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Autor*innen: Fürst, Kristina; Patonia, Aliaksei
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[Dachzeile]

Hydrogen vs. Carbon Capture: Why Europe Needs Both for Net Zero

In their decarbonisation journey, European countries have so far focused on policies to dramatically increase the share of renewables and improve energy efficiency across diverse sectors, including industry, construction and housing. However, it has become clear that renewables alone will not enable the industrial sector to achieve its decarbonisation goals, as a large share of the carbon dioxide emissions from industry are emitted during manufacturing processes. Emerging technologies for carbon capture and storage (CCS) and carbon capture and utilisation (CCU) as well as hydrogen (H2) are currently being explored as the most promising solutions.

1 CCU vs. CCS

Worldwide, a variety of technologies for the capture of carbon dioxide emissions and their storage (CCS) in geological formations have been proposed, developed, and deployed. However, the volumes of CO2 produced in industrial processes significantly outstrip the capacity of both existing and emerging facilities. Despite the technical and economic feasibility of many technologies, the uptake of CCS has stalled in Germany, where protests led by media-savvy environmental action groups have resulted in the cancellation of several CCS pilot projects even as countries such as Norway and the United Kingdom forge ahead. But why has CCS faced such fierce opposition in Germany?
One explanation for this could lie in the framing of this technology. In Germany, CO2 is almost exclusively portrayed and perceived as a harmful greenhouse gas. In countries such as the UK, Norway and the Netherlands, the discourse about the development of CCS is more positive. Bringing CO2 emissions down to zero until 2045 is thus the ultimate climate goal. In Germany, the sequestration of CO2 is often characterised as an "artificial geoengineering" solution pushed by the fossil industry to facilitate the pursuit of a "business as usual scenario". CCS is also perceived as bearing risks for the environment or human health and high costs.
In contrast to CCS, carbon capture and utilization (CCU) is generally pictured in a more optimistic light, since it is often represented within a so-called 'benefit perception' frame in which CO2 figures as a resource rather than a harmful greenhouse gas that must be extracted from the atmosphere or from industrial processes and locked away, incurring immense costs and uncertainties. Instead, CCU allows us to believe that by reusing captured CO2 in the production of plastics, insulation, medicine or synthetic fuels, for example, we will continue to make economic gains. In reality, however, the net benefit for economies, in terms of the costs and energy savings for carbon intensive industries, varies across different use cases. It could well be that in some instances CCS will deliver better environmental and economic outcomes. Experts working on industrial decarbonization have conducted

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comprehensive "Life Cycle Assessment Studies" to determine the CO2 reduction potential for decarbonization technologies (H2, CCU, CCS) for individual industries.

2 Hydrogen vs. CCU/CCS

In light of the complex uncertainties around CCU and CCS, hydrogen is often portrayed as a more viable solution to extend the carbon budget, as so-called 'green hydrogen', produced using renewable energy, provides a 'clean' fuel and feedstock that does not emit any CO2 when burned. In Germany, hydrogen is generally perceived more favourably than CCS or CCU solutions. Following the adoption of Germany's National Hydrogen Strategy in 2020, most carbon intensive sectors (steelmaking, aviation, maritime transport etc.) are keen to harness hydrogen to fast track their decarbonisation efforts. But can hydrogen deliver on the expectations of policymakers and businesses?

As is often the case, the reality might be more complicated. Green hydrogen currently accounts for less than five percent of total hydrogen production worldwide. In view of this, many experts have suggested that conventional hydrogen production from fossil fuels should be coupled with either CCS or CCU as a first step towards a low-carbon hydrogen economy. Besides, many industrial processes need carbon dioxide to manufacture their products such as fertilisers and urea. That is why these technical approaches to decarbonisation are intertwined, although they are often portrayed as alternatives to each other or even substitutes.

3 Hydrogen's troubled first steps

Even if green hydrogen production could be scaled up to replace fossil fuels without the assistance of CCU or CCS, real-life hydrogen projects might still struggle to gain public acceptance. Indeed, recent hydrogen projects abroad have met with similar opposition to proposed CCS projects in Germany. In the United Kingdom, planning for the Whitby Hydrogen Village – the first British hydrogen-heated village – has been derailed by a public backlash. Although the idea of converting existing natural gas infrastructure to hydrogen appeared to be both technically and economically feasible, the project rapidly became a PR disaster, with local groups expressing significant concerns about both costs and potential safety hazards. Many of those affected feel that they are being forced to participate in an experiment that could leave them stranded with obsolete appliances and burdened by higher costs. Many were also concerned that hydrogen might prove to be more dangerous than natural gas, with one report produced for the UK government reporting a four-fold increase in the risk of explosive events. With opposition within the community showing no sign of decline, the future of Britain's first hydrogen-heated residential area is uncertain.

So while hydrogen is often promoted by researchers, businesses, and policymakers as a panacea, like CCU and CCS, it may prove to be far more controversial than anticipated. Given the complex nature of our economic and energy systems and the unfolding climate crisis, the CO2 mitigation potentials and environmental impacts of these technological solutions (CCS, CCU, and H2) will need to be carefully and comprehensively evaluated to optimise their use in the energy transition toolset.

Contact: aliaksei.patonia@oxfordenergy.org