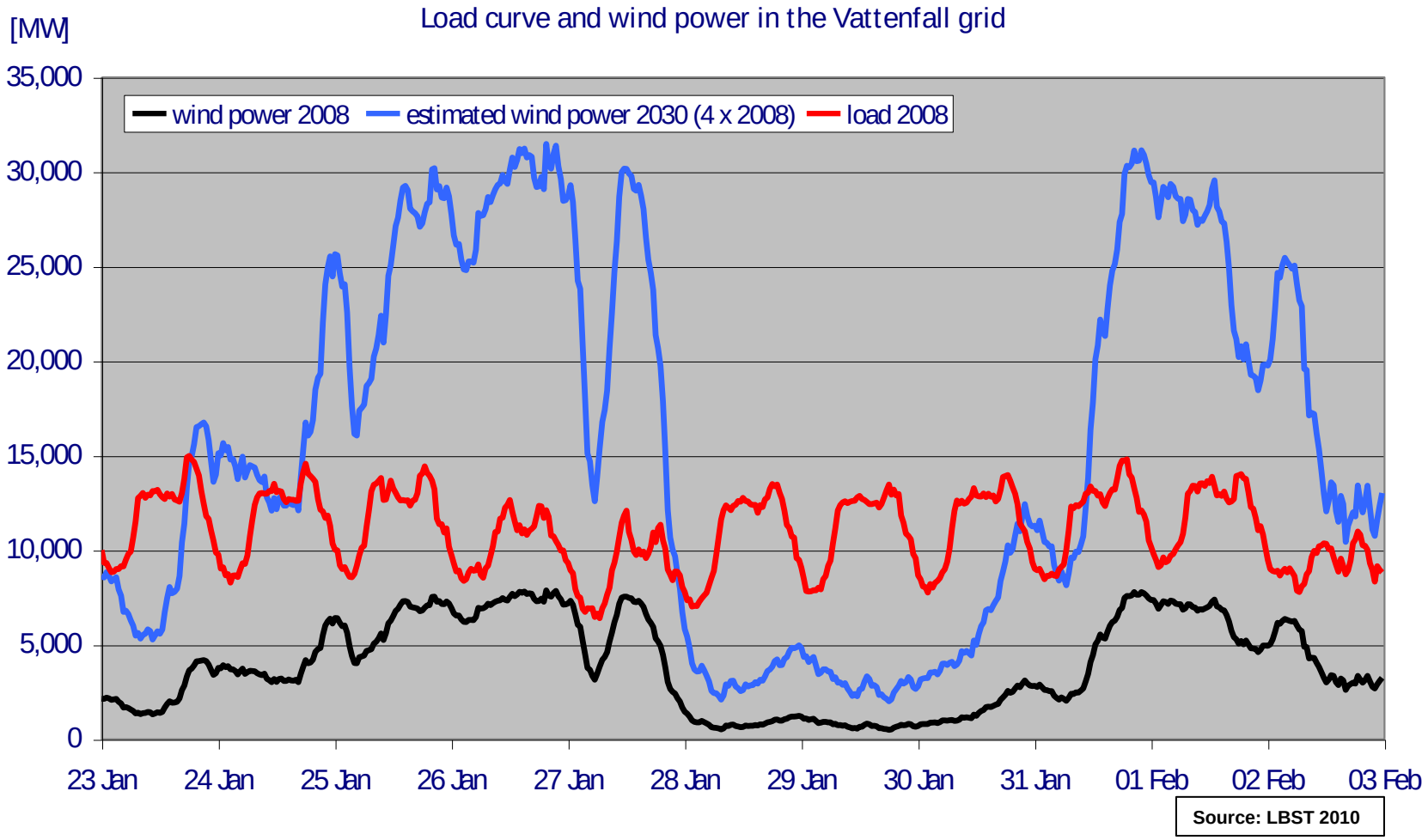


Energy challenges

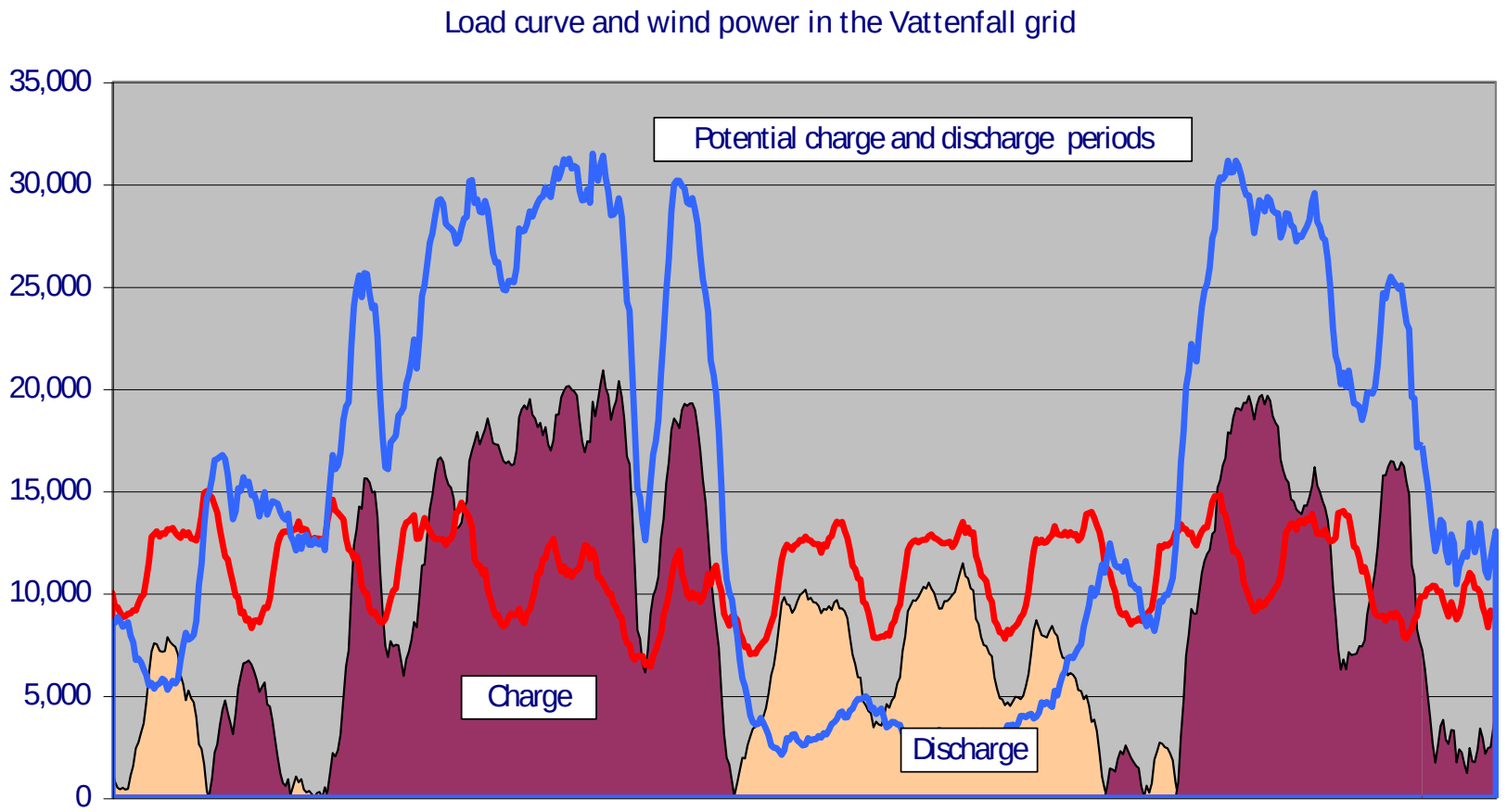
- Securing future energy supply
  - Reduce dependence on imports
  - Anticipate resource depletion
- Reducing air pollution
  - NO_X; CO; SO_2; VOC; $PM_{10\,/\,2.5}$
- Reducing greenhouse gas emissions
  - -20% in 2020
  - -80% in 2050
  - All sectors: power, industry, transport, …

- Tool box:
  - Energy saving
  - Wind
  - Solar
  - Biomass
  - Hydro
  - Tidal & wave
  - Geothermal
  - Fossil/CCS
  - Nuclear
  - Fusion

Challenge: integration variable RES

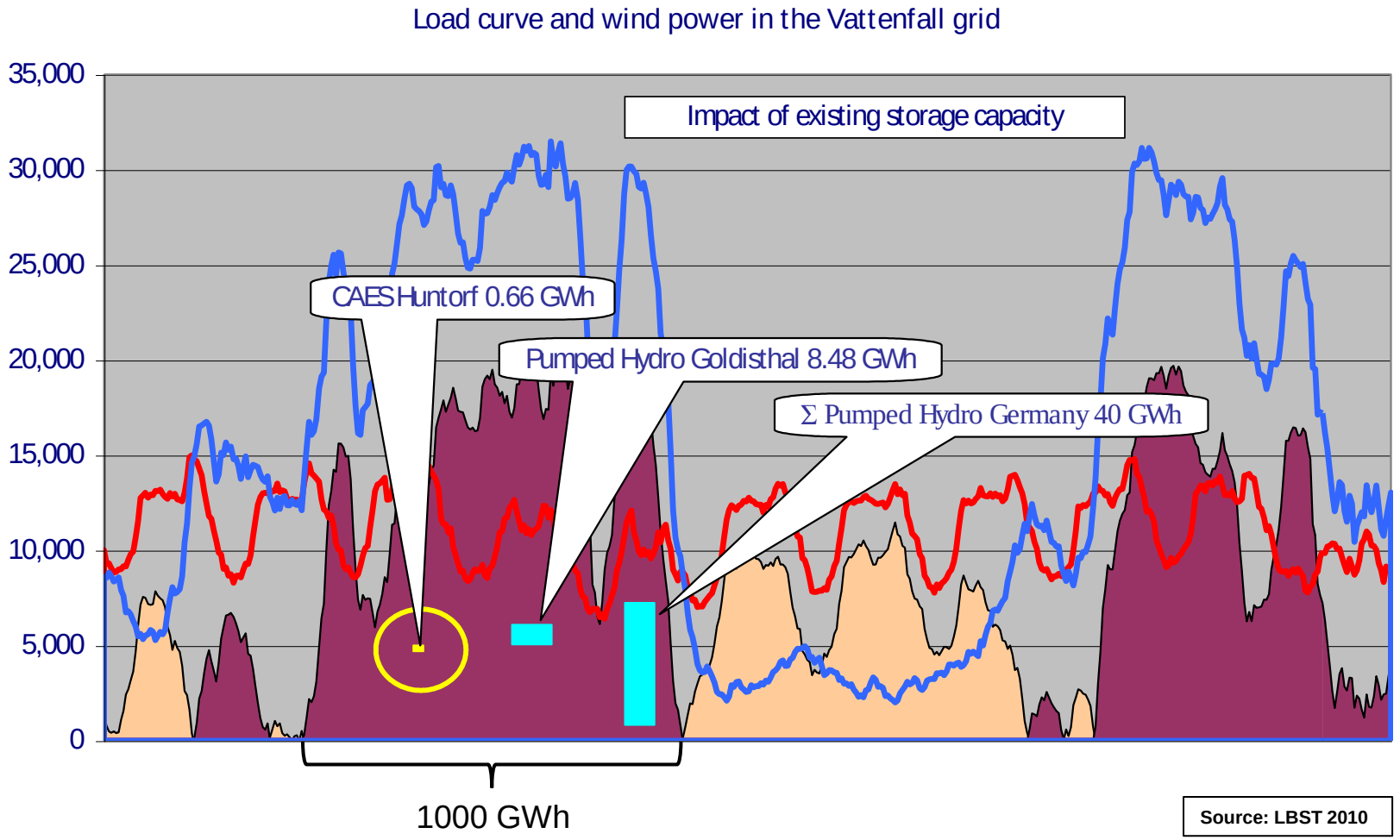


Challenge: integration variable RES

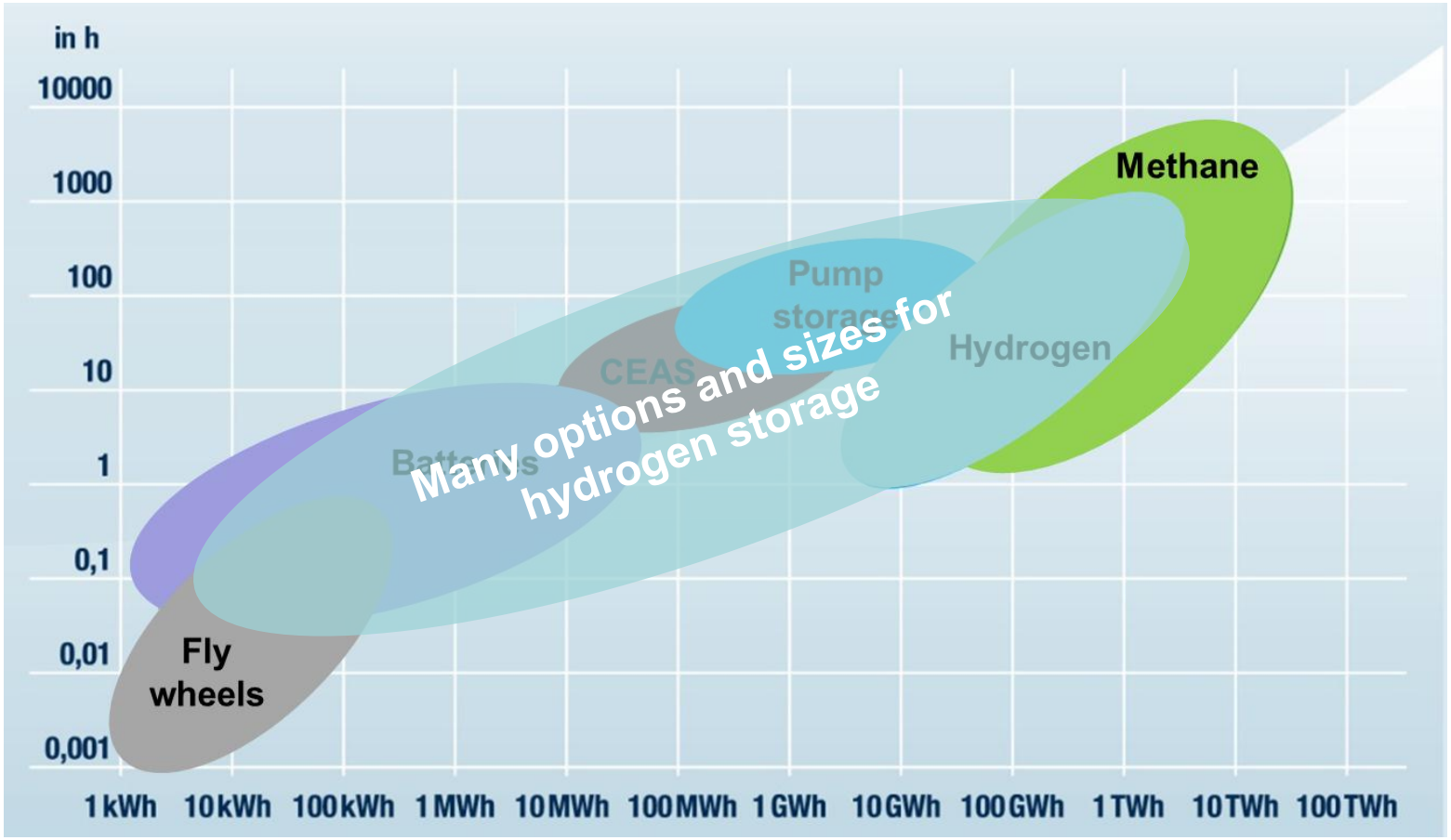


Source: LBST 2010

Challenge: integration variable RES

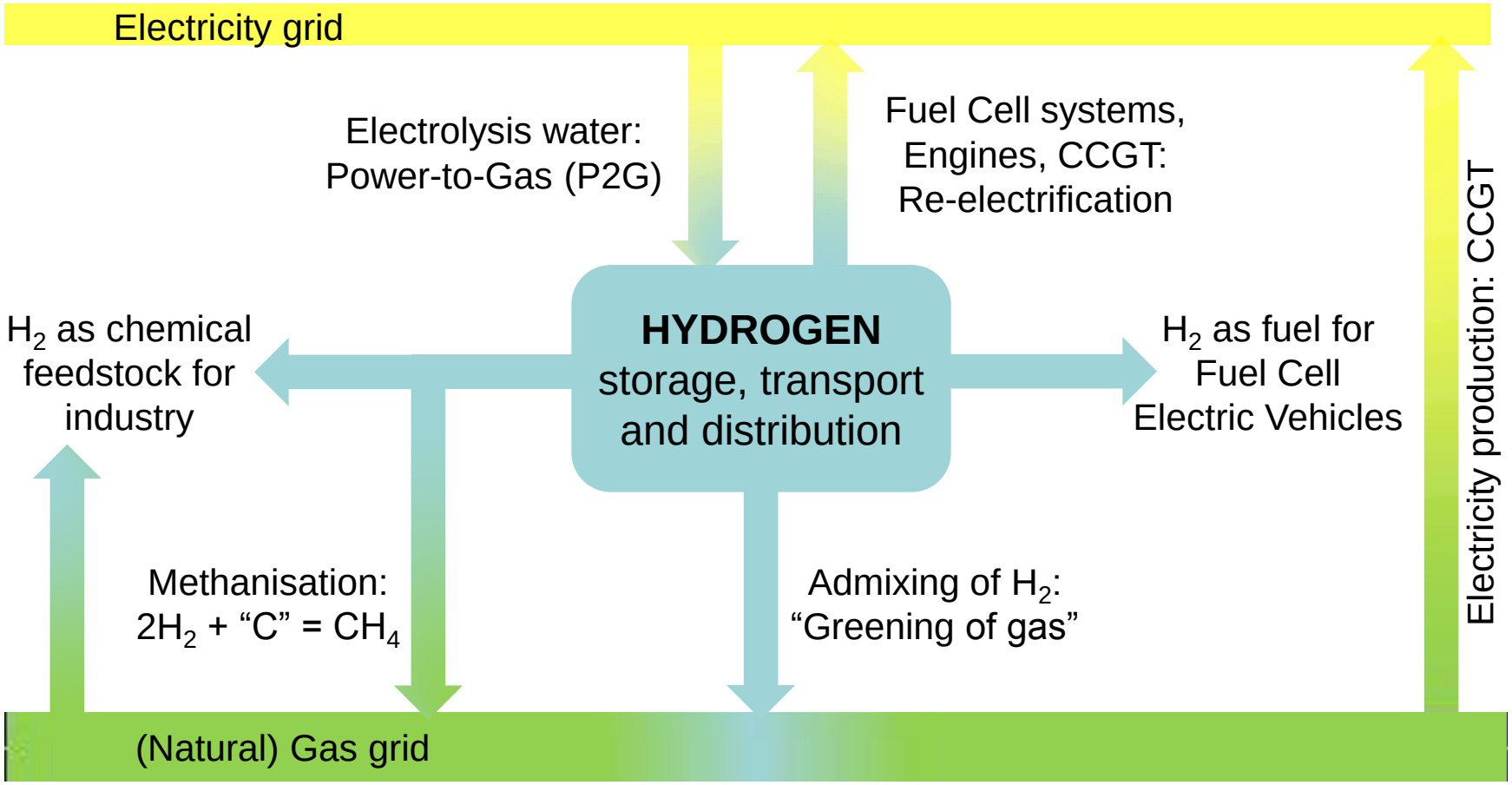


Energy storage technologies



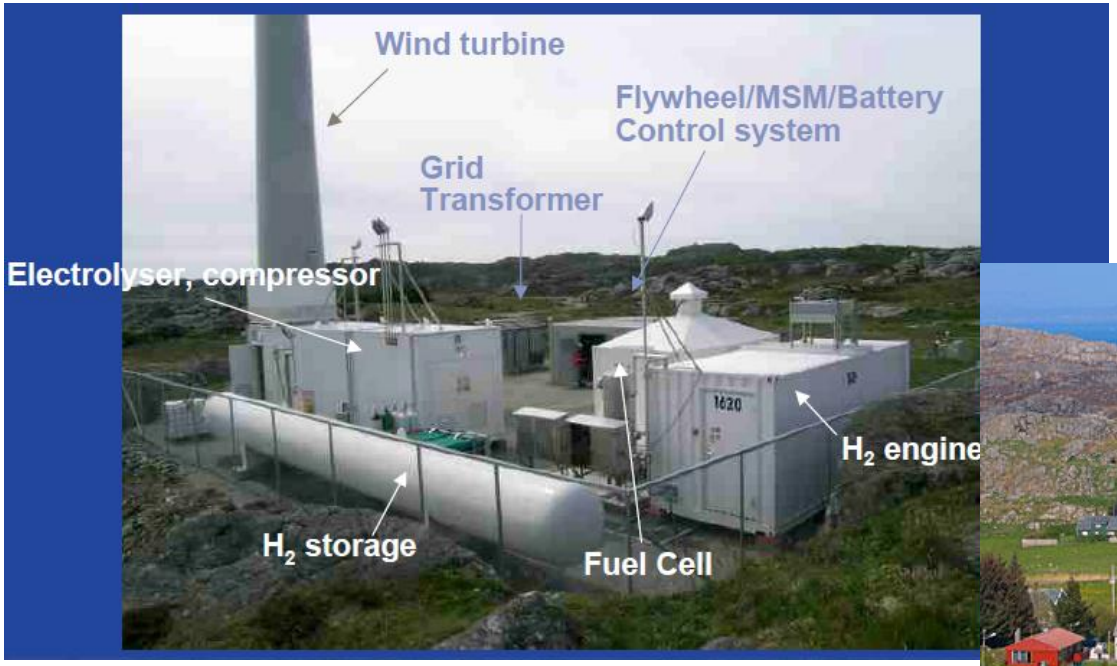
Source: Deutscher Verein des Gas- und Wasserfaches (DVWG), Mit Gas-Innovationen in die Zukunft!, 2011

Vision hydrogen: integrated energy system



Large scale and small scale solution

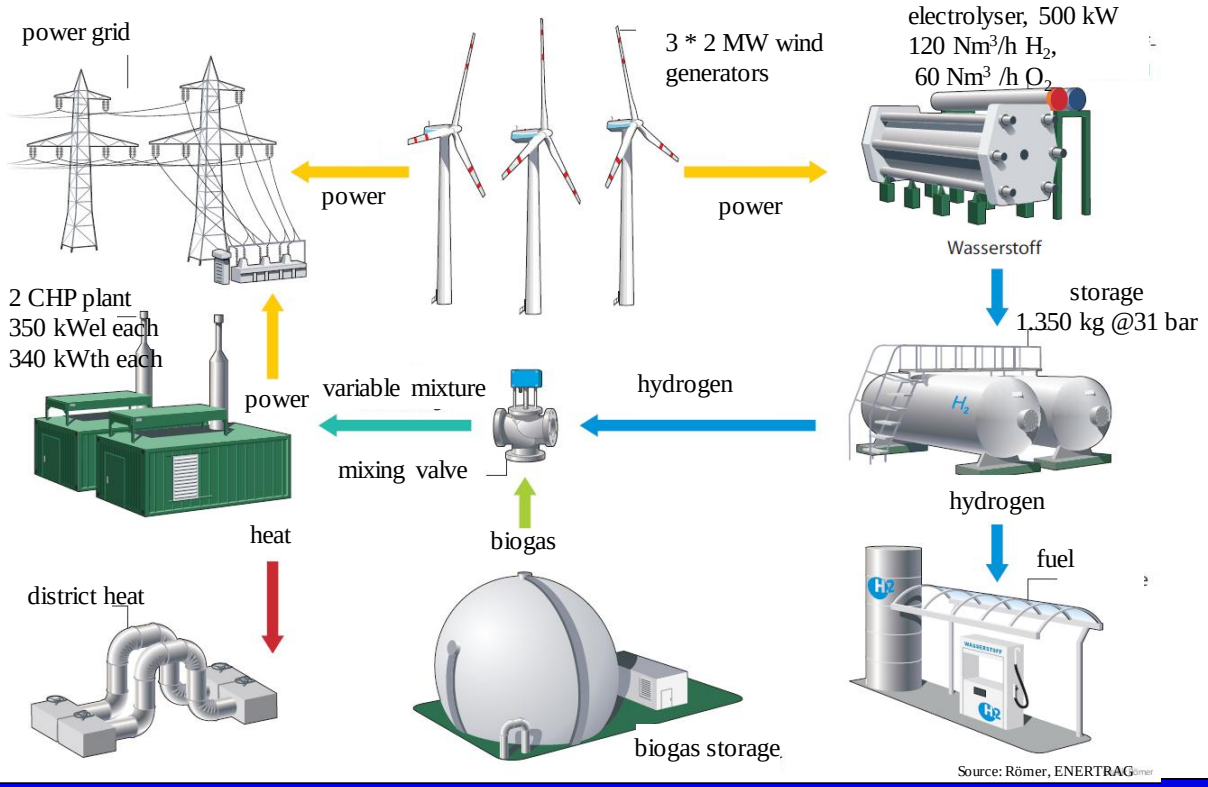
- Integration RES in remote (rural, islands) energy systems (Task 29)
- Virtual hydrogen plants; local grids and filling stations



Òne of many examples: Utsira Hydrogen project

Performing Energy Alliance for H_2 from Wind

- Vattenfall, Enertrag, Total and Siemens
- Hybrid power plant in Prenzlau – start of production 2011

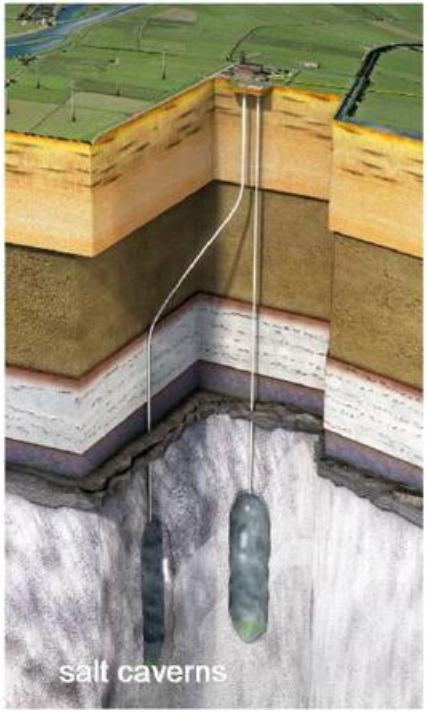


EU project hydrogen storage

- **HyUnder**: Assessment of the potential, actors, and relevant business cases for large scale storage of renewable electricity by hydrogen underground storage in Europe
- 2 year project starting June 2012
- Project consortium:

ludwig bölkow systemtechnik · Hinicio · ECN · e·on Gas Storage · KBB UNDERGROUND TECHNOLOGIES · cenex · National Center for Hydrogen & Fuel Cells Romania · Ha FOUNDATION FOR THE DEVELOPMENT OF NEW HYDROGEN TECHNOLOGIES IN ARAGON · SOLVAY · Shell · DEEP.

- Wide range of supporting partners



Take away messages

- **Hydrogen one of only two zero-emission energy carriers**
- **Hydrogen and electricity are compatible**:
  - P2G: Electrolysis
  - G2P: Fuel cells, GT, engine
- **Hydrogen and electricity are complementary energy carriers:**
  - Major RES options are power producing options
  - Hydrogen is a gas: easy to transport and easy to store
  - Hydrogen turns “non-controllable” RES into dispatchable reserves
- **Hydrogen - fuel for transitions:**
  - At present, produced from hydrocarbons
  - Fits in CCS scheme: decarbonise hydrocarbons
  - Fully sustainable on the basis of water and renewable energy
  - Support integration variable RES: electricity, but also fuel and feedstock

International Energy Agency Hydrogen Implementing Agreement

... A premier global resource for technical expertise in hydrogen research, development and demonstrations

For more information about IEA HIA:

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Thank you very much !