

GEO ENeRGY

Promoting *R&D capability* in the service of European Industry

Second Test Program CO₂ Injection into an Existing Gas Field (CRUST)

In February 2005 the second test of the CO₂ re-injection project has been started. This test aims to evaluate the potential for storage and enhanced gas recovery by CO₂ injection into the gas field K12-B in the Dutch part of the North Sea. The CO₂ will be injected from the K12-B platform into one of the K12-B reservoir compartments where two wells are currently producing reservoir gas.

The K12-B platform belongs to a consortium of companies. Gaz de France Production Nederland B.V., a fully owned subsidiary of Gaz de France, is the operator. The platform lies 100 km northwest of The Hague and has undergone various modifications to make the CO₂ injection possible (Fig. 2).

The natural gas production from the K12-B field is in decline but is expected to continue for approximately 1.5 years. The natural gas contains 13% CO₂. This CO₂ is captured and re-injected, reducing the atmospheric CO₂ emissions by 30,000 m³ per day. On a yearly basis this amounts to approximately 22,000 tons per year. The first test in 2004 proved that the CO₂ could be successfully captured, re-injected and

stored. The injection was in the northernmost reservoir compartment, not in pressure communication with the still producing compartments (Fig. 1).

Gaz de France is carrying out this project in association with the Dutch government within the CRUST framework. With this project, the government aims to gain as much information as possible on the technical possibilities to support future decision-making

concerning applications of large-scale CO₂ reduction. A number of technical parameters are monitored in association with TNO, EXPRO North Sea and DRC.

In the second test, a chemical tracer will be injected with the aim to gain insight in the lateral spread of CO₂ in the reservoir and to evaluate the degree of communication between the injection well and the production wells. Apart from the tracer, other parameters such as the well-head and down-hole pressures and temperatures will also be monitored. With the collected information, the future potential for enhanced gas recovery will be assessed. The minimum duration of this test has been scheduled at half a year.

Emile Elewaut

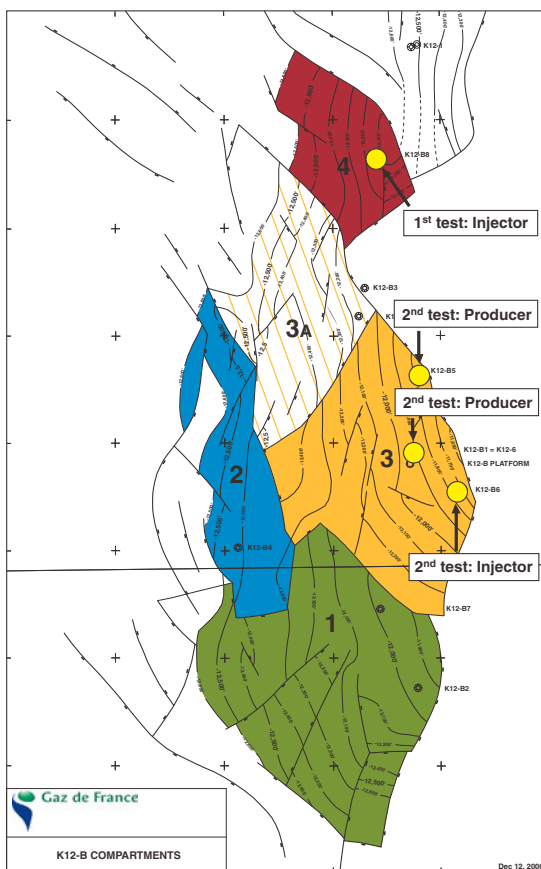


Fig. 1: The K12-B gasfield is a Rotliegend field, strongly compartmentalised by a set of normal faults. The K12-B top reservoir sketch, not to scale, shows the position of the different injector wells. (Courtesy Gaz de France)



Fig 2: The K12-b platform consists of a well-satellite on the right hand side, connected by a bridge to the gas treatment platform on the left. The treatment platform shows on the top structure, the accommodations quarters on the left and the upper part of the CO₂ treatment columns on the right. (Courtesy Gaz de France)

Inside:
ENeRG position paper on future
of geo-energy research

Energy Conference in Warsaw

Conference on the Future of Energy in Enlarged Europe: Perspectives for R&D cooperation (a contribution to the Weimar Triangle) took place in Warsaw on October 7–8, 2004. It was organized by the German-French Society for Science and Technology (AFAST) under the patronage of ministries of research (Poland), economy (Germany) and foreign affairs (France).

Oral presentations and a poster exhibition given by speakers from government, research organizations and industry were focused on both R&D general strategies of the energy sector and specific topics, included capture and storage of CO₂. Presentations can be found at <http://www.6pr.pl/info/energy-conf/cp.html>.

Adam Wojcicki, Peter Gerling



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European Commission Funds CO₂ Capture and Storage Projects (Part II)

Following the introduction of CO₂SINK and CASTOR projects in the last issue, GEO ENeRGY brings brief descriptions of another two projects funded by the 6th Framework Programme for Research and Technological Development. These are a Network of Excellence selected in the call Energy-1 of December 2002 (CO₂GeoNet) and a Specific Support Action from the call Energy-2 of December 2003 (InCA-CO₂). Further projects on CO₂ capture and storage will probably be selected for funding in 2005, based on the December 2004 Energy-3 call.

CO₂GeoNet

Coordinator – British Geological Survey (BGS – UK)



European funding: 6 million Euro (2004–2009)

The Network of Excellence (NoE) is a new instrument under the 6th Framework Programme, of which CO₂GeoNet is a pioneer, and the only NoE addressing CO₂ mitigation from fossil fuel use. Its focus is on the geological storage of CO₂. This technology is fundamental to prevent emissions reaching the atmosphere from large industrial point sources (e.g. oil & gas production/processing, hydrogen production,

petrochemicals, agrochemicals, power generation, cement manufacture and metal smelting) and could deal with over 40% of global emissions in the first few decades of this century. This will be vital if the EC's objective of keeping global average temperature rise at less than 2°C above pre-industrial levels is to be achieved (requiring stabilisation around 420 ppm CO₂ in the atmosphere; emissions are currently at 378 ppm).

The initial partnership is between 13 institutes, most of whom have a long and established history of research in geological storage of CO₂. The new players included are expected to have significant national strategic profile in future CO₂ storage projects, or have capabilities, which can be realigned to strengthen the network, or even bring uniqueness. For example marine and aquatic biologists are involved in geological storage for the first time – a key capability needed to address the potential impact of any CO₂ leakage, particularly from underground storage operations beneath the sea.

The principal aim of the network is to form a durable, complementary and co-dependent partnership, by aligning each partner's own research programme/resourcing with the network, sharing and investing in facilities, developing specialist centres of excellence, training, developing and sharing researchers and providing world class advice and

research outputs. The network will maintain and build upon the momentum and world lead that Europe has on geological CO₂ storage (as a result of previous Framework Programmes), and will collaborate with other international programmes in third countries; agreements are already being forged with research institutes in Canada, Japan and Russia.

The Network's activities are divided into three main areas – Integrating Activities, Jointly Executed Research and the Spreading of Excellence. In the initial 18 month period, work has concentrated on making inventories of each partner's relevant infrastructure, staff capabilities and CO₂ research activities. This will identify gaps and areas of overlap. In the following period the NoE grant will be used to address the inventory outcome to stimulate integration and alignment of each partner's own research programme with the other partners and invest in common research infrastructure and staff development. As the network matures efforts will increasingly be made to disseminate to, and engage with, the wider research community, industry, policymakers and the public. It is also intended in the future to grow the network strategically with the addition of new research partners.

Project website:
<http://www.co2geonet.com>

Nick Riley

International Co-operation Actions on CO₂ Capture and Storage – InCA-CO₂

Coordinator – Institut Français du Pétrole (IFP – France)



European funding:
444 900 Euro
(2005–2007)

This Specific Support Action aims at strengthening European excellence and enhancing technical competitiveness of Europe in the area of CO₂ Capture and Storage (CCS), by:

- Providing to European stakeholders support for the international forums such as CSLF (Carbon Sequestration Leadership Forum).
- Establishing international relations with international projects & programs (USA, Canada, Japan, Australia) for exchanging information on past and ongoing projects, and identifying opportunities for future co-operation.
- Analysing new information on CCS and providing a coherent view on international activities for input into policy.

The consortium is composed of 7 research institutes, key-players in the co-ordination of past and ongoing research projects (IFP, TNO, GEUS, SINTEF, BGS, OGS, BRGM), the action is actively supported by 4 industrial partners representing different sectors of CO₂ activities (Statoil, Vattenfall, ALSTOM Power, BP).

Georges Mosditchian

ENeRG – European Network for Research in Geo-Energy

ENeRG president

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ENeRG Newsletter – GEO ENeRGY

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Introduction of New ENeRG Members

AGH – University of Science and Technology / Department of Fossil Fuels (Poland)

<http://www.uci.agh.edu.pl>
AGH was founded in 1912 as the Academy of Mining in Cracow. During its development, further faculties were added (from metallurgy and geology to informatics and management) and the institution has started to educate engineers and to perform applied research in these fields, cooperating with other European technical universities. The Department of Fossil Fuels carries out applied research on petroleum geology (geochemistry, hydrocarbon generation and basin modelling) and on geothermal resources prospects and assessment and studies on economic and environmental impacts of geothermal investments.
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Geozneniring d.o.o. (Slovenia)

<http://www.geo-inz.si>
Geozneniring is a Slovenian SME engaged in geological and geomechanical engineering. The company's main activities comprise investigations, project designing, technical

support and consulting in the areas of geo-energy, soil and rock mechanics, engineering geology and near surface geophysics. Co-ordination of these activities allows Geozneniring to provide complete, cost-effective and environment friendly solutions. With its legal predecessor Geological Institute (since 1946), the company successfully completed numerous projects in structural and tectonic studies, thermal water resources, power plant construction, mitigation of geo-hazards, underground gas storage, as well as environmental protection studies in Slovenia and abroad.
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IGME – Geological and Mining Institute of Spain (Spain)

<http://www.igme.es>
IGME, founded in 1849, is a Public Research Organization, an autonomous body attached to the Ministry of Education and Science. IGME develops activities on geology, groundwater, environment, geological risks and mineral resources. On an international level, IGME participates in the Forum

of the European Geological Surveys Directors (FOREGS), and is also member of the Association of the Geological Surveys of the European Union (EuroGeoSurveys), as well as founding member of the Latin American Geology and Mining Services Association (ASGMI). More than 400 IGME researchers and technical staff work in its three technical divisions: Geology & Geophysics, Hydrogeology & Groundwater and Mineral Resources & Geoenvironment.
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LGT – Geological Survey of Lithuania (Lithuania)

<http://www.lgt.lt>
The Geological Survey of Lithuania has four main programmes: State Regulation of the Underground Use, the state geological investigations "Geology for Society", special applied investigations and assessment of engineering-geological conditions. The results of LGT geological work can be implemented in various spheres of human activities. The institution has 115 employees, 78 of them having a university degree. The LGT specialists have taken part

in 11 international projects (as e.g. "Magnetic anomaly map of Fennoscandian shield" and "Seismological Monitoring in Lithuania" around the Ignalina Nuclear Power Plant) and have represented Lithuanian geology in 19 international organizations and working groups.
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MEERI PAS – Mineral Energy Economy Research Institute of Polish Academy of Sciences / Geotechnology Division (Poland);

<http://www.min-pan.krakow.pl>
The Institute's main research activities are domestic mineral resources, geodynamic and geothermal issues, information systems to economy of resources, fuels and energy economics, energy policy issues, waste management and sustainable development. The institute has participated in several projects in EC framework programs. The Geotechnology Division performs research on aquifers, hot dry rocks, CO₂ industrial emissions and underground geological storage. It participates in the FP6 CO₂SINK project.
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Geothermal Energy in Europe – Recent Research

The increasing awareness of the public and governments on the effects of greenhouse gases on the global climate have raised interest in further developing geothermal energy as a renewable clean energy source. Both high and low enthalpy systems could contribute to decrease CO₂ emissions in the atmosphere, by substituting fossil fuels in electricity production and by direct use in heating and cooling.

High-temperature geothermal energy is one of the most attractive renewable energies for electricity production as it can be produced continually, it only requires a small space for the installation of the power plant and can replace a large amount of fossil fuels at a low cost. The high-temperature fields in Europe are well known and have been exploited for many years (e.g. in Italy, Iceland, Germany, etc.), although some fields are not used due to environmental restrictions for example in Greece (e.g. Milos and Nisyros).

Recently research has focused on Enhanced Geothermal

Systems (EGS). The EU supported Soultz-sous-Forets project has demonstrated the economic viability of such projects and has worked towards plants becoming commercially viable. A similar EGS cogeneration plant is being tested in Basel, Switzerland with national funds. Both sites are situated in magmatic bodies (Fig. 1) while the research at Gross-Shoenebeck, Germany deals with deep sedimentary rocks. The research in EGS is supported by EU through FP6 (the 2004 call for proposals included improved deep exploration methods for EGS, high temperature downhole instruments and tools and a network of excellence for EGS).

Low-temperature geothermal fields are more abundant in Europe and here geothermal heat pumps and heat storage are installed. The research is focused on improvement of equipment for better heat recovery, reservoir characterization and simulation. The exploration for such fields is not supported and the new call for proposals under FP6

in 2005 will cover low-enthalpy geothermal energy. With a lot of attention focused on heat pumps and direct uses

of geothermal energy, it is expected that interest will be great and many proposals will be submitted. G. Hatziyannis

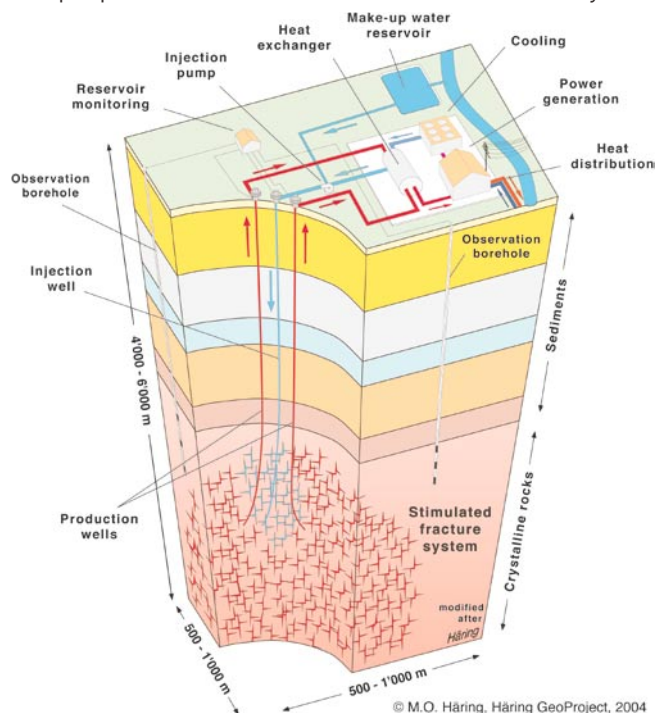


Fig. 1: Scheme of combined power and heat production plant based on the Hot Fractured Rock concept

GEO ENeRG Country Profile – Italy



ENeRG member: Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS

The National Institute of Oceanography and Applied Geophysics is a public research institute financed by the Ministry of Education, University and Research. Its mission is to promote, co-ordinate and perform – in collaboration with other national, international, and European institutions – R&D studies on the Earth and its resources in the following areas:

- applied geophysical and environmental disciplines.
- delineation and evaluation of mineral and energy resources, on land and at sea.
- marine sciences, in particular the interaction of the oceans with the atmosphere and the lithosphere.
- seismicity, hydrodynamic and geodynamic phenomena, for civil protection purposes.

OGS roots go back to second half of 1700s. The institute has offices in Trieste, Udine and Rome. It has a total staff of 191 employees plus approximately 40 post-doctoral and research fellowships.

OGS has a long tradition of applied geophysical research undertaken with and for the energy industry. Which notably includes seismic survey for the Italian Deep Crust Project (CROP) and offshore seismic profiles acquired by OGS Explora (a geophysical vessel also equipped for oceanography, biology and sedimentology) in the seas surrounding Antarctica. OGS has co-ordinated and participated in more than 55 EU-funded research and demonstration projects in the fields of Energy, Environment and Marine Sciences. It is member of the Marine Board of the European Science Foundation, as well as a national representative in ECORD and ESSAC and Italian national reference for many international geophysical and oceanographic data banks.

Other institutions

Geo-energy research activities are conducted in Italy by Universities, and Institutes which are members of the CNR (National Research Council), ENEA (Italian National Agency for New Technologies, Energy and the Environment), INGV (National Institute of Geophysics and Vulcanology), ENEL (National Company for Electric Energy) and by Eni, the largest oil company in Italy.

Main activities in the field of geo-energy

Italy has proven natural gas reserves of about 8 trillion cubic feet (which is less than a twenty-year supply at current production rates) and proven oil reserves of about 620 million barrels, which are located in the northern part of the country, Sicily, and along the Adriatic coast. Exploration is continuing and this number may increase with potential new discoveries. Italy wants to decrease its dependence on foreign hydrocarbons by increasing its domestic production, but even so it will

remain a net importer by a large margin. A contribution to this goal comes from advanced interdisciplinary research in reservoir monitoring by 4D and time-lapse cross-well seismic, advanced deep-water drilling, multilateral wells, multiphase boosting systems and advanced technologies for natural gas treatment.

Research on CO₂ geological storage

Italy is currently responsible for about 1.8% of the world's total fossil fuel-based carbon emissions (ranking it 10th in the world), but has taken steps to attempt to reduce its carbon emissions, by encouraging the use of natural gas for power generation and implementing a carbon tax. No national project on CO₂ geological storage has been started yet in Italy. OGS contributes European research by participating in CO₂Net2, CASTOR, InCA-CO₂ and CO₂ GeoNet EU-funded projects and is trying to stimulate similar research activities in Italy.

Sergio Persoglia

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European Network for Research in Geo-Energy



Energy Is Not for Free

A position paper

Prospective energy studies from institutions like the International Energy Agency predict that throughout the first half of this century the world will, to a large extent, further depend on non-renewable fossil fuels. Oil and gas will continue to play a key role in the energy supply. Recently the oil price has increased, reaching an all-time high of more than 55 US\$/b on October 25, 2004, and has remained high since.

Irrespective of speculation as to whether this is due to a shortage in production capacity or the result of political instabilities, keeping energy supply in line with the permanently growing demand needs a strong and sustained effort in exploration and exploitation. The key factors for success are sufficient capital investment, abundance of skilled human resources, together with a clear commitment to an increased investment in technological progress, hence research and development.

ENeRG is a network of European research institutions on Geo-Energy. ENeRG is involved in European energy policy development and subsequent technological innovation related to new subsurface energy infrastructures. The network's "research portfolio", established through research investment over decades, encompasses oil, gas and coal exploration and production, geological storage of CO₂, underground production and storage of thermal energy and nuclear waste disposal. Members in the network are recognized global innovators and leaders in their respective fields. This paper provides a view of ENeRG members on the future of geo-energy related research.

Hydrocarbon systems

In order to guarantee security of energy supply, world wide necessary investments over the coming 30 years will amount to almost 3 trillion €. This creates a major opportunity for export of European technology and 'know-how'.

European hydrocarbon basins are mature and production profiles will soon start to decline. Therefore, in Europe, research should focus on innovative and enhanced recovery methods (getting more out of existing fields) and on the development of unconventional resources such as coal-bed methane, tight gas fields and oil shales. Major efforts will also have to be made in technology for infrastructure and supporting policies to enable the development of economically marginal fields.

ENeRG supports the Technology Master Plan of Eurogif (<http://www.eurogif.org>) expressing the need for more European research and development to safeguard Europe's position in this energy market sector. Research spent in Europe to enhance hydrocarbon recovery can be leveraged by further research spend and demonstration studies in the global market. Every

percentage point that oil recovery can be improved at the global scale can extend hydrocarbon supplies for several years. The ENeRG network can sustain percentage point improvements given support and encouragement for research.

Coal

Coal exploration and mining in Europe has declined for decades due to high production cost and environmental concerns. Now, with the application of controlled gasification and capture of NO_x , SO_x and CO_2 , a renewed growth of coal usage can be expected to balance possible shortage in oil and gas. In-situ gasification, coal bed methane and CO_2 -enhanced coal bed methane benefit from synergies between traditional coal and the innovative hydrocarbon industries and the ENeRG network is well placed to promote interactions.

CO_2 capture and geological storage

Large scale CO_2 capture and storage is a promising solution for Europe to fulfil the Kyoto CO_2 reduction targets for 2010 and beyond. Research focuses currently on developing cheaper capture technologies and on the safety of long-term geological storage of CO_2 . The European 6th Framework Program for Research and Technological Development strongly stimulates (30 million €) ongoing research in this area.

Geothermal production and storage systems

Heat represents an important percentage of energy consumption in Northern Europe, produced and distributed either in central district heating systems, or generated locally. A small part of that heat is produced from low enthalpy geothermal energy or from soil storage and exchange systems. Geothermal energy is environmentally friendly and needs little space and infrastructure at the surface.

Much more summer waste heat could be made available for heating in winter, through seasonal subsurface storage. In southern Europe, geothermal systems could provide for the growing cold energy demand. A relatively small research effort into geothermal energy production and thermal energy storage could have a major impact on clean heat production, energy efficiency and CO_2 reduction. Synergies between heat-generating facilities and geological storage sites need to be mapped and promoted by the ENeRG network.

Nuclear energy

Nuclear energy is expected to remain an important source of energy in Europe. Especially the safe storage of nuclear waste is an issue to be solved in the coming decades. Geological storage provides a durable, environmentally safe way of dealing with both high and low nuclear waste materials, for thousands of years to come.

European Coordination of Geo-Energy Research

ENeRG has established itself as the exemplary pan-European research network in Geo-Energy, and has rapidly and enthusiastically taken up new members in the joining countries. The network is promoting Geo-Energy research in the 7th EU Framework Program for Research and Technological Development, where the needs for further investment in energy (including hydrocarbons) can be recognized.

A strong and well coordinated investment in European Geo-Energy R&D is needed to enable the transition towards a sustainable energy future.