



CCS - It is not all about electricity!

The world's energy consumption is increasing and electricity is making a growing contribution. Fossil fuels are the main beneficiary of the increased demand. This raises further concerns about accelerating climate change.

There is a common perception that electricity generation is the major source of anthropogenic carbon dioxide (CO₂) through the burning of fossil fuels. This to a large extent is true – though it accounts for only 40% of the total man-made emissions of CO₂. The use of fossil fuels in various forms of transportation (mainly petroleum products in cars and other vehicles) and the use of fossil fuels in industry together account for much of the rest. Many also believe that most of our coal and gas are only used to produce electricity. While this is mainly true for coal, at least 25% of all the coal in the world is used outside the electricity sector. However, no more than half of our natural gas is used to produce electricity and, in Europe, this drops

to one-third of the gas we burn. As a result of this, there are very significant CO₂ emissions from solid fuel and gas use outside of the electricity sector. If we are to slow down climate change we will need to address these emissions and to do so urgently.

The European Union (EU) has been relatively successful in curbing its own emissions over the last 20 years or so, with overall declines in all sectors in which fuels are consumed – with the one exception of the transport sector where emissions have increased (in the case of aviation, the emissions have almost doubled). However, if the EU is to meet its agreed emission targets for 2050 – of between 79 and 82% reduction - much more will need to be done.

The power sector, for example, will need to reduce its emissions to "near zero" (93%-99% reduction). This has been shown to be possible and the actual technology to do this using carbon dioxide capture and storage (CCS) has already

been developed though not yet deployed on a real commercial scale.

For the industrial sector – which includes such major emitters as: oil refineries; iron and steel works; aluminium and other metal industries; cement, lime, glass and ceramic producers; pulp and paper; and acid and bulk organic chemicals – the emission reductions will need to be around 87%. Unfortunately, even though these are all covered by the EU's emission trading system (ETS) which puts a price on carbon emissions, none of these industries has shown much progress towards developing carbon capture technologies for their various processes. The challenge for these sectors is bigger and more complex than for the electricity generation sector. The ongoing work will need to be accelerated rapidly and new efforts are urgently needed.

To achieve the agreed reductions in time will require lots of money, effort, enthusiasm and – above all – clear and strong political support.

Derek Taylor, GERC, UK

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CO₂GeoNet now a CTCN member

CO₂GeoNet has been granted CTCN (Climate Technology Centre and Network) membership. We look forward to working as a network member, to provide technical assistance, capacity building, participating in outreach and networking activities and providing technical advice in response to country enquiries. As a member we benefit from having pre-qualified access to a competitive bidding process to deliver CTCN technical services to developing countries. We will learn about emerging activities which



will increase our global recognition by engaging in new technology projects.

The CTCN (www.ctc-n.org) was established by COP16 and is the operational body of the UNFCCC Technology Mechanism, managed by UNEP in collaboration with UNIDO. CTCN provides technology solutions, capacity building and advice on policy, legal and regulatory frameworks tailored to the needs of individual countries.

Niels Poulsen, GEUS, Denmark

Outcomes of the 11th CO₂GeoNet Open Forum; Increasing the momentum for CCS

Researchers from the global Carbon dioxide Capture and Storage (CCS) Community and many international stakeholders gathered in Venice for the 11th CO₂GeoNet Open Forum (9 - 10 May 2016) to discuss the status and way forward for CCS in Europe. The Open Forum aims to present the latest advancements in the science and technology of geological CO₂ storage such that the science is accessible to all.

CO₂GeoNet considers 2016 a key time to demonstrate the key role CCS can play in meeting the ambitious emission reduction targets of the Paris Agreement.

Key messages

The key messages for CCS from the Open Forum are:

- Sustained and clear political support remains a key driver for CCS. This support is an important part of improving the business case for CCS
- CCS is a flexible technology, ready to be progressively deployed to reduce CO₂ emissions from the industrial and power sectors
- CCS can play an important role in achieving negative emissions through CO₂ removal from the atmosphere via sustainable biomass with CCS or direct capture of CO₂ from the atmosphere and storage in the deep subsurface.
- Strategic development and investment are required in order to grow integrated CCS infrastructures.
- Flexibility needs to be built into CCS projects and infrastructure in order to be responsive to the needs of stakeholders, such as systems with intermittent energy sources and CO₂ sources from different sectors, as well as to respond to funding opportunities.
- Research and Development (R&D) needs to enable continuous refinement of storage site performance and reduce costs of emission reduction technologies. R&D is an important collaboration opportunity for Member States
- Dialogue, knowledge sharing and capacity building activities are key to advancing CCS.

Please visit our website <http://conference2016.co2geonet.com/> where you can find presentations and short interviews from the speakers at the 2016 Open Forum and workshops and a summary report summarising the key messages from the Open Forum.

Ensuing workshops

The workshops following the Open Forum were jointly organised by CO₂GeoNet, the European Energy Research Alliance (EERA), Gassnova and the REPP-CO₂ project. The workshops considered in more detail three aspects of CCS, which related to liability, transport and storage infrastructure and storage pilots. More detail on the content of these workshops is given in the following page.

The Open Forum

As CCS moves forward, a forum for open discussions becomes even more important. The CO₂GeoNet Open Forum offers the opportunity for the free exchange of views on the science supporting CCS. The involvement, support and engagement in this event of many major global

A special thanks to our endorsers: the European Commission, IEA Greenhouse Gas research and development programme, the Carbon Sequestration Leadership Forum and the Zero Emissions Platform
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players that are influencing the strategy for emission mitigation actions represents a strong global drive to work together to mitigate climate change in a post-COP 21 world. We encourage the reader to join us for the 12th Open Forum in Venice in 2017. More news on this upcoming event will be announced via our [website](#).

Ceri J. Vincent, BGS, UK



Lecturers at the Open Forum (above) and the workshop (below) (photo courtesy C. Vincent)

Scientific workshops following the Open Forum 2016

Dealing with liability: Final closure, liability and transfer of responsibility of the storage site

The aim of the workshop was to discuss liability if leakage were to occur from a storage site, including governing law in different European countries, risk assessment, risk sharing and the different players in a CO₂ storage setting. To shed light on these topics, the workshop was divided into three sessions; "Regulatory issues", "Case studies" and "Leakage mitigation".

In the [Regulatory issues](#) attendees discussed how liability is shared between the CCS operating company and the governing state in EU and UK law through a CCS project timeline. Liability and risk sharing were further considered through the presentation of possible approaches taken by the insurance sector and considering who would provide financial security, with several real examples from the ROAD project.

A lively discussion followed the three presentations; the recommendations from the speakers being:

- We need to get more projects up and running to demonstrate that this really works
- "Be practical, act fast and use existing frameworks"
- If this is going to be a "real thing", a greater level of coordination is needed
- This is "politics, politics and politics" and should be looked at from a broad EU perspective.

Three potential CCS projects in the North Sea region were presented in the [Case Studies](#) session. There was consensus among the workshop participants that we understand the risks related to CO₂ storage well, mainly due to the knowledge of geological conditions and cement that has been acquired during decades of oil & gas production. It was pointed out that although wells represent the highest risk, in fact the risk of well leakage is very small.

The [Leakage mitigation](#) session showed various results from the MiReCOL research project (<http://www.mirecol-co2.eu/>). Methods and software used to choose best scenarios for stopping or reducing CO₂ leakage if containment fails were presented.

Participants of the workshop exchanged their views openly and honestly. It was suggested that a follow up and discussion

group could be established and was well received by the audience.

Enabling Transport and Storage Networks to Serve Distributed Cap- ture Projects – The Missing Link?

The European Energy Research Alliance – CCS (EERA-CCS) and CO₂GeoNet workshop explored opportunities for catalysing and developing transport and storage infrastructure to provide confidence to nascent capture projects that their CO₂ can be transported and stored. The transport and storage 'service' provided needs to enable capture from multiple sources and to be guaranteed and flexible.

The workshop was divided into three sessions to explore key issues: the next steps required to verify European CO₂ storage capacity; the challenges and opportunities for flexible CO₂ transport networks; and developing integrated CCS transport networks. The sessions were introduced by presentations from key experts which enabled lively discussion sessions that focused on the need to develop a network approach to transport and storage, the development of a storage 'service', sharing European experience of CCS projects and the identification of 'bankable' storage capacity (i.e. a site with a storage permit). Presentations can be found on the [CO₂GeoNet website](#). A short report outlining the key messages from the discussion session will also be prepared.

In summary the key messages were:

- Storage capacity in Europe has been assessed over the last 20 years. Assessments range from storage potential assessments to Front End Engineering and Design (FEED) studies. Detailed site-specific studies are available for some sites in the North Sea, these can provide ready-to-go storage capacity.
- A source can't be considered 'storage ready' until an actionable plan to

transport and store the CO₂ is in place.

- A Europe-wide transport and storage network could develop gradually around such early mover projects if the business case for CCS can be developed.

CO₂ Storage Pilot Projects in Europe

The workshop 'CO₂ storage pilot projects in Europe' was organised by the Czech-Norwegian REPP-CO₂ project, in cooperation with CO₂GeoNet. Funded from Norway Grants, REPP-CO₂ will lay the groundwork for a proposed CO₂ storage research pilot in the Czech Republic. The project is led by two CO₂GeoNet partners; the Czech Geological Survey and the International Research Institute of Stavanger. The project involves five more research institutions from the Czech Republic and more than 100 researchers in total.

The first part of the workshop was devoted to presenting the REPP-CO₂ project. Workshop participants received general information about the project and were acquainted with some of the project results including the 3D static geological model of the storage complex and the subsequent dynamic modelling.

The second part of the workshop provided further information about recent developments and future plans of other CO₂ storage pilot projects in Europe. Presentations were given on two currently running pilots at Heletz in Israel and Hontomin in Spain, as well as on projects under preparation; the Geo-Energy Test Bed in the UK and the Q16Maas site in the Netherlands.

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CO₂ storage session at the 43rd Congress of the IAH



CO₂ storage session at the 43rd Congress of the International Association of Hydrogeologists "Groundwater and society: 60 years of IAH", Montpellier, France, 25-29 September 2016: on Wednesday 28 September, CO₂GeoNet is organizing a session entitled "[Carbon dioxide storage in deep saline aquifers and potential impacts on shallow aquifers](#)".

Convenors are Isabelle Czernichowski-Lauriol (BRGM/CO₂GeoNet, France), Stan Beaubien (Sapienza University of Rome/CO₂GeoNet, Italy), and Jean-Philippe Nicot (University of Texas at Austin, USA). Detailed programme can be found at [IAH website](#).

I. Czernichowski-Lauriol, BRGM, France

Workshop "Coupling CO₂ storage and Renewable Energy as part of integrated territorial energy and climate plans"

CO₂GeoNet co-organised this ATEE (Technical Association Energy Environment) workshop which took place at BRGM offices in Orléans, France on 30th March. It was dedicated to the combination of CO₂ geological storage with renewable energy (geothermal and biomass), with the case study of the Artenay sugar biorefinery in the Region Centre - Loire Valley. The main outcomes are the following:

- CO₂ geological storage is a solution that can be integrated into national and regional climate-energy plans, whether CO₂ is stored in a dense or dissolved form.

- CO₂ storage in dissolved form, combined with the production of geothermal heat, is a new concept well suited to small CO₂ emitters and decentralised solutions.
- Coupling biomass energy with CO₂ storage offers a real opportunity to form a carbon sink.
- Future steps include the preparation in France of a CO₂ storage pilot combined with renewable energy production, and the integration of CO₂ storage in regional policies.

The summary report and presentations can be read in the [news section](#) of CO₂GeoNet website.

Opportunities in Africa - COP22

Following the successful participation of CO₂GeoNet at the UNFCCC COP21 climate change conference in Paris at the end of last year, plans are underway to renew our activities at COP22 hosted in Marrakesh, Morocco, 7 – 18 November 2016. As a recognised UNFCCC observer organisation (RINGO – research NGO), CO₂GeoNet will participate in the blue negotiation zone through an exhibit and a side event (11.30 am on Tue 08/11, Room 6). Collaborations will be renewed with IEAGHG, the University of Texas at Austin, and the Carbon Capture and Storage Association (CCSA). This year, the focus will be to highlight opportunities for CCS in Africa, progress towards deployment in Africa and global CCS developments relevant for Africa, both onshore and offshore. The exhibit will promote CCS as a recognised technology to achieve greenhouse gas emission reductions and helping to reach the Paris Agreement targets. Steps for CCS pilot project development and new opportunities for technology transfer will also be explored.

CO₂GeoNet session at AGU Fall Meeting

The annual American Geophysical Union (AGU) Fall Meeting is one of the largest Earth and space science meetings globally. The AGU Program Committee adopted CO₂GeoNet's initiative to organise a session specifically devoted to the geological, geochemical and geophysical research around geological storage of CO₂ in Europe. Amongst the many issues covered, recent European CCS research projects and activities conducted at demo, pilot, and industrial scale, will be discussed.

This year the event will take place in San Francisco, from 12 – 16 December 2016. The reader is invited to follow the session "*Lessons learned from CO₂ Geological Storage research in Europe: natural laboratories, site characterisation, monitoring, modelling, and advances in understanding associated processes*". Sabina Bigi is the Primary Convener, who will be supported by Ton Wildenborg, Ceri J. Vincent and Axel Liebscher (all CO₂GeoNet members) in shaping the session. Details will be announced later.

CO₂GeoNet at GHGT-13

At the 13th Conference on Greenhouse Gas Control Technologies (GHGT-13) (14 - 18 November 2016, Lausanne, Switzerland) CO₂GeoNet will present "*CO₂ Capture and Storage, a viable and flexible technology vital for completing the climate change mitigation portfolio – The perspective from CO₂GeoNet, the European Network of Excellence on CO₂ geological storage*". Read more [here](#).



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