A new energy horizon for Europe: technological opportunities to support the transition

Hydrogen

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Why Hydrogen and why are we talking about it

- Mitigating climate change will require decarbonizing all forms of energy, not just electricity
- Hydrogen, when produced with zero-carbon processes, is a completely emissions-free fuel source – the only by-product of burning it is water.
- Many industrial processes already use hydrogen as a feedstock, and there is potential for use in a wide array of heavy industry, transportation, and storage applications.
- For some sectors this will be the or one of the critical transitional pathways (eg. Steel, 8.5% of global CO2 emissions, Ammonia, 1% of global CO2 emissions, global maritime shipping, ~2.5% of global emissions)
- Decarbonized hydrogen could complement renewable energy sources of electricity to fully decarbonize our economy.

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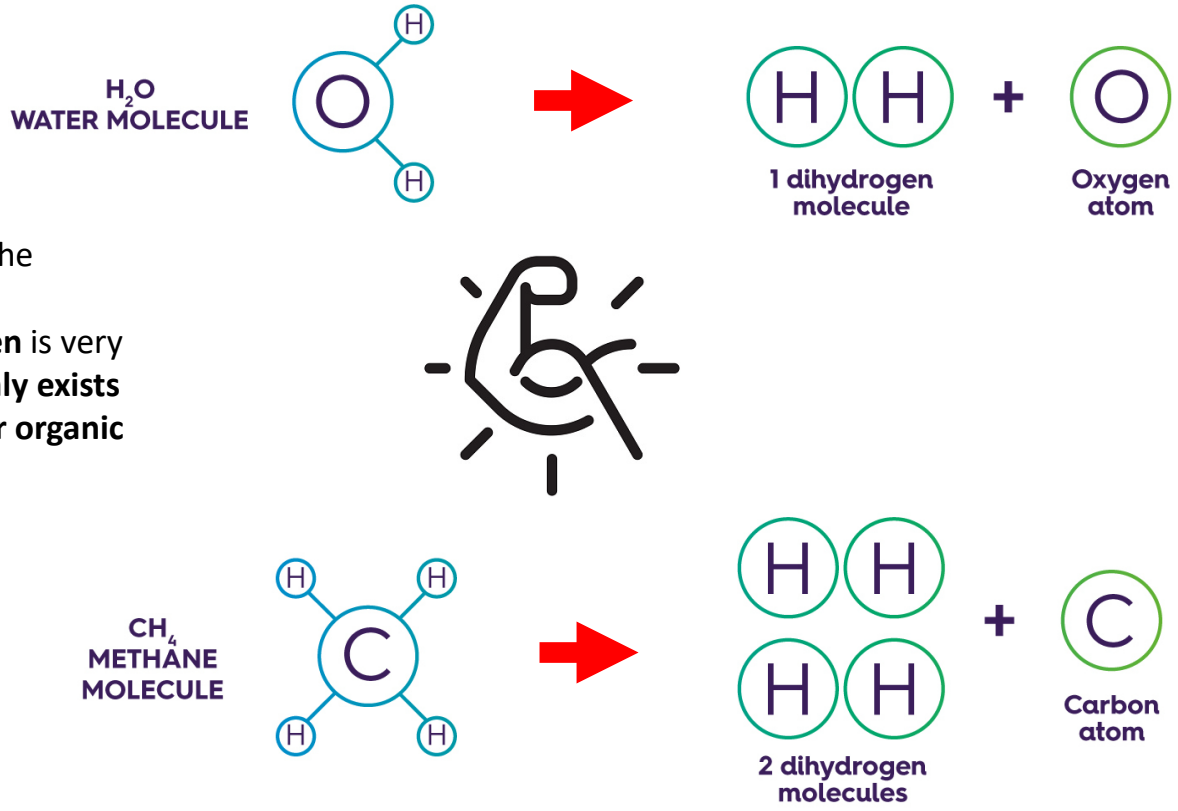
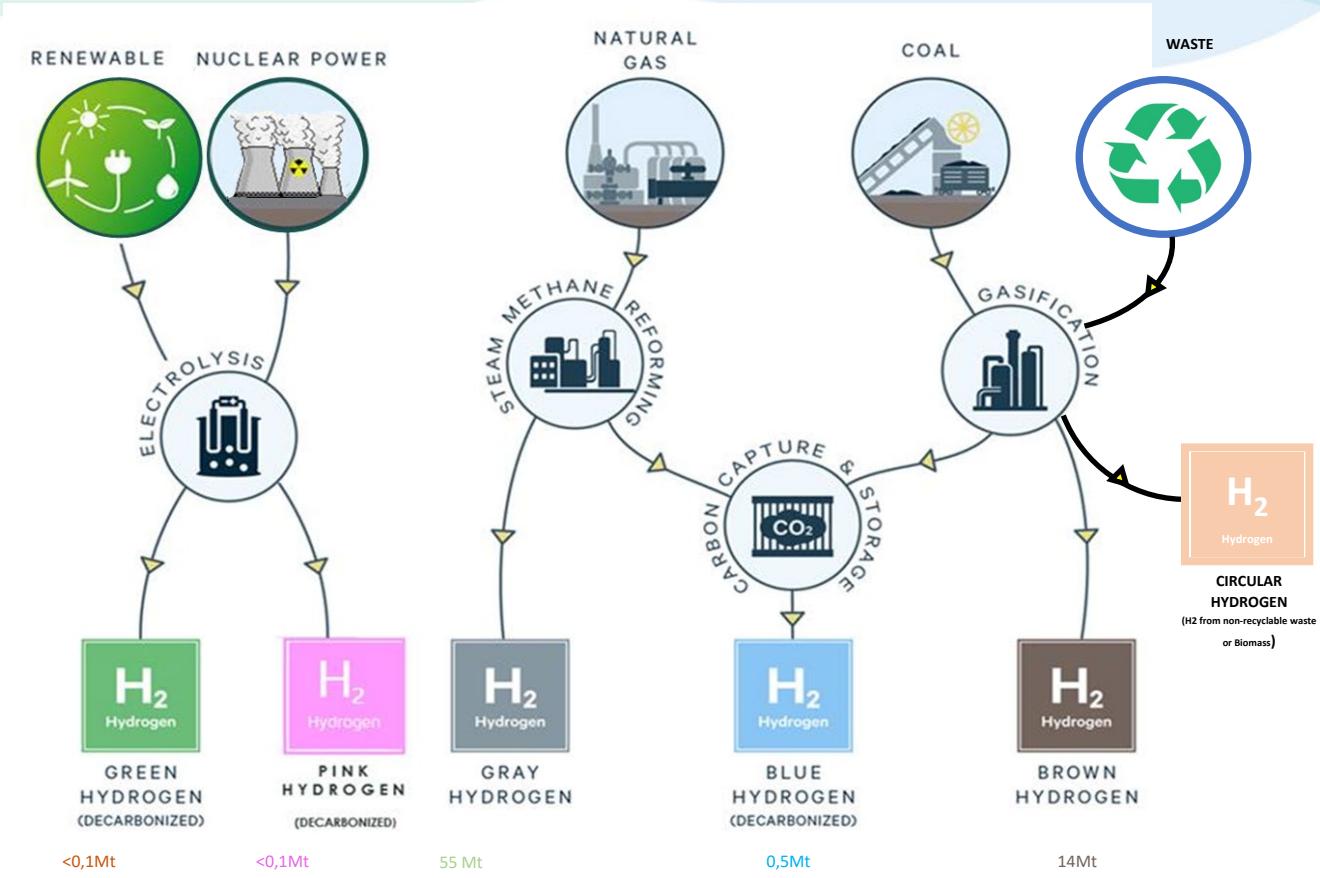
Hydrogen is an energy carrier: it needs energy to be obtained

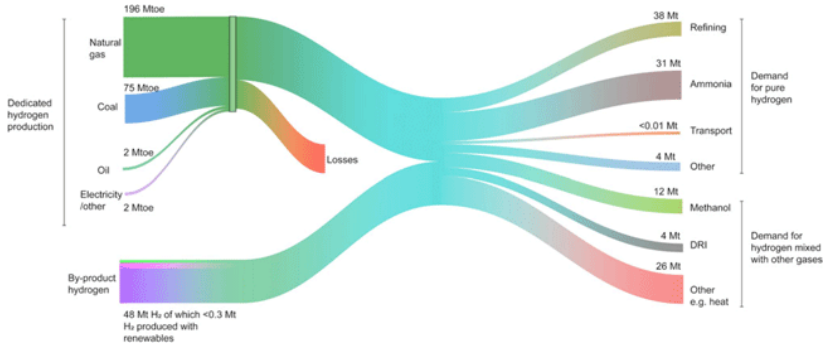
Hydrogen is the **most abundant** element in the universe (73%).
On earth pure **hydrogen** is very scarse, instead, it **mainly exists in the form of water or organic compound**

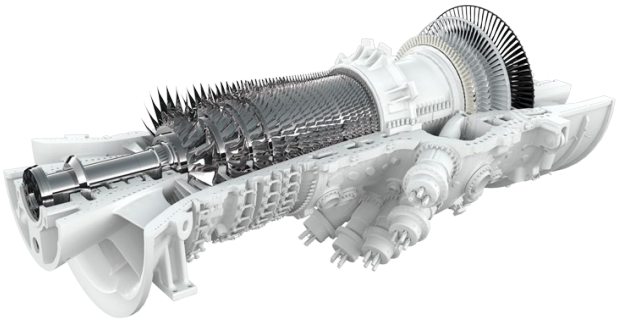


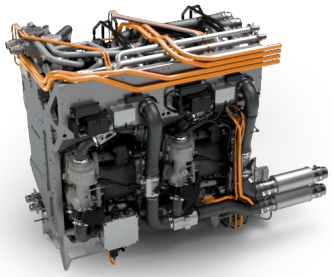
Different energies, different sources, different colours of hydrogen



Once you have Hydrogen we can:







Use as **feedstock** in the chemical industry**, burn it** directly or mix it with oxygen in **fuel cell** to produce **electricity**, **without any CO2 emission**

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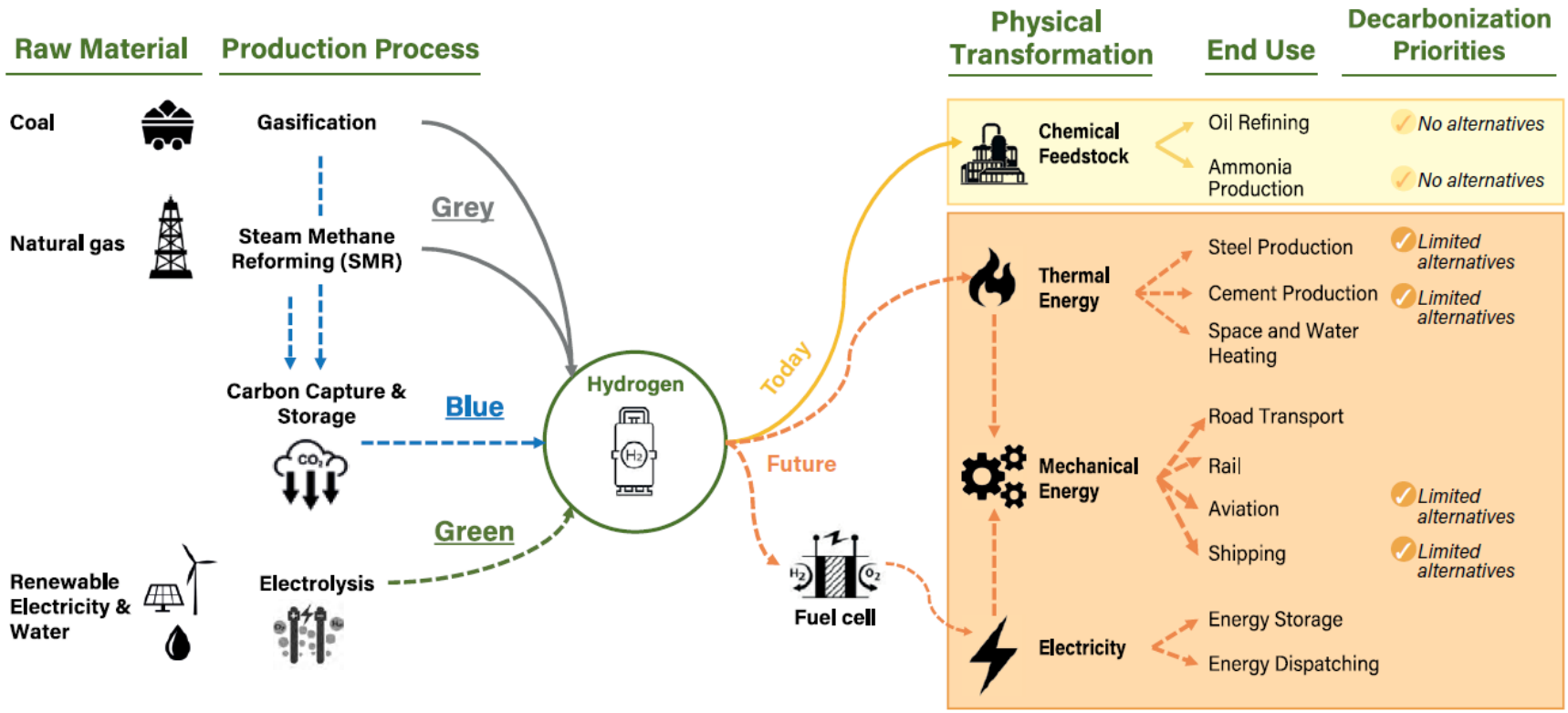
Evolution of the hydrogen value chain



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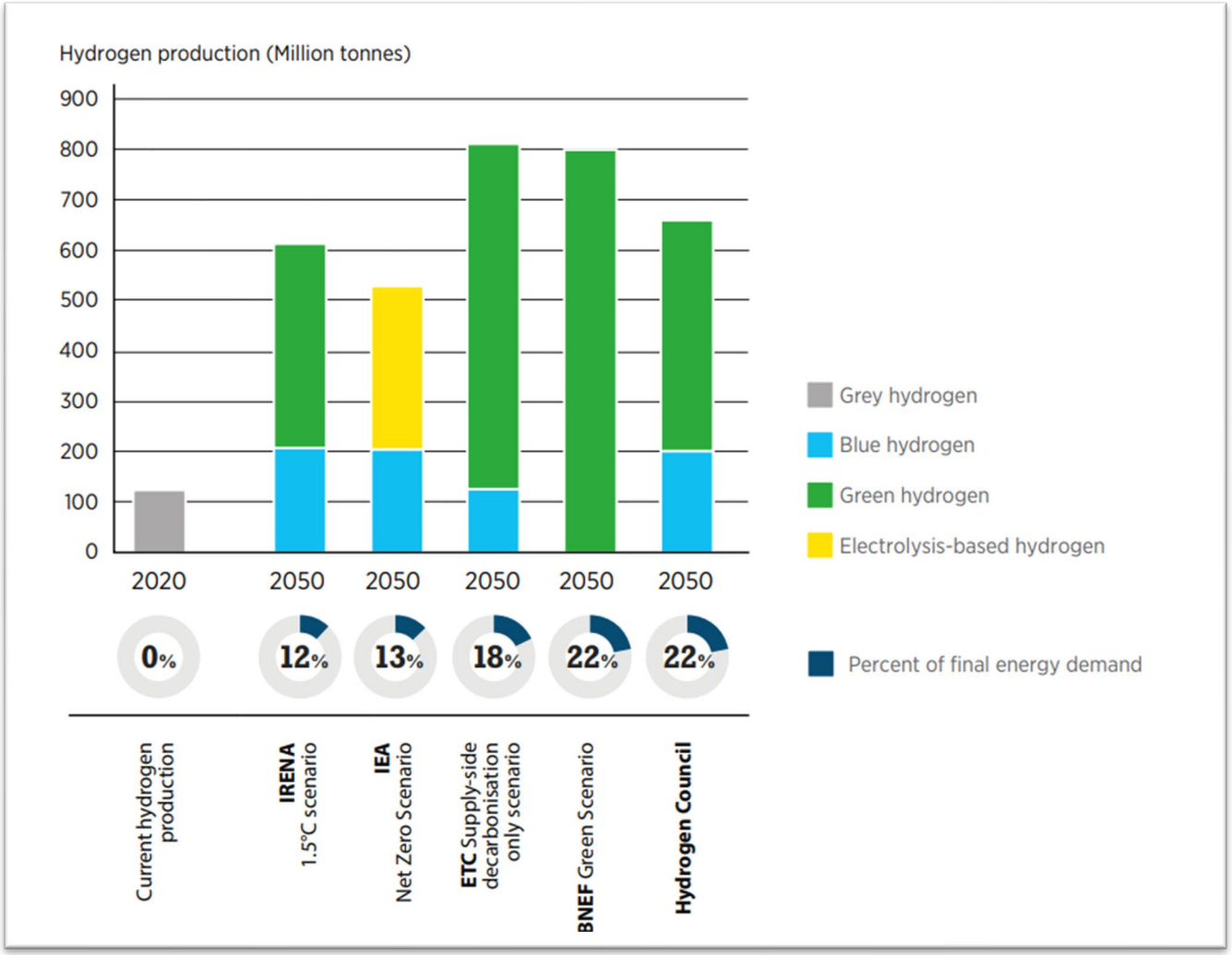
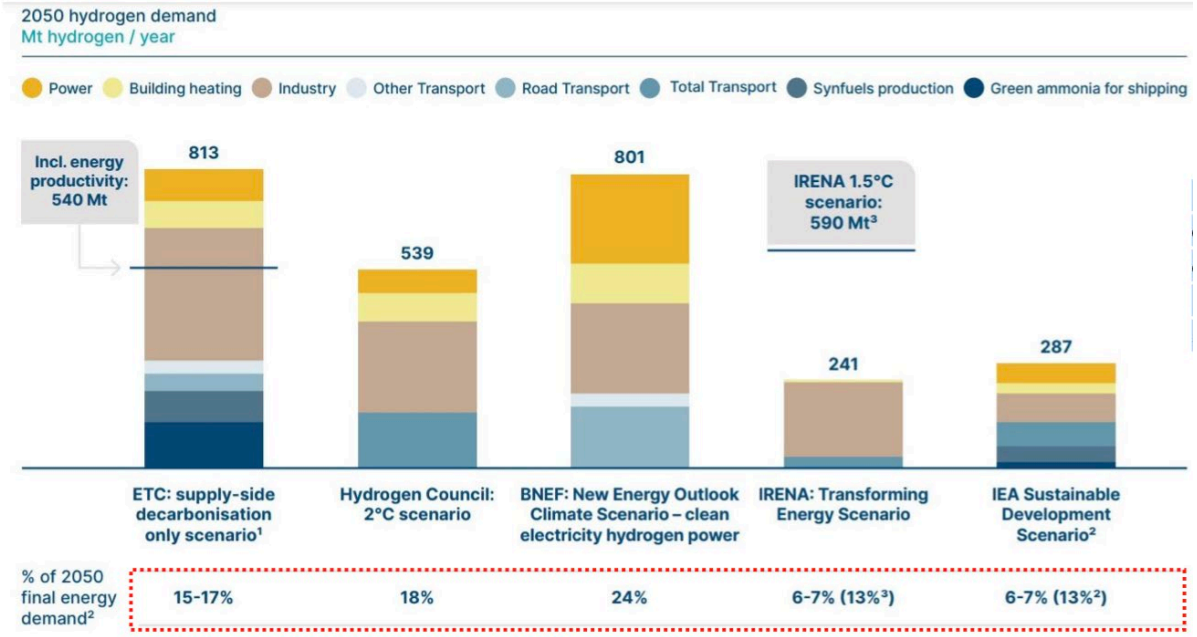
The future scenario



The Hydrogen Opportunity



Hydrogen will play a key role in decarbonizing hard-to-abate sectors

All major decarbonization studies and reports project a massive increase in the amount of hydrogen required and in new industrial applications

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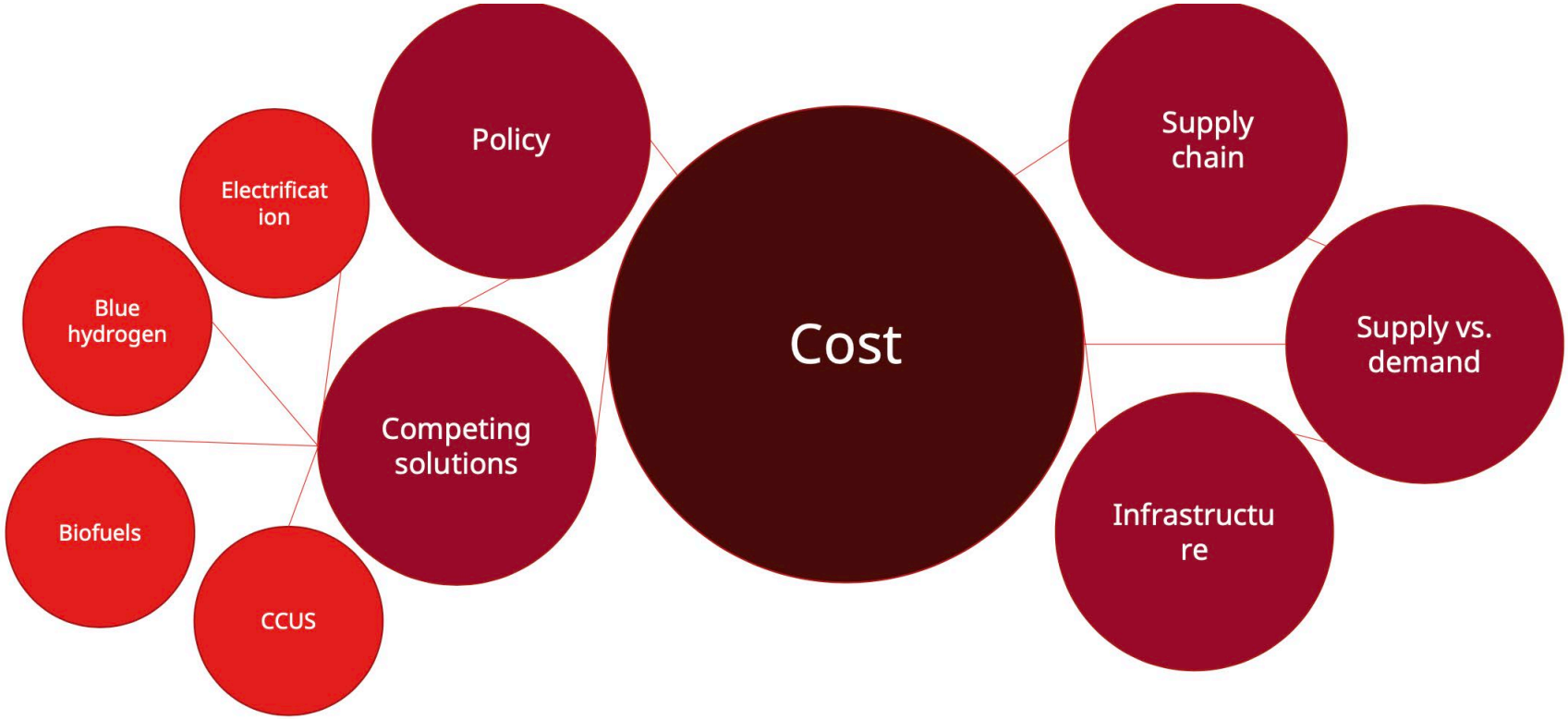
Green hydrogen: the challenges

A Green Hydrogen economy faces four key challenges:

- **Energy efficiency**: The conversion of electricity to hydrogen and back is inefficient. Plus, hydrogen's low (volumetric) energy density requires high pressures or liquefaction for its storage, which further increases the energy loss. Depending on the final use, 50% to 80% of the renewable energy generated is lost along the processing steps.
- **Cost**: Green hydrogen is currently 3-5 times more expensive than grey hydrogen to produce. Optimistic projections foresee that this gap will close by 2030

  https://fchobservatory.eu/index.php/observatory/technology-and-market/levelised-cost-of-hydrogen-green-hydrogen-costs
- **Technology readiness**: The use of hydrogen in hard-to-abate sectors such as steel, cement, aviation and shipping, is still immature from a technological point of view, as only pilot projects exist today.
- **Safety**: Hydrogen's high reactivity and flammability pose security risks that require specific safety controls, especially in end-uses involving retail consumers.

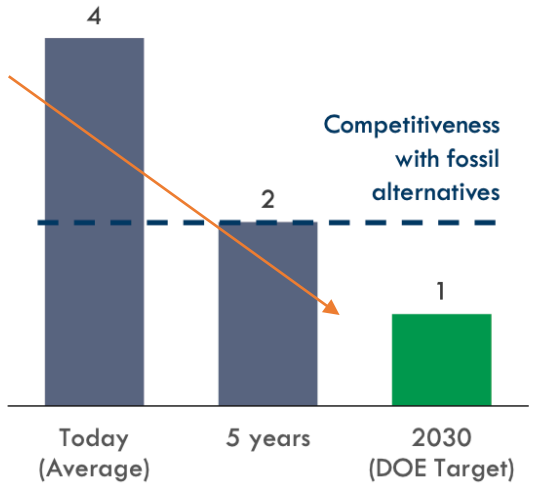
Why isn’t this fully commercialised and globalized today?



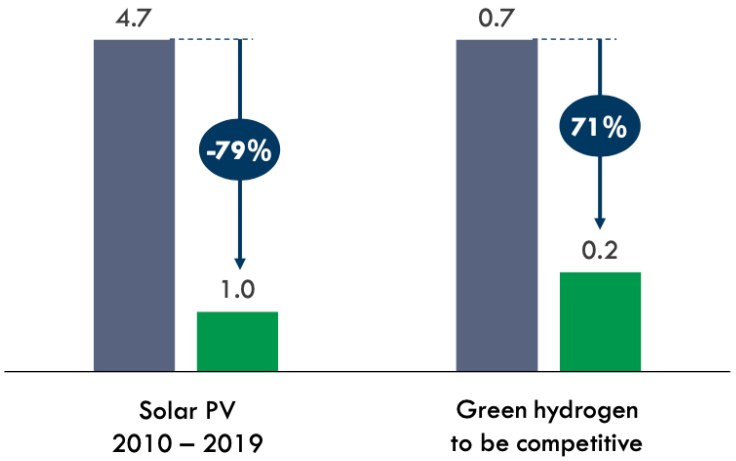
Cost reduction of Green Hydrogen to scale up

Following the same curve as renewables

Production cost of Green Hydrogen
US$ / kg



System Cost Reduction
US$ / kW



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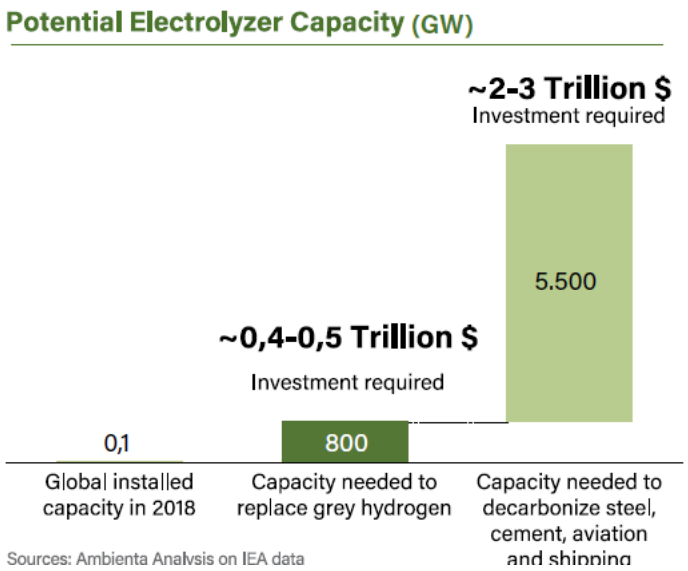
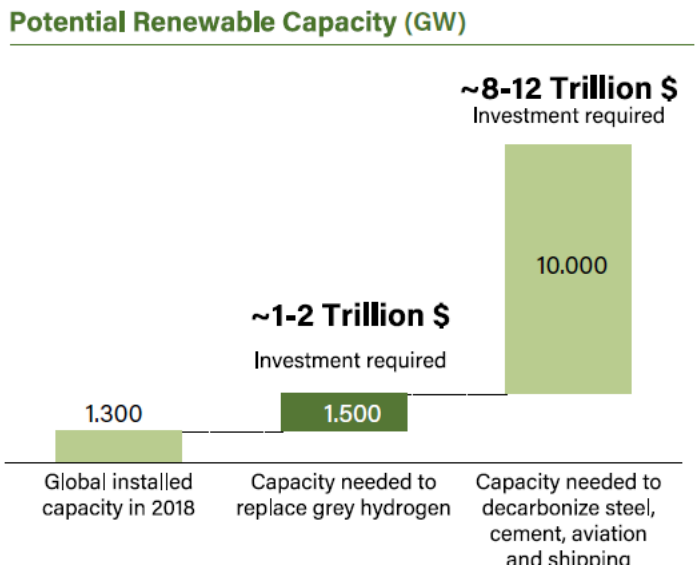
Market potential of green hydrogen production





Grey Hydrogen actual need is **70 M tons/year**. To replace it with green hydrogen we need **800 GW of electrolyzer capacity** and **3,500 TWh of electricity** (about **1,500 GW of additional renewable capacity** installations).
Other sectors with limited decarbonization alternatives (steel,cement, aviation, shipping) could drive hydrogen growth by **~400 M tons/year**, that would imply **5500 GW of additional electrolyzer** capacity and **20,000 TWh* of electricity** (about **10,000 GW of additional renewable capacity**).

https://fchobservatory.eu/observatory/technology-and-market/hydrogen-demand

*1 Kg of green hydrogen requires 55 kWh of renewable energy to be produced.

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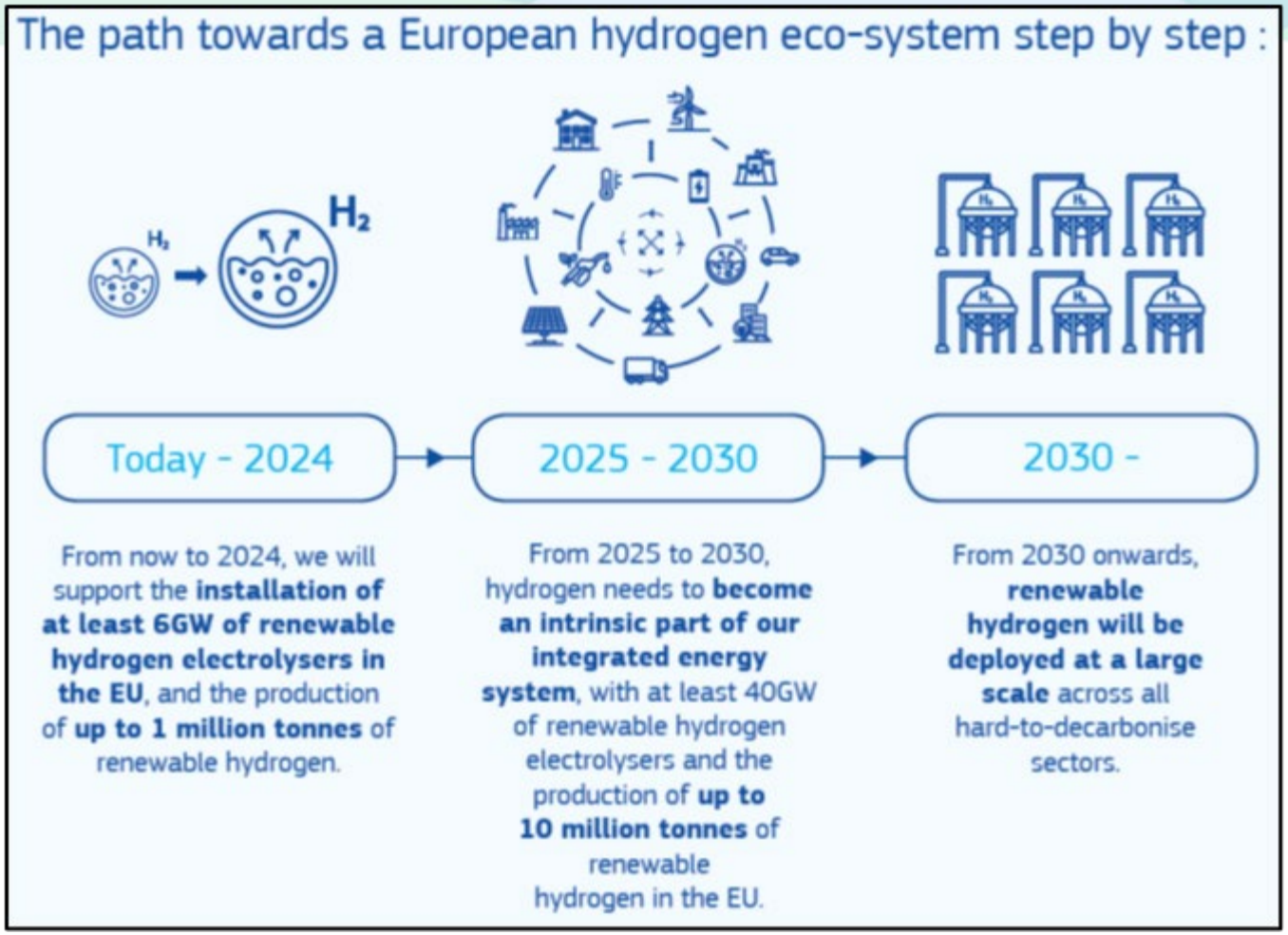
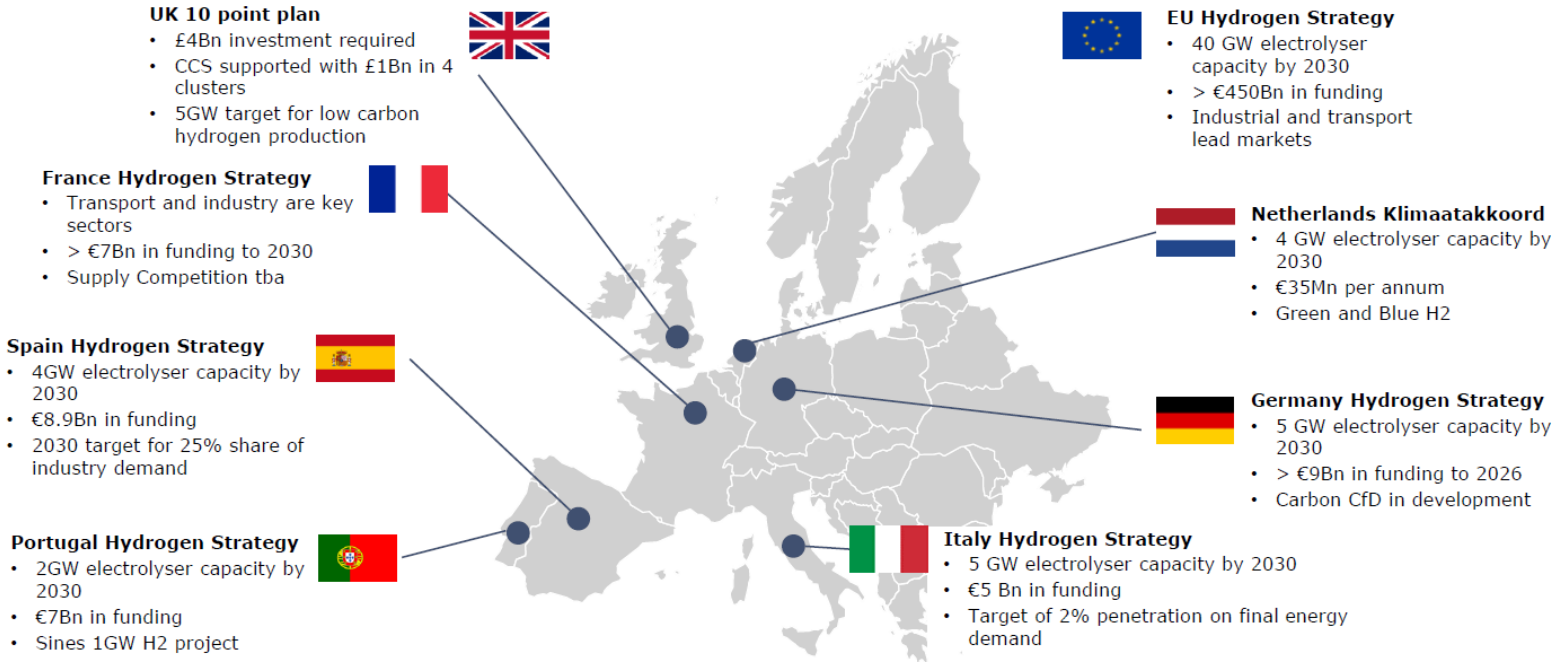
The European Strategy for hydrogen (2020)



National and EU strategies have a clear focus on Green H2



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REPowerEU Plan

RePowerEU is aimed at ending the European dependency on Russian fossil fuel imports by 2027, while tackling the climate crisis through saving energy, clean energy production, and energy supply diversification.

It is backed by further financial and legal measures to build the new energy infrastructure and system that Europe needs.

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Short-Term measures

- **Rapid roll out of solar and wind energy projects** combined with **renewable hydrogen** deployment to save around 50 bcm of gas imports
- approval of first **EU-wide hydrogen projects** by the summer
- common purchases of gas, LNG and hydrogen via the EU Energy Platform for all Member States who want to participate as well as Ukraine, Moldova, Georgia and the Western Balkans
- New energy partnerships with reliable suppliers, including future **cooperation on renewables and low carbon gases**
- Increase the production of biomethane to save 17 bcm of gas imports
- An EU Save Energy Communication with recommendations for how citizens and businesses can save around 13 bcm of gas imports
- Fill gas storage to 80% of capacity by 1 November 2022
- EU-coordinated demand reduction plans in case of gas supply disruption

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Medium-term measures

- **New national REPowerEU Plans** under the **modified Recovery and Resilience Fund** to support investment and reforms worth €300 billion
- New legislation and recommendations for **faster permitting of renewables** especially in dedicated **'go–to areas' with low environmental risk**
- Investments in an integrated and adapted gas and **electricity infrastructure network**
- Increase the **EU renewables target for 2030** from 40% to **45%**
- Boosting **industrial decarbonisation** with around €3 billion of frontloaded projects under the Innovation Fund
- A **hydrogen accelerator to build 17.5 GW by 2025** of **electrolysers** to fuel EU industry with homegrown production of 10 million tonnes renewable hydrogen
- A modern **regulatory framework for hydrogen**
- Increased ambition on **energy savings** by raising the **EU-wide target on efficiency** for 2030 from 9% to **13%**
- Regulatory measures to increase energy efficiency in the transport sector
- New EU proposals to ensure industry has access to critical raw materials

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