

# Pan-European coordination action on CO<sub>2</sub> Geological Storage

## Reporting

### Project Information

CGS EUROPE

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## Final Report Summary - CGS EUROPE (Pan-European coordination action on CO<sub>2</sub> Geological Storage)

### Executive Summary:

CGS Europe, a 3-year Coordination Action on CO<sub>2</sub> Geological Storage funded by the EC 7th Framework Programme, ended on 31 October 2013. CGS Europe pooled together the expertise of 34 key research institutes across 28 countries (24 MS and 4 AC). Building upon the experience of CO<sub>2</sub>GeoNet, the objective of CGS Europe was to develop a credible, independent and representative pan-European scientific body of expertise on CO<sub>2</sub> geological storage that would: (i) create a durable network of research capacity on CO<sub>2</sub> storage in Europe, (ii) liaise and coordinate its activities with other stakeholders, (iii) help reduce the gap between countries in terms of CO<sub>2</sub> storage research and knowledge, (iv) facilitate the large-scale demonstration and industrial deployment of CCS, (v) support the implementation of the EU Directive and other regulatory regimes.

Reports and publications: Comprehensive key reports summarizing knowledge and the state of play on CO<sub>2</sub> geological storage have been produced to help stakeholders easily find pertinent information.

Brochures and papers for various audiences have also been published in many EU languages.

Organisation of events: Workshops targeting a wide range of stakeholders were organised across Europe for disseminating knowledge on CO<sub>2</sub> storage (6), and raising awareness on CCS (3). Other events included 6 co-organised workshops or conference sessions, 3 annual CO<sub>2</sub>GeoNet Open Forums in Venice, 2 Spring Schools, and knowledge-sharing workshops (3 internal and 3 external) on latest developments.

Cooperation with European, international, and national bodies: In Europe, a positive relationship with the EC (DG Climate Action and DG Research and Innovation) was maintained throughout the project. Collaboration with the ZEP Technology Platform led to preparation of the CGS Europe report on opportunities for CO<sub>2</sub> storage pilots in Europe, released in January 2014. Interaction with EERA CCS Joint Programme ensured a joined-up approach to future research on CO<sub>2</sub> storage. CGS Europe/CO<sub>2</sub>GeoNet was invited to sit on the Advisory Forum of the CCS Demo Project Network and responded to consultations and invitations from the EC and Parliament. At international level, CO<sub>2</sub>GeoNet, as a legal association representing the project, joined the ISO CCS Technical Committee, became a member of the Global CCS Institute, and was accepted as an Observer Organisation (Research NGO) at UNFCCC and subsequently participated in the COP-19 Conference in Warsaw in November 2013. CGS Europe is a CSLF-recognised project. Collaboration with IEAGHG continued. At national level, CGS Europe partners held numerous consultations/in-house presentations to support their national authorities/stakeholders in implementing CO<sub>2</sub> storage-related legislation, planning and decision-making.

Media outreach: An internal workshop was held in the early stage to enhance participants' capabilities in communication. Several workshops on CO<sub>2</sub> storage were organised for science journalists in order to inform and promote dialogue. These events, as well as 7 press releases, resulted in numerous media outputs (journal and online media articles, TV and radio broadcasts) around Europe.

Expansion of the membership of the CO<sub>2</sub>GeoNet Association: This was a key goal to ensure continuity of the pan-European networking activities after the end of the CGS Europe project. Founded as an FP6 project (2004-2009), the CO<sub>2</sub>GeoNet Network of Excellence became an association under French law in 2008 with 13 founding members over 7 European countries. In 2013, 11 new members joined the Network of Excellence, 9 of which are CGS Europe partners. CO<sub>2</sub>GeoNet now comprises 24 members over 16 European countries and a further expansion phase is planned for 2014.

In conclusion, CGS Europe has had a powerful leverage effect in allowing the development of a credible, independent and pan-European scientific body on CO<sub>2</sub> storage. Activities will now continue in the framework of the enlarged and more powerful CO<sub>2</sub>GeoNet Association: interaction with stakeholders and responding to future needs in research, training, scientific advice and information in the area of CO<sub>2</sub> geological storage as a key technology for combating climate change, in accordance with the CO<sub>2</sub>GeoNet Strategy and Values.

Project Context and Objectives:

CGS Europe – responding to the global climate change issue at European scale

The European Union has already made significant progress in advancing CO<sub>2</sub> Capture and Storage

The European Union has already made significant progress in advancing CO<sub>2</sub> Capture and Storage (CCS) as a bridging technology for combating climate change. The situation now calls for acceleration and an even spread throughout the EU Member States and Associated Countries. CGS Europe ([www.cgseurope.net](http://www.cgseurope.net)) a three-year Coordination action funded by the EC FP7, has been created to complement existing CCS initiatives and, more specifically, to tackle the part of the CCS chain dealing with CO<sub>2</sub> Geological Storage on a true European scale.

### Returning the carbon back to the ground

Our prolific burning of fossil fuels for power production, heating, industry and transportation is responsible for 80% of anthropogenic CO<sub>2</sub> emissions into the atmosphere, of which 60% comes from large fixed emitters where CCS can be applied. CCS is a promising mitigation pathway that could contribute 20% of the CO<sub>2</sub> reduction needed by 2050. It involves capturing CO<sub>2</sub> at coal- or gas-fired power stations and industrial plants, transporting it by pipeline or ship to a storage location, and injecting it via a well into a suitable deep geological formation for long-term storage. In doing so, the carbon extracted from the ground in the form of coal, oil or gas is returned back again in the form of CO<sub>2</sub>.

### The scientific challenges of CO<sub>2</sub> storage

The storage component of CCS requires particular attention because it is site-specific: local geology, regulations still being developed, large-scale feasibility in terms of capacity, efficiency and safety still to be fully proven. The scientific challenges are numerous: site selection and characterisation, modelling and monitoring of CO<sub>2</sub> fate and site behaviour, risk assessment – including possible local impacts on humans and ecosystems – and safety protocols. CO<sub>2</sub> storage is a complex field of research in which many different disciplines interact: geology, geophysics, geochemistry, geomechanics, hydrogeology, microbiology, ecology, reservoir engineering, oceanography, etc. Furthermore, various components of a storage site have to be considered: reservoir, cap rock, overburden, groundwater, soils, surface, vegetation, wells. Similarly with the different phases: planning period (~5 years), injection period (~40 years), closure period (~5 years) and post-closure period (~1000 years).

Based on the knowledge acquired through the major research programmes conducted since the 1990s and the pioneering industrial-scale storage projects, the world is now moving into a large-scale demonstration phase to harness knowledge and experience from a number of different geological, geographical and industrial contexts and push commercial deployment from 2020-2025 onward.

### CGS Europe Objectives

At this critical point in the implementation of CCS worldwide, and in order to support Europe's strategy in terms of CCS demonstration and deployment as expressed in the Climate and Energy Package adopted in December 2008, CGS Europe was created to reinforce and enlarge trans-national cooperation and networking on CO<sub>2</sub> geological storage across EU Member States (MS) and Associated Countries (AC). CGS Europe has the capacity to do this through its 34 research institutes, all with CO<sub>2</sub> storage research experience, and its wide European coverage across 24 EU MS and 4 AC.

Building on the sound foundation of CO<sub>2</sub>GeoNet, the European Network of Excellence on CO<sub>2</sub> geological storage ([www.co2geonet.eu](http://www.co2geonet.eu)) CGS Europe's objective was to develop a credible, independent and long-lasting pan-European scientific body of expertise on CO<sub>2</sub> geological storage in order to:

1. Instigate a durable networking of research capacity on CO<sub>2</sub> storage in all the relevant EU Member States and Associated Countries;

2. Unify and coordinate its activities with other stakeholders in Europe, including the ZEP Technology

2. Liaise and coordinate its activities with other stakeholders in Europe, including the ZEP Technology Platform;
3. Help reduce the existing gap between the 'forerunner' countries, where CCS activities have been started or planned, and the 'follower' countries where these actions are not yet happening;
4. Contribute to the large-scale demonstration and industrial deployment of CCS;
5. Support the implementation of the European Directive on the geological storage of CO<sub>2</sub> and other regulatory regimes.

CGS Europe has succeeded in tackling these objectives. Through the last seven months of the CGS Europe project, the CO<sub>2</sub>GeoNet Association underwent two phases of expansion where new partners from the CGS Europe project joined, so that the activities are now continued in the framework of the enlarged CO<sub>2</sub>GeoNet Association.

#### Project Results:

CGS Europe achieved all its activities in the 3 years of the project duration. Main outcomes are reported here below organized by Work Package: Integration & networking, knowledge repository, knowledge development and knowledge dissemination.

#### Integration and networking

##### Development of a durable pan-European scientific body on CO<sub>2</sub> Geological Storage

During the first year, a solution was sought to ensure durability of CGS Europe beyond the end of the project duration so that the initiated cooperation could continue. Several options were envisaged, such as creating a not-for-profit international association under Belgian law (AISBL) or a European Economic Interest Grouping (EEIG). After much discussion, the solution adopted was the expansion of the membership of the CO<sub>2</sub>GeoNet Association, a non-profit legal entity registered under French law. This offered the advantage of ease and rapidity of building upon an existing renowned body on CO<sub>2</sub> geological storage, all members of which were all involved in CGS Europe. CO<sub>2</sub>GeoNet was created in 2004 as a Network of Excellence supported by the EC FP6 programme for 5 years and became an association under French law in 2008 with 13 founding members over 7 countries.

The CO<sub>2</sub>GeoNet Statutes and Consortium Agreement were revised to enable the expansion process. End 2012, after iterative interaction between CO<sub>2</sub>GeoNet and CGS Europe partners, the revised statutes and CA were signed by the 13 founding CO<sub>2</sub>GeoNet members.

Then, early 2013, all CGS Europe partners were invited to apply to join the CO<sub>2</sub>GeoNet Association. Two calls for application followed, and 9 CGS Europe partners applied and entered the association after unanimous vote by the CO<sub>2</sub>GeoNet General Meeting: RBINS (Belgium), UNIZG (Croatia), Geoinženiring (Slovenia), S-IGME (Spain), METU-PAL (Turkey), GBA (Austria), CzGS (Czech Republic), MFGI (Hungary), GEOECOMAR (Romania). Therefore 9 CGS Europe partners out of 21 not yet members (43%) joined CO<sub>2</sub>GeoNet. CO<sub>2</sub>GeoNet has in turn flourished from 13 to 24 research institutes and from covering 7 to 16 European countries.

The invitation to join CO<sub>2</sub>GeoNet will remain open for the remaining 12 partners after the end of the project. A third call for applicants was launched in December 2013 and it is expected that some other CGS Europe partners will apply. Some reasons quoted by those partners who did not apply during the timeframe of the project are: difficulty to pay a yearly fee, legal status prohibiting CO<sub>2</sub> storage in their countries.

## Collaboration with National entities

CGS Europe produced a database on Member States' networks, R&D programmes, national pilots and demonstrations concerning geological storage of CO<sub>2</sub>, which has been regularly updated during the project. The public report (D2.10) summarising the “State of play on CO<sub>2</sub> geological storage in 28 European countries” was published in July 2013.

The report is a unique overview of the CO<sub>2</sub> storage research and presents in different chapters:

- Storage options, potentials and capacities in Europe
- Structure and organisation of research funding related to CO<sub>2</sub> storage on a national level
- Research topics addressed by the CGS Europe partners and other research institutions in the CGS Europe countries
- Summary of current pilot, demo and test sites in the CGS Europe countries
- Overview of the current state of transposition of the EU Directive on the geological storage of CO<sub>2</sub> in the CGS Europe countries
- Information on a national level is complemented by an overview of ongoing EU-funded research projects related to CO<sub>2</sub> storage and a summary of activities of the European Energy Research Alliance.

CGS Europe partners, in particular the participants from “follower” countries, held numerous consultations/in-house presentations to support their national authorities/stakeholders in implementing CO<sub>2</sub> storage-related legislation, planning and decision-making. These included, amongst other things:

- regular or requested consultations with relevant ministries/departments on the transposition of the EC directive on CO<sub>2</sub> geological storage and/or the infringement proceedings (e.g. in Austria, Belgium, Bulgaria, Croatia, Czech Republic, Estonia, France, Greece, Hungary, Ireland, Latvia, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Sweden, The Netherlands).
- consultations with national regulators, policy makers, national or local authorities or/and industry on the local/regional possibilities for CO<sub>2</sub> storage and the importance of CCS for economy (e.g. in Belgium, Bulgaria, Croatia, Estonia, Germany, Hungary, Ireland, Norway, Portugal, Slovakia, Slovenia, Sweden, UK);
- periodic/regular interactions with national CCS networks (e.g. France, Poland, Spain);
- consultations with national governments and/or relevant committees on defining national R&D priorities (e.g. Czech Republic);
- periodic/regular interactions with national funding agencies (e.g. CLIMIT programme of Norway).

## Collaboration with European entities

CGS Europe set up numerous actions to create / reinforce links with many European initiatives. Notably CGS Europe answered collectively in 2013 to:

- the EC consultative communication on CCS,
- the request from Chris Davies, member of the European Parliament, for giving input to the report under preparation by the Parliament on the future of CCS in Europe and for taking part in a workshop and a round table discussion at the Parliament.

Representatives of most of the major European bodies and initiatives were invited to attend and give a presentation each year at the Venice Open Forum.

Examples of some of the most important actions with key European bodies and initiatives include:

Examples of some of the most important actions with key European bodies and initiatives include:

- ZEP (Zero Emission Platform for fossil-fuel based power plants):

Many CGS Europe Participants are members of the Zero Emission Platform and attended various ZEP meetings. In 2012 CGS Europe also became directly involved in a new Working Group “Storage Infrastructures” of the ZEP Technology Task Force. This working group, set up to recommend actions to promote the appraisal and characterisation of potential European CO<sub>2</sub> storage sites, was co-chaired by CGS Europe and ZEP. Two reports were published as a result of cooperation with ZEP:

- Contribution to the ZEP report ‘Accelerating the demonstration of CO<sub>2</sub> geological storage in Europe’, prepared by the new ZEP TFT WG Storage pilots.
- Preparation and publication of the CGS Europe report “Opportunities for CO<sub>2</sub> storage pilots in Europe”, in collaboration with the new ZEP TFT WG Storage Infrastructures.

- EERA CCS Programme (European Energy Research Alliance):

Many partners of CGS Europe are also part of the EERA storage team, which has ensured a joined-up approach to future research on CO<sub>2</sub> storage.

- CCS Demo Project Network:

A representative of CGS Europe was invited to sit on the Advisory Forum of the CCS Demo Project Network.

- ENeRG (European Network for Research in Geo-energy):

The strong liaison with this European Network on Research in Geo-Energy led to the joint preparation of the CO<sub>2</sub>StoP project (benefitting from ENeRG membership covering countries outside CGS Europe). The collaboration was also used for disseminating CGS Europe results and news in the ENeRG newsletter.

- EAGE (European Association of Geoscientists and Engineers):

CO<sub>2</sub>GeoNet as a partner of CGS Europe was organiser of a CGS Europe workshop at the EAGE conference in Vienna in 2011 and co-organiser of the 1st and 2nd EAGE Sustainable Earth Sciences conference held in Valencia (Spain) in 2011 and in Pau (France) in October 2013. A CGS Europe paper on the state of play of CO<sub>2</sub> storage in Europe was also presented in Valencia.

Collaboration with International entities

CGS Europe developed interactions with international initiatives. In particular:

- CSLF (Carbon Sequestration Leadership Forum)

After a successful application, CGS Europe became a CSLF-recognised project in 2011 and is since visible on the CSLF website. The collaborative aims of CGS Europe align with the priorities of CSLF.

- IEAGHG (International Energy Agency GreenHouse Gas R&D programme)

IEAGHG was member of the Advisory Body of CGS Europe and provided a teacher for the CGS Europe Spring School. Short papers on the Venice Open Forum outcomes were published in the IEAGHG newsletter Greenhouse Issues.

- GCCSI (Global CCS Institute)

GCCSI was member of the Advisory Body of CGS Europe. CGS Europe provided input for the global status of CCS in 2012 report. After a successful application, CO<sub>2</sub>GeoNet (as a legal entity, partner of CGS

status of CCS in 2012 report. After a successful application, CO2GeoNet (as a legal entity, partner of CGS Europe) became member of GCCSI in May 2013.

- UNFCCC (United Nations Framework Convention on Climate Change):

Enquiries were made regarding the admission requirements and procedures, following recommendations of the Advisory Body to seek affiliation. As CGS Europe is a project and the intention is that most partners of CGS Europe will become members of the CO2GeoNet Association, it was decided that CO2GeoNet should apply for admission as an observer organisation of UNFCCC. Application was made in February 2013, and notification of acceptance arrived in time to participate at the COP-19 conference in Warsaw in November 2013.

- ISO TC 265 (International Organization for Standardization Technical Committee 265):

In 2013, the CO2GeoNet Association (a partner of CGS Europe) applied to ISO TC 265 “Carbon dioxide capture, transportation, and geological storage” for a ‘Category A Liaison Status’ in order to be involved in discussions on ISO standards for Carbon dioxide Capture and Storage.

As a result of these various actions, CGS Europe is now well integrated in the European and international CCS landscape. The cooperations launched during the project will be maintained through CO2GeoNet.

### External Funding

In order to expand CGS Europe activities and to prepare the end of the EC contract, external funding was sought. Successful initiatives include:

- Call for tender DG Energy on mapping storage potential in Europe: CO2StoP proposal submitted end August 2011, coordinated by GEUS and involving many other CGS Europe partners. The project started in January 2012 for two years.
- Calls for tender DG Clima: Two proposals were submitted in July 2011 led by ICF and involving CO2GeoNet and CGS Europe partners: Framework contract in relation to climate change proposal was successful. Service Requests may arrive from the EC in relation to CCS, for example, CO2GeoNet / CGS Europe were involved in 2012-2013 in the service request “Conformity checking of measures of Member States to transpose Directive 2009/31/EC on the geological storage of CO2 (CCS-Directive)”.

### Knowledge repository

Accessible through the website ([www.cgseurope.net](http://www.cgseurope.net)) the CGS Europe knowledge repository now comprises:

- EU and National project reports

This section includes i) all completed and ongoing projects dealing with CO2 geological storage supported by the European Commission under Framework Programme 5, 6 and 7 and ii) National projects. A link is provided towards the reports of each project and, where possible, the reports are also stored in the CGS Europe website.

- Scientific publications

Scientific publications dealing with various aspects of CO2 geological storage are stored in a database (characterized by title, type of publication, year of publication, bibliographic references, authors, citation code, abstract, external link to the publication). A search tool enables users to find specific publications

code, abstract, external link to the publication). A search tool enables users to find specific publications according to search criteria (free text, year or publication type). The repository also offers the possibility to subscribe and be automatically notified when a new publication is added.

#### - CO2 Storage glossary

The CO2 Storage glossary lists vocabulary related to CCS. Each key word is clarified by a short definition. These key words and the related definitions can be consulted by the user either as a list on the glossary page, or directly in the Key Reports if a specific term needs defining.

#### - CGS Europe Key reports

The key reports are a synthesis work on specific topics, prepared jointly by CGS Europe partners and based on a collection of relevant national, European and international documents relating to past or current storage R&D or applications and scientific publications. As planned, three key reports have been produced, treating three main topics of great importance for the geological storage of CO2:

- Directive and regulatory regimes related to operational aspects and safety criteria
- State-of-the-art of CO2 storage site selection and characterisation methods
- State-of-the-art of monitoring methods to evaluate storage site performance

The key Reports can be consulted interactively online. There is also the possibility to download the Full Text Document or the Executive Summary.

#### Knowledge development

##### Coordination and promotion of research activities

CGS Europe has been establishing common actions between its partners in aspects such as field research, regulatory development support, storage capacity estimations.

In order to do so, and gain a dynamic overview of participants' activities related to the geological storage of CO2, CGS Europe carried out the Mapping of scientific and technical capabilities of CGS Europe partners.

CGS Europe partners identified, promoted, and prepared proposals for CO2 storage pilots in Europe in order to advance research based on field experience. The report "Opportunities for CO2 storage pilot projects across Europe" is the fruit of this collaboration, listing many possible locations both onshore and offshore in a wide range of geological and geographical settings.

CGS Europe partners also succeeded in progressing towards mapping the CO2 storage potential in Europe. They promoted the realisation of an Atlas assessing possible storage locations and storage capacities and, as an intermediate step, succeeded in getting a contract with DG Energy for preparing a database compiling all public information obtained so far.

CGS Europe promoted transposition of the EU Directive on Geological Storage of Carbon Dioxide and further legislation, by providing expertise to the member states, sharing of experience and providing data on the implementation when requested. A paper on this subject was presented at the International Greenhouse Gas Technologies Congress in Kyoto, November 2012.



## Knowledge sharing

Knowledge sharing workshops on specific topics were organised twice a year. The aim of these workshops was to share knowledge and latest research results amongst partners. The 1st, 3rd and 5th workshops were open to external participants and held in conjunction with the Venice Open Forums. The 2nd 4th and 6th were internal although relevant external speakers were invited.

- 1st Knowledge Sharing Workshop on “Legal and regulatory issues for the implementation of the EU Directive on the geological storage of CO<sub>2</sub>”. Venice, Italy, May 11th 2011.
- 2nd Knowledge Sharing Workshop on “Natural Analogues”. Maria Laach, Germany, October 17th – 19th 2011.
- 3rd Knowledge Sharing Workshop on “National research programmes”. Venice, Italy, April 19th 2012.
- 4th Knowledge Sharing Workshop on “Lessons learned and to be learned from pilot and demonstration projects”. Madrid, Spain, September 28th & 29th 2012.
- 5th Knowledge Sharing Workshop on “International cooperation and key results from European Projects”. Venice, Italy, April 11th 2013.
- 6th Knowledge Sharing Workshop on “Other promising options for CO<sub>2</sub> storage”. Bratislava, Slovakia, September 16th – 17th 2013.

## Staff exchange

An internal Staff Exchange Programme was created with the aim of helping set up new efficient multinational and multidisciplinary teams. This exchange programme involved not only young researchers, but also senior researchers through facilitating study visits. CGS Europe opened bids to support this mobility within Europe in the form of travel and subsistence grants, accessible to all project participants. During the project, 12 visits took place between consortium members. The staff exchange also funded an internal training week, based on the success of the “spring school” (see knowledge dissemination), which took place in Athens in September 2013.

## Knowledge dissemination

### Website

The central project website, in English, has been in operation since February 2011. It consists of a public part and a restricted part available only to project participants. The central project website [www.cgseurope.net](http://www.cgseurope.net) served as the central dissemination tool of the project, providing information about the project itself, its achievements, planned actions, publications, etc. From this point of view, especially the ‘News&Events’ sub-page is of great importance, providing information on recent project activities as well as on all dissemination events organised or co-organised by the project. For project events (Open Forums, workshops), special event webpages were created providing detailed information and on-line registration. Presentations from past project events are available in this section as well.

The ‘Hot-off-the-Press’ sub-page informs about project publications, while the ‘CGS Europe’ and ‘Partners’ sub-pages describe the project and the consortium partners. The ‘Knowledge repository’ sub-page hosts the CGS Europe knowledge repository and the “Publications” section contains all the public deliverables and other publications of the Project. A ‘Contact us’ form is available to the public for posting questions and receiving answers from the experts.

The website will be kept online for at least one year after the end of the project, after which, all data (knowledge repository, available presentations etc.) will be transferred to the CO<sub>2</sub>GeoNet website.

## CO2GeoNet Annual Venice Open Forum

In continuity with CO2GeoNet activities, CGS Europe organised three Open Forums in Venice during the project: May 2011, April 2012, and April 2013. The conferences, attended by 125, 140 and 135 participants provided an excellent opportunity for scientists, industrials and decisions makers to keep up-to-date with and discuss the latest progress in the field of CO2 geological storage and related research. The open forums addressed each time a specific topic:

- In 2011 'CO2 storage developments in Europe'
- In 2012 'European CO2 storage research: Major results and future perspectives'
- In 2013 'Are pilot-scale CO2 storage projects the way forward for CCS in Europe?'

After the end of the project the Open forum will continue with CO2GeoNet. The 2014 edition topic is "Horizon CO2 storage", in the context of the new European Framework Programme Horizon 2020, the new 2030 framework for EU climate and energy policies (which considers the response to the EC Consultative Communication on the future of CCS in Europe), and the new European Parliament report on the development and application of CCS in Europe.

## Workshops

CGS Europe organised various types of workshops for external stakeholders, each with a different target and aim.

### Awareness raising workshops

The awareness-raising workshops were organised in countries with a very low level of general awareness and activity in the area of CCS. Project participants with longer experience in CO2 geological storage provided presentations and speakers for these workshops. The targeted audience was decision makers, industrials and scientists.

Three CCS awareness-raising workshops were organised:

- in Vilnius, Lithuania, in April 2011,
- in Ankara, Turkey, in June 2012
- in Sofia, Bulgaria, in October 2013.

### Knowledge dissemination workshops

The main goal of these workshops was 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. The targeted audience was scientists mainly, but also industry and decision makers.

Six knowledge-dissemination workshops were organised in:

- Denmark (December 2012)
- Italy (December 2012),
- Germany (May 2013),
- Finland (May 2013),
- Belgium (June 2013) and
- Greece (June 2013).

In addition, 3 extra national knowledge-dissemination seminars in Turkey (twice) and in Spain, and 6 workshops and conference sessions with CO2 storage focus were co-organised in co-operation with other

workshops and conference sessions with CO<sub>2</sub> storage focus were co-organised in co-operation with other CCS stakeholders and entities, such as with IEAGHG, the Romanian CO<sub>2</sub> Club, the Evangelical Academy of Berlin, the port of Antwerp, the Ministry of Energy and Natural Resources of Turkey, the European Science Foundation.

### CGS Europe Spring School on CO<sub>2</sub> storage

A 7-day training course was designed and run by a team of 7 participants. The course offers a good overview of the different aspects of CO<sub>2</sub> Geological storage and the issues that have to be dealt with when designing a project. The theory presentations were complemented by a case study where teams of participants develop and present their own CO<sub>2</sub> Geological Storage project.

The first run of the spring school was organised at Leszcze, Poland, in March 2012. The second run was organised at Murighiol - Uzlina, Romania, in April 2013. Each session gathered around 20 participants, mostly PHD students, eager to learn more on other aspects of CCS than their own specific topics.

The course received a very good appreciation from participants and is ready to be repeated in the coming years. CO<sub>2</sub>GeoNet is currently looking for sponsors to fund a new edition of this course.

15 new language versions of the CO<sub>2</sub>GeoNet educational brochure 'What does CO<sub>2</sub> geological storage really mean?' were prepared and published in the CGS Europe project: Bulgarian, Croatian, Czech, Estonian, Finnish, Greek, Latvian, Lithuanian, Portuguese, Russian, Serbian, Slovak, Slovenian, Swedish and Turkish. All languages in the consortium are therefore covered and the brochures are available on line in pdf format and in paper from the local participant institute.

A similar activity was launched at the end of the project to translate and adapt the brochure 'Geological storage of CO<sub>2</sub>', originally produced by the French Club CO<sub>2</sub>. This 4-page leaflet was chosen as a suitable material because it presents briefly the stakes of CCS and is aimed at a large audience. Boxes are adapted to provide country-specific information. Two partners have undertaken the translation (Croatia and Slovenia) and others will continue after the end of CGS Europe.

### Online encyclopedia

A coordinated action was performed to improve the appearance of the CO<sub>2</sub> geological storage entry on national encyclopaedic websites (mostly national Wikipedia pages), covering 26 European languages. Before the action, information on CO<sub>2</sub> geological storage was available in 15 languages and missing in 11. Based on a commonly prepared wording of the encyclopaedic headword 'Geological storage of CO<sub>2</sub>', new entries in 11 languages and entry updates in 7 languages were arranged, while in 8 languages the existing information was considered satisfactory.

### Presentations and publications

In general, the CGS Europe publication and presentation activities fell into four main categories:

- Dissemination of information about the project and its achievement;
- Dissemination of research results of other projects carried out by project participants where the dissemination activity itself is (at least partly) a CGS Europe activity;
- Dissemination of general knowledge and information related to CCS and CO<sub>2</sub> storage that has been gained by CGS Europe networking activities;
- Dissemination of national CCS- and CO<sub>2</sub> storage-related information on both European and national levels.

In total 118 oral presentations – 47 on international and 71 on national level, as well as 19 posters, were reported by project participants. They were presented at various events, ranging from scientific conferences and workshops through seminars and round tables on CO<sub>2</sub> storage and CCS, to focused in-house presentations with rather an awareness-raising purpose. These figures do not include activities connected with events organised and co-organised by the project, which are described above (Open Forums, workshops).

Publication activities embrace (in addition to the brochures described above) 90 reported actions, including 13 newsletter articles, 39 publications in journals and magazines, 25 website postings, 2 leaflets, and 2 book chapters. A detailed overview of all activities is provided in the dissemination plan in annexe.

#### Interaction with media

Media is one of the main vehicles used to approach the general public. Opportunities were sought to present CO<sub>2</sub> geological storage, as an integrated part of the CCS technology, in the media (journal and magazine articles, radio broadcasts, direct contacts with journalists) to raise general awareness of CCS in the partner countries and to provide objective and unbiased information about CO<sub>2</sub> geological storage.

Among these actions, 5 articles in Public Service Review – an international journal presenting analyses of issues that crucially affect the public sector throughout Europe – are especially worth mentioning. This journal is distributed by name to almost 6,000 individuals within government departments, directorates and agencies in the regional and central governments of the 27 EU Member States.

To enhance the communication capabilities of project participants, an experience-sharing workshop was organised for spokespersons / communication officers of CGS Europe partner institutions, with focus on communication in the field of CO<sub>2</sub> geological storage. It aimed at raising awareness of CO<sub>2</sub> geological storage communication issues and CGS Europe communication actions, both at the level of researchers and of people in charge of communication activities in the partner institutions. In particular, it addressed the need for internal organization for media interaction, providing the media with high quality scientific information and positioning our Network on a wide European level, gradually building up a reputation to become a reference source on the science of CO<sub>2</sub> geological storage.

On the European level, the key action was the joint workshop on CO<sub>2</sub> geological storage between CGS Europe researchers and European science journalists. The event was organised in cooperation with the European Union of Science Journalists' Associations (EUSJA) in Venice on 8 April 2013. 17 journalists from 9 countries and 24 researchers participated in the event. Presentations, short videos, discussions and individual interviews were used to explain the CO<sub>2</sub> geological storage technology and discuss the pros and cons to the participating journalists. In addition, national workshops with science journalists were held in Italy and France in 2013: in Paris, in French, in cooperation with the Associations of environment journalists (AJE) and of information press' scientific journalists (AJSPI); in Rome, in Italian, in cooperation with the Union of Italian scientific journalists (UGIS). These events, as well as press releases on the occasion of the Open Forum and release of reports, resulted in numerous media outputs (newspaper, journal and online media articles, TV and radio broadcasts) around Europe.

The press releases prepared by CGS Europe were disseminated via the project participants' communication channels, as well as CORDIS Wire, a press releases service provided by CORDIS, the Community Research and Development Information Service.

#### Potential Impact:

The aim of CGS Europe was to facilitate the large-scale demonstration and deployment of CCS, and support the implementation of the Directive on geological storage of carbon dioxide in all relevant EU

support the implementation of the Directive on geological storage of carbon dioxide in all relevant EU Member States and Associated Countries. Such a major, broad-scale impact can only be achieved by joining together as building bricks many smaller-scale steps or actions (each with its own related impact) at a pan-European level.

The overarching action was to develop a Pan-European scientific body, enabling networking of research capacity and mechanisms of disseminating the scientific knowledge to relevant stakeholders involved in CCS. The scale of the actions was pan-European in order to avoid repeating processes at national level, to share and learn from experience and to fast-track the development of CO<sub>2</sub> storage industrial practice. CGS Europe's ambition was to form the crossroads between national-European-Worldwide perspectives and needs in the field of CO<sub>2</sub> geological storage. Thanks to its different actions, CGS Europe had a beneficial impact on the whole range of stakeholders, not only the research community.

Some examples are given below of the smaller-scale actions/steps involved in bringing about the main impact mentioned above, as well as the type of stakeholders that will benefit.

#### Internal impacts – project participants

##### Knowledge Sharing and integration

The six Knowledge Sharing Workshops helped true networking and integration between the project participants. These workshops were a powerful tool to reduce the knowledge gap between those countries with greater development in geological storage research ('forerunners') and other countries lacking in their own research and thus having a greater need ('followers'). These acted also as catalysts for knowledge development in the whole of Europe allowing members to assess the progress made on a specific topic and identify outstanding knowledge gaps.

The Staff-exchange program, aimed at both young and senior researchers, increased the integration of the CCS research community, and the sharing of expertise, through joint work on specific issues and knowledge transfer from participant to participant. Two additional activities were added to the staff exchange program and also participated to this purpose: 1) organization of a strategic meeting to reflect on the development of CCS in the Baltic area and joint creation of new projects; 2) an internal training week, based on the model of the CGS Europe spring school, to help bridge the knowledge gap between different participants.

The key reports also participated to the integration of participants and to knowledge transfer. A collaborative system was adopted to allow less experienced partners produce chapters of the key report under the supervision of a more experienced member to ensure quality was maintained.

##### Building of new projects and research alignment

The Knowledge sharing prevents the duplication of research: a better knowledge of what has(is) been(being) done elsewhere in Europe enables partner to better define their program and not repeat existing research. It also contributes to the identification of complementarity and the creation of new projects. The CO<sub>2</sub>stop project was born thanks to the collaboration of the CGS Europe and ENeRG partners.

The alignment of internal research plans of the project participants, which results in a much more effective use of research resources across the EU, helped reduce certain individual weaknesses and reinforced research groups and research capacity. As the CGS Europe participants are key national research institutions in the CO<sub>2</sub> storage field, this helps focus efforts on identified knowledge gaps that could have hindered CCS deployment if left unattended.

## Visibility

CGS Europe helped partners increase the visibility of their expertise on CO<sub>2</sub> geological storage and their current activities, for example through production of reports (state of play, opportunities for storage pilots, key reports) and the exercise of mapping partners' capacities with regards to CO<sub>2</sub> geological storage.

## External impacts

As a body of expertise, CGS Europe mainly centered its actions on knowledge, i.e. existing knowledge within the consortium, the knowledge we are able to develop and the knowledge we are able to transfer. The main impact of the project at a pan-European scale was to give the scientific R&D community a structured view and access to this knowledge. This transfer will help reduce duplication of efforts, maximise the impacts of the individual projects, and provide a clear view on where we stand and where to go.

In fact, information is too often only available in an inhomogeneous and fragmented form in terms of quality, detail, accuracy, and also language. To get a grasp of the true research capacity on CO<sub>2</sub>

geological storage in Europe, CGS Europe collected, structured, added value to, developed, and disseminated knowledge on CO<sub>2</sub> storage to a wide range of stakeholders in a form adapted to their respective needs, as described here below.

## Facilitating access to CO<sub>2</sub> geological storage knowledge

Through the creation of a knowledge repository, CGS Europe gave a wide range of end users the opportunity to easily obtain information related to CO<sub>2</sub> storage. For example, the identification of key topics and the elaboration of reports on these topics gathering knowledge from many different sources will have a major impact on the research community, significantly facilitating the search for information.

The repository offers a single gate to the largest collection of publicly available reports on CO<sub>2</sub> Geological storage projects (national and European) and main publications. It also provides 3 topical key reports and an interactive glossary. It will be maintained and updated by CO<sub>2</sub>GeoNet after the end of CGS Europe contract.

## Providing a dynamic overview on CO<sub>2</sub> Geological storage developments in Europe

The "State of play" report provides a unique overview of all the national initiatives in Europe related to CO<sub>2</sub> Geological storage. For each country, it includes a summary of the storage opportunities, of the research dedicated to storage, a list of pilots and demonstrators, and also an overview of the state of transposition of the EU Directive on the geological storage of CO<sub>2</sub> and the level of awareness in the individual countries.

Facing the decline in the number of planned demonstrators, CGS Europe also produced in collaboration with ZEP a report on pilot site opportunities in Europe to highlight the many possibilities for continuing research through pilots to compensate the delay in demonstrators in Europe.

The annual Open Forum in Venice provides an excellent opportunity for a range of CCS stakeholders to keep up-to-date with the latest progress in the field of CO<sub>2</sub> geological storage and related research in Europe, with links to the worldwide context where possible. Lively discussion sessions enable the stakeholders to interact with researchers. The Open Forum will continue through CO<sub>2</sub>GeoNet.

## Supporting deployment of CCS

## Supporting deployment of CCS

Even though times are hard for CCS with the cancelation of several projects during CGS Europe project duration, all CGS Europe actions aimed at supporting the SET plan and the deployment of CCS: creating an integrated scientific community, providing structured unbiased information, disseminating knowledge. One key action was providing relevant information to relevant Stakeholders, including:

### Scientists

CGS Europe was deeply involved in bringing research results to the widest community. Many scientific events were organized: knowledge sharing workshops, knowledge dissemination events, Open forums. The knowledge repository gives access to key reports summarizing the progress made on key topics as well as information on research results and on-going research.

### Industrials

Industrials are key to the deployment of CCS. During CGS Europe, industrials were given the opportunity to discover the technology at the Awareness raising events, interact with stakeholders and the research community at the Open Forums, and also some contacts developed into dedicated visits from the partners to present CO<sub>2</sub> geological storage.

### Decision makers

In order to support the transposition of the Directive, CGS Europe participants held consultations to support their national stakeholders in implementing CO<sub>2</sub> storage-related legislation, planning and decision-making. Such consultations were provided by project partners to national law-making and regulatory authorities (including even the Parliament level in several cases) within the process of transposition and implementation of the EU Directive on the geological storage of carbon dioxide into national laws. Such activity was reported by 19 partners, and the knowledge and experience sharing among partners proved extremely useful in this case. As an excellent example of the use of CGS Europe results, the distribution of the Swedish version of the CO<sub>2</sub>GeoNet educational brochure on CO<sub>2</sub> storage to all MPs of the Swedish Parliament during the debate on the national CO<sub>2</sub> storage law can be mentioned. At the European level, CGS Europe submitted a joint answer to both the EC consultation and Chris Davies initiative at the European Parliament, thus providing a coherent vision on CO<sub>2</sub> Geological storage from the researcher's point of view.

The Key reports, the "state of play" and "pilot opportunities" reports provide relevant information for stakeholders to get an overview of the CO<sub>2</sub> Geological storage research activities and can be a useful tool for informed decision making.

All these CGS Europe activities contributed to maintaining CCS on the agenda for CO<sub>2</sub> emission reduction. Unbiased scientific information was provided on the state of the art, the main challenges to be faced and the opportunities and benefits to be had, so that informed decision can be taken by authorities.

### Training the young generation

If CCS is to be deployed on a wide scale, then a large number of scientists and engineers need to be involved. Experts should be trained. CGS Europe created and delivered three times a 1 week training course on CO<sub>2</sub> Geological storage. This course aims at young scientists but can be adapted for other audiences with a minimum of scientific background (for local authorities for instance). The course can be repeated and CO<sub>2</sub>GeoNet is seeking opportunities for a new edition.

## Raising general awareness

Awareness of CCS is still low. CGS Europe worked at presenting the technology, especially in countries where not much is going on in terms of CCS, through a broad spectrum of awareness-raising and dissemination activities. Even though progress is slow, CGS Europe participated in making CCS more familiar in many countries.

## Media and general public

In order for CCS to be deployed on a large scale, the public has to get acquainted with the technology. Presenting the real implications of the technology, including advantages, disadvantages, risks, monitoring and verification techniques, is key to increasing general awareness of CO<sub>2</sub> geological storage and enabling European citizens to form an informed opinion on these technologies. CGS Europe, as an independent pan-European scientific body of expertise, made such information available in most European languages through the brochure 'What does CO<sub>2</sub> geological storage really mean?' and updating/creating online encyclopedia texts on geological storage. In addition, regular contact with journalists and dedicated events with associations of journalists allowed not only to give visibility to CCS in the general media but also to make sure the concepts are conveyed based on the current knowledge of research.

A glance forward: a long lasting, independent reference body on CO<sub>2</sub> Geological storage in Europe  
One main impact expected from CGS Europe was to develop a Pan-European scientific body of expertise on geological storage issues for European stakeholders involved in CCS deployment. This is underway through the expansion of the CO<sub>2</sub>GeoNet association to include the CGS Europe Members. Founded as an FP6 project (2004-2009), the CO<sub>2</sub>GeoNet Network of Excellence became an association under French law in 2008 with 13 founding members over 7 European countries. In 2013, 11 new members joined the Network of Excellence, 9 of which are CGS Europe partners. CO<sub>2</sub>GeoNet now comprises 24 members over 16 European countries and a further expansion phase is planned for 2014 and to which the remaining CGS Europe partners can apply. For those partners unable to join the association, for example for legal reasons, a partnership formalized by an agreement will be established.

CO<sub>2</sub>GeoNet will build upon and extend the activities that were started during the CGS Europe contract, such as the knowledge repository update or the Spring School for example.

Both CGS Europe and CO<sub>2</sub>GeoNet are now well-established and integrated players in the CCS landscape. Strong cooperation with existing platforms and bodies that are promoting CCS research and deployment have been crafted thus creating a crossroads where stakeholders of national, European and worldwide influence can meet to exchange opinions, input and feedback. At a more local scale, CGS Europe participants play important roles in the communication with CO<sub>2</sub> Clubs and national platforms and also serve in the interaction between these bodies, national decision makers and industrials.

Continuation of activities will now take place in the frame-work of the enlarged and more powerful CO<sub>2</sub>GeoNet Association, which will continue to interact with stakeholders and respond to future research, training, scientific advice and information needs in the area of CO<sub>2</sub> geological storage as a key technology for combating climate change, in accordance with the CO<sub>2</sub>GeoNet Strategy and Values.

The collaboration with national, European and international bodies that was launched and/or nurtured during the CGS Europe project will continue in the future through CO<sub>2</sub>GeoNet, such as:



In Europe: ZEP Technology Platform (co-lead of the Working Group on Storage Infrastructure including a joint position paper as a follow up to the report on opportunities for CO2 storage pilots in Europe), CCS Demo Project Network (CO2GeoNet has a seat on the Advisory Forum), EERA CCS Joint Programme (interaction on research issues), and the European Commission (DG Climate Action, DG Research, DG Energy) and European Parliament (e.g. invitations to experts to participate/lead conference sessions, response to consultations).

At international level: ISO CCS Technical Committee (CO2GeoNet is Category A Liaison organization), Global CCS Institute (CO2GeoNet is a member), UNFCCC (CO2GeoNet is an Observer Organisation as a Research NGO, participation to COP-21 hosted in Paris), CSLF (both CO2GeoNet and CGS Europe are endorsed), IEAGHG (CO2GeoNet has a longstanding collaboration and MoU).

#### List of Websites:

Project Website: [www.cgseurope.net](http://www.cgseurope.net) will be available for at least one year after the end of the project. All information then will be transferred to the CO2GeoNet website. Contact: [info@cgseurope.net](mailto:info@cgseurope.net)

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## Related documents

 [final1-256725-cgs-europe-finalreport.pdf](#)

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