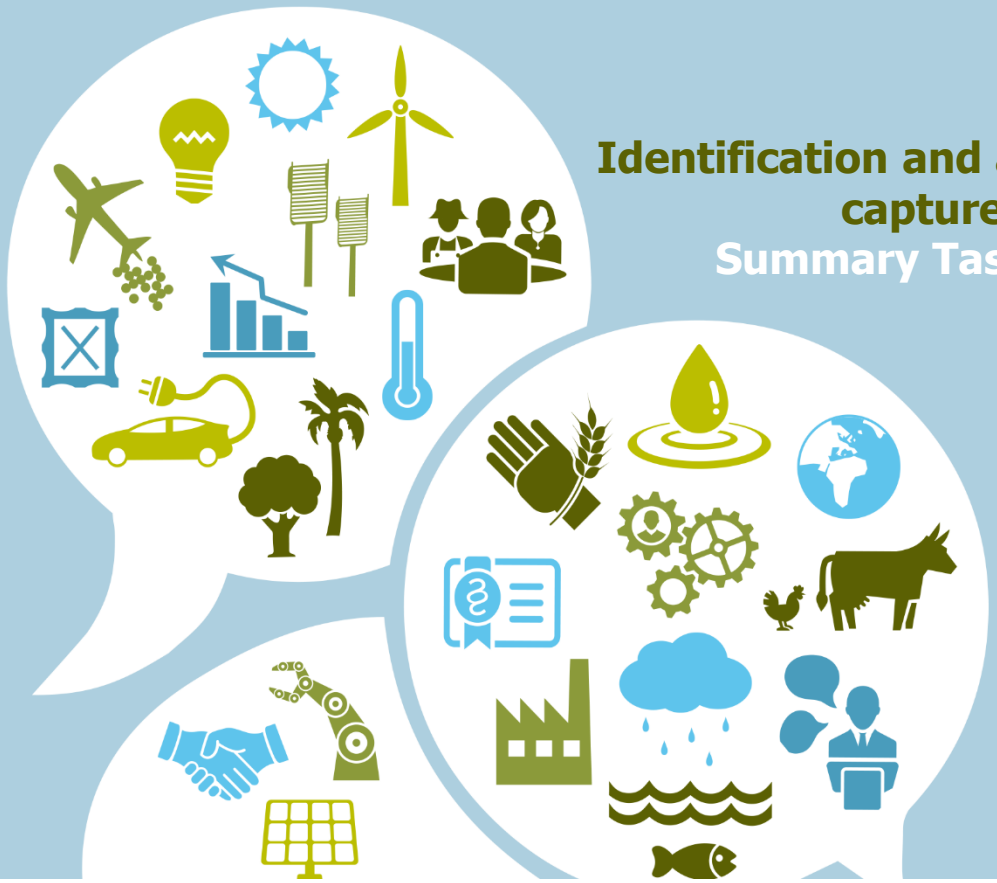
RESEARCH AND DIALOGUE FOR SUSTAINABLE SOCIETIES



Identification and analysis of promising carbon capture and utilisation technologies
Summary Task 1: Technology Assessment

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Agenda

- Basic introduction: What is CCU?
- Overview approach technology assessment
- Insights in a few results:
    - Task 1.1 Technology Assessment
    - Task. 1.3 Societal and Market Aspects
- Selection criteria for ETS Innovation Fund

What are CCU technologies?

Carbon Capture and Utilization (CCU) refers to technologies and processes which **use carbon dioxide as a component of a carbon dioxide compound in materials or energy sources**, thus rendering the carbon dioxide useful.[1]

CCU processes involve:

- **capture** and compaction of CO_2
- its transport (if necessary)
- **functional utilization** of the CO_2
- also **end of life** needs to be taken into account in a circular approach

Excluded related processes are:

- CCS (generally)
- EOR/EGR (generally)
- Not novel processes (here)
- Fine chemicals (here)

[1] von der Assen et al. 2013

Aim of CCU technologies

Carbon Capture and Utilization (CCU) as a concept aims at:

- reducing greenhouse gas emissions
- reducing fossil resource depletion

- supporting energy transition processes
- fostering a "green" chemical industry
- creating valuable products/patents
- imitating a natural carbon cycle
- contributing to a circular economy approach

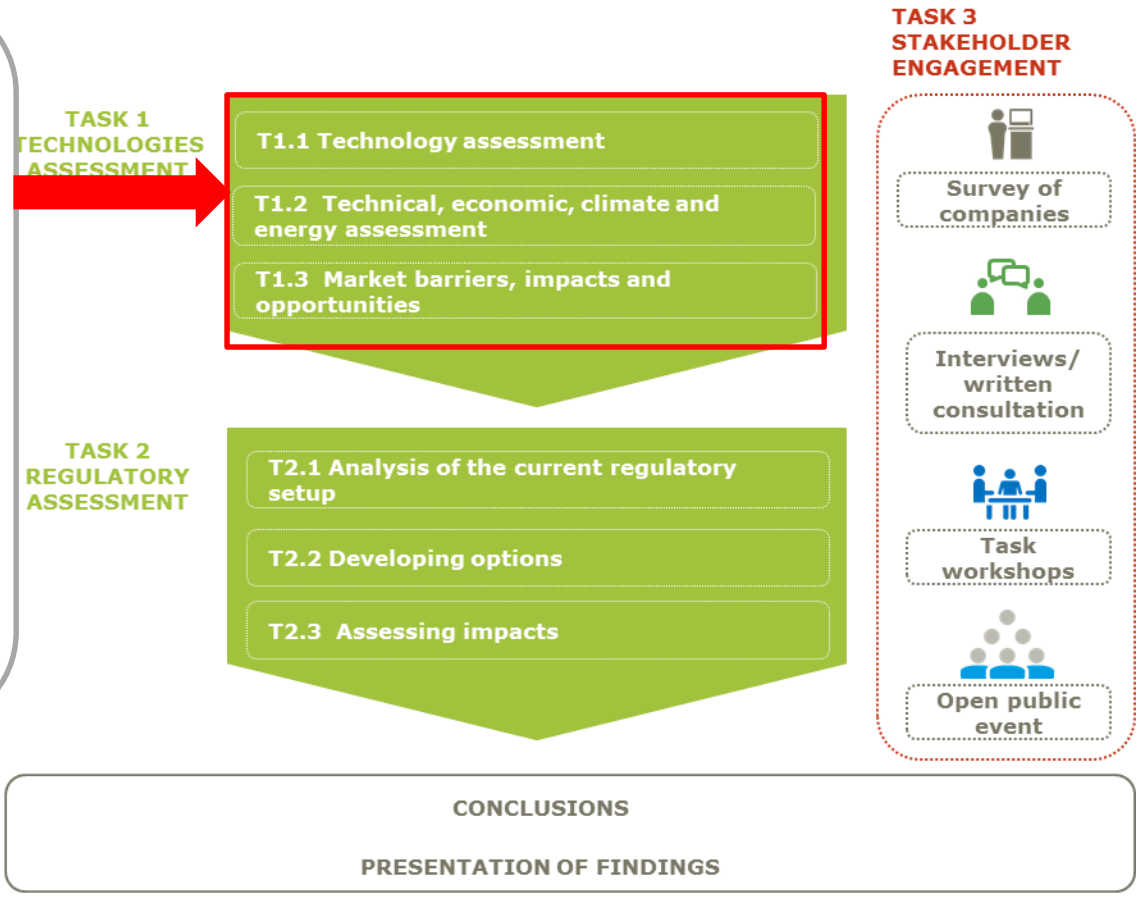
Unclear:

- Will CCU technologies be able to hold promise?
- Which CCU technologies are the most promising and shall receive public funding?

Context and objectives

Objective task 1:

Gather **up-to-date information** on CCU technologies that can become ready **for large-scale pre-commercial demonstration** in the period 2021-2030



Overview technology assessment

Subtask 1.1	Subtask 1.2.	Subtask 1.3
technology longlist → technology shortlist	LCA	market & societal aspects
• **Identification** of relevant routes and technologies • Screening > more than 200 routes > 130 longlisted routes and resulting products • **TRL based selection** from longlisted technologies (TRL 4 and higher) > 15 shortlisted products • Multicriteria **assessment shortlist products**, based on literature and stakeholder information	**Environmental assessment** of five most promising CCU routes	Identification and discussion of **possible impacts of a large scale CCU implementation** (e.g. synergy potentials with and influences on other industries or energy policy implications)

Product	Abbreviation
Biological	
Ethanol	EtOH
Methane	Methane
Chemical hydrogenative	
Ethylene	Ethylene
Methane	Methane
Methanol	Methanol
Monooxymethylether (OME1)	OME1
Polyethylene (PE)	PE
Polyoxymethylene (POM)	POM
Polypropylene (PP)	PP
Propylene	Propylene
Synthetic fuels	Fuels
Chemical non-hydrogenative	
Polycarbonate (BisA-PC)	BisA-PC
Polyols for Polyurethane (PU) foams production	PU
Inorganic	
Calcium carbonate	CC
Sodium carbonate	SC

Theoretical total annual binding volume

Estimate "best case" - assuming the complete substitution of conventional product by CCU products, based on the

- binding potential of the specific chemical formula and
- the existing market volumes of conventional products

Retention Time [years]	Total Annual CO_2 Binding Volume [Mt CO_2/year]
1	1765
10	48
50	115
Total	1928

Theoretical annual binding volume does not equal a reduction of the products' carbon footprint

Market conditions

Challenges

- Current low prices for fossil resources and energy
- Growing need for renewable energy
- Dependency on policy support (fuel)

Opportunities

- Access to new markets is usually not necessary
- Cross-sectoral collaborations as "industrial symbiosis"

Economic benefits and implications

Challenges

- Regulatory conditions not sufficient to enable investment security
- Rebound effects
- Mismanagement of public and private investments in CCU

Opportunities

- Technological advantage (patents)
- Reduction of dependency on import of fossil resources

Interlinkages and path dependencies with energy policies

Challenges

- Undesirable lock-in effects of conventional electricity generation infrastructures
- Coupling with undesirable industrial plants and fossil power stations as CO_2 sources

Opportunities

- Possible contribution to various environmental policy aspects
- Energy storage: supportive to renewable energy policies

ETS innovation fund selection criteria

- **Potential emission reduction as the immediate ecological use of CCU technology applications**

Technical criteria:
- Industry sector (e.g. building materials, fuels,..)
- CCU route
- Technological readiness

Ecological criteria:
- Global Warming Impact (GWI)
- Ressource efficiency

Other:
- Economic viability
- Innovativeness
- Strategic fit with EU policies

> LCA as a <u>minimum requirement</u> for transparency and comparability

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