

# GEO ENeRGY

This issue is dedicated to CO<sub>2</sub> capture and storage activities in Europe

## Results of the EU GeoCapacity project

### EU GeoCapacity is drawing to a close

The EU GeoCapacity project, involving 25 European partners and 1 Chinese partner, is rapidly approaching the end of its three-year contract due to finish 31 December 2008. The data collection and input process for the GIS database is now completed and, over the past few months, final checking and fine tuning of the capacity estimates have been performed according to the standards developed throughout the duration of the project. The GeoCapacity GIS database contains updated data on CO<sub>2</sub> emissions, infrastructure such as pipelines, and the location of potential geological storage capacity in deep saline formations, hydrocarbon reservoirs and coal fields. The emission data include technical information on the type of industry (power, cement, iron and steel, paper), fuel, technology, capacity, etc. The pipeline data include properties such as type (oil, gas, etc.), diameter and length. The storage data include geological information and physical properties of the reservoir and sealing formations, as well as estimates of the storage capacity of each of the identified potential storage possibilities. Figure 1 shows an example of the content of the GeoCapacity GIS database. The results of the study will be summarized at the completion of the project, and the technical and geological results are intended to provide a solid foundation upon which the application of CCS in Europe can be judged and, hopefully, be declared sufficiently sound to warrant widespread application.

The GeoCapacity project was designed specifically to provide contributions to CCS standards within the following areas.

### GIS-based inventorying & mapping

The basic methodology for GIS-based inventorying and mapping of CO<sub>2</sub> emissions and geological storage capacity was



developed under the GESTCO project. GeoCapacity has provided further development of the GIS, plus improved functionality and a more user-friendly system. The database now covers 25 countries in Europe (including two countries covered in GESTCO but not updated in GeoCapacity), and a web-based GIS is available to the project partners. The GIS database also includes input data for the economic evaluations carried out using the Decision Support System (DSS) and, overall, the aim was to produce work of sufficient quality and detail to set the standard for building this type of GIS system.

### The Decision Support System economic evaluation method

The DSS software tool for the economic evaluation of

'source-transport-storage' scenarios was also initially developed under the GESTCO project. It has already set standards for the evaluation of source-sink scenario economics. New facilities developed under GeoCapacity include multi-source and multi-sink evaluations, a stochastic approach for calculations and web application of the tool.

### Site selection criteria and storage capacity estimation standards

An understanding of the basic geological/technical site selection criteria is important. A set of criteria has been produced for the selection of potential storage sites along with descriptions of the related geological/physical parameters.

Previous assessments of the geological storage capacity of different countries, areas and regions vary tremendously in terms of detail and quality. One aim of GeoCapacity was to adapt and define common standards in order to produce uniform assessments of geological storage capacity. The work of establishing internationally recognized standards for capacity assessments was initiated by the Carbon Sequestration Leadership Forum (CSLF) about a year before the start of the GeoCapacity project. A CSLF Task Force has been active since then and GeoCapacity has contributed to the work in addition to continuing progress on this issue in Europe. The application of the methodologies described by CSLF has already led to the initiation of further work by the Task Force, reflecting the synergetic effects between projects.

### International cooperation

Last but not least, GeoCapacity has also been focusing on international cooperation, particularly knowledge transfer and capacity building in China. GeoCapacity has thus pioneered storage capacity estimation and GIS mapping in China through a comprehensive study of the Hebei Province (near Beijing and located in the Bohai Bay sedimentary basin). A GIS database of the Hebei Province was built in parallel with the GIS work in Europe. Other provinces around Beijing will be covered as various projects evolve, such as the EU-funded COACH project and the UK-NZEC project.

Please visit our project website at [www.geocapacity.eu](http://www.geocapacity.eu) for more information.

Thomas Vangkilde-Pedersen

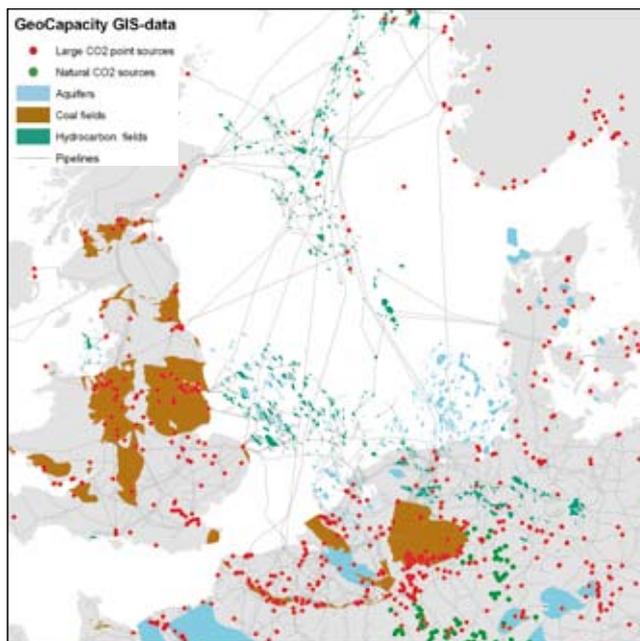


Fig. 1: Example of the content of the GeoCapacity GIS database



# Launch of the FP7 project ,ECCO – European value Chain for CO<sub>2</sub>'

,ECCO – European value Chain for CO<sub>2</sub>' is a new EU collaboration project under the 7<sup>th</sup> framework programme for research. It was launched at the official kick-off meeting in Trondheim, Norway, on 2 September 2008. The main objective of ECCO is to facilitate robust strategic decision making regarding early and future implementation of CO<sub>2</sub> value chains in the face of uncertainty. The project will be coordinated by SINTEF Energy Research and has a total budget of 5.35 M€ over three years. It is worth mentioning that this is the first EU-funded CO<sub>2</sub> project that will focus on oil and gas production through enhanced oil and gas recovery (EOR/EGR) with CO<sub>2</sub> injection.

In the first phase of ECCO, the main emphasis will be to identify future scenarios

relevant for the realisation of CO<sub>2</sub> value chains in Europe, involving experience from previous studies that have identified specific show-stoppers. The involvement of all project partners, including background from power generation, oil and gas production and R&D, will ensure that all aspects that could affect the realisation of a CO<sub>2</sub> value chain will be taken into consideration. The time perspective evaluated in ECCO is up to 2020.

In the following phases, the project will:

- Provide the basis for, and the recommendations leading to the implementation of the most promising EOR and EGR alternatives, with the basis in scenario studies for the future in Europe (2020).
- Prepare for analyses and

recommendations through the development of a CO<sub>2</sub> value chain analysis tool. This will be a mathematical tool that will include models related to global, economical, technical and regulatory issues. This also includes reservoir-related issues, such as CO<sub>2</sub> injection, processing of CO<sub>2</sub> in the produced oil and the possible integration of aquifers for intermediate CO<sub>2</sub> storage in a large-scale CO<sub>2</sub> infrastructure.

- Assess specific scenarios (as defined in the first phase of ECCO) with the analysis tool. The results from the scenario studies will be used to set the frames for the future value chains, and the models developed in the project will be used with input from project partners that are operators or power producers in various regions of Europe.

- Quantify the potential for enhanced hydrocarbon recovery (EOR/EGR) and CO<sub>2</sub> storage in European petroleum reservoirs and evaluate the technological challenges, both onshore and offshore.

The main result of the project will be the report "ECCO strategies for CO<sub>2</sub> value chain deployment", which is due in the last month of the project. This will comprise ECCO's joint strategies and recommendations regarding deployment of the CO<sub>2</sub> infrastructure in the near and mid-term future, liability issues and cross-border regulations, Emission Trading Schemes (ETS), financing schemes, and regime of incentives, and organization of the supply chain.

The expected impacts of the project are to:

- Underpin the realisation of CO<sub>2</sub> value chains for captured CO<sub>2</sub> from large point sources for CO<sub>2</sub> injection in petroleum reservoirs with the combined aim of EOR/EGR and CO<sub>2</sub> storage.
- Improve security of supply by enabling the sustainable use of fossil fuels, protracting increases in fuel imports by making better use of existing resources and shortening time to market for promising CCS-related technologies.
- Strengthen the competitiveness of the European economy by maintaining and reinforcing the leading position in CCS technologies and by sharing and building on the existing EOR experience in Central and Eastern Europe and on-going activities in the North Sea.

ECCO comprises 18 partners from 8 countries. The project is co-ordinated by SINTEF Energy research. For more information about the project visit [eeco.sintef.no](http://eeco.sintef.no).

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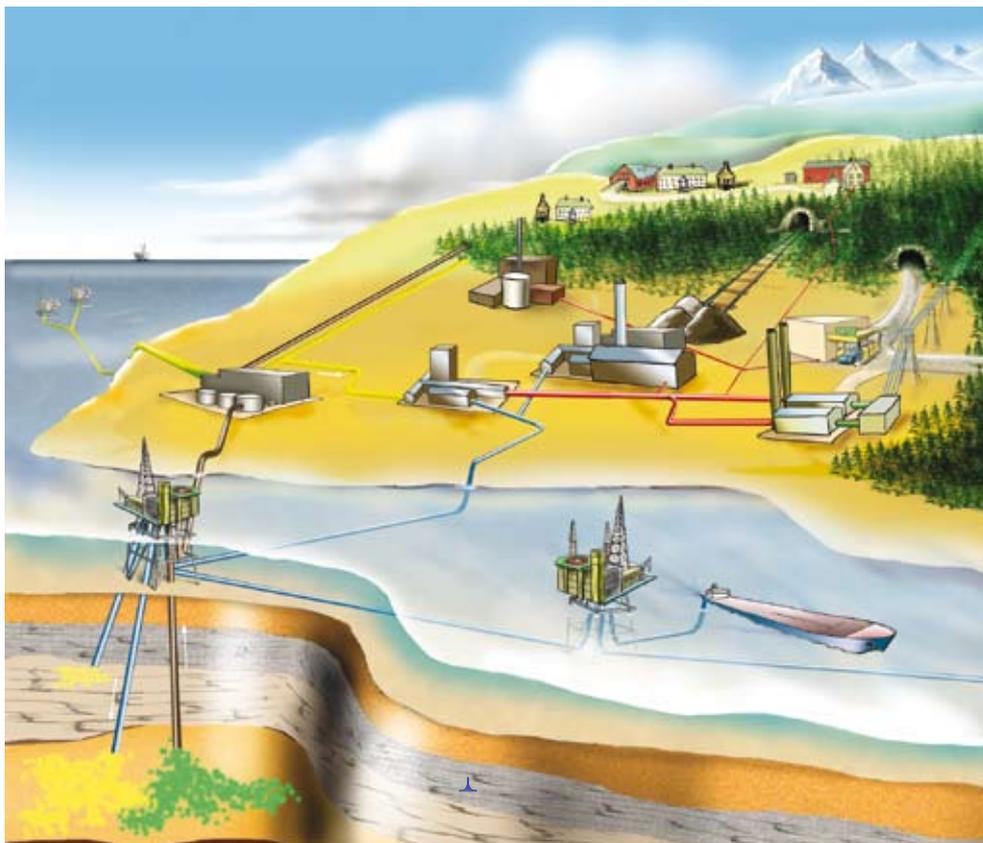


Fig. 2: A vision of CO<sub>2</sub> capture and storage (picture courtesy of DYNAMIS project)

**ENeRG - European Network for Research in Geo-Energy** – is an informal contact network open to all European organisations who have a primary mission and objective to conduct basic and applied research and technological activities related to the exploration and production of energy sources derived from the Earth's crust.

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#### ENeRG Newsletter – GEO ENeRGY

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# Capture, Transport & Geological Storage of CO<sub>2</sub> in the Vedsted structure near Aalborg in the northern part of Jutland

## Vattenfall's Danish CCS demo project

Denmark emits on a yearly basis about 60 million tons of CO<sub>2</sub> into the atmosphere...

On 6 February 2008, Vattenfall Nordic Thermal Power Generation announced the intention to develop a full-scale CO<sub>2</sub> Capture & Storage (CCS) demonstration project in the Danish area. One of the main objectives is to help the development of CCS in Europe.

To facilitate the development of CCS, it is not sufficient to only consider the technical challenges related to the up-scaling of the capture technology or trials concerning storage capacity, injectivity and containment. Several other matters must also be addressed before being anywhere near the commercialization of CCS, such as long-term monitoring and liability, the terms for operation and relinquishment of license and a broader public knowledge on CCS. These challenges, and more, are addressed in demonstration projects.

### The "CCS Demo Denmark"

The project comprises a full-scale post-combustion retrofit CO<sub>2</sub> capture plant at the 380-MW coal-fired Nordjyllandsværket power plant near the city of Aalborg. The captured CO<sub>2</sub> will

be transported along an approximately 30-km-long pipeline from the power plant to the storage facilities in the Vedsted structure to the west of Aalborg in the northern part of Jutland.

The Nordjyllandsværket power plant is highly efficient (47% in condensing mode) and the project will handle some 1.8 million tons of CO<sub>2</sub> per annum. Besides electricity, the plant also produces district heat to the city of Aalborg, which results in an even higher efficiency. A high efficiency is crucial because today's CO<sub>2</sub> capture process technology reduces the efficiency of the

power plant by approximately 8–10%.

The CO<sub>2</sub> will be stored in a saline aquifer, more specifically within the onshore Vedsted geological structure, which comprises an anticlinal closure within a large fault block. The cap rock includes several thick clay stone intervals above the reservoir, and also a thick chalk section close to surface constituting a secondary seal. The target storage reservoirs consist of Triassic to Jurassic sandstones with good porosities and permeabilities. The expected storage capacity is approximately 100 million tons or more.

### The project timeline

Dialogue is currently ongoing with the various possible suppliers of the capture technology. Before any firm decisions can be made, however, the expected storage capacity, injectivity and containment have to be verified through detailed geological investigations.

On 1 September 2008, Vattenfall started collecting new 2D seismic data in northern Jutland in the aim of better constraining the structural setting of the area and updating existing maps with respect to fault locations and the structural contoured closure at different levels. A comprehensive drilling and testing campaign is scheduled for late 2009 and, based on these results, application for a storage permit is anticipated during 2010.

Based on the conclusions of the storage investigations and the feasibility of the capture process, a potential investment decision is expected by 2010. The project aims to begin CO<sub>2</sub> storage in late 2013.

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Fig. 3: Seismic vibrators working in the northern part of Denmark

## 2nd CO<sub>2</sub>NET EAST Workshop on CO<sub>2</sub> Capture and Storage

3–4 March 2009, Bratislava, Slovakia  
<http://www.geology.sk/co2neteast/co2net-east.htm>

## CO<sub>2</sub>GeoNet Open Forum

18–20 March 2009, San Servolo Island, Venice, Italy  
<http://www.co2geonet.com>

to be confirmed

## Introduction of New ENeRG Members

### BRGM (France)

<http://www.brgm.fr>  
BRGM is France's Public Institution responsible for mobilizing the Earth Sciences in the sustainable management of natural resources and the subsurface domain. Its activities are organized according to its roles of scientific research, support for government policy, and international cooperation and development assistance. BRGM is active in 34 countries and works on 10 thematic areas: Mapping and geoinformation, Mineral resources, Geothermal energy, Geological storage

of CO<sub>2</sub>, Water, Post-mining, Development planning and natural risks, Contaminated land and waste management, Metrology, Digital information systems. With 879 employees, including more than 600 engineers and technicians, BRGM integrates the experience and the competence of specialists in all branches of the Earth Sciences: geologists, hydrogeologists, hydraulic and geotechnical engineers, agronomists, ecologists, chemists, geochemists, seismologists, geophysicists, as well as economists.

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### Institute of Geology and Seismology of the Academy of Sciences of Moldova

<http://igg.asm.md>  
Founded in 1949, the Institute of Geology and Seismology is an academic institution focusing on geology, seismology, seismic risk assessment, hydrogeology, geotechnics, mineral resources and environmental geochemistry. The Institute also hosts a network of seismic stations that collect earthquake

data in the Vrancea region. The institute has a staff of 82, including 27 scientific researchers and 12 engineers. The Institute has several well-equipped laboratories and an experimental methodologies centre. The broad sufficient and positive experience gained through its participation in international (NATO, TACIS, INTAS etc.) and local research and applied projects reflect the high level of expertise within the Institute.

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# CBM-ECBM Carbosulcis Project

Coal still represents an important fossil energy resource worldwide in terms of exploitability, profitability, and capability to meet today's energy requirements until the full-scale development of new alternative sources. Its responsible exploitation requires the joint use of technologies to minimize CO<sub>2</sub> emissions in the atmosphere.

In Italy, the Sardinian Sulcis coal basin is considered to be one of the most interesting sites, where technologies are applied for conventional and enhanced methane recovery and also for CO<sub>2</sub> geological storage.

The Carbosulcis Company, owner of the "Miniera Monte Sinni" mineral concession, manages the only active coal mine in Italy and a research authorization "Is Urigus" for methane exploration in a wider area in the Sulcis coal basin, southwest Sardinia.

Over recent years, Carbosulcis has increased its presence in national and international energy and environmental activities, as national delegate in the Methane to Markets Coal Mine Methane Subcommittee, technical partner in the Ad Hoc Group of Experts for

the UNECE, and technical representative for Italy in the Carbon Sequestration Leadership Forum.

Moreover, as end-user of the European project MOVECBM, Carbosulcis has recently started a project entitled "Coal-bed methane and enhanced coal-bed methane (CBM/ECBM) recovery and CO<sub>2</sub> geological storage performance assessment at the Sulcis Basin" in collaboration with BRGM, IFP, Imperial College, OGS,



Fig. 4: Core drilling in the Sulcis basin

TNO, University of Rome "La Sapienza" (all members of CO<sub>2</sub>GeoNet, the European Network of Excellence for the geological storage of CO<sub>2</sub>) and Geotec S.p.A., Italy's largest geophysical service company.

The license area, subject of this study, is relatively large and previously unexplored. Current mining operations in the area occupy only a fraction of the basin and, consequently, the reservoir geology and flow characteristics of the basin are not sufficiently known to enable a meaningful assessment of its gas and CO<sub>2</sub> storage potential. The two-year project involves a systematic programme of data acquisition, interpretation and predictive modelling to assess the CBM/ECBM production and CO<sub>2</sub> storage performance of the basin. The overall programme comprises:

Part A (to be delivered by the Research Consortium)

- WP1A: Data Room Evaluation
- WP2A: Seismic Data Acquisition and Interpretation
- WP3A: Reservoir Geology and Geological Model Development
- WP4A: Reservoir Characterization
- WP5A: Reservoir Performance Prediction

Part B (to be delivered by Carbosulcis, supported by Geod, a Polish drilling company)

- WP1B: Data Room Evaluation
- WP2B: Drilling and Coring
- WP3B: Well Logging
- WP4B: Well Testing, Completion and Stimulation
- WP5B: Long Term Production and Injection Testing

The current project status is that all previous information on the research area has been re-considered and 40 km of high-resolution multi-channel reflection seismic profiles have been acquired. The data processing and interpretation is still in progress. The site operations are progressing well, with drilling and coring down to 1000-meter depth to collect samples in the coal formation (assumed to extend from -750 m to about -900 m) and in the underlying aquifer, considered a highly promising opportunity for storing large quantities of CO<sub>2</sub>.

Sergio Persoglia



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