

Carbon Capture and Utilization Cluster

COMMITTED TO
IMPROVING THE STATE
OF THE WORLD

Collaborative Innovation for Low-Carbon Emitting Technologies

The objective

The objective of the Carbon Capture and Utilization (CCU) cluster of the World Economic Forum's Collaborative Innovation for Low-Carbon Emitting Technologies (LCET) initiative is to determine the conditions under which current CCU technologies can be upscaled and made economically viable. The cluster will also identify a series of CCU technologies that should be developed for demonstration projects in the future.

Background

Despite a continuous reduction of CO₂ emissions associated with chemical operations, the industry will not be able to fulfil climate goals without the adoption of new low-carbon emitting technologies as the optimization of current production processes has technical limitations.

The chemical industry's GHG emissions come from two sources: energy-related emissions (85% of total emissions) and process-related emissions (15% of total emissions).¹

In 2019, the Governors Community for the Chemical and Advanced Materials Industry created the LCET initiative. The objective of the initiative is to accelerate the development and upscaling of low-carbon emitting technologies for chemical production and related value chains. The ambition of the initiative is to set the industry on a path to net-zero emissions by 2050.

Carbon capture and Utilization is one of the five technology clusters identified as part of the initiative, along with Biomass Utilization, Electrification, Alternative Hydrogen Production and Waste Processing.

The opportunity

CCU can be seen as a circular economy solution to transform waste into product. The chemical industry has the potential to eventually become a net CO₂ consumer, while also providing CCU solutions to itself and other industries such as cement, steel and power.

Currently, CCU requires technical improvements. In particular, the development of CO₂ activation is key for CCU to become efficient and affordable. There is an opportunity for chemical companies to work on the

development of new CO₂-to-chemicals routes for molecules (C₂, C₃) other than methanol. These include the activation of CO₂ via electrochemistry followed by biotechnological conversion or direct gas fermentation of CO₂-containing gases.

It is important to acknowledge that CO₂ use does not necessarily reduce emissions, and measuring climate benefits is complex, requiring for instance a comprehensive life-cycle assessment. CO₂ use can provide climate benefits where the application is scalable, uses low-carbon energy, and shifts a product with higher life-cycle emissions.²

Thus, CCU technologies can be applied only in certain cases (e.g. no emission storage possibilities; transition period; excess of renewable energy is available) and have to be considered as a complement, not an alternative to other low-carbon technologies.

State-of-the-art and challenges

Many technologies are available at different readiness levels, including demonstration levels. However, upscaling of these technologies is currently not economically viable.

Policy and economics aspects (e.g. electricity prices) are also challenging, along with the need for significant amounts of energy for the conversion process. The CO₂ conversion process is energy intensive and upscaling of CCU technologies will require significant supply of renewable energy.

The challenge remains in ranking and sorting technologies on which to focus on. The absence of a unified certification system for "green/sustainable" chemical products is an additional challenge.

Our approach

Members of the technology cluster identified a high potential for mid- and long-term collaboration on multiple levels and identified two main work streams for the development of their collaboration:

1. A joint study on current CCU technologies

The cluster proposes to elaborate on what would be needed to upscale the current CCU technologies and make them economically viable.

¹ [Clean Technology Scenario. The Future of Petrochemicals. IEA. 2018](#)

² [Putting CO₂ to Use. International Energy Agency. 2019](#)

Technical and economical key parameters would be the availability and cost of renewable electric energy, as well as the CAPEX required per metric ton per year produced, especially if affordable renewable electric energy is only available part of the year.

On the regulatory side, the cluster will elaborate on what type of regulatory interventions would be required for CCU technologies upscaling.

Based on outcomes of the study, joint policy recommendation might be developed along with collaborative projects with high technological feasibility and potential impact.

2. Develop an idea pipeline for CO₂ conversion

The cluster would like to focus on developing a pipeline for CO₂ conversion and identify the parameters (e.g. market size, market price, net CO₂ consumption, etc.) that should be applied to determine what are the molecules for which CO₂ conversion would be appropriate. The project would also investigate what sources of CO₂ would be suitable for CCU.

The work will focus on the CO₂ conversion into chemicals; therefore, carbon capture technology, fuels and mineralization are out of scope.

Progress through 2019

After the initiative kick-off meeting (hosted by BASF) held in July 2019, the technology cluster advanced the development of the work streams and held a series of calls in order to define the scope of the work.

Preliminary roadmaps for potential collaborations, including the scope, state-of-the-art, challenges, opportunities, timeline and resources needed were defined at the Second Technology Meeting on 5-6 December 2019 hosted by the World Economic Forum in Geneva.

Current activities and next steps

Cluster members have planned regular calls in order to further develop their roadmap and studies.

In parallel, legal consultation and scoping for the CO₂ conversion pipeline will be done along with technology mapping in order to lead the effort towards demonstration projects development.

Calendar

2020-2021 key events:

- The Governors Community for the Chemical and Advanced Materials Industry convened at the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland (19-24 January 2020)
- The Third Technology Meeting will take place in June 2020 (tbc)
- The Fourth Technology Meeting will take place in October 2020 (tbc)
- The Governors Community for the Chemical and Advanced Materials Industry will convene at the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland (26-29 January 2021)

Participants

The LCET Carbon Capture and Utilization cluster is composed of chief technology officers and senior technology experts from partner organizations in the chemicals, materials and oil and gas sectors, experts in process technology, and selected emerging technology leaders.

LCET Carbon Capture and Utilization cluster partner organizations

- Air Liquide
- Arcelor Mittal
- Covestro
- Dow
- Repsol
- SIBUR
- Total (lead)

How to engage?

Other companies from relevant industries are invited to join and engage with the core partners group. This might include, but is not limited to cement, biomass, steel, consumer companies.

Other organizations such as governments, knowledge partners, associations, research institutes and universities are invited to engage in the project activities and dialogues.

The LCET initiative is a part of the [Mission Possible Platform](#).

For more information on this initiative and to engage, please visit the [LCET initiative webpage](#) or contact:

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