Building a Paris Agreement Compatible (PAC) energy scenario

CAN Europe/EEB technical summary of key elements

June 2020

2.12 Producing non-fossil gases and fuels

Key assumptions

- Non-fossil gases and fuels are based on hydrogen that is exclusively produced with renewable electricity. In order to respond to specific demands of industry and transport sectors, renewable hydrogen can be converted into renewable ammonia, synthetic methane and liquid synthetic fuels.[1]
- All non-fossil gases are linked with important losses of primary energy input. Efficiencies of electrolysers and conversion processes gradually improve. Levelised costs of renewable hydrogen production however remain relatively high compared to direct electrification and constrain market introduction.[2]
- Against the background of limited potentials and low efficiencies, the PAC scenario restricts the use of non-fossil gases to sectors and processes that cannot use renewable electricity directly and that do not have any alternative to substitute fossil fuels, i.e. to energy-intensive industries and parts of transport.

Evolution of energy supply

Demand for renewable hydrogen firstly occurs in the energy-intensive industry processes that require an energy carrier with high energy density such as steel, chemicals, non-ferrous metals and pulp, paper and printing. By 2030, 6% of industry's final energy demand is covered by 161 TWh of renewable hydrogen. Between 2035 and 2050, renewable hydrogen demand remains stable in these sectors with 320 to 340 TWh, covering 15% of demand. In addition, synthetic methane is introduced to a minor extent to replace fossil gas in certain industry processes such as in cement, ceramics, glass, non-ferrous metals and pulp, paper and printing.[3] In 2030, 37 TWh of synthetic methane are consumed in the industry. Demand doubles to reach 63 TWh to 81 TWh between 2035 and 2050, covering up to 4% of industry's final energy demand.

In the transport sector, renewable hydrogen is scaled up at comparable pace to cover 131 TWh of demand in 2030 (5% of transport's final energy demand), increasing to 250 TWh in 2050 (13% of demand). It is mainly used to substitute fossil oil products in heavy freight where electric drives are not fully deployed, and in fuel cells in mid-distance shipping. In parallel, renewable hydrogen is converted to renewable ammonia for long-distance shipping (maximum of 86 TWh in 2050, 4% of the transport sector's final energy demand).

For aviation, liquid synthetic fuels are the only short-term renewable alternative besides liquid biofuels to phase-out the fossil oil product kerosene. Aeroplanes become the most important consumer of renewable gases and fuels with 192 TWh of liquid synthetic fuels consumed in 2030 (7% of transport's final energy demand), rising to 374 TWh (20% of demand) in 2050, while electric aircraft are firstly used to substitute the use of biofuels.

1 CAN Europe: Position on the use of gas in the future energy system, January 2020. Sustainably sourced biogas and biomethane also are non-fossil gases but covered in chapter 3.6. Hydrogen produced through steam methane reformation with fossil gas currently dominates European hydrogen consumption in industry. In the PAC scenario data, the current fossil hydrogen demand is not disclosed as such explicitly but included in the industry's primary energy demand.

2 ICCT; International Energy Agency: The future of hydrogen, June 2019; Cambridge Econometrics/Element Energy/European Climate Foundation: Towards fossil-free energy in 2050, March 2019; Agentur für Erneuerbare Energien (AEE, German Renewable Energies Agency): Metaanalyse Erneuerbare Gase in der Energiewende, March 2018; Agora Energiewende/Enervis: Power to gas/Power to liquid calculator, February 2018.

3 Material Economics; European Commission: A clean planet for all; AEE: Erneuerbare Energie für die Industrie. Renews Kompakt, June 2017; UK Department of Energy and Climate Change/Department for Business, Innovation and Skills: Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050. Glass, Ceramic sector, Food and Drink, March 2015.

Integration of members' and experts' feedback

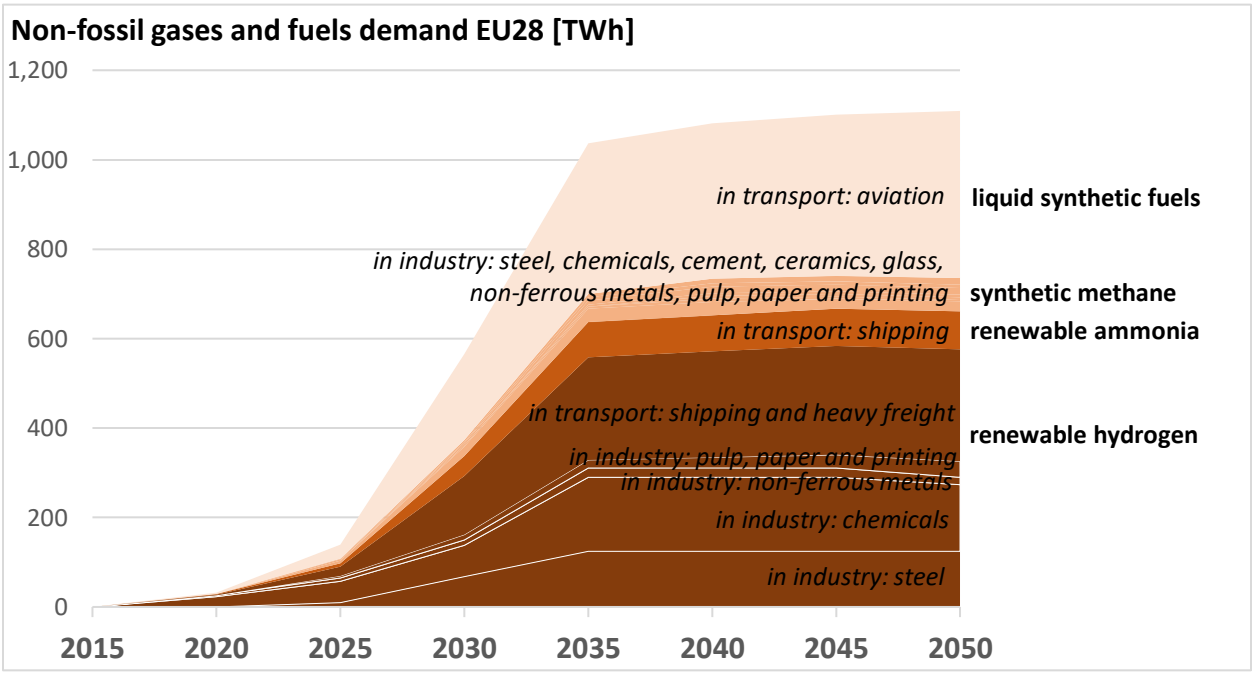
Members and participants of the PAC scenario workshops agreed that, given the availability of more efficient and easier to deploy solutions, non-fossil gases and fuels would not play any role in the residential and tertiary sectors, neither in agriculture. Additional electricity needed for producing renewable hydrogen should come from domestic EU potentials. Imports of renewable hydrogen from beyond the EU should be avoided.[4]

Sensitivities and limitations

Potential imports of renewable hydrogen are not included in the PAC scenario. Depending on costs, infrastructure and policy frameworks, such imports might play a role in the future. A complex set of economic and environmental parameters still would need to be assessed in order to explore its feasibility and desirability.

Key results

- Non-fossil gases have climate benefits only if they are exclusively produced with renewable electricity and replace fossil fuels in distinct demand sectors where there is no other sustainable alternative such as renewable heat or direct electrification with renewable electricity.
- Already during the 2020s, first relevant shares of renewable hydrogen have to be introduced to accompany the phase-out of coal and fossil gas in energy-intensive industries. In view of their poor efficiency, non-fossil gases however will only play a limited role compared to direct electrification.
- Compared to industry, renewable hydrogen, renewable ammonia and in particular liquid synthetic fuels cover a higher share of transport's final energy demand (up to 37% in 2050). Only a very swift and broad scaling up of renewable hydrogen generation allows for the ambitious fossil oil phase out in transport.



4 CAN Europe/EEB: Summaries of PAC scenario workshops and General Assemblies workshops.