TABLE OF CONTENTS:

ABSTRACTS AND SPEAKERS' BIOGRAPHIES	2
CHAIRS' BIOGRAPHIES	52
LIST OF PARTICIPANTS	55

ABSTRACTS AND SPEAKERS' BIOGRAPHIES

Session 1: Overview and context

The Potential of Air Capture

Klaus S. Lackner
Columbia University

Abstract
Even without arguing the fine points of climate change predictions, the case for stopping carbon dioxide (CO_2) emissions is persuasive. CO_2 in the air matters. CO_2 is an important greenhouse gas; it is physiologically important to plants and animals; and excess CO_2 in the air acidifies the ocean. Equally important, CO_2 accumulates in the air. Once emitted, its removal from the world's mobile carbon pools, i.e. the air, the ocean and biomass, will take tens of thousands of years. It will take many hundreds of years before the ocean will establish a new equilibrium with the air. Substantively slowing down the rise in CO_2 concentrations can only be achieved if the world's per capita CO_2 emissions drop to a few percent of today's per capita emissions in the developed countries. There are only two ways to stabilize the CO_2 level in the atmosphere: abandon fossil fuels, or find a way of capturing the CO_2 that is unavoidably produced in the consumption of fossil fuels. Carbon dioxide capture and storage (CCS for short) enables the second approach. Without some form of CCS, fossil fuels would need to be outlawed in a matter of decades. CO_2 capture at big sources, like power plants, is technically feasible. Capture would add cost and reduce efficiency. Novel plant designs could integrate capture of CO_2 with eliminating other pollutants at high efficiency. Such plants are still far from practical implementations. The far bigger challenge is CO_2 storage. Century scale storage volumes far exceed the carbon currently stored in trees and other biomass. Relying on fossil fuels throughout the 21st century, the world could easily produce 5000 Gigatons of CO_2, matching the amount of water in Lake Michigan. Storage options include ocean disposal, underground injection, and mineral sequestration. Ocean disposal is limited in scope. It raises environmental issues and would not confine CO_2 for a sufficient time. Mineral sequestration, which accelerates the natural process of geological weathering of forming carbonates from rock and CO_2, has virtually unlimited storage capacity and storage time. However, costs are still too high. Underground injection, also known as geological storage is the method closest to practical implementation. There are many underground reservoirs that could accommodate large volumes of CO_2. The injection technology and reservoir engineering are well understood. Injection costs are minimal. However, geological storage still needs public acceptance, which depends on a good understanding of the safety and environmental

issues as well as a credible accounting and verification regime. This will require a strong regulatory framework. CO_2 capture at large concentrated sources could only address half of all emissions, leaving out the transportation sector. Hence the continued use of petroleum which mainly goes to transportation fuels depends critically on the option of collecting CO_2 directly from the air. Air capture of CO_2 can be performed far away from the source. Air capture is feasible, but still has to be demonstrated in a commercial setting. A successful implementation would enable the continued use of liquid hydrocarbon fuels, and make it possible to recapture CO_2 that gradually leaked from storage sites. This last option could affect how CO_2 storage will be regulated.

Biography

Klaus Lackner is the Ewing Worzel Professor of Geophysics, Director of the Lenfest Center for Sustainable Energy at the Earth Institute and the Chair of the Department of Earth and Environmental Engineering at Columbia University. Lackner's current research interests include carbon capture and sequestration, air capture, energy systems and scaling properties, energy and environmental policy, and zero emission modeling for coal and cement plants.
Lackner's scientific career started in the phenomenology of weakly interacting particles. He participated in matter searches for particles with a non-integer charge in an experiment conducted at Stanford by Martin Perl and his group. After joining Los Alamos National Laboratory (LANL) in 1983, Lackner became involved in hydrodynamic work and fusion-related research. He was instrumental in forming the Zero Emission Coal Alliance and was a lead author in the IPCC Report on Carbon Capture and Storage.
Lackner earned his degrees from Heidelberg University, Germany: the Vordiplom, in 1975; the Diplom (or M.S.) in 1976; and his Ph.D. in theoretical particle physics, summa cum laude, in 1978. He was awarded the Clemm-Haas Prize for his outstanding Ph.D. thesis at Heidelberg University. Lackner was also awarded the Weapons Recognition of Excellence Award in 1991 and the National Laboratory Consortium Award for Technology in 2001.

Session 1: Overview and context

Stuart Haszeldine
University of Edinburgh

A geologist by initial training, Stuart has worked on coal, oil and gas deposits, with a wide interest in fossil fuels, radioactive waste disposal and environmental impact. He is Professor of Geology at the University of Edinburgh, and his current research examines geological storage of CO_2, in the context of climate change and changing energy use. He is a topic leader for the Carbon Management theme of the UK Energy Research Centre (www.ukerc.ac.uk). He leads the UK's largest university research group for CO_2 storage and capture (at Edinburgh, Heriot-Watt and British Geological Survey at Edinburgh) (www.geos.ed.ac.uk/sccs/) and is co-leader of the academic UK Carbon Capture and Storage Consortium (www.geos.ed.ac.uk/ccs/). He was a technical advisor to the House of Commons Science and Technology Committee on CCS in 2006 and is currently (2007-10) a member of the independent ACCAT committee advising UK Government (DECC) on Carbon Abatement Technologies.

He has provided numerous comments on Carbon Capture and Storage to the print radio and TV media, and is invited speaker on CCS at public and technical conferences.

Session 1: Overview and context

Carbon Capture and Sequestration – an OEM's Perspective

Norm Shilling
GE Energy

Abstract

A primary focus of study and discussion on CCS has been the policy, regulatory, and liability issues associated with the subsurface injection and storage of CO_2. As an OEM that is commercially offering IGCC with carbon capture, GE's focus has been the requirements of carbon capture necessary for the utility market. A power plant's primary mission is to produce reliable power to the grid. When carbon capture is required, the plant must also produce CO_2 that meets certain specifications with respect to allowable impurity levels for transport and compatibility either with the sequestration geochemistry or with enhanced hydrocarbon recovery. Interoperability between carbon capture and a sequestration facility must accommodate the potential modes of operation of both and incorporate them in the overall integrated CCS system design. For example, power plants periodically shut down for maintenance or reduce load, as demand requires. This will impact the quantity of CO_2 delivered to the sequestration facility. Similarly, the storage facility may, from time to time, not be able to accept all of the CO_2 produced. In order to accommodate these modes and integrated design and operational procedures, GE and Schlumberger have collaborated on defining the interface between carbon capture and storage. There are also potential regulatory issues that will need resolution.

The EPA issued its endangerment finding that CO_2 is a pollutant subject to regulation under the Clean Air Acts. However, applying the current regulatory and enforcement framework for criteria pollutants has the potential to be especially problematic for CCS. In the development of CCS regulations, consideration needs to be given to "no-harm/no foul" provisions for potential negative outcomes even with good-faith effort to implement CCS. Examples include the potential for temporary reductions or cessation of CO_2 sequestration necessitated by well plugging, unanticipated plume movement or failure of confining cap rock. While experience will reduce the probability of such events, the complexity of geologic formations will not provide the performance certainty achieved with AQC equipment.

An implication of EPA's rulemaking for Final Mandatory Reporting of Greenhouse Gases is that credit for CCS will require verification through monitoring, measurement and verification of CO_2 storage. Related to this issue, several states have set a standard of no more than 1% leakage over 1,000 years. Such a level (0.001%/yr) will be difficult to verify, and a 1,000-year term or performance will be difficult for a commercial entity to accept. Therefore, regulators should be encouraged not to define a specific standard for long-term retention of CO_2 in a geological storage formation. Instead, site-

specific standards should be set that are based on risk and the need to control emissions of CO_2 to the atmosphere.

This is not a comprehensive summary of the issues with CCS but those that will have to be addressed. Overall, an effective regulatory approach dealing with both the process and the subsurface components of CCS should be performance-based. Other than defining detailed requirements, project risks should be adaptively managed as field experience yields more insight about the specific geological formation that is being used.

Biography

Dr. Shilling is government policy manager for GE Gasification at GE Energy. Norm has over 20 years of experience in the power industry. Previous to his current role, he was Product Line Leader for IGCC. At GE Corporate R&D he was program manager for environmental systems engineering, thermal systems and low-emissions diesel development. As Environmental Systems manager, he collaborated with GE businesses on pollution prevention and efficiency initiatives. Norm has also served in Strategic Technology Planning for GE.

His background in utility power generation includes Advanced Engineering Manager at GE Environmental Systems where he was responsible for the development and application of advanced scrubbers and particulate controls for utility power plants. His experience also includes nuclear steam generator development at Westinghouse and advanced automotive power-plant development at General Motors. Norm holds an SM degree from MIT and BS and D.Sc. degrees from New Jersey Institute of Technology. He has taught in the graduate engineering school at Penn State University and is a licensed Professional Engineer.

Session 2: Legal issues associated with capture technologies

Regulating CCS: Lessons from Illinois

David P Hackett
Baker & McKenzie

Abstract
Achieving the goals of the GCCSI to deploy 20 commercial scale CCS projects by 2020 will require a concerted effort to identify the legal and policy issues related to, among other things, permitting and approvals within various governmental authorities. As part of that effort, the following questions warrant consideration: What permits are needed? Which laws and regulations currently apply? What amendments or new laws may be needed? What is the current relationship between local, state and federal governments in respect of permitting? How should you address construction, operations, long-term monitoring, site closure and post-closure responsibilities (including the liability for long-term storage of carbon)? These questions all relate to the broader question of how to achieve a streamlined process that enables rapid scalability while ensuring environmental and public safety protections are maintained?

These were some of the considerations that were contemplated during the efforts of Illinois to attract the FutureGen project. The idea behind that project was to not only be a model for how the technology works, but also a learning tool for the policy and regulatory frameworks to support CCS.

Biography
Mr Hackett is the North American managing partner of Baker & McKenzie. His practice concentrates on the representation of multinationals in US and international environmental matters. He has litigated a number of major US civil and criminal environmental cases. He has assisted numerous multinational companies with environmental issues in over 50 countries, as well as multiple matters relating to international environmental treaties and multilateral lenders. Mr Hackett also regularly assists companies and financial institutions with environmental issues in US and multi-country transactions.

Mr Hackett has considerable experience managing diverse international environmental legal projects, namely, air, water, solid and hazardous waste, toxic substances and underground storage tank matters. He has extensive experience in counseling, negotiation and litigation on behalf of multinational clients regarding state, federal and foreign civil and criminal environmental matters.

Mr Hackett is the author of multiple articles published in *The Environmental Corporate Counsel Report; The Environmental Counselor; American Bar Association Journal; Yearbook on International Environmental Law; The American University Journal of International Law and Policy; Natural Resources, Energy and Environmental Law: The Year in Review; European*

Economic Community; Product Liability Rules and Environmental Policy; Chemical and Radiation Waste Litigation Reporter; The Environmental Forum; and *The Natural Resources Lawyer*.

Mr Hackett is a member of the Business Law, International Law and Environment and Natural Resource sections of the American Bar Association. He is past chairman of the American Bar Association Committee on International Environmental Law.

He was awarded his BA from Haverford College in 1976 and received his Juris Doctorate from the University of Pennsylvania in 1981. He was admitted to practice law in Illinois in 1990, and Washington, DC in 1981.

Session 2: Legal issues associated with capture technologies

Treatment of Carbon Capture Under Greenhouse Gas Regulatory Programmes

Robert R Nordhaus
Van Ness Feldman and George Washington University Law School

Abstract

Carbon capture technologies raise a host of legal issues, including siting and permitting requirements under existing environmental law, liability for downstream operations, and treatment of carbon capture under a greenhouse gas (GHG) regulatory program. This presentation will focus on the last issue: How will carbon capture be treated for regulatory purposes under the varied proposals currently under consideration for control of GHG emissions from stationary sources?

If the United States Environmental Protection Agency (EPA) proceeds with its current proposals to regulate GHGs under the existing Clean Air Act stationary source GHG regulation will proceed through direct controls of GHG emissions from large stationary sources. Performance standards or Best Available Technology requirements may ultimately have the effect of requiring carbon capture and sequestration (CCS) for power plants and other large stationary sources fueled by coal, petroleum, coke, and perhaps other fuels. Users of carbon capture technologies will be required to show both capture and ultimately sequestration, and will be subject to penalties or make-whole requirements if captured GHGs ultimately return to the atmosphere.

If, on the other hand, GHG regulation relies on a cap-and-trade program, the legal regime for carbon capture can take a much different turn, depending on program design. Under a program with a "downstream" point of regulation, large stationary sources are regulated directly and must surrender allowances to cover their GHG emissions. To the extent a quantity of GHGs is captured and sequestered, these GHGs are treated as avoided emissions. No allowances need to be surrendered for these GHGs, so long as the source shows they are in fact sequestered and not subsequently leaked back to the atmosphere. However, under an "upstream" program where fuel providers surrender allowances to cover the carbon content of fuels distributed in commerce, the avoided emissions model for CCS will not work. The emitter has no allowance surrender requirement and no incentive to capture and sequester. Here, some form of credit mechanism is required, under which the stationary source receives an allowance credit (equal in value to an allowance) for each ton of GHG captured and sequestered. Finally, because most cap-and-trade programs do not cover all sources of GHG emissions, sources in uncapped sectors will have no incentive to capture and sequester, unless some form of offset or similar credit is provided for capture and sequestration.

The discussion above centers on cap-and-trade; however, most of the same considerations would be applicable to a carbon tax, which must grapple with

point of taxation issues that are parallel to the point of regulation issue under a cap-and-trade program.

Biography

Bob Nordhaus is a member of the Washington DC law firm of Van Ness Feldman, P.C., where he specializes in energy and environmental regulation.

Mr Nordhaus originally jointed Van Ness Feldman in 1981, after serving three years as the Federal Energy Regulatory Commission (FERC)'s first General Counsel. He practised with the firm until 1993, when he was appointed General Counsel of the Department of Energy by President Clinton. He rejoined the firm in 1997.

In 1977, prior to his service at FERC, Mr. Nordhaus was a member of the Energy Policy and Planning Office in the Carter White House. In 1975 and 1976, he was counsel to the House Interstate and Foreign Commerce Committee, and from 1963 to 1974, he served in the House Legislative Counsel's Office.

Mr. Nordhaus currently serves on the adjunct faculty of the George Washington University Law School, and was Adjunct Professor of Law at Georgetown University Law Center from 1980 to 1985.

He is a graduate of Stanford University and Yale Law School and a member of the New Mexico, District of Columbia and Supreme Court bars.

Session 2: Legal issues associated with capture technologies

Legal Issues Associated with Capture Technologies in Canada

Henry Krupa
Lang Michener LLP

Abstract

Canada's current situation can be stated succinctly: Canada has numerous large final emitters of CO_2 and enormous potential for the geologic storage of CO_2, but its legal regimes for carbon capture and storage (CCS) are regionalized and not comprehensive, and large scale CCS projects have not been economic. Paradoxically, Canada has significant experience with CCS technologies. For more than two decades economic benefits have been extracted from Canada's abundant fossil fuel reserves, natural gas deposits, including unconventional natural gas resource opportunities in deep gas, tight gas, gas-containing shales, coalbed methane, geopressurized zones, and its coal reserves, by using CCS technologies. The Weyburn, Saskatchewan CO_2 Monitoring and Storage Project, is the best known example. This project is an international undertaking which utilizes US generated CO_2 for enhance oil recovery in a large Canadian reservoir. This is the largest CO_2 storage project in the world.

A number of factors have contributed to Canada's current situation. First, the regulation of CCS undertakings is primarily a provincial not a federal responsibly, except for the northern territories and offshore. Consequently, the laws regulating CCS have developed to reflect each province's experiences and in pace with their needs.

Second, the geological formations that are appropriate for CCS are not uniformly distributed across the country. Alberta, Saskatchewan and parts of British Columba, the former two provinces being responsible for a large proportion of Canada's national CO_2 emissions, are situated on a geological structure that favours the development of CCS undertakings. Ontario, on the other hand, which is Canada's largest CO_2 emitter, has limited favourable geological structures, mineralogy and hydrogeology. Accordingly, there are limited opportunities for Ontario to engage in CCS undertakings even if there is the political or economic will to do so.

Finally, there has been uncertainty regarding Canada's Kyoto commitment occasioned by a lack of action on the part of both the federal and provincial governments. The failure of political leadership is manifested in both the regulatory regimes governing CCS and by the lack of incentives to pursue CCS technologies. For this reason until recently, exploiting the geological disposal of CO_2 to stabilize or reduce anthropogenic emissions to the atmosphere has been a secondary consideration to the direct economic benefit derived from using CO_2 to enhance resource recovery. This situation has changed considerably with many provinces now mandating a reduction in greenhouse gas (GHG) emissions, setting caps and imposing a carbon tax.

The federal government has also declared CO_2 to be a toxic substance, but not one for virtual elimination. This leaves CO_2 subject to life-cycle management. As part of its strategy to reduce GHG, the federal government has expressed its intention to require oil-sands and coal-fired power facilities that come on stream after the end of 2011 to implement a CCS strategy. As well, following Copenhagen, the federal government announced a new absolute GHG emission reduction target. Alberta, as befits its status as one of the world's premier oil and gas producing jurisdictions, has targeted an Alberta-wide 50% reduction in GHG emissions by 2020 relative to 1990 levels. Alberta has also implemented a CCS strategy to support the development of large scale CCS projects. However, while CO_2 sequestration to reduce anthropogenic emissions is now viewed as important as the use of CO_2 for resource recovery, the approach of each jurisdiction to fundamental legal issues regarding property (pore-space ownership and surface rights), regulation (approval and post-closure regulation) and liability (legal, remedial and accounting liability) issues generally relies on legal regimes that evolved from that that governed mineral and oil and gas exploitation. In some ways these legal issues are adequately addressed. Yet, in other ways, CCS technologies utilized to stabilize anthropogenic emissions raise legal issues that have not had to be considered when the technologies were employed earlier. Those Canadian jurisdictions that have had to address the use of CO_2 for resource recovery or that have dealt with acid gas disposal operations, offer an excellent opportunity to examine the legal issues related to effective CCS deployment.

Biography

Mr. Krupa received his legal education in Canada and the United Kingdom and has received a Master of Laws in Environment, Energy and Natural Resources Law and Policy with honours. He was called to the Bar of the Law Society of Upper Canada in 1989. Mr. Krupa is Counsel to the law firm of Lang Michener LLP, where his practice is restricted to environmental, energy and government relations with particular emphasis on environmental and resource approvals, compliance and enforcement and energy law. Mr. Krupa was formerly the Legal Director of the Ontario Ministries of the Environment and of Energy and an Adjunct Professor in the Faculty of Laws at the University of Western Ontario. Mr. Krupa has also taught at law schools in United States and the United Kingdom. Mr. Krupa writes and speaks regularly on environmental and energy matters.

Session 3: CO_2 transportation for storage – Regulatory perspectives

CO_2 Pipeline Systems: Assessment of the Risks and Health & Safety Regulations

Ioannis Chrysostomidis[1], **Alicia Smith[1]**, Mark Bohm[2], Eric Beynon[2] and Arthur Lee[3]
[1]Environmental Resources Management, *[2]Suncor Energy Inc,[3]Chevron Corporation*

Abstract
The widespread deployment of CCS to address climate change will require the construction and operation of a large network of pipeline systems to transport the CO_2 from the capture facility to storage sites. Because of the expected scale of these systems and the properties of the CO_2 being transported, CCS pipeline systems will require different approaches for risk assessment and regulation as compared to other, more common gases, such as natural gas. There is also a general lack of knowledge amongst stakeholders around the safety issues of CCS, which must be addressed to achieve acceptance.

This paper will outline the results of a study, commissioned by the CO_2 Capture Project (CCP) and completed by Environmental Resources Management (ERM) to better understand these considerations. This will include:

- Providing a comparative overview on the risks posed by natural gas, sour gas, and CO_2 pipelines. This will be done on a qualitative basis, and will identify gaps in current knowledge for performing risk assessments.
- Reviewing safety regulatory requirements for pipelines in general, with a special focus on CO_2 pipelines where these exist. This will include interviewing regulators in a number of jurisdictions, including Canada, US, UK and Europe.
- Characterizing the current state of acceptance of CO_2 pipelines from NGOs and other stakeholders that could have an influence on the implementation of regulations and oversight for CO_2 pipeline systems.

Understanding the risks and achieving stakeholder acceptance will be a key element in securing a 'license to operate' for CCS facilities, and this paper moves this issue forward by framing the issues and recommending future steps.

Biography
Alicia Smith is working as a Partner in the Impact Assessment and Planning Group. She has over 15 years of experience in the environmental consulting field working as part of and leading teams primarily focused on development projects (e.g., NEPA, Equator Principles).

Ms. Smith began her career working in chemical plants and refining facilities doing remediation, wastewater treatment, and risk assessment work for major

oil and gas clients. She then carried out environmental impact assessment and audit work for the U.S. Navy, U.S. Army Corps of Engineers, Federal Highway Administration, and land developers. Ms. Smith has worked on licensing projects for liquefied natural gas (LNG) terminals, pipelines, and gas storage facilities, as well as siting/routing/ NEPA studies for electrical transmission lines, power plants, and hydroelectric projects. More recently, Ms. Smith has worked on a variety of renewable energy (wind, solar, biofuels, etc.) and carbon capture projects.

All of this work also entails obtaining permits or clearances from a variety of environmental regulatory agencies, including clearances for protected species and biological resources. She is very familiar with biological/coastal/water resource issues and the environmental agencies regulating these resources. In addition, she has supported hurricane damage assessments, floodplain re-development, and after the fact permitting for emergency response work. She also has significant experience in due diligence work, including work associated with acquisitions, divestitures, compliance audits, and site assessments for a wide variety of clients, including power plants, pipelines, manufacturing facilities, electrical facilities, beverage plants, and chemical plants throughout the United States, Mexico, Central America, South America, and China.

Session 3: CO_2 transportation for storage – Regulatory perspectives

Carbon Capture and Storage and Ocean Fertilization: Developments Pursuant to the London Protocol

Rosalie Balkin
International Maritime Organization

Abstract

In her presentation, Dr. Balkin will brief the Symposium on developments that have taken place under the aegis of the International Maritime Organization (IMO) with regard to CO_2 sequestration in sub-seabed geological formations and ocean fertilization. Both of these issues have been pursued in the context of the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Protocol). These developments were prompted by the concern of Contracting Parties to the London Protocol about the implications for the marine environment of climate change and ocean acidification due to elevated concentrations of CO_2 in the atmosphere.

The first part of the presentation, on CO_2 sequestration in sub-seabed geological formations, will address several questions, including why CO_2 sequestration? And why the need for international action? It will then address CO_2 sequestration as a dumping activity within the framework of the London Protocol. In this connection, it will trace developments from 2006, when discussions first began in earnest, and inform the Symposium of the content and effect of the new rules and related measures which have now been adopted. It will discuss, in particular, the issues arising from CO_2 sequestration in transboundary sub-seabed geological formations and the amendment adopted in October 2009 to article 6 of the London Protocol, which prohibits the export of wastes and other matter.

The second part of the presentation aims to inform the Symposium of discussions that have taken place within the context of the London Convention and Protocol relating to large-scale iron fertilization of the oceans to sequester CO_2. This practice is aimed at drawing down an additional amount of surplus CO_2 from the atmosphere into the oceans for sequestration purposes. The presentation will show that this exercise is very much a “work in progress”, and that those involved are making cautious progress, in view of the concern that knowledge about the effectiveness and the potential environmental impact of ocean fertilization is currently insufficient to justify large-scale operations other than legitimate scientific research, which could have negative impacts on the marine environment and human health. The presentation will, in this connection, inform the Symposium about the work and recommendations, if any, of an Intersessional Working Group on Ocean Fertilization under the London Protocol that is due to meet from 1 to 5 March 2010 to focus on deepening the understanding of the implications of legally binding options and so enable the informed consideration and discussion on

this issue by the governing bodies of the London Convention and Protocol, in October 2010.

Biography

Dr. Rosalie Balkin is Director of the Legal Affairs and External Relations Division, IMO (London), a position she has held since 1998. Her duties include advising the Secretary-General on all legal issues associated with the functioning of the Organization, with special emphasis on matters of treaty law and those relating to the law of the sea. She also has particular responsibility as secretary for the Organization's Legal Committee, which meets twice annually and she oversights the Organization's role as depositary for the 51 multilateral conventions adopted under the aegis of IMO.

She was previously Assistant Secretary in the Office of International Law at the Federal Attorney-General's Department in Canberra, Australia in which capacity she advised the Government on matters of public international law. Dr. Balkin has also held academic posts at a number of universities, including the University of the Witwatersrand in Johannesburg, South Africa; Melbourne and New South Wales Universities in Australia and Cambridge University, U.K. She has published extensively in the field of public international law and is also the co-author of a textbook on the Law of Torts, the fourth edition of which has just been published. Before joining IMO, Dr. Balkin headed the Australian delegation to the IMO Legal Committee and was, for a number of years, Vice-Chairman of that Committee.

Session 3: CO_2 transportation for storage – Regulatory perspectives

Regulating CO_2 Pipelines

Martha Roggenkamp
University of Groningen

Abstract

Carbon Capture and Storage ("CCS") is a relatively new technique, which may be applied as a transitional instrument to combat climate change. In the EU a regulatory framework is in place since June 2009 following the entry into force of Directive (2009/31/EC) governing the geological storage of carbon dioxide ("CCS Directive"). Member States may opt for permanent storage of captured CO_2 in geological formations.

In practice an emitter will hardly ever be situated near or on top of a suitable geological formation and CCS will thus usually involve the following three stages: capture, transport and storage. The CCS Directive provides few provisions on the role of transport. The focus seems to be on transportation through pipelines, but obviously other means of transportation may be applied. We need to keep in mind that capturing and transporting CO_2 is not a new phenomenon. The soft drink industry, for example, already utilizes CO_2 which may be transported by lorry.[1]

However, in case of CCS it is generally assumed that use will be made of subsoil pipelines as this mode of transportation is relatively safe and better suited to transport large quantities of CO_2. The use of pipelines raises a number of practical and legal issues. Due to the lack of regulatory guidance on EU level, these issues need to be solved on national level and therefore result into several different national solutions. This paper will concentrate on how to qualify CO_2 pipelines and whether use can be made of regulatory practice of the energy sector.

How to qualify CO_2 pipelines? In the energy sector, we usually distinguish between several types of pipelines and/or cables. Connected to the production facilities there are upstream pipelines or cables being part of an installation. These pipelines and cables are then connected to a transportation and/or transmission grid and these systems on their turn are connected to the distribution system. Can this qualification also be applied to CO_2 transportation systems?

In case of CCS, pipelines will connect a "producer" of CO_2 (= an emitter) with a "consumer" of CO_2 (= a subsoil storage facility). These storage facilities are often depleted oil and/or gas fields. It could therefore be argued that CO_2 pipelines can be considered as "reverse" energy systems. In stead of the reservoir being the starting point of the chain (the "producer") it is now the terminus point of the chain (the "consumer"). Consequently, sometimes use

[1] Cf the Shell refinery in Rotterdam where CO_2 is captured and brought to a range of industrial consumers, including the soft drink industry.

can be made existing infrastructure (if a field is depleted) and sometimes new pipelines need to be constructed (if CO_2 is injected in producing field). It seems therefore that pipelines directly connected to the subsoil reservoir can be qualified as upstream pipelines, although this may depend on the definitions used in national petroleum and/or mining laws. As long as these pipelines are considered as "reversed" upstream pipelines, the upstream regulatory and safety regimes will apply to the construction and use of these pipelines and there are few restrictions regarding the parties owning or operating such a pipeline.

Although the terminus point of the pipeline is known (= the reservoir), it is less clear where the pipeline begins. It may be that the pipeline is directly connected to the emitter. In that case, the pipeline is some sort of direct line. In addition, the entire pipeline may even be considered as an upstream pipeline, even more so if the captured CO_2 (= a gas) is treated before it enters into the pipeline system. Does this assumption change if several "emitters" or "consumers/fields" are connected to the pipeline? Not necessarily. In the upstream petroleum sector it is common practice that several producers/fields are connected to one (very long) upstream pipeline.

It follows from the above that there are sufficient arguments/reasons to treat CO_2 pipelines as some sort of reverse upstream pipeline. To do so has certain advantages. First and foremost, it would entail that the oil and gas upstream regulatory and safety regime also applies to these pipelines. This is a regime which has proven itself and with competent regulatory authorities in place. Apart from this, it would also mean that the regulatory regimes applying to the use of these pipelines can be applied.

The CCS Directive acknowledges that there may be limited storage facilities and pipelines available and that operators/owners of such infrastructure should open their infrastructure to interested third parties. Article 21 of the CCS Directive clearly obliges operators/owners to negotiate access with any interested party. When analyzing this provision, it also becomes clear that the EU legislator considers CO_2 pipelines (and the storage facilities) as essential facilities. The text is seems to include the principles of the ECJ's essential facility doctrine and almost an exact copy is included in article 20 of the Gas Directive, which governs access to upstream gas pipelines. The fact that also the CCS Directive's access regime is a copy of existing upstream regulation, emphasizes the earlier conclusion that CO_2 pipelines should be considered as some sort of reverse upstream pipelines and should be regulated in a similar way as upstream petroleum pipelines

Biography

Martha Roggenkamp is Professor of Energy Law at the University of Groningen, Director of the Groningen Centre of Energy Law and appointed as Counsel at the law firm Brinkhof in Amsterdam. She has published widely on energy law issues since the early 1990s. She is the author of the monograph "Oil and Gas: Netherlands Law and Practice" (Chancery 1991) and "*Het Juridisch Kader van Pijpleidingen in de Olie- en Gasindustrie*" (PhD,

Intersentia 1999). She is one of the co-editors of the book *Energy Law in Europe* (OUP 2003, 2007), *The Regulation of Power Exchanges in Europe* (Intersentia 2004) and the *European Energy Law Report I – VI* (Intersentia 2004-2009).

Martha is the editor in chief of the series *Energy & Law* published by Intersentia (Antwerp) and member of the editorial board of the *Dutch Journal of Energy Law* and of the editorial committee of the *Journal of Energy and Natural Resources Law* and the *International Energy Law Review*. She is a member of the Academic Advisory Group of the IBA's Section on Energy, Environment, Resources and Infrastructure Law and the founder and chair of the Dutch Association of Energy Lawyers as well as a fellow of the Energy Delta Research Centre of the University of Groningen. She teaches energy law at the University of Groningen and the Energy Delta Institute and is the coordinator of the North Sea Energy Law Program.

Session 3: CO_2 transportation for storage – Regulatory perspectives

Regulatory Perspectives from the United States

Lawrence Wolfe
Holland & Hart

Abstract

The presentation will address the following topics. The development of CCS on a utility scale in the United States will require the delivery of CO_2 by pipeline from power plants and other production sources to sequestration sites. This will necessitate a large investment in CO_2 pipelines, with the associated compression and delivery components. The US already has a small but well developed CO_2 pipeline system in the southeast, Texas, the upper Midwest and the Rockies. This system serves the needs of the oil and gas industry for use of CO_2 for Enhanced Oil Recovery (EOR). CO_2 floods have been used for tertiary recovery in the oil patch for more than 40 years and the oil and gas industry has tremendous experience with the injection, field management and sequestration aspects of CO_2. About 5600 KM of CO_2 pipelines exist, compared to about 800,000 KM of natural gas and hazardous liquid pipelines.

CO_2 pipelines are not currently regulated by the federal government. Both the Federal Energy Regulatory Commission (FERC) and the Surface Transportation Board (STB) have declined jurisdiction over CO2 pipelines. Tariffs for transportation of CO_2 are not regulated by a federal agency, although the STB can hear complaints about rates. Siting of CO_2 pipelines resides with the individual states. There is no federal eminent domain power for CO_2 pipelines, although individual states may confer that authority on pipeline companies in general. If CO_2 pipelines cross federal land, permits will need to be acquired from the federal land management agencies, and the developer will have to comply with National Environmental Policy Act (NEPA) and other environmental laws. Interstate CO_2 pipelines are regulated by the Department of Transportation (DOT) for safety, and the DOT applies the same safety requirements to CO_2 lines as it does to gasoline, crude oil and other hazardous liquids.

The presentation will describe the regulatory schemes for CO_2 pipelines in selected states. It will also describe the plans that are underway in a number of states to expand the CO_2 delivery system for EOR. These plans are dependent on the development of additional supplies of CO_2, with those supplies coming from proposed coal gasification facilities, or capture from existing power plants and oil and gas processing facilities.

Biography

Larry Wolfe is a partner in the Rocky Mountain regional law firm of Holland & Hart. Holland & Hart is a firm of about 440 lawyers with offices in seven western states and Washington, D.C. He resides in the Cheyenne, Wyoming

office where he practices energy, natural resources, water and state tax law, including representing coal, oil, natural gas and mining interests, as well as pipeline, wind and electric transmission clients. Wyoming is one of the top energy producing states in the US, leading the nation in the production of coal and uranium, second in the production of natural gas, and seventh in the production of oil.

From 2007 through 2008 Larry was the Managing Partner of Holland & Hart, operating out of its Denver headquarters. He was responsible for the day to day operations of the law firm. From 2001 – 2006 Mr. Wolfe chaired Holland & Hart's Natural Resources practice, which is the largest natural resources and energy law practice in the Rockies. Larry is included in the most recent editions of Best Lawyers, Super Lawyers, and Who's Who of Business Lawyer in International Mining. He is a graduate of the University of California, Davis and the University of Wyoming College of Law.

Session 4: The regulation of CO_2 storage

The Regulation of Geological Storage of Greenhouse Gases in Australia

Meredith Gibbs
Blake Dawson

Abstract
Australia is one of the first nations to enact broad-scale legislation to regulate the geological storage of greenhouse gases. In the last two years Governments at both the Commonwealth and State levels have made laws allowing the geosequestration in onshore and offshore jurisdictions. Unfortunately, there has been no consistent approach to this regulation and the Acts differ in important respects. This paper will canvass these different legislative approaches, with a focus on the long-term liability of storage proponents. Key aspects of the greenhouse gases tenure processes and the risks surrounding site closure will be discussed. The various approaches to long-term liability will then be contrasted and compared.

Biography
Meredith Gibbs specialises in environmental, water and climate law. Meredith has worked in environmental law in Australia and New Zealand since 1991. She is a Senior Associate with Blake Dawson lawyers, Melbourne where she acts for a range of corporate and government clients. She advises on the regulatory aspects of CCS projects in Australia. Meredith was recently recognised in Australia's "Best Lawyers" 2010 for her climate change expertise.

Meredith's publications have appeared in the *Australian Resources and Energy Law Journal World Development*, *Society & Natural Resources*, *New Zealand Universities Law Review*, *New Zealand Journal of Environmental Law*, *Australasian Journal of Environmental Management*, *Political Science, Resource Management Journal* and *Contemporary Justice Review*.

She has recently published an article analysing the impact of greenhouse gas storage on petroleum titles, "Greenhouse Gas Storage in Offshore Waters: Balancing Competing Interests" (2009) 28 *Australian Resources and Energy Law Journal* 52, which won the Australian Energy and Resources Law Association's best journal article for 2009.

Session 4: The regulation of CO_2 storage

The European Union and CCS

Martina Doppelhammer
European Commission (DG Climate Action)

Abstract

The 2007 Spring European Council called for the EU to be at the forefront of efforts to combat climate change and endorsed ambitious targets aimed at setting the European energy system on a sustainable path. To ensure that these targets are met, the European Commission proposed a set of policy instruments, the Climate Action and Renewable Energy Package, in January 2008. The Package was adopted by the EU legislators in April 2009 and entered into force on 25 June 2009. A key element of the Package is the Directive on the geological storage of carbon dioxide. It establishes a legal framework for the management of environmental and health risks related to carbon dioxide capture and storage, including requirements on permitting, composition of the CO_2 stream, monitoring, reporting, inspections, corrective measures, closure and post-closure obligations, transfer of responsibility to the State, and financial security. The Directive also amends a number of other EU laws with a view to establishing requirements on capture and transport operations and to removing existing legal barriers to the geological storage of CO_2. Member States have until 25 June 2011 to transpose the Directive into national legislation. The Commission services have set up an Information Exchange Group to facilitate discussions on the transposition and implementation of the Directive amongst Member State authorities, but also to provide guidance on the interpretation of the Directive. The Commission services are also preparing written guidance on a number of central provisions of Directive, including on site characterisation, composition of the CO2 stream, transfer of responsibility and financial security.

In parallel, the Commission services are developing a mechanism to co-finance commercial CCS and RES demonstration projects with 300 million allowances provided in the New Entrants Reserve of the Emissions Trading System. The draft Decision, which provides criteria for project selection as well as for the conversion of the allowances and the disbursement of the revenues, was voted upon positively in the Climate Change Committee in February 2009. Adoption is envisaged for June 2010, following a three months scrutiny period by the EU legislators. On the basis of this Decision, projects will be selected for award with the help of the European Investment Bank (EIB), which will also be responsible for the conversion of the allowances and distribution of the revenues to the Member States, who will in turn pass the revenues on to the selected projects. The 300 million allowances will be awarded in two tranches, the first to be completed by 31 December 2011. This should ensure a first range of demonstration projects being operational by 31 December 2015.

Biography

Martina Doppelhammer is legal adviser in Unit C.1 "Low Carbon Technologies" of the European Commission's Directorate-General for Climate Action. She is *inter alia* responsible for legal questions related to carbon dioxide capture and storage and has drafted the recently adopted Directive on the geological storage of carbon dioxide. Currently, she is working on the draft Decision establishing modalities for the co-financing of CCS and innovative renewables demonstration projects under the Emissions Trading Directive. Ms Doppelhammer joined the European Commission in 2002. She is a German lawyer and holds an LL.M. in European law from the College of Europe in Bruges. She spent several years studying and researching into European environmental law and has authored and co-authored a number of publications in the field.

Session 4: The regulation of CO_2 storage

Permitting a CCS Injection Well within a Developing Regulatory Framework

Sallie Greenberg
Advanced Energy Technology Initiative, Illinois State Geological Survey

Abstract

Injection of all materials in the subsurface in the United States is regulated under the Safe Drinking Water Act (SDWA) through the Underground Injection Control (UIC) Program. Five classes of injection wells are defined: 1) Class I – isolation of hazardous and non-hazardous industrial and municipal waste, 2) Class II – oil and gas related activities, 3) Class III – solution mining activities, 4) Class IV – prohibits shallow hazardous waste, and 5) Class V – other fluids and experimental activities. Currently, the US Environmental Protection Agency (EPA) is conducting a rule making to devise a Class VI specifically related to the injection of CO_2. Specifics about the U.S. permitting process are discussed from the individual State perspective with a summary of differences in the current regulatory system highlighted.

Permitting a large-scale CCS demonstration project in this emerging regulatory environment presents multiple challenges. Research projects and early commercial projects must operate within the current regulatory framework while trying to anticipate the new regulations. The Midwest Geological Sequestration Consortium (MGSC) is one of seven regional partnerships funded by the U.S. Department of Energy to conduct sequestration demonstration projects throughout the United States. The MGSC, Archer Daniels Midland Company (ADM), and Schlumberger Carbon Services are working together to store 1 million tonnes of CO_2 collected, dehydrated, and compressed from the ADM ethanol production process on-site at the ADM facility in Decatur, Illinois. The MGSC, in conjunction with ADM, began the permit application process for the deep, saline reservoir sequestration project in August 2007 and the permit was issued in January 2009.

The ADM-CCS #1 injection well permitting process provides a case study of permitting a CCS project in the current environment. Components to be discussed are scope, timing, documentation, data requirements, and future considerations. The ADM-CCS #1 well is permitted as a UIC Class I – Non-hazardous well at the recommendation of the Illinois Environmental Protection Agency (IEPA), which has primacy over regulatory matters in Illinois. Three fundamental challenges encountered in the UIC application process will be discussed: 1) permitting a research project, 2) permitting a site where there was no existing wellbore, and 3) permit modifications. Permitting an injection well that has numerous research components, which may exceed the minimum requirements outlined in a UIC permit application has complicated the process. Prior to drilling the injection well, little site specific geologic data were available. Additionally, the permit for this well was the first new UIC

Class I permit issued in thirty years in Illinois. Changes in the scope of the research and accumulation of new information have made major permit modifications necessary, which add to length of the permitting process. An update on the current status of the permitting process and on-going progress will be discussed and updated as new information is learned, including the completion report, that allows injection to proceed, which is submitted after the well is drilled and the site specific parameters are evaluated. Based on this permit application, the implications for the commercialization of sequestration will be examined in the context of an evolving regulatory framework.

Biography

Sallie Greenberg is the Sequestration Communications Coordinator for the Illinois State Geological Survey (ISGS) and Midwest Geological Sequestration Consortium (MGSC), one of the U.S. Department of Energy's seven regional sequestration partnerships. As the Assistant Director for the ISGS's Advanced Energy Technology Initiative, she helps lead a team of scientists working on several carbon capture and geologic sequestration projects, including the Illinois Basin – Decatur Project (IBDP) and FutureGen. Sallie spearheaded the Class 1 – Non-hazardous UIC permit process for the IBDP and recently received funding to launch the MGSC Sequestration Technology Transfer Center to disseminate information and provide training for the emerging carbon sequestration industry.

Ms. Greenberg began her career as an isotope geochemist more than fifteen years ago. Her combined training as an environmental geologist and a geoscience educator provide a unique perspective on understanding public perception challenges related to carbon sequestration. Her research focuses on understanding social components of complex geological issues. Sallie holds a Master of Science degree in Geology from the University of Illinois and a Bachelor of Arts degree in Geology from Alfred University in New York. She is currently working on a Ph.D. in Curriculum and Instruction at the University of Illinois.

Session 4: The regulation of CO_2 storage

Long-term Liability for CO_2 Storage

Chris Clarke
University College London

Abstract

Legislating for the long-term liabilities of CCS storage presents public policymakers with an awkward dilemma: how to balance the legal certainty and liability limitation sought by CCS operators with a level of liability risk sufficient to secure effective risk management and environmental protection, and convince public opinion that CCS is safe.

The crux of the solution most widely adopted so far is relatively simple: a combination of existing liability rules, suitably adapted, for the active phases of the operation, with special arrangements to reduce liability exposure for the long-term, post-closure risks, based primarily on a transfer of liability to the state at some point after operations have ended.

Though that combination certainly has merit and may well turn out to be the best solution, it may prove more complicated or more difficult to implement than it initially seems. As with all liability laws, the details matter. Given the sums of money involved, every nuance and provision is likely to be tested at some stage, and such litigation could easily throw up some unexpected outcomes.

There are four main areas which need close attention.

First, the existing liability rules are complex and evolving. The provisions in underlying laws that govern actionable harm, remediation standards, definition of the liable party, apportionment between multiple parties, burdens of proof, defences and exceptions, etc, are both ambiguous and still developing, irrespective of the CCS laws, and those changes will inevitably impinge upon liability for CCS operations.

Second, the transfer of responsibility to the state is unlikely to be as absolute as some seem to think. Depending upon provisions in each CCS regulation, transfer may well exclude civil and common law claims, actions brought under other public regulatory laws and conditions which remain unresolved at the time when transfer is due. More fundamentally, the whole transfer agreement is likely to be rescinded in cases of fault, with considerable latitude attaching to that critical concept.

Third, the imposition of a duty on the state to repair any harm once transfer has occurred may not be enough to guarantee that remediation takes place. Even where CCS laws specify such a duty, it may be confined to clean-up commitments within those laws and not extend to broader remediation and compensation requirements in underlying liability regimes. In the long run, there is a good chance that new environmental priorities will take precedence

over CCS harm and compete for appropriation of public funds. A dedicated funding mechanism, financed prior to transfer, might offer a better solution.

Fourth, in the long term – in this case, extending well beyond any normal long-term commercial or political horizons – there is no such thing as absolute legal certainty or a "clean break". This is ultimately a public policy matter, not just a legal one, and the state always retains the means to re-open financial responsibility, whether through imposition of continuing liability or through some kind of levy on specified parties.

Biography

Chris Clarke is an independent environment policy analyst, specialising in liability issues. He is a Visiting Fellow in the Carbon Capture Legal Programme at University College London and an Honorary Lecturer in UCL's Faculty of Laws. He is also an Associate of the Institute for European Environmental Policy (IEEP), in London, and of Risk & Policy Analysts Ltd (RPA), in London (Norfolk).

In 1996-97, he was a member of the Legal Unit of DG Environment (then DG XI) of the European Commission, with special responsibility for the environmental liability directive, and has since advised the Commission, Member State governments, industry groups, regulatory agencies and NGOs in several countries on the implementation of the directive and wider liability developments. Among other things, in 2000-01, he conducted the *Update Comparative Legal Study* on environmental liability for DG Environment. He was previously the founding Editor of the Financial Times newsletter, *Environmental Liability Report*, Deputy Editor of FT *Energy Economist*, liability correspondent for FT *World Insurance Report* and a contributor to numerous other publications, having been an energy policy specialist through most of the 1980s.

Session 4: The regulation of CO_2 storage

Allyson Anderson
US Senate

Allyson Anderson is a professional staff member on Chairman Jeff Bingaman's Senate Energy and Natural Resources Committee. Allyson came to the hill as the 2006-2007 American Geological Institute Congressional Science Fellow. She has worked for the Energy Committee on several issues, including carbon sequestration and geothermal energy resources. She continues to maintain the same portfolio in addition to fossil energy research and development, upstream petroleum issues, and other geological and science related policy areas.

Prior to joining the Energy Committee staff, Allyson was a petrophysicist/senior geoscientist in the Formation Evaluation Core Group of the ExxonMobil Exploration Company in Houston, Texas and a student/researcher at the Kansas Geological Survey. She earned a Master's degree in Geology from the Indiana University-Purdue University at Indianapolis in 2000. She is the Past-President of the Association for Women Geoscientists (AWG), Former Chair of the Professional Women in the Geoscience Professions Ad Hoc Committee of the American Association of Petroleum Geologists (AAPG), as well as serves on many other volunteer, professional outreach committees.

Session 4: The regulation of CO_2 storage

Issues Addressed by US States in Regulating CO_2 Storage

J Jared Snyder
New York State Department of Environmental Conservation

Abstract

In the United States, regulation of carbon capture and storage combines elements of federal and state regulation. The federal government's jurisdiction is derived primarily from the Safe Drinking Water Act (SDWA); pursuant to Underground Injection Control program established under the SDWA, EPA issues permits for sequestration wells. Various federal energy and climate bills have included broader CCS programs, but those bills have not been enacted to date.

In the absence of a comprehensive federal program for regulation of GHGs, several states have enacted legislation establishing comprehensive regulatory programs. These state laws address many issues that are unaddressed at the federal level, such as acquisition of property rights, eminent domain and allocation of liability. Some states have also promulgated emission standards that effectively mandate CCS for new coal-fired plants.

Last year, Governor Paterson proposed CCS legislation that was intended to regulate the proposal of the Jamestown Board of Public Utilities to build a new coal-fired power plant with carbon capture and storage. This legislation, which was not acted upon by the state legislature, was limited to demonstration CCS projects, with the intent of updating the legislation after completion of one or more demonstration projects. This legislation embodies the view of the Paterson administration on issues such as property rights and liability. In addition, New York Department of Environmental Conservation is developing a regulation establishing performance standards for new or modified power plants and industrial boilers.

Working from New York's experience, Jared Snyder will address the challenging issues facing states when they develop a regulatory program for carbon capture and sequestration. Many of the most difficult issues faced by state policymakers involve the allocation of risks associated with CCS in the early stage of development, before a substantial record of performance has been developed.

Biography

Jared Snyder is Assistant Commissioner for Air Resources, Climate Change & Energy at the New York State Department of Environmental Conservation. In that capacity, he oversees New York's development and implementation of the Department's programs to reduce air pollution and combat climate change. Prior to joining DEC in 2007, he served as Chief of the Affirmative Litigation Section of the Environmental Protection Bureau for the State Office of the

Attorney General for 12 years. In that position, he handled numerous climate change and clean air lawsuits for the State of New York.

From 1990-1995, Mr. Snyder worked at the U.S. Department of Justice, enforcing a variety of federal laws in the areas of air pollution, water pollution and hazardous waste. Prior to his federal service, he worked in private firms in New York, San Francisco, and Los Angeles. He graduated with a B.A. in economics from Cornell University and a J.D. from Harvard Law School.

Introductory session for the IEA Model CCS Legal & Regulatory Framework – Aims & objectives

Brendan Beck
International Energy Agency
Ian Havercroft
University College London

Abstract

To assist in the rapid deployment of CCS in line with the recent findings of the IEA CCS Roadmap, the International Energy Agency (IEA), with assistance from the University College London Carbon Capture Legal Programme (UCL CCLP) and ReedSmith, are in the process of developing a model CCS legal and regulatory framework that can be used as a tool to assist governments in the development of national legal and regulatory frameworks around the world. The model framework will draw from current CCS legal and regulatory developments in Europe, Australia, the USA, and elsewhere, to ensure that the work done in these countries can be leveraged elsewhere. It is the intention of the IEA, through this analysis, to provide assistance in CCS legal and regulatory development and not to be prescriptive as to the legal and regulatory approach countries should take.

Through consultation with the model CCS legal and regulatory framework advisory committee, 30 key issues for CCS regulation were identified. The framework will address each of these key issues in turn and provide a description, together with model text that is based upon reviews of existing legislation. An explanation section will include background information and provide more detailed reasoning behind the selection of the model text. This section will also be used to provide alternative options and to make recommendations as to the types of situation in which they may be applied, especially where there is a lack of consensus within the reviewed legislation.

This presentation will include an overview of the work to date and provide a foundation for the discussions to be held later in the afternoon.

Biographies

Brendan Beck is an Energy Analyst at the International Energy Agency (IEA) in Paris where he focuses on CO_2 capture and storage (CCS). Amongst his responsibilities are the management of the IEA CCS Regulators' Network and of the IEA CCS Roundtable initiative, including the most recent Roundtables in Brazil, South Africa and Indonesia. Brendan has been with the agency since 2009. Between 2006 and 2009, Brendan worked for the IEA Greenhouse Gas R&D Programme where he focussed on the legal and regulatory aspects of CCS as well as technical aspects of CO_2 storage and monitoring. Before joining the IEA GHG Brendan worked at the World Coal Institute as the Technical & Research Manager with a focus on clean coal technologies and other coal related technologies. Brendan started working on CCS as a researcher at the Co-operative Research Centre for Greenhouse Gas Technologies (CO2CRC) in Australia where he completed a study on the

global potential for CCS as a CO_2 mitigation option. Brendan graduated from the Australian National University in 2004 with a Bachelor of Systems Engineering with Honours.

Ian Havercroft is Senior Research Fellow in environmental law at UCL Law Faculty's Centre for Law and the Environment. He joined the Faculty in May 2004, following the completion of his Masters degree.

He maintains a strong research interest in energy and environmental law and he is the lead researcher on the Carbon Capture Legal Programme, an initiative which aims to provide a comprehensive and authoritative source of objective and up to date legal information on Carbon Capture and Storage (CCS). As the pace of CCS legal and policy developments increases, Ian has increasingly played a more active role in the CCS arena, including working with the International Energy Agency (IEA) to set up the International CCS Regulators' Network and participating in their CCS roadmapping exercise. Ian was also an expert reviewer for the IEA's recent report on CCS, *CO2 Capture and Storage - A Key Abatement Option*, which was published in 2008.

Ian has also worked on other contracted research projects based at the Centre. His most recent work has centred upon domestic and EU environmental law and policy and he has conducted research on behalf of; the European Commission (DG Environment), The Cabinet Office, Freshfields Bruckhaus Deringer, RPS Group plc and Haymarket Media Group.

Session 5: Regulation of CCS finance and role of market mechanisms

Accessing Carbon Finance for CCS Projects in Emerging and Developing Economies

Paul Zakkour
Carbon Counts

Abstract

The Kyoto Protocol's flexible mechanisms allow projects that reduce greenhouse gas emissions to generate carbon credits which can be traded on the international carbon market. For emerging and developing economies – by far the largest source of such credits – the mechanism is known as the clean development mechanism (CDM) which generates credits tradable certified emission reduction units (CERs). The CDM has proved an important catalyst for investment in low carbon technologies in these jurisdictions.

However, for carbon dioxide capture and geological storage (CCS), negotiations about its eligibility within the CDM have been a protracted process over the last 4.5 years. Over this period the matter has passed back and forth between various bodies of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, including the CDM Methodologies Panel (MP), the CDM Executive Board (EB), the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Conference of Parties Serving as the Meeting of Parties to the Kyoto Protocol (CMP).

However, it fails to progress towards any firm conclusions on eligibility. Current concerns hampering progress are *inter alia* [2]: (a) Non-permanence, including long-term permanence; (b) Measuring, reporting and verification; (c) Environmental impacts; (d) Project activity boundaries; (e) International law; (f) Liability; (g) The potential for perverse outcomes; (h) Safety; (i) Insurance coverage and compensation for damages caused due to seepage or leakage. Other concerns include the potential effects on the overall stability of the carbon market because of potentially large amounts of CERs being generated, and the effects this could have in diverting investment away from other types of emission reduction measures.

The impasse poses several questions for observers and governments alike:

- How important is CCS in emerging and developing economies? How much is needed and at what cost?
- How can CCS be incentivised and financed in these jurisdictions?
- How important is the development of appropriate legal and regulatory frameworks to support implementation?

On the first item, the IEA has suggested that around 50 CCS projects capturing around 116 $MtCO_2$/yr will be needed in non-OECD regions by 2020 – and increasing significantly thereafter – as part of a pathway reach an

[2] Draft Decision -/CMP.5 Further guidance relating to the clean development mechanism. Para 29.

atmospheric stabilisation of CO_2 at 450 ppm. Reaching this target could entail bilateral finance of $1.5-2.5Bn per year over the period 2010-2020[3]. This is small compared to the current level of financial flows associated with the CDM, and equal to around 2-4% of the total financial flows envisioned by the Copenhagen Accord. As to the mechanisms which can support such flows, much is left to be decided; they could include sectoral crediting, sectoral trading, crediting for actions taken as part of nationally appropriate mitigation actions (NAMAs), or project-based such as the CDM. Notwithstanding which mechanism might apply, the fundamental concerns appear rooted in matters of a distinctly legal and regulatory nature: good site selection, appropriate operation, monitoring and reporting, short- and long-term liability for stored CO_2 and so on. This backdrop poses a more pertinent question: can any mechanism be developed which – through appropriate design – provides *de facto* regulation for CCS at an international level, or should the delivery of funds through any such mechanism be contingent on the introduction of national level regulation by participating countries? This is political matter which has yet to be addressed in any of the negotiations to date: resolving this matter may go some way to progressing finance for CCS in emerging and developing economies over coming years.

Biography

Paul Zakkour is a Director of Carbon Counts, a consultancy specialised in international climate change policy. He has worked for over 12 years in the field of low carbon policy, strategy and implementation.

Recently Paul has worked extensively on CCS policy implementation, including with the European Commission in the design of its CCS Directive and linking to the EU ETS, on issues for CCS in the CDM, and he has been involved extensively in several initiatives relating to CCS deployment in Europe, the US, South Africa, China, India and South East Asia.

Paul previously spent over six years as a Principal Consultant with ERM's Energy & Climate Change Practice in London. He has a PhD in environmental technology from Imperial College London.

[3] *Technology Roadmap: Carbon Capture and Storage*. International Energy Agency, 2009. Paris.

Session 5 – Regulation of CCS finance and role of market mechanisms

Cross-Subsidising Issues Under Market-based Support to CCS Projects

Catherine Banet
University of Oslo

Abstract

Market-based instruments are being proposed as one manner to support CCS project, in addition to more traditional and direct types of aid. The regulation of subsidies, and in particular state aids, are already raising issues for CCS support. A market approach should remove part of these concerns. However, the manner CCS projects are treated under market mechanisms does not totally solve the issue and CCS subsidising remains. Cross-subsidising was much debated during the energy restructuring process at the end of the 1990s at the moment of the transitioning from regulated industries to competitive markets, but could well reappear today in another form, a more subtle one.

The purpose of this presentation is to identify the types of possible cross-subsidies under market-based support to CCS projects. It is also to present how the cross-subsidising phenomenon is encompassed by the law in force today in the European Union, with a particular emphasis on the energy sector.

CCS is to be implemented by carbon intensive industries such as fossil fuel power stations - based on coal, natural gas or oil - , cement, steel, aluminium or chemicals. Some of these sectors benefit, directly or indirectly, from subsidies. Subsidies to fossil fuels are difficult to identify, but several initiatives and empirical studies provide sufficient information to start with. Recent sources include works from the Global Subsidies Initiative or the European Environment Agency. The efforts to better identify the extent of these aids are also to be put in perspective with the G-20 Call to Phase Out Subsidies to Fossil Fuels.

Of particular interest are the subsidies allocated to fossil fuel energy sources that can benefit from the allowances generated by CCS emissions reductions under the EU emissions trading scheme (EU ETS). Indeed, the European carbon legislation provides the most advance regulation of CCS support by market-based approach (with the exception of the Clean Development Mechanism). The presentation evaluates to which extend the current regulation of the EU ETS and its coverage of the energy sector can reintroduce the problem of cross-subsidising. Preliminary conclusions can be drawn from the study of the scope of application of the scheme. The amending EU ETS Directive 2009/29/EC to Directive 2003/87/EC includes CO_2 emissions obtained from CCS projects as emission reductions under the scheme. Some sectors pertaining to the so-called 'carbon leakage list' are also entitled to receive free allowances until 2020 (Commission Decision 2010/2/EU of 24 December 2009).

Biography

Catherine Banet (LL.B, M.A., LL.M) is a doctoral researcher at University of Oslo, Scandinavian Institute of Maritime Law, Petroleum and Energy Law Department, Norway. She is writing a PhD entitled “Promoting sustainable energy by market-based instruments: design and trading rules for renewable energy and energy efficiency certificates”. Catherine Banet has joined the University of Oslo in September 2006 after having been working at the Brussels office of the French Law Firm Huglo Lepage & Partners. She has previous work experience from the European Commission (DG Environment) and the US Embassy in Belgium (DoC, Energy and Environment). She has lecturing experience in European Law, Petroleum Law and EU Environmental Law. At the University of Oslo, Catherine researches on the regulation of supporting instruments at the intersection of energy and environmental law. Catherine Banet is member of the Research Group for Natural Resources Law of the University of Oslo, the Nordic Environmental Law Network, and the Energy Law Research Forum.

Session 5 – Regulation of CCS finance and role of market mechanisms

Mark Brownstein
Environmental Defense Fund

Mark Brownstein is deputy director of Environmental Defense Fund's national energy program. Mark leads EDF's efforts on smart grid deployment, transmission development, wholesale and retail electric market design, and the environmentally sustainable siting of both renewable and conventional utility scale generation.

Mark was one of two EDF staff leads on the United States Climate Action Partnership, a coalition of the nation's leading corporations and environmental groups championing immediate action on federal legislation to cap and substantially reduce greenhouse gas pollution across the U.S. economy. He is co-author of the *Carbon Principles*, a set of enhanced due diligence principles for investment banks considering the financing of coal fired power plants.

Prior to joining EDF, Mark was director of Enterprise Strategy for Public Service Enterprise Group (PSEG), where he worked directly with PSEG's senior leadership in crafting and implementing the corporation's business strategy. Over his nearly 10-year career with PSEG, Mark served the company in a variety of environmental management roles, including director of Environmental Strategy and Policy. Mark was active in numerous environmental legislative and regulatory proceedings including efforts to develop federal legislation limiting emissions of sulfur dioxide, nitrogen oxides, mercury, and carbon dioxide from power plants, and the Environmental Council of States' (ECOS) 37-state Ozone Transport Assessment Group (OTAG) process, which developed specific recommendations to address the persistent problem of ozone transport in the eastern United States. Mark was also an active member of the U.S. EPA's Clean Air Act Advisory Committee and New Jersey’s Renewable Energy Task Force.

Aside from PSEG, Mark's career includes time as an attorney in private environmental practice, a regulator with the New Jersey Department of Environmental Protection, and an aide to then-Congressman Robert G. Torricelli (D–NJ).

J.D., University of Michigan Law School; B.A., Vassar College.

Session 5 – Regulation of CCS finance and role of market mechanisms

Kent Rowey
Freshfields Bruckhaus Derringer LLP

Kent is the Head of our Americas Energy & Infrastructure practice. He specializes in representing lenders, other credit providers, sponsors, contractors and other participants in project finance transactions. His sector experience includes transportation and other infrastructure projects and power and natural resources projects. His experience includes advising:

- Florida Department of Transportation (FDOT) in connection with the brownfield lease of Alligator Alley;
- EQT Infrastructure Partners in connection with its acquisition of the Midland Cogeneration Project in Michigan;
- Morgan Stanley Infrastructure Partners in connection with their successful bid for the 75-year concession of the City of Chicago's Metered Parking System for $1.15 billion;
- the Regional Transportation District of Denver, Colorado (RTD) in relation to establishing a public-private partnership for the design, build, finance, operations and maintenance of one or more commuter rail corridors to be built under the RTD FasTracks Program;
- the mandated lead arrangers supporting the consortium of Abertis Infraestructuras, Citi Infrastructure Investors (CII), and Criteria Caixa Corporation in connection with their successful bid to the Commonwealth of Pennsylvania to enter into a long-term lease and concession of the Pennsylvania Turnpike;
- the Royal Bank of Scotland, the proposed mandated lead arranger on the Northwest Parkway project in connection with its debt financing of the Northwest Parkway project, the concession based long-term lease of an 11-mile section of tolled beltway servicing the Denver metropolitan area;
- Morgan Stanley Infrastructure Partners in connection with their bid for the City of Chicago's downtown metered parking system;
- Morgan Stanley in connection with their successful bid for a concession agreement to operate and maintain Chicago Downtown Parking System for a period of 99 years and the financing arrangements relating to such bid;
- Morgan Stanley Infrastructure Partners in connection with their bid for the Luis Munoz Marin Airport parking garages lease;

- Bay Area Rapid Transport District (BART) on the first ever rail PPP in California; and
- the lenders in Morgan Stanley's acquisition of Montreal Gateway Terminals from TUI's Hapac-Lloyd shipping business.

Kent is recognized by *Chambers* as one of the world's leading practitioners in private infrastructure finance. He was educated at UCLA and New York University Law School. He has been a partner at the firm since 1996.

Session 5 – Regulation of CCS finance and role of market mechanisms

The European Union and CCS

Martina Doppelhammer
European Commission (DG Climate Action)

Abstract & Biography

See entry under Session 3

Session 6: Public participation in decision making: Legal and policy constraints

CCS Guidelines for Local Community Engagement

Sarah Forbes
World Resources Institute

Abstract

Community engagement is critical both to the long-term success of most proposed industrial projects worldwide and for achieving environmental sustainability and social equity. Effective engagement is especially important for relatively new technologies, where communities may have more questions and concerns than they would for more established industries. CCS is an application of both new and existing technologies that will require additional attention to stakeholder engagement.

CCS has the potential to play a critical role in climate change mitigation worldwide. Governments have proposed plans to construct at least twenty commercial-scale carbon dioxide capture and storage facilities worldwide over the next twenty years. Construction of future CCS projects is at least partially contingent on local community acceptance for individual projects as strong opposition could potentially hinder or raise the costs of intended projects beyond economic feasibility. This is why anticipating community concerns and providing clear guidelines on community engagement for CCS projects is a critical component in project development. If nations embark on the siting of large CCS projects, it is also important for local community concerns and sensitivities to be respected, and for projects to be designed and sited in a sound manner.

The World Resources Institute is convening a stakeholder process to develop guidelines for local community engagement and public involvement in anticipated carbon dioxide (CO_2) capture and storage (CCS) projects, with the goal of ensuring that future projects are executed with both technical success and community support. This effort builds on WRI's previous two-year consensus building stakeholder effort which resulted in the publication of the *Guidelines for Carbon Dioxide Capture, Transport and Storage,*[4] a robust set of technical guidelines for how to responsibly proceed with safe CCS projects. Like the previous effort, the CCS Community Engagement Guidelines are being developed by a diverse set of stakeholders through an iterative process. The effort was initiated in April 2009 and the guidelines are expected to be published in June 2010.

These guidelines will outline how local communities, particularly those living or working nearby a CO_2 storage site, should be engaged and how they can proactively help shape the engagement process around projects in their locales. An important component of this work is a set of guidelines aimed at

[4] "Guidelines for Carbon Dioxide Capture, Transport, and Storage." Forbes et. Al, 2008 World Resources Institute Report. http://www.wri.org/publication/ccs-guidelines

regulatory policy-makers that are designed to inform public participation requirements in future regulations.
This presentation will highlight the similarities and differences in public participation requirements in some of the key geographic regions considering CCS projects and will summarize the subset of the draft Guidelines for community engagement which are aimed at regulatory policy makers. These guidelines are expected to have global applicability and to inform CCS regulatory policy development to include robust requirements for effective community engagement.

Biography

Sarah M. Forbes has led the World Resources Institute's (WRI) work on Carbon Dioxide Capture and Storage since May 2008, including the stakeholder process that resulted in the publication of the *Guidelines for Carbon Dioxide Capture, Transport and Storage,* a robust set of technical guidelines for how to responsibly proceed with safe CCS projects. WRI is a non-profit environmental think-tank that works at the intersection of human and environment needs. WRI's CCS research is aimed at developing tools and analyses that inform CCS regulatory developments, with a focus on environmental integrity.

Prior to joining WRI, Sarah worked at the National Energy Technology Laboratory (NETL), serving in a number of capacities. Notably she led the roadmap development for the Department of Energy's carbon sequestration research program, chaired the outreach working group for the regional sequestration partnerships and conducted analyses on environmental aspects of CCS, the energy-water nexus, and climate change.

For the past ten years Sarah has applied her ecological perspective to the regulatory, political and engineering challenges associated with demonstrating and deploying CCS technology. She authored an early paper on regulatory barriers to CCS technology deployment in 2001 and has contributed to high-level governmental and academic reports, including the CCS Roadmap published by the International Energy Agency in 2009, and the US-China CCS roadmap published by the Center for American Progress. Sarah is a frequent keynote speaker.

Sarah has a bachelor's degree from Wheaton College in Illinois and a master's degree from Mississippi State University, both in biology.

For more information:

- CCS Guidelines http://www.wri.org/publication/ccs-guidelines
- CCS legislative summary examples: http://www.wri.org/stories/2009/10/carbon-dioxide-capture-storage-and-s-1733-clean-energy-jobs-american-power-act-2009 and http://www.wri.org/stories/2009/05/summary-s-1013-department-energy-carbon-capture-and-sequestration-program-amendments
- Regulatory analysis tool: http://www.wri.org/project/carbon-capture-sequestration/proposal-matrix

- Guidelines for CCS in China http://www.wri.org/stories/2009/03/ensuring-safe-carbon-capture-and-storage-china and http://www.wri.org/stories/2009/07/first-hand-view-chinas-carbon-capture-and-storage-actions

Session 6: Public participation in decision making - Legal and policy constraints

Adequate or Sufficient? Going Beyond the Formal Requirements for Public Participation

George Peridas
Natural Resources Defense Council

Abstract
Two key areas of public participation in decision making related to CCS stand out currently: participation in the drafting of new standards and regulations for CCS, and participation in specific project siting cases. In the U.S., formal processes and legal requirements exist in both cases. These include, among others, formal notice publication, opportunity for public comment within defined time periods, the duty to respond to public comments, opportunities to make oral statements at hearings, to request data and formally to examine witnesses, appeal decisions and others. These are important safeguards that aim to ensure adequate opportunity for the public to participate in decision making. However, the nature of these processes requires a public that is accustomed to their formalised structure, and it also often drives an adversarial nature. There is no substitute, therefore, to a dialogue and interaction that goes beyond, and takes place outside, the legally mandated participation requirements. Such dialogue should be pursued early by all interested parties, and can greatly increase the chances of finding common ground or mutually acceptable solutions. As such, it is in the interest of developers, regulators and stakeholders alike to engage in a substantial exchange early on in any process.

Biography
George Peridas is a Scientist at NRDC's Climate Center, where currently he leads NRDC's efforts in Carbon Capture & Sequestration technology, regulation, and policy, and also plays an active role in the organization's state and federal climate and energy advocacy efforts. Prior to joining NRDC in October 2006, George worked as a Senior Consultant on energy markets for Pöyry. His expertise includes power, oil, natural gas and renewables markets, as well as emissions trading. George received his M.Eng. and Ph.D. degrees in mechanical engineering from the University of Oxford and his M.Sc. in Environmental Science & Policy from Imperial College, London. He comes from Athens, Greece.

Session 6: Public participation in decision making: Legal and policy constraints

Enabling the Social Shaping of CCS Technology

Peta Ashworth
CSIRO

Abstract

Parallels between the development of carbon dioxide capture and storage (CCS) and the introduction of other new technologies are often drawn. Examples include nuclear power stations, disposal of toxic chemical wastes and biotechnology (Malone et al., 2004; Cormick, C. 2002). Although, it is difficult to make comparisons about the processes used for public participation across different technologies (Webler 1995), these issues share some fundamental uncertainties. All these technologies have identified associated potential risks diffused across time and space, and, have highly uncertain impact. Therefore it is helpful to focus on issues surrounding risk communication and perceptions of risk.

One area of strength in existing literature is the process of managing social risks to the process of technology adoption. One key issue is how technologies and the risks that are associated with them are perceived. Many researchers claim that the manner in which people perceive risks is both quantifiable and predictable (Wilkins 2001; Marks & Kalaitzandonakes 2004). This finding alone is a valuable rationale for participation – to identify the risks people perceive with low emission technologies so as to predict the risk to technology diffusion and hence investment risk. Additionally, the literature demonstrates that people can accept risks if there are tangible benefits associated with them (Fischhoff and Fischhoff 2001; Wilkins 2001; Moon & Balasubramanian 2003).

Participation is increasingly seen as a way of determining social interests and also managing the social risk to a project – i.e. the risk that the project will be delayed or terminated because of community or regulatory objections. The attitude of those entering into dialogue has a big influence on the outcomes. The process of engagement (the building of relationships and mutual understanding) is as important as the articulated outcomes of the engagement (i.e. ideas, concerns, plans, proposals, analyses and assessments). Indeed, given the qualitative and subjective nature of social issues, the relationship itself may be the most influential outcome. Stakeholder engagement therefore should be seen as an ongoing process, not a one off exercise.

There is a lot of debate and even conflict in the literature about whether the reason for stakeholder engagement should be:

- to understand the concerns of the stakeholder groups and hence improve the social value of the organisation's business (an exercise in partnering);

- to manage or influence the stakeholders and hence improve ability to operate and reduce risk of failure (exercising power).

These two reasons are not necessarily mutually exclusive. For emerging technologies in the CCS arena it is appropriate for there to be a twofold reason for engagement, both to understand some of the issues and concerns that arise from the technology and to inform a wider community about the technology so that they can make a knowledgeable contribution to its development (or not). However, the two reasons reflect very different attitudes to the stakeholders. In one, the stakeholder is respected as a source of knowledge and information. In the other, the stakeholder is seen as a potential interferer with an inadequate source of knowledge and information.

Participation at an early stage in technology development is a route to building respectful relationships between stakeholder groups, even those who have little common ground (Wilsdon and Willis 2004). Whilst respectful relationships alone are valuable collateral for the activities of an institution, where trust is nurtured this can influence levels of support for the technology once developed. Trust is as important, if not more so, in garnering and maintaining consumer support as logic. A lack of confidence on the part of consumers in the ability of industry, government, and science to manage the associated health, environmental, and social risks of any technology is likely to compound any negative risk perceptions that consumers may already hold. Indeed, the effectiveness of risk communication depends to a large extent on the degree to which the messenger is both independent and trusted. If one trusts the risk messenger communication is relatively easy. If trust is lacking, the process is much more difficult (Slovic 2000; Fischhoff and Fischhoff 2001; Marks & Kalaitzandonakes 2004; Moon & Balasubramanian 2003). Recent experience of public opposition to emerging CCS projects demonstrates that without planned early engagement the successful deployment of ongoing projects may be severely hampered.

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Biography

Peta Ashworth brings over twenty years of experience working in a range of senior management and research roles. Peta is currently group leader of the Science into Society Group within CSIRO's Division of Earth Sciences and Resource Engineering. Peta leads a team of social researchers examining stakeholder perceptions to areas of national significance to Australia. Peta's main research interest is how to deliver information to best effect. Peta Ashworth has gained an international reputation as a leading researcher in understanding stakeholder perceptions to climate change and low emission energy technologies, in particular CCS. This research is critical because although much of the effort to address climate change will be led by industry and government, energy users at the community level will also play a critical role both in technology acceptance and behaviour change. Peta believes it is important to educate and empower them to engage with this issue and work towards environmental sustainability. As part of her work Peta co-authored *The CSIRO Home Energy Saving Handbook – How to save energy, save money and reduce your carbon footprint*, which was released late last year. Peta is currently Chair of the IEA GHG Social Research Network.

Session 6: Public participation in decision making: Legal and policy constraints

Public Participation – Industry's Role

Tony Booer
Schlumberger Carbon Services
Tim Dixon
International Energy Agency Greenhouse Gas

Abstract
Public participation in decision making for CCS projects brings dilemmas for the role of industry. Private sector project developers generally have straightforward requirements from any large-scale capital investment project such as a CCS project. They are required to be legal and need to be profitable while minimizing cost. Regulations mandate public involvement in projects, for example from the Aarhus Convention, the EU EIA, IPCC and CO_2 Storage Directives, OSPAR, and the US Administrative Procedures Act and National Environmental Policy Act. There is a strong case that project developers will benefit from doing more than just the regulatory minimum for a new and potentially controversial technology like CCS. The new US DOE Best Practice manual provides very good guidance to doing this 'extra', keeping in mind that there may be differences in future between public engagement / involvement in research vs. commercial projects.

Before commercial deployment of CCS projects at industry scale, the need for large scale demonstration projects to learn from and prove the integrated concept of CCS is imperative. Hence it is vital that these demonstration projects proceed, set good precedents, and positive influences – strong incentives, again, for high quality public engagement beyond the regulatory required minimum. Good examples of this in practice is the US DOE Midwest Geological Sequestration Consortium Illinois Basin-Decatur Project , as well as the Petroleum Technology Research Centre's Aquistore Project in Saskatchewan, Canada. Schlumberger is involved in both projects.
There is of course the conundrum that, generally speaking, the public has a low trust of industry, yet industry experts must be involved in the provision of technically accurate information. However, at the level of real projects, industry can have a very good rapport with their local regions, often being the employers of many of the local stakeholders. Examples show how lessons learned in one project provide valuable help and insights for others, and that local stakeholder concerns and possible low trust issues can be accommodated.

Biographies
Tony Booer is a Technologist and Manager. His role is currently Marketing Manager, for Schlumberger Carbon Services, which was formed in 2005 as a business focusing on the long-term geological storage of carbon dioxide. He has 25 years experience at Schlumberger in various roles in their UK and US

research laboratories and technology centres. Tony holds and B.Sc in electronic engineering, a Ph.D. in geophysics and an MBA. He serves as a Board member of the UK's Carbon Capture and Storage Association and is on several of their working groups.

Schlumberger is the world's leading supplier of technology, integrated project management and information solutions to customers working in the oil and gas industry worldwide. Employing approximately 77,000 people representing over 140 nationalities and working in more than 80 countries, Schlumberger provides the industry's widest range of products and services from exploration to production.

Schlumberger Carbon Services provides technical expertise, project management and technology for comprehensive carbon dioxide geological storage solutions, consistent with care for health, safety and the environment. For more information, visit www.slb.com/carbonservices.

Tim Dixon joined the IEA Greenhouse Gas R&D Programme (IEA GHG) in January 2008, as Programme Manager CCS and Regulatory Affairs. He is responsible for ensuring IEA GHG activities provide the evidence-base to support the growing regulatory and policy developments for CCS. This includes responsibility for the Research Networks on Risk Assessment, Monitoring and Social Science, the International Summer School, and input to the UNFCCC.

From January 2010 Tim is seconded part-time to the Global CCS Institute in Canberra to develop their CCS regulatory support capability and activities.

From 2002 to 2008 Tim worked in the UK Department for Business, Enterprise and Regulatory Reform – BERR (formerly Department of Trade and Industry - DTI) as Senior Policy Advisor, seconded from AEA Technology. He worked in the area of carbon capture and storage (CCS) and also cleaner fossil fuels, coal mine methane, and related international collaborations and agreements. As well as working on UK and EU regulatory developments for CCS, Tim led the DTI work on CCS and emissions trading (EU ETS and CDM), and worked on the amendments of the London Protocol (1996) and OSPAR (1997) marine conventions to remove their prohibitions on CO_2 storage. Tim also worked on the CCS and cleaner fossil fuel initiatives for the UK's G8 Presidency and the EU-China NZEC Project for the UK's EU-Presidency in 2005.

Prior to BERR, in AEA Technology's ETSU at Harwell since 1995, Tim worked as Programme Area Manager for UK DTI's Cleaner Fossil Fuels and Carbon Abatement Programmes, Principal Consultant for International Emissions Trading, and Manager of DTI Renewable Energy Exports. Tim has also worked in Non-Destructive Testing in UKAEA, with a spell at Curtin University, Perth, Australia. Tim has an MBA from Oxford Brookes University (1997), a BSc Applied Physics from the University of Hull (1986), and is a member of the UK Energy Institute and the UK Environmental Law Association.

Session 7: Interactive session – Discussion of objectives and model and more detailed presentation of the IEA framework

Brendan Beck
International Energy Agency
Ian Havercroft
University College London
Richard B Stewart
New York University
Christopher Short
Global CCS Institute

Abstract

Please see the introductory session for day two.

CHAIRS' BIOGRAPHIES

Richard Macrory
University College London

Richard Macrory is a barrister at Brick Court Chambers, London and Professor of environmental law at the Faculty of Laws, University College, London where he is director of the Centre for Law and the Environment. He has been a member of the Royal Commission on Environmental Pollution, and a board member of the Environment Agency, England and Wales, the main environmental regulator. In 2005/6 Professor Macrory was appointed by the UK Cabinet Office to lead the Review on Regulatory Sanctions, covering some 61 national regulators as well as local government and almost every area of business regulation. All the recommendations in his final report *Regulatory Justice – Making Sanctions Effective* published at the end of 2006 were accepted by Government.

Richard B Stewart
New York University

Richard Stewart is recognized as one of the world's leading scholars in environmental and administrative law. Before joining the NYU faculty, he was Byrne Professor of Administrative Law at Harvard Law School. He also served from 1989-91 as Assistant Attorney General in charge of the Environment and Natural Resource Division of the U.S. Department of Justice, where he formulated the U.S. government's position on the Rio Climate Convention.

Recently, Stewart launched, with Professor Benedict Kingsbury, a major new research initiative on Climate Finance, including an international conference in Abu Dhabi in May 2009 and recent publication of Climate Finance: Regulatory and Funding Strategies for Climate Change and Global Development (2009). He also co-directs the NYU project on Global Administrative Law, and Breaking the Logjam, a major environmental law reform project, which recently published a book, Breaking the Logjam: Environmental Protection That Will Work (2010), which presents a program for major innovations in US environmental laws. Stewart is Advisory Trustee and formed Chairman, Environmental Defense Fund.

Ian Havercroft
University College London

Ian is Senior Research Fellow in environmental law at UCL Law Faculty's Centre for Law and the Environment. He joined the Faculty in May 2004, following the completion of his Masters degree.

He maintains a strong research interest in energy and environmental law and he is the lead researcher on the Carbon Capture Legal Programme, an initiative which aims to provide a comprehensive and authoritative source of objective and up to date legal information on Carbon Capture and Storage (CCS). As the pace of CCS legal and policy developments increases, Ian has increasingly played a more active role in the CCS arena, including working

with the International Energy Agency (IEA) to set up the International CCS Regulators' Network and participating in their CCS roadmapping exercise. Ian was also an expert reviewer for the IEA's recent report on CCS, *CO2 Capture and Storage - A Key Abatement Option*, which was published in 2008.

Ian has also worked on other contracted research projects based at the Centre. His most recent work has centred upon domestic and EU environmental law and policy and he has conducted research on behalf of; the European Commission (DG Environment), The Cabinet Office, Freshfields Bruckhaus Deringer, RPS Group plc and Haymarket Media Group.

Catherine Redgwell
University College London

Catherine Redgwell joined the Faculty of Laws at UCL in January 2004 as Professor of International Law having previously held academic positions at the Universities of Oxford, Nottingham, and Manchester. She is presently joint general editor of the International and Comparative Law Quarterly. Her teaching and research interests include public international law, international environmental law, law of the sea, natural resources and energy law, and treaty law. She has been a member of the Academic Advisory Group of the Section on Energy, Environment, Natural Resources and Infrastructure Law of the International Bar Association for nearly 20 years. She served as a member of the Royal Society Working Group on Geoengineering the Climate in 2009. Her recent publications include: *International Law and the Environment* (OUP, 3rd edn, 2009, with Alan Boyle); *Lyster's International Wildlife Law* (CUP, 2nd edn, 2010, with Michael Bowmand and Peter Davies), *Moving Beyond the Carbon Economy* (co-edited with D. Zillman, Y. Omorogbe and L. Barrera-Hernandez, Oxford University Press, 2008), and *Energy Law in Europe: National, EU and International Law* (OUP, 2nd edn, 2007, co-edited with M. Roggenkamp, A. Ronne and I. Del Guayo).

Michael Gerrard
Columbia Law School

Michael B. Gerrard is Andrew Sabin Professor of Professional Practice at Columbia Law School, where he teaches courses on environmental and energy law and directs the Center for Climate Change Law. He also holds a joint appointment as a member of the faculty of Columbia's Earth Institute. Before joining the Columbia faculty in January 2009, he was managing partner of the 110-lawyer New York office of Arnold & Porter LLP; he is now Senior Counsel to the firm. He practiced environmental law in New York City full time from 1979 to 2008 and tried numerous cases and argued many appeals in federal and state courts and administrative tribunals. He was the 2004-2005 chair of the American Bar Association's 10,000-member Section of Environment, Energy and Resources. He has also chaired the Executive Committee of the Association of the Bar of the City of New York, and the Environmental Law Section of the New York State Bar Association.

Since 1986, Gerrard has written an environmental law column for the *New York Law Journal*, and since 1989 he has been editor of a monthly newsletter, *Environmental Law in New York*. He is author or editor of seven books, two of which were named Best Law Book of the Year by the Association of American Publishers: *Environmental Law Practice Guide* (twelve volumes, 1992) and *Brownfields Law and Practice: The Cleanup and Redevelopment of Contaminated Land* (four volumes, 1998). His other books are *Environmental Impact Review in New York* (two volumes, with Philip Weinberg and Daniel Ruzow, 1990); *Whose Backyard, Whose Risk: Fear and Fairness in Toxic and Nuclear Waste Siting* (1994); *The Law of Environmental Justice* (1999, 2d ed. 2008); *Amending CERCLA* (with Joel Gross) (2006); and *Global Climate Change and U.S. Law* (2007).

Legal Media Group's *Guide to the World's Leading Environment Lawyers,* based on 4,000 questionnaires, reported in 2005 and again in 2007 that Gerrard "received more personal nominations for this guide than any other lawyer in the world."

He received his B.A. from Columbia University and his J.D. from New York University Law School, where he was a Root Tilden Scholar.

List of Participants

Melissa	Batum	Geologist	US Department of the Interior, Minerals Management Service
Martin	Burke	CCS Projects Officer	Global CSS Institute
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Ann E.	Condon	Director and Counsel, EHS Programs	GE
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