

# Accelerating CCS Technologies

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## Collaboration with European CCUS initiatives, 2016-2021

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**Authors:** Nicoleta Dumitrache (UEFISCDI) and Ragnhild Rønneberg (RCN)

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## 1. This is ACT

ACT was established in 2016 with 10 partners from 9 European countries as a response to the H2020 call in 2015 on low carbon technologies. This consortium joined forces with the aims to accelerate and mature CCUS technologies by making funds available for R&D and innovation projects and a solid basis for knowledge sharing in an open mind approach.

ACT has since it was kicked off in February 2016 become a widely known program within the transnational CCUS R&D initiatives in Europe and beyond, and extended the consortium with funding agencies from Europe, India, Canada and USA. A total of 16 funding agencies are involved since 2020.

The background for ACT is based on the fact that the level of carbon dioxide (CO<sub>2</sub>) released into the atmosphere has increased significantly since the industrial era, and it is well documented that burning fossil fuels emits CO<sub>2</sub> with serious and negative impact on the climate.

Carbon Capture, Utilisation and Storage (CCUS) is part of a portfolio of technologies to combat climate change. CCUS can help mitigate CO<sub>2</sub> emissions from electricity production and is a prerequisite for reducing CO<sub>2</sub> emissions from industry such as steel, cement, chemicals and petrochemical refining.

ACT has contributed to accelerating CCUS Technologies by making available funds for transnational research and innovation activities. CCUS has an important role in the transition to a low-carbon economy.

The CCUS technology involves capturing CO<sub>2</sub> from large CO<sub>2</sub> emission point sources, such as fossil fuelled power plants and large, energy intensive industrial plants, compressing it for transportation and then injecting it deep into a rock formation at a carefully selected and safe site, where it is permanently stored. In addition, CCUS projects which deal with innovative and cost reducing utilisation of CO<sub>2</sub> have also been in the scope for ACT.



Figure 1: Geological storage of CO<sub>2</sub>

The IPCC 1.5 degrees report makes it very clear that CCUS must be part of an affordable and socially acceptable energy transition. The thematic priority CCUS is essential to the climate-neutrality goal of Europe, which has been underlined in a number of policy documents issued by EC and others the recent years.

The ACT calls have asked for RD&I projects that can lead to deployment of CCUS. Project proposals with high industrial relevance and industrial involvement have been prioritised. Of major importance is also that the projects being funded should comply with the SET Plan implementation plan for CCUS and the Mission Innovation research priorities for CCUS.

We welcome your visit to the ACT webpage [ACT \(act-ccs.eu\)](https://act-ccs.eu) for updates on activities, events and projects results. Even if ACT formally ended as an EC initiative 30 September 2021, the follow-up, monitoring and close interaction with the running projects will continue. The ACT2-projects end in 2022 and the ACT3-projects will end in 2024.

## 2. Executive summary

ACT is a fit-for-purpose, partner-driven, flexible and an easy-to-join funding scheme that serves our ambition: **to make CCUS a commercially viable climate mitigation technology.**

ACT has undertaken three successful calls (in 2016, 2018 and 2020), and the ACT partners have established themselves as a powerful multilateral funding scheme for research and innovation dedicated to CCUS.

A total of 33 projects have been funded with a total amount of ~100 mill EUR; the ACT projects are in different stage of their life: the ACT1-projects were completed in December 2020, the ACT2-projects are in their last year of operation and the ACT3-projects are kicked off in the autumn 2021 and will run for 3 years.

ACT also aimed at building and intensifying the collaboration with other European CCUS initiatives (both networks and pilot/demonstration projects) in order to increase knowledge sharing and accelerate deployment of CCUS.

In the following pages a more detailed report is given on the sharing of knowledge to and from other CCUS initiatives.

## 3. Collaboration with CCUS initiatives inside ACT workshops

Producing and sharing qualitative knowledge was one of the actions ACT strongly believed in. This is the reason why, in every sharing workshop we organised, representatives from other CCUS initiatives were invited, present and actively involved in the success of the workshop and in the success of spreading the knowledge.

For each workshop, the involvement of CCUS initiatives were:

- **2016:** 1<sup>st</sup> workshop in Lausanne (Switzerland) with their **US-American Department of Energy, Australian (ANLEC R&D)** and Canadian (**NRCan**) counterparts to discuss and share good practices in devising and managing funding schemes for CCS research and innovation projects. The topic of the workshop was: *Joint programming and joint calls, selection, funding and monitoring of pilot and demonstration projects: sharing and collaborating with other regions*, with the following themes:
  - Theme 1: Setting the stage (overall funding schemes in the regions; why do they exist and so on; organizational set-ups);
  - Theme 2: Formulation, set up of calls, proposals and their evaluation, and selection process of projects – based on a call, funding opportunity announcement, solicitation;
  - Theme 3: Execution of projects (contracting; monitoring; quality assurance and control);
  - Theme 4: Dissemination, exploitation of project results – what are minimum expectations; what constitutes success and how does it impact future joint programming and additional joint calls, funding opportunities.
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- **2017:** 2nd workshop in Bucharest (Romania). Representatives from the Ministry of Energy in Romania and from the Institute of Studies and Power Engineering. In addition, 2 experts from New Mexico who have cooperation with GeoEcoMar in Romania were attending.

The European Commission was also represented and actively took part in the discussion and knowledge sharing with the ACT partners and the ACT-project leaders.

This workshop was dedicated to the 8 funded projects with three main objectives:

- more knowledge about the projects - their scope and ambitions
  - intensifying possibilities for collaboration between the funded projects and their partners
  - learnings from the first call in order to provide improvements for the next call.
- **2018:** 3rd workshop in Niederaußem, Germany at the facilities of RWE (*Rheinisch-Westfälisches Elektrizitätswerk* power plant).

The topic of the workshop was **presentation of the 8 ACT funded projects, CCU programs in the USA and the Energy Research Program in Germany**. This workshop was dedicated to get updating from the 8 funded projects and focus on three main objectives:

- Reach-out:
  - How do the projects contribute to accelerating CCS by reach-out to industry, to decision makers, to the public, to the scientific community?
  - How do you communicate?
  - What do you know or measure about the effectiveness of your communication?
- Collaboration within the project:
  - How do you collaborate/communicate in your transnational project?
  - What works well, what could be improved?
- Synergies with other ACT projects:
  - Are there any results?
  - Should this be taken forward?

At this workshop also a guided tour through the RWE plant and information about their power-production (based on lignite) and their CCU-projects was provided. Peter Moser at RWE talked about the importance of CCUS technology in a conventional power plant to reduce emissions, save energy and storage efficiently.

Johannes Kerner from the Federal Ministry of Economic Affairs and [Energy presented the Energiwende](#) and the 7th Energy Research program, and Vassilios Kougiouas from the EC talked about the [Clean Energy Transition and CCUS- EU Perspective](#).

John Litynski (US-DOE) gave an inspiring overview of the [CCUS in the United States of America](#). The goal is to reduce costs of carbon capture by at least 50% through technology development, he said. He presented the US Policy incentives for CCUS, the big opportunity by the 45Q tax credits. The technology push through R&D and market pull through financial incentives are important issues. A comprehensive presentation three major demonstration projects were given:

- Air products facility in Texas
  - Petra Nova CCS in Texas
  - ADM Ethanol Facility in Illinois (IL)
- **2019:** 4th ACT Knowledge sharing workshop in Athens, Greece.
- The European Commission was represented by Project Officer Vassilios Kougiouas, who talked about the [CCUS under the new Horizon Europe Programme](#), and he underlined the

importance of ACT. He also addressed the topics in which R&I cooperation with Mission Innovation countries is encouraged (e.g. *Pilots on CO<sub>2</sub> conversion to fuels, 2018*, and *CCS in industry 2019, 2020*) and where international collaboration is needed in general.

[CCUS-initiatives in Greece](#) were very well presented by Prof. Athanasios Kyriazis, Secretary General for Research and Technology in Greece and Dr. Kyriakos Panopoulos, Coordinator of the Energy Platform for Smart Specialisation in Greece.

Espen Bernhard Kjærgaard, adviser at the Norwegian Ministry of Petroleum and Energy, gave the Norwegian perspective on CCUS and updates on the [Norwegian full-scale CCS project](#) (which later has been given the name Longship). He also underlined the importance of R&D at an international perspective in order to accelerate this essential climate measure that CCUS is.

- **2020:** 5th workshop was undertaken virtually (due to covid-19). There was a session on transport and storage, and a session on capture and utilization technologies. The latter session included a keynote presentation on "[Large-scale CO<sub>2</sub> capture from the AVR waste-to-energy plant in Duiven, the Netherlands](#)", delivered by Hans Wassenaar (AVR). He highlighted the importance of exchange between technology experts and industrial partners.

The ACT1-projects presented their status and views for the remaining month of operation period, and the ACT2-projects gave the status for their projects since kick off Autumn 2019.

These workshops allowed to identify and address issues within and outside Europe that are of importance for acceleration of CCUS in a global scale and stimulate transnational R&D cooperation.

#### 4. Collaboration with other CCUS initiatives at national level

The ACT coordinator and several of the ACT funding partners have been active in collaboration and interaction with other **CCUS initiatives** both at national and at international levels. Many presentations have been given focusing on who we are, what we do and what we have achieved and results from projects. Hence, focus on research and innovation process, funding and knowledge sharing have been pointed out and results achieved shared with a broader audience.

In several ACT Countries, ACT-funded projects and ACT contacts have looked for opportunities to connect to national stakeholders. For example, ACT has presented at the Norwegian Climit summit and the Dutch CATO days. These are just two examples of how ACT was reaching out to national stakeholders.

Academic and other research institutions such as EERA JP CCS, CCS-Association, ZEP, Club-CO<sub>2</sub>, CO<sub>2</sub>GeoNet have been targeted stakeholders and discussion groups – some of them on a continuous and annual basis since 2016, some even more frequently visited. Likewise have ACT members presented ACT results and achievements to the SET Plan Implementation working group for Action 9 (CCUS) on a yearly basis.

The ACT coordinator and ACT members have also had a close interaction with the EERA network, the ECCSEL – CCUS research infrastructure organisation, IEAGHG, CSLF, Mission Innovation and CEM CCUS.

The result of this is that all ACT1-funders have continued to support ACT (in the second and third call and taken part in funding high quality projects even without the EC cofund) and also at their national levels been good ambassadors for ACT and the benefit for international collaboration in the CCUS field.

## 5. Collaboration with overseas CCUS initiatives/bodies

ACT has also succeeded in reached out to overseas CCUS initiatives/bodies with the intention to strengthen R&D collaboration with key stakeholders outside Europe. The result of this is that US-Department of Energy (US-DOE) joined ACT in 2018, The Emission Reduction Alberta (ERA) joined in 2019 and The Department of Science and Technology (DST), India joined in 2020. US-DOE has taken part in both the second and third ACT calls, whereas ERA and DST have been in the third ACT call.

Through the collaboration with US-DOE and some of the ACT1-funding partners, the ACT group has stood up as a relevant and practical initiative for the Mission innovation.

In the first ACT call, the research priorities were linked to the SET Plan Implementation goals, whereas the Mission innovation Research priorities were included in addition to the SET Plan goals for Action 9 (CCUS) in the second and third ACT calls.

## 6. An overview of CCUS-initiatives where ACT has been present

The ACT partners and the ACT coordinator have been interacting with a number of CCUS initiatives in Europe and beyond, either as a member of the initiative group/board, as invited speakers or otherwise interacted to promote ACT and discuss CCUS-actions in general.

Below is shown some of the groups that ACT has interacted with annually or even on a more frequent basis.

SET-plan implementation working group, Action 9

CCS-association

ZEP- zero emission platform

EERA (European energy research agenda)

CO2-GeoNet

IEAGHG

Mission innovation and CEM-CCUS group

CSLF

TCCC

CO2-Conference Norway

ECCSEL-annual meetings

CLIMIT-summit (bi-annual)

CO2-Club

## **7. Conclusions**

A strong international collaboration is needed for a successful implementation of CCUS as climate measure.

Through the actions implemented, we managed to promote the main outcomes derived from the EU funded projects and in collaboration with other CCUS initiatives, in the scientific community and through them identify the next steps and work towards their implementation and funding.

We also actively support the implementation of CCUS in industries and the power sector, including:

- Identification of EU initiatives and CCUS projects and establishment of collaboration;
- Organisation of workshops and seminars for the promotion of knowledge sharing, complementary to other initiatives and the initiatives of the research projects themselves;
- Support of the results and inclusion of the gaps identified and in the future calls for the promotion of research and innovation.

The ACT-partners have also been instrumental in the development of the Clean Energy Transition Partnership (CETP) – and especially the section (TR13) focusing on CCU and CCUS, storage and renewable fuels. During this work, more countries (than currently involved in ACT) have shown interest in participating and develop the transnational CCUS collaboration further.