INTERNATIONAL ENERGY AGENCY

WORKSHOP REPORT 2012

4th IEA International CCS Regulatory Network Meeting

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This workshop report was prepared for the 4th IEA International Regulatory Network Meeting held in May 2012 in Paris. It was drafted by the IEA CCS Unit. This paper reflects the views of the International Energy Agency (IEA) Secretariat, but does not necessarily reflect those of individual IEA member countries. For further information, please contact the CCS Unit at:ccsinfo@iea.org.

INTERNATIONAL ENERGY AGENCY

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Table of Contents

Executive Summary

On 9 and 10 May 2012, the IEA International CCS Regulatory Network (Network) held its fourth meeting at the International Energy Agency (IEA) offices in Paris, France, to: provide an update on government efforts to develop and implement carbon capture and storage (CCS) legal and regulatory frameworks; and consider ways in which governments are dealing with some of the more difficult or complex aspects of CCS regulation.

Sessions on Day 1 provided updates on CCS regulatory developments in Africa, the Americas, Asia, Australia and Europe, as well as international legal developments relevant to CCS. Day 2 focused on a series of key CCS regulatory issues, including: assessing risk and managing liability; third party access to CCS infrastructure; competition between resources; transboundary issues; pore space management; calculating financial contributions to long-term stewardship; and regulatory issues associated with enhanced oil recovery (CO_2-EOR). This report summarises the proceedings of the meeting.

The Network was launched in Paris in May 2008 to provide a neutral forum for CCS regulators, policy makers and stakeholders to share updates and views on CCS regulatory developments. In addition to its annual face-to-face meeting, the Network engages through quarterly, web-based seminars and ad hoc meetings on specific CCS regulatory issues. It currently has a membership of over 1 400 people from 50 countries around the world, including 20 developing countries.

Background and objectives

On 9 and 10 May 2012, the IEA International CCS Regulatory Network (Network) held its fourth meeting at the International Energy Agency (IEA) offices in Paris, France. The objective of the meeting was to: provide an update on government efforts to develop and implement carbon capture and storage (CCS) legal and regulatory frameworks; and consider ways in which governments are dealing with some of the more difficult or complex aspects of CCS regulation.

The meeting was organised into eight topical sessions spread over two days. Sessions on the first day provided updates on CCS regulatory developments in Africa, the Americas, Asia, Australia and Europe, as well as international legal developments relevant to CCS. The second day's sessions focused on key CCS regulatory issues, including: assessing risk and managing liability; third party access to CCS infrastructure; competition between resources; transboundary issues; pore space management; calculating financial contributions to long-term stewardship; and regulatory issues associated with enhanced oil recovery (CO_2-EOR). Each topical session was chaired by an expert in the field and included time for either open discussion or a panel discussion. The meeting agenda is set out at Annex 1. This report summarises the proceedings of the meeting.

Welcome and introductions

IEA Executive Director Maria van der Hoeven formally opened the meeting. The Executive Director highlighted the importance that IEA analysis places on CCS within a low-carbon energy system that achieves a diverse energy mix in support of enhanced energy security. In the 2011 *World Energy Outlook* (*WEO 2011*) New Policies Scenario (NPS), in which governments implement announced policies, global energy demand increases by 40% between 2009 and 2035. In this scenario, Fossil fuels continue to be predominant, meeting 75% of global energy demand in 2035. This is despite a significant expansion in nuclear generation and renewables. Global, energy-related CO_2 emissions are set to increase by 26% over the same period. In the IEA *Energy Technology Perspectives 2012* publication (*ETP 2012*), which provides a technology-oriented analysis of the energy system up to 2050, emissions increase nearly 30% between 2009 and 2050 in the 4°C Scenario (4DS).

Against this backdrop, *ETP 2012* sets out a 2°C Scenario (2DS) – an illustrative energy pathway consistent with an 80% chance of limiting average global temperature increase to 2°C, in accordance with international climate targets. This scenario demonstrates that it is possible to achieve by 2050 more than a 50% reduction in CO_2 emissions from 2009 levels, through the aggressive deployment of a portfolio of technology options that includes energy efficiency, renewables, nuclear and CCS. The 2DS relies on CCS to contribute around one-fifth of total emissions reductions by 2050. This level of deployment will be a significant challenge; currently, global CCS deployment is far off pace to meeting its potential contribution, as highlighted by the IEA-Global CCS Institute report to the 2012 Clean Energy Ministerial, *Tracking Progress in Carbon Capture and Storage*.[1] Significant further work is required to get CCS back on track to meeting its emission reduction potential.

Juho Lipponen, head of the IEA CCS Unit, and IEA legal analyst Justine Garrett expanded on work being undertaken by the agency to support a stepping up of efforts in CCS demonstration and deployment, before providing an introduction to the meeting's themes. The IEA CCS Unit undertakes analysis on strategic, technical, economic, legal and regulatory and broader policy aspects of CCS technologies, with the aim of enabling CCS to play the role that broader IEA analysis – and the 2009 IEA *Technology Roadmap: Carbon capture and storage* (*CCS Roadmap*) – envisages. The IEA has been working on the legal and regulatory aspects of CCS for over a decade, including more recently in the context of the Network. The Network was launched in Paris in May 2008 to provide a neutral forum for CCS regulators, policy makers and stakeholders to share updates and

[1] www.iea.org/publications/freepublications/publication/name,26622,en.html

views on CCS regulatory developments. In addition to its annual face-to-face meeting, the Network engages through quarterly, web-based seminars and ad hoc meetings on specific CCS regulatory issues. The Network currently has a membership of over 1 400 people from 50 countries around the world, including 20 developing countries. It operates with the ongoing support of the IEA Greenhouse Gas R&D Programme Implementing Agreement and University College London's Carbon Capture Legal Programme (UCL-CCLP).

Session 1: Challenges facing CCS and recent advances

The aim of the first session, which was chaired by IEA's Juho Lipponen, was to review the current status of CCS technology and deployment in relation to the emissions reduction needs identified by the IEA. The first presentation was delivered by Sean McCoy, Energy Analyst at the IEA, who highlighted three key messages:

1. The CCS deployment challenge is as great as ever: the *ETP 2012* 2DS scenario requires 16 GW of CCS equipped power generation and nearly 200 $MtCO_2$/y captured from industrial applications by 2020.
2. Globally, we are not on track to achieve the 2DS scenario milestones for CCS in 2020 and, hence, the longer-term.
3. The gap between the 2DS scenario and our current trajectory can be closed through policy action.

In the *ETP 2012* 2DS scenario, the bulk of cost-effective CCS deployment in the near term occurs in OECD member countries, particularly in the Americas (*i.e.* Canada, Chile, Mexico and the United States). However, over time, CCS deployment delivers the greatest emissions reductions in China, India, and other OECD non-member countries. One of the most important new messages in *ETP 2012* is that, while emissions reductions from industrial and power-sector application of CCS are split about evenly at the global level in the 2DS, industrial application deliver far greater emissions reductions in some regions.

Looking at the project development pipeline, which was covered in greater detail in the second presentation of the session, it is difficult to envisage more than around 30 large scale CCS projects in operation in 2020 with current policies: *i.e.* around 5 GW of CCS-equipped power generation and 20 $MtCO_2$/y of capture from industrial applications. While achieving these levels of deployment in 2020 would be an achievement, they would, nonetheless, mean that CCS delivers far fewer emissions reductions than envisions in the 2DS. Given the long lead times for CCS project development, the window of opportunity is rapidly closing for governments and industry to achieve the deployment and emissions reductions of the 2DS.

The gap between the current trajectory for CCS and the 2DS scenario can be closed, but concerted policy action is urgently needed from all levels of government. In *ETP 2012*, the IEA makes seven recommendations for policy actions that could close this gap, the most important and overarching of which is for governments to assess the role of CCS in their energy futures and develop suitable deployment strategies, including appropriate incentives for CCS, and a clear timeline to develop enabling regulations. These policies must be motivated, in the long run, by a clear and unambiguous commitment to reduce emissions.

Ian Havercroft of the Global CCS Institute (GCCSI) gave the second presentation of the session on recent CCS project developments. In autumn 2011, the GCCSI released the latest in its series of annual CCS status updates. This highlighted that: progress is being made in developing CCS projects; there are numerous projects in the development pipeline in addition to those operating today; and six or seven projects are expected to come on stream by 2015. Many of the currently-operating projects capture CO_2 from relatively high concentration vent streams from industrial processes, meaning the costs are low relative to power, and sell the CO_2 for use in EOR. Nonetheless, there are

two projects in power generation and several projects, such as the Gorgon Project (in Western Australia), that will store CO_2 in deep saline aquifers under construction (*i.e.* execution in GCCSI terms). Ian also highlighted that policy and regulations are not creating conditions that are conducive to CCS technology, with many failed projects pointing to a lack of adequate policy support, and that there remain issues with public acceptance of CCS projects.

Ian's presentation segued into the next topic, which was an update from Marianna Bolshakova of the UNFCCC Secretariat on the next steps for CCS under the Clean Development Mechanism (CDM). In November 2011, the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP) agreed on modalities and procedures for inclusion of CCS in the CDM. These cover the majority of relevant issues for CCS, including the ways in which liability for environmental damages and "net reversals of storage" (*i.e.* leakage of CO_2 to the atmosphere) are to be handled. However, the CMP highlighted issues for further consideration at its upcoming Doha meeting, including: eligibility of transboundary CCS projects – that is, projects in which CO_2 is moved between countries for storage or where the storage site spans more than one country; and the establishment of a global reserve of certified emissions reduction units (CERs) to address non-permanence. In the interim, the CMP asked the Subsidiary Body on Scientific and Technical Advice (SBSTA) to consider both of these issues.

As part of this process, the UNFCCC Secretariat asked for submissions from stakeholders on both the transboundary and global CER reserve issues. They received numerous comments. Comments on the transboundary question highlighted, amongst other things, that: a clear definition is needed for what constitutes a transboundary project; participation requirements must account for the cross-jurisdictional nature of projects; and the London Protocol currently prohibits transboundary movement of CO_2 for offshore storage. Comments on the global CER reserve noted that, while this may address leakage from projects decades to centuries after projects are closed, the scientific consensus is that security of storage increases over time and that this may reduce the incentive for project developers to chose and operate sites to minimise the risk of leakage.

Mariana's presentation was followed by a presentation from Luke Warren of the CCSA on developments in international marine treaties relevant to CCS. Luke highlighted that the 2007 OSPAR treaty amendment enabling sub-seabed storage has now entered into force for all parties to the OSPAR treaty to have ratified the amendment.

The picture is less rosy, however, for CCS in the London Protocol. In 2006, an amendment to the protocol was adopted that allows for disposal of CO_2 in sub-seabed geological formations, and this amendment automatically entered into force in 2007. Article 6 of the London Protocol currently prohibits export of CO_2 to other countries for offshore geological storage. In 2009, contracting parties agreed to amend article 6 to enable transboundary transfer of CO_2 for sub-seabed storage, but the amendment requires ratification by two-thirds of contracting parties to enter into force (currently, 28 contracting parties). Only two contracting parties, Norway and the United Kingdom, have ratified to date, and few other parties appear to have an interest in ratification; thus, a significant international effort will likely be required to reach the required number of ratifications. Raising awareness among relevant government ministries of the importance to global CCS deployment of ratifying international marine treaty amendments, including the London Protocol article 6 amendment, was one of eight recommendations made by the Carbon Capture, Use and Storage (CCUS) Action Group at the 2011 Clean Energy Ministerial (CEM).

Following the CEM, the IEA released a working paper identifying and evaluating potential interim options to enable trans-boundary movement of CO_2 for storage while ratification of the Article 6 amendment progresses: *Carbon Capture and Storage and the London Protocol: Options for Enabling*

Transboundary CO_2 Transfer.[2] IEA legal analyst Justine Garrett outlined a number of options that may be available to contracting parties under international law, as highlighted in the publication. The quickest and potentially most straightforward option would be for London Protocol contracting parties to pass a resolution at a meeting of the contracting parties recommending provisional application of the 2009 amendment, pending ratification by a sufficient number of contracting parties. The paper was presented to London Protocol contracting parties at their meeting in October 2011.

Session 2: Recent developments – Australia and the Americas

The second session of Day 1, chaired by IEA's Sean McCoy, opened with a presentation by Steve Tantala from the **Australian** Department of Resources, Energy and Tourism, in which he summarised the state of play in federal regulation. Responsibility for regulating CCS falls to the Commonwealth (*i.e.* national government) for offshore federal waters; on- and near-shore, the responsibility for regulating CCS falls to the states and territories. However, the Commonwealth and state governments coordinate the development of CCS regulation through the Council of Australian Governments (COAG) and its CCS Working Group. In 2005, members of the COAG, which is chaired by the Prime Minister, agreed to six key principles for regulating CO_2 storage in Australia. The CCS Working Group was then established and charged with promoting consistent, effective, and efficient regulation of CCS across Australia in adherence with the six principles.

The CCS Working Group has been dealing with several issues: consistency on long-term liability policy, cross-jurisdictional CO_2 storage projects, use of abandoned petroleum wells and reservoirs for storage, third party access to CO_2 transport and storage facilities, and identification of potential CO_2 pipeline corridors. Developing consistent policies on long-term liability is a priority because the Commonwealth and the states and territories have taken very different approaches to dealing with the issue in their legislation. Cross-boundary issues are also pressing because provisions in existing CCS regulation are not adequate to deal with cross-boundary projects and Geoscience Australia has identified prospective storage formations that cross Commonwealth-state, state-state, and title boundaries. In both the case of long-term liability and cross-boundary issues, the working group is developing legislative solutions that can be serve as a model for all Australian jurisdictions.

The presentation from the Commonwealth of Australia was then followed-up with a presentation by Colin Harvey from the **Western Australia** Department of Mines and Petroleum. Colin's presentation reviewed the development of the Western Australia Greenhouse Gas Storage Bill, the *Barrow Island Act 2003* and provided a brief update on the ongoing Collie South West Hub Project.

The government of Western Australia examined three options to regulate CCS: project specific agreements, incorporation within existing legislation, or stand-alone legislation. For the first project in Western Australia, the Gorgon Project, the government used project specific regulation through the *Barrow Island Act 2003*. However, moving forward, the government determined that amending existing petroleum legislation was the best approach and will introduce amendments to existing law that will allow them to regulate onshore storage and transport of greenhouse gases (*i.e.* predominantly CO_2) through the *Petroleum and Geothermal Energy Legislation Amendment Bill 2012*. Through these amendments, the government will make it clear that ownership of storage formations is vested in the Crown. Furthermore, the government will introduce a title structure similar to that used in petroleum regulation, with GHG exploration permits, retention leases, and injection licences. The government expects that the bill will be introduced in 2012.

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[2] Available at www.iea.org/topics/ccs/ccslegalandregulatoryissues/londonprotocol/. The paper was developed in collaboration with the Carbon Capture and Storage Association, the IEA Greenhouse Gas R&D Programme and Baker & McKenzie's Sydney office.

Acreage releases for exploration will be handled through a process that is similar to that used for petroleum exploration. Where titles for existing retention leases or production licenses overlap with storage acreage releases, the existing title holders have the option to apply for a storage title. To mitigate any impacts on pre-existing title holders, GHG exploration permit applicants are required to consult with pre-existing title holders and address their concerns. For all GHG titles, including exploration permits, the requirements for data release and fees are similar to those for petroleum titles. Site plans that address monitoring, measurement and verification (MMV) will be required to obtain a GHG injection license.

For management of long-term liability, Western Australia has followed the Commonwealth approach: the crown will assume liabilities associated with the site after a site closure certificate has been granted and a minimum of 15 years have elapsed. By following the Commonwealth approach, the government of Western Australia expects that issues for cross-boundary projects will be minimised.

The update on Western Australia was followed by an update on regulation in **Canada**, presented by Kathryn Gagnon, Natural Resources Canada, and Colin Alie, Environment Canada. Kathryn noted that CCS could contribute up to approximately 40% of emissions reductions by 2050, according to estimates by the National Roundtable on Environment and Economy. Thus, aside from development of suitable policies, the federal government is financially supporting five early-mover demonstration projects to reduce technology risk, in addition to their contributions to the IEA GHG Weyburn-Midale CO_2 Monitoring and Storage Project. Responsibility for regulating CCS is shared between the federal and provincial (and territorial) governments – for example, resources are owned and managed by the provinces while certain aspects of environmental regulation (e.g. GHG emissions) are shared between the federal and provincial governments. The federal government has moved to implement a CO_2 emissions performance standard for coal-fired electricity generating units that includes special treatment for units using CCS that may incentivise CCS deployment. However, the provincial governments are leading in the area of CCS-specific regulatory development. To date, Alberta, British Columbia (BC), Saskatchewan, and Nova Scotia have either regulated aspects of CCS or are contemplating policies that will do so. Alberta passed legislation in 2010 that amended existing law to accommodate CCS, and is currently undertaking an assessment of its regulatory framework for CCS to identify any remaining gaps (Mike Fernandez, from Alberta Energy reviewed this process in Session 6 on Day 2). Saskatchewan has taken a similar approach to Alberta in that the government has modified its oil and gas law and associated regulation to enable CCS. The Government of BC intends to promote use of CCS in BC as part of its Natural Gas Strategy,[3] which was released in 2012 and is developing amendments to existing law that may be introduced in the future to enable CCS.

Melisa Pollak from the University of Minnesota reviewed the recent history of CCS regulatory development in the **United States** and highlighted several recent developments at both the federal and state levels. In late 2010, regulations for CO_2 storage injection wells were promulgated by the Environmental Protection Agency (EPA) under the Underground Injection Control (UIC) program (*i.e.* the Class VI rules)[4] and measurement and reporting rules were also promulgated under the Clean Air Act.[5] Under the UIC program, US states can assume "primacy" for implementing the Class VI rules (and those for any other well class) if the states rules are as or more stringent than the federal Class VI rules. To date, at least two states have applied for primacy for Class VI (North Dakota and Louisiana) and several more are likely to do so, and there have been at least four Class VI well permit applications. The EPA is also developing a series of 13 publically-available guidance documents aimed at state-level regulations and owners and operators of Class VI wells.[6] These

[3] http://www.gov.bc.ca/ener/popt/down/natural_gas_strategy.pdf
[4] 40 CFR Parts 124, 144, 145, 146, and 147
[5] 40 CFR Parts 72, 78, and 98
[6] http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm

documents explain various technical requirements imposed by the Class VI rule and provide advice on how these requirements can be met. Melisa also spoke about some of the pressing issues for permitting wells for geologic storage, which include eligibility for shortened (*i.e.* less than 50 years) Post Injection Site Care (PISC) period; the requirements to transition between a CO_2-EOR (Class II) to a geologic storage (Class VI) well permit; permitting of pilot and demonstration wells as experimental wells (Class V), rather than Class VI wells; and the strong industry preference to store CO_2 through EOR with a Class II well permit. In addition, the EPA has proposed that CO_2 captured from anthropogenic sources would be exempted from hazardous waste management regulations that may otherwise apply, simplifying liability management issues.

Specific measurement and reporting rules have been designed for "geologic sequestration" (Subpart RR), CO_2-EOR (Subpart UU), and CO_2 suppliers (Subpart PP). For geologic storage, the rules require a site-specific Monitoring Reporting and Verification (MRV) plan that assesses the risk of leakage from the site, a monitoring strategy, establishment of pre-injection baselines, and a mass balance equation.

In the area of deployment incentives for CCS, the EPA requires GHG emissions permits for large emissions sources (>100 $ktCO_2/y$) and has proposed emissions limits for new power plants. The permitting process for large emissions sources requires that applicants demonstrate that they have considered the "Best Available Control Technology" (BACT) to reduce emissions, which may include CCS, and, if they do not apply the technology, provide a rationale. However, because economic considerations can be factors in the selection of the BACT it is, at this time, unlikely that CCS would be selected. In the area of emissions limits, the EPA has proposed standards[7] that would limit emissions from new fossil fuelled electric generating units to 1000 $lbCO_2/MWh$ (454 $kgCO_2/MWh$) gross,[8] which could only be met by coal-fired units by use of CCS. In addition, the proposal includes a 30-year compliance option, in which coal- and petcoke-fired units could comply with the standard on a 30-year average basis by emitting 1800 $lbCO_2/MWh$ (816 $kgCO_2/MWh$) or less for the first 10 years of operation, and emitting less than 600 $lbCO_2/MWh$ (272 $kgCO_2/MWh$) through use of CCS beginning in the 11th year of operation. At the state level, Washington, Oregon, and California already have equivalent standards and Montana and Illinois require CCS for new coal-fired generation.

Melisa's presentation was then followed by open discussion. Questions in the session focused on the rationale for the different approaches to incentive mechanisms (*e.g.* performance standards, cap-and-trade, etc.), and the complexity that arises from overlapping jurisdictions in federal systems of government.

Session 3: Recent developments – Europe

Richard Macrory of UCL-CCLP chaired Session 3, which looked at recent CCS regulatory developments in Europe. Martina Doppelhammer from the European Commission commenced the session with an overview of developments from a European Commission perspective. European Union member states were required to transpose the EU CO_2 Storage Directive,[9] which established the legal framework for the environmentally safe geological storage of CO_2 in the European Union, by 25 June 2011. The European Commission launched infringement proceedings against 26 out of 27 member states for incomplete (11 member states) or non-communication of transposition measures (15 member states) following the 25 June deadline, with Spain being the exception. Despite the number of official infringement proceedings, the transposition deadline galvanised

[7] www.gpo.gov/fdsys/pkg/FR-2012-04-13/pdf/2012-7820.pdf

[8] Gross refers to the amount of electricity generated before electricity used for running of the plant (i.e. that used to run motors, compressors, etc.) is deducted.

[9] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide. Adopted in April 2009, the directive entered into force in May of that year.

action across the European Union. Furthermore, in practice, infringement proceedings are not uncommon: the Commission commences them automatically once a transposition deadline has passed, where no measures or only partial measures have been communicated.[10] In addition, as at 26 January 2012, seven cases had been closed following communication of full transposition legislation.[11] Almost all member states with planned CCS demonstration projects have completed transposition, although work is generally ongoing in areas where the EU CO_2 Storage Directive affords discretion to member states.[12]

The Commission is now verifying conformity of notified measures with the EU CO_2 Storage Directive. It has also issued its first opinion under article 10 of the directive, which requires the Commission to review draft storage permits to ensure that relevant legislation is applied consistently throughout the European Union, with respect to the Dutch ROAD project (see http://ec.europa.eu/clima/news/articles/news_2012022901_en.htm). Implementation of the NER300 demonstration funding programme is ongoing and on track for award decisions to be made by end-2012, although it is clear that CCS deployment in Europe continues to face a number of hurdles.

To assist national transposition and implementation of the directive, the European Union has an information exchange group that meets regularly on an informal basis to discuss questions of interpretation and implementation and provide information on progress in different member states. The European Commission also released Guidance Documents on various elements of the directive, including risk management across the CCS chain, site characterisation, composition of the CO_2 stream, monitoring and corrective measures, transfer of liability, financial security and financial contributions from operators, in March 2011.[13]

Chiara Armeni from UCL-CCLP then presented on key legal issues arising from transposition of the EU CO_2 Storage Directive, drawing on the outcomes of UCL-CCLP's *European Union Case Studies Project* conducted in 2011.[14] The aim of the project was to analyse transposition of the EU CO_2 Storage Directive in selected European jurisdictions (the United Kingdom, Germany, Poland, Romania, Spain, and Norway), with a particular focus on how member states are addressing discretionary elements of the directive. This reflects that, as a legal instrument, directives are binding upon members states as to the result to be achieved, but leave to national authorities the choice of form and methods (article 249.3 Treaty on the European Union). This discretion extends to the techniques used by member states to transpose the directive; a number of member states have chosen to reflect the requirements of the directive within existing oil and gas or environmental frameworks (such as the United Kingdom, Poland, the Netherlands, France and Norway); others have developed dedicated pieces of legislation (Spain, Romania, Germany and Italy); all have made amendments to existing legislation.

Legal issues arising from the transposition process, the impact of which varies across jurisdictions, include:

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[10] The legal basis for the Commission's enforcement powers is Article 258 of the Treaty on the Functioning of the European Union. The infringement process consists of three phases: letter of formal notice to the member state, which then has two months to reply; issue of a reasoned opinion if the member state's reply is not satisfactory, setting the details of the infringement and establishing a new deadline for compliance; and referral to the Court of Justice of the European Union, if the member state remains non-compliant. The infringement process includes an ability on the part of the Commission to recommend a financial penalty against member states.

[11] This total was at nine at the time of writing this meeting report.

[12] See www.ucl.ac.uk/cclp/pdf/CCSDirective-Analytical%20Table.pdf for a comprehensive analysis of the discretionary elements of the EU CO_2 Storage Directive.

[13] http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/documentation_en.htm

[14] See www.ucl.ac.uk/cclp/ccsresearch.php

- the novelty of regulating CCS, including how CCS fits within existing national environmental and energy law;
- public participation, which is regulated by pre-existing EU law but leaves the form of public participation largely to the discretion and traditions of member states;
- devolved powers and potential tensions between different levels of government regarding the transposition process and/ or CCS deployment more broadly;
- whether a member state can limit transposition for "demonstration purposes only" or does not have to transpose the directive if CCS is to be prohibited in its territory;[15] and
- the issues of long-term liability, financial security and conflicting uses of storage sites, which are complex, regulatory issues left largely to member states to resolve.

Work to address these and other issues associated with transposition of the EU CO_2 Storage Directive is ongoing; the coming few years are likely to be crucial to assessing the fate of CCS in Europe and whether Europe is likely to be a leader in CCS deployment internationally.

The presentations were followed by a panel discussion on implementation of the EU CO_2 Storage Directive, involving representatives from the United Kingdom, Germany, France, Spain and the Netherlands. Representatives gave short updates on developments in each member state. Brian Allison of the Department of Energy and Climate Change reviewed the situation in the **United Kingdom.** The UK notified the European Commission of full transposition on 23 February 2012, after final implementation measures were put in place during 2011 that built on the Energy Act 2008. However, Northern Ireland and Wales have implemented a straight prohibition on CCS.

Almut Fischer, of the **German** Federal Ministry of Economics and Technology, advised that stakeholder opposition to CCS continued to sideline the German legislative process, with a formal conciliation process underway between the federal parliament and the German Bundesrat (the body that represents the German states at federal level) following stakeholder pressure at state level. A compromise agreement was finally reached within the conciliation committee on 27 June 2012, although this required a number of concessions in the terms of the law.[16]

Lionel Perrette, of the Ministry for Ecology, Sustainable Development, Transport and Housing, reviewed the situation in **France**, where the government notified the European Commission of full transposition measures a couple of months after the 25 June 2011 deadline. Stakeholder engagement is a key area of focus for France and the French transposition measures provide for public enquiries and commissions at various stages across the project life cycle. Transposition measures build on existing laws and have been primarily integrated into the French Environment Code, rather than the Mining Code, as part of stakeholder engagement efforts. To accelerate the transposition process, the French government sought permission from the French parliament to transpose the EU CO_2 Storage Directive directly.

Helena Fabra of the Ministry of Agriculture, Food and Environment noted that **Spain** had transposed the EU CO_2 Storage Directive as a stand alone law in 2010, well ahead of the 25 June 2011 deadline for transposition. The Ministries of Environment and Industry dealt with the

[15] Traditionally, member states have not had to transpose a directive where there is a physical impossibility of carrying out the activity in their jurisdiction. Conversely, a policy decision not to undertake the relevant activity has been insufficient justification for non-transposition. Member states therefore appear to be obliged to transpose the directive even where they choose to prohibit CCS in the whole of their territory, as is permitted under the EU CO_2 Storage Directive. As the directive is intended to regulate wide scale CCS deployment, is it difficult to see how member states can purport to limit transposition legislation to CCS demonst ration only.

[16] At the time of publication, Germany's CCS law is in the final stages of the legislative process and anticipated to enter into force shortly. For a comprehensive write-up of the developments in Germany, see the third edition of the IEA *Carbon Capture and Storage Legal and Regulatory Review*, available at www.iea.org/publications/freepublications/publication/name,28506,en.html

transposition process; however, further developments by regulations are still pending. In addition, the CCS law is currently being appealed in the country's constitutional court on an issue of division of state and community competency.

Hans Schoenmakers from the Dutch ROAD project gave the update on developments in the **Netherlands**, which finalised transposition in September 2011 though amendment of its Mining Law and a number of other decrees. The country is currently preparing legislation to amend its Civil Code to introduce a tailored liability regime for CO_2 storage. As noted by the European Commission, the Netherlands was the first member state to submit a draft storage permit to the commission for approval under article 10 of the EU CO_2 Storage Directive, on which the Commission adopted an opinion on 29 February 2012.[17]

An issue raised in subsequent discussion was that of financial security requirements under the EU CO_2 Storage Directive (*i.e.* to cover operator responsibilities arising during the operational phase, including obligations arising under the EU-ETS – see article 19). Discussion focussed on how government and industry can manage climate liability risk associated with CO_2 storage. While financial and policy mechanisms are required to support CCS demonstration and deployment – including broader CO_2 emissions reductions policies – inclusion of storage sites under the EU-ETS is currently seen as a critical challenge by the private sector. It is not clear what mechanisms are available to industry to manage climate risk associated with storage sites; further work is required with the insurance sector on this issue. A question for government will be what action it can potentially take to enable the private sector to offer appropriate instruments to manage this risk.

Session 4: Recent developments – Africa and Asia

The last regional session of the meeting was chaired by Tom Mikunda, Researcher at the Energy Research Centre of the Netherlands.

Datuk Loo Took Gee, the Secretary General for the Malaysian Ministry of Energy, Green Technology and Water, highlighted that the over 90% of electricity generated in **Malaysia** comes from fossil fuels—primarily natural gas. The government plans to encourage increased generation from renewable resources and to slow growth in energy demand through efficiency and conservation measures. Nonetheless, the government expects an average, annual growth in electricity demand of around 2.4% between 2010 and 2020, and anticipates that the amount of coal used for electricity generation will continue to grow.

At the 2009 Copenhagen UNFCCC negotiations, the Malaysian Prime Minister made a voluntary commitment to reduce CO_2 intensity per unit GDP by 40% by 2020 relative to 2005. Thus, in light of the government's expectation that electricity demand and coal use will continue to increase, CCS is an important tool for Malaysia to reduce emissions. The CCS Strategy for Malaysia is to expose relevant Malaysian stakeholders and clients to CCS technology in the short-term; in the medium-term, build both technical and human capacity in CCS and develop appropriate law and regulation for CCS; and, over the longer-term, consider implementation of CCS. In the area of developing appropriate regulatory frameworks for CCS, Loo Took Gee noted that, while gaps undoubtedly exist, current law could form the basis for CCS regulation. One important issue, however, is that there are no current legal means to regulate CO_2 as it is not classified as a pollutant in Malaysia.

Over the past three years, the government has undertaken numerous activities in support of its CCS strategy. These include a scoping study for CCS implementation, undertaken jointly with the Clinton Climate Initiative and the Global CCS Institute; a roundtable on CCS with the IEA; as well as participating in the APEC CCS Regulatory Assistance Project. Moving forward, the government is proposing to form an inter-agency CCS steering committee to plan for CCS activities; launch a study into law and regulation and take the appropriate follow-up activities; plan for the development of

[17] http://ec.europa.eu/clima/news/articles/news_2012022901_en.htm

storage infrastructure; and implement its plans for capacity building.

The presentation on Malaysia was followed by an update from **Botswana,** which was delivered by Tebogo Segwabe, of the Department of Minerals, Energy and Water Resources. At the current time, the economy of Botswana is heavily dependent on diamond mining and the country hopes to diversify by exploiting other natural resources such as coal and coal-bed methane (CBM), and ample solar irradiation for domestic electricity generation and exports. Thus, the Government of Botswana intends to develop CBM, as well as exploring solar thermal technologies, and investigating CCS as a means to mitigate emissions from coal use. At the current time the Government is in the process of conducting a CCS pilot feasibility study, with support from the World Bank, with the aim of assessing the opportunity for CCS in Botswana and making recommendations on necessary laws and regulations.

The main challenges that the government of Botswana sees are the relatively high cost of capture and the absence of incentives to capture and store CO_2, difficulties around the model by which long-term liabilities for stored CO_2 should be handled, a lack of information about storage resources, and the difficulty of "selling" CCS projects to the local community. Preliminary investigation of storage resources suggest that there are prospective storage resources in Botswana, notably the Karoo Supergroup, which underlies the Kalahari Desert.

An update from **South Africa** rounded out the country updates for the first day of the meeting. In this presentation, Muzi Mkhize, Chief Director for Hydrocarbons in the Department of Energy reviewed progress since the previous year's regulatory network meeting in which he participated. The South Africa CCS roadmap calls for an injection experiment in 2016 (10's $ktCO_2$), followed by an integrated demonstration project in 2020 (100's $ktCO_2$), and a commercial-scale facility in 2020. The roadmap was endorsed by Cabinet on May 4, 2012. In addition, an Interdepartmental Task Team (IDTT) held its inaugural meeting in November 2011. The Departments of Energy, Mineral Resources, Public Enterprises, Science and Technology, Trade and Industry, Transport, and Water and Environmental Affairs are represented, along with the National Treasury. In the near term, the Department of Energy, in conjunction with other departments, will continue to develop a CCS legal and regulatory framework for South Africa; assess funding, long-term liability, financial assurance for long-term stewardship, as well as enhance human capacity development and public awareness; and concluding preparatory work for the next milestone of the CCS Roadmap (*i.e.* the test injection).

As the final presentation for the first day, Jeff Walker of CSA Group made a presentation on emerging standards for CCS.[18] At the current time, the Canadian Standards Association (CSA) is leading development of a joint Canadian–US standard that is intended to establish requirements and recommendations for the geological storage of CO_2. The purpose of these requirements is to promote environmentally safe and long-term containment of carbon dioxide in a way that minimises risks to the environment and human health. The Standard is primarily applicable to saline aquifers and depleted hydrocarbon reservoirs, but this does not preclude its application to storage associated with hydrocarbon recovery.

The CSA standard has been drafted by a technical committee (TC) of around 30 experts in the field drawn from Canada and the US, in both industry and academia. The TC assembled a draft standard that went out for public review in the fourth quarter of 2011. Around 500 or 600 comments were received by the close of the review period and have since been addressed by the TC. Jeff expects that the standard will be publically available in the fourth quarter of 2012 after the final draft has been approved by the TC, CSA, and the Standards Council of Canada (SCC).

In parallel to the Canadian process, the SCC has been pursuing the formation of an International Standards Organization (ISO) TC on CCS. The TC will cover standardisation of materials, equipment,

[18] Jeff was scheduled to speak at this time because he participated from Toronto and a presentation earlier in the day was not reasonable given the time change.

environmental planning and management, risk management, quantification and verification, and related activities in the field of CCS that are not covered by other ISO TCs. At the current time the SCC and the China National Institute of Standardization are acting as the secretariat for the ISO TC, which held its first meeting in early June in Paris. Given the complexity of forming an ISO TC on this topic, it may be a few years before any draft standards emerge.

Session 5: Assessing risk and managing liability

Bernard Frois of CEA chaired Session 5, which was the first session of the second day and tackled the topic of risk assessment and liability management. Andrew Beatty of law-firm Baker & McKenzie commenced the session with a scene-setting presentation, "Framing the liability discussion". This looked at: what sort of potential harm generates what sort of potential liability; traditional approaches to, and issues with, liability management; and balancing environmental risks.

From a legal perspective, liability accrual in a CCS context may be driven by who has title to relevant resources, plant or equipment, etc.; who has acted negligently; or who is in breach of a relevant contract or agreement. Plaintiffs will comprise those who can demonstrate foreseeable harm or losses have been suffered or, potentially, those affected by general (and long-term) environmental harm. In terms of managing potential liability, there are a number of traditional mechanisms, including contract, insurance, statutory protections or caps, and "pooled" liability/industry funds. The need to prove causation, or a link between an act or omission of the defendant and the harm or damage in question, can also impact on liability. This may be a particular issue in the case of geologic storage, for which it may be more difficult to identify the cause of any damage. In some jurisdictions, certain defences may also be relevant to the question of liability, such as the defence of statutory authority (*i.e.* where the fact that a project is operated in accordance with an authorisation from the state may serve as a defence).

A key question is whether "typical" environmental liability models should apply to CCS projects, or whether another approach is worth examining for CCS projects, given the competing environmental risks at play (*i.e.* risks associated with CCS, versus atmospheric "storage" of CO_2). If CCS can be seen as a form of public service to be agreed to or imposed upon power generators and other key industries, should state actors be facilitating CCS, including with respect to liability issues? Is there potentially a case for a global, liability management framework for long term environmental risks associated with CCS?

Jonathan Pearce of the British Geological Survey then addressed assessment of technical risks in geological storage of CO_2. Assessing storage risks is essential, given: that storage remains the least proven and least predictable element of the CCS chain; and the long timescales associated with CO_2 storage, which require operators to demonstrate storage will be safe both during injection and following site closure. Government has an important role in determining acceptable levels of risk and uncertainty for CO_2 storage projects; in particular, to advance demonstration projects, operators have asked government to accept the uncertain risks inherent in storage. Principal forms of storage risk are associated with: impacts on other resources (due to, for example, pressure responses and brine displacement) and risk of leakage leading to both potential environmental impacts and loss of revenue. Of course, these risks are compounded by inherent geological uncertainty, although this uncertainty can be reduced, to a large extent, by appropriate site characterisation.

Physical processes that influence storage site risk, such as geochemical reactions or movement of CO_2 and other fluids underground and at the surface, can be quite accurately quantified. However, identifying a hazardous event and quantifying it's likelihood or probability of occurrence is more challenging: the lack of a mature industry prevents the use of statistical enquiry on the number of incidents, failures, etc; expert opinions on probability can vary widely; and any probability can have a large range of uncertainty. It may be that, rather than requiring operators to quantify risk, a

better approach is to require operators to demonstrate that relevant risks have been identified and qualitatively ranked (e.g. by consequence or subjective probability); that, where possible, these risks have been mitigated through the site selection, site characterisation and project design processes; and that any unmitigated risks are acceptable (*i.e.* anticipated consequences are minor in nature; qualitative likelihood is low; relevant monitoring and remediation plans are comprehensive, flexible and meet requirements).

Chris Clarke of UCL-CCLP then presented on analogues for liability management, including waste management, environmental liability, and marine and nuclear regimes, and lessons learnt. "Liability" is used in the context of CCS to refer to a number of different responsibilities, obligations and exposures, including: permit obligations (such as those associated with closure/post-closure); corrective measures in case of leakage or significant irregularity; wider remediation under environmental laws; surrender of emissions credits/allowances in case of CO_2 leakage to atmosphere; and civil or common law liabilities (personal injury, property damage, economic loss, etc). Generally, CCS frameworks: require operators to have financial security to cover some or all of the above; provide for transfer of responsibility *x* years after cessation of injection, subject to specified conditions and carve-outs (*i.e.* for fault); and require a contribution to post-transfer costs.

Liability management is complicated in a CCS context due to: the long timescales involved in CCS projects; the fact that CCS deployment is still in its early stages; the unusual nature of emissions allowance/ credit market risk; ambiguities in the transfer of responsibility; the highly politicised debate surrounding CCS technologies, etc. Liability for environmental harm/ harm to human health is just one aspect of a wide range of complex project risks in any CCS development, so it is important that policy makers are clear about exactly what kind of risks they want to address.

Generally, financial security is required to meet all obligations arising under operating permits, such as monitoring, corrective measures, etc. Financial security mechanisms should be certain, liquid, flexible and of appropriate duration. The amount that is demanded will generally need to reflect a technical assessment of costs and risks, including any decisions about discounting and phasing of the pay-in period, and may be subject to periodic review.

These security requirements raise both political and technical issues, which need to be distinguished: the former concern what the security is supposed to achieve, while the latter relate primarily to the capacity limits of markets and individual security instruments. Decisions in this field need to take on board the lessons from a number of "cautionary tales" associated with past financial security regimes covering various industries, some of which have collapsed or failed to be implemented. On the other hand, certain types of financial security mechanisms are routinely used in several industries.

Possible lessons that emerge from this experience are:

- that financial security and liability management need to be taken more seriously at the policy stage, including by securing the active involvement of people with financial services expertise;
- more care should be taken to distinguish contingent risks from unavoidable obligations, and genuine risk transfer products (like insurance) from non-risk transfer instruments (like bonds and letters of credit, etc), which have quite different implications;
- the key issue is the amount of financial security required (where low to medium level amounts can probably be covered by conventional security instruments, whereas ultra-large amounts are likely to require radical solutions such as pooling or state underwriting);
- some sort of limit based on probability of occurrence is unavoidable (reflecting that to demand full funding from all operators for ultra-low probability events would involve massive opportunity costs);
- governments and policymakers need to make clearer decisions about tolerance of risk. .

For CCS in particular, the carbon credit/ emissions allowance risk is the "potential joker in the pack". Here, greater clarity is needed on maximum probable releases, which should then be priced on a short-medium term basis. Alternatively, government or pool support could underwrite risk above a certain price, although that threshold would probably need to be set at a high level in order to protect the ETS. Finally, governments and policymakers should recognise that insurers and financial services providers have limited capacity and have reason to be cautious about these kinds of risk, so setting requirements too high can act as a brake on deployment and therefore a *de facto* policy decision not to enable CCS technologies. Governments need to make a political decision on the level of risk that can be tolerated if they wish CCS to proceed as a major climate change mitigation technology.

Following the three presentations, there was a panel discussion on experiences to date, involving Mike Fernandez of Alberta Energy, Ian Havercroft of the Global CCS Institute and Lionel Perrette from the French Ministry for Ecology, Sustainable Development, Transport and Housing. Key points coming out of the discussion include:

1. Regulatory frameworks are predicated on identification and mitigation of risk; this means that good government understanding of sub-surface risk is essential to sound CCS regulation and effective regulatory process. Governments should become familiar with sub-surface risk and risk mitigation, including by engaging third party support and, potentially, undertaking an "audit" of regulatory processes before live projects move through government processes. The Government of Alberta, for example, learnt a great deal by moving the Shell Quest project through its CCS framework and feels that it would have been beneficial to run a fictional application process prior to receiving Shell's application.
2. Climate liability is key: while CO_2 emissions-reduction policies will be critical for CCS deployment, in Europe inclusion of CO_2 storage in the EU-ETS is currently seen by industry as a potential "show-stopper". This is on the basis that climate liability is currently an un-quantified liability that will rise over time as the price of carbon increases to an unknown, future price, which makes it difficult for companies to balance sheet under current policy conditions.
3. Even in regions advanced in CCS framework development, many open questions remain on long-term liability and risk. For example, in the European Union, the EU CO_2 Storage Directive sets out broad parameters for managing long-term liability, but issues such as how financial contributions to long-term stewardship are to be calculated remain open. In France, for example, work to date has focused on requirements for transfer of responsibility to the state, as set by the directive: work is ongoing in areas where the directive affords discretion to member states.
4. Industrial Economics, with support from the Global CCS Institute and a number of other organisations, has recently released a report valuing potential economic damages associated with CCS projects, including damage to the environment and human health. *Valuation of Potential Risks Arising from a Model, Commercial-Scale CCS Project Site*[19] applies a model approach to a "realistic" project based on a publicly available risk assessment (related to a site from the FutureGen 1.0 site selection process). For this project, the "most likely" (50th percentile) estimated damages arising from CO_2 total approximately USD 7.3 million; "upper end" (95th percentile) estimated damages total approximately USD 16.9 million ("most likely" estimated damages of USD 0.15 per metric ton and "upper end" estimated damages of USD 0.34 per metric ton). The report highlights that damage estimates will ultimately need to be tailored to take into specifics of a project.

[19] The report was pending at the time of the meeting but is now available at www.globalccsinstitute.com/campaign/2012/06/valuation-potential-risks-arising-model-commercial-scale-ccs-project-site

Session 6: Getting down to details

Justine Garrett of the IEA CCS Unit chaired Session 6, which looked at work being undertaken in jurisdictions advanced in framework development to try to pin down the detail of regulatory approaches to some of the more challenging issues associated with regulating CO_2 storage activities. Greg Leamon from Geoscience Australia presented on detailed provisions dealing with competition between resources enacted in **Australia** in June 2011, as part of the *Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011*. The regulations deal with the interaction of GHG storage and petroleum activities, the principal competing resource within Commonwealth waters. This reflects that Australia's primary legislation, the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (the act), allows GHG storage titles and petroleum titles to overlap in relevant offshore areas. The provisions reflect a concern about the potential of GHG operations to negatively impact petroleum operations, however the act and regulations include a series of equivalent provisions in respect of petroleum titles (*i.e.* where the responsible Commonwealth Minister is required to consider the potential impact of petroleum operations on GHG operations).

The central mechanism established by the act is that of "significant risk of significant adverse impact" (SROSAI), *i.e.* whether there is a significant risk that proposed GHG operations will have a significant adverse impact on petroleum exploration or recovery operations. The act takes into account whether registered petroleum title holders have agreed in writing to the relevant GHG operations, thereby encouraging commercial agreements between parties where projects are proposed in the same area.

The act specifies that the SROSAI question must, without limitation, take into account the probability of the occurrence of the adverse impact; economic consequences of the adverse impact; and how those consequences compare with the potential economic value of the petroleum operations in question. "Adverse impact" is taken to mean an increase in capital or operating costs of the petroleum operations, or a reduction in the rate of petroleum recovery or quantity of recoverable petroleum. Risk – and adverse impact – is not significant under the act if the expected adverse impact of the operation is less than a threshold amount under the regulations. The 2011 regulations underpin these requirements, setting out, amongst other things, how the economic consequences of an adverse impact are to be estimated; how the economic consequences of an adverse impact relative to the potential economic value of operations that are being, or could be, carried on are to be estimated; relevant threshold amounts beyond which a SROSAI is deemed to exist, etc.

The probability of a GHG storage project having an impact on existing petroleum production activities will depend on the location of the two operations, the timing and the geology. The regulator should be aware of: the expected travel time for CO_2 to move from the injection well to the production well; quantity of CO_2 that could reach a production well; the potential impact if CO_2 reaches a production well; options to prevent an adverse event; and measures to mitigate an adverse impact. Information needed to assess risk includes geology (depth, thickness, structure of formation etc); baseline conditions (natural CO_2 in the storage complex); distance and travel time between CO_2 injection and petroleum producers; CO_2 injection rates and petroleum production rates; and economic lives of petroleum production and CO_2 storage. Risk of adverse impacts on other resources can be reduced by: delaying the start of GHG injection; setting minimum horizontal and vertical separation distances between injection wells and other resources; limiting the quantity of GHG injected before a given year; and other engineering solutions.

Brian Allison from the UK Department of Energy and Climate Change presented on measures put in place in the **United Kingdom** in September 2011 to facilitate third party access to CO_2 transportation and storage infrastructure. This followed a formal consultation on implementation of the third party access provisions of the EU CO_2 Storage Directive (10 December 2010 - 4 February

2011). Article 21 of the EU CO_2 Storage Directive requires member states to take necessary measures to ensure that potential users can obtain access to transport networks and storage sites in a transparent and non-discriminatory manner, applying the objectives of fair and open access. Operators may refuse access on grounds of lack of capacity, giving duly substantiated reasons; in this situation, member states are required to take measures to ensure that the operator makes any necessary enhancements as far as it is economic to do so or when a potential customer is willing to pay for them, provided this would not negatively impact on the environmental security of transport and storage. Member states are also required under article 22 to implement dispute settlement arrangements for disputes relating to access to transport networks and storage sites.

To comply with the requirements of the EU CO_2 Storage Directive, the UK's *The Storage of Carbon Dioxide (Access to Infrastructure) Regulations 2011* extend the approach to third party access in existing UK pipeline legislation to CO_2 storage sites. This approach is one of negotiated access, with an ability for the party seeking access to appeal to an independent authority in the event a commercial agreement cannot be reached with relevant transport or storage infrastructure owners. Additional provisions are incorporated to reflect the transparency requirements of the directive, including a requirement that infrastructure owners make publicly available information on spare capacity. It is unlikely that the United Kingdom would have legislated on third party access without the directive; rather, it is likely that it would have relied on its existing pipeline legislation only.

To address stakeholder concerns about storage site capacity, the draft regulations were modified to clarify that a determination regarding an existing storage site could not require an increase in the total quantity of CO_2 authorised to be stored under the relevant permit. This reflects the potential for such a determination to compromise the environmental integrity of a storage site. In addition, and unlike transportation infrastructure, the ability to increase the capacity of CO_2 storage sites beyond permitted amounts is subject to a large degree of uncertainty, given that they are natural rather than man-made facilities.

The UK government is currently developing guidance on the approach that will be taken to determine access where an appropriate authority is required to determine third party access, including principles for establishing financial conditions. The guidance will be made available for consultation later in 2012.

The Canadian province of **Alberta** has taken an in-depth look at a host of regulatory issues as part of its Regulatory Framework Assessment (RFA) process, as reported by Mike Fernandez of Alberta Energy. The *Carbon Capture and Storage Statutes Amendment Act, 2010* was passed in December 2010 (the act). It amends several existing pieces of provincial oil and gas legislation to address regulatory barriers to CCS deployment, addressing pore space ownership and tenure, long-term liability, and post-closure stewardship. About 20% of mineral rights are privately owned in the province; the act addresses this by declaring that all pore space in the province is owned by the crown. It then enables the Minister of Energy to enter into agreements to grant pore space rights, creating two separate instruments: evaluation permits and carbon sequestration leases. This right is supported by the *Carbon Sequestration Tenure Regulation*, which was passed in April 2011 and sets out administrative details concerning maximum area, rent, grouping etc. The act also gives the crown the authority to assume long-term liability: on issuance of a closure certificate, Alberta becomes owner of the stored CO_2, assumes any obligations under provincial environmental legislation and indemnifies lessees against damages. In addition, the act creates a post-closure stewardship fund (PCSF), to ensure that money is available when the province assumes liability for a site. It provides for a levy to be applied per tonne of CO_2 injected, to be applied toward MMV and other Crown obligations.

Alberta's RFA is aimed at ensuring that Alberta's CCS framework will comprehensively and effectively regulate large-scale deployment. Four specialised working groups have been examining specific issues since March 2011, to identify gaps and barriers, and develop draft recommendations

for regulatory improvements. Alberta anticipates that a series of recommendations across the issues examined will be presented to the Minister of Energy for final approval by end-2012. Regulatory issues under consideration as part of the RFA include, amongst others: pore space management and open access; long-term liability; and financial security mechanisms and method to determine rates paid into Alberta's PCSF.

Using the financial security and PCSF issue as an example of the approach taken across the various issues, the relevant working group was tasked with: identifying gaps between existing financial security mechanisms and Alberta's PCSF (*i.e.* are any aspects of CCS operations not covered by either existing financial security mechanisms or the PCSF?); making recommendations on how to fill any gaps; and developing recommendations around the methodology for determining what rate operators are to pay into the PCSF (should PCSF rates be uniform or project-specific? Should there be a mechanism to adjust the rate? Should PCSF funds be pooled? Should the PCSF have a maximum or minimum balance?).

Finally, Tom Mikunda of ECN presented on a recent study by CATO$_2$ on transboundary legal issues associated with CCS. CATO$_2$ is a Dutch R&D programme that focuses on facilitating and enabling integrated development of CCS projects and brings together a consortium of 40 industry, academic, research and non-governmental partners.

Broad CCS deployment in Europe may require cross-border transportation of CO_2 for storage and development of associated infrastructure, depending on usable, CO_2 storage capacity across European jurisdictions. From a legal and regulatory perspective, there are a number of potential barriers to transportation of CO_2 in Europe. First, each member state has jurisdiction over its own territory, which means that multiple regulatory regimes will be applicable to cross border transport infrastructure. Importantly, considerable discretion is left to member states within the EU CO_2 Storage Directive: this means that there is real scope for varying regulatory requirements between jurisdictions. Provisions on cross-border regulation specifically are also limited within the directive: article 24 provides that in cases of transboundary transport of CO_2, transboundary storage sites or storage complexes, the competent authorities of member states are to jointly meet the requirements of the directive and other relevant community legislation. Article 22 deals with dispute settlement in the event of cross-border disputes.

Offshore, the regulation of CO_2 transportation infrastructure will depend on the relevant maritime zone, as determined under the 1982 United Nations Convention on the Law of the Seas, and the extent to which relevant infrastructure is connected to an installation or storage site over which a state may have jurisdiction. In the case of transboundary transport, conflicting jurisdiction may arise with regard to siting and construction and environmental and safety demands. Operators may face delay due to issues of establishing jurisdiction. In addition, transboundary transfer of CO_2 for sub-seabed storage is currently prohibited under the London Protocol, for those countries that are contracting parties to that instrument.

Gas sector experience indicates that the need to deal with multiple jurisdictions can be a time consuming process, to the extent that in the case of certain cross-border gas transportation projects, dedicated companies have been set up to deal with all relevant authorities. The Nord Stream pipeline project, for example, involved 5 transit states implementing EU Directives in their national law as well as relevant international instruments. Bilateral and multilateral agreements have also been concluded in certain circumstances.

Key recommendations for policy makers coming out of the CATO$_2$ report include: that further guidance should be provided to member states to prevent the emergence of divergent national regulation, which could affect the development of CO_2 transportation infrastructure; that member states should enter cross-border dialogue on consistent regulatory approaches to be applied to future transboundary CCS infrastructure; and that a useful way to regulate transboundary CCS and to harmonise national rules is to form bilateral and multilateral treaties.

Session 7: Regulating CO_2 storage through EOR

The session on regulating CO_2 storage through EOR was chaired by Philip Marston, of Marston Law. IEA's Sean McCoy began the session by delivering a technical and historical overview of CO_2-EOR and reviewing some of the issues that need to be addressed when regulating EOR as a means of CO_2 storage. Sean highlighted three key messages:

1. CO_2-EOR is a technically-proven and well understood process that is applied commercially today.
2. CO_2-EOR results in storage of CO_2, however the resulting emissions reduction benefit is dependent on design of the project and the policy environment.
3. There are barriers to designing and operating a CO_2-EOR project as part of a CCS project that need to be resolved for CO_2-EOR to play a role in reducing emissions.

In CO_2-EOR, CO_2 is injected into an oil reservoir, where it mixes completely with the oil in place, reducing the density and viscosity of the oil and, thus, improving the ability of the oil to flow towards production wells. In some reservoirs, the composition of the oil, and reservoir temperature and pressure, are not conducive to forming a single-phase mixture, and the CO_2 instead drives oil towards production wells. In either case, the mixture of oil, CO_2 and water is separated at the surface and the CO_2 processed (if necessary), compressed and re-injected.

In 2010, there were well over 100 CO_2-EOR projects operating globally, producing upwards of 270,000 bbl oil per day. The majority of these projects are located in the United States, with other projects operating in Brazil, Canada, Trinidad, and Turkey. Between 1984 and 2010, between 600 and 800 $MtCO_2$ were injected, the majority of which came from naturally occurring sources of CO_2. Of the total amount injected over this period, only around half may be stored due to re-injection of produced CO_2. Today, approximately a quarter of the CO_2 purchased for use in EOR is captured from anthropogenic sources, such as natural gas processing. The most notable (and only) example of a CO_2-EOR project that uses captured CO_2 and carries out monitoring, measurement and verification activities sufficient to demonstrate retention of injected CO_2 is the Weyburn-Midale project, located in the Canadian province of Saskatchewan, Canada. The Weyburn-Midale project receives CO_2 from the Dakota Plains Gasification Company, located in the US state of North Dakota. Thus, CO_2-EOR is a relatively well understood process and there is considerable experience in some countries and companies with developing and operating CO_2-EOR projects.

Many studies have been undertaken that examine the net-emissions from typical CO_2-EOR projects; however, these studies have come to widely different conclusions as to whether typical CO_2-EOR projects result in net reductions in CO_2 emissions. The fundamental difference between studies is the boundaries of the analysis—specifically whether the emissions from combustion of the produced oil are attributed to the CCS project. If emissions from combustion of the produced oil are attributed to the project, the question then arises as to whether the products from the project (*i.e.* oil and, presumably electricity where CCS is applied for power generation) are displacing production of other higher-CO_2 intensity products. If the products from the project are displacing those with higher emissions intensity, the lifecycle assessment could take credit for the difference in emissions between the produced and displaced products. It is difficult, however, to know what products, if any, are being displaced. Thus, while these life-cycle assessment studies can inform public policy, they are merely accounting tools and provide no definitive general answers. The actual CO_2 emissions or emissions reduction achieved by a CO_2-EOR project depend on the energy and climate policy environment under which the project operates, in addition to the technical details of the project.

Numerous attributes must be present for a CO_2-EOR project injecting anthropogenic CO_2 be recognized as storing CO_2. These attributes include conducive energy and climate policies that will ensure emissions are avoided; law that clearly defines ownership of relevant resources and allows

recovery or use of these resources; environmental, health and safety regulations to ensure CO_2-EOR in a way that protects the local environment and human health; monitoring, measurement, and verification requirements of a stringency similar to those for other storage options; accounting rules to ensure that emissions reductions are accurately quantified; and well design and abandonment requirements that ensure retention of the injected CO_2. In addition, there may be incentives required to encourage development of CO_2-EOR projects that use anthropogenic CO_2 over other, more attractive investment options.

Sean's review of issues in CCS was followed by a closer look at how countries account for emissions reductions through CO_2–EOR in their national greenhouse gas inventory, presented by Paul Zakkour of Carbon Counts. The international monitoring, reporting, and verification (MRV) rules set out in the IPCC Guidelines for National Greenhouse Gas Inventories (1996, 2000, and 2006) state that CO_2 capture be reported only when linked to long-term storage. This implies that that governments should only subtract the mass of CO_2 captured from anthropogenic sources from emissions (and report it as such) where long-term storage – through EOR or otherwise – is carried out and adequately documented (i.e., "MRV-ed") in accordance with IPCC guidelines. The MRV requirements for storage are relatively extensive, and may not be part of "business as usual" CO_2-EOR projects.

As an example, the US EPA accounts for all CO_2 that is captured from anthropogenic sources for use in CO_2-EOR as emitted to the atmosphere and all CO_2 produced from natural accumulations as stored. This is despite CO_2 from both sources being used in CO_2-EOR projects that do not, in general, perform sufficient MRV to comply with IPCC guidelines. This meant that the US EPA reported the 12 $MtCO_2/y$ captured from anthropogenic sources in 2010 that were used in CO_2-EOR as emitted and the 34 $MtCO_2/y$ produced from natural accumulations that were used in CO_2-EOR as stored.

Other countries, such as Canada, Brazil, Trinidad, and Turkey are less clear about how CO_2-EOR (or any other CO_2 injection) is treated. Thus, Paul concluded that, generally, for CCS and CO_2-EOR there is little transparency and, possibly, consistency in how emissions are reported. This makes it very challenging to identify problems, address issues, and measure progress.

The final presentation of the session was delivered by Ian Havercroft of the Global CCS Institute and Philip Marston, who described a current Global CCS Institute study comparing legal and regulatory frameworks for CO_2-EOR, and frameworks for storage not associated with oil production. Sean McCoy temporarily took over as chair of the session while Philip presented. The objective of the study is to consider the existing regimes for EOR activities, primarily in the US, and their relationship with the nascent regulatory regimes for CCS; examine the 'gap' between these regimes and the potential for a project to incorporate anthropogenic CO_2 into EOR and ultimately transition from EOR to full-scale storage (*i.e.* CCS); and to consider the essential characteristics of a flexible regulatory regime for those jurisdictions with an existing EOR industry.

Ian and Phillip observed that the existing legal and regulatory regimes for CO_2-EOR are well characterised where CO_2-EOR industry exists, and are based on the case law and permitting regimes associated with other resource extraction industries. In these environments, there also tend to be clearly defined roles and responsibilities for national and state or provincial regulators. In these regimes, there are many similarities between the CO_2-EOR regulatory regimes and those being developed for CCS, although some key distinctions remain. In the US, an early "transitional" model is emerging, although it is a lone example and many questions remain about its attractiveness for CO_2-EOR operators.

There are numerous emerging legal and regulatory frameworks for CCS (*e.g.* EU member states under the EU CCS Directive, and individual US states and Canadian provinces under applicable state or provincial laws). These frameworks set the objective as emissions reductions—rather than increased oil production, as is sought in EOR—and tend to adapt a waste management model rather than the commodity model that is prevalent in CO_2-EOR frameworks. A few of these

standards do contemplate a role for EOR, but numerous issues remain to be addressed. For example, in the EU, the EU CO_2 Storage Directive establishes a comprehensive legal and regulatory framework that accepts, in principle, that CCS can be achieved through EOR, but requires any storage to be regulated under the directive.

Ian and Philip's conclusion is that: "operational legal and regulatory frameworks in the US and Canada demonstrate that there are already elements which may successfully accommodate [storage of anthropogenic CO_2] in EOR", although experience is limited in other jurisdictions. Nonetheless, they conclude that there are numerous issues that will need to be addressed relating to incidental storage during "normal" CO_2-EOR operations, the transition from incidental storage to incremental storage during oil production, and incremental storage after the cessation of oil production.

The three presentations were followed by a panel discussion where we heard government perspectives on the challenges of regulating CO_2-EOR for storage. The participants were Mike Fernandez from Alberta Energy; Eva Halland from the Norwegian Petroleum Directorate; and David Hill from the Railroad Commission of Texas (RRC). In his comments, Mike Fernandez emphasised that conventional EOR is a big opportunity for the province from a resource extraction standpoint; however, that it is probably not likely that projects will transition from EOR to storage because there is concern over resource sterilisation, proper site selection, stakeholder engagement, and how these sorts of projects would be treated under the province's scheme for post-closure stewardship.

Eva Halland noted that one of the important factors in determining whether CO_2-EOR projects are economic is the amount of residual oil in place. In the large offshore Norwegian fields, secondary recovery is usually by waterflooding, which results in an average 46% recovery, but approaches 70% in some of the larger fields. The relatively small amount of result of residual oil in place makes it challenging to justify the relatively high up-front cost of converting offshore production infrastructure to handle CO_2. The Norwegian Petroleum Directorate (NPD) undertook a screening study to examine the potential for CO_2-EOR several years ago, and they are in the process of updating the study to assess locations where EOR make more sense than pure storage.

David Hill reviewed the great experience that the RRC has is regulating CO_2-EOR projects. The majority of US projects have been located in the Permian Basin in Texas and these are also some of the longest operating projects (*e.g*. SACROC). The RRC has promulgated new rules for CCS, codified as 16 TAC Chapter 5 (20 December 2010). These new state rules implement technical, financial, legal, and administrative considerations for CCS, and together with existing state rules, address issues related to capture and storage of anthropogenic CO_2 (CCS-a). Dave also reviewed some of the Texas-specific studies that have demonstrated that well regulated CO_2-EOR projects have little or no impact on groundwater resources and retain the injected CO_2.

One of the points that came up in discussion highlighted that, while there is a lot of anecdotal evidence (and an increasing body of research) that points to CO_2-EOR is an effective means of storage, there is a lack of data in the public domain. This will likely be addressed as data collected under the US Mandatory Reporting Rules for CCS and from CO_2-EOR (i.e. 40 CFR part 98 subparts RR and UU) are reported and made publically available. Nonetheless, because much of this evidence and research is focused on US operations, there is a need to understand how it translates into other national contexts.

Session 8: Incentive policies for CCS

IEA energy analyst Sean McCoy chaired session 8 on incentive policies to support CCS demonstration and wide-scale deployment. Wolf Heidug of the IEA presented the results of IEA publication *A Policy Strategy for Carbon Capture and Storage*, which was released in January 2012.[20] In addition to the development of legal and regulatory frameworks for safe and effective storage, CCS deployment requires strong incentives from government. This is necessary to stimulate new markets, address market barriers and failures (e.g. the absence of a price on CO_2 emissions), reduce risk for early-movers and promote learning, and encourage infrastructure development.

Given that CCS deployment will not happen without additional financial and policy action to support demonstration and wide-scale deployment, the publication therefore sets out guidance for CCS policy makers on how incentive policy design can support CCS technology uptake, from demonstration to wide-scale deployment. It specifies how overall CCS policy architecture and individual policy instruments can support conditions for CCS deployment in a way that maintains the balance between policy certainty and flexibility, as CCS develops.

While CCS technologies remain relatively untested on an integrated, large-scale, incentive policies should initially aim to overcome technical and commercial barriers and support technology learning, through technology-specific support for both capital deployment[21] and the operation of capture units, networks and storage.[22] Assuming CCS technologies progress as intended, policies should eventually evolve to technology-neutral incentives to reduce emissions (*i.e.* cap-and-trade schemes, carbon taxes) that will support mass deployment of CCS when it is cost-effective in relation to other abatement options.

When shifts in policies occur will depend on how CCS and other low-carbon options develop, but governments can provide some certainty to industry by setting clearly defined break points or "gateways" that indicate when or if policy will move to a further stage. For example, a first gateway, where policies move from instruments such as capital grants, operating subsidies and loan guarantees to a quantity support mechanism, may be triggered based on CCS technologies demonstrating technical feasibility on an integrated basis at scale, passing a first cost threshold, and confirmation of storage capacity availability.

The publication also covers bioenergy with CCS (BECCS). Among the many applications of CCS, BECCS is of particular interest because it offers the potential not only to reduce emissions, but also to actually *remove* CO_2 from the atmosphere. An additional incentive targeted specifically at BECCS may help to realise its potential, but it would only be fully effective in combination with an update of accounting policy and methods to account for emissions from land-use change.

Alice Gibson of the Global CCS Institute then presented on a recent publication looking at funding mechanisms to support large-scale CCS demonstration projects in developing economies. *Funding CCS in Developing Countries*[23] was released at the third Clean Energy Ministerial (CEM, London, April 2012). The publication is the output of a working group established following CEM 2, following a recommendation of the Carbon Capture, Use and Storage Action Group to energy ministers to identify and advance appropriate funding mechanisms to support the demonstration of large-scale CCS projects in developing economies.[24] The working group included the Global CCS Institute, the Asian Development Bank, the World Bank and World Resources Institute; the Australian

[20] www.iea.org/papers/2012/policy_strategy_for_ccs.pdf

[21] *I.e.* through grants or provision of debt or equity capital.

[22] Through, for example, incentive mechanisms supplementing revenue per unit of output.

[23] Available at www.globalccsinstitute.com/

[24] This recommendation formed part of a suite of recommendations delivered by the CCUS AG to energy ministers at CEM 2: see www.cleanenergyministerial.org/our_work/carbon_capture/index.html and page 2 at www.iea.org/newsroomandevents/news/2012/april/name,26644,en.html

government, the Clinton Climate Initiative, the IEA and the UK government also provided support in development of the publication.

A key impediment to the development of CCS in developing countries is that there is a lack of commercial or market based incentives to justify the "extra" costs and risks of CCS. Public funding is required to address this market failure, including failure of the market to put a price on carbon, and the imbalance between risk and reward for first movers (*i.e.* where first movers take on all the risk, but subsequent operators reap the reward of reduced technology costs). Public funding can help expand CCS knowledge and learnings and lower costs to a point where they are more viable. This is similar to the support required for other low-carbon technologies, such as renewables. Policy support is justified by the strong climate change case for CCS; the IEA estimates that CCS will contribute around 20% of required emissions reductions by 2050, with non-OECD countries to have captured more CO_2 than OECD countries by 2050.

Key messages and recommendations on financial mechanisms to support demonstration in developing economies include that, in the short term (to 2015), additional funding of USD 150-200 million be made available for CCS enabling and pre-investment activities in developing countries. This is to enable between 5-10 demonstration projects to proceed to final investment decision by around 2015. The United Kingdom announced GBP 60 million in response to this call for funding. The report identifies a number of potential funding vehicles that could be used to deliver these funds. The report also recommends that donor countries seek to lift the exclusion of CCS in the Clean Technology Fund; donor and developing countries engage in bilateral and/or multilateral project support; and developing countries seek complementary funding for capacity building activities under the Global Environment Facility. In the medium term, it recommends that dedicated CCS funding in the order of USD 5 billion be made available for the "extra" CCS costs of construction and operation of demonstration projects.

In terms of next steps, the working group is planning to: consult further with developing and developed country governments regarding which funding vehicle they prefer and why, and what the key principles and funding criteria might be under each funding vehicle; and identify any barriers preventing implementation of the recommendations, and if applicable, make recommendations to Clean Energy Ministers and officials to address these barriers.

Closing session: Network discussion and wrap-up

IEA consultant Lachlan Tait from Baker & McKenzie's Sydney office opened the final session with a presentation on a key Network initiative commenced by the IEA in 2012: the development of a publicly-available, internet accessible database of existing CCS law and regulation. The *IEA International CCS Law and Regulation Database* (CCS Database) will consolidate and make more accessible information on key global approaches to a broad range of CCS regulatory issues, building on IEA progress tracking and facilitating CCS regulatory developments world-wide. It is intended to:

1. Enable the IEA to respond more effectively to requests from governments and other stakeholders for detailed guidance on CCS regulatory approaches and developments across various jurisdictions.
2. Support ongoing efforts by national governments to implement regulatory frameworks for CO_2 storage, by facilitating access to information on existing and emerging frameworks.

The target audience for the *CCS Database* will be CCS policy makers, policy analysts and other individuals who are likely to support or advise governments in the development of CCS regulation, including lawyers, academics and industry. The *CCS Database* will catalogue, both in high-level summary form and by inclusion of relevant legislative extracts, how relevant legal instruments address key regulatory issues associated with CCS, as derived from regulatory issues identified in

the IEA's 2010 *Carbon Capture and Storage Model Regulatory Framework* (*Model Framework*).[25] Users will be able to gain an understanding of whether and how a particular jurisdiction deals with any particular regulatory issue, and how specific issues are addressed across multiple frameworks. The *CCS Database* is being developed in collaboration with Baker & McKenzie (Sydney) and UCL-CCLP, amongst others.

The meeting concluded with a general discussion of activities the Network could undertake to build on work to date and better support global CCS legal and regulatory development, led by Justine Garrett and Sean McCoy of the IEA. A key theme emerging from the session was that participants would like to see theme-based meetings or sessions on specific CCS regulatory issues feature more predominantly in Network activities. The Network meetings have been tending more and more to a "lessons learnt" approach over the past two years – as opposed to a purely update-based approach – and, based on the feedback from this year, the IEA will continue to move in this direction.

Participants also felt that it would be good to see enhanced participation from industry, to draw on industry experience with CCS regulation and feed that experience into ongoing framework development. The IEA will look at ways in which it can more effectively engage industry in Network activities over the coming year.

Finally, it was suggested that it would beneficial for the IEA to produce a technology-focussed publication that highlights global experience with CCS technologies. This would seek to respond to the notion that "CCS is an unproven technology"; while CCS technologies are not yet commercial and more experience is required with industrial scale applications of CCS, the various elements of the CCS chain are proven and are currently used in multiple applications around the world. Such work would necessarily build on the 2005 IPCC Special Report on CCS, which clearly highlighted the fact that each part of the CCS chain is currently undertaken commercially.

The IEA is embarking on a process to revise its 2009 CCS Roadmap in 2012/ 2013 and could potentially consider how it might incorporate a "technology status" update within this publication, to highlight how far knowledge and experience with CCS has progressed.

Further information

For further information on the 4th meeting of the IEA International CCS Regulatory Network or on the Network generally, please contact:

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[25] www.iea.org/ccs/legal/model_framework.pdf

Annex 1: Meeting agenda

4th IEA International CCS Regulatory Network Meeting
International Energy Agency
9, rue de la Fédération
75015 Paris, France

Day 1: Wednesday, 9 May 2012

08:30	Registration & coffee	
09:00	Opening session: Welcome and introductions	
	Welcoming remarks	Maria van der Hoeven, Executive Director, IEA
	CCS analysis at the IEA	Juho Lipponen, IEA
	CCS legal and regulatory analysis at the IEA and introduction to the meeting themes	Justine Garrett, IEA
09:30	Session 1: Challenges facing CCS and recent advances	Chair: Juho Lipponen, IEA
	Stepping-up to the CCS deployment challenge	Sean McCoy, IEA
	CCS project developments	Ian Havercroft, Global CCS Institute
	Next steps for CCS in the CDM and beyond	Marianna Bolshakova, UNFCCC
	International marine treaty developments	Luke Warren, Carbon Capture and Storage Association
	Open discussion	
11:00	Coffee	
11:30	Session 2: Recent developments- Australia and the Americas	Chair: Sean McCoy, IEA
	Australia	Steve Tantala, Department of Resources, Energy and Tourism
	Western Australia	Colin Harvey, Department of Mines and Petroleum
	Canada	Kathryn Gagnon, Natural Resources Canada and Colin Alie, Environment Canada
	United States	Melisa Pollak, University of Minnesota
	Open discussion	
13:00	Lunch	
14:00	Session 3: Recent developments- Europe	Chair: Richard Macrory, University College London
	Transposition of the EU CO_2 Storage Directive: process and current status	Martina Doppelhammer, European Commission
	Key legal issues arising from transposition	Chiara Armeni, University College London
	Panel discussion: Implementing the EU CO_2 Storage Directive	Brian Allison, Department of Energy and Climate Change, United Kingdom Almut Fischer, Federal Ministry of Economics and Technology, Germany Helena Fabra, Ministry of Agriculture, Food and Environment, Spain Lionel Perrette, Ministry for Ecology, Sustainable Development, Transport and Housing, France Hans Schoenmakers, ROAD Project, Netherlands
15:30	Coffee	

16:00	Session 4: Recent developments- Africa and Asia	Chair: Tom Mikunda, ECN
	Malaysia	Datuk Loo Took Gee, Ministry of Energy, Green Technology and Water
	Botswana	Tebogo Segwabe, Geological Survey of Botswana
	South Africa	Muzi Mkhize, Department of Energy
	Open discussion	
17:10	Emerging CCS Standards	Jeff Walker, CSA Standards
17:30	Closing remarks	
19:30	Dinner	

Day 2: Thursday, 10 May 2012

09:00	Recap of Day 1	Juho Lipponen, IEA
09:10	Session 5: Assessing risk and managing liability	Chair: Bernard Frois, CEA
	Framing the liability discussion	Andrew Beatty, Baker & McKenzie
	Quantifying risk	Jonathan Pearce, British Geological Survey
	Analogues for liability management	Chris Clarke, University College London
	Panel discussion: Experiences to date	Mike Fernandez, Alberta Energy Ian Havercroft, Global CCS Institute Lionel Perrette, Ministry for Ecology, Sustainable Development, Transport and Housing, France
10:30	Coffee	
11:00	Session 6: Getting down to details	Chair: Justine Garrett, IEA
	Competition between resources	Greg Leamon, Geoscience Australia
	3rd party access to CCS infrastructure	Brian Allison, Department of Energy and Climate Change, UK
	Trans-boundary issues	Tom Mikunda, ECN
	Key open issues in the Alberta RFA	Mike Fernandez, Alberta Energy
	Open discussion	
13:00	Lunch	
14:00	Session 7: Regulating EOR for storage	Chair: Philip Marston, Marston Law
	Global impacts and issues with CCS through EOR	Sean McCoy, IEA
	Accounting for emissions reductions in international greenhouse gas inventories	Paul Zakkour, Carbon Counts
	Legal and regulatory gaps between the regulation of EOR and geologic storage	Ian Havercroft, Global CCS Institute and Philip Marston, Marston Law
	Panel discussion: Government perspectives	Mike Fernandez, Alberta Energy Eva Halland, Norwegian Petroleum Directorate David Hill, Railroad Commission of Texas
15:30	Coffee	
16:00	Session 8: Incentive policies for CCS	Chair: Sean McCoy, IEA
	A policy strategy for CCS	Wolf Heidug, IEA
	Incentivising CCS in developing countries	Alice Gibson, Global CCS Institute
	Open discussion	
16:50	Closing Session	Chairs: Justine Garrett and Sean McCoy, IEA
	IEA CCS Law and Regulation Database	Lachlan Tait, Baker & McKenzie
	Discussion of open issues and wrap-up	
	How can the network help you?	
17:30	Close	

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