Conference Reports

8th International Conference on Greenhouse Gas Control Technologies (GHGT-8)

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The focus for this conference, with 1,000 participants attending, was on technology, policy and economics associated with CO_2 capture and storage (CCS).

CCS has arisen as a technical approach to help solve a global problem. The solution is an 'end-of-pipe' solution proposing storage and disposal of CO_2, rather than the more modern approach of minimisation at source. Some would argue that this is a step in the wrong direction, having seen the development from end of pipe, through a product systems approach to the development of industrial ecology (Amundsen 2004). However, as many of the speakers at this conference argued very eloquently: Global warming is a serious problem, which requires action NOW. The energy requirements of the world's population are continuing to increase rapidly, with an associated rapid increase in CO_2 emissions. The fact that China is currently investing in coal power generation on a grand scale (without CCS), with investment plans for almost 300,000 MW added capacity between 2005–2008 (Monkejord 2006) and plans to continue increasing capacity, gave an added urgency to the issue for many speakers. The view that we cannot afford to do more research and sit on the fence was often expressed. The argument was that CO_2 sequestration is a solution that can begin to work now. If the geological formations that CO_2 is stored in should show leaks over time, it can be pumped up again and put elsewhere (Lindberg 2006).

The conference had 1,000 participants, which has been a large increase in comparison to earlier conferences on this subject (e.g. only a handful of participants at the first conference), which illustrates the growing interest and activity in this field. CCS is the subject of several large international research projects, like CASTOR, DYNAMIS, CACHET and ENCAP. These research programmes all contain broad industry collaborations (companies like Shell, Statoil, Aker Kværner, Norsk Hydro, Vattenfall and BP working side by side in order to make progress, see Eriksson et al. 2006, and the abstract below), as well as international research institutions. The main focus of the conference was the technical aspects of separation and containment of CO_2. Post combustion, pre-combustion[1] and oxyfuel combustion solutions for CO_2 treatment were presented, as well as membrane, or traditional amine separation systems. Papers presented at the conference focussed on current knowledge and technology for the separation of CO_2, which gives an overall power production efficiency reduction of from 8–40% (Panesar et al. 2006 and Metz et al. 2005). These figures are discouraging as they show that much research and development work is still needed before separation, capture and storage of CO_2 are efficient solutions.

Different power generation fuels were considered in the research presented, with a strong coal industry presence. Coal gasification and integrated plants that produced both H_2 and other chemical products were presented. The infrastructure and safety issues associated with H_2 as an energy carrier were also covered. There was, of course, extensive research presented on the geological aspects of CCS and the potential for seepage and leaks of both a diffuse and catastrophic nature.

A large part of the conference also addressed legal and regulatory aspects of CO_2 disposal and storage. Current regulations and laws in force in the EU impose restrictions on long-term deposition and storage of waste. Where CO_2 is considered a waste stream, legal restrictions need to be lifted in order to make CCS practicable. Current activities for CCS in Norway and the USA have been exempt from these issues, as the CO_2 removed has not been defined as waste (e.g. the process was needed in order to improve the quality of the methane gas extracted, or used as an EOR[2] medium). Several papers addressed the legal and political aspects of CCS, including the needs of industry in terms of long-term predictable and reliable systems for CO_2 prices and financial assistance, in order to make the large investments required economically viable for industry. Another important legal aspect was who would be left with the legal responsibility for the CO_2 that was stored. Long-term storage in aquifers, or other geological storage, will mean storage over geological time scales (i.e. 1,000s of years). Many presenters argued that this is not something that companies can be liable for. This means there is a lot of activity for legal and regulatory experts, which was also covered in the conference programme. Over what time scales shall companies be liable if there should be a leak, or remediation action necessary, and at what point will this responsibility become a responsibility for national authorities? What sort of insurance schemes, or funds, could be required in order to provide for potential future remediation action was also an issue that was addressed.

Another issue of interest which was in focus during GHGT-8 was the potential use of the Cleaner Development Mechanism (CDM), as a way of making CCS projects more economically viable. If CO_2 credits could be obtained for CCS for fossil, or bio-energy systems, the economics of the investments would make them much more interesting for companies. There is a lot of international industry interest in lobbying for the inclusion of CCS the CDM (including organisations such as OPEC). The applicability of CDM for CCS for fossil systems can be called into question and, so far, all attempts to achieve inclusion in the CDM have failed. However, this has also given added interest in biofuel systems, which produce CO_2 of biological origin, that oil companies consider can be captured and stored in order to enable them to realise CDM credits for disposal of biological CO_2. Companies such as Shell are actively investigating and lobbying for such possibilities (Sweeney 2006).

Many assessments of CCS systems presented at the conference focussed on the economics and energy efficiency associated with CCS systems. Few papers addressed assessment of the systems from an holistic environmental perspective, but those that did where fairly damning for the current technology routes for CCS.

[1] Pre-combustion CO_2 is the term used where Hydrogen is made (for combustion), so the carbon is removed before the energy carrier is combusted.

[2] Enhanced Oil Recovery – where CO_2 gas is injected in order to achieve increased oil production.

The increased energy requirements and use of separation systems that require solvents, seem to lead to increased environmental impacts for almost all of the aspects considered, except the total global warming potential (Viebahn et al. 2006, see the abstract below, and van Gijlswijk et al. 2006). Although these studies are screening studies, they do show that reduction of environmental impacts is complex and a single impact approach can lead to sub-optimal solutions. However, if, as many of the presenters argued, global warming is such a large problem, do we have to accept that the solution of the global warming problem will lead to other environmental problems (of a more local nature)? The need for innovative research and development and detailed knowledge of the complexity of the environmental issues associated with CCS systems is certainly a prerequisite for long-term sustainability.

The conference papers will be published in November 2006 (http://www.ghgt8.no). The short extracts from abstracts that are included in this review give a taste of some of the presentations given. The next GHGT conference will be held in Washington D.C. and this author is sure that the number of participants will continue to increase, as the reality of the global warming problem and the amount of research and development activity in this field increases.

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Vattenfall AB, a large producer of electricity and heat in Europe, runs the research and development project 'Carbon Dioxide Free Power Plant' on carbon dioxide (CO_2) capture and storage from coal-fired power plants. An assessment of environmental consequences must be performed when carrying out projects such as the introduction of CO_2 capture and storage from power plants on a large scale. A Strategic Environmental Assessment (SEA) is a structured and systematic methodology for evaluating environmental impacts of proposed policies, plans and programmes. The methodology behind an SEA is used by Vattenfall to analyse and evaluate environmental aspects of technical alternatives for CO_2 capture, transport and storage. The SEA methodology was chosen to ensure that the environmental assessment is comprehensive and that all aspects are considered. Comprehensive knowledge will aid the concept design and allocation of resources, and minimise or obviate environmental impacts and risks.

The main objective of storing CO_2 is to mitigate anthropogenic climate change and, hence, have a positive impact on the environment. The basic requisites are that CO_2 capture, transport and storage, whether onshore or offshore, are undertaken in a way that does not implicate human health and safety and that does not lead to unacceptable impacts on the environment. A combination of thorough site selection and the utilisation of good operational, safety and monitoring procedures are keys to successful capture, transport and storage of CO_2, undertaken in a safe way with a minor impact on the environment.

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This paper focussed on the problem that there are still many unanswered questions regarding safe, socially compatible as well as ecological and economic sound applications of CCS. Therefore, a first system-analytic view in the form of a life cycle analysis and a cost assessment combined with a systematic comparison with renewable energies regarding future conditions in the power plant market in Germany between 2020 and 2050 was performed (WI et al. 2006, Viebahn et al. 2007). The calculations showed that, in case of a CO_2 capture rate of 88% at the power plants' stack (post and pre-combustion), a greenhouse gas reduction by only 65% to 79% could be achieved. An oxyfuel combustion based power plant with a CO_2 capture rate of 99.5% results in a greenhouse gas reduction of 78%. In contrast, renewable electricity based on wind and solar thermal power plants causes only 2% of the hard coal fired power plant's greenhouse gas emissions.

Furthermore, Viebahn showed that renewables would be competitive with electricity from CCS based power plants from the beginning of CCS technology in 2020 (in the case of wind and solar thermal) or from latest 2030 (considering a mix of all renewables), depending mainly on the price development of the fossil fuels and the CO_2 certificates. Under an energy economic view, the CCS option might come too late for Germany, regarding both the required retirement of 60 GW power in the next 15 years and the proposed sustainable energy system with an ecologically optimised extension of renewable energy utilisation and energy efficient measures in discussion in Germany. Concerning this background, the question of the retrofit possibility of CCS arises to create conditions, so that a later coupling of a CO_2 capture process is technically possible and can be applied with the smallest auxiliary costs.

Summarising, this analysis showed that a future-oriented approach is necessary to assess new technologies depending on several parameters not currently known. Most studies only consider state-of-the-art conditions or – if at all – a situation in 2020, when CCS power plants are expected to run commercially. The results of Viebahn et al. reveal that conclusions based only on a year 2020 analysis lead to wrong and insufficient results. It is needed to think along long-term conditions and to analyse the impacts of measures launched today along the time frame for long-term targets.

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