ELEGANCy

Fast-tracking pathways to the hydrogen economy

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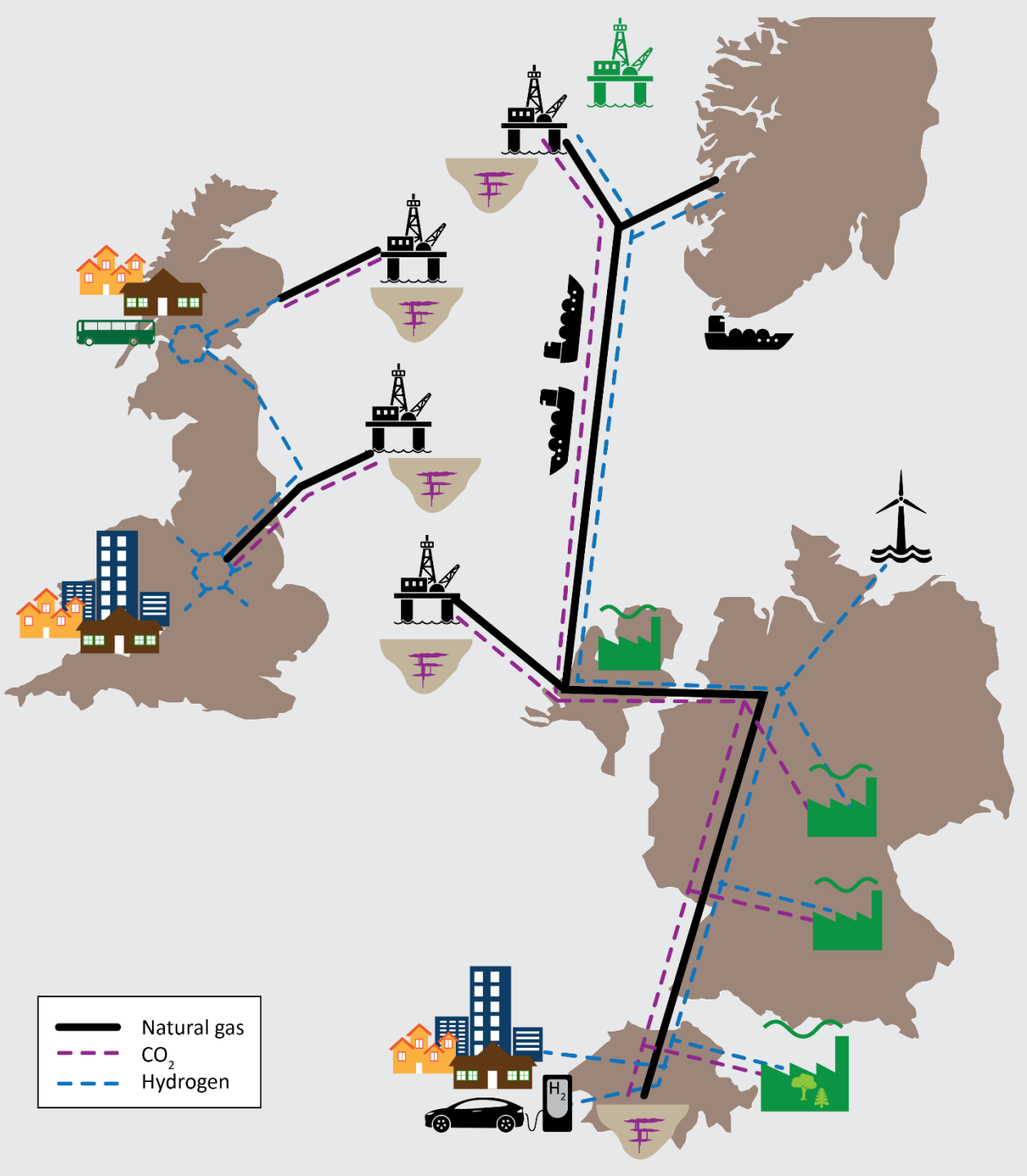
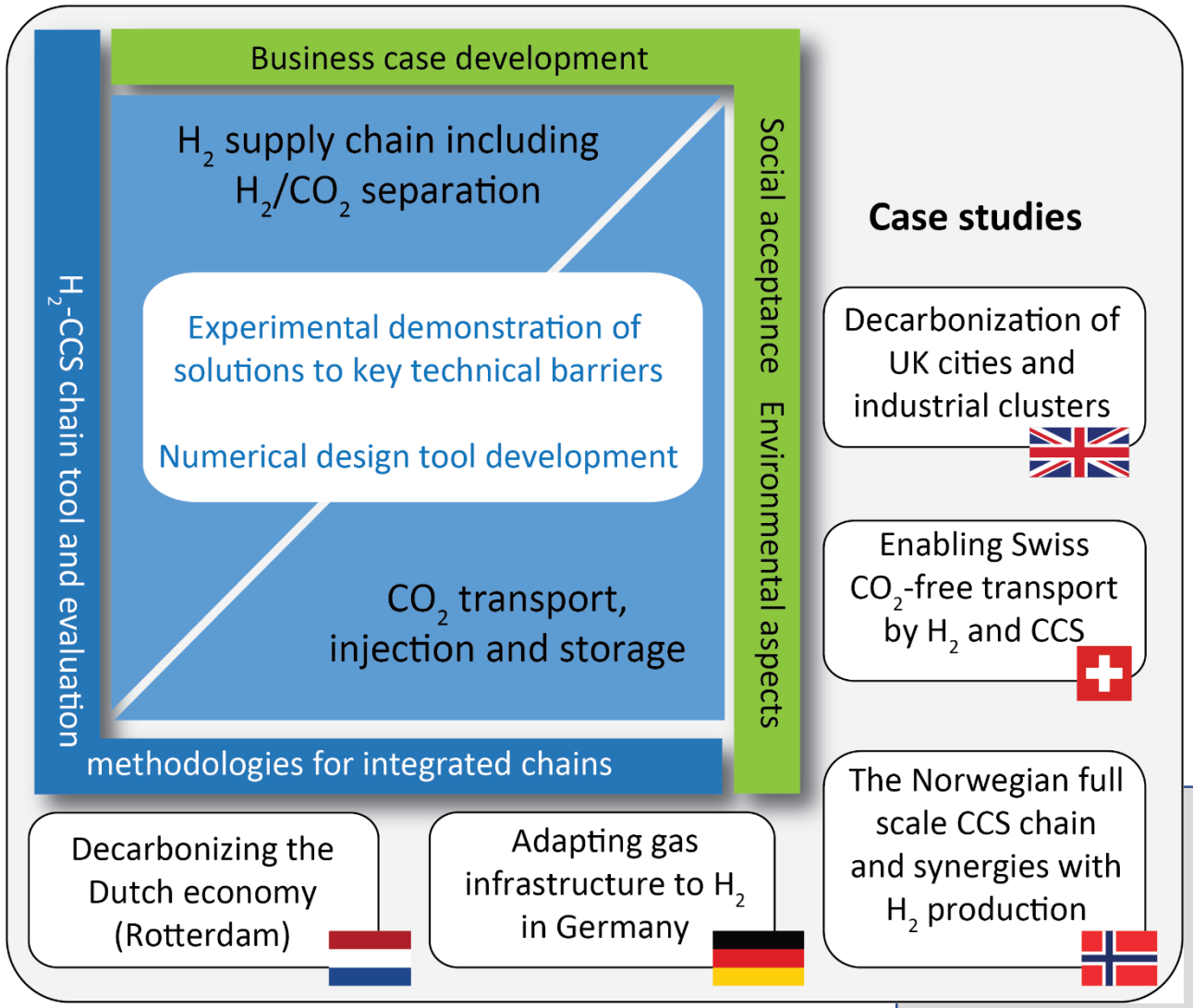
Accelerating CCS Technologies

The EU Framework Programme for Research and Innovation
HORIZON 2020



ELEGANCY – key information



British Geological Survey – Expert | Impartial | Innovative; Sustainable Decisions; Imperial College London; INEOS; Scottish Enterprise

ETH zürich; CLIMEWORKS; firstclimate; PAUL SCHERRER INSTITUT PSI

GERG – the european gas research group – Innovation for Europe's Energy Future

SWERIM

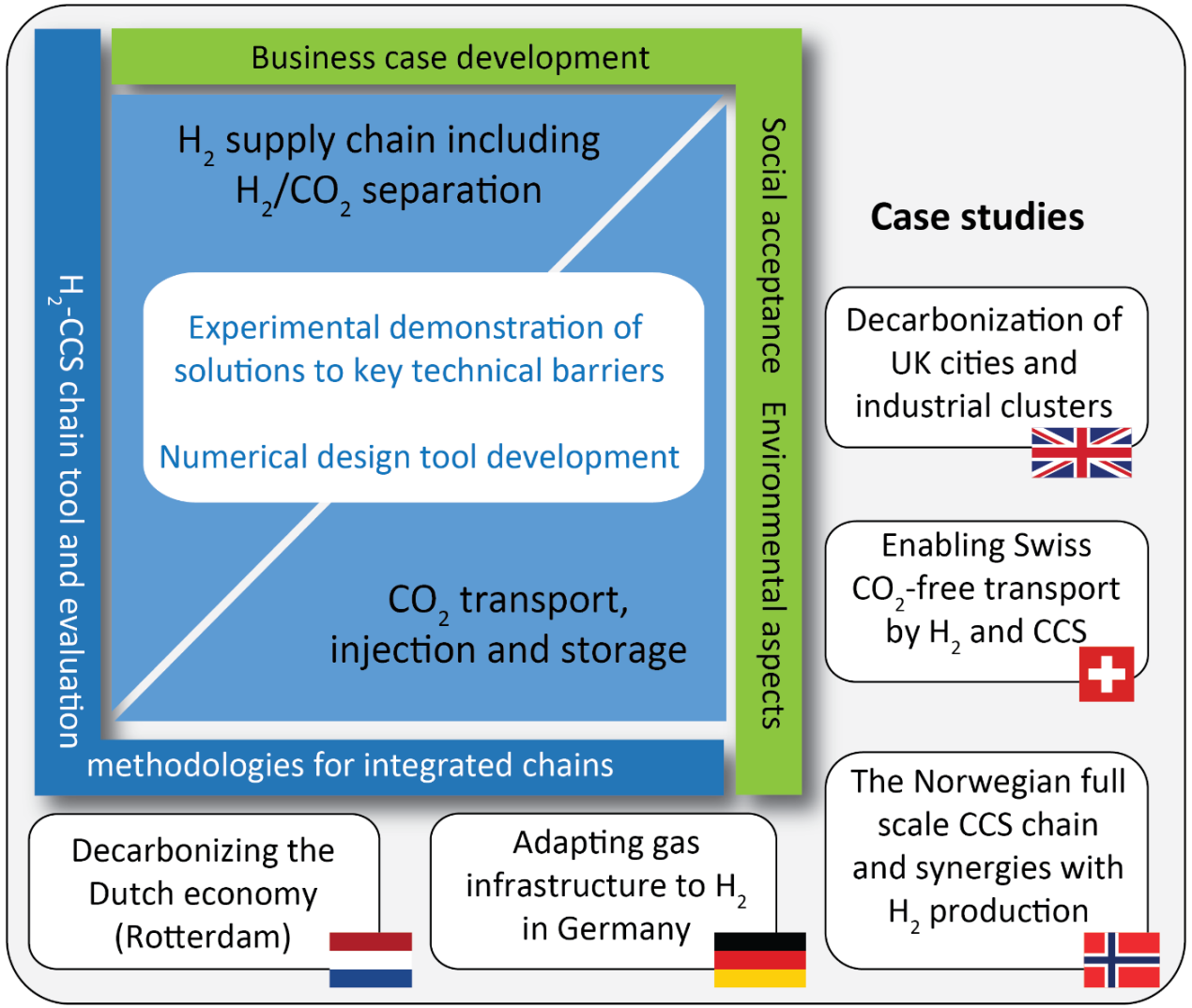
SINTEF; GASSCO; TOTAL; AkerSolutions; UiO: University of Oslo; equinor

ECN; TNO innovation for life

RUHR UNIVERSITÄT BOCHUM RUB; uniper; Open Grid Europe – The Gas Wheel

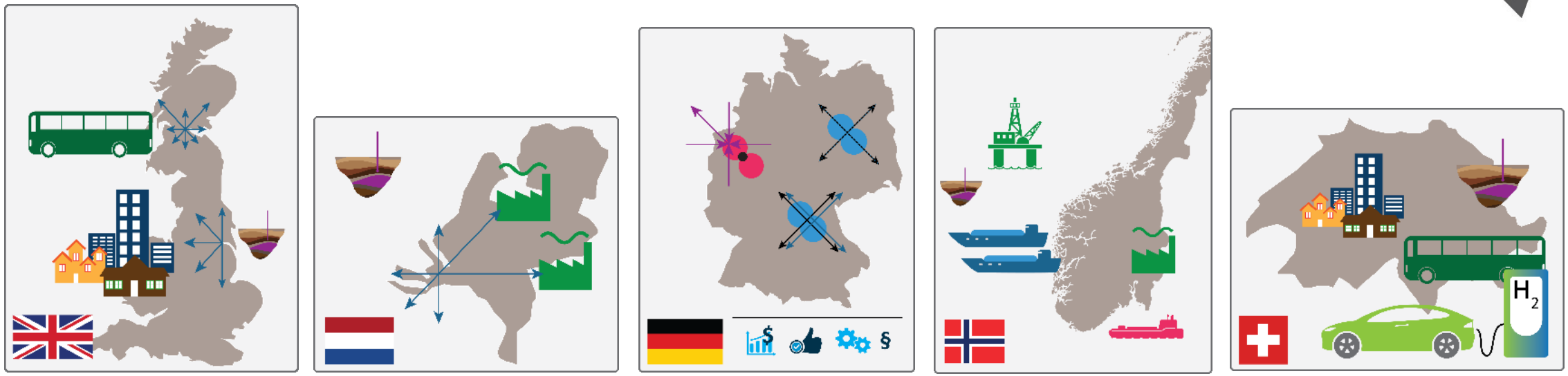
- **Duration: 2017-08-31 to 2020-08-31.**
- **Budget: 15 599 kEUR**

ELEGANCY – Enabling a low-carbon economy via H_2 and CCS



Publications and news:
www.elegancy.no

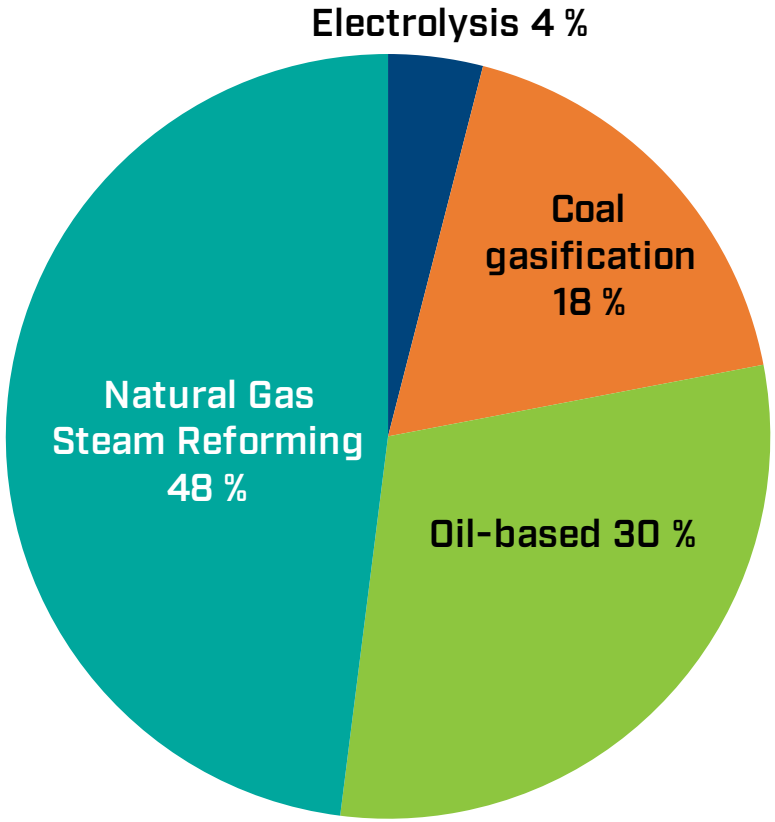
Yes, we can!



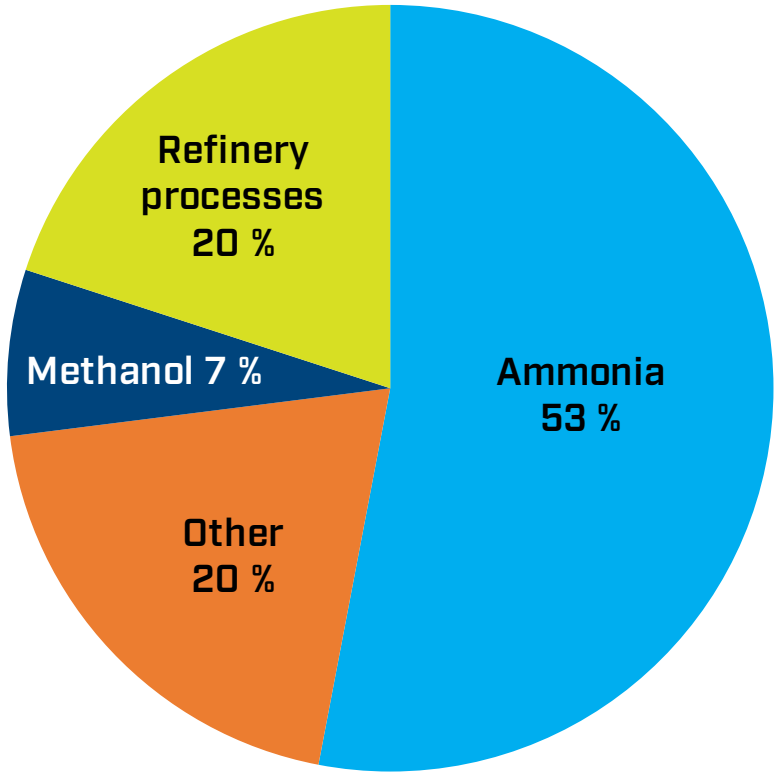
Conclusions:

- Hydrogen can be delivered at scale – fast-tracking the 2050 net-zero emission goal.
- Hydrogen produced from renewable energy and natural gas with CCS will be needed.
- CCS is an efficient and safe way to eliminate CO_2 emissions.
- The Hydrogen Pathway needs financial, regulatory and political frameworks.

Hydrogen by source and consumption



Source: International Journal of Hydrogen Energy, Voldsund et al.

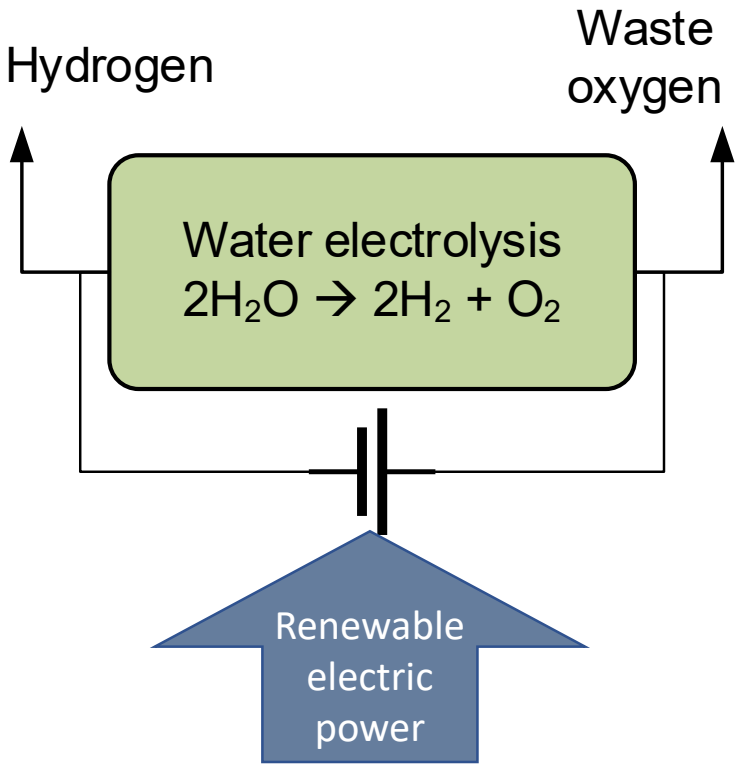


Source: The essential chemical industry - online

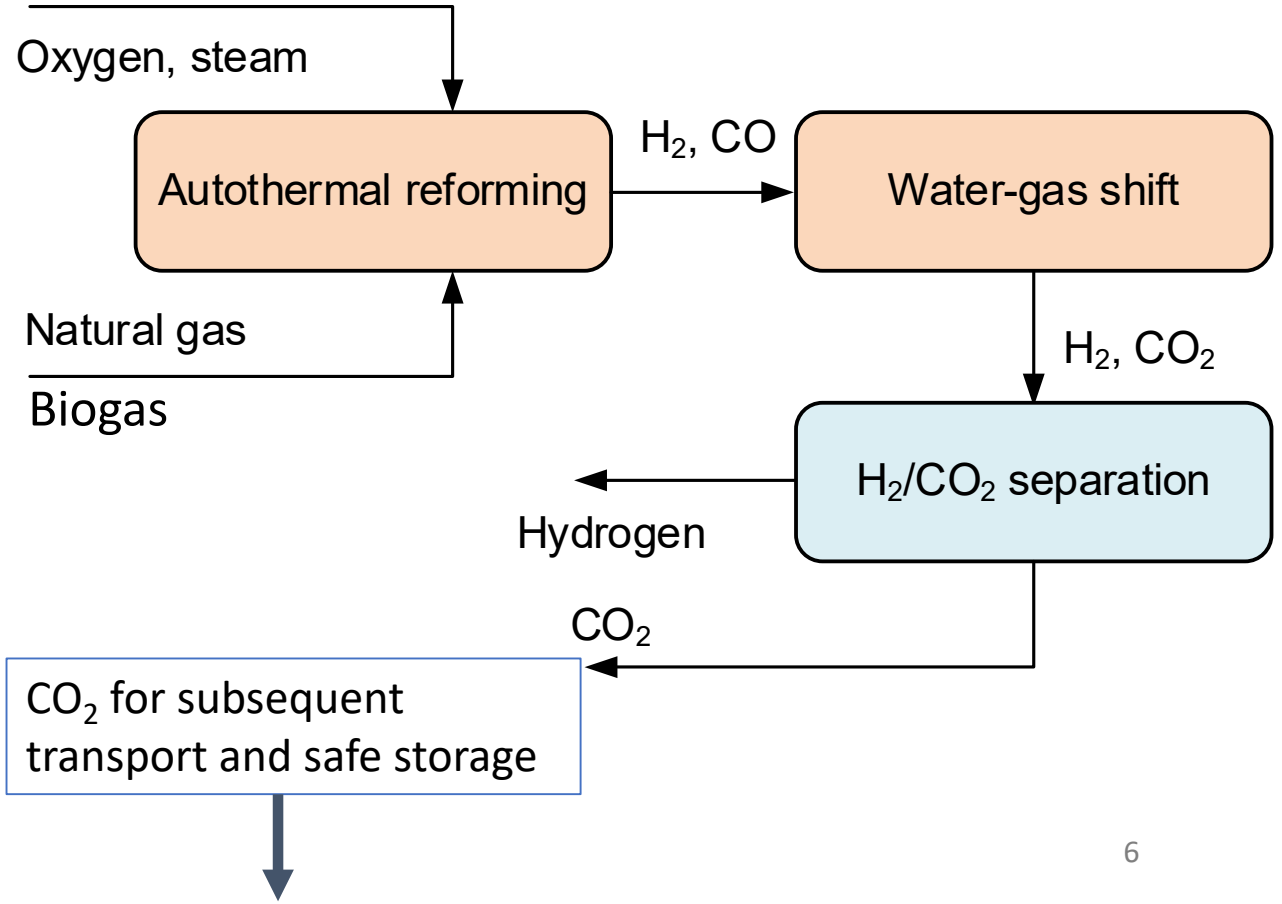
Global annual production: ~65M metric tons

Hydrogen production schemes

From Electrolysis



From natural gas with CCS



Enabling the Hydrogen Pathway

- Hydrogen can be an important part of the future European energy system.
- A comprehensive hydrogen infrastructure is required, also using existing assets.
- Full-scale deployment of hydrogen with CCS should start now.
- Open access infrastructure for CO_2 transport and storage is required – being able to store CO_2 will enable new pathways to climate neutrality

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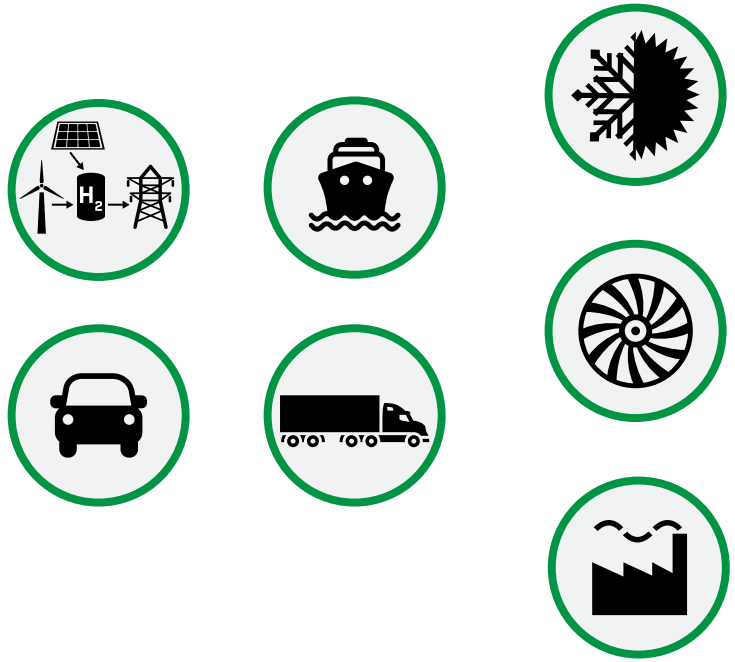
We need hydrogen both from electrolysis and natural gas with CCS

- Complementary and benefit from common infrastructure
- Markets differ in Europe
- From renewables by electrolysis, typical:
  - 1–10 MW, modular.
  - Market: Transport, FCH compatible, energy storage, industrial pilots
  - Currently restricted by insufficient renewable electricity at scale.
- From natural gas with CCS
  - Large scale, 100 MW +
  - Market: Industry, heat and power, heavy-duty transport
  - Can deliver large scale fast.
  - Currently restricted by lack of CCS infrastructure, technology is mature



H_2 production and electricity source

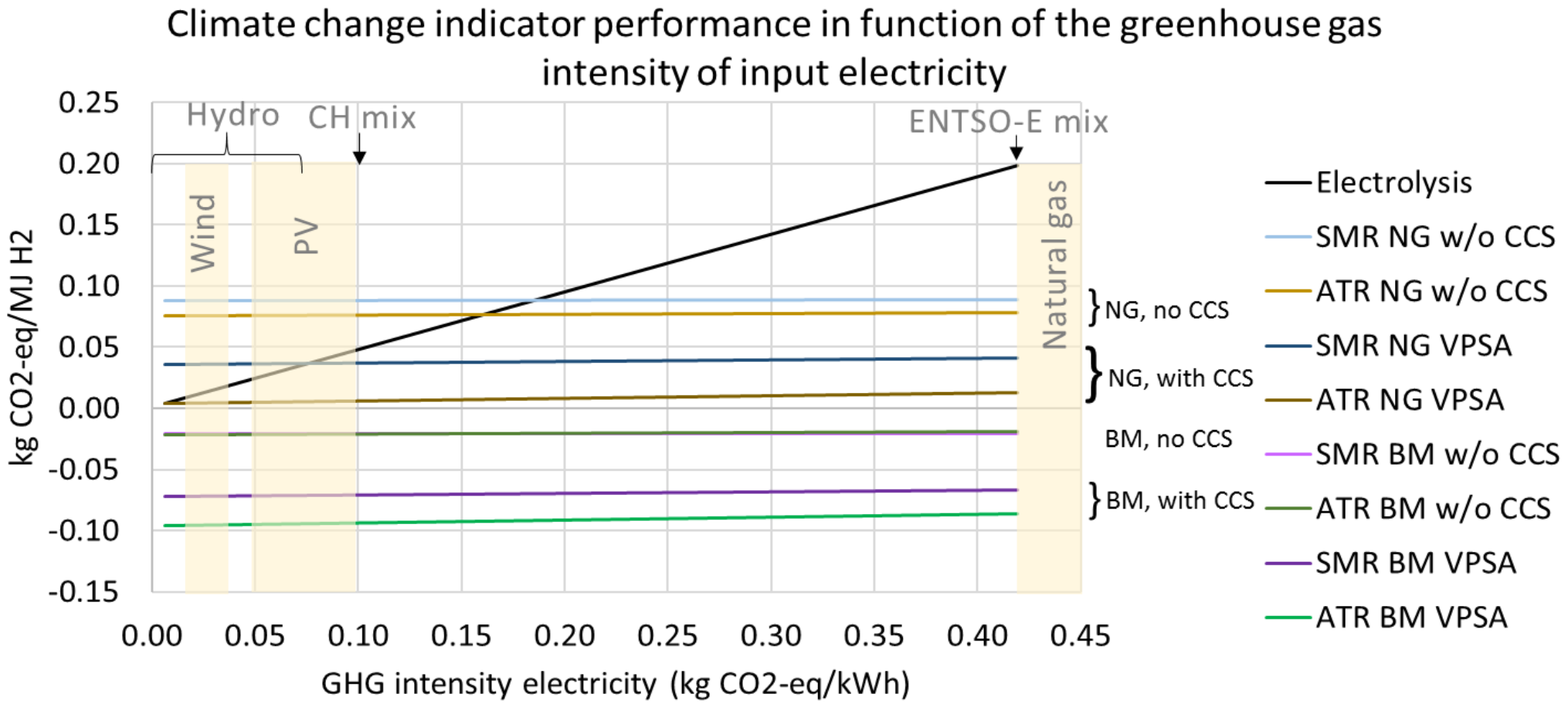
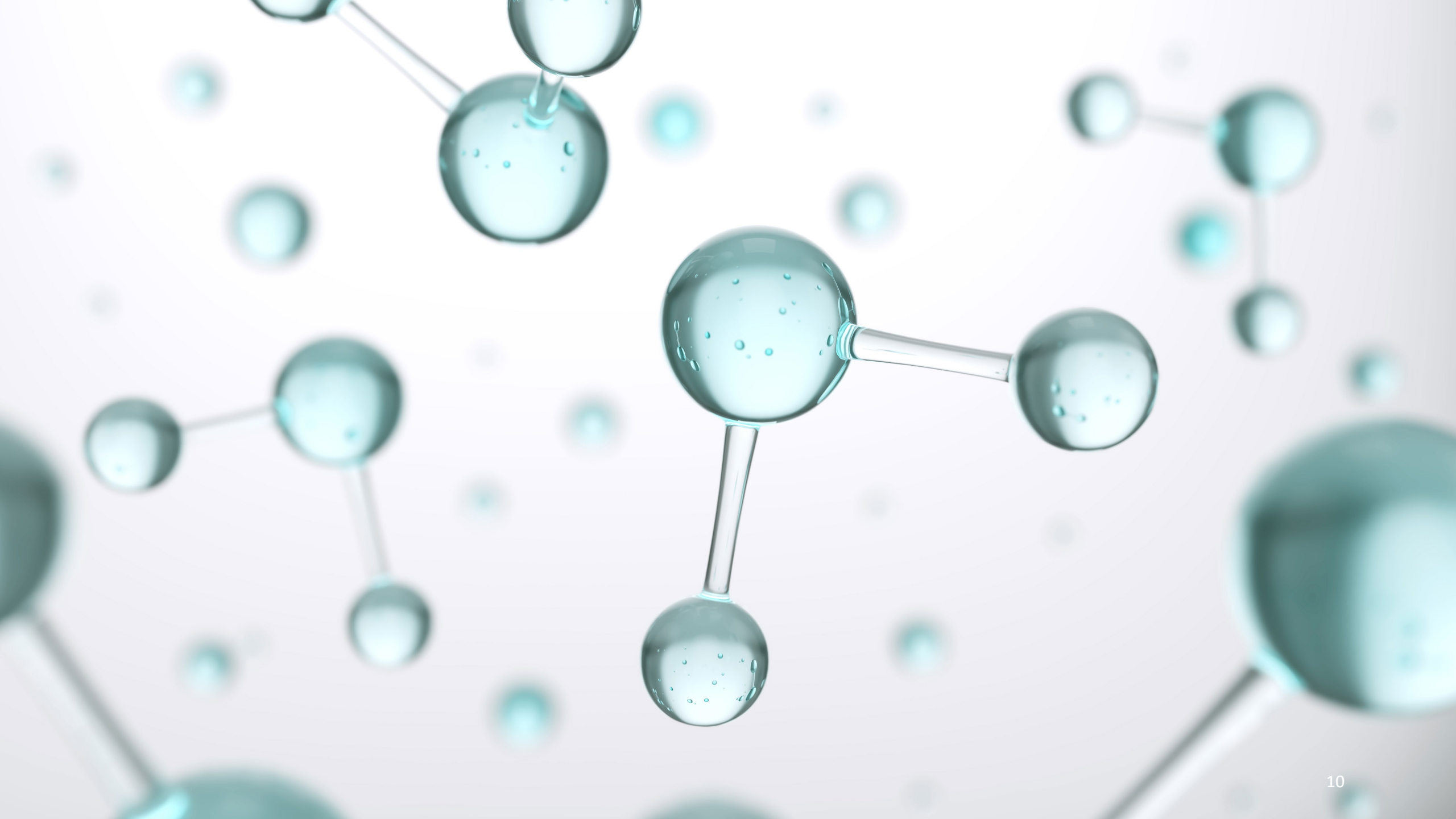
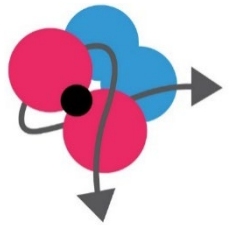


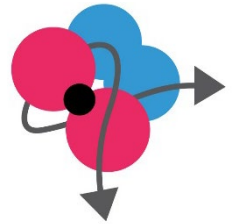
Figure: PSI



A mix is essential



- Holistic view needed to assess climate impact of hydrogen production
- The point is however- realising the potential of hydrogen and zero emission energy carriers
- Clean hydrogen from natural gas with CCS can deliver scale fast for commodity markets- in principle with zero to negative emissions when mixed with biogas hydrogen
- Fast tracking hydrogen and CO_2 infrastructure is essential to deliver on Paris agreement goals – scale and dispatchability key
- Hydrogen can offer benefits as cross-sectorial enabler in the European economy and thus energy and climate transistion



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