

7-10 JULY 2015
PARIS, FRANCE

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SCIENTIFIC SESSION

REPORTING

Session Number: 3307

Session Title: Negative emissions for climate change stabilization & the role of CO₂ geological storage

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1. What are the session key findings? What are the new lesson(s) learned / scientific progress (since AR5 release, if relevant)?

- Negative emissions in the AR5 scenarios are mostly achieved through combining carbon-neutral Bioenergy with Carbon dioxide Capture and Storage (BECCS), but also through afforestation. Most of the ambitious climate stabilization pathways require BECCS already in the middle of the century, even though the removed emissions do not outweigh the remaining positive emissions at that point, i.e. no net negative emissions. It is not surprising that for achieving a 2°C target, it is likely that CO₂ will need to be removed from the atmosphere, as we are already at 405ppm, we are late with mitigation and some emissions in the food system and our existing infrastructures are difficult or even impossible to reduce to zero.
- Negative emissions of up to 13.2 GtCO₂-eq./yr in 2100 are needed in the most recent scenarios of Integrated Assessment Models (IAMs). This could be reached by BECCS, which might run into problems as competing for land with other demands, or Direct Air Capture, which is more energy-intensive. Enhanced Weathering and afforestation might also deliver negative emissions. However, all the presented Negative Emission Technologies (NETs) have limits/downsides and none is a magic bullet, so we will probably have to aim for a portfolio

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respecting limits and tradeoffs with other policy goals, but also opportunities and synergies, as demonstrated by one of the posters analyzing tradeoffs and synergies between two land-based mitigation strategies (reducing emissions from deforestation and BECCS).

- Negative emissions cannot be used to continue Business as Usual and then remove the bulk of the emissions mid-century. The required carbon flows would simply be too large, while such a strategy possibly also suffers from the negative environmental feedbacks associated with Business as Usual in 2050. Thus, negative emissions have to be understood as part of a mitigation portfolio complementing drastic GHG emission reductions in the near term.
- CCS is already happening in several parts of the world and is ready to be scaled up offering flexibility in achieving climate targets. Over 20 Mt of CO₂ are captured each year from power and gas production worldwide and injected into deep geological formations, with 50 Mt already securely stored. CCS is currently the only mitigation option to decarbonise the fossil energy sector (and potentially steel and cement production) and is also critical to achieving negative emissions through the underground storage of CO₂ captured at bioenergy plants (BECCS) or by Direct Air Capture technologies.
- IAM models show that CCS combined with fossil fuel combustion *and* combined with bioenergy can be very cost-effective as part of an emission reduction strategy (alongside many other technologies). The resulting rates of use of CCS (i.e. the total amount) in the stringent scenarios amount, depending on scenario assumptions, to 10 GtCO₂ per year in 2050 and 25 GtCO₂ per year in 2100 with cumulative storage ranging between 800 and 3,000 GtCO₂ in the AR5 scenarios.
- Previous studies (IPCC report, EU GeoCapacity project, CO2STOP) have indicated there is great storage potential that should be able to store our emissions for hundreds of years. This identified storage potential now needs to be advanced to a set of viable storage sites with assured capacity. Assured storage capacity is fundamental to the success of individual CCS projects but also to implementation of CCS on a regional and national scale. Several storage sites have been advanced to 'assured' status and are part of existing or planned demonstration projects. Assured storage capacity relies not only on geological characteristics, but also on a supportive regulatory regime, long-term political and public support and available finance.

2. What are the major knowledge gaps and research needs identified in the session?

- Some negative emission options are not yet included in AR5 scenarios and the examples in this session on Enhanced Weathering, Direct Air Capture and a new technology suggested in a poster on improving CCS and BECCS with geothermal energy need further assessment.
- Tradeoffs and interactions with other policy goals and other land-based mitigation strategies need to be understood and quantified.

7-10 JULY 2015

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- Analyzing assumptions behind current low-stabilization scenarios and taking into account expert opinions on feasibility - as outlined in one of the posters introducing a BECCS research project in the UK – will help to improve our understanding of negative emissions, thereby enabling better representation in models and better-informed decision-making.
- Inclusion of social aspects in modeling exercises is required to make models and scenarios meaningful not only in technical terms but also in terms of obtaining a societal license to operate.
- Detailed research is needed to advance the worldwide CO₂ geological storage potential to a stock of storage sites with assured capacity within promising regions. For storage sites to be available at the right time, characterization and capacity assessment of storage formations need to be undertaken now.
- More CCS pilot and demonstration projects are needed to broaden the portfolio of experience to more storage site types and to reduce costs through experience.
- Improvement of communication between scientists and society is required.
- Uncertainties on the climate science side need to be resolved. New insights were presented by two Earth system modeling teams during the poster session (reaction to overshoot, negative emissions physically needed to keep global warming below 2°C).

3. Did the session discuss/identify promising approaches in the fields of adaptation and mitigation, or both?

- The session topic was on mitigation, for example CO₂ geological storage was discussed as a salient ingredient of CCS, which could enable CO₂ emissions reductions from power and industrial plants and CO₂ removal from the atmosphere.
- At the same time, it became clear in the discussion that it is important - particularly for land-based mitigation strategies - that other policy goals are taken into account including adaptation agendas (e.g. ensuring food security).

4. Are there take-home messages from the session?

- Need more R&D, pilot and demonstration projects – to learn by doing, to see if CCS and NETs are scalable, to facilitate knowledge transfer and public engagement. In particular, the development of onshore CO₂ storage pilots is highly encouraged. (policymakers and practitioners, private sector)

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- More education is needed for the public to understand the need for climate change mitigation and negative emissions in particular and the risks for other policy goals this might entail (policymakers, practitioners, NGOs, cf. point 6 for storage).
- Technologies for achieving negative emissions are not part of geo-engineering and should not be confused with it. (scientists, media)
- Media communication needs to carry clear messages and avoid focusing on minutiae of scenarios which could create confusion and unfounded concerns in the public. For example, if one scenario needs more land for biomass for bioenergy than another one because the model is only allowed to put additional biomass on less productive abandoned land in order to avoid interference with food security, then the size of the area needed should not be advertised as a major concern. (media)
- More research and communication needed on the impacts of not having the option to remove carbon and on the distribution of those impacts' costs. (scientists)

5. Are there important quotes from the session?

- "Under high carbon prices, CCS and BECCS are very competitive compared to other mitigation technologies such as wind and nuclear. The exclusion of CCS in IAM models leads to higher costs and possibly unfeasibility of mitigation targets." (D. van Vuuren)
- "Negative emissions are not meant to enable us to continue on a Business as Usual path: they are part of a mitigation portfolio, which foresees large emissions reductions using "standard" mitigation options in the near term." (Sabine Fuss)
- "CO₂ geological storage is feasible, safe, legal, already happening and ready to be scaled up" (Ton Wildenberg)
- "Using negative emissions from air capture or biomass with CCS to offset CO₂ release from burning fossil fuels is definitely not geoengineering!" (Jon Gibbins)

6. Please include any other remark that you might have

- Research-based dissemination tools are available on CO₂ geological storage, for example the [CO₂GeoNet brochure available in 27 languages](#) and the [ECO2 video available in 4 languages](#).
- Global Carbon Project research initiative on negative emissions: [MaGNET](#).

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