

# GEO ENeRGY

## CCS in Siberia: “Assessment of the Feasibility of CO<sub>2</sub> Storage in the Russian Permafrost”

Under the auspices of INTAS (International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union), a two year project “Assessment of the Feasibility of CO<sub>2</sub> Storage in the Russian Permafrost” was carried out in Russia, with the Siberian branch of the Russian Academy of Sciences.

The purpose of the project was to assess the feasibility and capacity of CO<sub>2</sub> storage in the northern territories of Russia underlain by permafrost. Based on the experience that has been gained by EC projects in the investigation of experimental sites for CO<sub>2</sub> storage, it assembled information on the particular conditions of the permafrost, and it evaluated how these conditions will influence – in a positive or a negative way – the process of CO<sub>2</sub> storage. Considering that the northern territories of Russia are the site of intense oil and gas exploitation, the project also considered the compatibility of CO<sub>2</sub> storage with the oil industry. The project also recommends future studies in order to further investigate the technical aspects of the application of the method in the permafrost. A major aim of the project is to disseminate the project results and conclusions to decision makers and to the public in order to promote the application of this method in the region. This is achieved through the web site <http://www.ibes.be/permafrost/>.

The project participants include IBES (International Bureau for Environmental Studies, Brussels, Belgium, coordinator) and BRGM (French Geological Survey, Orléans, France) with a Siberian partnership: IPGG (Trofimuk Institute of Petroleum Geology and Geophysics, Tomsk and Novosibirsk branches), IPC (Institute of Petroleum Chemistry, Tomsk) and the Melnikov Permafrost Institute (Yakutsk).



This two-year project has delivered new conclusions about the safety role of the permafrost and specific conditions of storage in abnormal geothermal gradient in Western Siberia. Fundamental results are given on the permafrost characterisation and on the guidelines for geological storage of CO<sub>2</sub> (<http://www.ibes.be/permafrost/HTML/database.htm>).

The description of the permafrost in Siberia has shown that:

- The thickness of permafrost varies from 1500 m in the north-east to a few meters in the south and south-west
- There is an obvious control of the permafrost depth by the geodynamic context and the rock type

- Stable and instable permafrost were characterised by their geothermal profiles, by their present geometry, especially in western Siberia and by their kinetics of recession
- Oil production is fully compatible with permafrost.

Except torched gas in the fields of northern Siberia, major sources of industrial CO<sub>2</sub> are located in the Khanty Mansi Province where 32 hydrocarbon fields, suitable for EOR, are present. Deep aquifers such as the Pokur formation, overlain by the Kupnetsov formation as caprock, could also be storage targets but their potential is unknown as they have been poorly explored.

Mapping the permafrost depth and thickness, and the associated stability domain of the CO<sub>2</sub> hydrates, has shown that a good overlap could exist between these industrial areas and the stability domain of the gas hydrates, underneath the permafrost. Therefore considering that storing beneath the permafrost as CO<sub>2</sub> hydrate is not suitable (likely rapid plugging of the porosity by solid gas hydrates), the CO<sub>2</sub> should be stored at supercritical state in the HC fields or deep aquifers, and trapped by a cap-rock. The isotherms at different depths delineate the domain matching the two conditions of supercritical CO<sub>2</sub> (below) and of gas hydrates (above). The permafrost will act as a secondary cap-rock if the immediate cap-rock should fail, trapping the CO<sub>2</sub> as hydrate.

In conclusion, the CO<sub>2</sub> storage could be performed by EOR near the emission sources within the stability domain of the gas hydrates.

**Acknowledgements:**  
This result was achieved thanks to the skills of the Siberian branch of Russian A.S. and to the GIS mapping of all key parameters with EU aid.

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Fig. 1: Siberian taiga near Tomsk (photo L. K. Altunina)

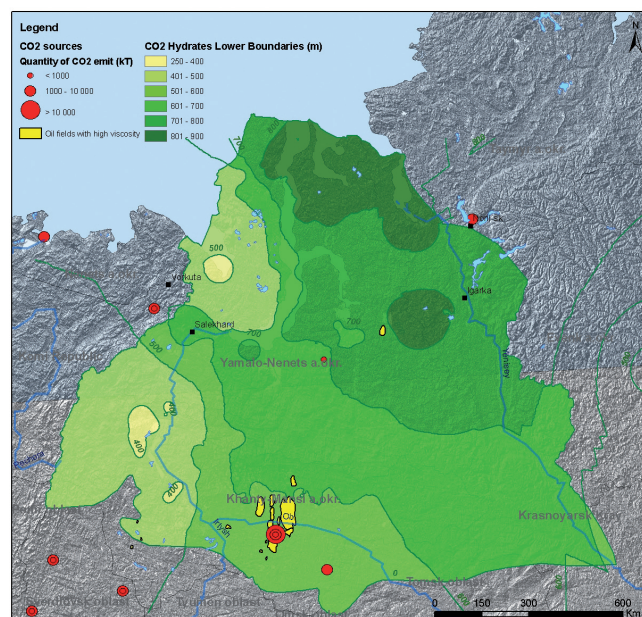


Fig. 2: Location of heavy oil HC fields, major industrial CO<sub>2</sub> sources, and gas hydrates stability zone in Western Siberia

# Geothermal Panel

## of the European Technology Platform on Renewable Heating and Cooling

The European Technology Platform – Renewable Heating and Cooling (RHC) was endorsed by the European Commission on 27 October 2008. The objective of the RHC is to develop a H&C Technology Roadmap. European stakeholders (large companies, SMEs, Universities, Research Centres, etc.) of the geothermal sector decided in early 2009 to create a geothermal panel within the ETP in order to produce a strategic research agenda for the heating & cooling sector. The European Geothermal Energy Council (EGEC) was active in the creation of this panel as well. The action was successful and within

the ETP – RHC four panels were created: Solar Thermal / Biomass / Geothermal / Cross cutting issues (District heating, Storage, Cooling).

### Geothermal Panel

The establishment of a geothermal panel in this ETP is an important step to help accelerate the development of geothermal technology so that it can quickly become a significant energy resource in Europe.

### Aims of the geothermal panel:

- Strengthen the awareness of the huge potential of geothermal technologies in contributing to a sustainable energy infrastructure

- Increase R&D activities in the geothermal sector
- Accelerate the development of geothermal technology

### Objectives of the geothermal panel:

- Develop a vision for geothermal technology in 2030
- Work out a strategic research agenda to achieve this vision
- Support the implementation of the strategic research agenda
- Identify non-technological framework conditions to facilitate a broad market deployment for geothermal technologies

The kick-off meeting of the ETP-RHC geothermal panel

took place in the Renewable Energy House in Brussels on the 26<sup>th</sup> of June 2009. The meeting served as the first step in creating the different focus groups and in electing the Geothermal Panel's Steering Committee. Three focus groups were created:

1. Shallow Geothermal Energy
2. Deep Geothermal Energy
3. Non-technical issues

Some members of the Steering Committee of ENErg participate also in the Steering Committee of the Geothermal Panel.

*George Hatziyannis*

## EU GeoCapacity Final Open Conference

Since January 1st 2006 and during a challenging period of three years, the project known as EU GeoCapacity was developed with the goal of obtaining a homogeneous evaluation of the European capacity for geological storage of CO<sub>2</sub>. This evaluation had to be based in a common definition of the standards used. The standards were developed in order to avoid subjective differences that would lead to non-comparable estimates. One of the most important results of the project is a GIS based database that contains complete information about CO<sub>2</sub> sources, transport infrastructure and potential storages of CO<sub>2</sub>.

As part of the dissemination of the results of the project, a final open conference was conducted on 21<sup>st</sup> and 22<sup>nd</sup> October 2009 in



Copenhagen. The conference was hosted by the Geological Survey of Denmark and Greenland (GEUS), coordinator of the project and member of ENErg. In this conference, titled "GeoCapacity results and the future for geological storage of CO<sub>2</sub>", all participating countries presented final results of their evaluation as well as common work of the project. The design of the GIS database, the development of the new Decision Support System (DSS) for economic evaluations and evaluation of the possibilities for Enhanced Oil Recovery (EOR) or Enhanced Coal-Bed Methane Recovery (ECBMR)

was also displayed together with common site selection criteria and storage capacity estimation standards.

The conference also included presentations on the near future of geological storage in Europe and the research needs as well as an overview of GEUS EU and national activities. The conference had 85 registered participants of which 38 were GeoCapacity project partners and 47 external stakeholders interested in learning more about the project results. A brochure summarizing GeoCapacity results was produced and handed out at the conference in Copenhagen and 33 presentations were given on project results.

The GeoCapacity project has involved 26 participants from 21 different countries and can be considered the main

reference for studying CO<sub>2</sub> storage in European geological formations. A number of 23 technical reports have been produced, of which 7 work package summary reports are publicly available from the project website ([www.geocapacity.eu](http://www.geocapacity.eu)) hosted by the Czech Geological Survey.

The GeoCapacity project has so far been represented and presented at 34 international seminars, conferences and meetings. The list of publications includes 33 entries of which 12 are scientific papers, 4 are popular science articles and 17 are conference abstracts. 20 posters have been presented and 55 oral presentations have been given at international conferences including the 33 given in Copenhagen.

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## ENErg Awards at EAGE Amsterdam 2009

On June 9, 2009, ENErg Student Awards were presented at the 71<sup>st</sup> EAGE Conference & Exhibition incorporating SPE EUROPEC 2009, held in Amsterdam. A prize of 1,000 Euros is awarded to both the best oral and best poster presentations given at the 2008 EAGE Conference held in Rome. Winners of this year were Hassan Karimaie from NTNU, Norway, with his paper 'Low IFT Gas-oil Gravity Drainage in Fractured

Carbonate Porous Media', and Zhongping Qian from BGS, UK, with the poster 'Fracture Characterization with Azimuthal Attribute Analysis of PS-wave Data – Modelling and Application'. The awards were presented by ENErg Steering Committee members Snezana Komatina-Petrovic, Patrick Corbett and Chris te Stroët.

The ENErg Student Award was also announced this year, and it will be given to



Fig. 3: Snezana Komatina-Petrovic announcing ENErg Student Awards at the EAGE conference in Amsterdam

the author of the best student presentation at the 2009 EAGE Conference in Amsterdam. The official award ceremony will take place at the next EAGE Conference that will be held in Barcelona (Spain) in June 2010. Based on the ENErg Steering Committee decision of September 2009, the ENErg Student Award tradition will also continue in 2010, and the best student presentation will again be chosen in Barcelona.



# Introduction of New ENeRG Members

**VNIGRI (Russia)**  
<http://www.vnigri.spb.ru>



VNIGRI (All Russia Petroleum Research Exploration Institute), based in St Petersburg, is the oldest petroleum institute of Russia. It was founded in 1929 as the first petroleum geological centre of the country, providing the scientific basis for oil and gas exploration.

For three quarters of the 20<sup>th</sup> century, VNIGRI scientists have contributed significantly to exploration of petroleum districts of Russia, discovered a number of oil and gas fields and justified the development of some petroleum provinces. Besides, a set of scientific directions has been created forming the fundamentals of Russian petroleum geology.

The VNIGRI is a founder and creator of a system of scientific organizations of the Russian oil & gas branch. Such large scientific-research institutions as the VNIGRI (All-Russian Research Institute of Oil Geology) and VNIIneft (All-Russian Oil And Gas Research Institute) in Moscow, SNIIGGIMS (Siberian Research Institute of Geology, Geophysics and Mineral Resources) in Novosibirsk, ZapSibNIGRI (West Siberian Scientific-Research Gas-Petroleum Institute) in Tyumen, or even UkrNIGRI (Ukrainian Scientific-Research Institute for Geological Exploration)

in Lviv, Ukraine, and many others have been formed from its former departments, expeditions and branches.

At present VNIGRI is one of the leading petroleum institutes of the country. VNIGRI has a highly trained staff (24 Dr.Sc. and 42 Ph.D.) and an enormous information base. Preserving the tradition of Russian geoscientific schools, VNIGRI undertakes research in a wide spectrum of petroleum geology modern theoretical and practical problems. The most up-to-date developments of VNIGRI are:

- Development of complex programs to develop the hydrocarbon resources of the North-Western region and the Far East of Russia
- Scientific-analytical and normative-legal provisions for exploration and use of the State strategic reserve of useful minerals
- Development of techniques for identifying and estimating reserves of hydrocarbons in non-structural traps, use of scientific-methodical bases and forecast of large oil and gas fields in Russia onshore and offshore
- Revaluation of hydrocarbon reserves by the undistributed fund fields in accordance with the new classification of reserves and resources.

VNIGRI services are in high demand from the Ministry of Natural Resources, Rosnedra

(Russian Federal Subsurface Management Agency) and the leading petroleum companies. The priority programs of VNIGRI scientific activities are:

- Economic evaluation of oil and gas resources and economic-geological zoning of resources (reports and studies "Resources Economic-geological Evaluation System", "Maps of Russia's Oil Resources Economic-geological Zoning")
- Estimation of large-scale investment projects of fuel pipeline systems and construction, analysis and forecast of mineral resources and strategic development (reports and studies "Oil and Gas Resources Development Forecast", "Exploration Works Efficiency Evaluation System", "Long-Term Strategy of Oil and Gas Resources Development");
- Russia's Fuel and Energy Complex reformation and development strategy ("Energy Strategy of Russian Federation until 2020", "Gazprom Strategy until 2015");
- Programs of regional economics development (participation in investment potential evaluation program for Leningrad Region, Komi Region, Siberia, Far East);
- Monitoring, estimating the efficiency of exploration for oil and gas and developing the programs of exploration, forecast and estimation of petroleum potential of Russia both onshore and offshore.

Recently VNIGRI has begun research into CO<sub>2</sub> capture and storage (CCS). CCS research includes CO<sub>2</sub> decomposition, CO<sub>2</sub> capture and transport technology and CO<sub>2</sub> re-injection. The CO<sub>2</sub> storage potential of Russia has been estimated and in more detail that of the Northwest District. An estimation of CO<sub>2</sub> capture at coal-fired power plants (using western analogues) has been carried out. An economic model evaluating CO<sub>2</sub> storage in geological reservoirs in the different regions of Russia has been developed. Recommendations regarding sequestration mechanisms integration in the Russian economy have been compiled. Main results are:

- CO<sub>2</sub> storage in oil and gas reservoirs and other natural traps – geo-economical criteria (for Nordic Energy Research, Norway)
- Technology development of CO<sub>2</sub> capture and storage in the Russian Federation (for the Ministry of Education and Science of Russia)
- Development of delineation methods and geological conditions estimation for reservoirs arrangement in Russia (for the Ministry of Natural Resources of Russia)
- Maps of saliferous deposits in the regions favorable for construction of underground storage (for the Ministry of Natural Resources of Russia).

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**GTK (Finland)**  
<http://en.gtk.fi/>



Established in 1885, the Geological Survey of Finland (GTK) produces and disseminates geological information for use in promoting systematic, sustainable use of the national geological endowment. GTK operates under Finland's Ministry of Employment and the Economy. GTK has 700 permanent staff of about half of which have an academic degree. The yearly expenditure is 56 million € and about 12 million € is revenue

from external sources (2008). As a government agency GTK operates primarily within the minerals, construction and energy sectors. GTK plays a vital role in providing geological expertise to government, industry and the wider

community by mapping the Earth's crust, inventorying mineral ore and energy resources and proving national geological information. GTK also contributes to a wide range of international geoscience mapping and environmental monitoring projects and is active

in developing multidisciplinary research programs with universities, government agencies and stakeholders across related sectors.

The GTK's energy research programme provides energy-related information as part of Finland's efforts to reduce its dependence on imported fuels and lower the impact of energy production on climate change. Organized around the themes of geoenery, bioenergy and nuclear power, the programme seeks to apply basic research findings to commercially viable applications. It promotes

energy-efficient business models and technologies, and provides policy-makers, urban planners and other officials with unbiased research data on domestic renewable energy sources. The programme also examines opportunities for carbon dioxide capture and sequestration. Development of original solutions is emphasized with a view to the emerging international and national demand for CO<sub>2</sub> capture and sequestration.

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## ENeRG – European Network for Research in Geo-Energy

### ENeRG – European Network for Research in Geo-Energy

– is an informal contact network open to all European organisations with 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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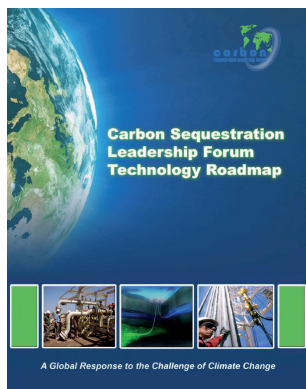
# News from the Carbon Sequestration Leadership Forum

Carbon Sequestration Leadership Forum (CSLF), the voluntary climate initiative of developed and developing nations, was first introduced to GEO ENeRGY readers in issue No 15 of the newsletter in 2007, followed by another article in issue No 17 in 2008. This article is the third part of this series, bringing the latest news of 2009.

In March 2009, CSLF launched a new version of its website at [www.cslforum.org](http://www.cslforum.org). The website has been redesigned with a "new look" that should make it more user-friendly and informative. New features of the website include CSLF Member pages, where information is available about CCS projects and activities of the 22 CSLF Members, and a "Press Room", which contains CSLF news releases, CSLF Member Outreach, and an archive of news clippings about CO<sub>2</sub> capture and storage (CCS).

In August 2009, a new CSLF Technology Roadmap was published on the CSLF website; it can be found at the address [http://www.cslforum.org/publications/documents/CSLF\\_Tech\\_Roadmap\\_081809.pdf](http://www.cslforum.org/publications/documents/CSLF_Tech_Roadmap_081809.pdf). The Roadmap identifies the current status of CCS technologies around the world, the increasing level of activity

in the industry, the major technology needs and gaps, and the key milestones for the development of improved cost-effective technologies for the separation, capture, transport, and long-term storage of CO<sub>2</sub>.



The Roadmap is divided into 5 modules – Introduction, Current status of CO<sub>2</sub> capture and storage technology, Ongoing activities in CO<sub>2</sub> capture and storage, Gap identification and Technology roadmap. The first parts provide a concentrated overview of the current status of the CCS technology and its individual parts. Various types of capture, transport, storage and use of CO<sub>2</sub> are explained and an overview of the costs of CCS is given. The ongoing

CCS activities worldwide are described, including the four running major industrial projects (Sleipner, Weyburn-Midale, In Salah and Sleipner), the running pilot projects (e.g. Schwarze Pumpe) as well as 24 other major project announcements from around the world. For each project basic data and links to relevant websites are provided. The summary is supplemented by a brief overview of the current status of CCS-related activities in each of the CSLF member states.

Module 3 – 'Gap identification' – represents probably the most important part of the Roadmap. Its first part explains the general reasons why a new/improved technology like CCS is needed and summarizes the key technological needs to assure widespread deployment of CCS, while the 2<sup>nd</sup> part focuses on technology gaps. Key gaps and lacking knowledge are identified for all the main parts of the CCS technology, i.e. for CO<sub>2</sub> capture, transport, storage, uses of CO<sub>2</sub>, storage security and integration. Priority activities that are necessary for filling the identified gaps are listed for each part of the technology. The final table provides an excellent overview of the key technology needs and gaps related to CCS. The last Module includes the

Technology Roadmap itself, defining the main activities and expected achievements for periods 2009–2013, 2014–2020 and post–2020 that are necessary for answering the main technology needs of CCS. The role of the CSLF and respective CSLF actions are described, including key milestones defined by topic and timescale. An updated Strategic Plan covering the years 2009–2013 supports the new Roadmap.

An important CSLF event – a Ministerial meeting was held in London on 11–14 October 2009. Energy and Environment Ministers of CSLF member countries endorsed carbon capture and storage technologies as a key component of international plans to combat climate change and called for additional CCS projects on a global scale. Other results from the meeting included welcoming of Poland as the CSLF's 24<sup>th</sup> member, recognition of 10 new collaborative projects and launch of a major new capacity building initiative.

*Vit Hladik with the aid of  
[www.cslforum.org](http://www.cslforum.org)*

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CO<sub>2</sub>NET EAST project.*

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