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Project acronym: CGS Europe

Project title: Pan-European Coordination Action on CO_2 Geological Storage

Instrument: Coordination and Support Action

Thematic Priority: SP1-Cooperation, FP7-ENERGY-2010-1

Deliverable D5.10
CO_2 geological storage knowledge-dissemination workshops – 2nd period

Due date of deliverable: 30/09/2013
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Start date of project: 1 November 2010 Duration: 36 months

Organisation name of lead contractor for this deliverable:
CzGS (Czech Geological Survey)

Authors: Vit Hladik (CzGS), Ender Okandan (METU-PAL), Salvatore Lombardi (CO2GeoNet-URS), Kris Piessens (RBINS-GSB), Tuija Vähäkuopus (GTK), Bruno Saftic (UNIZG-RGNF), Heike Rütters (BGR), Roberto Martinez (S-IGME), Apostolos Arvanitis (G-IGME)

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***PU** = Public

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1. Introduction

A series of knowledge-dissemination workshops focused on CO_2 geological storage (CGS) has been planned within WP5 'Knowledge dissemination', task 5.3 'Workshops'. The idea was to hold these workshops in countries where the first CCS demonstration projects are under preparation, i.e. those co-funded from the EEPR and potentially from the NER300 mechanisms. The main goal of these workshops was to support the first CCS demonstration projects by providing scientific information on CO_2 geological storage and thus increasing the ability to appraise the safety of CGS. Relevant topics included: Basics of CO_2 geological storage, Frequent misunderstandings, Similarities and differences with natural gas storage, Risk management, Impact on the inhabitants of the storage area, etc. CGS Europe participants were expected to provide presentations at these workshops; other relevant experts from outside of the consortium could be invited whenever suitable, in particular national experts. In addition to the workshops in the 'forerunner' countries, 1-2 proposals were deemed acceptable from countries with significant CO_2 emissions but with limited CCS activities. Altogether, the original plan anticipated organisation of up to 13 workshops of this kind.

An internal call was opened at the beginning of the project (November-December 2010), inviting project participants to submit proposals to prepare these workshops, including suitable dates, locations and main focus. In response to this call, 9 proposals were submitted, and six of them were approved by the Management Board. Four of them were planned for the 1st project period and two for the 2nd period. The approved proposals are summarised in Tab. 1.

No	Countries involved	Proposed date	Place	Project participants involved
1	Denmark / Norway	May 2011	Copenhagen	CO_2GeoNet (GEUS, IRIS, SINTEF, NIVA)
2	Spain	October 2011	Not announced	S-IGME
3	Italy	Spring 2012	Rome	CO_2GeoNet (URS, OGS)
4	France	2nd half of 2012	Lorraine	BRGM, CO_2GeoNet – IFPEN
5	Finland	2013	Espoo	GTK
6	Greece	May 2011	Athens	G-IGME

Table 1: Overview of workshop proposals submitted in response to the 1st call for proposals (December 2010)

Some of the approved workshops Spain, Italy, France, Greece), however, experienced difficulties with time planning for various reasons, incl. difficult negotiations with demonstration projects' managing entities, overlapping time schedule of various CCS-related events, the financial and economic crisis (hardly affected, among others, the planned workshop in Greece), etc. These resulted into postponement of these workshops into the 2nd project period. The only workshop organised in the 1st project period was the Danish-Norwegian workshop in Copenhagen. Following a decision by the Management Board, this event was supplemented by five other events of similar focus where CGS Europe acted as co-organiser, together with other entities like professional associations or national CCS stakeholders, in order to approach the relevant target audiences. See Deliverable D5.9 for details on the events organised in the 1st project period.

In order to encourage project partners to organise more workshops, a second call for workshop proposals was opened at the mid-term of the project and participants from 'forerunner' countries were especially

invited to submit proposals. The call was launched on 4 April 2012 with a deadline for submitting proposal on 30 April 2012. The call wording is presented in Annex I to this report.

The call resulted into three new workshop proposals from Belgium, Germany and Poland, which were all approved by the project Management Board. Together with the workshops proposed within the 1st call (partly re-scheduled), the plan for the 2nd project period included organisation of 8 workshops. An overview of them is given in Tab. 2.

No	Countries involved	Proposed date	Place	Project participants involved
1	Spain	June 2012	Madrid	S-IGME
2	Italy	Autumn 2012	Rome	CO_2GeoNet (URS, OGS)
3	France	2013	Lorraine (probably Nancy)	BRGM, CO_2GeoNet – IFPEN
4	Finland	2013	Espoo	GTK
5	Greece	2013	Athens	G-IGME
6	Poland	October 2012 or spring 2013	Warsaw	PGI-NRI
7	Germany	End of 2012	Berlin	BGR
8	Belgium	January 2013	Antwerp or Brussels	RBINS-GSB, CO2GeoNet-GEUS, CO2GeoNet-TNO, CO2GeoNet-BGS, ELGI

Table 2: Overview of workshops planned for the 2nd project period (status May 2012)

The unfortunate outcome of the 1st round of the NER 300 competition, when no CCS demonstration projects were chosen for funding, and related delays and cancellations of demonstration projects (e.g. Florange or Belchatów) lead to cancellation of three workshops that were closely related to the national CCS demonstration projects (Spain, France, Poland). The other five workshops were successfully carried out, partly with some delay compared with the original schedule.

Similarly to the 1st project period, in order to partly make up for the cancelled workshops, opportunities were sought by the WP5 team to co-organise CGS knowledge dissemination events together with other entities. This resulted in CGS Europe engagement in organisation of CGS sessions at the Sustainable Earth Sciences conference in Pau in September-October 2013 and at the International scientific conference ‘'Environmental and Climate Technologies 2013’ in Riga in October 2013, as well as in two national events in Spain and Turkey. In France, the workshop was replaced by a workshop with French science journalists held on 15 October 2015 (part of Task 5.6, see Deliverable D5.15 for details).

The actual time schedule of all the workshops and other events in the 2nd project period is presented in Tab. 3.

No	Title	Date & place	Countries addressed	Project participants involved
1	CGS Europe Knowledge-Dissemination Workshop 'CO2 Capture and Geological Storage (CCS)'	3 December 2012, Valmontone, Italy	Italy	CO_2GeoNet-URS, CO_2GeoNet-OGS, TTUGI
2	CGS Europe Knowledge-Dissemination Workshop 'Pinning hopes for climate protection on CO2 storage ? Perspectives of a bridging technology'	10-11 May 2013, Berlin, Germany	Germany	BGR
3	CGS Europe Knowledge-Dissemination Workshop 'CO2 Capture and Storage in the Baltic Sea Countries - Status and future cooperation opportunities'	23 May 2013, Espoo, Finland	Finland, Baltic Sea region	GTK, CzGS, CO2GeoNet-GEUS, TTUGI, PGI-NRI
4	CGS Europe national knowledge-sharing workshop 'Carbon Market, developments in CCS around the World and in Turkey'	29 May 2013, Ankara, Turkey	Turkey	METU-PAL
5	CGS Europe Knowledge-Dissemination Workshop 'EOR – the catalyst for carbon capture clusters, in ports and other industrial regions'	18 June 2013, Antwerp, Belgium	Belgium, North-Western Europe	RBINS-GSB, CO2GeoNet-TNO, CO2GeoNet-GEUS, CO2GeoNet-BGS
6	CGS Europe Knowledge-Dissemination Workshop 'CO2 Geological Storage: Scientific knowledge - Present situation - Perspectives'	26 June 2013, Athens, Greece	Greece	G-IGME, CO_2GeoNet-Imperial, CO2GeoNet-IRIS
7	Workshop / course on CCS technologies	15-26 July 2013, Ponferrada, Spain	Spain	S-IGME
8	Sustainable Earth Sciences conference – CGS sessions	30 September – 4 October 2013, Pau, France	Europe	BRGM, CO_2GeoNet-IFPEN, CO2GeoNet-OGS, CO_2GeoNet-HWU, CzGS, BGR, CO_2GeoNet-TNO, CO2GeoNet-Imperial
9	International scientific conference 'Environmental and Climate Technologies 2013' – session 'Geological storage of CO2 as a way to reduce carbon footprint'	14-15 October 2013, Riga, Latvia	Baltic Sea countries, Europe	UNIZG-RGNF, LEGMC, TTUGI, GTC, CO2GeoNet-BGS, BGR

Table 3: Overview of workshops organised in the 2nd project period

In the following chapters, the events organised within the 2nd project period are described more in detail, in chronological order.

2. CGS Europe knowledge-dissemination workshop, Valmontone, Italy

Event title:	CGS Europe Knowledge-Dissemination Workshop 'CO2 Capture and Geological Storage (CCS)'
Date:	3 December 2012
Place:	Valmontone, Italy
Number of participants:	85
Type of audience:	researchers, regulators, geologists, industry, students
CGS Europe partner in charge:	CO_2GeoNet-URS
Other partners involved:	CO_2GeoNet-OGS, TTUGI
Cooperating entities:	-

A separate special report on this workshop was prepared by its organisers. The report is attached to this deliverable as Annex II.

3. CGS Europe knowledge-dissemination workshop, Berlin, Germany

Event title:	'Hoffnungsträger CO2-Speicherung? Perspektiven einer Brückentechnologie zum Klimaschutz (Pinning hopes for climate protection on CO2 storage? Perspectives of a bridging technology)'
Date:	10-11 May 2013
Place:	Berlin, Germany
Number of participants:	35
Type of audience:	mainly "multiplicators" (academic/educated public), politicians, teachers, representatives of a trade union and of industry organisations, members of a 'citizens' protest group, also a president of a state geological survey and a few researchers, including social scientists
CGS Europe partner in charge:	BGR
Other partners involved:	-
Cooperating entities:	Evangelische Akademie zu Berlin (EAB)

In Germany, public acceptance of the CCS technology is low and the debate about CCS has been very controversial and highly emotional. In addition, all CO2 storage projects in Germany have been cancelled including the EEPR-awarded project of Vattenfall in Brandenburg. In this situation, the aim of this workshop was to continue the public discussion about CCS in Germany in a rational, fact-based way by informing about the options, benefits and potential risks of the CCS technology in the more general context of energy systems, economic development and climate change. This was done including national, international and global perspectives in order to raise awareness that there is an urgent need for actions against climate change and that the discussion about the German options for a reduction of CO2 emissions must be continued.

Berlin, the capital of Germany where many decision-makers, politicians, lobby organisations, etc. are based, was selected as the conference venue. In addition, Berlin is in proximity to the formerly proposed storage project of Vattenfall, that failed because of public protests against the granted exploration permit, and to the successfully run research pilot at Ketzin. In consequence, public awareness of the technology is presumably higher in and around Berlin in comparison to other areas without specific CO2 storage

activities. Target audience of the workshop were academics and the educated public, who could serve as "multiplicators" in spreading knowledge within their spheres of influence.

The Evangelische Akademie zu Berlin was considered a well-experienced partner who

- is specialized in high-level public workshops for and with influential and engaged citizens,
- provided infrastructure and support for the event in a convenient and attractive environment,
- had contacts to groups beyond our own, generally geotechnical contacts,
- had conducted related events within their workshop series (e.g. on shale gas),
- can help communicating common responsibility and fairness for the global problem of climate change to a yet little affected and little-caring population,
- represents churches actively involved in the controversial discussions and protests against CCS in Brandenburg.

Also, the discussion about the CCS technology within the church had been controversial and very emotional. Hence, the Academy strongly supported the workshop's aim of stimulating rational public debates on the pros and cons of the CCS technology as one option to reduce anthropogenic CO2 emissions.

The workshop programme (see below) comprised presentations on climate change, the current scientific evidence for this, ocean acidification and its (potential) consequences, and the portfolio of options currently discussed for the reduction of anthropogenic CO2 emissions and for the limitation of climate change – nationally, internationally and globally. It also included a discussion on alternative (sustainable) economic strategies. BGR experts contributed to the workshop by providing basic scientific and technical information on CO2 storage (storage options, storage potentials and capacities) and on potential conflicts of interest with other subsurface uses.

Prior to the workshop, citizens' protest groups and environmentalists had sent protest letters to the organiser and the speakers urging them to cancel the workshop. However, no representative of these protest groups participated to the workshop. Overall, the atmosphere of workshop was very objective with participants being interested in the scientific and technical facts. One part of the audience considered CCS as a technically feasible interim option, whereas others remained sceptical, favouring alternative ways to reduce CO2 emissions. All participants were very engaged in the discussions while respecting other persons’ views.

The feedback, which the EAB and BGR received from participants, was generally positive and resulted in some requests for further advice and follow-up activities. For example, a member of a state parliament who has been decisively involved in CCS legislation asked BGR experts for technical advice on whether to allow or prohibit CO2 storage in his state. Thus, the EAB and BGR consider the small workshop successful and hope that the seed that was sowed will grow with the help of the participating “multiplicators”.

Workshop announcement and programme are shown below on pp. 8-9.

12 HOFFNUNGSTRÄGER CO_2-SPEICHERUNG?

Nach Veranstaltungsbeginn können wir einen Einlass nicht mehr garantieren.

Tagungsort

Evangelische Bildungsstätte auf Schwanenwerder
Inselstraße 27 - 28, 14129 Berlin (Nikolassee)
Telefon: 030 847 14 - 207, Fax: 030 803 69 61

Tagungsbeitrag

Verpflegungbeitrag	15,- EUR inkl. 19% Mwst
Übernachtung (optional)	50,- EUR / im DZ p. P. 35,- EUR inkl. 7% Mwst

Wir bitten um Zahlung des Tagungsbeitrags zu Beginn der Tagung. Es ist der volle Verpflegungsbeitrag zu bezahlen, auch wenn Sie nur teilweise teilnehmen.

Anmeldung

wird bis zum **03.05.2013** mit der anhängenden Postkarte, per Fax oder per Email mit Ihren kompletten Daten erbeten. Erst mit unserer Bestätigung wird Ihre Anmeldung verbindlich.

Abmeldung

Im Falle Ihrer Abmeldung bitten wir um eine schriftliche Benachrichtigung. Erreicht uns Ihre Abmeldung nach dem 06.05.2013 erheben wir eine Ausfallgebühr von 30%. Ab dem 10.05.2013 stellen wir Ihnen den vollen Tagungsbeitrag in Rechnung.

Tagungssekretariat

Kerstin Koschinski
Evangelische Akademie zu Berlin
Charlottenstraße 53/54, 10117 Berlin

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Tagungsbegleitung

Franziska Brand

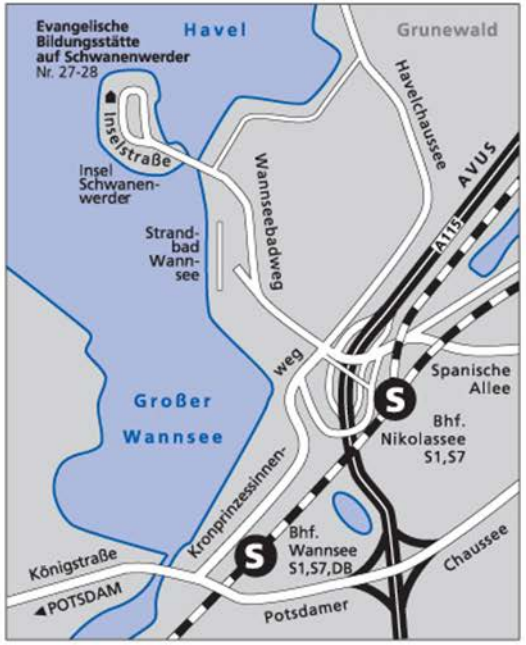
Evangelische Akademie zu Berlin

Prof. Dr. Paul Nolte, Präsident
Dr. Rüdiger Sachau, Direktor

bpb: Gefördert durch die Bundeszentrale für politische Bildung

Mit freundlicher Unterstützung: CGS EUROPE

ANFAHRT / LAGEPLAN



Anreise

mit PKW
Autobahn115 (AVUS), Ausfahrt Spanische Allee, Wannseebadweg, Inselstraße

mit öffentlichen Verkehrsmitteln
S7 (Richtung Potsdam-Hbf.) und S1 (Richtung Wannsee) bis Bhf. Nikolassee, Ausgang Borussenstraße.
Dort wird vor Tagungsbeginn am Freitag (09.45 Uhr bis 10.45 Uhr) und bei Tagungsende ein Pendelverkehr zum/vom Tagungshaus angeboten. Ein gekennzeichnetes Fahrzeug erwartet Sie hinter der letzten Bushaltestelle links des Ausgangs. Der Fußweg vom S-Bahnhof Nikolassee zur Tagungsstätte beträgt ca. 40 Minuten.

Deutsche Bahn und S-Bhf. Wannsee
Hier gibt es Taxis, die Sie in ca. 10 Minuten zum Tagungshaus bringen.

Flughafen Tegel
Express-Bus X9 bis Bahnhof Zoologischer Garten; weiter mit der S-Bahn wie oben beschrieben.

Evangelische Akademie zu Berlin

HOFFNUNGSTRÄGER CO_2-SPEICHERUNG?

12

Evangelische Akademie zu Berlin

Hoffnungsträger CO_2-Speicherung?

Perspektiven einer Brückentechnologie zum Klimaschutz

10. bis 11. Mai 2013

Evangelische Bildungsstätte auf Schwanenwerder

www.eaberlin.de

HOFFNUNGSTRÄGER CO_2-SPEICHERUNG?

Die Abscheidung und unterirdische Speicherung von Kohlendioxid (engl.: Carbon Dioxide Capture and Storage, CCS) gilt als eine Option im Kampf gegen den Klimawandel.

Am 24.8.2012 trat das CCS-Gesetz in Kraft, das eine EU-Richtlinie umsetzt und die Erprobung der Abscheidung, des Transports und der Speicherung von CO_2 in Deutschland ermöglicht. Das Gesetz erlaubt den Bundesländern zu bestimmen, dass eine Erprobung und Demonstration der dauerhaften Speicherung nur in bestimmten Gebieten zulässig ist oder in bestimmten Gebieten unzulässig ist.

CO_2 wird bereits bei der Erdöl- und Erdgasförderung abgeschieden, der routinemäßige Einsatz der CO_2-Abscheidung in Großkraftwerken ist jedoch noch Zukunftsmusik. In Nordamerika oder Osteuropa wird CO_2 seit vielen Jahren zur Ausbeutesteigerung in Erdöllagerstätten gepumpt. Die dauerhafte Speicherung von CO_2 im Untergrund wird derzeit weltweit an ausgewählten Standorten erprobt. Im brandenburgischen Ketzin wird versuchsweise CO_2 in tiefen, salzwasserführenden Gesteinsschichten gespeichert.
Der Energieversorger Vattenfall hatte vor, die CCS-Technologie in Brandenburg zu demonstrieren und hierfür bis 2015 ein großes Kraftwerk in Jänschwalde zu errichten und das CO_2 an einem zuvor auf seine Eignung überprüften Standort im tiefen Untergrund zu speichern. Vattenfall hat das Projekt aber wegen der damals unklaren Rechtslage und des örtlichen Widerstands gegen eine Speichererkundung abgesagt und die Erkundungsgenehmigung zurückgegeben.

Der weitere Abbau von Braunkohle in der Lausitz zur Stromerzeugung ist auch vom Ausgang der Debatte über die CCS-Technologie betroffen. Die Strukturschwäche der regionalen Wirtschaft im südöstlichen Brandenburg wird seit dem Scheitern der Pläne zur Demonstration der Abscheidung und Speicherung von CO_2 aus dem Kohlekraftwerk Jänschwalde wieder verstärkt von den Sozialpartnern beklagt.

Klimaschutz und Anpassung an den Klimawandel sind globale Aufgaben, die nicht von einzelnen Staaten gelöst werden können. Daher muss die Debatte über den möglichen Einsatz, den Nutzen und die Risiken der CCS-Technologie auch die Begrenztheit erneuerbarer und fossiler Rohstoffe sowie eine faire globale Lastenverteilung mit betrachten. Wir möchten mit der Tagung zum Dialog über die Zukunft dieser Technologie beitragen. Den wissenschaftlichen Hintergrund zur geologischen Speicherung von CO_2 werden die Experten der Bundesanstalt für Geowissenschaften und Rohstoffe erläutern. Die Tagung schließt sich an unsere Veranstaltung zum Thema „Hoffnungsträger unkonventionelles Erdgas" vom Mai 2012 an.

Wir laden Sie herzlich zur Tagung in die Villa am Wannseeufer ein.

Dr. Michael Hartmann
Evangelische Akademie zu Berlin

PROGRAMM

Freitag, den 10. Mai 2013

09.45 Uhr Anmeldung

10.45 Uhr Eröffnung und Einführung

11.00 Uhr **Forum I:**
Der Klimawandel ist real

CCS: ein notwendiger und handhabbarer Bestandteil zur Umsetzung des 2°- Limits?
Prof. Dr. Hermann Held, Leiter der Forschungsstelle Nachhaltige Umweltentwicklung, Universität Hamburg

Ozeanversauerung
Jeffrey H. Michel, Energieberater und Wissenschaftler, Hamburg

Welche Optionen zur Reduktion von CO_2-Emissionen haben Industriegesellschaften?
Dr. Peter Viebahn, Wuppertal Institut für Klima, Umwelt, Energie

12.30 Uhr Mittagessen

14.00 Uhr **Forum II:**
Die Ressourcen sind begrenzt

Die Ressourcen sind begrenzt. Sind sie es wirklich?
Saral Sarkar, Autor, Köln

CCS–Speicheroptionen, Kapazität, Nutzungskonkurrenzen
Stefan Knopf, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover

15.30 Uhr Kaffeepause

16.00 Uhr **Forum III:**
Wege zur Nachhaltigkeit und das Wachstumsziel

Sind technischer Fortschritt und Suffizienz kompatibel?
Roland Zieschank, Forschungszentrum für Umweltpolitik, Freie Universität Berlin

17.30 Uhr **Die gesellschaftliche Akzeptanz von Klimaschutz** – das Beispiel China
Prof. Dr. Miranda Schreurs, Leiterin Forschungszentrum für Umweltpolitik, Freie Universität Berlin

18.30 Uhr Abendessen

20.00 Uhr Abendprogramm: Verantwortung und Vorreiter

Klimaschutz und nachhaltiges Wirtschaften aus der Perspektive eines OECD-Landes
Jeffrey H. Michel, Hamburg

Ende gegen 21.30 Uhr

Samstag, den 11. Mai 2013

9.30 Uhr **Forum IV:**
CCS (Carbon Dioxide Capture and Storage) – eine internationale Aufgabe

Vorstellung der Arbeitsgruppen
Dr. Franz May, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover

Arbeitsgruppen

- Perspektiven für die technische Zusammenarbeit
- Faire globale Lastenverteilung
- Risiken der Speicherung
- Risiken des Klimawandels
- Optionen von CCS für Deutschland

dazwischen Kaffeepause

12.00 Uhr **Resümee und Ausblick**

Anmerkungen des Tagungsbeobachters
Dr. Johannes Peter Gerling, Bundesanstalt für Geowissenschaften und Rohstoffe

12.30 Uhr Mittagessen und Ende der Tagung

Diese Tagung ist bei der Senatsverwaltung für Arbeit, Integration und Frauen gemäß § 11 Berliner Bildungsurlaubsgesetzes (BiurlG) vom 24.10.1990 als Bildungsveranstaltung beantragt.

Workshop venue

BGR expert Franz May presenting

Conversation between representatives of BGR and EAB

4. CGS Europe knowledge-dissemination workshop, Espoo, Finland

Event title:	'CO2 Capture and Storage in the Baltic Sea Countries - Status and future cooperation opportunities'
Date:	23 May 2013
Place:	Espoo, Finland
Number of participants:	50
Type of audience:	geoscientists, engineers, regulators, students
CGS Europe partner in charge:	GTK
Other partners involved:	CzGS, CO2GeoNet-GEUS, TTUGI, PGI-NRI
Cooperating entities:	Finnish Carbon Capture and Storage Program (CCSP)

The CGS Europe & CCSP joint workshop titled "CO2 Capture and Storage in the Baltic Sea Countries – Status and future cooperation opportunities" was held in the GTK head office's Sederholm hall in Espoo on 23 May 2013. The focus of the workshop was on the Baltic Sea area, with the purpose to bring the experts of the area together to share knowledge and get the latest news on CO2 storage and other promising options with CCS in focus. More than 50 participants all over the Baltic Sea area attended the one-day workshop.

Totally, three sessions were organized within the workshop. The first session focused on status of geological storage of CO2 and international cooperation; it was opened by the interesting overview by Ludmilla Basava-Reddi (IEAGHG) who presented the current status of CCS, and especially the cross-border cooperation actions around the world. The session followed with a presentation by Karen Lyng Anthonsen (CO2GeoNet-GEUS) who concentrated on the Nordic status of CCS from the NORDICCS point of view.

The second session was dedicated to the CCS research in Baltic Sea countries. Interesting research presentations from numerous Baltic Sea countries were seen, e.g. by Sebastian Teir (VTT/CCSP) on Finnish achievements, Auli Niemi (Uppsala University) from the Swedish point of view, Alla Shogenova (TTUGI) about the Estonian and Latvian cooperation and Adam Wojcicki (PGI-NRI) about the situation in Poland. Poland has vast opportunities for geological storage in the onshore area, but there are also promising areas in the Baltic Sea region, which are to be studied in the near future. Poland is also starting cooperation project with Germany in the Polish-German border area. Richard Vernon (SLR) introduced the latest outcomes of the Bastor project, giving the first calculated storage potential to the Baltic Sea area. Andrei Otmas (VNIGRI) concluded the session by a presentation on the Russian Kaliningrad area storage potential.

The third session was dedicated to the mineral carbonation opportunities. Ron Zevenhoven (Åbo Akademi University) gave a dynamic presentation on CO2 fixation by Serpentinite. Sonja Sjöblom (Åbo Akademi University) gave a geological insight in the mineral carbonation matter in Finland. The last presentation of the session and of the whole workshop was an inspiring talk by Sigurður Gíslason (University of Iceland), who described the CarbFix project. In this project, mineral carbonation is done in situ in basalt, bringing clear evidence that the mineralization takes a couple of years in these conditions, instead of thousands of years expected normally.

The last hour of the workshop was reserved to a general discussion lead by Vit Hladik (CzGS), where interesting viewpoints on CCS in the Baltic Sea countries and generally in Europe were discussed. The need for fostering the progress of CCS was identified, as well as the need for geologists to convince and

give accurate information to the decision makers on the national, EU and international level. Capture and storage of CO2 is essential for the future, but similarly to the renewables, it is not the only solution, but a crucial part of the many "must have" options that have to be involved.

The full agenda of the workshop (see p. 13) with all presentations is available on CGS Europe website at http://www.cgseurope.net/NewsData.aspx?IdNews=84&ViewType=Actual&IdType=478

Group photo of Espoo workshop participants

Photos from the Espoo workshop – from left to right: Karen Lyng Antonsen (CO2GeoNet-GEUS) and Adam Wojcicki (PGI-NRI) presenting their papers, Vit Hladik (CzGS) moderating the final discussion


CO_2 Capture and Storage in the Baltic Sea Countries

Status and future cooperation opportunities

23 May, Espoo, Finland

AGENDA

08:30	Registration
9:00-9:20	Sustainable energy activities in Geological Survey of Finland **Keijo Nenonen** (Geological Survey of Finland) CGS Europe & Baltic Sea Region countries unique situation & opportunities **Tuija Vähäkuopus** (Geological Survey of Finland)
Session 1	**Status of geological storage of CO2 and international cooperation** Chair: Vit Hladik (Czech Geological Survey)
9:20-9:50	Global Status of CCS, Crossborder Cooperation **Ludmilla Basava-Reddi** (IEA Greenhouse Gas R&D Programme)
9:50-10:20	NORDICCS **Karen Lyng Anthonsen** (The Geological Survey of Denmark and Greenland)
Coffee Break (20 minutes)	
Session 2	**Research on CCS in the Baltic Sea countries** Chair: Samu Valpola (Geological Survey of Finland)
10:40-11:10	Finnish Carbon Capture and Storage R&D Program (CCSP) **Sebastian Teir** (VTT Technical Research Centre of Finland)
11:10-11:40	Baltic Sea Storage Potential **Richard Vernon** (SLR)
11:40-12:10	Storage Potential in Poland **Adam Wojcicki** (Polish Geological Institute - National Research Institute)
Lunch & poster session (1 h 10 min)	
13:20-13:50	SwedestoreCO2/Mustang **Auli Niemi** (Uppsala University)
13:50-14:20	Economical, Geological and Geophysical Modelling of Estonian-Latvian Transboundary CO2 storage **Alla Shogenova & Kazbulat Shogenov** (TTU GI)
14:20-14:50	Research on CCS in Russia **Andrei Otmas** (VNIGRI)
Coffee Break (20 minutes)	
Session 3	**Mineral carbonation** Chair: Sebastian Teir (VTT Technical Research Centre of Finland)
15:10-15:30	CO_2 Fixation by Serpentinite **Ron Zevenhoven** (Åbo Akademi University)
15:30-15:50	Geology & Mineral Carbonation in Finland **Sonja Sjöblom** (Åbo Akademi University):
15:50-16:20	Mineral Storage of CO_2 in Basalt - The Carbfix Project **Sigurður Gíslason** (University of Iceland)
16:20-17:00	General discussion: Future of CCS in Baltic Sea area, conclusions of the workshop Lead: Vit Hladik

CGS Europe workshop Espoo – List of participants

Lasse	Ahonen	Geological Survey of Finland
Karen Lyng	Anthonsen	GEUS - Geological Survey of Denmark and Greenland
Millie	Basava-Reddi	IEAGHG
Antony	Benham	Nottingham Centre for CCS/British Geological Survey
Katrin	Bergmann	Vattenfall Research & Development
Olli	Breilin	Geological Survey of Finland
Kjell	Dahlberg	Nordkalk Oy Ab
Markus	Fager-Pintilä	Tampere University of Technology
Sigurdur	Gislason	Institute of Earth Sciences, University of Iceland
Vit	Hladik	Czech Geological Survey
Jüri	Ivask	Institute of Geology at Tallinn University of Technology
Veli-Matti	Jalovaara	Geological Survey of Finland
Laura	Kainiemi	Aalto university
Jarmo	Kallio	GTK
Matti	Kojo	University of Tampere
Vladimir	Kolejka	Czech Geological Survey
Szymon	Kuczynski	AGH
Gesa	Kuhlmann	Federal Institute for Geosciences and Natural Resources - BGR
Timo P.	Laukkanen	Aalto University, Deprtment of Energy Technolgy
Vladimir	Macarevich	VNIGRI
Marianne	Malm	ÅF-Consult Ltd
Tõnis	Meriste	Eesti Energia AS
Gry Möl	Mortensen	SGU
Jyrki	Määttä	Vapo oy
Keijo	Nenonen	Geological Survey of Finland
Auli	Niemi	Uppsala University
Matti	Nieminen	VTT
Per Arne	Nilsson	Panaware ab
Nicklas	Nordbäck	Geological Survey of Finland
Jaakko	Nummelin	ÅF-Consult Oy
Arko	Olesk	Postimees
Andrey	Otmas	ALL-RUSSIA PETROLEUM RESEARCH EXPLORATION INSTITUTE (VNIGRI)
Peter	Postpischl	ÅF-Consult Ltd
Kathleen	Pötzsch	Vapo Oy
Arshe	Said	Aalto University
Alla	Shogenova	Institute of Geology, Tallinn University of Technology
Sonja	Sjöblom	Åbo Akademi University
Traian	Stanescu	Vibrometric Oy Cosma
Tuija	Talsi	Ministry of the Environmment

Sebastian	Teir	VTT
Arho	Toikka	University of Helsinki, Department of Social Research
Samu	Valpola	Geological Survey of Finland
Richard	Vernon	SLR
Linda	Wickström	Geological Survey of Sweden
Joonas	Virtasalo	Geological Survey of Finland
Adam	Wójcicki	Polish Geological Institute - NRI
Tuija	Vähäkuopus	GTK
Ron	Zevenhoven	Åbo Akademi University, Thermal and Flow Engineering Lab.
Maria	Zevenhoven	Åbo Akademi University, Process Chemistry Centre

5. CGS Europe national knowledge-sharing workshop, Ankara, Turkey

Event title: 'Karbon Piyasası ve Karbondioksitin Yer Altında Depolanmasında Dünyadaki Gelişmeler ve Türkiye (Carbon Market, developments in CCS around the World and in Turkey)'
Date: 29 May 2013
Place: Ankara, Turkey
Number of participants: 91
Type of audience: geoscientists, engineers, academics
CGS Europe partner in charge: METU-PAL
Other partners involved: -
Cooperating entities: Ministry of Energy and Natural Resources of Turkey

The workshop on carbon market and developments in CCS was held at the METU Conference Center on May 29, 2013. It was a one-day workshop where government officials from the Ministry of Energy and Natural Resources, academicians from the universities and representatives of private industry participated. The opening session was opened by opening remarks by Prof. Ender Okandan (METU PAL), followed by talks by Dr. Selahattin Cimen, Deputy Undersecretary of Ministry of Energy and Natural Resources and Prof. Dr. Nevzat Özgüven, Vice President of the Middle East Technical University (METU).

The morning session started with a general review of the energy picture in Turkey, then a review of CCS technologies was presented, followed by a presentation on CO2-EOR technology application in Turkey.

The carbon market in Turkey presently exists on voluntary basis, but studies are underway to establish a market and the Borse of Istanbul (Istanbul Stock Exchange). The chair of the preparatory group gave a talk to review the world situation and expectations in Turkey. The presentation by the Ministry of Urbanization and Environment explained the new database that will monitor, report and verify the greenhouse gas emissions from industrial plants; the database is planned to start in 2014.

The following talks were related to the voluntary carbon trade in Turkey, the Renewable Energy Perspective in Turkey and the industrial and agricultural policies in the context of climate change. The programme of the workshop is shown below (in Turkish).

CGS Europe national knowledge-sharing workshop Ankara – Programme:

Karbon Piyasası ve Karbondioksitin Yer Altında Depolanmasında Dünyadaki Gelişmeler ve Türkiye

09:30-09:45	***Kayıt***
09:45-10:00	**Açılış Konuşmaları** **Prof. Dr. Ender Okandan,** ODTÜ Petrol ve Doğal Gaz Müh. ve Petrol Araştırma Merkezi **Prof. Dr. Nevzat Özgüven,** ODTÜ Rektör Yardımcısı **Dr. Selahattin Çimen,** Enerji ve Tabii Kaynaklar Bakanlığı Müsteşar Yardımcısı
10:00-10:25	**Öztürk SELVİTOP**, ETKB, Enerji Politikaları ve Strateji Daire Başkanlığı *"Türkiye'nin Enerji Görünümü"*
10:25-10:50	**Çağlar SINAYUÇ**, ODTÜ Petrol Araştırma Merkezi *"Karbon Tutma ve Depolama Teknolojisi"*
10:50-11:15	**Secaeddin ŞAHİN**, Türkiye Petrolleri Anonim Ortaklığı *"Karbondioksitin Petrol Sektöründe Kullanımı Batı Raman Sahası Petrol Üretimini Arttırma Projesi"*
11:15-11:40	**Murat MAZIBAŞ**, Borsa İstanbul *"Türkiye ve Dünyadaki Karbon Piyasası"*
11:40-12:00	***Çay-Kahve Arası***
12:00-12:25	**Müslüme NARİN**, Gazi Üniversitesi *"Kyoto Protokolü Esneklik Mekanizmaları: Emisyon Ticareti"*
12:25-12:50	**Öznur KUNTASAL**, UNDP *"İklim Değişikliği ile Mücadelede Uluslar Arası ve Ulusal Süreç"*
12:50-13:15	***Tartışma***
13:15-14:15	***Yemek Arası***
14:15-14:40	**Ali Osman KILINÇASLAN**, ETKB, Enerji İşleri Genel Müdürlüğü *"Gönüllü Karbon Piyasası"*
14:40-15:05	**Orhan SOLAK**, ÇŞB, İklim Değişikliği ve Hava Yönetimi Dairesi Başkanlığı *"Sera Gazlarının İzlenmesi, Raporlanması ve Doğrulanması"*
15:05-15:30	**A. Buğrahan KARAVELİ**, Bilim, Sanayi ve Teknoloji Bakanlığı *"İklim Değişikliği Bağlamında Sanayide Karbon Yönetimi"*
15:30-15:45	***Çay-Kahve Arası***
15:45-16:10	**Osman ÖZBAY**, Enerji Federasyonu *"İklim Değişikliği ile Mücadelede Karbon Piyasaları ve Türkiye'de Tarım ve Sanayi Politikaları"*
16:10-16:35	**Ozan SOYDAŞ**, ETKB, Enerji Yatırım Dairesi *"Türkiye'deki Enerji Yatırımlarına Yenilenebilir Enerji Perspektifinden Bakış"*
16:35-17:00	***Tartışma***

91 participants attended the workshop; the list is given below.

CGS Europe national knowledge-sharing workshop Ankara – List of participants:

Name	Affiliation
ALİ OSMAN KILINÇASLAN	Enerji ve Tabii Kaynaklar Bakanlığı
AYTEN SÜMER	Türkiye Elektrik Sanayi Birliği (TESAB)
BARIŞ SANLI	ETKB-Enerji İşleri Genel Müdürlüğü
BİLHAN BAŞEYMEZ	Enerji Federasyonu
CANİP SEVİNÇ	Enerji ve Tabii Kaynaklar Bakanlığı
ÇAĞLAR SINAYUÇ	ODTÜ Petrol Araştırma Merkezi
ÇAĞRI SAĞLAM	Enerji ve Tabii Kaynaklar Bakanlığı
ÇİSEM TUBA ÜNALDI	ETKB- Petrol İşleri Genel Müdürlüğü
DİDEM NUR SAĞLAM	ODTÜ PAL
ELÇİN ÜLKER	TÇMB- Kalite ve Çevre Kurulu
EMRE AKSOY	ETKB- Petrol İşleri Genel Müdürlüğü
EMRE ÖZGÜR	ODTÜ
ENDER OKANDAN	ODTÜ Petrol Araştırma Merkezi
ENGİN İLSEVEN	Enerji ve Tabii Kaynaklar Bakanlığı
ERDAL COŞKUN	Enerji Uzmanı
ERGUN AKALIN	ETKB-Enerji İşleri Genel Müdürlüğü
ERGÜN KOÇ	ETKB-Enerji İşleri Genel Müdürlüğü
ERKAN KALAYCI	Green Consult and Finance
EZGİ KOŞAN	Ekonomi Bakanlığı
EZGİ PETEK TURNA	OPET Petrolcülük A.Ş.
FATMA YEŞİM KURŞUN	TÇMB Kalite ve Çevre Kurulu
FUNDA ÇETİN	Tüpraş
GÖKHAN KARAN	ETKB- Petrol İşleri Genel Müdürlüğü
H. ASLI OĞUZ	ETKB/YEGM
HANDE DEMİRAL	OYAK
HANDE ÖZBAY	Enerji Federasyonu
HASRET ŞAHİN	ODTÜ
İLHAN TOPKAYA	METU-PAL
İLKNUR ERİŞTİREN	Enerji ve Tabii Kaynaklar Bakanlığı
İPEK BEZİRHAN	Ekonomi Bakanlığı
İREM ÜNVER	Türkiye Çimento Müstahsilleri Birliği
KEREM YILDIRIM	Hazine Müsteşarlığı
KIYMET GİZEM GÜL	ODTÜ
MAHMUT PARLAKTUNA	ODTÜ Petrol Araştırma Merkezi
MELİH SİVRİHİSAR	İpragaz A.Ş.
MERVE TURANLI	ODTÜ Petrol ve Doğal Gaz Mühendisliği
METE GÜLBAY	BOTAŞ
METİN KORÇAK	ETKB-Enerji İşleri Genel Müdürlüğü
MUHİDDİN İZGİ	Enerji ve Tabii Kaynaklar Bakanlığı

MURAT ÇİFTÇİ	Enerji ve Tabii Kaynaklar Bakanlığı
MURAT ÇİTİLGÜLÜ	Ekonomi Bakanlığı
MURAT HARDALAÇ	ETKB Enerji İşleri Genel Müdürlüğü
MURAT MAZIBAŞ	Borsa İstanbul
MURAT MISIR	Enerji ve Tabii Kaynaklar Bakanlığı
MUSTAFA KURT	Hazine Müsteşarlığı
MUZAFFER ALPER SEZEN	ETKB- Petrol İşleri Genel Müdürlüğü
MÜSLÜME NARİN	Gazi Üniversitesi İktisat Fakültesi
NAZLI İPEK KUL	TÇMB- Kalite ve Çevre Kurulu
NİLGUN GULEC	Orta Doğu Teknik Üniversitesi
NİLGÜN Ş. AÇIKALIN	ETKB-Enerji İşleri Genel Müdürlüğü
NURAY NURTEN KURT MUSLUOĞLU	ETKB Enerji İşleri Genel Müdürlüğü
NUSRET GÜNGÖR	Maden İşleri Genel Müdürlüğü
ONUR DÖNMEZÇELİK	Enerji ve Tabii Kaynaklar Bakanlığı
OSMAN ÖZBAY	Enerji Federasyonu
ÖMER ERDEM	Enerji ve Tabii Kaynaklar Bakanlığı
ÖMER YILMAZ	Aygaz A.Ş
ÖZGÜR ÇAKIR	EPDK
ÖZGÜR SARHAN	Enerji ve Tabii Kaynaklar Bakanlığı
ÖZTÜRK SELVİTOP	ETKB-Enerji İşleri Genel Müdürlüğü
SECAEDDİN ŞAHİN	Türkiye Petrolleri A.O. (TPAO)
SELAHATTİN ÇİMEN	Enerji ve Tabii Kaynaklar Bakanlığı
SELİN BABAOĞLU	EÜAŞ
SERKAN YALÇIN	ETKB- Petrol İşleri Genel Müdürlüğü
SEVTAÇ BÜLBÜL	ODTÜ Petrol Araştırma Merkezi
SİNEM ÇALIŞKAN	Aygaz A.Ş
ŞAZİYE BALKU	Atılım Üniversitesi
ŞÜKRÜ MEREY	ODTÜ, Petrol ve Doğalgaz Mühendisliği Bölümü
TANJU MEHMETOĞLU	ODTÜ-Petrol ve D. Gaz Müh.
TOLGA ÖZEK	ZED Etkinlik Yönetimi ve Danışmanlığı
TUĞBA BAYSAL	ETKB
TUĞÇE BAYRAM ERTÜRK	ODTÜ
TUĞÇE ÖZDEMİR	ODTÜ-Petrol ve Doğalgaz Mühendisliği Bölümü
ÜLKER KALFA	TPAO
ÜMİT ÇALIKOĞLU	Enerji ve Tabii Kaynaklar Bakanlığı YEGM
ÜMİT ŞAHİN	Yeşil Gazete
VOLKAN ORHAN TEKİN	Tüpraş
YALÇIN YILMAZ	Green Consult and Finance
YAPRAK KOCATEPE	Yüksel Proje Uluslararası A.Ş.
ZAFER DEMİRCAN	ETKB-Enerji İşleri Genel Müdürlüğü
ZEYNEP YENER	ETKB- Petrol İşleri Genel Müdürlüğü
Ilker Şengüler	MTA
Sevin Uslu	ETKB, Enerji İşleri Genel Müdürlüğü
Öznur Oğuz Kuntasal	UNDP, TURKEY
Aynur Tokel	Türkiye İstatistik Kurumu

Ertuğ Öztürk	BOTAŞ
Ahmet Anıl	ETKB
Can S. Bakiler	ODTÜ
Mehmet Kayhan	ETKB
Buğrahan Karaveli	Bilim Sanayi ve Teknoloji Bakanlığı
Aslı Gündoğar	ODTÜ
Murat Tuz	HABAŞ, A.Ş.

This workshop was the 4th workshop organized by METU PAL on CCS. We had the mission of explaining what CCS mean and whether it will be a technology that can be applied in Turkey, if we have storage sites, what the new developments in CCS technology are, and if government agencies have any plans for the application.

The outcomes of this workshop show that the rate of increase in CO2 emissions in Turkey is growing at a fast rate. To combat this situation, energy efficiency at industrial sites and domestic buildings is the first target. CCS application may become an issue in the future, if there is an incentive for the industry or a carbon tax.

Photos from the Ankara workshop: Ender Okandan (METU PAL) during her opening speech (left); chairpersons and speakers of Session 3 (right)

6. CGS Europe knowledge-dissemination workshop, Antwerp, Belgium

Event title:	'EOR – the catalyst for carbon capture clusters, in ports and other industrial regions'
Date:	18 June 2013
Place:	Antwerp, Belgium
Number of participants:	30
Type of audience:	industry, government, consultants, researchers, journalists
CGS Europe partner in charge:	RBINS-GSB
Other partners involved:	CO2GeoNet-TNO, CO2GeoNet-GEUS, CO2GeoNet-BGS
Cooperating entities:	Port of Antwerp, European Federation of Geologists

An international workshop on CO2-Enhanced Oil Recovery (CO2-EOR) was planned by the GSB-RBINS, and approved to be supported as an additional event by CGS Europe, in the course of 2012. CO2GeoNet-TNO and CO2GeoNet-GEUS accepted the invitation to be official co-organisers, as well as the Port of Antwerp (PoA) who also convened the event.

The workshop especially aimed to present CO2-EOR as a concrete option for CO2 intensive industry based onshore in port and other industrialised regions. When it comes to onshore industry, there is usually a clear lack of understanding of storage aspects of CO2, and therefore of their potential role in EOR projects.

At the moment of planning, the interest at national level for submitting a NER300 phase 2 project was used as leverage to involve the Port of Antwerp as co-organiser and host of the event. The focus of the workshop, however, was to attract as much as possible an international audience.

Context

Quite interestingly, the relevance of CO_2-EOR strongly changed during the planning of the EOR workshop. During the initial planning phase, EOR was one of the concrete options being evaluated by the PoA (intense preparation and paving-the-way). Only a few months later, following the unsuccessful outcome for CCS projects in NER300 phase 1, those plans were abruptly abandoned, although the PoA remained supportive of the EOR workshop. In the weeks running up to the workshop, CCS was again on the discussion table with the high level lunch debate that was organised by MEP Chris Davies in Brussels, at the same day the EOR event was held in Antwerp.

Invitation and registration

Save-the-dates and actual invitations were send out using the dedicated online application of the convenor, as well as through more promotional flyers provided by the GSB-RBINS (see below). Address lists from the PoA were used, as well as the list used for the CO2GeoNet Open Forum Venice event. Additionally, organisers and speakers were repeatedly asked to distribute the invitations and reminders to their own contacts. In Belgium, an A4 announcement was made in the monthly newsletter Miscellanea Geologica.

Although 30 participants is an acceptable number, a number between 40 and 50 was initially expected. For the events organised on different topics in Antwerp during the past 6 months, a steady decrease of participants has been observed without a direct or evident reason, and the interest in the EOR event was in line with this trend. The relative low number of local participants resulted in a relative high share of international participation, with just above 50% of the participants not having a Belgian affiliation (The

Netherlands, UK, Norway, Denmark, Poland, Germany and Spain). 14 registered people did not show, which is a normal number for events which are organised free of charge. The event was attended mainly by people from industry, but also by consultants, government and research institutes' representatives, as well as one journalist.

Two invitations that were used for announcing the EOR event. Left the e-mail generated by the online registration tool of the convenor (Port of Antwerp), and right the more promotional flyer prepared by the RBINS-GSB

Programme

The programme (see below for details) started with an introduction on the principles of EOR with presentations by CO2GeoNet-TNO, CO2GeoNet-GEUS and Statoil. After this, the organisational and logistical issues of organising a sufficiently large capture network on-shore were covered, with a small excursion to other applications of CO_2 in an industrial content. The final presentations focussed on the economic aspects and the business case, as well as on political aspects. The outcome of the black & white break-out sessions (see section 'Discussion') was used to moderate the discussion between the dedicated panel and the audience. The event closed with a networking reception.

As can be seen in the programme, a time slot of 30 minutes was foreseen for one presentation, including the time for questions. As is also indicated by the anonymous feedback of the participants (see section 'Evaluation'), each presentation was followed by a lively debate which typically needed to be continued during the coffee and lunch breaks.

On very short notice, one of the speakers announced to be prevented to come in person to the meeting. With support of the European Federation of Geologists, this presentation was successfully given using an

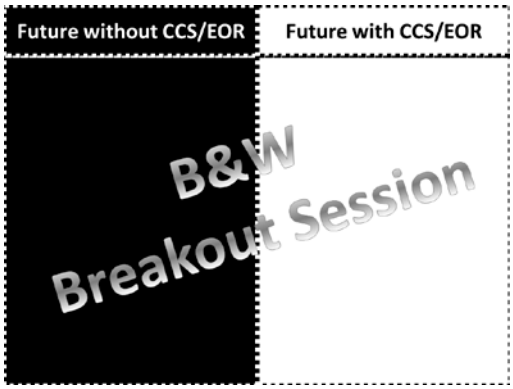
online meeting space. Due to technical restrictions (no microphone to provide audio feedback), questions were asked to the presenter using chat.

09.00 – 09.30	**Registration**
09.30 – 09.40	**Welcome speech**
09.40 – 10.10	**CO_2 Enhanced Oil Recovery uncovered** (Rob Arts, TNO & Niels Poulsen, GEUS)
10.10 – 10.40	**CO_2-EOR potential in the North Sea Basin: where and when** (Andrew Cavanagh, Statoil)
11.00 – 11.30	**Embedding CO_2-EOR in an actual project** (Stephen Brown, co2sense)
11.30 – 12.00	**Organising transport and buffer storage** (Ernest Groensmit)
12.00 – 12.30	**On-shore utilisation of CO_2 given EOR as baseline activity** (Fabrizio Sibilla & Michael Carus)
12.30 – 13.30	**Lunch break**
13.30 – 14.00	**Economics of single chain EOR projects** (Kris Welkenhuysen, GSB; Tine Compernolle, Uhasselt)
14.00 – 14.30	**On-shore organisation in industry: capturing CO_2 in cluster configurations** (Niels Berhout, UUtrecht)
14.30 – 15.00	**Politics: regulate or facilitate** (Nick Riley, BGS)
15.00 – 15.45	**Black & White breakout sessions**
15.45 – 16.05	**Tea break**
16.05 – 16.50	**Confrontation and discussion**
16.50 – 17.00	**Closing: how does it all add up?** (Kris Piessens, GSB)
17.00 – 18.00	**Network reception**

Programme of the CO2-EOR workshop in Antwerp as distributed to the participants (last-minute changes included).

Discussion

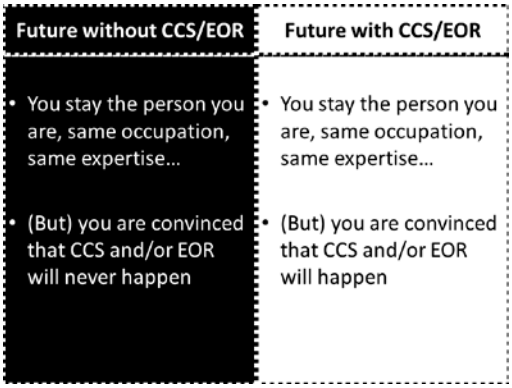
The EOR workshop used a concept, designed specifically for this occasion, which was referred to as the 'Black & White Break-Out Session' (see the title slide to the right). Except for the members of the discussion panel, who were to be confronted with the outcome of both sessions, the participants were randomly divided into two groups, and guided to separate rooms after a brief introduction.

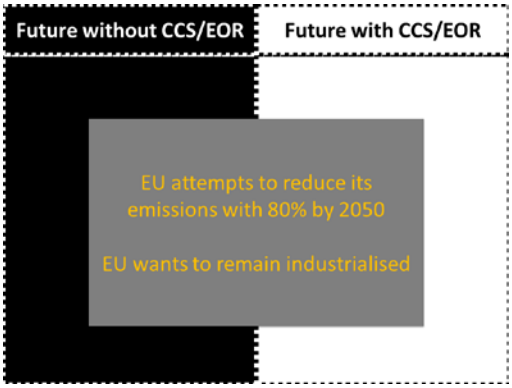


Title slide of the black and white breakout session

The participants in each group were asked to provide input based on their actual background and function (industry, government, NGO, research institute…). The target of the two sessions was the same: achieve an 80% CO2 emission reduction (context NW Europe), without affecting the current level of industrialisation. The fundamental difference between

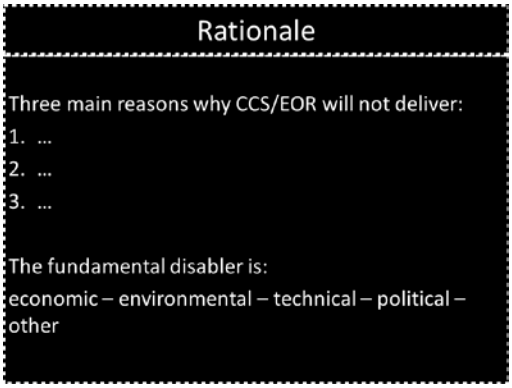
the two groups, forcing them to provide the arguments of perfect opponents, was that the white group had an absolute belief in CCS (and consequently CO2-EOR), while the black group were absolute disbelievers, and were to reject CCS as a possible means (see slide copies below).

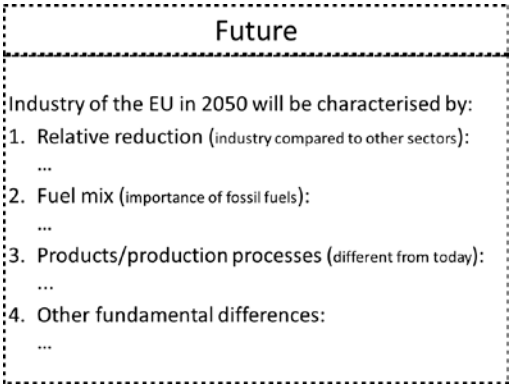


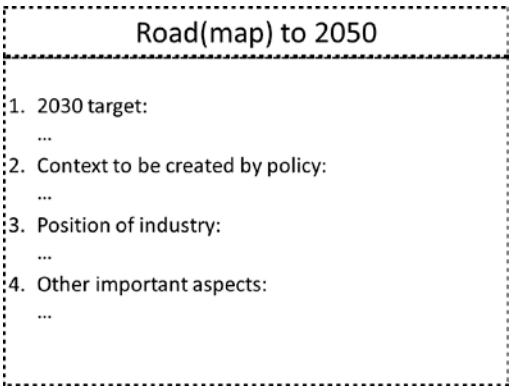


Two slides briefly explaining the role of each participant, as well as the two overall targets that needed to be respected

Based on this, the two groups were given 30 minutes time to answer the four questions summarised in the slides below. At the end, the groups were confronted with the question on how credible their scenario was, or, in other words, to personally judge how likely the two goals (emission reduction and industrialisation) could be reached.







Three slides (rationale, future, roadmap) with the main points of discussion in the black and white groups. The colour of the slides corresponds to the group for which they were prepared, here shown alternatingly. For the 1st slide (rationale), obviously an opposed version was used for the white group.

Although the participants were informed that the results of the black & white sessions could be used anonymously, the organisers do not consider it opportune to do so. There was some discussion on the exact interpretation of questions, and due to time constraints, discussion within groups were halted before consensus was reached. The input was, however, most useful for the following discussion, in which the panel consisting of three of the speakers was allowed to comment on the outcome of the black and white groups, leading to a lively debate. The coffee break allowed summarizing the outcome of the two sessions in one presentation. This greatly facilitated the work of the moderator because the discussion automatically stayed on course.

Evaluation

As a standard procedure for events organised by the PoA, participants were asked to fill out an evaluation form. 16 people returned their form. The replies show a general consensus that the objective of the workshop was reached (see evaluation results below) and that good to excellent speakers were approached. Also the organisational aspects (invitation, registration, catering, location, brochure) were positively judged. A number of participants provided textual input on 5 questions, including next steps to deploy CO2-EOR/CCUS, and the role of organisations such as the PoA (input will be presented for evaluation to the Flemish administration).

Results of project evaluation by participants

7. CGS Europe knowledge-dissemination workshop, Athens, Greece

Event title:	'CO2 Geological Storage: Scientific knowledge - Present situation - Perspectives'
Date:	26 June 2013
Place:	Athens, Greece
Number of participants:	135
Type of audience:	policy makers , officials and employees of the Hellenic Ministry of Environment, Energy and Climate Change, geoscientists, engineers, researchers, officers and employees of energy and construction companies and industries, environmental consultants, academic staff, university students
CGS Europe partner in charge:	G-IGME (now EKBAA-IGME)
Other partners involved:	CO2GeoNet-Imperial, CO2GeoNet-IRIS, CO2GeoNet-IFPEN
Cooperating entities:	-

The workshop was originally planned for 2011 but it was postponed to the final project period. Due to the economic crisis in Greece, some changes in the public sector were performed. In the frame of these changes, G-IGME was absorbed by the National Center of Environment and Sustainable Development (EKPAA) in accordance to the Ministerial Decision 25200 / 2011 (Official Gazette, 2612/B/8 November 2011) and a new legal entity called National Center for Sustainable Development (in Greek "Ethniko Kentro Viosimis kai Aeiforou Anaptyxis", EKBAA) was established. Therefore, nowadays, IGME is a part of the National Center for Sustainable Development (NCSD or EKBAA). Due to these development, the realization of the workshop in 2011 turned out as impossible.

The workshop was held at the Central Amphitheatre of the National Center for Sustainable Development (Entrance C, Olympic Village, Acharnae, Attica, Greece) on June 26, 2013. This knowledge-dissemination workshop was completely carried out within the CGS Europe project and had the general title "CO2 Geological Storage: Scientific knowledge - Present situation - Perspectives". Generally, there is a lack of information regarding the CO2 geological storage (CGS) in Greece. So, the aim of this workshop was to inform Greek people about the CGS technology, clarifying various aspects relating to geological storage. It was a very good opportunity for knowledge dissemination to a broader audience in Greece.

The workshop began with greetings of:

- Assoc. Prof. Apostolos Alexopoulos, member of the Hellenic Parliament;
- Prof. Efthymios Lekkas, President of the Greek Geological Society;
- Dr. Vassilios Karkoulias, President of the Hellenic Institute of Hydrocarbons;
- Nikolaos Nikolaou, Acting General Director of G-IGME.

Written salutational messages were sent by:

- Prof. Michail Stamatakis, Head of the Faculty of Geology and Geo-Environment at University of Athens;
- Prof. Kimon Christanis, Chairperson of the Department of Geology at University of Patras;
- Prof. Emmanouil Manoutsoglou, Acting Dean of the Mineral Resources Engineering School at Technical University of Crete;
- Stavros Zannopoulos, President of the Branch of Eastern Sterea Hellas of the Geotechnical Chamber of Greece;

- Dr Isabelle Czernichowski-Lauriol, Coordinator of the CGS Europe Project and President of the CO_2GeoNet Association.

All these messages were read during the opening session of the workshop.

The technical programme of the workshop program consisted of three sessions:

- 1st session: Various aspects of CO2 geological storage technology - scientific approach
- 2nd session: Present situation - CO2 geological storage (CGS) projects
- 3rd session: Greek and European policy and strategy for CO2 capture and storage (CCS)

The full programme of the workshop is presented below (pp. 27-29).

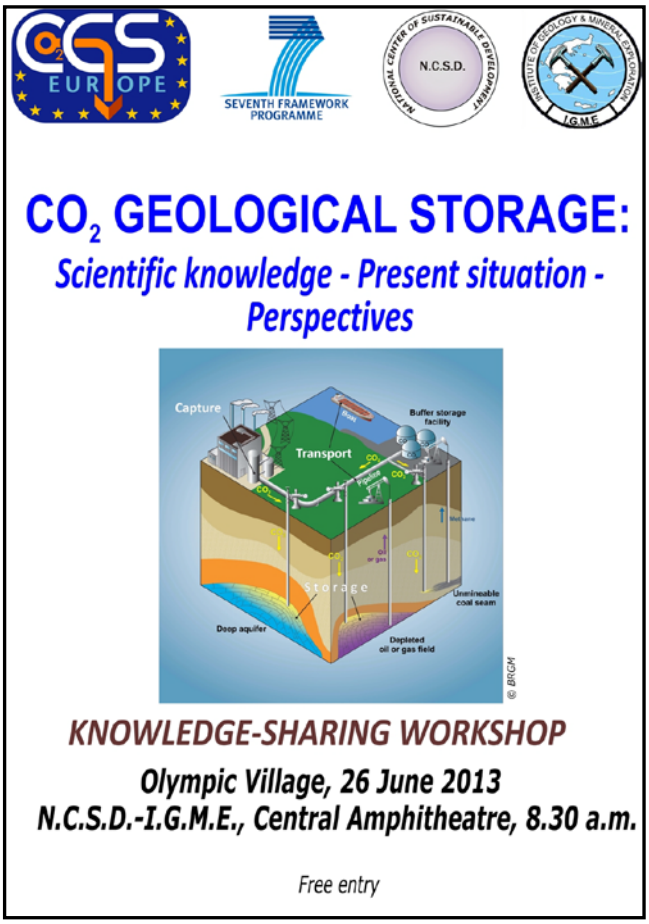
All oral presentations were given in Greek language; this was possible thanks to the fact that all speakers (both from Greece and from abroad) were of Greek origin. This increased the interest of the audience, and also the level of the presentations was very high.

Outside the Auditorium, a poster session was accessible during the workshop. The list of these posters is presented below on p. 31. Examples of presented posters are shown on p. 35.

The knowledge-dissemination workshop at G-IGME was very successful and fruitful. It was the first large event on the CO_2 geological storage technology organized in Greece. The interest in this topic was high, proving the fact that geological surveys have a key role to play in knowledge development and dissemination in this area. The workshop was an excellent opportunity for all participants to learn about the CGS technology, to raise questions and to have a dialogue with Greek scientists working on CO_2 storage in both Greece and Europe. A photo showing the audience during the workshop is provided on page 30.

The speakers thoroughly and clearly analyzed various subtopics of the CO_2 geological storage technology, presented pilot and demo projects at European and international level, highlighted the benefits accrued from the participation of Greek institutions in the research on CGS, formulated views on strategy and policy on CO_2 capture and storage at national and European levels and noted the European Commission's initiatives from the research perspective. The need for continued research and implementation of pilot and demo projects for a safe, efficient and effective CO_2 geological storage, consolidating the sense of security to the general public for this technology was highlighted. Among the presentations, special sensation was caused by the speeches of eminent Greek scientists with experience in this field and with international recognition, who are currently working at Imperial College (UK), IFPEN (France), IRIS & UiS (Norway) and the European Commission (Brussels). A photo gallery of workshop speakers is on pp. 32 – 33. Photos on page 34 depict two of the speakers giving their presentations.

All attendees were satisfied with the high scientific level of the presentations. There were numerous positive and complimentary comments. It is noteworthy that there was intense interest in the scientific documentation of the CO_2 geological storage by employees and officials of the Greek Ministry of Environment, Energy and Climate Change. During the workshop, the printed Greek edition of the brochure “What does CO_2 geological storage really mean?” was distributed to all participants.



Announcement posters of the workshop – Greek and English versions

Workshop venue – the facilities of EKBAA-IGME at the Olympic Village (about 26 km to the north of Athens city centre)

K n o w l e d g e - s h a r i n g W o r k s h o p

CO_2 Geological Storage:
Scientific knowledge - Present situation - Perspectives

Wednesday, 26 June 2013

Central Amphitheatre of
National Center for Sustainable Development (N.C.S.D.),
Entrance C, Olympic Village, Acharnae, Greece

A G E N D A

08.30 - 09.00	**Participants arrival - Registration**
09.00 - 09.15	**Welcome address -** **A brief presentation of the CGS Europe Project** ***Dr Apostolos Arvanitis*** *Institute of Geology and Mineral Exploration (I.G.M.E.),* *National Center for Sustainable Development (N.C.S.D.), Greece*
09.15 - 09.35	**Greetings - Opening**
09.35 - 09.50	**"CO_2 Geological Storage: General Principles and concepts"** ***Dr Apostolos Arvanitis*** *Institute of Geology and Mineral Exploration (I.G.M.E.),* *National Center for Sustainable Development (N.C.S.D.), Greece*
09.50 - 10.15	**Coffee break**
Session 1	**Various aspects of CO_2 geological storage technology - Scientific approach**
10.15 - 10.30	**"Physicochemical properties of Carbon Dioxide (CO_2)"** ***Dr Dimitrios Tsangaris*** *Institute of Physical Chemistry,* *National Center of Scientific Research "Demokritos",* *Agia Paraskevi, Attica, Greece*
10.30 - 10.50	**"The knowledge of the hydrocarbon borehole techniques as a very significant tool for CO_2 geological storage"** ***Grigorios Vrellis*** *Mining and Metallurgical Engineer NTUA,* *Member of the Hellenic Institute of Hydrocarbons (HELLINHY),* *Drilling and Production Engineer, E.N.S.P.M. - I.F.P.* *Former Technical Chief at Public Petroleum Corporation (P.P.C) &* *Geothermal Drilling Engineer at I.G.M.E.* *Athens, Greece*

10.50 - 11.20	**"CO_2 Storage Reservoir Performance: Key performance indicators for operability and efficiency assessment"** ***Dr Anna Korre*** *Reader in Environmental Engineering,* *Department of Earth Science and Engineering, Imperial College,* *London, United Kingdom*
11.20 - 11.50	**"An integrated approach to evaluate CO_2 injection for storage or enhanced oil recovery purposes - Reservoir engineering, Simulation and Modeling - Monitoring methods"** ***Dr Olga Vizika - Kavvadias*** *Director of Geosciences,* *IFP Energies nouvelles (IFPEN), Rueil-Malmaison, France*
11.50 - 12.00	**"Carbon Dioxide Utilization in tertiary oil recovery (CO_2 flooding)"** ***Stefanos Xenopoulos*** *Chemical and Petroleum Engineer M.Sc (Loughborough University & Imperial College)* *Board Member of the Hellenic Institute of Hydrocarbons (HELLINHY), Former employee at Public Petroleum Corporation (P.P.C.) & Hellenic Petroleum,* *Athens, Greece*
12.00 - 12.30	**Discussion**
12.30 - 13.00	**Coffee break**
Session 2	**Present situation - CO_2 Geological Storage (CGS) Projects**
13.00 - 13.25	**"Pilot and demo CO_2 Geological Storage Projects worldwide - Research activities of CERTH on CO_2 Geological Storage"** ***Dr Nikolaos Koukouzas*** *Director of Research* *Centre for Research and Technology Hellas (CE.R.T.H.) /* *Chemical Process & Energy Resources Institute (CPERI),* *Greece*
13.25 - 13.55	**"CO_2 Geological Storage - The Norwegian experience"** ***Prof. Dr. Dimitrios G. Hatzignatiou*** *CEng & EurIng* *Chief Technical Director -* *International Research Institute of Stavanger AS (IRIS),* *Center of Oil Recovery (COREC) Professor II - U. of Stavanger (UiS)* *Stavanger, Norway*
13.55 - 14.20	**"A review of research of I.G.M.E. and CO_2 storage capacity estimation in Greece"** ***George Hatziyannis*** *Former Director of the Geothermal Energy Department of I.G.M.E., contact person for the EU NASCENT, GESTCO and GeoCapacity Projects,* *Greece*
14.20 - 14.40	**Discussion**
14.40 - 15.30	**Lunch break**

Session 3	Greek and European policy and strategy for CO_2 Capture and Storage (CCS)
15.30 - 15.50	**"Carbon dioxide capture at the electricity production sector"** ***Vassiliki Tsadari, Athina Christou & Antonis Koumanakos*** *Generation Environment Department, Public Power Corporation S.A., Greece*
15.50 - 16.05	**"First consideration of CCS environmentally"** ***Irini Nikolaou*** *Head of Emissions Trading Office, Directorate of Air and Noise Control, General Directorate of Environment, General Secretariat of Environment, Ministry of Environment, Energy & Climate Change* *Athens, Greece*
16.05 - 16.30	**"European Commission initiatives on CCS - update from the research perspective"** ***Dr Vassilios Kougionas*** *Principal Research Programme Officer* *European Commission - DG Research & Innovation* *Brussels, Belgium*
16.30 - 17.00	**Discussion**
17.00	**Closing of the workshop**

A view of the audience during the workshop

Posters

1. **Development of key performance indicators for CO_2 storage operability and efficiency assessment: Application to the Southern North Sea Rotliegend Group**
   Anna Korre, Sevket Durucan, Ji-Quan Shi, Amer Syed, Rajesh Govindan, Sarah Hannis, John Williams, Gary Kirby and Martyn Quinn

2. **Snøhvit: Assessment of CO_2 injection performance through history matching of the injection well pressure over a 32-months period**
   Ji-Quan Shi, Claire Imrie, Caglar Sinayuc, Sevket Durucan, Anna Korre and Ola Eiken

3. **Full chain analysis and comparison of gas-fired power plants with CO_2 capture and storage with clean coal alternatives**
   Zhenggang Nie, Anna Korre and Sevket Durucan

4. **A coupled reservoir simulation-geomechanical modelling study of the CO_2 injection-induced ground surface uplift observed at Krechba, In Salah**
   Ji-Quan Shi, James Smith, Sevket Durucan and Anna Korre

5. **Application of an unsupervised methodology for the indirect detection of CO_2 leakages around the Laacher See in Germany using remote sensing data**
   Rajesh Govindan, Anna Korre and Sevket Durucan

6. **Geomechanical Analysis of Underground Coal Gasification Reactor Cool Down for Subsequent CO_2 Storage**
   Vasilis Sarhosis, Dongmin Yang, Thomas Kempka and Yong Sheng

7. **Underground Coal Gasification (UCG) and CO_2 Capture and Storage (CCS)**
   Vasileios Sarhosis, Yong Sheng, JiangQiao Ye, Doug Stewart, Dongmin Yang and Kenneth Eshiet

8. **Assessing capacity for geological storage of carbon dioxide in Central - East group of countries (EU GeoCapacity project)**
   George Hatziyannis, Gyorgy Falus, Georgi Georgiev and Constantin Sava

9. **In Salah CO_2 injection and modeling: a preliminary approach to predict short term reservoir behavior**
   Jean-Pierre Deflandre, Audrey Estublier, Axelle Baroni, Jean-Marc Daniel and Florence Adjémian

10. **To a dynamic update of the Sleipner CO_2 storage geological model using 4D seismic data**
    Alexandre Fornel and Audrey Estublier

Assoc. Prof. Apostolos Alexopoulos,
Geologist, Member of the Hellenic Parliament (greeting)

Prof. Efthymios Lekkas,
President of the Greek Geological Society (greeting)

Dr. Vassilios Karkoulias,
President of the Hellenic Institute of Hydrocarbons (greeting)

Nikolaos Nikolaou,
Acting General Director of IGME (opening speech)

Grigorios Vrellis,
Mining and Metallurgical Engineer (speaker)

Dr. Anna Korre,
CO_2GeoNet - Imperial College (speaker)

Dr. Olga Vizika - Kavvadias,
CO_2GeoNet - IFPEN (speaker)

Stefanos Xenopoulos,
Chemical and Petroleum Engineer, MSc (speaker)

Dr. Nikolaos Koukouzas,
C.E.R.T.H. / CPERI (speaker)

Prof. Dimitrios Hatzignatiou,
CO_2GeoNet - IRIS & UiS
(speaker)

George Hatziyannis
Ex-IGME project leader of the EU NASCENT, GESTCO & GeoCapacity projects
(speaker)

Dr. Vassilios Kougionas,
European Commission - DG Research & Innovation
(speaker)

Antonis Koumanakos,
Public Power Corporation S.A.
(speaker)

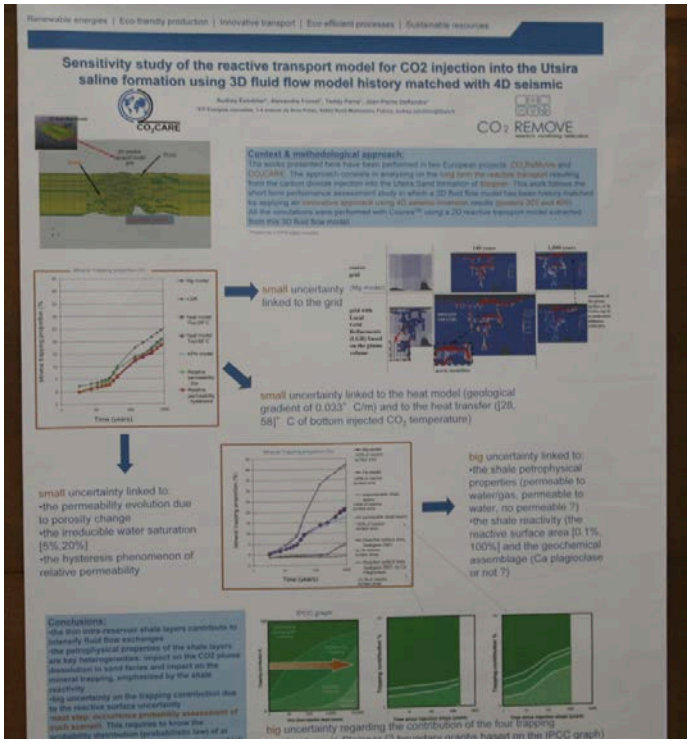
Irini Nikolaou,
Ministry of Environment, Energy & Climate Change
(speaker)

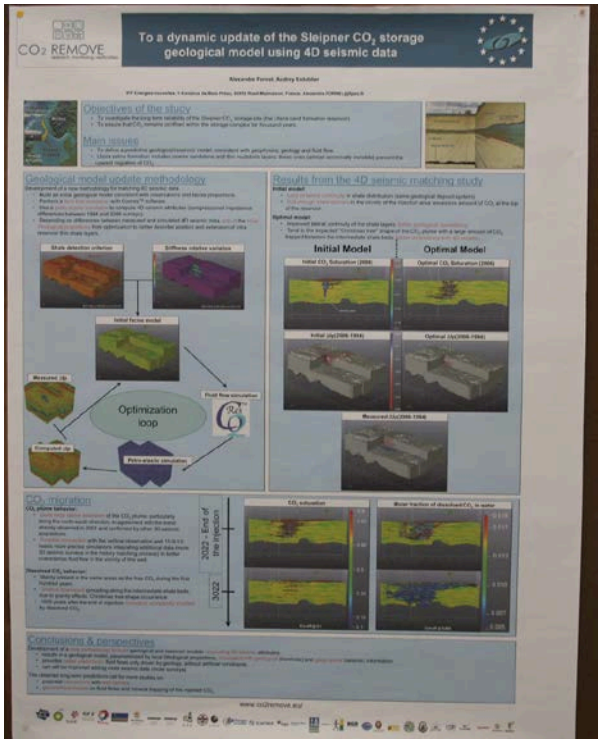
Dr. Apostolos Arvanitis,
EKBAA-IGME project leader of the CGS Europe project
(speaker)

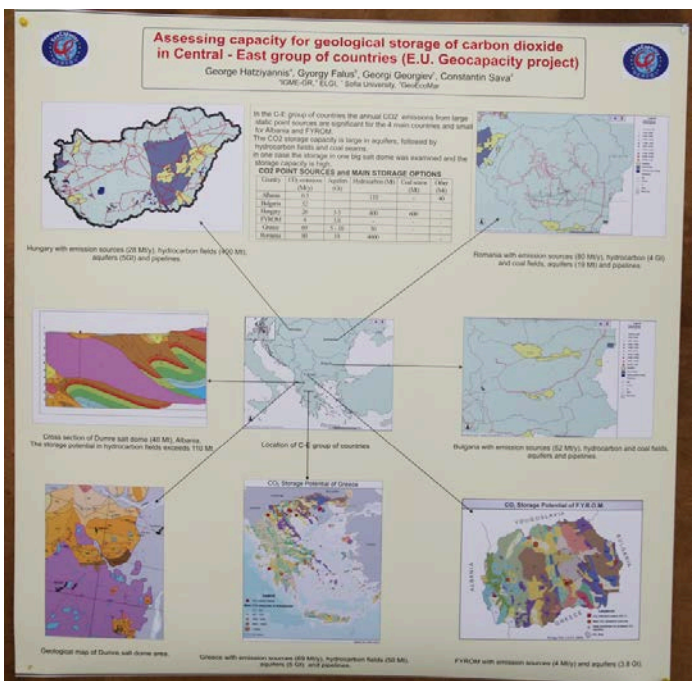
A few days after the workshop, a short article describing the workshop in Athens and the CGS Europe Project was published in the "Ecotec" magazine (issue 89, June 2013, pages 38-39), which is a monthly magazine for the environmental technology. The article entitled "CGS Europe: A European knowledge-dissemination, training and coordination project on CO_2 Geological Storage" was compiled by Dr Apostolos Arvanitis (EKBAA-IGME) in Greek language. In the first part of this article, a short overview of the workshop is given. In the second part, the CGS Europe project is briefly presented. The aims, the outcomes and the work plan of the project are mentioned therein. A copy of the article is provided on page 36.

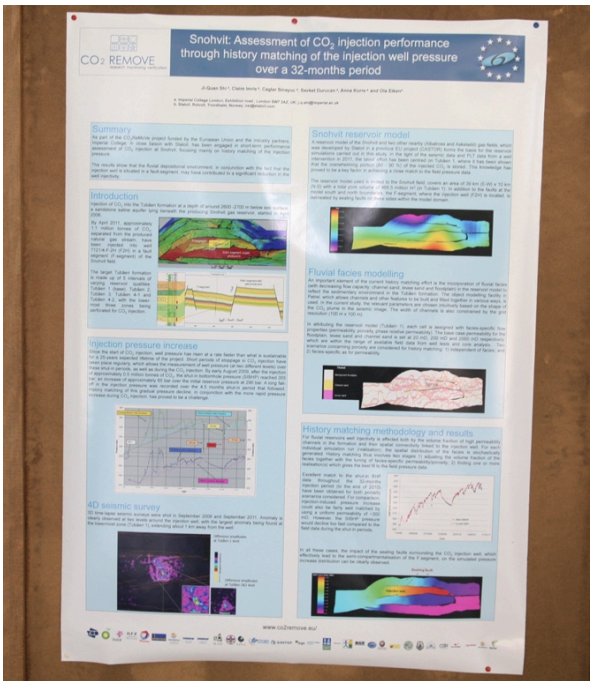
Dr Vassilios Kougionas (European Commission - DG Research & Innovation) giving his presentation

Dr Apostolos Arvanitis (EKBAA-IGME) giving his presentation

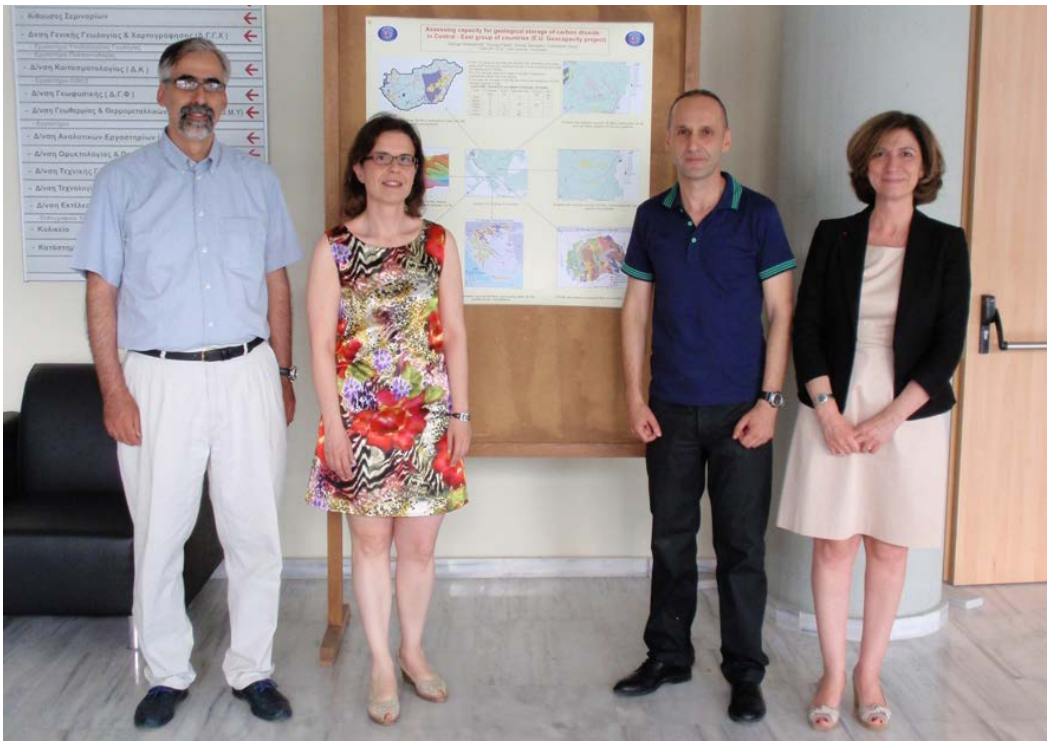








Examples of posters displayed in the poster session



Post-workshop photo of CGS Europe representatives involved in workshop organisation - from left to right: Prof. Dimitrios Hatzignatiou (CO2GeoNet-IRIS), Dr Anna Korre (CO2GeoNet-Imperial), Dr Apostolos Arvanitis (EKBAA-IGME) and Dr Olga Vizika - Kavvadias (CO2GeoNet-IFPEN)

CGS EUROPE:

Ευρωπαϊκό έργο ενημέρωσης, εκπαίδευσης και συντονισμού για τη γεωλογική αποθήκευση του CO_2

Κείμενο - Φωτό: Δρ Απόστολος Αρβανίτης,

Ινστιτούτο Γεωλογικών και Μεταλλευτικών Ερευνών και Μεθοδων (I.G.M.E.M.), Ελληνικό Κέντρο Βιώσιμης και Διατρόπου Ανάπτυξης (E.K.B.A.A.)

Υπεύθυνος Έργου «CGS Europe»

Τι είναι το CGS

Επισημάνθηκαν τα οφέλη που έχουν προκύψει μέχρι σήμερα από τη συμμετοχή ελληνικών ερευνητικών κέντρων για την αποθήκευση CO_2

Στόχος του Έργου

22 χρόνια πρωτοπόροι στις τεχνικές εκδόσεις

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Article in the "Ecotec" magazine describing the CGS Europe workshop in Athens and the aims and work plan of the CGS Europe Project

8. Workshop / course on CCS technologies, Ponferrada, Spain

Event title: Course on CCS Technologies: 'Capture, transport and storage of CO2'
Date: 15 - 26 July 2013
Place: Ponferrada, Spain
Number of participants: 30
Type of audience: Post-Doc students, geoscientists, academia
CGS Europe partner in charge: S-IGME
Other partners involved: -
Cooperating entities: CIUDEN, University of León

In order to partly compensate for the cancelled knowledge-dissemination workshop in Spain, the Spanish CGS Europe partner S-IGME decided to support organisation of a national educational course on CCS.

The First Course on CCS Technologies took place in Ponferrada (Spain), the industrial city where the City of Energy Foundation (CIUDEN) has located its headquarters. This foundation is carrying out a major pilot project on capture, transport and storage of CO2. Ponferrada is also the place selected for the Compostilla Project, the Spanish national CCS demonstration initiative.

CGS Europe and its Spanish partner S-IGME have been co-organizers of the course and supported sessions on CO2 storage (workshop-type) and a technical visit to the storage pilot site of Hontomín. During the storage sessions a lecture titled 'Storage capacity needed and estimated in Spain' was given by Roberto Martínez of S-IGME.

Promotion banner of the course on CCS technologies in Ponferrada

On July 25, a technical visit to the pilot site of Hontomín was held. Two wells were being drilled at that moment, one to be used as the injection well and the other as a monitoring well.

The course was well evaluated by participants and it is planned to have a second edition next year.

9. SES conference Pau, France – CO_2 storage sessions

Event title:	2nd Sustainable Earth Sciences Conference & Exhibition – CO_2 storage sessions
Date:	30 September - 4 October 2013
Place:	Pau, France
Number of participants:	140
Type of audience:	geoscientists, engineers, regulators, students
CGS Europe partner in charge:	CO_2GeoNet and BRGM
Other partners involved:	CO_2GeoNet-IFPEN, CO2GeoNet-OGS, CO2GeoNet-HWU, CzGS, BGR, CO2GeoNet-TNO, CO2GeoNet-Imperial
Cooperating entities:	EAGE – European Association of Geoscientists & Engineers, International Geothermal Association, European Geothermal Energy Council, Avenia, Global CCS Institute, House of Geoscience

The 2nd SES conference was another example of fruitful co-operation between CGS Europe, CO_2GeoNet and the European Association of Geoscientists & Engineers. It focused on sustainable use of the subsurface, incorporating three main technologies – CO_2 geological storage, geothermal energy and deep-earth storage. The main goal of the conference was to boost the exchange of experience and technology in the disciplines involved.

CGS Europe partners played an important role in the organisation of the conference: Sergio Persoglia (CO_2GeoNet-OGS), Isabelle Czernichowski (BRGM) and Henk Pagnier (CO2GeoNet-TNO) were members of the Steering Committee as representatives of CGS Europe and CO_2GeoNet. Further engagement included, i.a., chairing of conference sessions by representatives of CO_2GeoNet-HWU (Gillian Pickup), BRGM (Isabelle Czernichowski, Pascal Audigane) and CO_2GeoNet-IFPEN (Nicolas Maurand), oral and poster presentations, etc.

A poster entitled ‘Mapping of CO2 Storage Achievements Across Europe’, based on results of a CGS Europe WP2 activity and the related deliverable D2.10 ‘State of play on CO2 geological storage in 28 European countries’, was prepared by BGR, CzGS, TTUGI, S-IGME, BRGM and UNIZG-RGNF and presented at the conference by V. Hladik (CzGS). Many other oral presentations and posters were presented by CGS Europe partners, mostly based on results of other R&D projects they are involved in.

The following oral presentations were given by CGS Europe participants:
Plenary session – Resources for sustainable energy:

- European Resource Assessment for Geothermal Energy and CO2 Storage - J.D. van Wees & F. Neele (CO2GeoNet-TNO)

Plenary session – Microseismicity and deformation:

- New Challenges in Geomechanics - From the Enhanced Geothermal System towards the CO2 Underground Storage - S.S. Gentier (BRGM)

Session 'Modeling':

- Coupled Modelling of CO2 Injection into a Realistic North Sea Aquifer - P. Olden, M. Jin, G. Pickup & E. Mackay (CO2GeoNet-HWU)
- A Robust Multi-criterion Optimization of CO2 Sequestration Under Model Uncertainty - R. Petvipusit (CO2GeoNet-Imperial), A.H. Elsheikh (University of Texas at Austin), T. Laforce (CSIRO), P.R. King & M.J. Blunt (CO2GeoNet-Imperial)

Session 'Geochemistry I':

- Experimental and Numerical Study of CO2-water-minerals Interactions Applied to Rousse Reservoir Rock - P. Bachaud, T. Parra, M. Chardin & M. Masson (CO2GeoNet-IFPEN)
- Reactive Surface Area in Geochemical Models – Lessons Learned from a Natural Analogue - M. Koenen & L.J. Wasch (CO2GeoNet-TNO)
- Reactive Fluid Flow Simulations for Modelling the CO2 Injection in the Rousse Depleted Gas Reservoir - N. Maurand, T. Parra & A. Michel (CO2GeoNet-IFPEN)

Session 'Geochemistry II':

- Model Calibration on Cement Experiments at Realistic CO2 Storage Conditions - L.J. Wasch, M. Koenen, J. Wollenweber, J.H. ter Heege & T.J. Tambach (CO2GeoNet-TNO)

Session 'Improving sustainability':

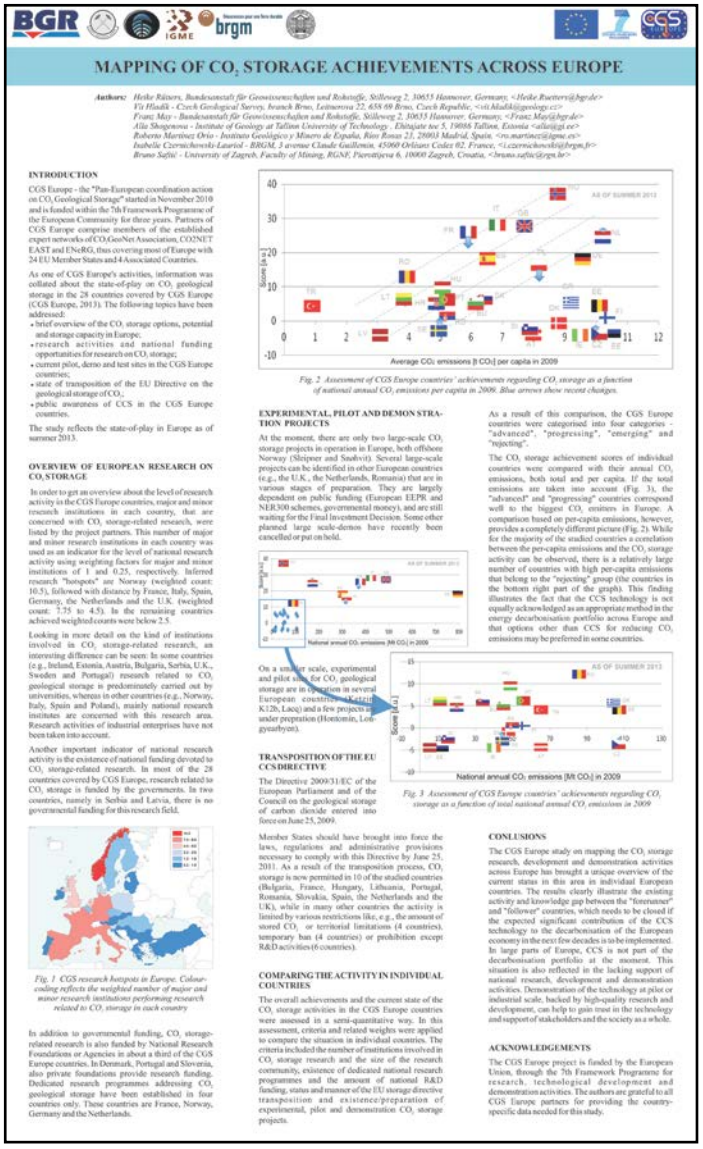
- CO2-Dissolved - A Novel Approach to Combining CCS and Geothermal Heat Recovery - C. Kervévan (BRGM), F. Bugarel (CFG Services), X. Galiègue (LEO, Université d'Orléans), Y. Le Gallo (Geogreen), F. May (BGR), K. O'Neil (Partnering in Innovation, Inc.) & J. Sterpenich (GéoRessources, Université de Lorraine)

Plenary session – Lacq-Rousse CO2 storage pilot:

- Experimental and Modeling Investigations of some Thermophysical Properties of CO2 Rich Mixtures - V. Lachet, B. Creton, A. Di Lella, D. Le Roux, P. Mougin (CO2GeoNet-IFPEN), C. Prinet) & P. Duchet-Suchaux (Total)
- A Geochemical Approach for Monitoring a CO2 Pilot Site - Rousse, France - B. Garcia (CO2GeoNet-IFPEN)

The following posters were presented by CGS Europe participants:

- Mapping of CO2 Storage Achievements Across Europe - H. Rütters (BGR), V. Hladik (CzGS), F. May (BGR), A. Shogenova (TTUGI), R. Martinez (S-IGME), I. Czernichowski (BRGM) & B. Saftic (UNIZG-RGNF)
- The Injection of Liquid Cool CO2 in a Warm Depleted Gas Reservoir - C. Hofstee, J.H. Maas & D. Loeve (CO2GeoNet-TNO)
- Could this be the Future of Secure CO2 Storage? - S.M. Shariatipour, E.J. Mackay & G.E. Pickup (CO2GeoNet-HWU)
- Exergy Analysis of Coupled CO2 Sequestration with Geothermal Energy Production - H. Woodrow (CO2GeoNet-Imperial)
- Surface and Near Surface Geochemical Surveying of a CO2 Injection Pilot: Application Study to the French Pyrenean Foreland (Rousse CCS Pilot) - F. Gal (BRGM), Z. Pokryszka (INERIS), S. Lafortune (INERIS) & K. Michel (BRGM)



MAPPING OF CO_2 STORAGE ACHIEVEMENTS ACROSS EUROPE

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INTRODUCTION

CGS Europe - the "Pan-European coordination action on CO_2 Geological Storage" started in November 2010 and is funded within the 7th Framework Programme of the European Community for three years. Partners of CGS Europe comprise members of the established expert networks of CO2GeoNet Association, CO2NET EAST and ENeRG, thus covering most of Europe with 24 EU Member States and 4 Associated Countries.

As one of CGS Europe's activities, information was collated about the state-of-play on CO_2 geological storage in the 28 countries covered by CGS Europe (CGS Europe, 2013). The following topics have been addressed:

- brief overview of the CO_2 storage options, potential and storage capacity in Europe;
- research activities and national funding opportunities for research on CO_2 storage;
- current pilot, demo and test sites in the CGS Europe countries;
- state of transposition of the EU Directive on the geological storage of CO_2;
- public awareness of CCS in the CGS Europe countries.

The study reflects the state-of-play in Europe as of summer 2013.

OVERVIEW OF EUROPEAN RESEARCH ON CO_2 STORAGE

In order to get an overview about the level of research activity in the CGS Europe countries, major and minor research institutions in each country, that are concerned with CO_2 storage-related research, were listed by the project partners. This number of major and minor research institutions in each country was used as an indicator for the level of national research activity using weighting factors for major and minor institutions of 1 and 0.25, respectively. Inferred research "hotspots" are Norway (weighted count: 10.5), followed with distance by France, Italy, Spain, Germany, the Netherlands and the U.K. (weighted count: 7.75 to 4.5). In the remaining countries achieved weighted counts were below 2.5.

Looking in more detail on the kind of institutions involved in CO_2 storage-related research, an interesting difference can be seen: In some countries (e.g., Ireland, Estonia, Austria, Bulgaria, Serbia, U.K., Sweden and Portugal) research related to CO_2 geological storage is predominately carried out by universities, whereas in other countries (e.g., Norway, Italy, Spain and Poland), mainly national research institutes are concerned with this research area. Research activities of industrial enterprises have not been taken into account.

Another important indicator of national research activity is the existence of national funding devoted to CO_2 storage-related research. In most of the 28 countries covered by CGS Europe, research related to CO_2 storage is funded by the governments. In two countries, namely in Serbia and Latvia, there is no governmental funding for this research field.

Fig. 1 CGS research hotspots in Europe. Colour-coding reflects the weighted number of major and minor research institutions performing research related to CO_2 storage in each country

In addition to governmental funding, CO_2 storage-related research is also funded by National Research Foundations or Agencies in about a third of the CGS Europe countries. In Denmark, Portugal and Slovenia, also private foundations provide research funding. Dedicated research programmes addressing CO_2 geological storage have been established in four countries only. These countries are France, Norway, Germany and the Netherlands.

Fig. 2 Assessment of CGS Europe countries' achievements regarding CO_2 storage as a function of national annual CO_2 emissions per capita in 2009. Blue arrows show recent changes.

EXPERIMENTAL, PILOT AND DEMON STRATION PROJECTS

At the moment, there are only two large-scale CO_2 storage projects in operation in Europe, both offshore Norway (Sleipner and Snøhvit). Several large-scale projects can be identified in other European countries (e.g., the U.K., the Netherlands, Romania) that are in various stages of preparation. They are largely dependent on public funding (European EEPR and NER300 schemes, governmental money), and are still waiting for the Final Investment Decision. Some other planned large scale-demos have recently been cancelled or put on hold.

On a smaller scale, experimental and pilot sites for CO_2 geological storage are in operation in several European countries (e.g., Ketzin, K12b, Lacq) and a few projects are under preparation (Hontomín, Lotgeyarbyen).

Fig. 3 Assessment of CGS Europe countries' achievements regarding CO_2 storage as a function of total national annual CO_2 emissions in 2009

TRANSPOSITION OF THE EU CCS DIRECTIVE

The Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide entered into force on June 25, 2009.

Member States should have brought into force the laws, regulations and administrative provisions necessary to comply with this Directive by June 25, 2011. As a result of the transposition process, CO_2 storage is now permitted in 10 of the studied countries (Bulgaria, France, Hungary, Lithuania, Portugal, Romania, Slovakia, Spain, the Netherlands and the UK), while in many other countries the activity is limited by various restrictions like, e.g., the amount of stored CO_2 or territorial limitations (4 countries), temporary ban (4 countries) or prohibition except R&D activities (6 countries).

COMPARING THE ACTIVITY IN INDIVIDUAL COUNTRIES

The overall achievements and the current state of the CO_2 storage activities in the CGS Europe countries were assessed in a semi-quantitative way. In this assessment, criteria and related weights were applied to compare the situation in individual countries. The criteria included the number of institutions involved in CO_2 storage research and the size of the research community, existence of dedicated national research programmes and the amount of national R&D funding, status and manner of the EU storage directive transposition and existence/preparation of experimental, pilot and demonstration CO_2 storage projects.

As a result of this comparison, the CGS Europe countries were categorised into four categories - "advanced", "progressing", "emerging" and "rejecting".

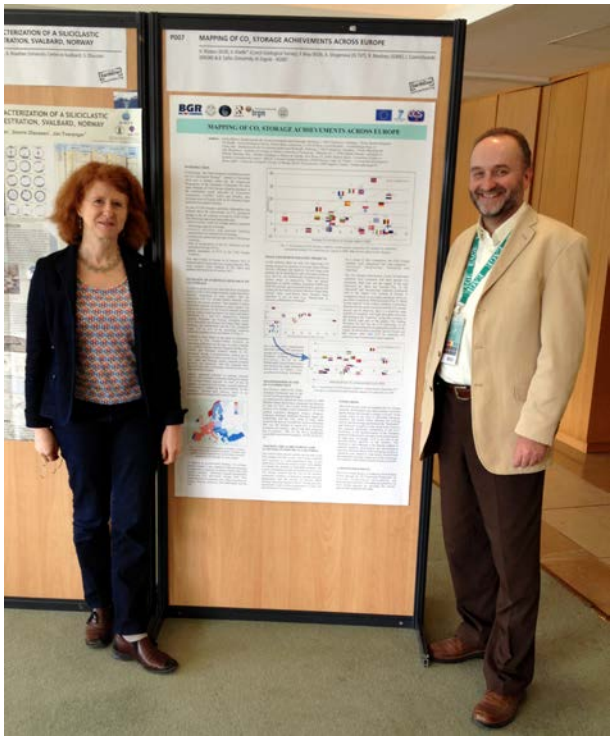
The CO_2 storage achievement scores of individual countries were compared with their annual CO_2 emissions, both total and per capita. If the total emissions are taken into account (Fig. 3), the "advanced" and "progressing" countries correspond well to the biggest CO_2 emitters in Europe. A comparison based on per-capita emissions, however, provides a completely different picture (Fig. 2). While for the majority of the studied countries a correlation between the per-capita emissions and the CO_2 storage activity can be observed, there is a relatively large number of countries with high per-capita emissions that belong to the "rejecting" group (the countries in the bottom right part of the graph). This finding illustrates the fact that the CCS technology is not equally acknowledged as an appropriate method in the energy decarbonisation portfolio across Europe and that options other than CCS for reducing CO_2 emissions may be preferred in some countries.

CONCLUSIONS

The CGS Europe study on mapping the CO_2 storage research, development and demonstration activities across Europe has brought a unique overview of the current status in this area in individual European countries. The results clearly illustrate the existing activity and knowledge gap between the "forerunner" and "follower" countries, which needs to be closed if the expected significant contribution of the CCS technology to the decarbonisation of the European economy in the next few decades is to be implemented. In large parts of Europe, CCS is not part of the decarbonisation portfolio at the moment. This situation is also reflected in the lacking support of national research, development and demonstration activities. Demonstration of the technology at pilot or industrial scale, backed by high-quality research and development, can help to gain trust in the technology and support of stakeholders and the society as a whole.

ACKNOWLEDGEMENTS

The CGS Europe project is funded by the European Union, through the 7th Framework Programme for research, technological development and demonstration activities. The authors are grateful to all CGS Europe partners for providing the country-specific data needed for this study.



Pictures from the EAGE SES conference in Pau: CGS Europe poster 'Mapping of CO2 Storage Achievements Across Europe' by Rütters et al. (left), Palais Beaumont – the conference venue (top right), co-authors Isabelle Czernichowski (BRGM) and Vit Hladik (CzGS) with the CGS Europe poster at the conference (bottom right)

10. International scientific conference 'Environmental and Climate Technologies 2013', Riga, Latvia – CO2 storage session

Event title:	54th International scientific conference 'Environmental and Climate Technologies 2013' – special session 'Geological storage of CO2 as a way to reduce carbon footprint'
Date:	14-15 October 2013
Place:	Riga, Latvia
Number of participants:	50
Type of audience:	engineers, scientists, graduate and post-graduate students
CGS Europe partner in charge:	UNIZG-RGNF
Other partners involved:	LEGMC, TTUGI, GTC, CO2GeoNet-BGS, BGR
Cooperating entities:	Riga Technical University (organiser of the conference), Panaware ab (on behalf of the BASTOR project)

Partners of the CGS Europe project decided to further disseminate the results of their joint efforts at scientific gatherings of regional scope and multi-disciplinary thematic. Such opportunity was seen in the 54th International Scientific Conference "Environmental and Climate Technologies", an event organised by the Riga Technical University every year and including all of its 11 faculties. Particularly good relations were established with the Faculty of Power and Electrical Engineering where Prof. D. Blumberga headed the Scientific Committee of the section "Environmental and Climate Technologies". It was agreed that a thematic set of lectures will be included in the two-day programme; so the special CGS session was put together under the title "Geological storage of CO2 as a way to reduce carbon footprint". It consisted of 9 lectures organised in two blocks and a discussion at the end.

The CGS Europe participation was organised by Prof. Bruno Saftic of UNIZG-RGNF, the "Presentations and publications" task leader, and a strong contribution was given by CO2GeoNet-BGS who prepared the two introductory talks. BGR provided a talk on the state of play on CGS in Europe that was compiled on the basis of the work in the project. Further contributions came from the Baltic Sea region partners – LEGMC (Latvia), TTUGI (Estonia) and GTC (Lithuania). Two more talks were invited from intitutions from outside the project – Panaware (on behalf of the BASTOR project) and the Riga Technical University.

Titles and authors of the talks are given in the session agenda on p. 42. The entire agenda of the conference can be seen at http://www.rtu.lv/en/component/option,com_docman/task,doc_download/gid,4129/rtu-54th-international-scientific-conference-programme.pdf.

The CGS session lasted the whole afternoon on 15 October. The discussion at the end lasted for an hour. The most important topics considered the CO2 geological storage potential in the Baltic region, viability of geological storage as a climate change mitigation technique and its relations to other options (energy efficiency, etc.). There were also considerations about the cross-border cooperation possibilities in the region and in particular about the availability of the subsurface data.

Riga Technical University
54th International Scientific Conference
Environmental and Climate Technologies

Tuesday, October 15	
SESSION "GEOLOGICAL STORAGE OF CO_2 AS A WAY TO REDUCE CARBON FOOTPRINT"	
Organized in collaboration with CGS Europe project	
13:00-13:20	**Global Climate Change and the Options Humanity is Going to Have** N. Riley, *CO2GeoNet-BGS, United Kingdom*
13:20-13:40	**Introduction to the technology of CO2 capture and geological storage as part of the special CGS Europe session on CCS** C. Vincent, *British Geological Survey, United Kingdom*
13:40-14:00	**State of Play of CO2 Storage in European Countries – a CGS Europe Inventory** H. Rűtters, *BGR, Germany*
14:00-14:20	**Geological Storage Capacity as a Vital Resource – Exploration Stages and Estimation Methodologies** B. Saftic, *UNIZG-RGNF, Croatia*
14:20-14:40	**Bastor2 - Halftime Report on Findings** P. A. Nilsson, *Panaware, Sweden*
14:40-15:00	*Coffee break*
15:00-15:20	**CCS Prospects in Lithuania and the Need for Coordinated Near- and Far-Cross-Border Scenarios** S. Sliaupa, *GTC, Lithuania*
15:20-15:40	**Geological Conditions and Opportunities of CCS in Latvia** U. Nulle *State Ltd. Latvian Environment, Geology and Meteorology Centre, Latvia*
15:40-16:00	**Principal Concepts of CO2 Geological Storage: from Rock Sampling to Coupled Time-Lapse Petrophysical and Seismic Numerical Modeling. Case Study of Prospective Onshore and Offshore Structures in Latvia** K. Shogenov, *Tallinn University of Technology, Estonia*
16:00-16:20	**Research on Development of Latvian Energy Sector. Impact Assessment of Carbon Dioxide Capture and Storage Processes** J. Gušča, *Riga Technical University, Latvia*
16:20-17:00	*Discussion*
SOCIAL EVENT	
19:00-21:00	*Gala dinner*

Programme of the CO2 storage session at the Riga conference

Prof. B. Saftic (UNIZG-RGNF) giving his talk at the CGS session of the Riga conference

N. Riley (CO2GeoNet-BGS) during the final discussion

Trans-national cooperation and networking in the field of geological storage of CO_2
FP7 Coordination Action

Call for workshop proposals – Round 2

The CGS Europe Management Board invites project participants to submit proposals to prepare and organise CGS knowledge-dissemination workshops as part of WP5 activities. The workshops should be organised in the period 7/2012 – 9/2013, taking into account the approved Description of work (see background information below).

The proposals must be submitted **before 30 April 2012**.

Background information – text from the Description of Work:
A series of CO2 storage knowledge-dissemination workshops will be held in countries where the first CCS demonstration projects are under preparation, i.e. those co-funded from the EEPR and the NER300 (the latter projects are not yet known but will be taken on board as they are decided). An internal call will be opened, inviting project participants to submit proposals to prepare these workshops, including suitable dates, locations and main focus. The main goal of these workshops is to support the first CCS demonstration projects by providing scientific information on CO2 geological storage and thus increasing the ability to appraise the safety of CO2 geological storage. Relevant topics could include: Basics of CO2 geological storage, Frequent misunderstandings, Similarities and differences with natural gas storage, Risk management, Impact on the inhabitants of the storage area, etc. CGS Europe participants will provide most of the presentations at these workshops; other relevant experts from outside of the consortium will be invited whenever suitable.

Six workshop applications were approved in the first round (Denmark, France, Italy, Spain, Greece and Finland). In the second round, we encourage applications from partners in **countries with demonstration projects** under preparation. In addition, 1-2 proposals can be accepted from countries with significant CO2 emissions but with limited CCS activities, or from countries where plans for possible future pilot / demonstration projects are under consideration. Altogether, up to 13 workshops can be organised.

The workshops can be either **stand-alone** CGS Europe actions, or actions **co-organised** by CGS Europe in cooperation with other national / international CCS stakeholder entities. They should have national or regional focus. The language should be either the national language or English.

The workshop organisation will be supported by the project as follows:

- 0,5 - 1 staff person-month can be charged under Task 5.3
- up to EUR 1,000 expenditures (other costs) can be covered from the project budget
- speakers from project participants' institutions can be engaged.

Additional financing in the form of in-kind contribution of the partner, of a third party, or in form of sponsorship is desirable.

The proposals will be evaluated by the project Management Board according to their fitting with the Description of work, the costs requested from the project budget and the expected impact.

To submit a proposal, please fill in the form on the following page and send it to the WP5 leader - Vit Hladik (vit.hladik@geology.cz) **before 30 April 2012**.

Workshop proposal form

Proposer (institution, name):

Preliminary date and location of the workshop:

Duration (1 day / 1,5 days / 2 days):

Workshop topics to be covered:

Will the workshop be attached to another CCS event or co-organised with another project? If yes – which one?

Will there be any co-organisers? If yes – please list them.

Number of participants expected:

Target audience:

Language to be used:

Budget requirements from the project (person-months, other costs):

Number of speakers required from other participants' institutions:

Expected sponsorship:

Expected impact, relevance to CCS demonstration programme, other benefits:

Project acronym: CGS Europe

Project title:
"Pan-European coordination action on CO_2 Geological Storage"

Knowledge dissemination workshop

CO_2 Capture and Geological Storage (CCS)

Monday, 3 December 2012

Palazzo Doria Pamphilj, Valmontone (Roma)

- Organizing Committee: Research Center on Geological Risks CERI – Sapienza; National Institute of Oceanography and Experimental Geophysics OGS; Fluid Chemistry Laboratory of the Earth Sciences Department of Sapienza - University of Rome.

- On-site organization: CERI, Sapienza.

  Oral presentations: Institute of Geology - Tallin University of Technology; Ministry of Environment (Italy); Ministry of Economic Development (Italy); ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development); ENI (Italian National Hydrocarbons Authority); CO2GeoNet (The European Network of Excellence on the Geological Storage of CO_2).

- Session chairs: Dr. Samuela Vercelli (CO2GeoNet - Sapienza) - Ing. Sergio Persoglia (CO2GeoNet - OGS).

Table of Contents

1. Introduction

Over the past century human activities have released into the atmosphere large amounts of carbon dioxide (CO_2) and other greenhouse gases like methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. Although CO_2 is not the strongest greenhouse gas, it is the most important because the man-made volume of this gas is by far the largest. The majority of greenhouse gases come from the burning fossil fuels to produce energy, but deforestation, industrial processes, and some agricultural practices also emit gases into the atmosphere. The overwhelming majority of the world's climate scientists agree that climate change is occurring and that the main cause is due to human activities (such as the use of fossil fuels). The accumulation of these gases in the atmosphere contributes to climate change because they trap part of sun's heat, which normally would be lost to space, causing the earth's surface to warm. In addition to the global warming, another problem caused specifically by the increased concentration of CO2 in the atmosphere is Ocean Acidification. Immediate radical action is needed to drastically reduce the amount of greenhouse gases that humanity releases to the atmosphere. To accomplish this we need to adopt many different strategies simultaneously, including, amongst others, increased energy efficiency, the use of increased renewable energy sources, and the development and application of innovative technologies. One of these latter, innovative technologies includes the capture of man-made greenhouse gases (principally CO_2) from point sources and its injection into deep geological reservoirs for permanent storage. This technique can capture up to 90% of the carbon dioxide emissions produced by using fossil fuels in electricity generation and industrial processes, and can prevent the carbon dioxide from entering the atmosphere. This method, which is commonly known by its acronym CCS (i.e. "carbon capture and storage) was the topic of discussion at this workshop.

Briefly, the Carbon Capture and Storage (CCS) chain consists of three parts: capturing the carbon dioxide, transporting the carbon dioxide, and securely storing its emissions underground in carefully selected geological rock formations that are typically located several kilometers below the earth's surface (fig.1). Storing carbon dioxide (CO_2) in this manner is a safe option when compared to risks and impacts of climate change if we continue to do nothing. CCS will allow us to continue using fossil fuels while at the same time substantially reducing greenhouse gas emissions into the atmosphere. We can also reduce the risks from climate changes both making choices which can reduce greenhouse gas pollution and preparing for the changes that are already in progress. Our decisions today will shape the world our children and grandchildren will live in.

CGS Europe, the "Pan-European coordination action on CO_2 Geological Storage", is a project funded within the 7th Framework Programme of the European

Community for research, technological development and demonstration activities. CGS Europe pools together the expertise of the key research institutes in the area of CO_2 geological storage in European Member States and Associated Countries. It sets up coordination and integration mechanisms between the CO2GeoNet Association - the European Network of Excellence on the Geological Storage of CO_2 - and 23 other participants, thus covering most of Europe with 24 EU Member States and 4 Associated Countries. CGS Europe provides an independent platform and reference source, where national, European and international experts, institutes and regulators are able to access the most up-to-date results of CO_2 storage-related studies, share experiences and good practices, discuss the implementation of regulations, identify research needs to face upcoming challenges, and build new projects. A total of 34 European research institutes have joined the CGS Europe project (http://www.cgseurope.net/) to explain and study the geological storage of CO_2.

In particular, this workshop was planned thanks to the collaboration amongst the Research Center on Geological Risks (CERI), the National Institute of Oceanography and Experimental Geophysics (OGS), and the Fluid Chemistry Laboratory of the Earth Sciences Department of "Sapienza" University of Rome.

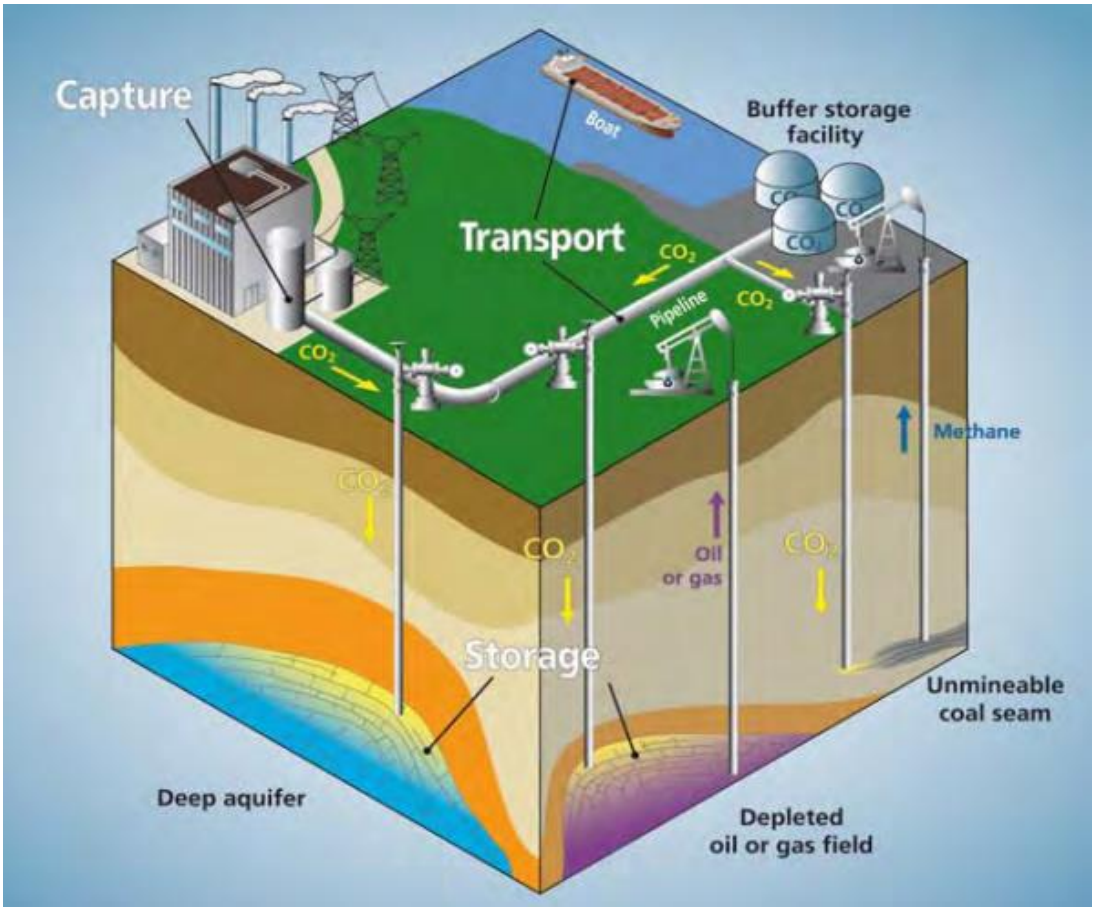


Fig.1. Sketch of capture and storage of Carbon Dioxide.

2. Workshop Report

The workshop took place in Valmontone, Italy, on the 3rd of December 2012 in Palazzo Doria – Pamphilj, the premises of CERI (Fig.2). This ancient building is a baronial palace**,** that was originally a fortified castle until the Barberinis decided to replace it with a bigger fortress. When Camillo Pamphilj bought the fief, he wanted to create an "ideal city" (the *'Città Panfilia*)*'* which included the main palace, the nearby church and other buildings (stables, warehouses, etc.). In 1652 the almost total demolition of the Sforza Castle (formerly owned by the Counts of Valmontone) started**,** and the new building was completed about 1670.

The workshop, organized by CGS Europe and entitled "CO_2 Capture and Geological Storage (CCS)"**,** focused on scientific basis of the technology and what would be needed its successful implementation. Everything was integrated in a wider legislative framework with the participation of Italian experts. The main goal of this workshop was to support the first CCS demonstration projects by providing scientific information on CO_2 geological storage and thus increasing the ability to evaluate the safety of CCS.

Fig.2. Workshop venue - Palazzo Doria Pamphilj and Collegiata dell'Assunta – Valmontone, Italy.

It was well attended by experts, professional geologists and students interested in the subject. In addition, experts from the Italian Ministry of Economic Development and the Ministry of Environment talked about European policies, national regulations and international initiatives. CCS concepts (capture, transport and storage of CO_2) were explained by specialists in the field, from the Italian National Agency for New Technologies, Energy and Sustainable Economic

Development (ENEA), the Italian National Hydrocarbons Authority (ENI) and OGS (CO2GeoNet), while the safety and public acceptance of this theme were discussed by researchers from CERI-Sapienza (CO_2GeoNet). In addition, a special invitation was accepted by a very important international guest, Prof. Alla Shogenova, researcher at Tallinn University of Technology, Institute of Geology, Estonia.

Fig.3. Dr. Samuela Vercelli (on the right) is seen here chairing one of the workshop sessions.

The workshop subject was highly topical in view of the recent adoption of the EU "climate-energy package", including the EU Directive on the geological storage of carbon dioxide and the ongoing transposition of the Directive to national laws of Member States.

85 delegates took part in the workshop: the attendees' list is provided in Annex I. The participants were from different areas: 26 from research institutions, 12 from government organizations, 3 from industry, 15 professional geologists, and 29 students.

The Agenda of the workshop is attached in Annex II. The workshop programme was subdivided into 4 sessions covering the major aspects of CCS:

- *Introduction:*

Welcome (Prof. Alberto Prestininzi, Director of CERI) and presentation of the main aspects of CCS (Prof. Salvatore Lombardi – Head of Fluid Chemestry Lab - CO2GeoNet Sapienza);

- *Session I :*
  European Policies, national regulations and international initiatives

Two experts from the Italian government described the national laws that regulate CCS projects. A geologist from the Ministry of the Environment (Dr. Francesca Cappelletti) and an expert from the Ministry of Economic Development (Dr Marco Strincone) talked about CCS legislations both in Italy and in Europe and the procedures for identifying the appropriate areas in Italy, while the special guest from Tallin, geologist Alla Shogenova, described legislation in the rest of Europe (fig.4). In this first phase of the workshop the European and world-wide importance of the topic has been made clear to all participants.

- *Session II:*
  CCS Concepts

During this session all the CCS concepts were explained by important scientists who have been working on this topic for years, such as: Ing. Giuseppe Girardi, Director of Research at ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economy Development) and Vice President of Sotacarbo S.p.a., who talked about the capture of CO_2**;** Ing. Carlo Spinelli of the Italian National Hydrocarbons Authority (ENI), who illustrated the Transport of CO_2; and Ing. Sergio Persoglia, OGS, who described the Storage of CO_2 in a geological formation.

In this session the entire CCS cycle, in all its components, was shown by researchers working in Italy for many years in their respective fields of expertise, and also heavily engaged in international research and in numerous projects funded by the European Community (EC). Given their expertise, the speakers were able to illustrate, in a simple and clear way, complex issues which are scarcely known to the public, and to convey an overview of CCS. In fact, a great number of questions submitted by the participants during the first phase of the section (a Q & A debate with the audience) clearly demonstrated their interest in a better understanding of the whole process. Particularly important was the subject about the transport of CO2, an essential part of the supply chain, which is often neglected in public presentations.

Fig. 4. Prof. Alla Shogenova (right) is shown here talking about European legislation.

- *Session III:*
  CO2 capture and CCS projects

In this session the speakers gave the following presentations: CCS projects throughout Europe and the world (Dr. Barbara Merson, OGS); natural CO_2 reservoirs in Italy, a theme studied since the 1980s (Prof. Salvatore Lombardi - Head of Fluid Chemistry Lab); and the methodology for selection and qualification of sites and project development for geological storage of CO_2 (Valentina Volpi, OGS).

This part specifically stimulated public's interest and the scientists answered many questions, such as: "Are real CCS projects present world-wide?", "How does geological storage actually work?", "How can we recognize the right place for storage?" or "Are there any suitable places in Italy?".

- *Session IV:*
  Safety and public acceptance

In the last session the topic concerned specific arguments. The first two presentations (by Prof. Sabina Bigi and Dr. Stan Beaubien, Sapienza – CERI) addressed public awareness of CCS regarding the monitoring and safety of the CCS sites. These discussions are important for the public opinion to know, giving answers to the most common questions. Dr. Samuela Vercelli, in the third and last

presentation, talked about the CCS projects developed by Sapienza in Italy and abroad; she showed the attendees how all the projects are interconnected and all together contribute to increase public awareness.

The workshop finished later than expected because of the interesting discussion that arose. The topic was highly appreciated by the audience, whereas the experts were attentive and interested in public concerns, and the students were also intrigued by job opportunities.

Annex I - List of participants

SURNAME	NAME	POSITION	ORGANIZATION
Angelucci	Luciano	Director	IAL
Antonaci	Luigi	Student	Earth Science Department - "Sapienza" University of Rome
Astorri	Francesco	Geologist	ISPRA
Attiani	Luciano	Geologist	City hall of Valmontone
Arcangeli	Michele	Geologist	City hall of Valmontone
Aresti	Anna	Master Student	Earth Science Department - "Sapienza" University of Rome
Baccani	Anna	Researcher	Earth Science Department - "Sapienza" University of Rome
Balestra	Martina	Master Student	Earth Science Department - "Sapienza" University of Rome
Battaglia	Francesca	Student	Earth Science Department - "Sapienza" University of Rome
Battisti	Nadia	Researcher	CERI
Beaubien	Stan	Researcher	Earth Science Department - "Sapienza" University of Rome
Bigi	Sabina	Researcher	Earth Science Department - "Sapienza" University of Rome
Calimera	Laura	Master Student	Earth Science Department - "Sapienza" University of Rome
Cantisano	Elisa	Student	Earth Science Department - "Sapienza" University of Rome
Cappelletti	Francesca	Geologist	Ministry of the Environment
Caputo	Adriana	Master Student	Earth Science Department - "Sapienza" University of Rome
Carnevale	Francesco	Student	"Sapienza" University of Rome
Celata	Beatrice	Master Student	Earth Science Department - "Sapienza" University of Rome
Ceraudo	Simonetta	Geologist	Nuova Indago srl
Cipriani	Ivan	PhD Student	Earth Science Department - "Sapienza" University of Rome
Colasanti	Lavinia	Researcher	CERI
Colella	Silvia	Geologist	Freelance Professional
Colombi	Francesco	Student	Earth Science Department - "Sapienza" University of Rome

SURNAME	NAME	POSITION	ORGANIZATION
Coppola	Giorgio	Geologist	Freelance Professional
Corsi	Andrea	Geologist	Earth Science Department - "Sapienza" University of Rome
Conte	Giovanni	Geologist	ISPRA
Corleto	Andrea	Researcher	ENEA
De Angelis	Davide	Student	Earth Science Department - "Sapienza" University of Rome
D'Ambrogi	Chiara	Researcher	ISPRA – SGI
Demofonti	Giuseppe	Engineer	CSM
Di Bucci	Daniela	Geologist	Italian Civil Protection Department
Di Lonardo	Domenico Paolo	PhD Student	Wageningen University, NL
Empilli	Ernesto	Engineer	H2Q Consulting
Gaudioso	Domenico	Head of Atmosphere and Climate Service	ISPRA
Giorgetti	Carolina	Student	Earth Science Department - "Sapienza" University of Rome
Giovanrosa	Tommaso	Student	Earth Science Department - "Sapienza" University of Rome
Girardi	Giuseppe	Researcher	ENEA
Graziani	Stefano	Researcher	Earth Science Department - "Sapienza" University of Rome
Guerra	Maurizio	Technologist	ISPRA
Gussati	Daniele	Geologist	Freelance Professional
Iannucci	Roberto	Master Student	Earth Science Department - "Sapienza" University of Rome
La Marra	Daniele	PhD Student	Roma Tre University, Earth Science Department
Libertini	Simone	Geologist	Freelance Professional
Lisi	Mauro	Researcher	CERI
Loffredo	Adriano	Master Student	Earth Science Department - "Sapienza" University of Rome
Lombardi	Salvatore	Head of Fluid Chemestry Lab	Earth Science Department - "Sapienza" University of Rome
Magliocco	Orazio Danny	Student	Earth Science Department - "Sapienza" University of Rome
Malaspina	Benedetta	Student	Earth Science Department - "Sapienza" University of Rome

SURNAME	NAME	POSITION	ORGANIZATION
Marmoni	Gian Marco	Student	Earth Science Department - "Sapienza" University of Rome
Mauro	Patrizia	Researcher	ENEA
Merson	Barbara	Researcher	OGS
Minelli	Francesco	Student	Earth Science Department - "Sapienza" University of Rome
Paganelli	Leonardo	Geologist	Freelance Professional
Pallone	Francesca	Geologist	Freelance Professional
Pannone	Serena	Geologist	Ministry of the Environment
Palomba	Andrea	Student	Earth Science Department - "Sapienza" University of Rome
Papale	Enrico	Student	Earth Science Department - "Sapienza" University of Rome
Patierno	Vincenzo	Coordinator at Observatory of Environmental Communication	Earth Science Department - "Sapienza" University of Rome
Pefumi	Fulvio	Geologist	Freelance Professional
Persoglia	Sergio	CO2GeoNet Secretary General	OGS
Piselli	Riccardo	Student	Earth Science Department - "Sapienza" University of Rome
Policicchio	Giuseppe	Student	Earth Science Department - "Sapienza" University of Rome
Prestininzi	Alberto	Director Research Center on Geological Risks	CERI - "Sapienza" University of Rome”
Raoli	Fabio	Geologist	Freelance Professional
Rocca	Alfredo	PhD Student	Earth Science Department - "Sapienza" University of Rome
Rubeis	Luca	Master Student	Earth Science Department - "Sapienza" University of Rome
Ruggiero	Livio	PhD Student	Earth Science Department - "Sapienza" University of Rome
Sacco	Pietro	Geologist	Earth Science Department - "Sapienza" University of Rome
Salvatori	Lorella	Geologist	Freelance Professional
Savarese	Giovanni	Geologist	Italian Geological Society
Shogenova	Alla	Senior Researcher	CGS, Tallin University, Estonia

SURNAME	NAME	POSITION	ORGANIZATION
Spinelli	Carlo	Engineer	ENI
Sterpa	Stefano	Master Student	Earth Science Department - "Sapienza" University of Rome
Strincone	Marco	Chemist	Ministry of Environment
Tartarello	Maria Chiara	PhD Student	Earth Science Department - "Sapienza" University of Rome
Tecchiato	Vanni	Student	Earth Science Department - "Sapienza" University of Rome
Terenzi	Daniele	Student	Earth Science Department - "Sapienza" University of Rome
Tomassetti	Karima	Reservoir Geologist	Enel Trade SpA
Tulliani	Valerio	Student	Earth Science Department - "Sapienza" University of Rome
Valensise	Gianluca	Researcher	INGV
Varone	Chiara	Student	Earth Science Department - "Sapienza" University of Rome
Vecchia	Antonella	Technologist	ISPRA
Vercelli	Samuela	Researcher	CERI "Sapienza" University of Rome
Volpi	Valentina	Researcher	OGS
Zannella	Andrea	Student	Earth Science Department - "Sapienza" University of Rome

Annex II - Workshop agenda

09.30 – 10.00	Registration

Chair: Samuela Vercelli - CO2GeoNet Sapienza	
10.00 – 10.10	**Welcome** (Prof. Prestininzi**,** Director of the Research Centre on Geological Risks of the University of Rome "Sapienza" - CERI - Valmontone)
10.10 – 10.20	**Climate change and CCS concepts: Capture and storage of CO_2** (Salvatore Lombardi – Head of Fluid Chemistry Lab - CO2GeoNet Sapienza)

Session I: European policy, National regulations & International initiatives	
10.20 – 10.35	**Ministry of Economic Development: CCS legislation development in Europe and in Italy** (Francesca Cappelletti, geologist, Italian Ministry of Economic Development)
10.35 – 10.55	**CCS legislation in the rest of Europe** (Alla Shogenova – Institute of Geology, Tallin University of Technology – CGS Europe)
10.55 – 11.10	**Ministry of Environment: CCS - procedures for the identification of areas in Italy** (Marco Strincone, Italian Ministry of the Environment)
11.10 – 11.30	**Discussion**

Session II: CCS Concepts	
11.30 – 11.40	**Movie**
11.40 – 12.00	**Q&A** (Girardi, Spinelli, Persoglia)
12.00 – 12.15	**What is CCS? - Capture** (Giuseppe Girardi - ENEA)
12.15 – 12.30	**What is CCS? - Transport** (Carlo Spinelli - ENI)
12.30 – 12.45	**What is CCS? - Storage** (Sergio Persoglia – CO2GeoNet OGS)

12.45 – 14.00	*Coffee Break*

Session III: CO2 Capture & CCS Projects	
Chair: Sergio Persoglia (CO2GeoNet – OGS)	
14.00 – 14.15	**CCS projects in Europe and the world** (Barbara Merson **–** CO2GeoNet-OGS)
14.15 – 14.30	**Natural CO_2 reservoirs (**Salvatore Lombardi - Head of Fluid Chemestry Lab - CO2GeoNet Sapienza)
14. 30 – 14.45	**Methodology for selection and qualification of sites and project development for geological storage of CO_2** (Valentina Volpi – OGS)
14.45 – 15.15	Discussion

15.15 – 15.45 *Coffee break*

Session IV: Safety and Public Acceptance	
15.45 – 16.00	**Evaluation of reservoir leaks using migration patterns of CO_2** (Sabina Bigi CO2GeoNet-La Sapienza)
16.00 -16.15	**Monitoring techniques of CO2 storage – methods and challenges** (Stan Beaubien – CO2GeoNet-La Sapienza)
16.15 – 16.30	**Public acceptance and viewpoint on CCS** (Vercelli – CO2GeoNet - La Sapienza)
16.30 – 17.00	Round table discussion
17.15	Conclusion