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GEO ENeRGY

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

How much CO_2 can be stored in the geology?

ENeRG proved once more a perfect incubator of international projects. The new European research project "EU GeoCapacity" – initiated within the network – successfully passed the evaluation procedure in Brussels. It is expected to start early next year.

EU GeoCapacity will build upon the basic work and results generated by the GESTCO project (European Potential for the Geological Storage of CO_2 from Fossil Fuel Combustion) within the EU 5th Framework Programme. This project pioneered the development of carbon dioxide emission mapping and geological storage assessment in Europe, and has served as an international example.

The main objective of EU GeoCapacity, which will be funded by the EU 6th Framework Programme, is to assess the European capacity for geological storage of carbon dioxide. The project will include full assessments of a number hitherto not covered countries, and updates of previously covered territory. Also a priority is the further development of innovative methods for capacity assessment, economic modelling and site selection criteria. Finally, an important mission is to initiate scientific collaboration with China, a member of the CSLF (Carbon Sequestration Leadership Forum). Future collaboration with other CSLF members is also anticipated in areas such as capacity estimation and site selection criteria.

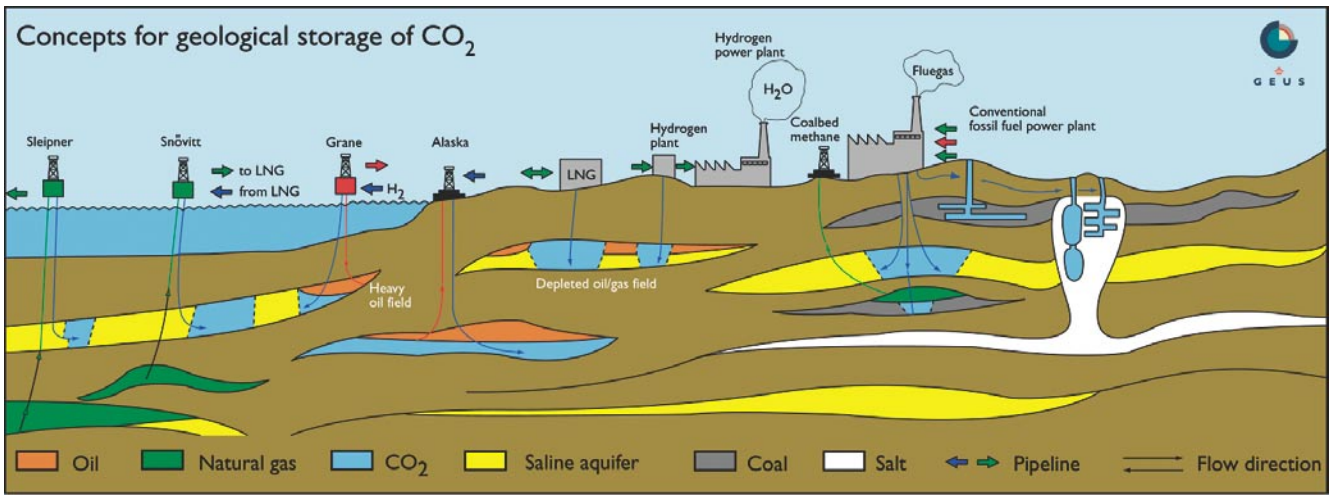
The GeoCapacity project will evaluate all or parts of the sedimentary basins suitable for geological storage of CO_2 located within the EU and the Central and Eastern European new member states and candidate countries. In areas, which were part of the GESTCO project completed in 2003, the work will include only supplementary updates.

The objectives of the project are to:

- make an inventory and mapping of major CO_2 emission point sources in 13 European countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Spain), and review of 4 neighbouring states: Albania, Macedonia (FYROM), Bosnia-Herzegovina, Luxemburg) as well as updates for 5 other countries (Germany, Denmark, UK, France, Greece)
- conduct assessment of regional and local potential for geological storage of CO_2 for each of the involved countries
- carry out analyses of source-transport-sink scenarios and conduct economical evaluations of these scenarios
- provide consistent and clear guidelines for assessment of geological capacity in Europe and elsewhere
- further develop mapping and analysis methodologies (i.e. GIS and Decision Support System)
- develop technical site selection criteria
- initiate international collaborative activities with the P.R. China, a CSLF member, with a view to further and closer joint activities

The project consortium will consist of 22 European research institutes from 19 countries, 3 industrial partners and 1 associated partner from China. Project coordinator is GEUS – Geological Survey of Denmark and Greenland. The project will run for 3 years and is expected to start in January of 2006.

Vit Hladik, Alla Shogenova & Niels Peter Christensen, project logo proposal by Sergio Persoglia



ENeRG – European Network for Research in Geo-Energy

ENeRG president
ENeRG president for 2005 is Prof Bruno Saftic from University of Zagreb, Croatia. Contact: bsaft@rgn.hr

ENeRG secretariat is run by Geological Survey of Slovak Republic, Bratislava, Slovakia. Contact person: Dr. Julia Kotulova <kotulova@gssr.sk>

ENeRG website: http://www.energnet.com is maintained by National Institute for Marine Geology and Geoecology – GeoEcoMar, Bucharest, Romania. Contact person: Dr. Andrei Oltean <andrei@nextnet.ro>

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The Newsletter is published by Czech Geological Survey (CGS), Prague, Czech Republic
Editor: Dr. Vít Hladík <hladik@gfb.cz>
Layout: Hana Převrátilová
Computer typesetting: Petr Maděra
Language review: Michelle Bentham (British Geological Survey)

Enhanced oil recovery is an attractive CO_2 sequestration option in Croatia

Among various strategies and technologies currently being developed in order to reduce CO_2 emissions, major consideration is being given to geological sequestration: capture of CO_2 followed by injection and permanent storage in underground geological formations like aquifers, coal mines and depleted hydrocarbon reservoirs. Enhanced oil recovery (EOR) by CO_2 injection is an attractive sequestration option, since (1) the process has been commercially used since 1970s and is well studied, (2) part of CO_2 sequestration costs are offset by the value of additional oil produced.

Since industrial quantities of CO_2 have been available in Croatia, from hydrocarbon operations at the natural gas processing plant in the Molve gas field and the Miocene sandstone of the Šandrovac oilfield, an extensive experimental CO_2/EOR programme has been performed at INA Oil Co. The experiments have been run during last two decades in order to determine CO_2/EOR potential of mature oilfields in Croatian part of Pannonian basin. A total of 14 small-to-medium size oilfields were studied. The results of experimental studies indicated that CO_2 is immiscible in 4 oilfields, in 8 oilfields CO_2 is near-miscible and miscible in 2 oilfields (Ivanić and Žutica). The oilfields of Sava depression contain 63 % (~ 140×10^6 m^3) of total oil remaining after waterflooding and are leading candidates for CO_2/EOR implementation.

The Ivanić oil field, discovered in 1963, is situated in the Sava depression, close to the Croatian capital of Zagreb. Porosity of the reservoir rock ranges 21.5–23.6 % and permeability from 14.6 to 79.6 mD. The initial reservoir pressure was 183 bar, and reservoir temperature is 97.7°C at depth of approximately 1600 m. Original oil in place was estimated at 21.62×10^6 Sm^3 (standard cubic meters). Out of 88 wells drilled, there are currently 43 oil producers, 11 observation wells and 14 water injectors while 20 wells were abandoned. Cumulative oil production until the end of 2003 was 8.68×10^6 Sm^3.

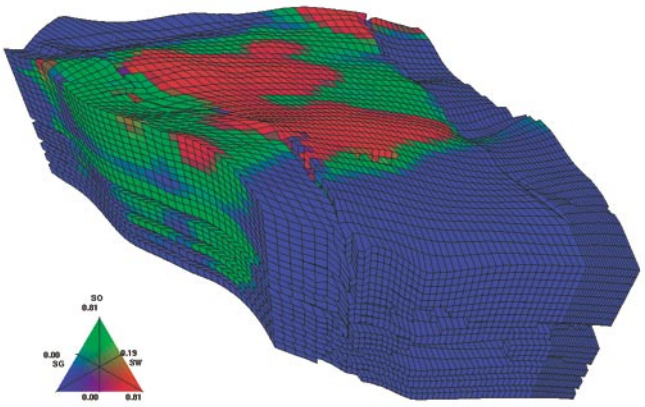

Figure 1. Simulation model of Ivanić oilfield (red = gas, green = oil, blue = water)

The Tertiary oil recovery simulation study first objective was to find the most favorable CO_2 flood conditions in terms of additional oil recovery, as compared with the recovery of the base case, i.e. continued waterflooding. A total of 18 CO_2 injection scenarios were simulated, based on combinations of: (1) number and placement of injection wells (existing injecting wells only, or with additional injectors), (2) reservoir pressure at the start of CO_2 flood (injection at actual reservoir pressure or repressuring to the initial reservoir pressure), and (3) number of CO_2 and water slugs. The results for the three best scenarios can be briefly summarized as follows: (1) repressuring prior to CO_2 injection and running the process at (or close to) the miscibility pressure increases oil displacement efficiency; (2) in non-repressuring scenarios, an increased number of injection wells, and thus reduced number of producers, negatively impacted field productivity. This made non-repressuring cases with only existing injection wells more effective.

The results of **CO_2 retention study** indicate that the simplest CO_2 injection scenario (no repressuring, no extra injectors) yields lowest total amount of incremental oil, but at the same time is characterized by the largest CO_2 consumption, as shown by the value of the associated CO_2 utilization ratio.

Ongoing work on the process optimization includes examination of (1) influence of additional water alternating gas schemes on CO_2 retention, (2) effects of well completions at the bottom of the productive formation, (3) injection of CO_2 into underlying aquifer, if and where feasible, which could also increase CO_2 storage capacity.

Similar, more detailed CO_2/EOR sequestration studies will be performed for the Žutica oilfield as well as other larger Croatian oilfields. At present, based on actual recovery factors and simple 1:1 replacement scheme, the minimum CO_2 storage capacity of six larger oilfields (original oil in place >20 Mm^3) has been estimated at approximately 60 Mt of CO_2.

Bogdan Goričnik & Bruno Saftić

The ENeRG website is changing face… and location

The ENeRG website has been recently renewed with a new user interface (Fig.1) and new functionalities.

New to the website include the following:

1. **News Flash** – the News are visible now on the main page and as a list of short texts, when clicking on the Main Menu on the left. The full texts are also available by clicking on their titles.
2. **Newsletter** - all the Newsletters (Fig.2) may be downloaded as Acrobat files and printed locally for a wider distribution.
3. **ENeRG Members** – comments and messages are, as usual, welcomed. By choosing a country on the map of Europe, you can set up a message to the corresponding Country representative.
4. **Search** - the search engine has been improved.
5. **ENeRG Members Login** – this section has been really improved to facilitate the contacts between the ENeRG members. Members can now insert News and Links directly, as well as up-load and down-load files in the web repository, without any

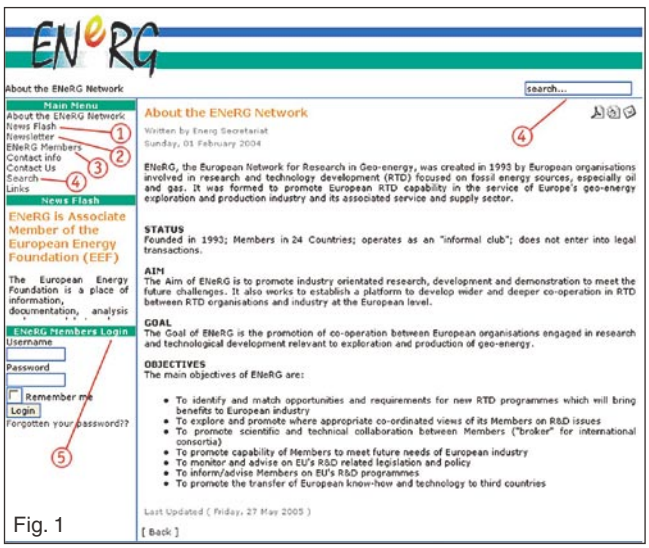

Fig. 1

intervention of the web administrator.

From a technical point of view, this new version is based on a content manager system, so that the addition of new functionalities will be easier and faster.

At the end of this major revision, the website has been moved and after many years at the OGS (thanks to Gianni Martini, the past web master) it will be managed and improved by GeoEcoMar, the national representative of Romania.

The address is the same (**www.energnet.com**), but the new person to contact is now Dr. Andrei Oltean (**andrei@nextnet.ro**).

Sergio Persoglia

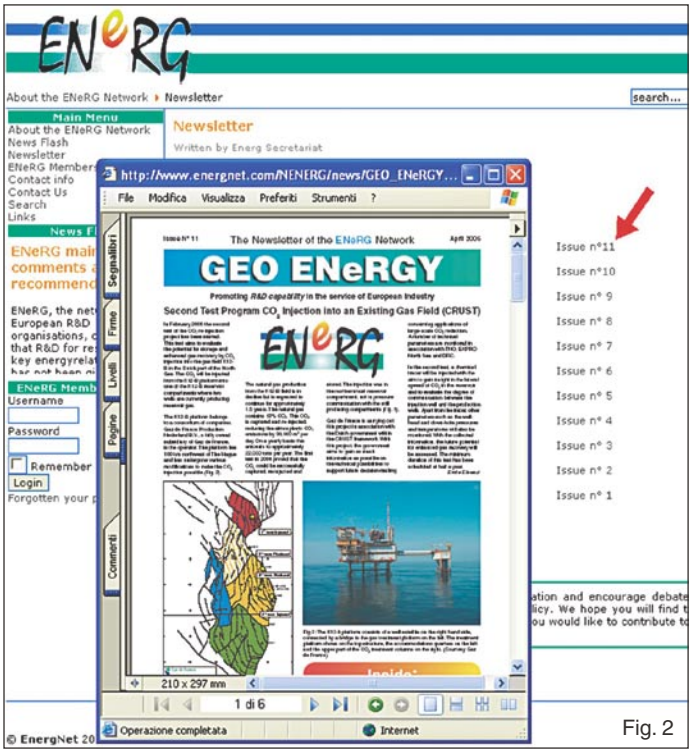

Fig. 2

New ENeRG president elected

At the last Steering Committee meeting in Bratislava on November 4th, 2005, ENeRG country representatives elected Dr. Ludovit Kucharic as the new ENeRG president for the year 2006. Dr. Kucharic, who represents Dionýz Štúr State Geological Institute in Bratislava, Slovakia, will succeed Prof. Bruno Saftić from The University of Zagreb, Croatia who served as ENeRG president in 2005.


Dr. Ludovit Kucharic

EU finances 14 projects on CCS

Under the Energy Programme of the 6th EU Framework Programme for Research and Technological Development, the EU awarded 14 contracts to projects related to CO_2 capture and storage technologies (CCS). The following table shows a brief overview of these projects:

Project acronym	Project topic	Project type*	EU indicative funding (million €)	Coordinator
CASTOR	CO_2 from capture to storage	IP	8.5	Institut Francais du Pétrole (France)
ENCAP	Enhanced capture of CO_2	IP	10.4	Vattefall (Sweden)
CO_2SINK	In-situ laboratory for capture and storage of CO_2	IP	8.7	GeoForschungsZentrum Potsdam (Germany)
CO_2GeoNet	Network of excellence on geological sequestration of CO_2	NoE	6.0	British Geological Survey (UK)
ISSC	Innovative in-situ CO_2 capture technology for solid fuel gasification	STREP	2.0	University of Stuttgart (Germany)
INCA-CO_2	International co-operation actions on CO_2 capture and storage	SSA	0.4	Institut Francais du Pétrole (France)
DYNAMIS	Towards hydrogen production with CO_2 management	IP	4.0	SINTEF Energiforskning AS (Norway)
CLC GAS POWER	Chemical looping combustion CO_2-ready gas power	STREP	1.7	Chalmers University of Technology (Sweden)
HY_2SEPS	Hybrid hydrogen – carbon dioxide separation systems	STREP	1.6	FORTH/ICEHT (Greece)
C_3-Capture	Calcium cycle for efficient and low cost CO_2 capture in fluidized bed systems	STREP	1.8	University of Stuttgart (Germany)
CACHET	Carbon dioxide capture and hydro-gen production from gaseous fuels	IP	7.5	BP International Limited (UK)
DeSANNS	Advanced separation and storage of carbon dioxide: Design, synthesis and applications of novel nanoporous sorbents	STREP	2.5	CNRS-MADIREL University of Provence (France)
EU GeoCapacity	Assessing European capacity for geological storage of carbon dioxide	STREP	1.9	Geological Survey of Denmark and Greenland (Denmark)
CO_2REMOVE	CO_2 geological storage: Research into monitoring and verification technology	IP	8.0	TNO (Netherlands)

* IP = Integrated Project, NoE = Network of Excellence, STREP = Specific Targeted Research Project, SSA = Specific Support Action
Information source: European Commission

GEO ENeRGY country profile – Poland

ENeRG representative: PBG - Geophysical Exploration Company (Warsaw, Cracow, Wrocław)
PBG is a state owned enterprise founded in 1950. It offers services in geophysical investigations to petroleum and structural geology, mineral and rocky raw material exploration, engineering geology, hydrogeology and environment protection in Poland and abroad. Its research activities in geo-energy include geological-geophysical aspects of hydrocarbon prospecting, geothermal energy and related environmental issues.

Other ENeRG members
PGI CB – Polish Geological Institute Carpathian Branch (Cracow). PGI is the country's leading institution on basic and applied geological research, acting as a state geological survey (EuroGeoSurveys member). PGI CB is involved in applied research in mineral and energy resources (oil & gas and geothermal) of Polish Carpathians and their Foreland.

MEERI PAS – Mineral Energy Economy Research Institute of Polish Academy of Sciences (Cracow); Geotechnology Division. The Institute research activities refer to mineral & energy resources, geodynamic, geothermal, CO_2 sequestration, fuel and energy economics, policy and waste management. The Division participates in FP6 CO_2SINK project.

AGH - University of Science and Technology (Cracow); Department of Fossil Fuels. AGH, founded in 1912, undertakes activities in areas ranging from metallurgy and geology to informatics and management. The Department carries out research in petroleum geology and geothermal resources prospect assessments and studies in economic and environmental impacts of the energy investments.

Other institutions
POGC – Polish Oil and Gas Company controls most of the country's activities on hydrocarbon exploration, production and distribution. It also operates underground geological gas and fuel storage sites. The Central Mining Institute (Katowice) is the principal research organisation of country's coal mining industry. It takes part in the FP5 project RECOPOL on field experiment of CO_2 storage in coal beds (ECBM). Ministry of Environment grants concessions on energy resources exploration and production and coordinates the National Allocation Plan of CO_2 Emission Allowances.

Current major activities in geo-energy in Poland:
Most of the energy production in Poland is based on the use of fossil fuels, mostly for electricity generation. Lignite is the primary fuel for electricity and heat production followed by hard coal and (a small share of) hydrocarbons. Abundant coal reserves are the most prevalent energy source – hard coal mines are located almost exclusively in Carboniferous basin of Upper Silesia and lignite outcrop mines in Tertiary basins of central and W/SW Poland. Total hydrocarbon production accounts for 32 % of country's consumption of gas and 4 % of oil. The main hydrocarbon provinces of Poland include the Carpathians and Miocene Foredeep, W and NW Poland (Permian). One offshore field provides about 30 % of oil production. Total current CO_2 emissions are 330 Mt/year which makes almost half of EU10 new member and candidate states emissions (6th position in EU25).

Future energy-related issues:
- privatisation and further liberalisation of energy market
- CO_2 storage in coal beds and depleted hydrocarbon fields (enhanced oil/gas recovery)
- CO_2 storage in deep saline aquifers usable for geothermal energy
- the use of nuclear energy (no commercial plants yet).

Adam Wojcicki

The ENeRG Network

Country representatives

AUSTRIA
Prof Karl Millahn
University of Leoben
karl.millahn@unileoben.ac.at

BULGARIA
Prof Georgi V. Georgiev
Sofia University
ggeor@gea.uni-sofia.bg

CROATIA
Prof Bruno Saftic
University of Zagreb
bsaft@rgn.hr

CZECH REPUBLIC
Dr Vit Hladik
Czech Geological Survey (CGS)
hladik@gfb.cz

DENMARK
Niels Peter Christensen
Geological Survey of Denmark and Greenland (GEUS)
npc@geus.dk

ESTONIA
Dr Alla Shogenova
Tallinn University of Technology
alla@gi.ee

FRANCE
Georges D. Mosditchian
Institut Francais du Petrole (IFP)
georges.mosditchian@ifp.fr

GERMANY
Dr Bernhard Cramer
Federal Institute for Geosciences & Natural Resources (BGR)
b.cramer@bgr.de

GREECE
Dr George H. Hatziyannis
Institute of Geology & Mineral Exploration (IGME)
ghatziyannis@igme.gr

HUNGARY
Endre Hegedüs
Eötvös Lorand Geophysical Institute (ELGI)
hegedus@elgi.hu

ITALY
Ing Sergio Persoglia
National Institute of Oceanography and Experimental Geophysics (OGS)
spersoglia@ogs.trieste.it

LITHUANIA
Dr Viktor Nasedkin
Geological Survey of Lithuania (LGT)
viktor@lgt.lt

THE NETHERLANDS
Emile F. M. Elewaut
Netherlands Institute of Applied Geoscience TNO – National Geological Survey
emile.elewaut@tno.nl

NORWAY
Prof Jan-Erik Karlsen
RF – Rogaland Research
jan-erik.karlsen@rf.no

POLAND
Dr Adam Wojcicki
PBG - Geophysical Exploration Company
wojcicki@waw.pdi.net

PORTUGAL
Virgilio Cabrita da Silva
Ministry of Economical Activities and Work – Directorate General for Geology and Energy
virgilio.cabrita@dge.pt

ROMANIA
Dr Constantin S. Sava
National Institute for Marine Geology and Geoecology – GeoEcoMar
savac@b.astral.ro

SLOVAKIA
Dr Ludovit Kucharic
Dionyz Stur State Geological Institute
kucharic@gssr.sk

SLOVENIA
Dr Zeljko Vukelic
University of Ljubljana
zeljko.vukelic@uni-lj.si

SPAIN
Gerardo Ramos Gonzales
Geological and Mining Institute of Spain (IGME)
g.ramos@igme.es

UK – England
Dr Nick Riley
British Geological Survey
njr@bgs.ac.uk

UK – Scotland
Dr Fatosh Gozalpour
Heriot-Watt University
fatollah.gozalpour@pet.hw.ac.uk

Other members

AGH University of Science and Technology (Poland)
ARMINES (France)
Chalmers University of Technology (Sweden)
Christian-Albrechts-University Kiel (Germany)
ENERGI E2 A/S (Denmark)
Freie Universität Berlin (Germany)
Gasunie Trade & Supply (The Netherlands)
Geophysical Institute of the Academy of Sciences of the Czech Republic (Czech Republic)
Geoinzeniring d.o.o. (Slovenia)
Groupement Europeen de Recherches Technologiques sur les Hydrocarbures – GERTH (France)
Hellenic Petroleum S.A. (Greece)
Hungarian Geological Survey (Hungary)
Institute for Mining, Geotechnology and Environment – IRGO (Slovenia)
Instituto Superior de la Energía (Spain)
KEANE Offshore Integrity Ltd. (Ireland)
MEERI PAS (Poland)
Miligal, s. r. o. (Czech Republic)
National Observatory of Athens (Greece)
National Technical University of Athens (Greece)
NIS-Naftagas (Serbia and Montenegro)
Odegaard A/S (Denmark)
PETROM – Geological Exploration Research and Design Center (Romania)
Polish Geological Institute (Poland)
Premogovnik Velenje d.d. (Slovenia)
Robert Gordon University (UK)
Romanian Academy – „Sabba S. Stefanescu" Institute of Geodynamics (Romania)
RTH – Rudnik Trbovlje-Hrastnik d.o.o. (Slovenia)
Technical University Clausthal (Germany)
Technical University of Denmark (Denmark)
University of Aberdeen (UK)
University of Belgrade (Serbia and Montenegro)
University of Durham (UK)
University of Milano (Italy)
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University of Trieste (Italy)
Vrije University Amsterdam (The Netherlands)