Building a Paris Agreement Compatible (PAC) energy scenario

CAN Europe/EEB technical summary of key elements

June 2020

1.1 Industry

Key assumptions

Industrial transformation implies a reduction of material demand through higher reuse and recycling rates.

- Implementing circular economy approaches in the different industry sectors together with increasing energy efficiency of processes cuts the final energy demand by a third between 2015 and 2050. The PAC scenario broadly adopts the circular economy pathway of the Material Economics research project.[1]
- Wherever possible, production processes electrify with direct use of renewable electricity.
- In order to cover energy-intensive industry sectors' demand for high temperature heat, a significant increase of renewable hydrogen and to a minor extent of synthetic methane production is required. The PAC scenario assumes no carbon capture and storage/usage (CCS/CCU) technology is introduced.

Evolution of energy demand

The PAC scenario assumes a strong demand reduction of energy-intensive steel, chemicals, cement and pulp and paper industries of 39% to 48% between 2015 and 2050 due to lower material demand: Raw material is reused, recycled or substituted more often. Other industry sectors (transport and machinery equipment, non-ferrous metals, food) can realise less energy savings (11% to 28% less demand between 2015 and 2050).[2] The demand for renewable hydrogen and synthetic methane that are produced exclusively with renewable electricity rises swiftly from almost zero in 2015 to reach a level of circa 400 TWh throughout the years 2035 to 2050. Despite efficiency gains from modernisation of production processes, final electricity demand grows by 41% between 2015 and 2050 due to the electrification of processes that previously were driven by fossil fuels. The introduction of heat pumps to cover low and medium temperature demand in industries' production processes also increases the electricity demand.[3]

Integration of members' and experts' feedback

Following discussions with members and experts on how to tackle in particular the steel, chemicals and ceramics industry's demand for energy carriers with high energy density, the PAC scenario opted for a swift market introduction of renewable hydrogen that substitutes coal and fossil gas. These assumptions allow to respect limited biomass potentials which are shifted to a non-energy use as feedstock in the chemicals industry in the PAC scenario. This however requires policy framing for sustainable bioenergy use. Given the scepticism with regards to climate benefits and roll-out of CCS, preference was given to renewable hydrogen.[4]

Sensitivities and limitations

1 Material Economics: Industrial Transformation 2050. Pathways to Net-Zero Emissions from EU Heavy Industry, April 2019.

2 Taking over assumptions from Material Economics and European Commission: A Clean Planet for all. A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy. In-Depth Analysis. COM(2018)773, Nov. 2018; European Commission: EU Reference Scenario 2016. Energy, transport and GHG emissions. Trends to 2050, July 2016; UK Department of Energy and Climate Change: Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050, March 2015.

3 Taking over assumptions from Rehfeldt et al.: A bottom-up estimation of heating and cooling demand in the European industry. In: Energy Efficiency, Dec. 2016; Renewable Heating and Cooling European Technology and Innovation Platform: 2050 vision, Oct. 2019; Agentur für Erneuerbare Energien (AEE): Erneuerbare Energie für die Industrie, June 2017; Ecofys/Fraunhofer ISI/Greenstream/
Adelphi: Impact on the Environment and the Economy of Technological Innovations for the Innovation Fund (IF), July 2018.

4 CAN Europe/EEB: Summaries of PAC scenario workshops and General Assemblies workshops on 24 April 2019, 9 July 2019, 9 October 2019, 7 November 2019 and 31 January 2020.

The mobilisation of solid biomass in industry is in line with the sustainability criteria discussed during the PAC scenario building. Distributed biomass potentials however might be difficult to shift from decentralised individual heating to industrial production processes, even if industry sectors are willing to pay more for this energy carrier.

While the PAC scenario integrates the electrolyser capacities and the required additional renewable electricity generation capacities, no detailed modelling was carried out with regards to the infrastructure use (electricity, gas and hydrogen grids). Following the positioning of members and experts during the PAC scenario building, renewable hydrogen is assumed to be produced domestically within the EU. Imports however might become more attractive. An in-depth comparison of costs and infrastructure is needed to analyse this sensitivity.

Key results

- Thanks to reduced demand and electrification with renewables, industry can already achieve a 100% renewable energy supply in 2040.
- Electricity constitutes more than 60% of industry's final energy demand in 2040.
- The demand for gaseous energy carriers falls to less than a quarter of final energy demand in 2040, covered by renewable hydrogen and to a minor extent by synthetic methane, biomethane and biogas.