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When could hydrogen contribute to energy security and flexibility for consumers and for the energy system?

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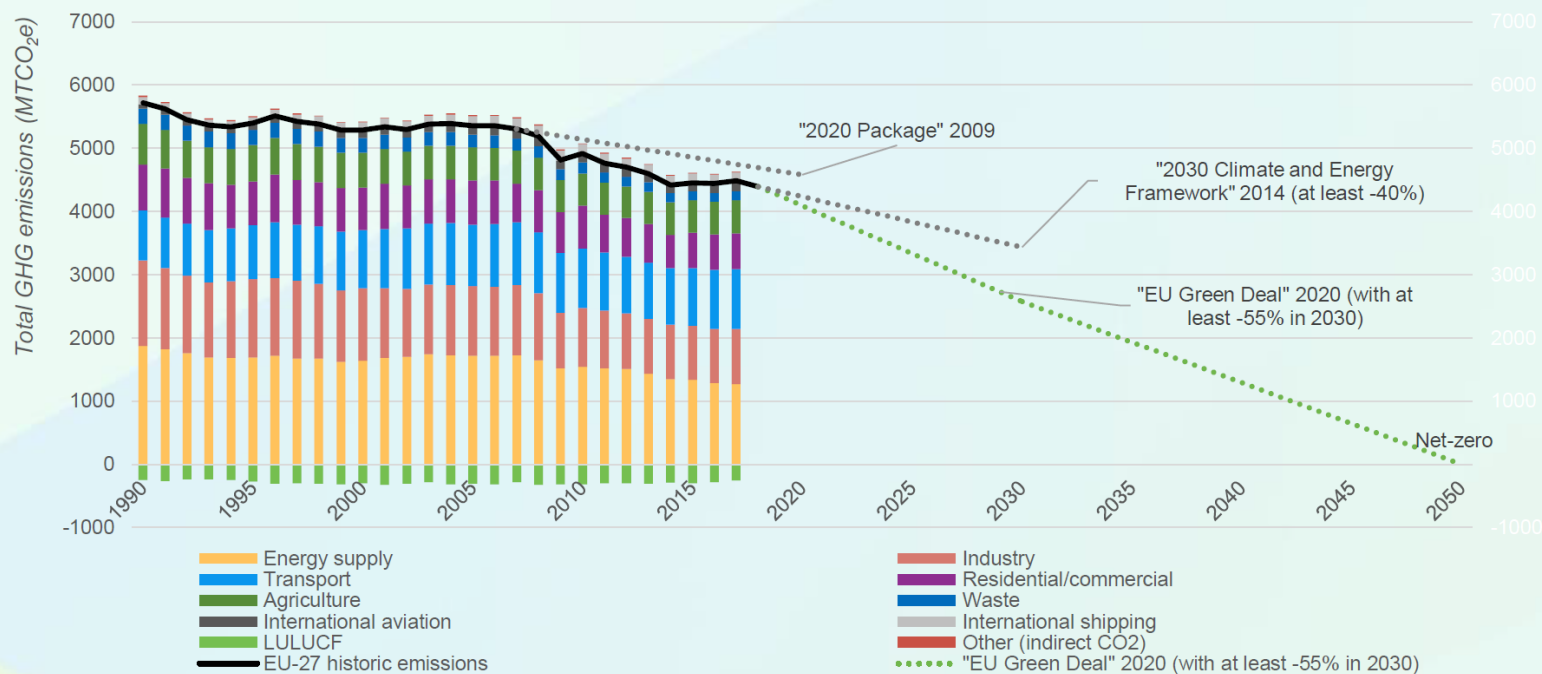




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The prerequisite – towards net-zero emissions in 2050

European energy transition and the new policy challenges



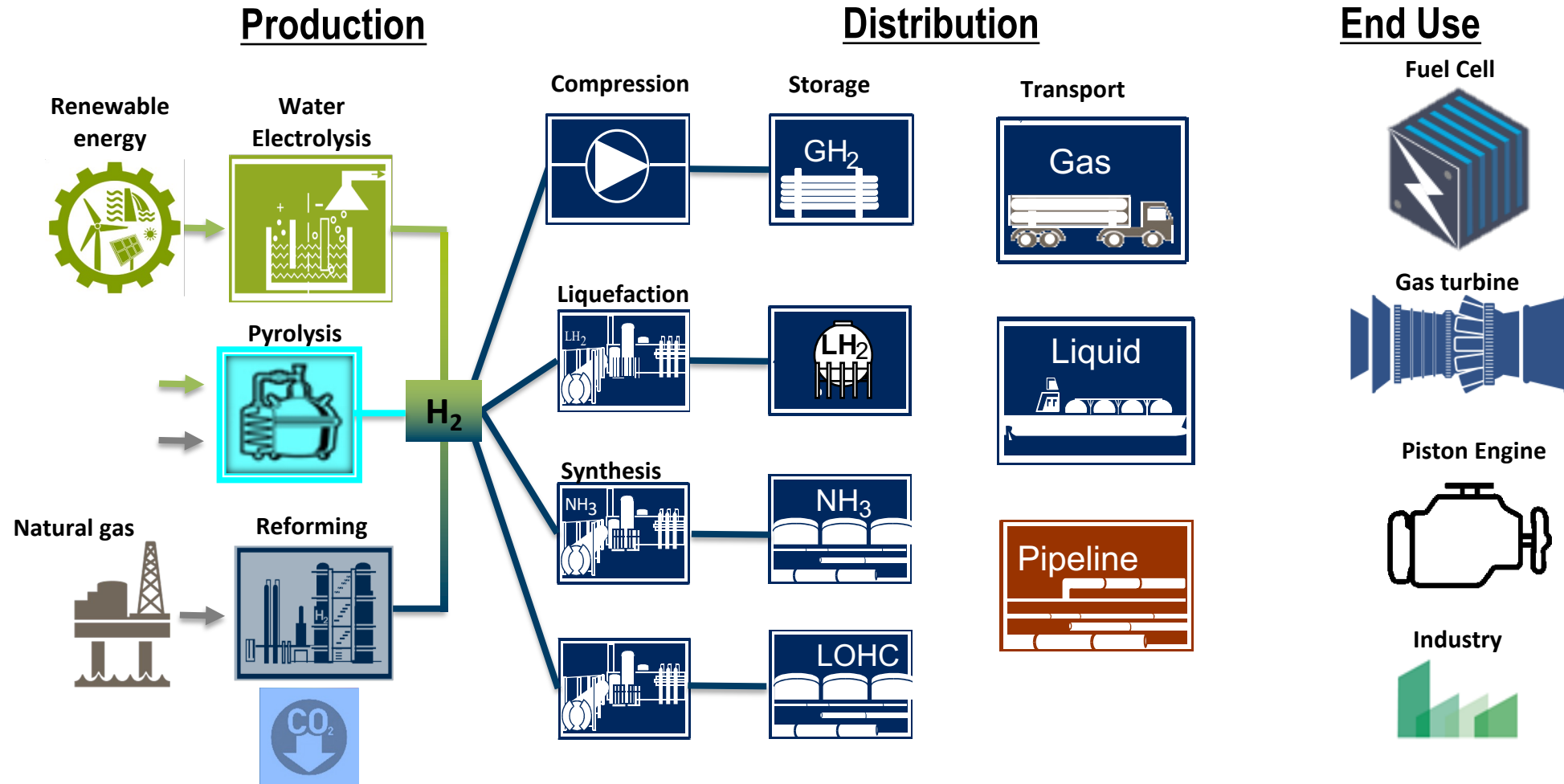
Own elaboration based in European Environmental Agency (EEA) data.

Note: The figure includes emissions from international aviation, and net removals from land use, land use change and forestry sector (LULUCF). Completed with linear trajectories to comply with enacted legislations.



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Hydrogen-based value chains





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Hydrogen in Europe today

PRODUCTION



475

Operational hydrogen production plants in Europe in 2022

11.30 Mt of total annual production capacity
8.20 Mt produced in 2022

DISTRIBUTION

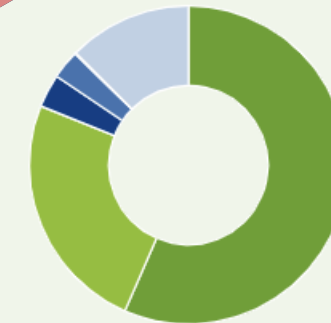


178

Hydrogen Refueling Stations (HRS) in operation in Europe

1569.00 km of operational hydrogen pipelines

END-USE



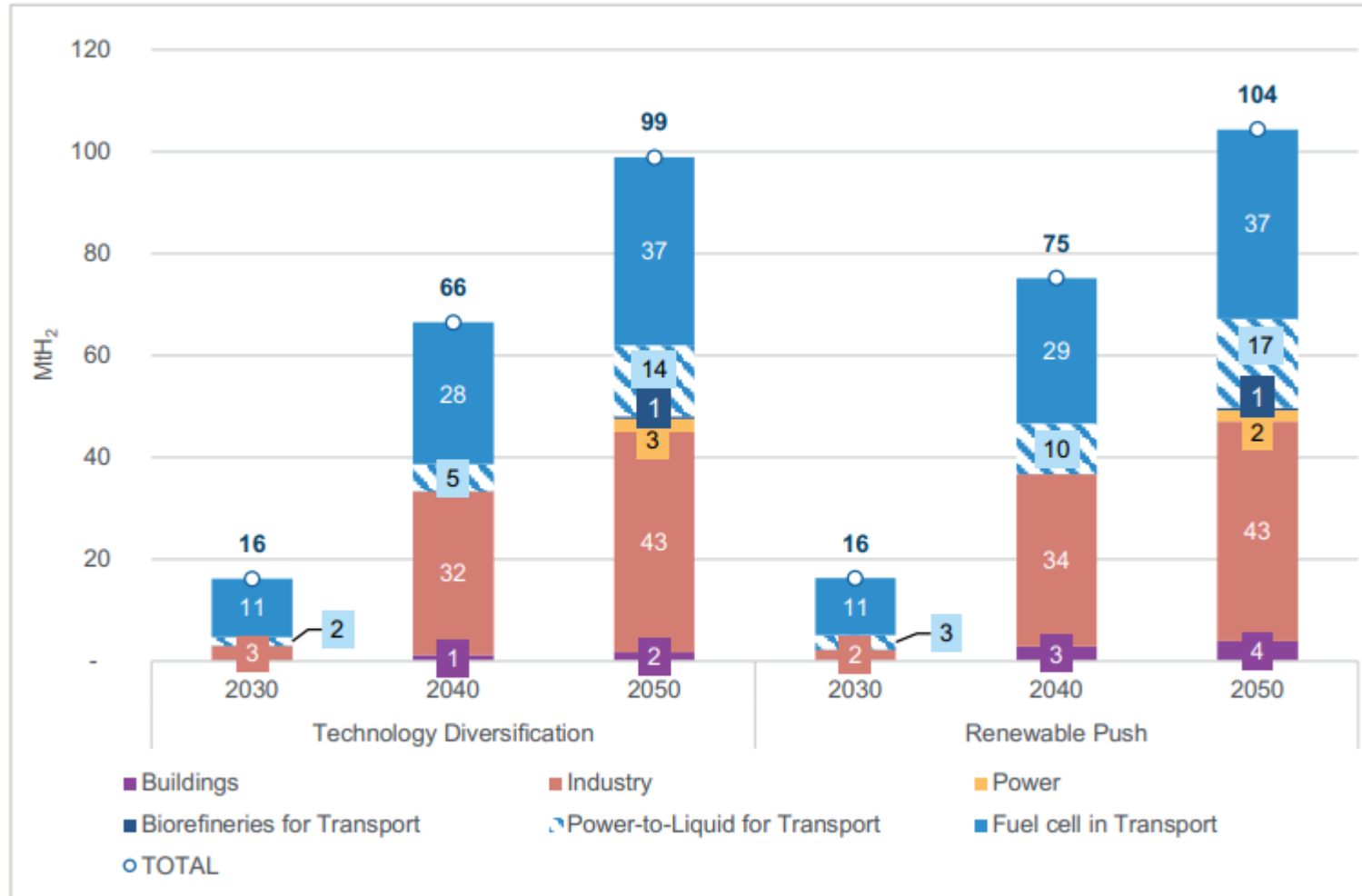
- Refining
- Ammonia
- Industrial heat
- Methanol
- Mobility
- Blending
- Other industries

Hydrogen consumption in Europe in 2022 >

RePowerEU calls for an EU production target of 10 Mt clean H₂ in 2030

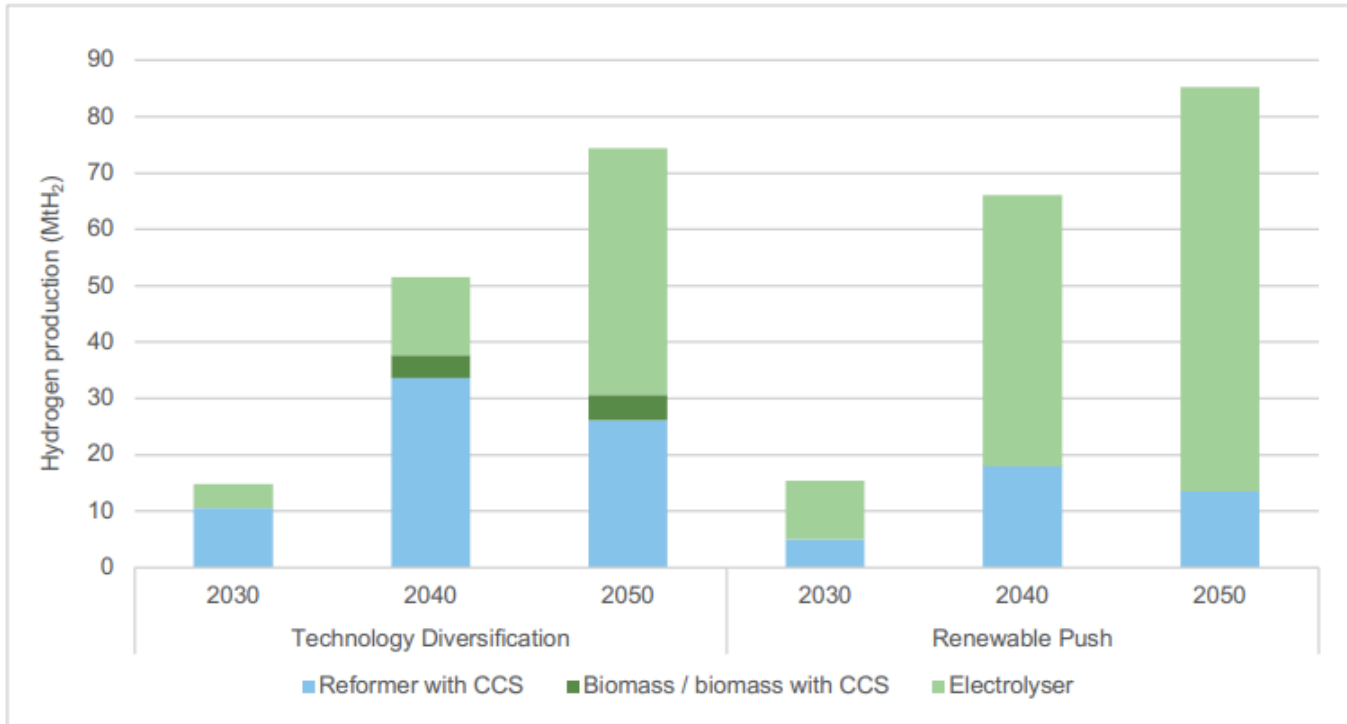
Where can clean hydrogen have an impact in Europe and how big?

Evolution of hydrogen energy-related demand by sector



- 'Hard-to-abate' sectors - transport and industry - make up the vast majority of hydrogen demand
- Hydrogen also contributes to a smaller degree to decarbonization in building and power generation

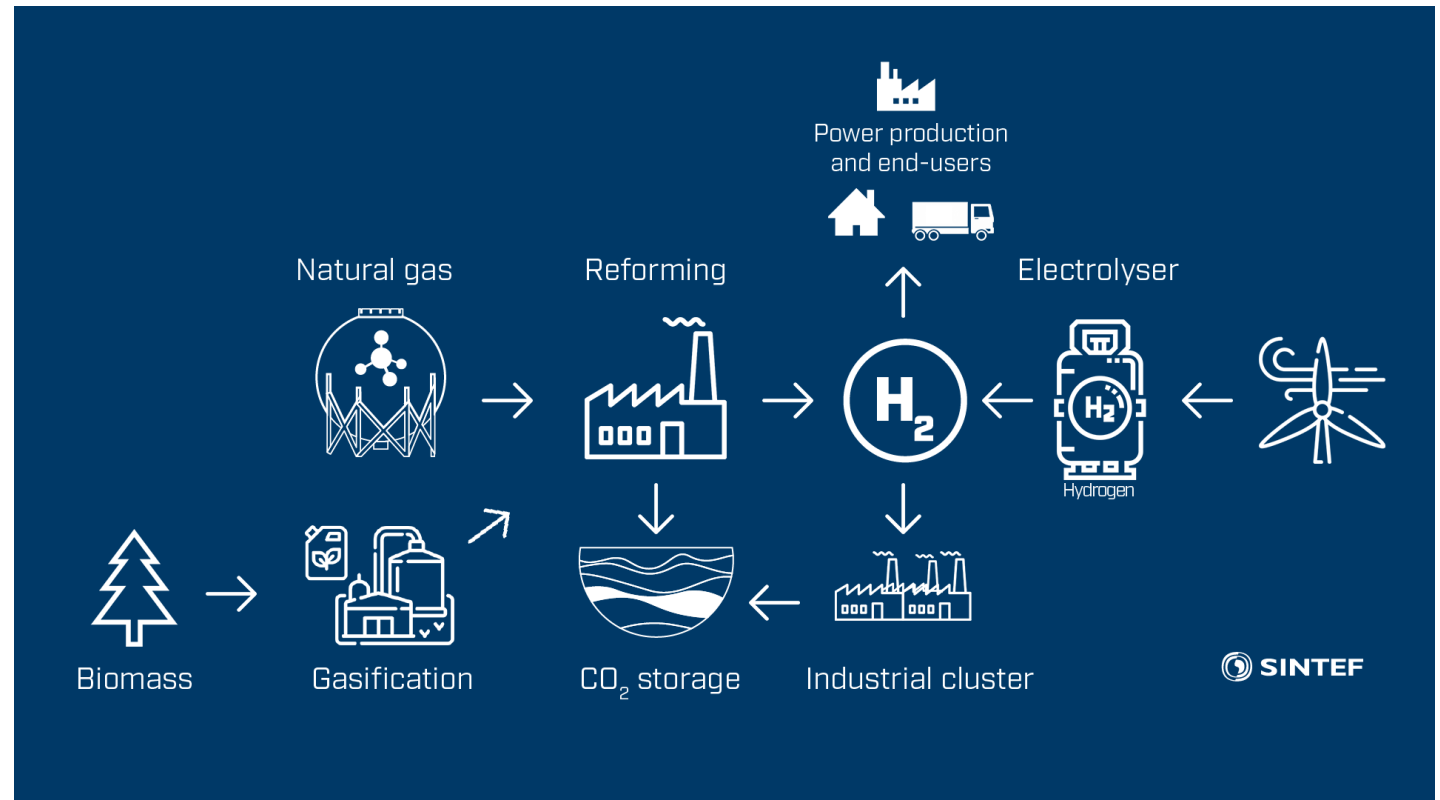
Step by step from now to 2050



- Building massive new renewable capacity will take time
- Competition for renewables to decarbonize different sectors such as power, transport, residential
- Low-carbon hydrogen from gas with CCS can play a critical role in establishing hydrogen market and infrastructure in the transition phase towards 2050
- Renewable and low-carbon hydrogen complement each other
- Up to a quarter of hydrogen needed in the transition to net-zero could be imported from outside EU

Industrial clusters – key enablers for large-scale supply and demand

- Strategies for decarbonization:
 - Capture of CO₂ & permanent storage
 - Electrification
 - Fuel switch/bio
 - Use of hydrogen
- Hard-to-decarbonize industry needs CCS infrastructure
- Hydrogen production from natural gas with CCS strengthens the business case for infrastructure investment



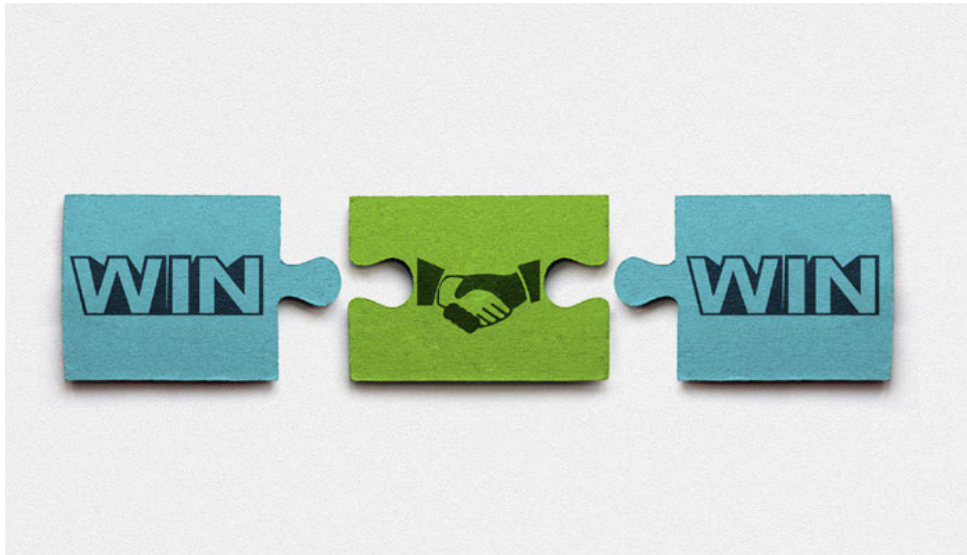
Sources:

- [ELEGANCY – Enabling a Low-Carbon Economy via Hydrogen and CCS](#)
- [Reigstad et al. Moving toward the low-carbon hydrogen economy: Experiences and key learning from national case studies](#)



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Benefits for the wider energy system



- Strategic development of industrial clusters for scaling up use of clean hydrogen
- Growing hydrogen demand in industries \leftrightarrow bring down costs of low-carbon hydrogen pathways and attract new sources of demand
- Coastal industrial clusters that are co-located near ports are especially attractive

Sources:

- [ELEGANCY – Enabling a Low-Carbon Economy via Hydrogen and CCS](#)
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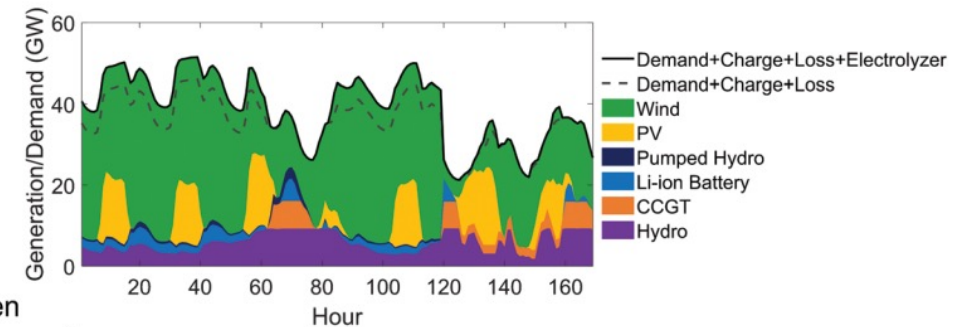
Sector coupling stimulates cost reductions and renewable energy generation

- Sector coupling exemplified for a case of the Northeast US
- Coupling power and H₂ sectors through electrolysis and/or H₂-based power generation and storage
 - stimulates integration of domestic variable renewable energy
 - reduces the need for dispatchable resources like gas power and battery storage
 - allows for greater CO₂ reductions on a system level

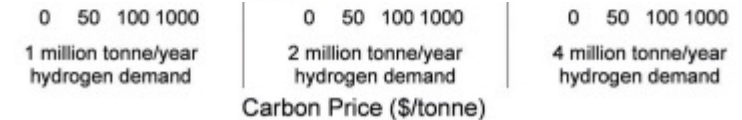
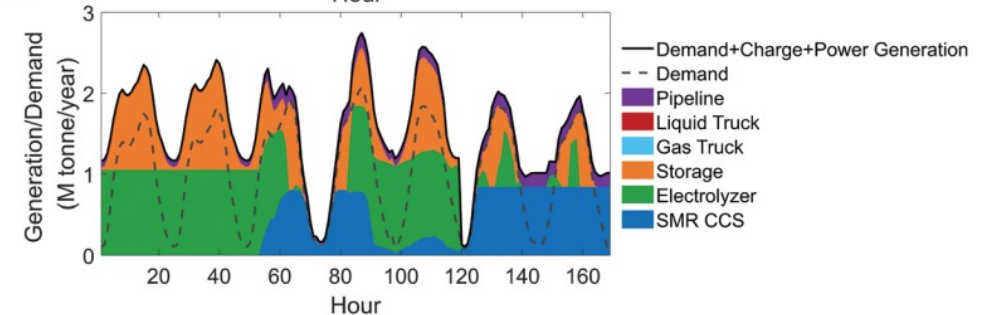
(a) Power system generation change due to sector coupling



(a) Power



(b) Hydrogen





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Policy measures and funding instruments are being developed and adopted as we speak...



Options for the production of 'green' hydrogen according to RED II DA (13.02.2023)

Same grid node
And smart metering system

or

No grid connection

+

Additionality
(Starting from 01.01.2028)
RE-installation no longer than 3 years before EL

FFE

EU strikes deal on new hydrogen grid supervisory body

By Nikolaus J. Kurmayer | Euractiv.com ⌚ Est. 4min

📅 9 Dec 2023

or

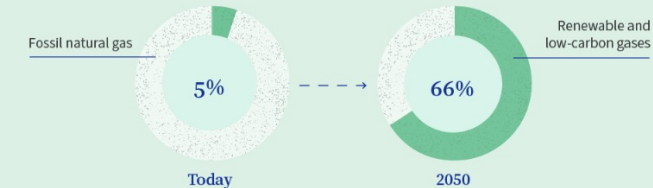
Emission intensity grid
< 64,8g CO₂eq/kWh

day-ahead-price <= 20 €/MWh
or <= 0,36 * CO₂-price (t)

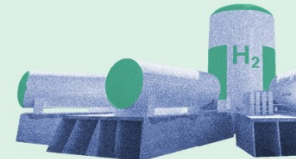
Avoidance of downward regulation of renewable energy plants for redispatch measures

fossil natural gas to renewable and low-carbon gases and boost their uptake in the EU by 2030 and beyond. The package also aims to help strengthen the security of gas supply and reduce dependency on imported fossil fuels.

Shift to renewable and low-carbon gases



led



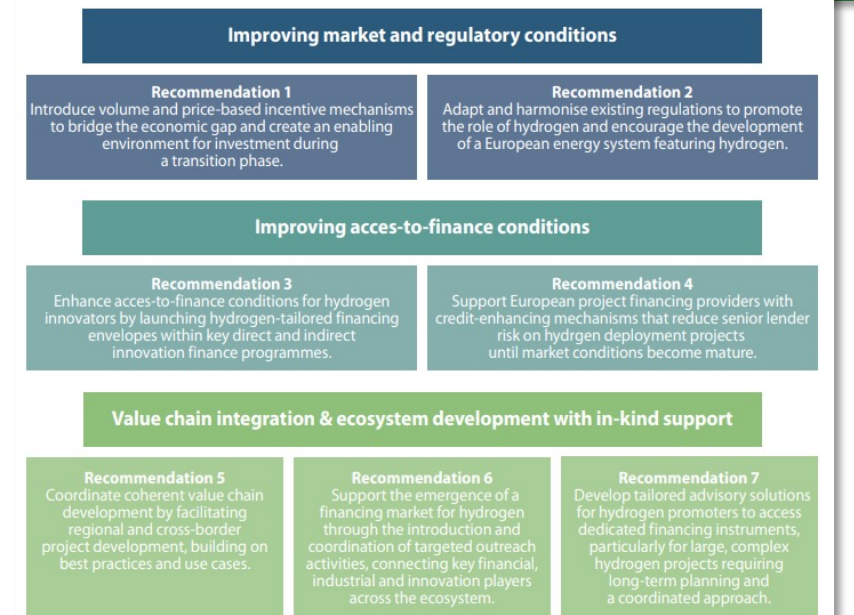
...but the road from initiatives to investment decisions is long and paved with hurdles

- Funding to support the first large-scale projects globally is increasingly being made available
 - However, slow implementation of support schemes is delaying investment decisions and putting projects at risk
 - Too strong focus on the supply side and too little on the demand side?
- Regulation and certification is also a key barrier to adoption
 - Referring to the emissions intensity of hydrogen production in regulation and certification can enable mutual recognition between countries



Unlocking the hydrogen economy — stimulating investment across the hydrogen value chain
Investor perspectives on risks, challenges and the role of the public sector

Figure 6: Summary of recommendations across the regulatory, access-to-finance and advisory support dimensions





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A few takeaway points

- Achieving climate-neutrality in 2050 will require a drastic transformation of today's energy system with massive expansion of renewable capacity
- Hydrogen can play a meaningful role in 'hard-to-abate' sectors, where deep electrification, energy efficiency improvements and other measures are challenging
- Hydrogen can contribute to increased energy security through development of new domestic renewable electricity generation and diversification of energy imports



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A few takeaway points

- Hydrogen can also link different sectors and different energy transmission and distribution networks and thus increase the operational flexibility of future low-carbon energy systems
- For hydrogen to make a significant impact there is a clear need to:
 - develop the market, implement support schemes for production and use, and stimulate demand creation
 - address regulatory barriers and accelerate certification solutions
 - support technology development, risk and cost reductions through public-private R&D efforts
 - and deploy large-scale infrastructures for CCS



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Technology for a better society