Advanced biofuels and carbon capture can pave the way for the EU climate goals

Recommendations:

- Government support (e.g., grants, loans, subsidies) can encourage investments in advanced biofuel projects and facilitate their development towards commercialization.
- Incentives for the deployment of CCS infrastructure in Europe such as higher price of EU carbon credits can be beneficial for the economic feasibility of advanced biofuels technologies and enable them as negative emission technologies.

Summary / Key Themes and Terminology:

- Advanced biofuels can smooth the energy transition in the transport sector and provide a short/medium-term solution for segments otherwise difficult to decarbonize, while meeting sustainability and GHG emission targets.
- The combination of advanced biofuels with carbon capture and storage (CCS) can boost the climate change mitigation potential of advance biofuels and reduce the price gap with conventional fossil fuels.
- Higher investments in advanced biofuel projects and a clear outlook of the deployment of CCS infrastructure in Europe are seen as necessary for the successful of future advanced biofuels-CCS

The role of advanced biofuels in the European climate targets

In Europe, the Renewable Energy Directive (REDII) has set a target of 14 % renewables in the transport sector by 2030. Within the target, the contribution of advanced biofuels and biogas as a share of final consumption of energy in the transport sector shall be at least 0.2 % in 2022, at least 1 % in 2025 and at least 3.5 % in 2030 [1].

Advanced biofuels are liquid fuels for transport produced from certain feedstock that **meet sustainability and GHG emission criteria**. Examples are lignocellulosic feedstocks (i.e. agricultural and forestry residues), non-food crops (i.e. grasses, miscanthus, algae), or industrial waste and residue streams that have low CO_2 emission or high GHG emission reduction, and reaches zero or low indirect land-use change (ILUC) impact. Due to their compatibility with existing fossil-fuels infrastructure and utilization pathways, advanced drop-in biofuels are considered the most readily available alternative to fossil fuels for direct implementation in the transport sector, enabling a faster carbon emission reduction in the segments that cannot be easily decarbonized by direct electrification (i.e. aviation, maritime, long-haul road).

However, currently just a few advanced biofuel technologies have reached commercialization, while many remain at demonstration and pilot scales. This is mainly due to high production costs and the absence of international incentives that foster their development, limiting their implementation potential. The estimated minimum fuel selling price of advanced biofuels remains higher than for their fossil counterparts being in the range of 0.5-2.0 euro/L.

Advanced biofuels and negative emission technologies

According to the IPCC's fifth assessment report, negative emission technologies will play a significant role to meet the climate targets in the future and hold global warming to well below 2 ºC compared to pre-industrial levels, as established in the Paris agreement. Among these, biofuel technologies combined with carbon capture and storage (BECCS) have shown the **highest CO_2 reduction potential**, being identified as a **key concept to achieve climate change** mitigation[2,3].

Based on recent research, the GHG emission reduction of advanced biofuels production is 85 % compared to the fossil baseline and, by coupling CCS to the process, it can be further increased up to 115 %, effectively performing as a negative emission technology (Figure 1). In terms of costs, when revenues from the European carbon allowance market are included at a price of 27 euro/ton, the extra cost of implementing carbon capture can be paid off, and in some scenarios even decrease the minimum fuel selling price by 7-15 %.

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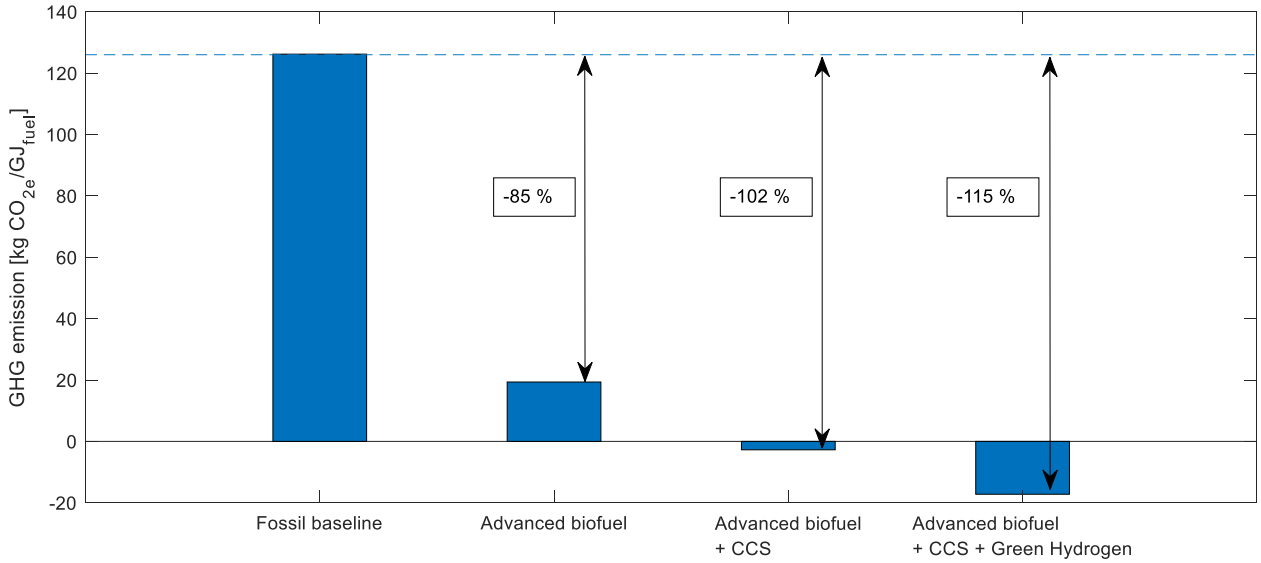

Figure 1. *Impact of carbon capture on estimated GHG emissions of advanced biofuels*

What is holding back advanced biofuels with CCS?

- → Regulatory uncertainty, as well as low subsidy levels and high financing costs, are seen as the most critical barriers by the industry to invest in advanced biofuels in the current market.
- → Technological challenges remain for advanced biofuels scale-up, so support for research and development will continue to be fundamental.
- → CCS has had a slow commercial implementation. Today, there are 37 major large scale CCS projects, 17 of these are in operation, 4 in construction and the remainder are in varying stages of development.
- → The dispersed value chain of advanced biofuels and CCS technologies over different geographical regions make the financing and share of such combined projects more complex.

Policy Implications

The combination of advanced biofuels and CCS can be beneficial to increase their climate change mitigation potential and to decrease the price gap between advanced biofuels and fossil fuels; however, regulatory uncertainty and low economic incentives are seen as institutional barriers for the development of advanced biofuel projects and the deployment of CCS infrastructure in Europe. The consolidation of CCS in Europe and monetary stimulus for advanced biofuels projects, such as subsidies and a higher carbon credit price, are considered crucial to enable this technology in the future while ensuring sustainable and high-quality outcomes. Transferring some of the associated financial risks from the private to the public sector can encourage private investments in advanced biofuel-CCS projects.

References

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