



Government of
the Netherlands

The Netherlands Perspective on Clean Hydrogen

Fifth IEF-KAPSARC Thought Leaders' Roundtable Session III

28 February 2019

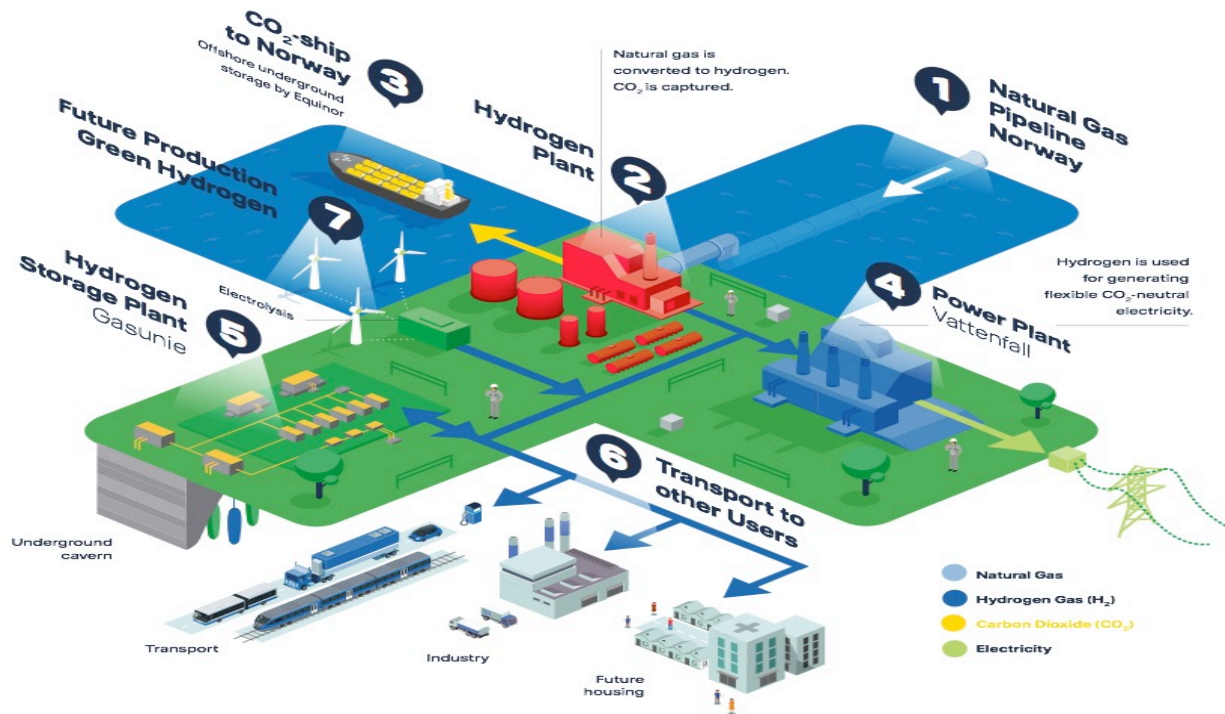
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The H2M project: Towards a clean and sustainable Dutch hydrogen economy

In order to live up to the ambitions of the Paris Climate Agreement, Vattenfall, Equinor and Gasunie have formed a consortium to explore the large-scale production and off-take of CO₂-neutral hydrogen in the Northern Netherlands and to establish a clean hydrogen value chain that paves the way for a sustainable hydrogen economy. This 'H2M'-project has the potential to reduce Dutch CO₂ emissions with 2 million tons per year from 2024 onwards.



Why hydrogen?

Hydrogen is reliable and clean, and its use is the most cost-effective way to decarbonize. It does not require new technology and can make use of existing infrastructure. It can be used to generate flexible CO₂-neutral electricity. And in addition, it can be used in many other applications such as transport and industry.

The Benefits of the H2M project

- CO₂-emission reduction of 2 million tons per year from 2024 onwards.
- Efficient and reliable energy system through the realisation of CO₂-free flexible power generation
- Enabler for hydrogen infrastructure and storage – realisation in time for green hydrogen

1 October 2018





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A POWER PLANT AS A SUPER-BATTERY

Vattenfall has the ambition to use gas-fired power plants as storage facilities for renewable energy and provide flexible CO₂-free electricity. The energy company aims to do so by producing hydrogen from renewable energy whenever there is a surplus. This hydrogen can be converted into ammonia as a carrier that is easy to store on a long-term basis. But the hydrogen can also be stored in underground caverns. Hydrogen can then be used as CO₂-free fuel in gas-fired power plants at times when there is a shortage of renewable energy.

Energy from wind and solar is not available on demand

Sometimes too much is produced...

The supply of wind and solar energy exceeds the electricity demand.

Now: The surplus is sold at low prices and consumed elsewhere.

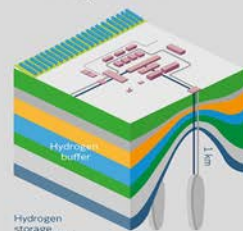
...while at other times there is a shortage

Electricity demand exceeds the production of renewable energy at that moment.

Now: Gas-fired power plants make up the deficit by producing electricity using natural gas.

In future, hydrogen is made from surplus renewable energy...

Option A: hydrogen is stored in underground caverns.



Electrolysis: split water into hydrogen and oxygen

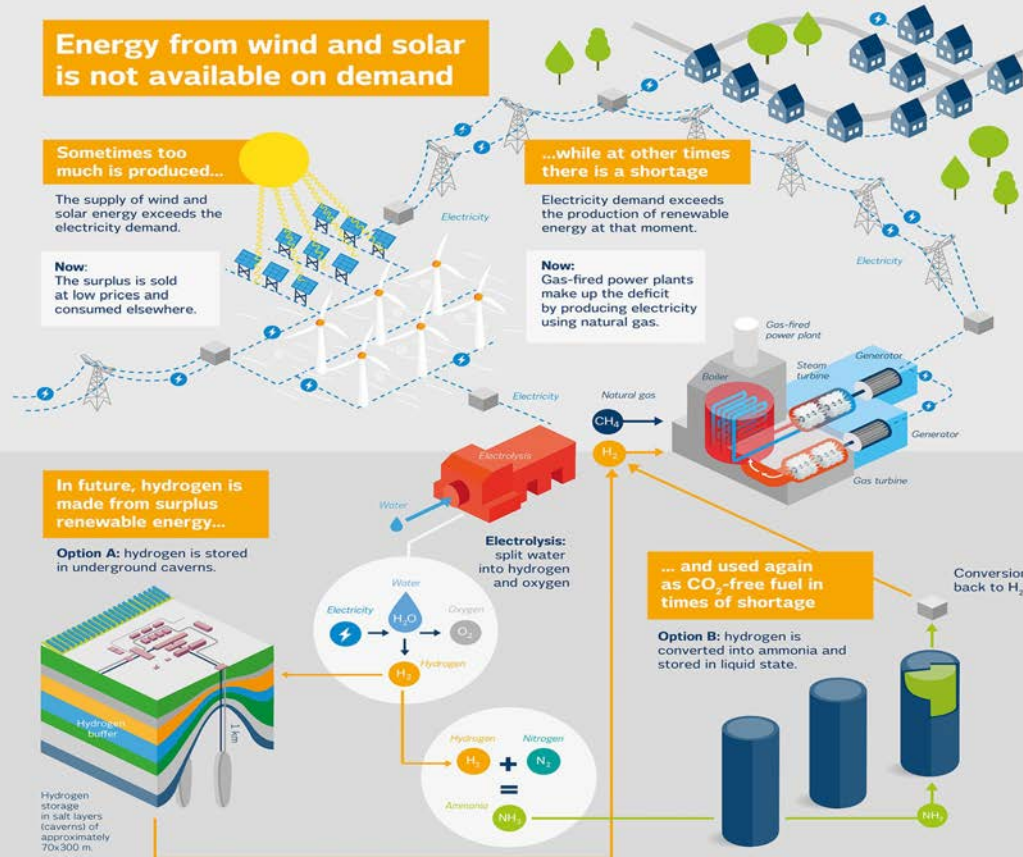


Hydrogen (H₂) + Nitrogen (N₂) = Ammonia (NH₃)

... and used again as CO₂-free fuel in times of shortage

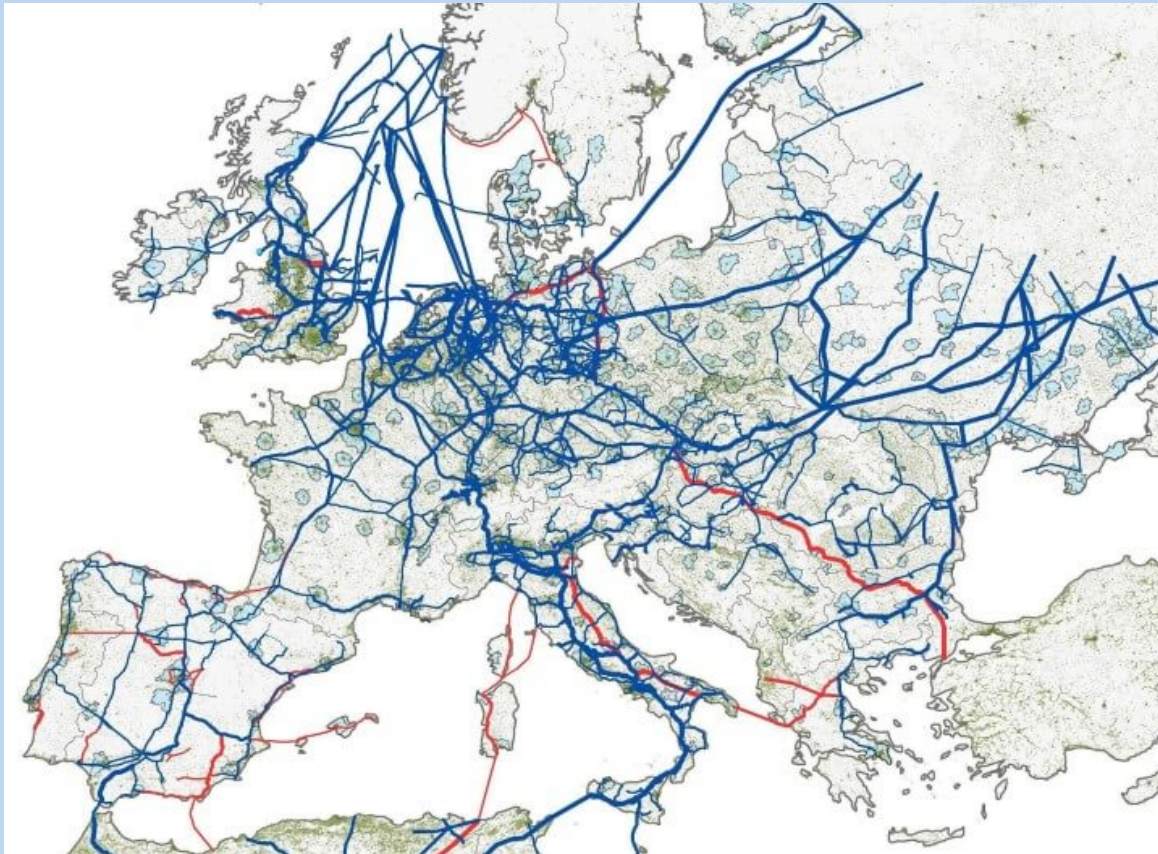
Option B: hydrogen is converted into ammonia and stored in liquid state.

Conversion back to H₂





European Gas Infrastructure





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European Hydrogen Infrastructure

- Unlock the offshore-onshore wind resources in North Europe
- Unlock the solar and wind resources in South Europe
- Unlock the solar and wind resources in Northern Africa

- Connect to large scale hydrogen storage, e.g. salt caverns

- Supply chemical, petrochemical and steel plants
- Supply electricity balancing plants
- Supply hydrogen fueling infrastructure
- Supply regional hydrogen distribution grids



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European Hydrogen Backbone

