



IEA Bioenergy

Technology Collaboration Programme



CCS/CCU/negative emissions and bio-based value chains/concepts

Management of Biogenic CO₂: BECCUS Inter-task Phase 2

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IEA-IETS Task XI on Industry-Based Biorefineries for Sustainability

First Intra-Task Meeting

Göteborg Sweden, 8 May 2023

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Technology Collaboration Programme

by **iea**

IEA Bioenergy

Technology Collaboration Programme (TCP), functioning within a framework created by the **International Energy Agency (IEA)**



Goal:

- International **collaboration and info exchange** on bioenergy research, technology development, demonstration, and policy analysis
- Facilitate the commercialization and market deployment of sustainable bioenergy systems = **climate positive, environmentally sound, socially acceptable and cost-competitive** (incl. external costs)

Work programme carried out through **Tasks and Special Projects**, covering the full value chain from feedstock to final energy product

IEA Bioenergy TCP Overview

ASIA/OCEANIA/AFRICA

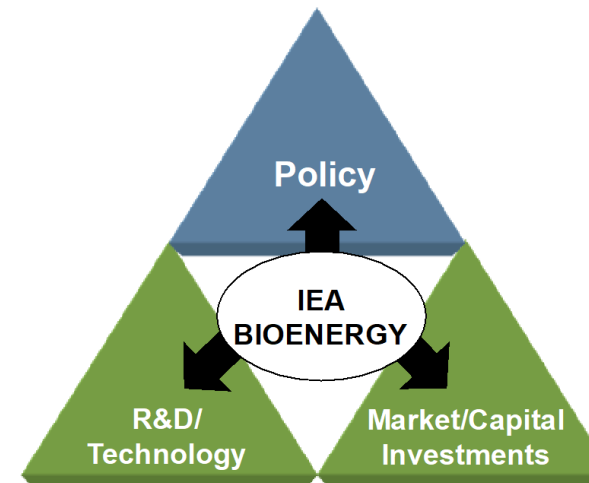
- China
- India
- Japan
- Korea
- Australia
- New Zealand
- South Africa

EUROPE:

- Austria
- Belgium
- Croatia
- Denmark
- European Commission
- Finland
- France
- Germany
- Ireland
- Italy
- Netherlands
- Norway
- Sweden
- Switzerland
- United Kingdom

AMERICA'S

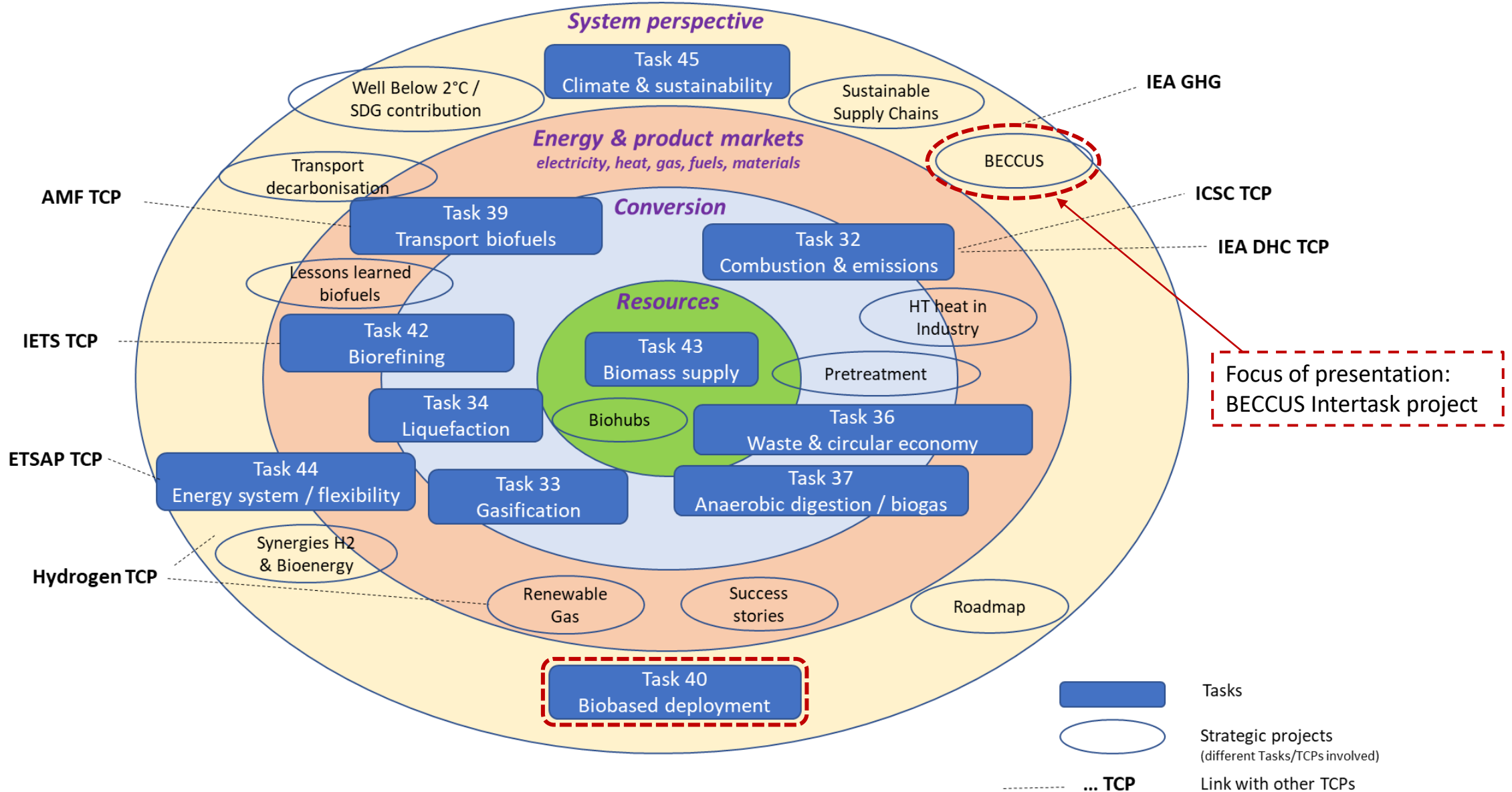
- Brazil
- Canada
- United States



25 Contracting Parties

Budget in 2022: 2 Million US\$
 Tasks: 11 + Strategic Projects
 Participation: 111
Direct participation: > 200 persons

Activities in IEA Bioenergy

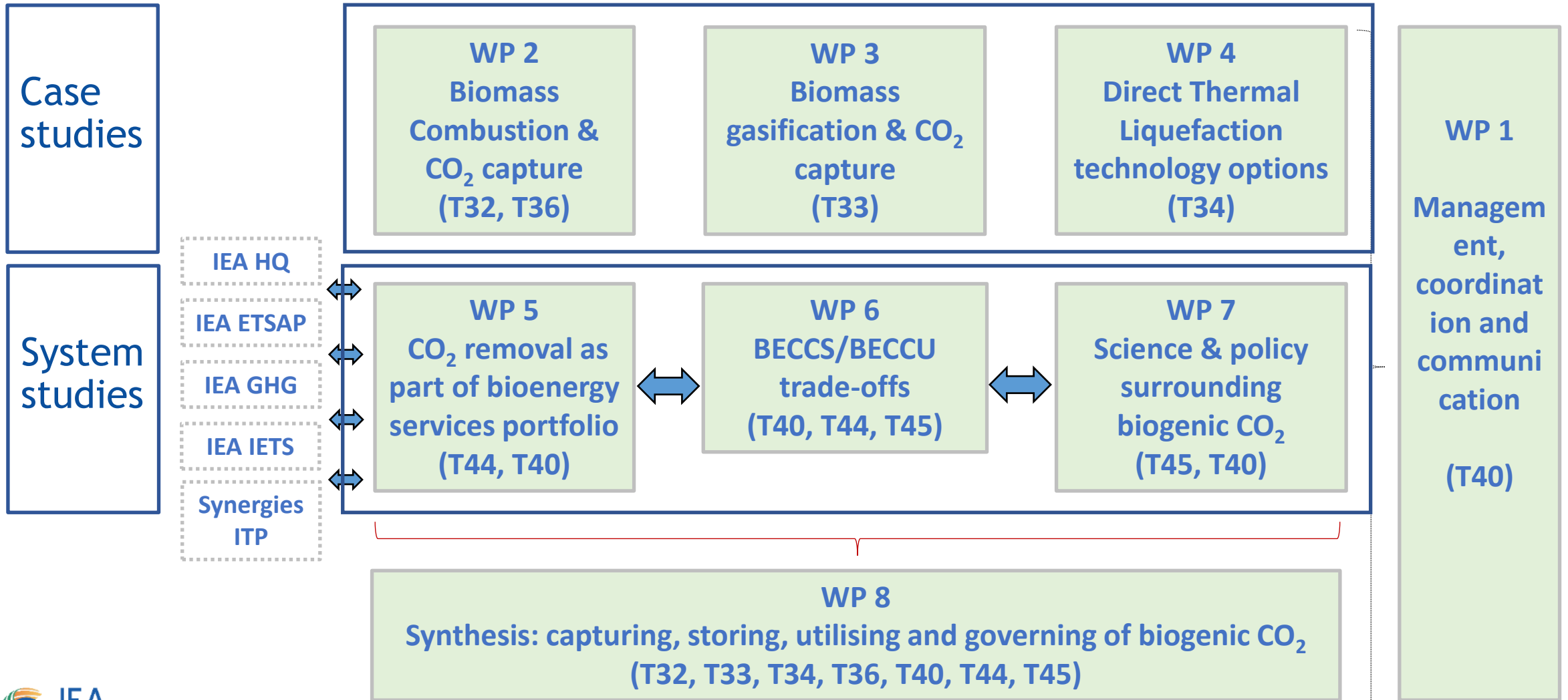


Management of Biogenic CO₂: BECCUS Inter-task Phase 2

Project essentials

- Timeframe
 - Started in Q2 of 2022, will run through the end of 2024.
- Overarching goal:
 - Systemic analysis of how to facilitate deployment of BECCUS applications
- Key questions to address:
 - In a given situation should biogenic CO₂ be sequestered, or utilised? What are the most important criteria and parameters to be considered in answering this question?
 - How to monetise the carbon negative products that bioenergy can deliver?
 - How to govern the different energy system services? What factors and parameters should guide this decision-making process?
- Outputs
 - Individual WP outputs will vary (workshops, factsheets, summary reports)
 - Final WP is tasked with producing a concise synthesis report summarising the project findings.

Main activities | project work packages



Summary of work to be undertaken I

- **WP2 - Biomass Combustion & CO₂ capture**
 - Modelling full-scale implementation of a CCU/S plant at an existing biomass CHP plant in Denmark
 - Options for small scale BECCS
 - Survey the potential of carbon capture and utilisation (CCU) within waste incineration (EfW)
- **WP3 - Biomass gasification and carbon capture**
 - Analyse the prospects of combining biomass gasification with carbon capture and utilisation or storage
- **WP4 - DTL technology options to support/enable BECCUS**
 - Investigates technological options for DTL processes (fast pyrolysis and hydrothermal liquefaction) to provide foreseeable system services in the field of carbon storage and utilisation.

Summary of work to be undertaken II

- **WP5 - CO₂ removal as part of bioenergy services portfolio**
 - Address the questions of how flexibility can support negative emissions approaches, and what the value is for the energy system.
- **WP6 - BECCS/BECCU trade-offs**
 - Address the core question of when to store, and when to utilise biogenic CO₂. Define and elaborate on important parameters that can assist in answering this question. Aspects to be looked at will include:
 - Access to district heating network
 - Access to CO₂ sequestration infrastructure (onshore/offshore)
 - Purity of captured CO₂
 - Quantity of captured CO₂
 - Electricity and heat costs/prices
 - Cost of H₂ production and value of PtX fuels
 - Development in price and regulatory scheme for negative CO₂ certificates
- **WP7 - Science & policy surrounding biogenic CO₂**
 - Highlight how capture and utilisation or storage of CO₂ affects overall system climate impacts.
 - How differences in CO₂ origin (fossil, biogenic & atmospheric via DAC) shape system performance in terms of climate change mitigation.
- **WP8 – Synthesis report**
 - Summarise findings and provide policy recommendations

Time for questions?

Thanks for your attention

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www.ieabioenergy.com

Extra slides - IEA Bioenergy

Unique role for sustainable bioenergy in the transition away from fossil energy

- Available now to phase out fossil fuels in existing energy infrastructure
- **Versatile:** role in different sectors - heat, power, transport fuels
- **Storable/dispatchable:** complements intermittent/seasonal renewables in power systems
- Next to producing energy, it can **remove atmospheric CO₂** (“negative emissions”) via deployment of Carbon Capture & Storage (CCS) : BECCS / Bio-CCS
- Provide **atmospheric CO₂** for carbon-containing e-products/e-fuels via Carbon Capture & Utilisation (Bio-CCU)
- **Enable biomass supply chains & sustainability governance systems** for the biobased economy

Bioenergy contributes to climate change mitigation when:

- Biomass is grown **sustainably** or based on waste/residues
- **Converted** to energy products **efficiently** (often together with other biobased products)
- Used to **displace fossil fuels**

Current strategic action areas

A sustainable system for energy and materials supply with biomass

- Demonstrating the key role of bioenergy in a decarbonising world, the complementary role with other renewables, and the potential to provide negative emissions (BECCUS)
- Contribution to Sustainable Development
- Embedding bioenergy into the broader bio-economy
- Incorporating the security, flexibility and stability provided by bioenergy in the fuels, electricity, gas and heating systems

Innovative Technologies

- Enabling the development and application of innovative technologies (collaboration & best practices)
- Developing advanced biofuels from lignocellulose and waste & consider their role in hard-to-abate transport sectors (aviation, marine, long-distance transport)

Current strategic actions areas

Sustainable Supply Chains

- Mobilize biomass resources through landscape management, reuse of abandoned agricultural lands; sustainable sourcing in agriculture and forestry; logistics to mobilize underutilized residues
- Support sustainability governance & certification
- Promote market deployment of efficient biobased value chains



Operational Optimisation

- Engaging relevant stakeholders in a dialogue & science based analysis to inform political/public debates
- Expanding collaboration with emerging and developing countries
- Ensuring the optimal use of communication channels

Extra slides: Management of Biogenic CO₂: BECCUS Inter-task Phase 2

BECCUS 1.0 & BECCUS 2.0

BECCUS 1.0

5 case studies

- Waste-to-energy
- Biomass-based CHP
- Biomass-based electricity generation
- Cement
- Bioethanol

3 system studies

- Scoping report
- Carbon accounting across BECCUS supply chains
- Bioenergy flexibility and carbon removal - finding the balance

BECCUS 2.0

3 case study WPs

- Biomass combustion and CO₂ capture (WP2)
- Biomass gasification and CO₂ capture (WP3)
- Direct Thermal Liquefaction technology options (WP4)

3 system study WPs

- CO₂ removal as part of the overall bioenergy services portfolio (WP5)
- BECCS/BECCU trade-offs (WP6)
- Science & policy surrounding biogenic CO₂ (WP7)

BECCUS 1.0 & BECCUS 2.0 combined will allow for a complete picture of technology options and a broader **systemic view**.

Timeline and main outputs

From June 2022 to December 2024

Kick-off meeting

First workshop

WP	Year	2022				2023				2024			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP1 Management, coordination and communication			PS		PS		PS		PS		PS		PS
WP2 Biomass combustion and CO ₂ capture													
WP 2.1											FS	SyC	
WP 2.2						WS					SR	SyC	
WP 2.3											FS	SyC	
WP3 Biomass gasification and CO ₂ capture									BN			SyC	
WP4 DTL technology options											FS	SyC	
WP5 CO ₂ removal as part of the overall bioenergy services portfolio										SR		SyC	
WP6 BECCS/BECCU trade-offs									webinar	ScR		SyC	
WP7 Science and policy surrounding biogenic CO ₂							WS				SR	SyC	
WP8 Synthesis: capturing, utilisation, storing & governing biogenic CO ₂													SyR

PS | reporting status to Technical Coordinator and ExCo
 FS | Fact sheet, SR | Summary Report, ScR | Scoping Report, BN | Briefing Note, SyC | Synthesis Report Contribution, SyR | Synthesis Report
 WS | Workshop

Brief summary of work to be undertaken

- Cross-sector and cross-country learning about implementation of BECCUS using different energy conversion processes (WP2-WP4).
- Shed some light on the effects of the integration of BECCUS facilities and systems within the overall energy system and its interaction with other energy system services (WP5).
- In addition, although we tend to refer to “BECCUS” as a unified concept, we also emphasise and analyse the important differences between BECCS and BECCU, not least from the perspective of potential business models and policy development (WP6).
- An understanding of the impacts of BECCUS on overall climate system in terms of potential for CO₂ mitigation is addressed (WP7)
- Provide policy recommendations (WP8).

Extra slides: Ea Energy Analyses

Ea Energy Analyses

- Consulting company operating in the field of energy and decarbonization
- Established in 2005
- Based in Copenhagen, Denmark
- The founding partners were managers in the TSO of Eastern Denmark



40 people

Projects in 20+
countries



3.5 m\$
yearly turnover

18y
experience within
the energy sector





For any inquiry, contact:
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