RESEARCH & INNOV

RESEARCH AND INNOVATION TO TURN CO₂ INTO A RESOURCE

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Secret



engie

Internal



Molecules needed for the 'hard to abate sectors', long term energy storage and long-distance energy transport

(2020)

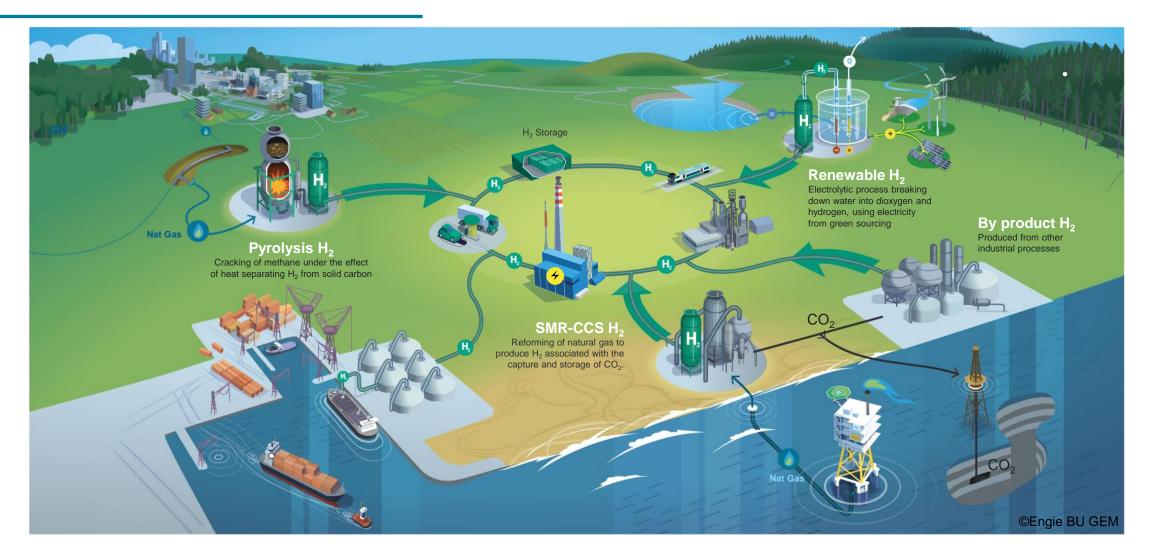
- **3 steps towards C-neutrality**
 - Energy efficiency first
 - Electrify where possible with renewable energy
 - **Green/carbon neutral molecules** where needed

Marginal 1) Sectors in which direct 2) Sectors in which direct 3) Sectors in which e-fuels 4) Sectors inaccessible electrification is significantly electrification and e-fuels ao beyond the barriers of to e-fuels and direct abatement cheaper than using e-fuels have similar costs direct electrification electrification. costs Aviation, shipping, feedstocks, light duty vehicles, Low/mid temperature industrial heat high temp. heat (>400°C), Process emissions €/tCO2 (<400°C, e.g. steam generation), Space heating heavy-duty transport primary steel (e.g. cement prod.) Other measures are required: CCS. compensation via CDR, alternative materials and recycling 1000 Hydrogen/e-fuels replacing natural gas Hydrogen/e-fuels replacing liquids and coal for steel) 500 -**Direct electrification** illustrative) 50 100 150 Final energy consumption (EJ) non-electric end-use sectors (OECD, 2014, incl. feedstocks)

Source : Falko Ueckerdt et. Al., Potential and risks of hydrogen-based e-fuels in climate change mitigation, 2021



Hydrogen is a low carbon energy solution with a lot of potential but ...



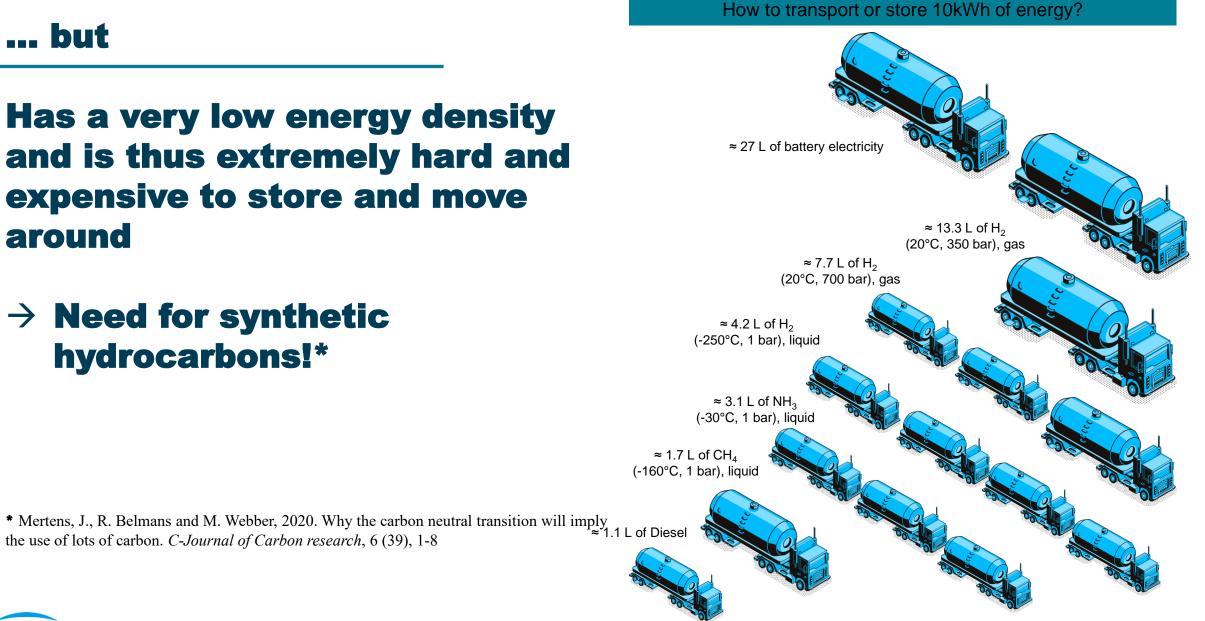


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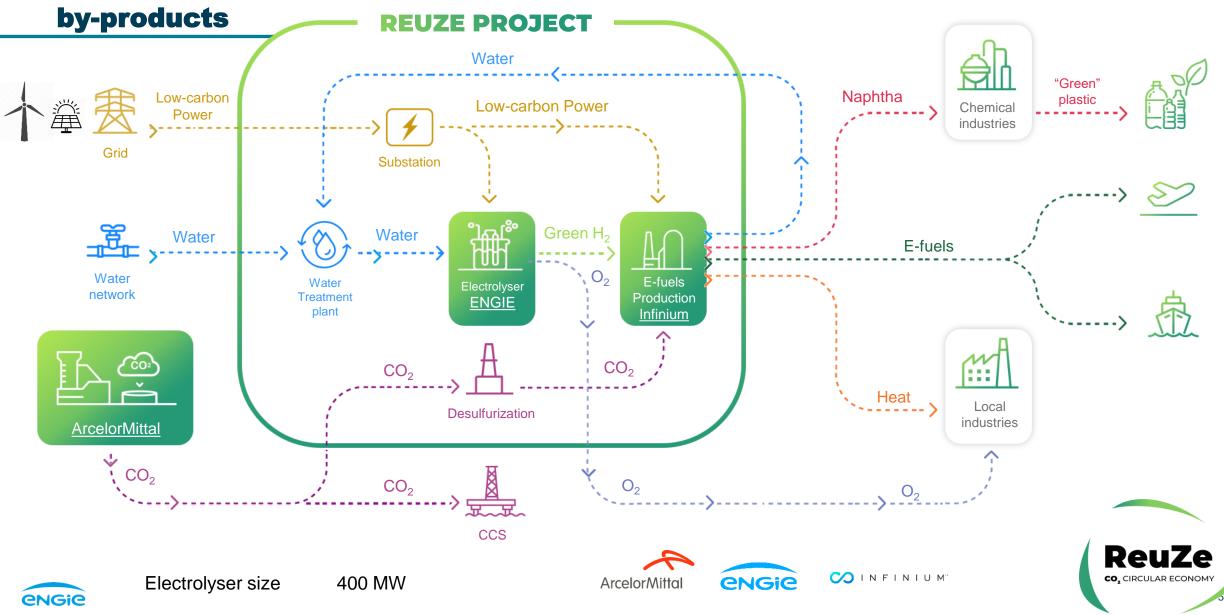
Has a very low energy density and is thus extremely hard and expensive to store and move around

 \rightarrow Need for synthetic hydrocarbons!*

the use of lots of carbon. C-Journal of Carbon research, 6 (39), 1-8





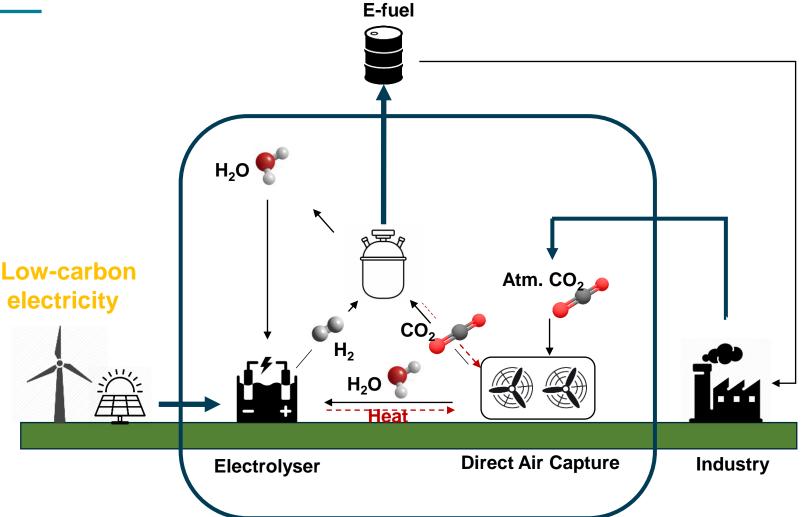


R&I Crucial: ReuZe project: Integrated project allowing to re-use

R&I crucial: CirculAIR fuels: converting low-carbon electricity to e-fuels in a fully circular manner!

With renewable electricity as only input, we can produce e-fuels for use in industry, heavy mobility, long distance transport or storage of energy,

As alternative to Direct Air Capture, we can **also capture CO₂ (i) from seawater** which could be useful for example for **producing e-fuels offshore** where off-shore wind is abundantly available or (ii) **anaerobic digestion** installations that produce biogas^{*,1}



* For this to be fully circular, water for electrolysis may be required unless wastewater is available and be purified.

eNGie ¹ Goffart De Roeck F., A. Buchmayr, J. Gripekoven, J. Mertens and J. Dewulf, 2022. Comparative life cycle assessment of Power-to-Methane pathways: biological vs catalytic biogas methanation. *Journal of Cleaner Production*, in press