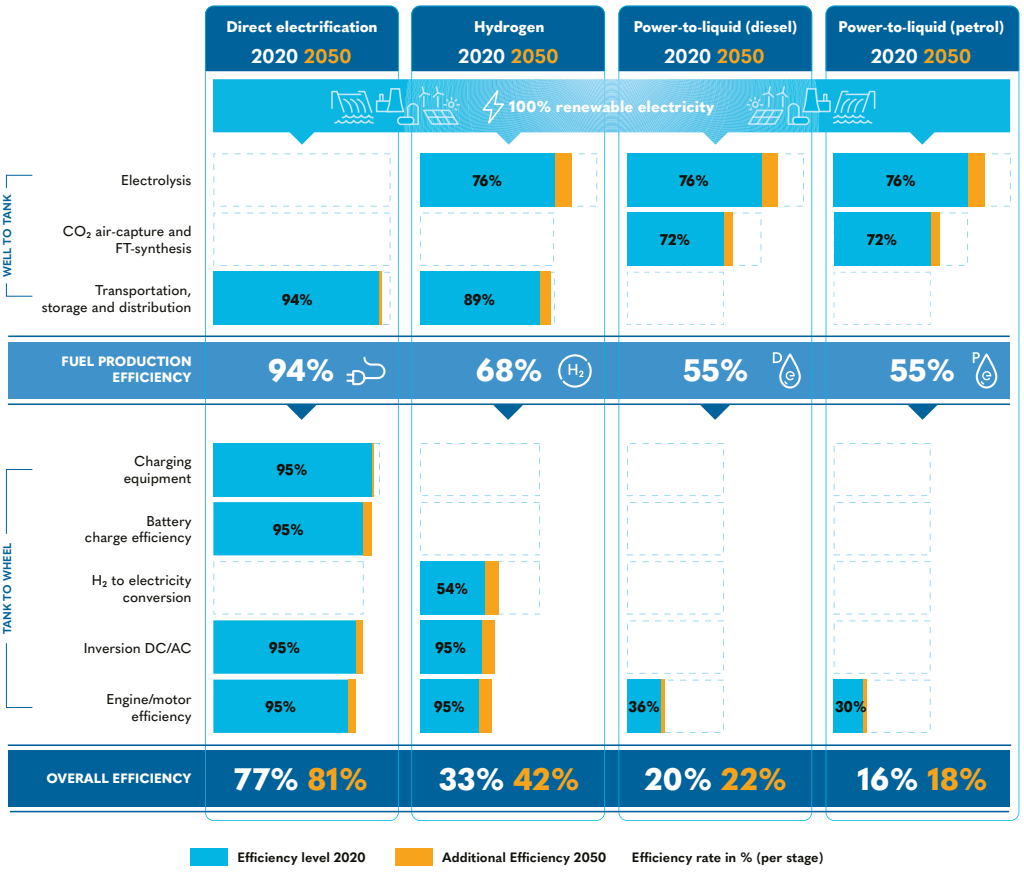
GREEN HYDROGEN:
WHAT IS IT GOOD FOR?

Finding its Role in a Low Carbon Future

Decarbonizing the Transport Sector – Will Hydrogen be Efficient Enough?

The use of hydrogen for fuel cell vehicles has been shown to be much less efficient, and the use of hydrogen to produce liquid fuels is much worse. Even heavy transport now appears to be leaning to battery powered vehicles for many applications.

Cars: Direct Electrification Most Efficient



Notes: To be understood as approximate mean values taking into account different production methods. Hydrogen includes onboard fuel. Excluding mechanical losses.

Source: Transport & Environment (2020), "Electrofuels? Yes, we can … if we're efficient – Decarbonising the EU's transport sector with renewable electricity and electrofuels", see Annex II, page 29 (www.transportenvironment.org/wp-content/uploads/2020/12/2020_12_Briefing_feasibility_study_renewables_decarbonisation.pdf)

EFFICIENCY

Using hydrogen made from electricity is always **less efficient** than using the electricity directly. Hydrogen storage is not easy or cheap. Battery storage is more effective for many applications, such as automobiles.

FEEDSTOCK

Hydrogen is the key feedstock for fertilizer that our food supply depends on.
10 million tons of hydrogen are made each year in the EU from natural gas, producing 100 million tons of CO2 annually.

Potential use of e-fuels will likely be limited to aviation and long-distance shipping, and will result in significant cost increases for these sectors.

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FEEDSTOCK

The most important application for green hydrogen in the near term is as a **replacement for current grey hydrogen** use for petro-chemical and fertilizer applications. There is no other alternative for these industries to reduce their CO2 impact. Producing enough green hydrogen for this task is already a mammoth undertaking, in terms of both capital expenditures and the amount of renewable energy required.

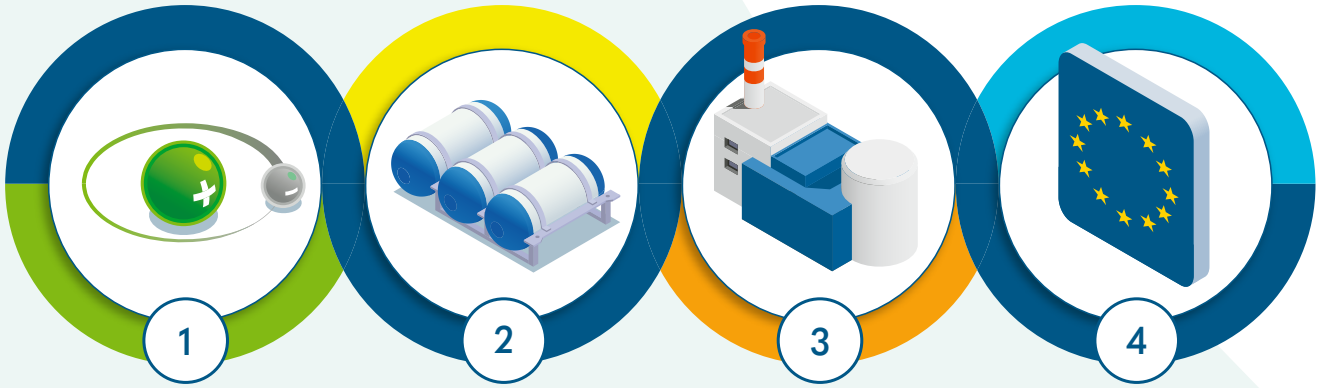
STORAGE

The need for green hydrogen production in the future, for grid scale storage, is difficult to predict. Any project should be carefully evaluated with respect to its efficiency, cost and added value to the total energy system. Perhaps most importantly, it depends on how the price and volume of "excess" renewable electricity behaves in the future. **There are widely conflicting visions of the future need for grid scale storage.**

Grid Scale Storage Options

If **green hydrogen** is to be considered for grid scale storage, it must be compared to the other options that are available. **Pumped hydropower** is only available in a very limited number of locations and is difficult to expand even in those locations. **Liquefied air storage** is a mature technology that can be scaled cost effectively, at least for short-term use (e.g. hours). Use of **solid batteries** is currently only suited to short discharge times at full power (e.g. tens of minutes). **Future battery technologies** (e.g. flow batteries) could extend this to hours. It is possible that different types of storage will be needed at all of these time scales, working together. It is difficult to make an evaluation of green hydrogen for grid scale storage, given how much uncertainty there is about the future of the power grid. At the same time, it is important to consider a wide range of scenarios to account for **possible future applications of green hydrogen**.

Policy Recommendations



1 REPLACE GREY HYDROGEN:

Green hydrogen should be first applied for replacement of grey hydrogen as feedstock.

2 EVALUATE GRID SCALE STORAGE:

The use of hydrogen for grid scale storage needs to be carefully evaluated based on effiency, cost and added value.

3 CONSIDER ALTERNATIVES FOR INDUSTRY:

Hydrogen is not the only alternative for decarbonizing heavy industries such as steel production.

4 DEVELOP CONSISTENT EU POLICY:

A consistent EU policy based on evaluation of the most cost effective options needs to developed to guide policy choices in individual countries with respect to green hydrogen projects.