IEAGHG Information Paper: 2015-IP30; Special Issue commemorating the 10th year anniversary of the publication of the Intergovernmental Panel on Climate Change Special Report on CO_2 Capture and Storage

International Journal of Greenhouse Gas Control

CO_2 Capture and Storage (CCS) became an internationally accepted mitigation option after the publication of the Intergovernmental Panel on Climate Change (IPCC) Special Report on CCS in 2005 (IPCC, 2005). Since then, CCS has been included in most major international assessments of climate change mitigation. In the 5th IPCC Assessment Report (IPCC AR5), the need for CCS was re-emphasised. IPCC AR5 showed that the global mitigation models could not meet the 2°C target without CCS and that mitigation costs would increase by 138% if CCS and Bio-CCS were excluded from the mitigation scenarios.

To update the status of underpinning science on CCS and policy and regulatory developments since the IPCC SRCCS, a Special Issue of the International Journal of Greenhouse Gas Control has been issued. The Special Issue (SI), comprises a collection of 17 peer reviewed papers covering areas in which significant progress on CCS R&D has been made in the last 10 years and there are now 15 large-scale CCS projects in operation with several more under construction. Over 100 authors participated in this major review exercise, who used nearly 3000 references to support their work.

The key messages from the SI include:

On CO_2 Capture.

- Post Combustion Capture (PCC) was already a mature technology in some industries when the IPCC SRCCS was published. Significant advancements have been made in terms of the design and scale up the technology in the last 10 years. The first full-scale demonstration plant using PCC technology on a coal fired power plant was built in Canada in 2014.
- CO_2 capture by oxy fuel combustion has also experienced developments in the last decade to the point that the technology is now ready for demonstration in the power sector. Oxyfuel combustion is well suited for industrial applications (cement, steel or oil refining) and is an emerging option for capturing CO_2 from natural gas combined cycles.
- Pre-combustion CO_2 capture processes use commercially-mature equipment for producing a syngas. The first fully integrated coal-based pre-combustion large scale system will be ready for operation in 2016, in the USA.
- There is now a substantial body of literature on new and emerging capture technologies. These include: chemical looping combustion for solid fuels, post combustion calcium looping systems, CO_2 separation at low temperature by solids adsorbents and polymeric membranes for post-combustion.

On Geological Storage of CO_2

- There is now a substantive body of literature on demonstrated storage in deep saline formations that indicate that CO_2 storage is a safe operation if storage sites are properly selected, characterized and managed.
- Numerous studies of potential environmental impacts of CO_2leakage have shown that the surface expression of leaks, if any should occur, would be in the form of small isolated areas. Also, any impacts on groundwater contamination would be limited, both in severity and in spatial extent.
- The techniques for monitoring and verification of the injected CO_2 have made significant progress both for onshore and in the marine environment. There is now common agreement on the ability of the available techniques for monitoring and interpretation to test and demonstrate both containment and conformance.
- The technical risks identified for geological storage were identified 10 years ago, but public perception, financial considerations and regulation have become more prominent in the risk

assessments now carried out. A technical risk that has gained focus is induced seismicity. Detailed procedures for assessing and managing this particular risk are now in place for projects and within regulatory or permitting frameworks.

On the Costs of CCS

- .CCS costs are now expected to begin to decrease as experience from demonstration projects leads to decreases in over-engineering. Also, the development of emerging capture technologies are expected to lead to significant cost reductions in the coming years.

On Bio-CCS

- Bio-CCS has become a focus of international interest because of its potential for negative emissions. The technological maturity and costs for Bio-CCS are comparable with other CCS technologies. Many low-carbon policies and associated greenhouse gas accounting frameworks do not yet recognise negative emissions from Bio-CCS.

On CCS Regulations

- Since the SRCCS there were numerous developments at the international, regional and national levels. The London Protocol and OSPAR international marine treaties were first to adapt to allow and regulate CCS, and developments quickly followed in Europe, Australia, the USA and Japan. Next followed the inclusion of CCS into the Clean Development Mechanism (CDM) under the UNFCCC's Kyoto Protocol in 2011. These international developments cover over 180 countries.

On Public Engagement on CCS

- Significant progress has been made on how best to communicate the concept of CCS, Much of this learning has been around communication activities at specific CCS pilot and demonstration projects.

In summary, the science and the technologies supporting CCS as a climate change mitigation tool have greatly advanced in the last 10 years, consolidating and expanding the knowledge base to more accurately assess and manage the potential impacts, risks and cost associated with large CCS projects. Storage in deep saline aquifers is a safe, secure option. The cost of avoided CO_2 from the full CCS chain, will go down as leading technologies are deployed. Emerging technologies are also being demonstrated at increasing scales, offering opportunities for more substantial reductions in cost and energy penalties.

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The Special Issue can be found at: http://www.sciencedirect.com/science/journal/17505836/40

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