



About ENhanced CAPture of CO₂ (ENCAP) Project

ENCAP is an integrated project (IP) within the EU FP6 Programme. ENCAP is a five-year project that started on March 1st, 2004. A group of 33 legal entities comprising 6 large European fossil fuel end users, 11 leading technology providers, and 16 high ranked RTD providers has agreed to establish the ENCAP consortium. The target of ENCAP is 50% CO₂ capture cost reduction and at least 90% CO₂-capture rate as relating to capture technologies that were current at the startup of the project. The objective is to develop new pre-combustion CO₂-capture technologies and processes for power generation based on fossil fuels - mainly hard coal, lignite and natural gas - that are conceived as affordable and clean, and which can be integrated with sustainable energy systems.

The RTD activities are structured in 6 sub-projects that directly meet the stated objectives of the EC Work Programme (WP). ENCAP will, in compliance with the stated objectives of the WP perform research and development on pre-combustion CO₂ capture (incl. pre-normative and socio-economic impacts) and validate by testing technical and economic feasibility of concepts, and also interact with research-related networks and carry out training and dissemination. ENCAP will generate knowledge and results that enable power companies to decide to launch a new design project by 2008-2010 aimed at a large-scale demonstration plant. The project will deliver results that have the potential for a wide commercial exploitation with a time horizon 2015-2020.



The work will enhance the competitiveness of European industry and contribute to the creation of a European Research Area for CO₂ capture.



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ENCAP Training Seminar — Workshop

A Training Seminar — Workshop, organized by ENCAP Project partners, is scheduled to take place in Autumn 2005.

The Workshop will comprise two sessions (pre- and post-capture technologies).

The status on CO₂ pre- and post-capture technologies outside the EU (e.g. in USA and Japan), will be also presented.

Experts from Research Centres, Industry, Manufacturers, Universities will be invited. Furthermore, Governmental and EC officers related to Environment and Climate Change will be also invited.

1st Announcement of the Training Seminar—Workshop with specific information on the dates, venue, agenda, etc. will be issued soon!



ENCAP Training Seminar—Workshop

Special points of interest:

- ENCAP Training Seminar — Workshop to be organized in Autumn 2005
- Highlights within the ENCAP Project

Project Structure

The RTD activities are structured in six sub-projects (SP) that directly meet the stated objectives of the Work Programme. These SPs are:

- SP1: [Process and Power Systems](#)
- SP2: [Pre-Combustion Decarbonisation Technologies](#)
- SP3: [OxyFuel Boiler Technologies](#)
- SP4: [Chemical Looping Combustion](#)
- SP5: [High-Temperature Oxygen Generation for Power Cycles](#)
- SP6: [Novel Pre-Combustion Capture Concepts](#)

In addition, a Training and Dissemination Committee has been established in order to assure that the knowledge generated within ENCAP is transferred to the research community, industry, manufacturers, education, policy makers and the general public.

SP1: Process and Power Systems

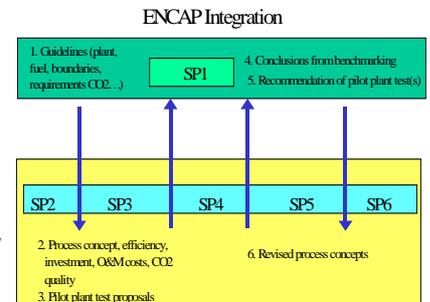
SP leader: **Vattenfall AB**

Objectives:

SP1 aims to *establish methodology* to ensure consistency in evaluations and benchmarking of capture technologies subjected to ENCAP, and to *assess the impact of candidate concepts* on the economy of power production and in reflection of their technical maturity and development risks.

Furthermore, within SP1, an overall *synthesis of the R&D conducted* in the other ENCAP SPs will be done and the *impact on regional and European level* on energy systems,

on the human health, environmental and safety aspects will be considered.



SP2: Pre-Combustion Decarbonisation Technologies

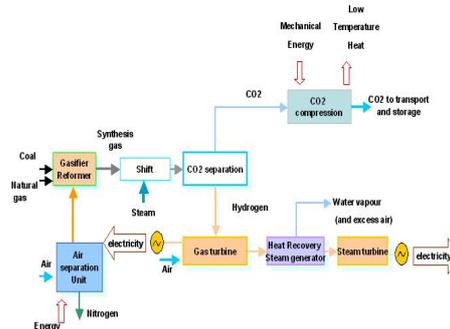
SP leader: **RWE Power AG**

Objective: SP2's scope is to investigate candidate pre-combustion decarbonisation processes with reference to:

1. the Integrated Gasification Combined Cycle (IGCC) for hard coal and lignite, and
2. the Integrated Reforming Combined Cycle (IRCC) for natural gas - with corresponding adaptations.

The work includes *gas processing, hydrogen combustion, power process design and cost assessment.*

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SP3: OxyFuel Boiler Technologies

SP leader: **Vattenfall AB**

SP3 focuses on oxy-fuel combustion, i.e. combustion using almost pure oxygen and recycle of flue gas to moderate the combustion temperature. The fuels

considered are *bituminous coal and lignite*, which can be burnt in large

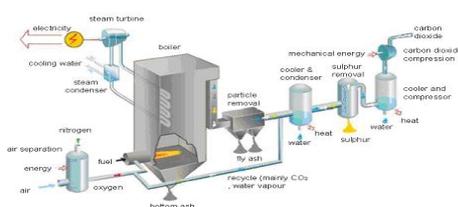
combustion plants (boilers).

Objective:

- Provide fundamental understanding

of *combustion in denitrogenated air*

- Undertake a conceptual study of *large-scale boiler technologies.*
- Suggest a *conceptual OxyFuel boiler design and synthesis-studies* of its integration with a power generation plant to provide an economically competitive technology.



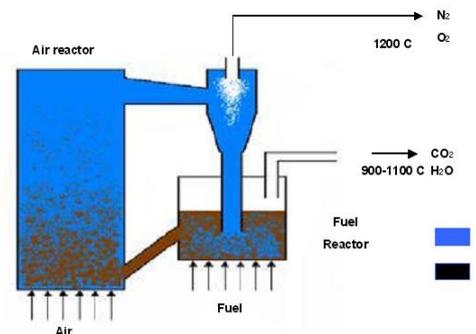
SP4: Chemical Looping Combustion

SP leader: *Institut Français du Pétrole*

Objective: SP4 plans to provide *entirely new combustion technology* - with no contact between fuel and combustion air - featuring the *inherent separation of CO₂* and *avoidance of nitrogen oxide formation*. This chemical-looping-combustion technology (CLC) will be developed for *gaseous and solid fuels* and operated at *atmospheric and pressurized conditions*. Substantial R&D will be directed towards materials and

conceptual CLC-processes. In pursuing prospective technology routes *stable reactive materials* at acceptable cost and *reactor concepts* must be developed and characterized. Especially concepts that apply *CFB reactors* in which the *oxygen carrier is a powder* will be addressed. Owing to fine particles that are prone to damage turbine blades, *optional reactor concepts* will be suggested in order to overcome this attrition problem. Innovative solutions are likely to have *fixed bed materials*, using a honeycomb structure or extruded pel-

lets. A strategy for selecting low cost raw materials will be established, and an optimised conceptual process design will be established.

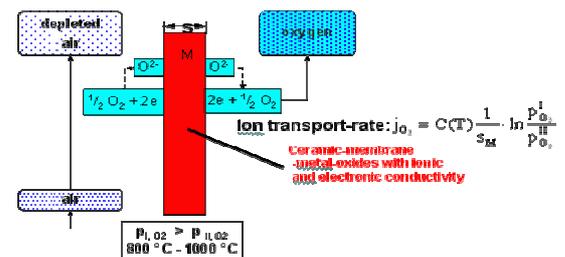


SP5: High-Temperature Oxygen Generation for Power Cycles

SP leader: *Linde*

Objective: This SP aims to identify and develop *promising, low cost advanced high temperature oxygen generation process options* for use in the power plant processes of SP2 and SP3. Successful development of low cost oxygen generation options and their effective integration in the power cycle will enable *achievement of overall cost targets* for carbon dioxide capture and seques-

tration from fossil fuel plants through reduction of cost of oxygen.



ENCAP is organised as an integrated project (IP), which started on March 1st 2004 and will be completed by February 2009.

SP6: Novel Pre-Combustion Capture Concepts

SP leader: *ALSTOM*

Objective: SP6's scope is to investigate *prospective emerging pre-combustion capture technologies* having a high potentiality for capture cost reduction while maintaining a high capture rate. The major part will be devoted to advanced oxy-fuel gas turbine concepts. The research will follow a vertical, three-step approach by *screening, mod-*

elling and verification. This involves actions like world-wide screening of energy conversion technologies, generating new ideas on advanced power generation and cycle development, classification of emerging technologies by in-depth investigation - supported by modeling, conceptual design, novel techniques for experimental clarification of selected key elements, and economic ranking. These actions will be

liaised with the relevant SPs. Emerging capture technologies for power cycles will be further addressed.

Contacts

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Highlights

Common framework for calculating power plant performance

An achievement in ENCAP (SP1 and SP6) has been to provide a common basis for the studies performed in SP2-SP6. The work is the result of the agreement between major power plant equipment manufacturers, power companies, research institutions and universities about a general framework for calculating power plant performance. SP1 has provided guidelines with several reference power plants without CO₂ capture, requirements on the quality of the captured CO₂, boundaries for the economical analysis and a procedure for evaluating different CO₂ capture technologies. As a complement to the SP1 guidelines, SP6 has provided a common framework for the modeling basis, which is useful when modeling innovative power plant concepts that cannot be based directly on the reference power plants treated by the SP1 guidelines. Sometimes the use of favorable and maybe unrealistic computational assumptions is used to promote some technologies at the expense of others. The SP6 framework makes it possible to deal with this general problem of comparison of power plant performance statements from various sources. The SP6 framework provides a detailed and transparent set of computational assumptions, models and fluid properties, as well as a definition of the boundary conditions for calculating plant efficiency. It is expected that the SP1 guidelines and the SP6 computational framework will be used by others outside ENCAP, and that standards are set which can be referred to in publications.

Information on Upcoming Events related to power generation with CO₂ capture

- European CO₂ Capture and Storage Conference, European Commission-DG Research, *April 13-15, 2005*, Brussels, Belgium
- European Combustion Meeting "ECM2005", Belgian Section of the Combustion Institute, *April 3-6, 2005*, Louvain-la-Neuve, Belgium
- Clearwater Conf.: 30Th International Technical Conference and Coal Utilization and Fuel Systems Coal Technology - Yesterday, Today, Tomorrow, DOE, ASME, NETL, *April 17-21, 2005*, Clearwater, FL, USA
- CCT 2005. Second International Conference on Clean Coal Technologies for our Future, SOTACARBO & IEA, *May 10-12, 2005*, Cagliari, Italy
- Annual Network Seminar at Statoil Trondheim, CO₂NET, *May 18-20, 2005*, Trondheim, Statoil, Norway
- Clean Coal Symposium der Brandenburgischen Technischen Universität Cottbus, *May 19 - 20, 2005*, Cottbus, Germany
- ASME Turboexpo 2005, ASME, *June 6-9, 2005*, Reno-Tahoe, Nevada, USA
- ASME Power Conference 2005, ASME, *July 5, 2005*, Chicago, Illinois, USA
- 18th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2005), Norwegian University of Science and Technology, *June 20-22, 2005*, Trondheim, Norway
- 3rd qtr 2005: Advisory Meetings on Future Standardization of CO₂ Capture and Storage, CO₂NET, *September 5, 2005*, Paris, France

More info about the events can be found in www.encapco2.org/news/events.html

Project Partners

