Reducing carbon emissions with geological storage

With demands under the Kyoto Protocol for developed countries to cut CO₂ emissions by eight per cent between now and 2012, the big challenge is to reduce such emissions from fossil fuels using geological storage. CO₂ Capture and Storage (CCS) could help to make huge emissions cuts, but if this is to happen a large-scale assessment of the storage potential across Europe is essential. The GeoCapacity project focuses on countries in eastern, southern and central Europe not previously covered in detail.

The work of GeoCapacity includes data collection and mapping of emission, infrastructure and storage sites and complementing the datasets by the application of advanced evaluation techniques (DSS & GIS) as well as undertaking economic evaluations. This will enable source-to-sink matching across Europe. Site selection criteria, standards and methodologies for capacity estimations are created and applied to the project. Locating potential CO₂ storage sites may be essential to the emergence of a hydrogen economy. Production of hydrogen will be heavily reliant on fossil fuels – at least in its early development – and will have to consider CO₂ reduction strategies.

In addition, the project aims to work towards a structure for international cooperation especially with countries including China, India and Russia. Focusing on technology transfer may help these countries to undertake similar studies, as they perhaps face an even greater challenge to reduce CO₂ emissions due to their rapidly growing energy demands.

The project is built on East – West and international cooperation, helping to find solutions to a global challenge. The detailed objectives of the project are:

- Data collection and mapping in 13 European countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Spain), and reviews of four neighbouring states (Albania, Macedonia, Bosnia-Hercegovina, Luxembourg) as well as updates for six other countries (Germany, the Netherlands, Denmark, UK, France, Greece).
- Inventory of major CO₂ emission point sources.
- To conduct assessment of regional and local potential for geological storage of CO₂ for each the involved countries.
- To carry out analyses of source-transport-sink scenarios and conduct economical evaluations of these scenarios.
- To provide consistent and clear guidelines for assessment of geological capacity in Europe and elsewhere.
- To further develop mapping and analysis methodologies (i.e. GIS and DSS).
- To develop technical site selection criteria.
- To initiate international collaborative activities with China with a view to further and closer joint activities.

Geological studies, mainly in western Europe and including the northern North Sea, map considerable potential, but geographically they are unevenly distributed. Analysis shows geological storage of CO₂ to be a real option in the majority of the countries studied. The storage of about 1 million tonnes of CO₂ annually at the Sleipner gas field demonstrates the technical feasibility of the method.

It is vital for Europe to develop and deploy the full range of technologies making up CCS, including the geological storage assessment...
methods to be developed in the GeoCapacity project. If Europe is to fulfil the Kyoto obligations and be able to carry out the much deeper emission reductions needed, domestic dominance is a must. The alternative is to import the technology for CO₂ capture from overseas, but a ‘home-grown’ solution would provide export opportunities, particularly to some of the rapidly evolving economies, such as China, India and Brazil.

The geological surveys and the range of other research partners throughout Europe participating in GeoCapacity are in a unique position to carry out research and development studies. The surveys and other state institutes have, over decades and in some instances for more than a century, studied and mapped the distribution and composition of hard rocks and sediments in the subsurface. The project partners have access to large amounts of accumulated knowledge of the subsurface geology of Europe obtained from work with mineral exploitation, geothermal studies, hydrocarbon activities such as seismic mapping and drilling for oil. The variety of existing maps, other data and previous work makes it possible for the project partners to produce reasonable evaluations of the CO₂ storage capacity of the selected study areas. Based on the methodologies developed in previous activities – particularly the EU FP5 GESTCO project – the GeoCapacity project is designed with distinct roles for the partners. The Coordinator GEUS oversees all activities, having made working relationships and agreements with all of the other partners and leads the work on capacity standards and site selection criteria. The British Geological Survey (BGS) leads all work relating to GIS while the Dutch Geological Survey TNO leads the economic work.

The work with assessment of geological storage capacity is divided into three geographical groups facilitating cooperation between the participants of these groups, and with the group leaders assisting the project coordinator:

- **North Eastern Group**: Lead by SGUDS of Slovakia, the other members are MEERI PAS and PBG of Poland, Vattenfall AB of Sweden (Poland) Tallin University of Estonia, LEGMA of Latvia, IGG of Lithuania and CGS of the Czech Republic.
- **Central East Group**: Lead by ELGI of Hungary the other members are GeoEcoMar of Romania, Sofia University of Bulgaria, and IGME of Greece (covering Albania and Macedonia – FYROM).
- **South Group**: Lead by Croatian University of Zagreb the other members are IGME and Endesa Generacion of Spain, OGS and EniTecnologie of Italy, GEO-INZ of Slovenia while Bosnia-Hercegovina is covered by University of Zagreb.

Three industrial partners are supporting the groups, adding considerable value to the project:

- **Vattenfall AB** is heavily involved in RTD on capture and is the most active European power company involved in the development of CCS. General RTD input is provided by Vattenfall AB – the Corporate HQ in Sweden – while Vattenfall Poland provides national input.
- **EniTecnologie** is actively engaged in investigating the potential for CCS in Italy and possesses experience, technical skills and data, which will improve the quality of the project work. EniTecnologie has already initiated work on standards and procedures for CCS.
- **Endesa Generacion**, while being one of the large power companies in Europe, is a relatively new player in the field of CSS. It is part owner of one of the only two IGCC power plants (advanced coal-fired technology) in Europe, making evaluation of geological storage potential in that region of Spain particularly interesting.

IFP of France leads the work with evaluations of storage potential in hydrocarbon and coal fields and the International Cooperation is lead by BRGM of France, working closely with the Chinese Ministry of Science and Technology. Contributions are provided by GEUS, BGS and TNO on key issues.

The GeoCapacity project has been designed specifically to provide contributions to CCS standards within the following four areas:

**Site Selection Criteria**
The understanding of the basic geological/technical site selection criteria is important and they have been described
together with their related geological/physical parameters. A set of site selection criteria for the selection of a proper storage site are being produced including features as depth, integrity of seal, storage capacity and petrophysical reservoir properties. The resulting standardised set of criteria is anticipated to be a valuable contribution to future practical work and to the development of future regulations in the area.

The GIS database also provides input for the DSS economic evaluations and overall, it has been the aim to produce work of such quality and detail that it sets the standard for building this type of GIS systems.

**The DSS Economic Evaluation Method**

The Decision Support System (DSS) software tool for economic evaluation of ‘source–transport–storage’ scenarios was also firstly developed in the GESTCO project, and it has already set the standards for evaluation of source-sink scenario economics. The GESTCO DSS has been used for evaluation work for the IEA GHG and it was recognised that a number of features need to be developed. New facilities developed in GeoCapacity include multi-source and multi-sink evaluations, a stochastic approach in calculations and web application of the tool.

**The Results So Far**

The GIS database will provide updated CO₂ emission data, such as pipelines and locations of potential geological storage capacity in deep saline geological formations, hydrocarbon and coal fields. The emission data will include technical information on the type of industry (e.g. power, cement, iron and steel, paper), fuel, technology, capacity etc. and the pipeline data e.g. diameter and length. The storage data will 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.

A preliminary summary of the results can be seen in the diagram in this feature – showing large CO₂ point sources and potential storage sites. The storage estimates given are conservative values compared to the total sum of the estimates in the database. The final results will be published on project completion.

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.

**An increase in EU membership countries in recent years has, rightly, been celebrated as a positive step. However, with the good news comes a variety of new challenges for the expanded EU, not least that of reducing CO₂ emissions across the continent**

**Storage Capacity Estimation Standards**

A number of assessments of geological storage capacity of different countries, areas and regions have shown that the quality of work is very varied, ranging from regional assessment using simple parameters over a whole sedimentary basin to detailed evaluations using state-of-the-art tools. The work in GeoCapacity aims at defining and adapting standards for the proper geological assessment of storage capacity.

The work with establishing internationally recognised standards for capacity assessments was initiated by the Carbon Sequestration Leadership Forum (CSLF) about a year before the start of the GeoCapacity project and a CSLF Task Force has been active since. GeoCapacity has contributed to the work of the Task Force and has continued the progress on this issue in Europe. The applications (for example, in GeoCapacity) of the methodologies described by the CSLF have already led to the initiation of further work by the Task Force, proving the synergic effects between projects.

**GIS-based Inventorying & Mapping**

The basic methodology for GIS-based inventorying and mapping of carbon dioxide emissions and geological storage capacity was developed in the GESTCO project. In GeoCapacity the GIS system has been further developed, improving the functionality and making the system more user-friendly. The database now covers 25 countries in Europe, including two countries covered in GESTCO but not updated in GeoCapacity, and a web-based GIS has been made available to the project partners. The GIS database also provides input

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**At a glance**

**Project Title**
EU GeoCapacity

**Research area:** 6.1.3.2.4 Capture and sequestration of CO₂, associated with cleaner fossil fuel plants

**Area:** Geological Sequestration of CO₂

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**Assessing European Capacity for Geological Storage of Carbon Dioxide**
EU GeoCapacity

**Participants**
Please consult our website at:

**W:** www.geocapacity.eu

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