



Growing CCS for a sustainable future – 13th CO₂GeoNet Open Forum

The 13th CO₂GeoNet Open Forum focused on 'Growing CCS for a sustainable future - Linking local actions for a global solution'. The title underlines the urgency to implement full-scale CO₂ Capture, Use and Storage (CCUS) projects across the world, and emphasises the existing diverse CCUS opportunities that will enable tailored solutions for individual regions, local communities and industrial entities.

Around 130 interested stakeholders from 26 countries attended the open Forum on 24 – 25th April 2018. As well as researchers, experts from the European Commission, national governments, industry, NGOs and the media came to the event. Workshops were organised adjacent to the Open Forum in collaboration with Gassnova, ENOS and ARI (see page 3). The Carbon Sequestration Leadership Forum held their bi-annual technical meeting adjacent to the Open Forum. These additional events enriched the Open Forum, bringing in even more participants who contributed to the lively discussions for which the Open Forum is renowned. The key messages extracted from presentations and discussions emphasised that CCS is back on the agenda and that industry recognises the role for CCS in

sustainable business development. Lessons learned from existing projects include that in order to get projects off the ground we should 'start simple – stay flexible – upgrade'. Other key points included reiteration of the need for sustained political support, the need for regulatory certainty to enable informed business decisions and the need for a level playing field alongside other climate-friendly technologies. Throughout the two days, a common theme was how to enable balanced and inclusive discussions with all stakeholders on CCS

to move forward together.

More information and the key messages from the Open Forum are available through <http://conference2018.co2geonet.com/>.

CO₂GeoNet wishes to thank the sponsors who generously supported the Open Forum as well as the organisations that endorsed the event.

*Ceri J. Vincent,
BGS, UK*

*Conny Schmidt-Hattenberger,
GFZ, Germany*

*Keynote speaker Jan Ros, PBL,
opened the event (photo courtesy S. Persoglia)*



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Join us at Open Forum 2019

The next CO₂GeoNet Open Forum will again take place on San Servolo Island, Venice, Italy in the week of 6-10 May 2019. The two day Open Forum is scheduled from 7 - 8 May 2019, with pre- and post event workshops. Please follow [the news](#) on our website.





CCUS in future energy and industry systems

Keynote talk from the 13th CO₂GeoNet Open Forum

Capture and storage or utilisation of CO₂ is a key measure specific to climate management. The Paris agreement clearly shows there is global concern about climate change. Although we cannot exactly forecast what might happen – and what future costs might be – IPCC-results show that a number of serious risks increase with global temperature rise.

Different chemicals such as CH₄, N₂O and F-compounds contribute to this temperature increase, but CO₂ is an especially threatening agent. Due to the complexity of the system there are uncertainties in our knowledge about the relationship between CO₂-emissions and the future temperature rise. However, it is concluded that in order to have a 66% likelihood of keeping temperature rise to less than 2 degrees gives us a total budget for global CO₂-emissions between 2015 and 2100 of about 1,000 Gton of CO₂ (for 1.5 degree much less). Global CO₂-emissions in 2015 were about 36 Gton and business as usual scenarios show a total CO₂-budget of more than 4,000 Gton during the rest of the century (see figure).

Therefore, it is clear the CO₂-emissions have to be reduced significantly. This means we face two big challenges: a rapid emission reduction in the coming years and a transition towards an almost zero-emission world half way through this century. Significant

reductions will be required to realise a 1,000 Gton budget: several scenarios include net negative emissions, the actual removal of CO₂ from the atmosphere, in the second half of this century.

Storage of CO₂ has not been a popular choice in some communities – and poor communication about a demonstration project in the Netherlands in the past has contributed to this – but it is widely regarded as inevitable to realise the climate target.

Short term

In the short term, i.e. the coming 10 to 20 years, it provides an option to reduce the emissions of sources without a carbon-free alternative. These sources are usually power plants, but in the Netherlands the focus is placed especially on some industrial processes. Some people fear CCS will allow for the continuation of the fossil fuel system and thus create a barrier for the transition towards an energy system based on renewable resources but this need not be the case.

Long term

CCS is not only a short-term solution. It is also an important option in almost all of the global 2 degree scenarios as well as in more specific projections of the low-carbon energy system in the Netherlands in 2050. Notable is the combination with bioenergy (BECCS)

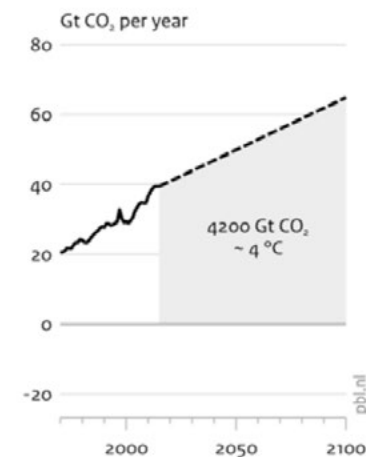
to realise the so-called negative emissions. This combination is crucial to compensate for emissions which cannot be eliminated in the coming decades, thus allowing realisation of a 95% emission reduction in 2050 in the Netherlands. On the very long term, many global scenarios indicate the potential of BECCS to realise net negative emissions in the second half of the century. It is a form of restoring the carbon cycle on our planet: putting back (part of) the carbon that has been taken out in the form of fossil resources (see figure). Therefore, the role of biomass in a future carbon-free energy system is strongly related to CCS.

However, if the use of fossil resources are eliminated in the future, biomass will also be the main resource of carbon. The reuse of carbon (CCU) might be an important option, but only to replace otherwise unavoidable fossil hydrocarbons. By 2050, it is anticipated that sectors such as the chemical industry and aviation will still be using hydrocarbons as their main source. Where carbon-free, renewable alternatives are available the utilisation of CO₂ for hydrocarbons instead of storing the CO₂ is the wrong way to go, **because this would not result in the creation of negative emissions nor prevent fossil emissions**. In other words wind or solar energy should take priority over CCU methods to produce methane for power generation and use of electric cars should overtake the production of transport fuels via CCU methods in the long term.

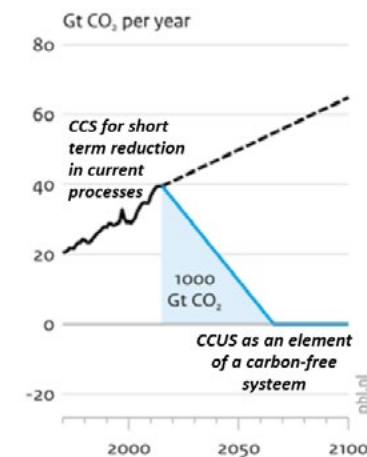
Jan Ros, PBL, Netherlands
Environmental Assessment Agency,
The Netherlands

Baseline and possible mitigation scenarios to prevent exceedance of the 2 °C target

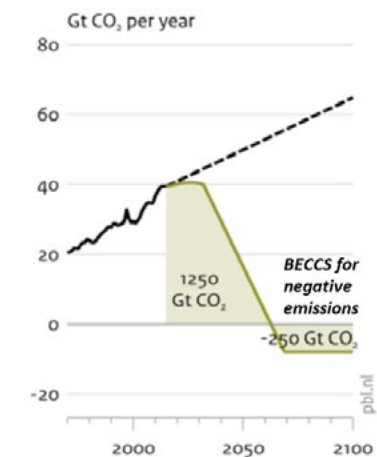
Baseline scenario



Linear reduction in about 50 years



Negative emissions in the long term



Source: PBL

Pre- and Post Open Forum 2018 workshops

Targeted workshops were organised adjacent to the Open Forum. The principal intention of these events was to build relationships between researchers working on storage site characterisation, to share and steer the development of monitoring technologies and techniques in the ENOS project and to share perspectives from the USA and Norway on CCUS.

ENOS workshop: Experience-sharing Focus Groups: advanced techniques for site characterisation

The day before the Open Forum, the ENOS project organised the second Experience Sharing Focus Group workshop. The main objective of these Focus Groups is to discuss and share experience on specific topics that are useful for the facilitation of onshore storage pilots. While the first workshop was dedicated to identifying the main topics of interest, this second workshop focused on advanced techniques for site characterisation in the context of CO₂ storage including geological investigations, geophysical studies, collection of borehole data, etc.

The workshop allowed a broad overview of novel techniques for site characterisation: from geophysical tools such as distributed acoustic sensors, to borehole-based solutions such as transient pressure analysis techniques. The examples provided were also very diverse with experience from Australia, Spain, Norway and the USA.

ENOS workshop: Storage site solutions: monitoring and verification

The event started with presentations from Shell, Battelle, University of Illinois, Geoscience Australia, CIUDEN and CMC Research Institutes on the latest research needs identified during monitoring of storage sites from pilot to demonstration scale. The second session comprised lightning presentations from ENOS researchers on technologies and techniques now being advanced through the H2020 project. The workshop focused on monitoring the zone above the reservoir to demonstrate containment. ENOS partners gave short presentations on their technologies explaining the key aspects of tools, benefits and practicalities of application.



ENOS
Enabling Onshore CO₂ Storage



There was good overlap between the research needs identified by storage operators/site monitoring teams and the tools being advanced through ENOS, plus some possibilities for future projects!

Gassnova and Advanced Resources International workshop: From Pilot Research to Application in the Field: a Norwegian-US Knowledge-sharing workshop

This workshop was organised by Gassnova and ARI. The aim was to share the US and Norwegian perspective on CCUS. It is widely accepted that building a business case for CCUS is still a challenging task. From this perspective, sharing knowledge and experience from real projects is indeed valuable. The US session focused on CO₂-EOR. Global perspectives on the topics were presented. The role and appropriateness of the US regulatory framework together with future aspects were discussed. Experience gained from developing the onshore commercial scale CO₂ geological storage site Kemper, Mississippi, were shared with the audience. A fruitful panel discussion developed around the central question 'what could possibly go wrong in CCUS/CO₂-EOR project development and operations?'. The Norwegian session focused around the full scale CCS project which integrates industrial emitters of CO₂ (cement plant,

ammonia plant and energy-to-waste plant) from the wider Oslo area, combined with ship/pipeline transportation of CO₂ and its permanent storage in the Smeaheia site in the North Sea. Challenges of this project are mainly associated with the cost – performance ratio and the multiple source of CO₂. Integration and optimisation of the whole CCS value chain is therefore paramount.

*Thomas Le Guenan,
BRGM, France
Marjeta Car,
Geoinženiring, Slovenia*



Presenting advanced monitoring technology developed within the ENOS project (above: F. Poletto, OGS; below: A. Chalari, Silixa) (photo courtesy V. Hladik)



CO₂GeoNet and CSLF

The Carbon Sequestration Leadership Forum (CSLF) is a Ministerial-level international climate change initiative that is focused on the development of improved cost-effective technologies for carbon capture and storage (CCS). It also promotes awareness and champions legal regulatory, financial and institutional environments conducive to such technologies.

The 26 CSLF member governments (25 countries plus the European Commission) represent over 3.5 billion people

(60% of the world's population) on six continents and comprise 80% of the world's total anthropogenic CO₂ emissions.

The CSLF Technical Group meeting was held at San Servolo just before the CO₂GeoNet Open Forum:

The ENOS project has been proposed for formal CSLF recognition by the CSLF Technical working group. This status was previously awarded to the CO₂GeoNet and CGS Europe projects (the latter of which then received the CSLF Global Achievement Award); CO₂GeoNet has been recognised by the CSLF as an "Allied Organisation" and, as such will have a seat at the table

during Technical Group meetings and give progress updates about Association activities and future plans.

The recent CO₂GeoNet activities in 2017-18 were presented by Ton Wildenborg, CO₂GeoNet President, at the CSLF 2018 Technical Group meeting in Venice. More on this topic can be found at <https://www.cslforum.org/cslf/Events/Venice2018>.

*Ceri J. Vincent,
BGS, UK*

*Sergio Persoglia,
CO₂GeoNet Secretary*

Sulcis CCUS Summer School 2018

The 6th edition of the Annual International Sulcis CCUS Summer School took place in the Sotacarbo Research Centre (Carbonia, Italy) 18-22 June this year. The School, organised by Sotacarbo with Enea and the University of Cagliari, in collaboration with IEA-Clean Coal Centre, CO₂GeoNet and the ECO-BASE project, focused on the advanced technologies for CO₂ capture (including oxy-combustion technologies), CO₂ utilisation (with particular reference to its conversion into liquid fuels) and CO₂ geological storage.

Thirty-nine expert speakers from 28 organisations from Europe, North America and Asia (including the U.S. Department of Energy, the National

Energy Technology Laboratory, the Seoul Technical University and many others) presented and discussed the most relevant topics and issues

related to the development of CCUS with the international audience.

*Alberto Pettinau,
Sotacarbo, Italy*



Membership:

Austria: GBA - Geologische Bundesanstalt; **Belgium:** RBINS-GSB - Royal Belgian Institute of Natural Sciences; **Croatia:** UNIZG-RGNF - University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering; **Czech Republic:** CGS - Czech Geological Survey; **Denmark:** GEUS - Geological Survey of Denmark and Greenland; **Estonia:** TTUGI - Institute of Geology at Tallinn University of Technology; **France:** BRGM - Bureau de Recherches Géologiques et Minières; **IFPEN** - IFP Energies nouvelles; **Germany:** BGR - Bundesanstalt für Geowissenschaften und Rohstoffe; **GFZ** - Helmholtz Centre Potsdam, German Research Centre for Geosciences /Deutsches GeoForschungsZentrum; **Greece:** CERTH - Centre for Research and Technology Hellas; **Hungary:** MFGI - Magyar Földtani és Geofizikai Intézet; **Italy:** Sapienza - Università di Roma "La Sapienza"; **OGS** - National Institute of Oceanography and Experimental Geophysics; **The Netherlands:** TNO - Netherlands Organisation for Applied Scientific Research; **Norway:** IRIS - International Research Institute of Stavanger; **NIVA** - Norwegian Institute for Water Research; **SPR** - SINTEF Petroleum Research; **Poland:** PGI-NRI - Polish Geological Institute - National Research Institute; **Romania:** GeoEcoMar - National Institute of Marine Geology and Geoecology; **Slovenia:** GEO-INZ - Geoinženiring d.o.o.; **Spain:** CIUDEN - Fundación Ciudad de la Energía; **IGME** - Instituto Geológico y Minero de España; **Sweden:** UU - Uppsala University, Department of Earth Sciences; **Switzerland:** ETH - Swiss Federal Institute of Technology Zurich; **Turkey:** METU-PAL - Middle East Technical University Petroleum Research Center; **UK:** BGS - British Geological Survey; **HWU** - Heriot-Watt University; **IMPERIAL** - Department of Earth Science and Engineering, Imperial College London.

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