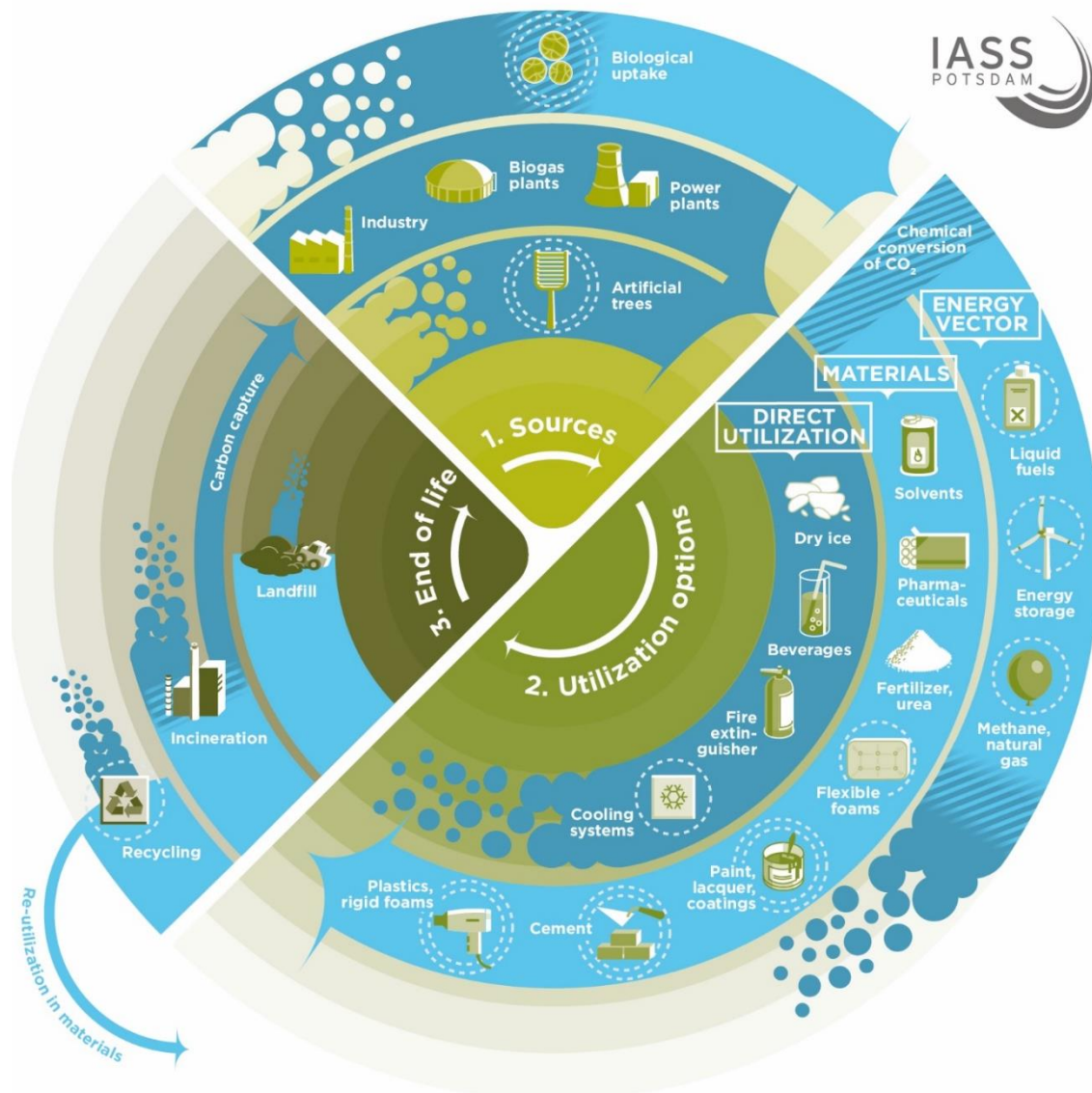


Carbon Capture and Utilisation Technologies Technological status, environmental impacts and policy developments – Stakeholder event – 17 September 2018

Summary report

A number of novel carbon capture and utilisation (CCU) technologies are under development for the production of low-carbon fuels, chemicals and building materials. They use CO₂ as a feedstock rather than letting it out in the atmosphere, thus potentially contributing to the circular economy, climate mitigation and the global competitiveness of European industry.



Overview of CO₂ sources, utilisation options and end of life considerations. *Source: [IASS Potsdam](https://www.iass-potsdam.de/)*

Most of these technologies are not yet commercialised. Therefore, there is a lot of uncertainty about their economic and environmental impacts. Many researchers and industries are working hard to further develop these technologies and provide clearer answers on the possible contribution of these technologies to the EU's policy objectives.

On 17 September 2018, the European Commission's Directorate-General for Climate Action organised a stakeholder event to present two major works on these technologies:

- the **study "Identification and analysis of promising Carbon Capture and Utilisation technologies, including their regulatory aspects"**, conducted by Ramboll, together with the Institute for Advanced Sustainability Studies (IASS Potsdam), Kassel University, Center for Environmental Systems Research (CESR), CE Delft and IOM Law.
- the **[scientific opinion](#) of the Group of Chief Scientific Advisors of the European Commission** underpinned by an **[evidence review report](#) produced by SAPEA** - a consortium of academies of science.

The panel discussion highlighted some of the findings of the studies and industry representatives, researchers, policy makers and NGOs brought additional elements from their experience. Some of the key points raised were:

- By 2050 we need solutions that will either circulate the carbon or remove it from the atmosphere at competitive costs. CCU technologies are one piece of the puzzle especially for industries that have hard to abate emissions or for industries that will need carbon as a feedstock.
- Cross-sectoral innovation will be very important where the waste of one industry can become the feedstock of another.
- Some mineralisation routes provide the opportunity to solve two problems at the same time: waste ashes and slags from industry can be converted with CO₂ to useful products like building materials instead of being landfilled.
- In the long-term, CCU fuels will have a potential to replace fossil fuels in sectors, where alternatives may be limited such as fuels for aviation.
- CCU technologies will need to overcome still a number of challenges related to conversion efficiencies, costs, developing of markets and persuading customers.
- Large-scale expansion of CCU technologies will require large volumes of renewable energy and hydrogen at competitive prices, which are in itself decarbonisation pathways. These developments will need to go hand in hand in order to reap the environmental and economic promise of CCU technologies where these will be relevant solutions.
- We must make sure that these technologies are further developed in the EU and become available for the relevant CCU applications in the mid-term. Otherwise, we reduce our options for the future, possibly leading to considerable costs and inefficient solutions.
- We have the financial support framework – the future Horizon Europe and Innovation Fund – to support the technological development and proving of concepts and impacts.
- Whereas, the main benefit of these technologies will be for the circular economy, we need to further develop our regulatory framework to acknowledge when there is

contribution from these technologies to our climate objectives. A harmonised life-cycle assessment (LCA) is a first and indispensable step. The revised Renewables Directive is already giving the impetus for fuels. We need to start rethinking our emissions monitoring framework for the period after 2030. We should also look at the possibilities that public procurement and state-aid rules offer to support innovative technologies that are beneficial for the climate.

In detail,

The study “**Identification and analysis of promising Carbon Capture and Utilisation technologies, including their regulatory aspects**” will be finished in the course of October 2018, but already some preliminary conclusions can be drawn:

Technical, economic and environmental assessment

- The ecological performance of many technological options, in particular PtX and air capture, relies on the availability of renewable energy, the economic precondition will be its sufficiently low pricing. The current main challenge is the energy and material demand of electrolysis and hence costs, which will be required for large-scale production.
- From a lifecycle perspective, the CO₂ mitigation effect by substitution is independent from the durability of products (= retention time of carbon) for a given product mix. The CO₂ mitigation can occur in the production phase of the CCU products while the use and end-of-life phase results in the same GHG emissions (e.g. crude oil diesel vs synthetic diesel).
- The results indicate that for methane and methanol production and subsequent synthesis stages, using cement kilns, waste incinerators and raw biogas as CO₂-source could be a promising option for saving GHG emissions. The beneficial use of point sources depends strongly on local conditions such as availability of waste heat. Direct air capture shows the lowest potential to reduce CO₂ emissions due to the high demand for heat.
- CCU technologies are particularly important for carbon recycling. Chemical recycling of CO₂ is a future focus for the chemical industry and the circular economy. CCU can provide chemical transformation options to shift from a linear fossil based carbon economy to a more circular approach using CCU to recycle carbon.
- Overall, the societal risks and barriers in implementing CCU technologies as well as the opportunities they offer are numerous and diverse, and to a large extent, technology specific. Some of them can be influenced by policy measures, others depend on market, technology or other developments that cannot be foreseen today yet.

- Potential synergies could be realised if CCU technologies are implemented via cross-sectoral collaborations in an 'industrial symbiosis' context. This approach can make them applicable and ecologically worthwhile as flows of production inputs and outputs are shared among production units.

Regulatory assessment

- The EU framework is, in general, flexible and robust. It is well-equipped to accommodate for new CCU technologies, however outstanding issues pertain to ensuring the full accountability, monitoring and verification of the CCU applications GHG emissions (e.g. in EU ETS).
- CCU projects that contribute significantly to reduction of GHG emissions through permanent storage or avoidance of GHG emissions can benefit from support through the EU ETS Innovation Fund. The lack of full recognition for CCU as a climate change mitigating tool under instruments such as EU ETS and Ecolabel is considered to be a disadvantage for the large-scale deployment of CCU technologies. However, the lack of standardised LCA and the uncertainty regarding the climate change mitigation potential of the technologies, indicate such recognition is premature.
- The Renewable Energy Directive has been revised, opening possibilities for CCU fuels to be counted towards national renewable energy targets and supported by the fuel blending quotas if they are recognised as renewable.
- Very few direct hurdles to commercialisation of CCU products were observed in EU legislation. For certain technologies, national implementation of EU legislation (e.g. Waste Framework Directive) may result in lack of harmonisation and potential barriers to the proper functioning of the internal market.
- The novelty of the technologies and the procedures leading up to the inclusion in the BAT reference documents, currently exclude the shortlisted technologies as eligible tools to set the emission limit values.

The scientific opinion of the Group of Chief Scientific Advisors of the European Commission on novel CCU technologies concluded in April 2018 that:

- CCU may play a role to de-fossilise the economy and help reaching climate change mitigation targets.
- It can contribute to leaving fossil carbon in the ground, and closing the carbon loop above the ground.
- CCU can also accomplish a number of other services to society with a more efficient use of energy.
- The uptake of CCU will depend on the availability of abundant low-carbon energy and a favourable legislative and investment environment.
- The introduction of CCU could start with high-density CO₂ streams from industrial processes and progressively move towards capturing CO₂ from less dense sources.

And also provided a **set of recommendations**:

- To develop a methodology to calculate the Climate Mitigation Potential of CCU.
- A CCU project should be considered eligible for funding or to be further included in Climate Change Schemes if the four following conditions are fulfilled:
 - o The required energy has low-carbon origin, with high availability and low cost;
 - o Other, simpler and more cost effective solutions do not yield comparable products available in sufficient quantities;
 - o The readiness level of CCU projects will meet the objectives;
 - o There are supplementary benefits of the CCU projects in addition to climate mitigation potential.
- CCU technologies are not stand-alone but part of a system. Both TRLs (Technology Readiness Levels) and IRLs (Integration Readiness Levels) should be considered to assess the readiness of and the contribution that CCU technologies can make.
- It is strongly recommended that European Commission develops a cross-sectorial and systemic regulatory and investment framework for CCU applications comprising a set of clear rules and operational guidelines for CCU applications.
- It is recommended that the European Commission advocates the methodologies of the Convention on Climate Change, the Kyoto Protocol and the Paris Agreement in international arenas, in particular in the scope of the UNFCCC.

The **panel discussion** highlighted some of the findings of the studies and industry and research representatives brought additional elements from their experience. Some of the key points raised were:

- We need to take a systemic approach and not look only at single projects and technologies or at part of the chain such as the use phase of products.
- CCU technologies are not necessarily the best solution in all cases, but there are situations where they will make sense, such as in the sectors that need dense energy carriers or sectors requiring carbon input for chemical and material use.
- CCU and CCS have a common first step of capturing the carbon dioxide, but then they are developed for different purposes. CCU has the advantage of providing an alternative carbon feedstock or new type of services such as energy storage or carbon recycling. Both families of technologies can take part in solving the decarbonisation challenge. We need to support their development at scale so they can deliver for our 2050 pledges.
- CCU technologies are very young and we are seeing the first concepts. We can expect advances in the conversion efficiencies as well as novel pathways.
- Policy needs to support technologies at various stages of their development: risk-sharing is key for closer to market technologies. Public-private partnerships like [Phoenix](#) may help overcoming the valley of death, developing the value chain and clarifying the added value of these technologies.

- Simplified LCA is possible to rule out inefficient concepts right from the start, but harmonised LCA methodology still needs to be applied when taking economic and policy decisions. Moreover, if the outcomes of the LCA are positive, industry and policy have the responsibility to act and find solutions to support these technologies.
- Public procurement should incentivise forerunners and can counteract the effects on industry from more stringent EU environmental regulation.

