Accelerating CCS Technologies

CO₂CE

Harnessing potential of biological CO_2 capture for Circular Economy

Co-funded by the European Commission within the Horizon 2020 programme

Dissemination, exploitation and communication plan (DEC plan)

Project information

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ACT Project Officer	Ragnhild Rønneberg
Project Manager	Prof. Tomas Morosinotto
Project Administrator	Prof. Luigi Bubacco

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CooCE

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Table of Contents

Abbreviations

ACRONYM	DEFINITION
DMP	Data Management Plan
DMPO	Data Management Portal
FAIR	Findable, Accessible, Interoperable and Re-usable
GDPR	General Data Protection Regulation
IPR	Intellectual Property Rights
OA	Open Access
PC	Project Coordinator
TL	Task Leaders
WPL	Work Package Leaders

Executive summary

This DEC plan is a living document; it will change and adapt to the Consortium needs during the project lifetime and as such it will be updated when needed. It is intended as a tool for all the partners that wish to communicate the project with a specific audience, it contains best practices and guidelines adapted to the different situations in which the project can be communicated.

With this version, we aim at setting up the first approach to CooCE communication, focusing on the definition of the main key messages and creating project awareness. As the project unfolds, more channels and strategies to reach out to the stakeholders will be implemented and more key-messages and engagement solutions will come.

Therefore, this document, for now, will be used for the channels foreseen in the first months:

- Website
- Social Media (first editorial plan)
- Press releases and news

1. Key-messages and communication strategy

1.1. Project overview suitable for all the audiences

The ACT-funded project CooCE aims to accelerate the use of CCUS and revolutionize CO_2 capture and utilization by closing carbon loops in a circular economy approach. In this frame, the project will contribute to the shift towards a resource-efficient, low-carbon and climate-resilient economy as the expected savings of greenhouse gas emissions from the proposed system will be higher than 100% compared to those generated during the production of conventional gasoline as fuel or corresponding chemicals for polymers.

Within the project, a consortium of commercial and academic partners is formed, with the ambitious goal of developing CCUS processes and integrating them with existing industrial workflows. The work is planned in accordance with the European Sustainable Development Goals and considering Circular Bioeconomy principles, by following a stepwise approach. Research activities of the project will be executed in an incremental manner with regards to the scale and complexity of the bioprocesses. Early experimental phases of the project will follow a Design-Build-Test-Learn cycle approach to improve process performance at lab-scale while contributing to generate knowledge on fundamental aspects of the biological processes. Subsequent phases of the project will include scale-up of the processes, development of downstream processes for purification of the relevant products, and comprehensive sustainability assessment of the life cycle of the developed CCUS technologies.

The dissemination of the findings and outcomes of the project will be directed to a range of different audiences and will be carried out through the following activities:

i. Inform, engage, aware and promote information about CooCE (aims, funding source, outputs and societal impacts) through the project website.

ii. Communicate project significance through courses and seminars, and involve BSc/MSc students and other collaborators in project activities

iii. Involve local stakeholders in the identification of barriers and opportunities for the developed CCUS to improve our communication strategy targeted to specific audiences.

iv. Organize workshops during pilot tests to communicate the CCUS technologies

v. Disseminate project's outcome on technical and end-user-oriented conferences

vi. Visit relevant carbon emitting sites and disseminate our CCUS technologies

vii. Host a final CooCE workshop which will be open for all audience

We will validate our findings.

Our team of 10 partners (1 research organization, 3 academic institutions, and 6 SMEs) from 4 different countries across Europe brings together the necessary expertise: bioprocess design, environmental and biochemical engineering, computational biology, life cycle assessment, molecular biology and microbiology.

The concepts and strategies developed within CooCE will serve as a research and innovation roadmap to attain similar CO_2 fixation processes in a broad range field.

1.2. Strengths to highlight

A stepwise approach will be applied by implementing multiple technologies to reach the objective; an incremental complexity of the processes, from lab to pilot scale, will optimize the biology-inspired solutions to carbon fixation. In the frame of enhance process sustainability, we will explore how the integration of the examined CCUS technologies will contribute to a sustainable future development of the energy and production (e.g. plastic) sectors.

Multidisciplinary - disciplines involved:

- genomics, systems biology
- metabolic modeling, computational biology
- microbiology
- bioprocess design
- environmental and biochemical engineering
- life cycle assessment.

1.3. Forbidden topics / wording

Topics or wording to avoid due to IP or because too sensitive for certain audiences. If related to IP then the IPR-team will be involved in their revision. New findings which can potentially lead to patens will be initially confidential until patent has been filed.

- *Sensitive topic:* **commercialization model related to the process**.

1.4. Attitude and key-messages declined for different stakeholders

1.4.1. General Public

Address possible **concerns** regarding environmental / health impact as well as the negative environmental impact of biogas system. Include key messages gathered from workshops related to public acceptance and inclusion of stakeholders' views. This is also part of the sustainability assessment that the project is performing.

Underline the **benefits** of this solution for the environment

Key-messages

- Boost CO_2 fixation with a biology-inspired solution.
- Establish sustainable tools to increase industrial sensitivity to the topic.
- The CCU bioprocesses can be extrapolated in other CO_2-emitting industries (e.g. cement and lime)
- Biological CCU methods are an unexplored area with huge potential
- Public acceptance on the use of the alternatives methods and products

Furthermore, for the general public, we will create a section of the website dedicated to FAQ about the project.

1.4.2. Scientific Community

The strategy is to **distinguish** the CooCE approach from other approaches and underline the most **innovative** aspects of the project:

- Stepwise approach, from lab to pilot
- Complementarity of processes
- Interdisciplinarity
- Biobased CCU technologies
- Use fundamental knowledge to develop bioengineering applications
- Sustainability assessment

Here some in depth content related to each aspect:

1. CooCE stepwise approaches to explore routes assisting carbon fixation:

  - Lab scale to educate young scientists on fundamental aspects on Carbon Dioxide Capture and Utilisation/Storage (CCUS) technologies.
  - Bench scale to train and enrich skills of scientists (especially targeting the youth) on issues related with operation and maintenance of bioreactor designs used to fixate carbon.
  - Pilot scale to demonstrate the key-concepts of carbon fixation to academia and relevant research community and thus increase general scientific awareness.

2. Complementarity of processes

The focus will be on biological CO_2 fixation processes. For that reason, microorganisms will be used as biocatalysts for successful implementation of CO_2 sequestration and utilization. Specifically, the project aims to explore the great potential of specific microbes (pure and mixed cultures) which can ultimately lead to superior CO_2 fixation, namely:

- Succinic acid producing bacteria
- Hydrogenotrophic archaea naturally growing in digestate obtained from biogas plants treating either agro-industrial wastes or sludge.
- Syntrophic bacteria residing in engineered microcosmos in vessel assisting to the process to overcome the thermodynamic burdens.
- Syntrophic mixed cultures
- PHA accumulators, a bacterium and a cyanobacterium.

3. Multidisciplinary Method

Overall, CooCE puts forward a highly integrative strategy, which combines microbiology, system biology and is further complemented by biochemical engineering approaches as well as life cycle assessment. The main expertise in the Consortium are:

- Microbiology (UNIPD, DTU).
- Biochemical engineering (DTU)
- Up-scaling of bioprocesses (ELGO, DTU)
- Sequencing, in silico metabolic modelling (UniPD).
- LCA, technoeconomic analysis (ICL).
- Integrated sustainability, environmental, social, economic and governance (ICL).

- Risks and health issues (ICL).
- Public and stakeholders' acceptance (ICL).
- Plastic manufacturing and quality assessment (ENP, BBP).
- Biogas plant construction and management (BTS, LBP).
- Microalgae and cyanobacteria (UNIPD).
- Waste and wastewater treatment and bioprocessing (ELGO).
- Science communication, technology assessment, road mapping and innovation management (ER).

1.4.3. Industrial Stakeholders (might overlap with scientific community)

CooCE targets to develop (TRL 4) and demonstrate (TRL 5-6) a novel biotechnological platform in which CO_2 (either from biogas or exhaust gasses) is converted into a) upgraded biofuels for flexible on-site hybrid energy storage and b) high market value platform chemicals, namely biosuccinic acid and polyhydroxyalkanoates, that form the building blocks of various biopolymers and bioproducts. Main strengths to highlight are:

- **Attainable** final target
- **Quantitative benefits** for the production (titer, productivity, yield, etc…)
- **Flexibility** towards intermittent energy system
- **Kinetic model** to support the establishment of pilot-scale operation **Extrapolability** of project outcomes through the generation of fundamental knowledge with potential applications and synergies in similar industrial processes
- **Industrial Synergy and Complementarity** through coupling of multiple processes for maximizing the benefits of all industrial partners, e.g. coupling biogas purification, waste stream treatment and production of high added-value products

Key-messages:

1. Establish methodology to create CO_2 supply chains for CooCE technologies, based on enhanced collaboration between end-users/relevant stakeholders (e.g. industry, clusters, bio-based producers/ consumers, public authorities etc.)

2. CooCE- Training programme (from TRL3 to TRL5): CooCE will implement a programme for enriching professional curricula and training professionals that will be piloted in the partnering Universities and via open-access free web-based channel to maximize the outreach to other stakeholders
3. CooCE explores environmental criteria, energy balances and quality standards to reduce CO_2 emissions.
4. Assess the sustainability of the value chains of CooCE considering the environmental, socio-economic, economic and engagement with stakeholders to provide a holistic sustainability analysis.
5. A workshop will be conducted with stakeholders to gauge their views on sustainability issues related to CooCE's value chains and produce a SWOT analysis.
6. CooCE makes simplest the implementation of the biogas upgrading technology by the introduction of an add-on, cost-effective and highly efficient technology able to provide high purity biomethane (CH_4>95%)
7. Microbes with capability of producing platform chemicals are adapted to residual resources and biogas to drive the next generation bio-manufacturing.

1.5. FAQ about the science behind COOCE

What is Carbon Fixation? Carbon fixation or carbon assimilation is the process by which inorganic carbon (particularly in the form of carbon dioxide) is converted to organic compounds by living organisms. The organic compounds are then used to store energy (e.g. sugars) and as building blocks for other important biomolecules. The most prominent example of carbon fixation is photosynthesis, in particular thanks to a set of reactions called the Calvin cycle that convert carbon dioxide and other compounds into glucose in the chloroplasts of plants and algae, and in the cyanobacteria.

Why adaptive evolution? By applying microbial adaptation procedures (e.g. adaptive laboratory evolution), the tolerance of the strain to specific substrates is enhanced and the yield of biomolecule production is improved. Consequent and successive incubations/inoculation of microbes at industrial sugar-rich side streams will boost the technological relevance level of the process.

How does Synthetic Biology work? Synthetic biology applies engineering principles to the natural networks of biology to design and build new tools or machines. A machine is generally made of parts that together perform a useful function; in synthetic biology, those parts are made from biological material, such as biomolecules like proteins or DNA. Handling and shaping the biological material enables us to redesign existing natural biological systems that overcome natural inefficiencies. We have exploited living organisms for thousands of years for our own purposes — from the domestication of animals for food and companionship to the use of microbes to make bread and alcohol. Now, thanks to the recent technological advances in genetics and biotechnology, we can enhance our utility of nature.

What is metabolic engineering? Genetic engineering can be used to optimize the production of certain substances in the cell by altering its metabolism. The cellular metabolism includes all the set of the life-sustaining chemical transformations performed inside the cell, catalyzed by specific molecules called enzymes. These enzyme-catalyzed reactions are responsible for vital tasks such as the conversion of food/fuel to energy or to building blocks for cellular components and the elimination of waste. Some of the enzymes involved in the pathway can be substituted or modified, thus altering the sequence of reactions or simply.

What is a carbon-negative route? According to the Intergovernmental Panel on Climate Change (IPCC), Negative Emission Technologies are needed to achieve climate goals of limiting the climate warming to 1.5°C. Practices or technologies that remove CO_2 are often described as achieving 'negative emissions'. The examined CooCE routes capture CO_2 to produce bioenergy or molecules of industrial interest.

In what way does CooCE differ from other attempts to improve the CO_2 fixation? First generation succinic acid production relies on agricultural resources (e.g. corn, sorghum, sugarcane, starch derivatives) competing with land and need pure CO_2 adding extra costs. The CooCE approach improves process sustainability through the exploitation of sugar-rich residual resources and pure biogas to produce succinic acid and biomethane.

2. Guidelines for partners

Any form of communication related to CooCE (i.e. press releases, interviews, etc.) should:

- Refer to the consortium and underline the contribution of all the members.
- Underline the ACT funding
- Refer to the project website (https://cooce.eu/)
- Use the same key messages as in this DCE plan

For written publication please always use this sentence: *This project is part of the ACT ERA-NET Cofund under the European Union's Horizon 2020 Research and Innovation programme (Project No 327331 CooCE, Grant Agreement 862087).*

2.1. Scientific Publications

When a paper related to CooCE has been ACCEPTED (not when it is already published)a piece of news (website/social media) or a press release is prepared to introduce the publication at the right timing (right after its publication).

2.2. Twitter & LinkedIN

Social media accounts for CooCE (Twitter & LinkedIn) are available to partners of the project. It is highly recommended to **follow, share, and re-post** the project content, to create more awareness on the project among scientific networks. If Partner's institutions have a social media officer, please share its contact so it can eventually create synergies.

2.3. News in the project website

In the website news partners achievements are promoted, such as prizes, new positions, relevant roles at events (i.e keynote speaker, organization committee, etc..) or any other achievement linked to the project (publications, milestones, etc).