



Providing access to cost-efficient, replicable, safe, and flexible CCUS

Horizon2020 Innovation Action

Duration: May 2021- April 2025

Coordinator: SINTEF Energy

Budget: 18.4 MEUR, EU funding 15.0 MEUR

Main objectives

- In blue: Test CO₂ capture and CO₂ use at TRL7 and integrate capture technologies in industrial installations
- In green: Develop and improve CCUS chains from continental Europe and the Baltic area to the North Sea
- In orange: Engage and inform stakeholders about CCUS and explain its societal benefits at large and for sustainable cities







Targeted results

Demonstrate at TRL7 (~2 tonnes CO₂/day) the "CO₂ Solutions by Saipem" capture technology combined with a Prospin rotary packed bed absorber at Stora Enso in Sweden and HeidelbergCement in Poland

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- Demonstrate at TRL7 (~5 tonnes/day) the Neustark carbonation process for demolition concrete recycling (CCU)
- Investigate CO₂ capture integration in pulp and paper, cement, waste to energy and biorefineries, aiming at CO₂ avoidance cost cuts of ~20-30%
- Establish a replicable CCUS chain development methodology, using integrated technoeconomic and environmental analysis, and deliver a supporting open-source chain development tool
- Identify feasible, safe and cost-efficient tank-based CO₂ transport solutions with potential for 50% cost cuts
- Deliver a Handbook on how CCUS can contribute to sustainable cities development



Objectives – capture demonstration and integration, CO₂ use

 Demonstrate at TRL7 on a 2 tonnes/day scale the enzymatic "CO₂ solutions by Saipem" capture technology operating with a Prospin rotary packed bed absorber at the Stora Enso kraft pulp mill in Skutskär, Sweden and the HeidelbergCement kiln in Gorazdze, Poland

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- Design an innovative cement kiln with integration of the cement clinker line and amine scrubbing
- Demonstrate at TRL7 the Neustark continuous two-step mineral carbonation process for demolition concrete recycling
- Perform systematic process integration studies of CO₂ capture for pulp and paper, çement, waste to energy and biorefineries, with the objective to cut CO₂ avoidance costs by 20-30%



Objectives – CCUS chains and clusters

- Establish a replicable CCUS chain development methodology, using integrated techno-economic and environmental analysis
- Develop designs for minimal cost and minimal environmental impact CCUS chains, serving intersectorial clusters and networks
- Deliver an open-source CCUS chain development tool
- Identify feasible, safe and cost-efficient tank-based CO₂ transport solutions with potential for 50% cost cuts
- Develop safe and time-efficient procedures for CO₂ loading/offloading along the CCUS chain





Objectives – Societal integration of CCUS

- Demonstrate how CCUS significantly can reduce housing and products' carbon footprint
- Deliver a Handbook on how CCUS can contribute to sustainable cities development
- Synthesize how cost efficient CO₂ capture can be integrated in industries and connect to CO₂ transport infrastructures
- Educate Swedish and German environmental authorities about how to regulate CO₂ capture installations
- Establish an International Liaisons Council to exchange knowledge and foster ideas for driving CCUS implementation globally



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The **ACCSESS** Vision is to

Develop replicable CCUS pathways towards a Climate Neutral Europe in 2050

- A need for net removal of CO₂ to reach the 1.5°C target
 - IPCC AR6 WGI: "Anthropogenic CO2 removal (CDR) leading to global net negative emissions would lower the atmospheric CO2 concentration and reverse surface ocean acidification."
- The industrial sectors in ACCSESS can contribute to net Carbon Dioxide Removal from the atmosphere
 - The extent of the contribution depends on the feedstocks and other characteristics of each sector





ACCSESS - a climate-positive project





CDR = Carbon

Dioxide Removal

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CO₂ capture piloting





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Definition of TRL7: system prototype demonstration in operational environment



CCU: Concrete recarbonation

Recarbonation of waste materials from demolished concrete by Neustark – making useful material from the world's largest waste stream

Demonstration at TRL7 of permanent storage of \sim 5 tonnes/day of CO₂ in CaCO₃





Innovative kiln design for integrated amine capture

- Combined steam generation and kiln heat supply
- Combined structural elements, e.g., for preheating tower and absorption tower
- Operational synergies
- Case study for HeidelbergCement kiln in Hannover with alternative fuels, including biomass
- Technology supplier cooperation between KHD and Linde









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CCUS Chain analysis

"The holistic approach for the development of the CCUS chain network targeted for large scale European CO₂ market is ground-breaking" (from Evaluation Summary Report)

- Technoeconomic analysis
- Regulatory/legal framework
- Environmental aspects/LCA along the chain
- Delivery of an Open-source code for optimizing CCUS networks over time and in space



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Connecting sustainable cities development and CCUS



Citizen engagement process, informing stakeholders, analyzing concerns and needs

Goal: public understanding and acceptance, generate a drive for **CCUS-based solutions**



Handbook on how CCUS-based solutions can be implemented as an integrated part of sustainable cities development









ACCSESS results and consortium expertise



Neutral information packages explaining the practicalities with replicating CCUS-based solutions in a sustainable city context



CCUS end-products cost









A multi-dimensional approach to innovation and impact

- ACCSESS ties together cities/citizens, industry, research, and public authorities to enhance innovation and maximise impact
- ACCSESS focuses on how business models can be developed by smart interaction between Policy, Academia, Industry and Citizens along the Innovation and Impact dimensions
- Cross-sectorial collaboration aims to progress CCUS, foster and exchange learnings and jointly address most relevant deployment challenges





Building CCUS business cases – cutting costs and increasing income



Situation before ACCSESS

The ACCSESS Business case



ACCSESS will

Demonstrate environmentally benign CO₂ capture in Waste-to-Energy, Pulp and Paper and Cement.

Develop a tool for optimal CO₂ capture deployment in industrial clusters

Deliver an Open-source code for optimizing CCUS networks over time and in space

Leverage on the Norwegian full-scale CCS project Longship, in operation from 2024

Connect to and draw on Northern Lights CO₂ transport and storage expertise

Develop CCUS chains from inland Europe and the Baltics, offering complementarity to the current Northern Lights PCI

Generate replicable methods, tools and plans that will have an impact on CCUS over the medium to long term, and contribute to the deployment of CCUS in hubs and clusters









Work breakdown structure





Work breakdown structure and main workflows







The ACCSESS consortium

- Covers four energy-intensive sectors: Pulp and Paper, Cement, Waste to Energy and Refining
- Technology and R&I competence along the full CCUS chain as well as complementary expertise







Consortium



Linked third parties





Universität Stuttgart Institut für Arbeitswissenschaft um Technologiemanagement IAT







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