



IEA Bioenergy
Technology Collaboration Programme



IEA Bioenergy BECCUS Inter-task projects

Phase 1: Deployment of BECCUS value chains

Phase 2: Management of Biogenic CO₂

Christian Bang, Ea Energy Analyses, Co-leader:
Management of Biogenic CO₂: BECCUS Inter-task Phase 2

Workshop on biomass combustion and CCUS

Copenhagen, Denmark. September 21st, 2023

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Technology Collaboration Programme

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Deployment of BECCUS value chains

BECCUS Inter-Task Project: 2019-2021

Project objective and approach

- Objective:
 - Improve the understanding of the opportunities and obstacles related to deployment of BECCUS* in different industries
- Approach involved analysis of:
 - Technology readiness and economics
 - Business models
 - Policy design and regulatory frameworks
- Project outputs could largely be classified as either:
 - System studies, i.e., cross-industrial and conceptual aspects
 - Industry case studies or deep-dives

* BECCUS: Bioenergy combined with carbon capture and utilisation or sequestration

Publications

- Scoping report:
 - [Deployment of BECCS/U value chains – Technological pathways, policy options and business models \(June 2020\)](#)
- Case studies:
 - [Biomass based combined heat and power \(CHP\) – HOFOR Amager CHP, Copenhagen, Denmark \(May 2021\)](#)
 - [Bioelectricity – Drax Power Station, United Kingdom \(May 2021\)](#)
 - [Waste-to-Energy – Fortum Oslo Varme \(FOV\), Oslo, Norway \(May 2021\)](#)
- Topical reports:
 - [Deployment of bio-CCS in the cement sector: an overview of technology options and policy tools \(December 2021\)](#)
 - [Sequestering CO2 from ethanol production in the United States \(January 2023\)](#)
- System Study:
 - [Carbon accounting in Bio-CCUS supply chains – Identifying key issues for science and policy \(February 2022\)](#)
- Summary report:
 - [Deployment of BECCUS value chains - From concept to commercialization - Synthesis Report](#)

Key findings and outstanding questions

- Key findings:
 - Much of the required CCUS technology can to a large extent be considered proven
 - I.e., technological obstacles to near to medium-term deployment of bio-CCUS systems are likely not prohibitive.
 - However, the policy measures required to incentivise the demonstration, deployment and operation of bio-CCUS value chains are essential but currently largely absent
- Focus areas for continued work:
 - Deployment options for small-scale BECCS, and different capture technologies
 - BECCS vs. BECCU, when is it preferable to store, and when to utilise, and what are the most important parameters affecting this decision?
 - Synergies and/or trade-offs with other energy system services (e.g., flexibility)
 - Policies incentivising and governing BECCUS, particularly Bio-CCU
 - Sustainability aspects and risks

Management of Biogenic CO₂: BECCUS Inter-task Phase 2

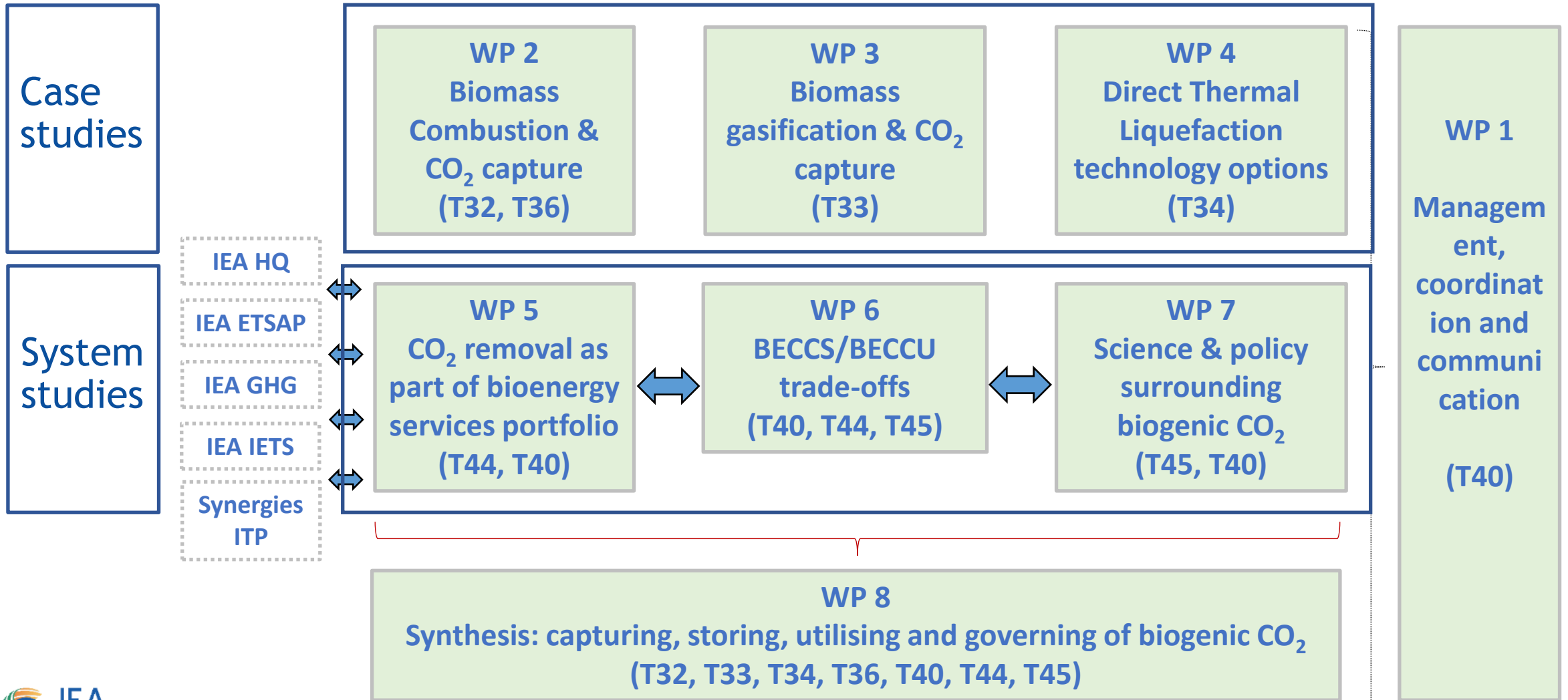
BECCUS Inter-Task Phase 2 Project: 2022-2024

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?
 - What options are available for small-medium scale projects?
- Outputs
 - Individual WP outputs will vary (workshops, factsheets, summary reports)
 - Final WP is tasked with producing a concise synthesis report summarising the project findings.

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

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

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**.

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





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