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1 Introduction

One of the key deliverables for the CGS Europe project is the continuation of the annual open forum in Venice, a tradition that started under the umbrella of the CO2GeoNet Network of Excellence in 2006. This year, 2013, the 8th edition was organised from April 9-11 at San Servolo Island. The first two days were addressing the theme “Are pilot-scale CO₂ storage projects the way forward for CCS in Europe?”. With large-scale integrated CCS chain demonstration projects facing major challenges in Europe to start in 2015, the question arises whether small-scale pilot projects may provide an alternative and/or complementary solution on the short term. Typical questions addressed during the forum were “What can we learn from pilot projects that can be applied to commercial scale implementation?” and “Should we design pilot storage projects on sites which could later become full-scale storage facilities?”. Different stakeholders have given their view through presentations, followed by panel discussions and debates.

The third day was dedicated to a knowledge sharing workshop organized by CGS Europe with a similar purpose to the Open Forum, but focused on international cooperation and key results from European projects. Results of this workshop (a deliverable of the CGS Europe project in itself) are described in a separate report (D4.6).

The Open Forum was prepared and organised by CO2GeoNet-TNO in cooperation with the executive committee of CO2GeoNet and with additional support specifically of CO2GeoNet-BRGM and CO2GeoNet-OGS for many practical issues including the on-site organisation and arrangements. Moreover, several other project partners were actively involved in form of conference presentations or chairing of conference sessions.

This report is restricted to the project partners, since it contains information like a list of participants. However, a summary of main observations and conclusions from the first two days is provided in chapter 3 and this part can be used for public dissemination purposes. More detailed information on individual subjects can be found in the presentations available through the CGS Europe website (www.cgseurope.net) for participants.

2 Scope of the 7th annual open forum in Venice

The CO2GeoNet Open Forum offers a unique opportunity for stakeholders and major players in the CCS arena to meet and interact directly with Europe's largest group of researchers on CO₂ geological storage. The involvement of the CGS Europe project: the "Pan-European Coordination Action on the Geological Storage of CO₂" brings together the CO2GeoNet Association and 21 other research institutes all with CO₂ storage research experience, thus covering 28 countries (24 European Member States plus 4 Associated Countries).

The aim of this 8th annual open forum on "Are pilot-scale CO₂ storage projects the way forward for CCS in Europe?" was essentially to assess the need and added value of small-scale pilot projects compared to large-scale demonstrations, the critical issues that need to be addressed, and whether goals can be achieved in time. A large number of proposed sites were presented and discussed in terms of specific aims, with intervening panel discussions and ample opportunity for participants to express their views. Key stakeholders including regulators, EU representatives, industry and the research community attended in order to ensure that different perspectives were aired.

Major elements of the forum included:

- A country-by-country status
- Presentations of proposed small-scale pilots and field experiments
- Scientific developments and exchange on latest results of CO2GeoNet studies
- Extensive panel discussions

To achieve the goals of the forum it was considered important to create an open atmosphere where participants could discuss freely. To create such an open environment allowing particularly the various stakeholders such as regulators, policy makers, industry and researchers to exchange ideas and share points of view, different timeslots were allocated throughout the program to panel discussions and group discussions.

3 Summary of the open forum

The 8th CO2GeoNet Open Forum took place in Venice from April 9-11, 2013, with a good attendance of 135 participants from research organizations, industry, funding agencies, regulatory bodies, and international press, overall representing more than 30 countries. An intensive two-day programme demonstrated the high interest in this subject throughout Europe, and included much lively and valuable debate. We were very happy to have representatives of the European Commission present at our forum.

After a warm welcome by CO2GeoNet / CGS Europe representatives, explaining the scope of the forum, it kicked off with the vision of the hosting organisations to grow further to the independent scientific body in Europe on the subject of CO₂ geological storage. This included an invitation to potential new members. An inventory of research activities spread over Europe was presented.

This was followed by a clear overview of large scale (envisaged) demos by the CCS project network. Unfortunately the number of projects was not as large as hoped for over the last years, as illustrated by the message that also the Belchatow CCS project in Poland has now been officially withdrawn from international funding programs. The EU officer representing DG-Clima added to this overview by explaining the results of the recent NER300 first round, where no single CCS project finally got funded, despite an initial list of 13 submissions. The main reasons summarized were funding gaps, delays in permitting, not sufficiently mature projects and still ongoing national funding competitions. The second call of the NER300 is launched on April 3, 2013, with a tight deadline of submission by member states of projects of July 3, 2013. The available budget encompasses the selling of another 100 million credits plus unspent funds from the first round. Award decisions are expected mid-2014, and projects are expected to start 4 years later.

The EU officer, supported by a presentation of CGS Europe afterwards, also highlighted the progress of the implementation of the storage directive by the member states in Europe. Up to now 10 member states have implemented the directive in their legislation, the 17 other countries are delayed. An example of the implementation was given in a separate presentation by the Italian ministry of economic development.

After this more regulatory oriented block, the perspective of the Zero Emission Platform was expressed. The analysis of ZEP to why CCS has such difficulties, comprised as main elements the missing economics, the high costs and lack of infrastructure, and the availability of suitable storage. As to the question, whether pilot projects are necessary, the main messages were, that storage pilots are NOT substitutes for demo projects, nor necessary to close knowledge gaps for demo projects. However, storage pilots will deploy CCS across Europe in combination with few demos, will qualify the knowledge about storage, will optimise technologies and operations and will increase financial, technical, political and public confidence. In other words, pilots can pave the way for wide-scale CCS deployment.

The situation in the UK was explained by the BGS, where results of a national funding competition were just publicly announced. Two projects were assigned for potential funding: a gas-fired powerstation at Peterhead combined with offshore storage (about 100 km out of the coast) in the Goldeneye depleted gasfield, and the new efficient coal-fired powerplant at Whiterose in Yorkshire with storage in an aquifer offshore at a depth of about 1 km.

This was followed by a presentation of Shell showing the planned Quest project in Alberta (Canada), where 1 Mt/yr of CO₂ storage is foreseen for 25 years, with CO₂ captured from three hydrogen manufacturing units at a plant 50 km North-East of Edmonton. Injection is scheduled to start in 2015 using three injection wells. The aquifer consists of basal Cambrian sands with overlying salts at a depth of 2300 m, with no (old) wells in the vicinity (less than 10 km) of the storage site. The total costs of the project are estimated at 1400 million euro.

The USGS showed the CO₂ storage project Decatur in the Illinois basin, that already started in 2011 and at the time of the forum had about 0.440 Mtonnes of CO₂ injected. The storage formation is the Mount

Sandstone at about 2.2 km depth with a good reservoir quality (permeability of 200 mD, porosity of 20%). Time-lapse seismic data after the first 70 Ktonnes of CO₂ injected have not given satisfactory results yet in terms of CO₂ detection, but a second repeat has just been acquired with almost half a million tonnes of CO₂ injected. Results will be published soon. Microseismic monitoring showed only weak events in the order of -0.5 to -2.0 up to now, using 4C geophones installed in the injection well. Total costs of the project amount approximately to 90-100 million dollar.

The plenary discussion after this session resulted in the conclusion, that projects on the pilot to medium scale, such as Decatur, are very important to go through the whole capture, transport and storage chain and will help both to improve the design and to bring down the costs of future projects.

The importance of leakage experiments was also stressed, both to verify our monitoring capabilities as well as to test and develop further remediation actions. Such experiments will most likely only take place at a pilot-scale size.

The final session of the first day was dedicated to provide an update of the framework of the European CCS research landscape. The functioning of the IEA-GHG, with its expert network meetings and key reports, was explained, as well as the roadmapping activities undertaken in the CSLF by representatives of member countries. The EC explained the new research program Horizon 2020, introducing instruments like EERA and ECCSEL, highlighting the considerable budgets reserved for CO₂ storage research. Pilot projects are expected to play a major role together with large scale integrated demos in Horizon2020. The EERA and ECCSEL instruments were then discussed each in more detail separately, with the first focussing on joint research, and the second on joint infrastructure. Finally the process for the development of ISO standards for CCS was explained.

The second day started with a keynote lecture by IPCC representative Herve le Treut, an expert in climate modelling, showing clearly the necessity for action with respect to climate change and ocean acidification. This gave rise to vivid discussions. As a general consensus, particularly the aspect of ocean acidification deserves more attention and appears not sufficiently stressed in public debates about reducing greenhouse gas emissions.

Afterwards the session on the research agenda continued, with status reports by CO2GeoNet / CGS Europe on technologies related to monitoring, site characterisation and mitigation actions.

The next session addressed directly the question raised by the title of the conference. Various ongoing as well as newly planned pilot projects were presented, each with particular research goals. The kick-off was given by CGS Europe, who performed an inventory of potential new pilots addressing specific issues. A high level overview of over 20 projects was given. The follow-up presentations went into more detail per site, starting with the Spanish Hontomin site. This site has an extensive injection testing program to improve the understanding of the reservoir to various injection strategies and the effect of residual trapping. Moreover, the pilot is a test for expanding to larger scale storage. Then the future plans for the existing Ketzin pilot site were presented. At this site for the first time the abandonment procedures will be put to the test. Moreover, back-production, often mentioned as a mitigating measure, will be tested here as well. The Skagerrak pilot in Denmark was introduced, where injection in an aquifer will be tested for later upscaling purposes. In Poland a pilot was proposed to examine the potential for combining geothermal energy with CO₂ storage. In the Netherlands the offshore K12-B field, a running pilot since 2004, could be used to test the feasibility of ship transport combined with direct injection. Questions like intermittent injection and required PVT conditions for injection will be addressed. In Australia the Otway project is planning to do a test injection in an aquifer offshore as a test for the larger scale storage envisaged by Carboned. Finally a pilot at Svalbard was proposed, where injection under arctic conditions could be tested. Overall a wide variety of pilots was presented, each addressing interesting aspects with potential impact on large scale storage in the future. The overall conclusion of the discussion afterwards was, that pilots can indeed be complementary to large scale integrated projects and can be used to address specific issues to improve the effectiveness of the entire process.

The final session was dedicated to public perception studies and their relevance for pilot sites. It was interesting to see, how local communities in Poland and Scotland reacted very differently on a potential CO₂ storage project. An important learning to take away was probably, that history matters a lot. One has to take into account what happened in the past to understand some of the reactions, since CO₂ storage is only one of the causes of change in the environment. It illustrates, that for a proper communication towards communities a thorough study is necessary to understand, what concerns people might have that need to be addressed.

After two long days of presentations and discussions, the advisory board of CGS Europe was asked to give some general feedback, comments and observations on the forum. A few of the main remarks include: “Pilots are necessary to address research gaps, they are a vehicle for research and a way to communicate”, “Pilots must be seen complementary to integrated demo projects. One can test more easily new concepts at small scale pilots than at large scale demos.”, “CCS is not a simple technology, we have to demonstrate that it works”.

The best quote summarizing the current situation is probably “Finding the CO₂ to store is currently the biggest problem”.

Overall the organizers look back on two intense, but interesting days with lots of discussions and interactions in an open atmosphere. The latter was also proven by the presence of the press during most of the workshop. This resulted already in several newspaper articles.

Immediately after the two-day forum a knowledge sharing workshop was organized by CGS Europe with a similar purpose as the Open Forum, but focused on international cooperation and key results from European projects. This was kind of an update of last-years open forum.

We thank all the presenters and participants and hope to see you again next year in Venice.

4 The program

Day 1 - 9 April 2013				
8:30	9:00	Registration		
Session 1: Welcome by CO ₂ GeoNet and CGS Europe				
Chair: Sergio Persoglia & Isabelle Czernichowski				
9:00	9:05	Welcome	Sergio Persoglia	CO ₂ GeoNet-Secretary
9:05	9:20	Objectives of the 8th CO ₂ GeoNet Open Forum	Rob Arts	CO ₂ GeoNet-TNO
9:20	9:40	CO ₂ GeoNet and CGS Europe: what it is all about	Isabelle Czernichowski-Lauriol	CO ₂ GeoNet-BRGM
9:40	10:00	CO ₂ GeoNet strategy 2013-2015	Dominique Durand	CO ₂ GeoNet-IRIS
10:00	10:20	State of play of CO ₂ storage in European countries, a CGS Europe inventory	Heike Rütters	CO ₂ GeoNet-BGR
10:20	10:50	Coffee Break		
Session 2: Status of large scale CCS demonstration projects worldwide				
Chair: Derek Taylor & Hervé Quinquis				
10:50	11:10	Status of demo sites worldwide and particularly in Europe	Angeline Kneppers	Representative of GCCSI-Europe and CCS project network
11:10	11:30	European Commission initiatives: update on the implementation of the CCS Directive and the NER300 Programme	Alexandr Jevsejenko	EC DG Climate Action
11:30	11:40	Implementation of the EU Directive: where do we stand? A CGS Europe analysis	Alla Shogenova	CGS Europe-TTUGI
11:40	12:00	Implementation of the EU Directive in Italy	Liliana Panei	Italian Ministry of Economic Development
12:00	12:15	Panel discussion		
12:15	13:30	Lunch		
13:30	14:00	State and way forward of CCS in Europe - ZEP position	Wolfgang Rolland	ZEP
14:00	14:20	The UK-CCS competition	Nick Riley	CO ₂ GeoNet-BGS
14:20	14:40	The Quest project (Canada)	Owain Tucker	Shell
14:40	15:00	Illinois Basin – Decatur Project (US)	Robert Finley	ISGS
15:00	15:20	Panel discussion on the value of large scale demos		
15:20	15:50	Coffee Break		

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Session 3: CO₂ storage R&D - current status, research needs and strategy				
Chair: Gary Kirby & Sergio Persoglia				
15:50	16:10	Perspective from the European Commission	Vassilios Kougionas	EC DG Reseach
16:10	16:30	International perspective from the IEA Greenhouse Gas R&D Programme (IEAGHG)	Millie Basava-Reddi	IEAGHG
16:30	16:50	Carbon Sequestration Leadership Forum (CSLF) recognized projects and Task Forces on storage	Giuseppe Girardi	CSLF - ENEA
16:50	17:10	Perspective from the European Energy Research Alliance (EERA)- CCS Joint Programme	Jonathan Pearce	CO ₂ GeoNet-BGS
17:10	17:30	ECCSEL initiatives for developing shared European Research Infrastructures	Sverre Quale	NTNU, Coordinator ECCSEL
17:30	17:40	Development of the ISO standards for CCS	Hervé Quinquis	CO ₂ GeoNet-IFPEN
17:40	17:45	Closing remarks for day 1		
19:30		Gala dinner		

Day 2 - 10 April 2013				
Keynote speaker				
9:00	9:25	Keynote lecture on Climate Change	Hervé le Treut	IPCC, Director of Institut Pierre Simon Laplace, member of l'Académie des sciences
9:25	9:40	Discussion on Climate Change and CO ₂ storage mitigation option		
Session 3 (continued): CO ₂ storage R&D - current status, research needs and strategy				
Chair: Dominique Durand & Rob Arts				
9:40	9:55	A CO ₂ GeoNet / CGS Europe perspective on research	Roberto Martinez, Gary Kirby	CGS Europe-S-IGME, CO ₂ GeoNet-BGS
9:55	10:10	Key learnings from monitoring, where do the gaps remain – A CGS Europe analysis	Anna Korre	CO ₂ GeoNet-IMPERIAL
10:10	10:25	Key learnings from storage site selection and characterisation, where do the gaps remain - Results from CGS Europe and SiteChar	Florence Delprat-Jannaud	CO ₂ GeoNet-IFPEN
10:25	10:40	Results of the IEAGHG study on mitigation of undesired CO ₂ migration in the subsurface	Jean-Charles Manceau	CO ₂ GeoNet-BRGM
10:40	11:00	Panel discussion on how to organise CCS-R&D in Europe		
11:00	11:30	Coffee break		

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Session 4: Small scale pilot projects				
Chair: Nick Riley & Niels Peter Christensen				
11:30	11:45	A ZEP-CGS Europe study on “inventory and rationale for CO ₂ storage pilot sites”	Roberto Martinez	CGS Europe-S-IGME
11:45	12:05	Hontomín Large Scale Pilot. A challenge in onshore CO2 geological storage	Carlos de Dios	CIUDEN
12:05	12:25	Hydraulic tests to address the specific needs of CO ₂ storage: application to Hontomín	Jesús Carrera	IDAEA-CSIC, CIUDEN
12:25	12:45	The Ketzin pilot site in Germany – status and the way forward	Sonja Martens	GFZ Potsdam
12:45	14:00	Lunch		
14:00	14:15	CO ₂ pilot injection in “Skagerrak,” Denmark	Niels Poulsen	CO ₂ GeoNet-GEUS
14:15	14:30		A study on the pilot CO ₂ injection into a Jurassic aquifer in central Poland	Adam Wojcicki
14:30	14:45	Continuation of the K12-B pilot in the Netherlands: status and the possible way forward	Rob Arts	CO ₂ GeoNet-TNO
14:45	15:00	The CO2CRC Otway Project: status and plans	Charles Jenkins	CO2CRC Monitoring & Verification Project Leader
15:00	15:30	Panel discussion on the match between knowledge gaps and learnings from proposed sites		
15:30	16:00	Coffee break		
Session 5: Public perception studies and their possible relevance for the new pilot sites				
Chair: Sergio Persoglia & Niels Poulsen				
16:00	16:15	Introduction	Samuela Vercelli	CO ₂ GeoNet-URS
16:15	16:35	ECO ₂ public perception studies (Italy)	Samuela Vercelli	CO ₂ GeoNet-URS
16:35	16:55	ECO ₂ public perception studies (Scotland)	Leslie Mabon	Univ. of Edinburgh
16:55	17:15	Socially balanced development of CCS pilot projects	Marta Kaiser	UFU
17:15	17:45	Panel discussion on public perception		

Session 6: Closing remarks and introduction to the third day on international research collaboration Chair: Isabelle Czernichowski & Samuela Vercelli				
17:45	18:15	Highlights of the forum by the CGS Europe Advisory Body and the EC	CGS Europe Advisory Body and EC: Millie Basava-Reddi (IEAGHG), Niels Peter Christensen (ZEP), Alexandr Jevsejenko (EC DG Clima), Vassilios Kougionas (EC DG Research), Lionel Perrette (French Ministry of Ecology – Directorate General for Energy and Climate), Derek Taylor (Consultant), Manfred Treber (GermanWatch)	
18:15	18:30	Closing remarks	Sergio Persoglia	CO ₂ GeoNet-Secretary

Day 3 - 11 April 2013				
5th CGS Europe knowledge-sharing workshop International cooperation and key results from European projects				
9:00	9:05	Introduction	Alla Shogenova	CGS Europe-TTUGI
Session 1. International cooperation outside Europe Chair: Roberto Martinez (CGS Europe-S-IGME) & Kazbulat Shogenov (CGS Europe-TTU GI, OGS)				
9:05	9:30	International research networks of the IEA Greenhouse Gas R&D Programme (IEAGHG)	Millie Basava-Reddi	IEAGHG
9:30	9:55	Gaps closure and recommendations from the CSLF technology Road Map	Sergio Persoglia	CSLF - OGS
9:55	10:20	SIMSEQ - Progress of the international Model Comparison Study for Geologic CO ₂ Storage	Sumit Mukhopadhyay	LBNL (USA)
10:20	10:50	Coffee break		
10:50	11:10	Is CCS a feasible option in developing countries? Presenting CCS as a realistic choice for Kazakhstan	Kris Welkenhuysen	CGS Europe-RBINS-GSB
11:10	11:30	Potentiality of carbon dioxide geological storage in Morocco. Cooperation with Iberian countries	Roberto Martinez	CGS Europe-S-IGME
11:30	12:00	Discussion on CCS research worldwide	Moderator: Gary Kirby	CO ₂ GeoNet-BGS
12:00	13:10	Lunch		
Session 2. Key results from European projects: remarkable contribution to implement CO₂ storage Chair: Adam Wojcicki (CGS Europe-PGI-NRI) & Heike Rütters (CO ₂ GeoNet-BGR)				
13:10	13:30	CO ₂ StoP & European CO ₂ Storage Atlas	Niels Poulsen	CO ₂ GeoNet-GEUS
13:30	13:50	Progress of MUSTANG project on Quantification of Saline Aquifers; results on method development and field testing programs so far	Auli Niemi	Uppsala University
13:50	14:10	SiteChar: demonstrating safe and permanent storage before injection begins	Jonathan Pearce	CO ₂ GeoNet-BGS
14:10	14:30	Hydrogeological modeling of CO ₂ storage at the basin scale: preliminary results of ULTimateCO ₂ project	Nicolas Maurand	CO ₂ GeoNet-IFPEN

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14:30	15:00	Coffee break		
15:00	15:20	CO ₂ Field Lab - CO ₂ Field Laboratory for Monitoring & Safety Assessment	Menno Dillen	CO ₂ GeoNet-SINTEF
15:20	15:40	What is the likely extent of ecosystem impacts should a CO ₂ storage site leak? Findings from the RISCs project	David Jones	CO ₂ GeoNet-BGS
15:40	16:00	CarbFix - mineral storage of CO ₂ in basalt	Bergur Sigfússon	Reykjavik Energy
16:00	16:20	Research on site closure assessment - results from the CO ₂ CARE project	Axel Liebscher	GFZ Potsdam
16:20	16:50	Discussion on filled gaps and key issues Conclusions	Moderator: Alla Shogenova	CGS Europe-TTUGI

5 Final remarks

In retrospect we can look back at a successful event and the intention is definitely to continue the tradition of this annual open forum. The exact dates for next years forum in 2013 will be announced soon on the CO2GeoNet and CGS Europe webpages. The theme will depend on developments over the coming months.

SEE YOU NEXT YEAR IN VENICE !!!

