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The role of CCUS in an Integrated Energy System

The Implementation Working Group 9 (IWG 9) was established within the context of the European Strategic Energy and Technology (SET) Plan to help progress the Research and Innovation (R&I) activities required to achieve the 2020 targets for CCS and CCU agreed by the European Commission, SET-Plan countries, and industry.

The IWG9 is co-chaired by the Netherlands, Norway, and the Zero Emissions Platform. Czechia, Germany, France, Hungary, Italy, Spain, Sweden, Turkey, and the United Kingdom are also represented under action 9 (CCUS) of the SET-Plan.

The IWG9 would like to give the following input regarding the EU Strategy on Energy System Integration.

CO_2 infrastructure, CCS, CCU and hydrogen should be at the core of a truly integrated, climate-neutral energy system.

The European Commission has recently released a Communication on An EU Strategy for Energy System Integration, outlining how a climate-neutral energy system should be developed and what steps Europe needs to take to deliver on this promise. To achieve the EU's objective of becoming climate-neutral by 2050 in a cost-effective way, all low-carbon technologies, such as CCS and CCU, that are scientifically proven and readily available, should be deployed. The strategy for Energy System Integration also takes the view that a technology-neutral approach should be privileged to deliver a net-zero compliant energy system.

Through the strategy for Energy System Integration, the European Commission should especially support projects that will underpin the development of cross-border CO_2 transport, usage and storage infrastructure, thereby supporting projects along the CCS and CCU industrial chain. The strategic development of CO_2 infrastructure is vital to ensure the large-scale decarbonisation of European industrial and energy sectors, while continuing to invest in the scale up of renewable energy sources. CO_2 transport and storage infrastructure is also instrumental in delivering early, large-scale volumes of low-carbon hydrogen produced from reformed natural gas[1] with CCS, which will enable many industrial processes to be redesigned to avoid CO_2 emissions.

There is no doubt that electrification will become an increasingly important feature of future energy systems. Any pathway to climate neutrality by 2050 in the European Union will require a deep electrification of our economy, with renewable energy sources as the primary source

[1] By Steam Methane Reformers and Auto Thermal Reforming

of power generation[2]. Large-scale electrification will be a lengthy process that will happen over a considerable period of time. Roughly 20% of the EU's energy demand is met by electricity and 80% by molecules. The reason for this lies in the natural characteristics of molecules, as they have a higher energy density and are easier to transport and store. With a legally binding target of reaching climate neutrality by 2050, electrification alone will not be a viable pathway for energy-intensive industries to decarbonise. Therefore, complementary methods of decarbonisation must be deployed – such as CCS and CCU – which can provide real emissions reduction and abatement and ensure a cost-efficient transition[3].

When applied to renewable gases, CCS is likely to play a role in a climate-neutral energy system, in particular for the decarbonisation of energy-intensive industries (EIIs). An alternative to the permanent storage of CO_2 is CCU (like the production of synthetic fuels). Synthetic fuels can be associated with very different levels of GHG emissions depending on the origin of CO_2 (fossil, biogenic, or directly captured from the air), and the process used. It is of key importance to properly monitor, report, and account for the emissions and removals of CO_2 associated with the production and use of synthetic fuels to correctly reflect their actual carbon footprint. A robust carbon removal certification mechanism will allow the tracking of the CO_2 fluxes involved in CCU processes. Such certifications can allow regulatory incentives for market take-up of synthetic fuels or other CCU products to be provided, which will be slow due to high investment costs.

CCS and CCU and CO2 infrastructure can support a low-carbon European economy, safeguarding jobs, industrial activity, and delivering sustainable growth

Reaching climate neutrality by 2050 requires strategic investment decisions, even more so as Europe deals with the aftermath of the COVID-19 health and economic crisis. The pathway towards climate neutrality will bring about a major transformation of energy-intensive industries, such as cement, lime, steel and chemicals, that are at the core of the European economy and provide products that are at the heart of how we live our lives. For these sectors, pathways including CCS and CCU represent the lowest-cost route to decarbonisation whilst maintaining industrial activity[4] and preserving existing jobs. It can capture, reuse and store emissions produced during industrial processes, and it also plays an important role in the manufacturing of clean hydrogen, which can be used to fuel energy-intensive industries and households. An appropriate and thorough GHG emissions accounting is key to ensure that real climate change mitigation is delivered.

When applied to industrial processes and power plants, CCS can secure jobs and incomes and ensure European industrial competitiveness in international markets, while delivering sustainable growth.

Parallel to the storage of CO2, industry may look into the commercial use of CO2 for low-carbon products, provided that a thorough life-cycle analysis is conducted. While several CCU applications, in many cases, have a limited potential for CO2 abatement at scale, they could

[2] European Commission, A Clean Planet for All, 2018, Shell Sky Scenarios (based on IEA data), A Climate Neutral EU by 2050, 2020
[3] ZEP report, Climate Solutions for EU Industry, 2017. The report argues that "while electrification can reduce CO2 emissions in some industries and locations, the abatement potential is limited in sectors where CO2 emissions are a product of chemical processes and not the combustion of fossil fuels. The amount of electricity required for large scale electrification of Europe's energy-intensive industry would necessitate levels of new low-carbon electricity generation that stretch the concept of feasibility".
[4] Zero Emissions Platform, "Climate Solutions for EU industry", 2017

provide a valuable means of incentivising investment in enhanced CO2 capture technology in the short term, reducing costs for industry and society. Any CO2 reduction allocation needs accurate carbon accounting covering all processes involved, including e.g. energy inputs and embedded emissions.

Upon an accurate carbon accounting and life-cycle analysis, these solutions should be combined to enable large-scale permanent storage for captured CO2 to meet the required level of reductions, thus enabling the long-term sustainability of energy-intensive industries in a low carbon Europe. Given the critical importance of CCS in enabling decarbonisation of Europe's energy-intensive industries, the rapid deployment of CO2 transport and storage infrastructure to support these important sectors is a matter of priority. A failure to provide such enabling infrastructure in the short term will increase CO2 liability risk and undermine investments in jobs and economic activity.

CCUS will help both the retention of existing jobs and create new jobs by supporting the gradual yet irreversible decarbonisation of European energy-intensive industries that will be impacted by climate change and the economic crisis. By providing a low-carbon alternative, existing jobs in industries – such as cement, steel, lime, and chemicals – will be preserved. Ultimately, CCUS can enable European industrial regions to remain competitive in a net-zero landscape.

Additionally, the European Union should lay the foundation for a transition towards a climate-neutral economy, incentivising decarbonised industrial products. Coupled with a functional CO_2 price, this should enable the CCS and CCU industry to become self-sustainable in the long term, after the initial support mechanisms that are needed to demonstrate CCS and CCU at a large scale in Europe.

Investing in shared CO_2 transport and storage infrastructure is the **ultimate European project**, and it represents a strategic and instrumental policy decision to preserve Europe's welfare and to make the European society future-proof for a climate-neutral economy. As several CO_2 capture projects are near-ready for large-scale deployment, European CO_2 transport, usage and storage infrastructure would connect CO_2 emitters (industrial hubs and power plants) to storage sites and/or CO_2 off-takers enable the extensive decarbonisation that will be needed to meet the climate neutrality target. Timely development of this infrastructure is crucial and will also enable industry to take a proactive role in the discussions around 2030 and 2050 climate targets.

Europe benefits from privileged conditions. The North Sea basin area is a world-class region for storage. Industrial hubs – such as those around the Ports of Rotterdam, Antwerp, Amsterdam, Le Havre, Dunkerque, and the North Sea Port, as well as the Teesside, Humber, Ruhr, and Cork regions – would be able to capture CO_2 from industrial processes and power plants and use CO_2 transport and storage infrastructure to securely store the CO_2 under the North Sea. Such hubs also profit from the concentrated industrial activity; therefore they might also develop some initial applications of CCU. The next step will be to extend this infrastructure more inland to unlock access to CO_2 storage for industrial areas and power plants that are located further from the coast. Last year's provisional application of amendment 6 of the London Protocol makes it possible to transport CO_2 between countries for the purpose of offshore CO_2 storage. Still it is crucial to formally ratify this amendment.

Securing political support for the five cross-border CO_2 Projects of Common Interest[5] (PCI) is vital, since these projects are on the right track to become operational before 2025. A solid policy framework providing a degree of predictability for long-term investments should be a priority for European policymakers, which brings about the need to revise and extend the scope of existing legislation – such as the TEN-E regulation and EU ETS directive – to prepare for the rollout of CO_2 and clean hydrogen infrastructure. As indicated in the European Taxonomy for Sustainable Finance, all modes of CO_2 transportation to permanent geological storage – pipeline, ship, barge, train, truck – are allowed. This outcome is critical and should be preserved in relevant pieces of legislation, as it will allow near-ready projects to be realised and to create opportunities for numerous CO_2 emitters throughout the entire EU area to have access to low-cost decarbonisation pathways. CO2 transport for utilisation by pipeline is currently a shortcoming of the European Taxonomy. By allowing a small amount of CO2 to be transported for utilisation with an initial threshold, the pipeline network should be deemed eligible under the Taxonomy.

A clean hydrogen economy will initially rely on large volumes of clean hydrogen produced from natural gas with CCS, therefore requiring the development of cross-border CO_2 infrastructure[6]. The initial investment in 'blue' hydrogen production and associated infrastructure – linking this clean energy carrier to the customer – will pave the way for the scaling up of green hydrogen, as renewable electricity becomes more abundant.

All efforts to mitigate the impact of climate change must also look at increasing carbon removals from the atmosphere. Carbon removals are needed to address residual emissions to achieve overall net-zero emissions. Given possibilities to connect to the CO_2 transport and storage infrastructure, Europe would have great opportunities to become a global leader on carbon removal solutions.

The work of the Implementation Working Group 9 in the European Strategic Energy Technology Plan (SET-Plan)

Europe is taking a leading role in the fight against climate change and aims at an economy with net-zero greenhouse gas (GHG) emissions by 2050. The adoption of low-carbon technologies at industrial scale is essential to achieve this goal. This is exactly what the European Strategic Energy Technology Plan (SET-Plan) aims at realising by bringing together the European Commission and national authorities, as well as industrial, societal and research stakeholders, in a coordinated effort towards climate-neutral energy systems.

Among other priorities within the SET-Plan, **Carbon Capture and Storage and Carbon Capture and Utilisation** is recognised as an essential solution to meet this goal (Priority No. 9). An Implementation Plan laying down specific targets for CCS and CCU deployment and

[5] European Commission, "Technical Information on Projects of Common Interest", 2020

[6] Material Economics, "Industrial Transformation 2050. Pathways to Net-Zero from EU Heavy Industry", 2019

associated R&I priorities for 2020 and 2030 has been developed and the Implementation Working Group (IWG9) has been mandated to follow up the progress. The targets are clustered around five areas: full-scale projects, clusters and infrastructure, capture, storage, and CCU and modelling.

Since 2017, the IWG9 was composed of 11 SET-Plan countries (Czechia, France, Germany, Hungary, Italy, Norway, the Netherlands, Turkey, Spain, Sweden and the UK), industrial stakeholders, non-governmental organisations, and research institutions, and it is chaired by the Netherlands, Norway and the Zero Emissions Platform. IWG9 aims at involving more countries, more funders, and more stakeholders in order to accelerate the large-scale deployment of CCUS technologies and meet the targets of the Implementation Plan.

To assist IWG9 with this work, the IMPACTS9 Consortium – combining the expertise of four partners in the CCS and CCU area – serves as an 'operational arm' for the IWG9. You can find more details on the CCUS SET-Plan at the dedicated website of the projects under www.ccus-setplan.eu. CCS technologies can make a significant contribution to climate change mitigation. Their potential for carbon emissions abatement and removal is scientifically proven and acknowledged by the European Taxonomy for Sustainable Finance[7] and the 'Clean Planet for All' scenario[8]. Commercial, full-chain CCS projects have been operational since the 1980s, with more than 260 million tonnes of CO_2 emissions from human activity captured and stored over 40 years and an overall estimation of around 40 million tonnes of captured and stored CO_2 per year[9] at present. Currently, CCU technologies present different levels of maturity, depending on the final product. Life Cycle Assessments and further scientific evidence describing their climate mitigation potential will be needed to make a case for these technologies.

[7] European Commission, "Taxonomy Report: Technical Annex", 2019
[8] European Commission, "A Clean planet for All", 2018
[9] Global CCS Institute, "2019 Global Status of CCS Report", 2019.