DECARBONISATION OF ENERGY IN THE EUROPEAN UNION BY 2050: CHALLENGES AND POTENTIALS

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Overview

The EU aims to become climate-neutral by 2050. Decarbonising the energy sector is crucial because the production and use of energy accounts for more than 75% of the EU's GHG emissions and three-quarters of the EU energy system relies on fossil fuels. Decarbonisation of the energy system will require a massive transformation in the way energy is provided, transported and used. The European Green Deal can only be successful when the unabated combustion of oil, natural gas and coal is phased out. For energy-based services, a number of climate-friendly technology options and energy carriers are possible, ranging from electrification to synthetic methane gas and other synthetic hydrocarbons to hydrogen. In the medium- and long-term, only a limited number of fuel types will continue to require carbon (long-distance shipping and trucks, aviation fuels). Where solar and wind power is often produced in surplus, it is possible to produce green hydrogen, that can be used for energy as well.

The circular bioeconomy is a major lever for decarbonizing the economy and sequestering the carbon captured by agriculture. The success of the EU Bioeconomy Strategy has already encouraged 10 Member States to develop their own national bioeconomy strategies and more Member States are in the process of developing their respective strategies. But the new Member States have not yet developed a bioeconomy strategy and lag behind the decarbonisation process of the energy sector. The EU target for renewable energy sources (20%) was met by 2020; however, the target set for most of the new Member States was lower than the average target of the EU, therefore massive decarbonisation plans should be put in place to be able to reach the GHG emission targets by 2050.

A sufficiently tight EU Emissions Trading System (ETS) cap could lead to a phase out of coal by 2030 because it makes coal power plants unprofitable. Since the 2018 EU ETS reform, the European CO_2 allowance price has risen substantially: from well below €10/t CO_2 until early 2018, to a price around €25/t CO_2 in 2019 and even above €60/t CO_2 in September 2021.Several options for decarbonising the use of natural gas exist.

Biogas/methane are already used today, but have a limited potential. Rather, green hydrogen is likely to replace natural gas in several end uses. Fugitive methane emissions from imported natural gas mostly arise outside the European Union. Comprehensive methane emission monitoring, and reporting requirements for natural gas imports are an important step. Alongside its chemical uses, hydrogen can also be combusted in a turbine to generate heat, or passed through a fuel cell to produce electricity to replace fossil fuel consumption in sectors such as steel production, large road vehicles, or aviation and maritime. The driving cost component of production is the fuel input required for transformation (water electrolysis).

There are already many measures in place that reduce oil consumption e.g. by taxing the consumption of energy products and promoting renewable energy, electrification and energy efficiency. The transport sector is the biggest driver of oil demand at the EU level – two-thirds of the final demand for oil comes from transport. Transport is the largest source of greenhouse gas (GHG) emissions in the EU after energy generation. Europe still needs to find a way to phase out fossil oil, pushing forward both electric vehicles and sustainable advanced biofuels. Today, biofuels, biogas and biomethane account for only 3.5% of all gases and fuels consumption and are largely based on food and feed crops. The integration of the mobility and the energy (electrical power distribution) sector into the energy and mobility system is crucial. Electromobility is key in road and rail transport, while new mobility services will increase the efficiency of transport. Other transport modes will have to rely more on advanced biofuels and e-fuels.

Renewable electricity is expected to decarbonize a large proportion of the energy system by 2050, and hydrogen is seen as a way to decarbonize parts of the energy system electricity cannot reach (including industrial processes such as steel and cement production, and transport sectors such as trucking, shipping, and aviation). Electrification of transport and heating, and also any production of hydrogen or synthetic fuels in Europe, will require a massive build-out of renewable electricity generation. But according to the proposal of the European Commission at the beginning of 2022, gas and nuclear has a role to facilitate the transition towards a predominantly renewable-based future and could be classified as "sustainable investments" under certain conditions (temporary green label to certain gas and nuclear projects). As fossil fuel resources gradually phase out, crops cultivated for bioenergy (including biofuels) and for the production of biobased materials could affect food security (taking away land and calories from human nutrition), with the risk of increasing food prices.

The proposal to tighten the EU ETS, extend it to shipping and introduce a second EU ETS for transport and buildings will help to strengthen the central role of carbon pricing. The EU imports significantly more carbon than it

exports, and the issue of carbon leakage cannot be ignored. The challenge for the EU is to design a carbon border tax to prevent carbon leakage by incentivizing other countries across the world to decarbonize.

Methods

- decarbonisation challenges: analysis of the share of renewables in the Member States,
- examination of trends and effects of variables influencing decarbonisation: investigation of decarbonisation policies in Member States with national bioeconomy strategies,
- the challenge of decarbonisation in the Member States with no national bioecomy strategies: analysis of possible policies leading to decarbonisation,
- scenarios for what the future of decarbonisation of energy might look like in 2050.

Results

Decarbonisation of the energy system will require a massive transformation in the way energy is provided, transported and used. Views on what the system should or would look like in 2050 still strongly diverge. Electrification of transport and heating will require a massive build-up of renewable electricity generation. Current national energy and climate plans are insufficient to achieve an EU-wide climate neutrality by 2050. A strong commitment is needed to ensure that Member States' policies are aligned with the European targets.

Conclusions

While we cannot provide a comprehensive assessment of the massive European Green Deal proposal, we think this analysis addresses crucial elements. Greenhouse gas pricing should cover all sectors and greenhouse gases. Upcoming revisions of the EU ETS have to ensure the alignment with the long-term goal of climate neutrality.The climate balance of energy imports should be certified to encourage suppliers to ensure carbon-neutral value chains. The EU will require an energy network infrastructure that enables a substantial increase in electricity generation from renewables. Key challenge is how to carry abundantly available renewable energy over to periods when energy is less available.

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