



CO₂ CAPTURE & STORAGE

*international progress &
future prospects*

PROGRAMME

A workshop co-hosted by:
The Royal Society
The Royal Academy of Engineering
IEA Coal Industry Advisory Board
7/8 November 2007

International Energy Agency
9, rue de la Fédération – 75015 Paris

Introduction to the workshop

The Stern Review identified carbon dioxide capture and storage (CCS) as essential if fossil fuels are to continue making their necessary contribution to energy security whilst achieving deep cuts in greenhouse gas emissions. But technological and financing barriers mean that a full-scale demonstration of CCS has yet to be built. This workshop, to be held at the IEA offices in Paris, is hosted jointly by the UK's Royal Society, the UK's Royal Academy of Engineering and the IEA Coal Industry Advisory Board. It will review the science, technology and engineering aspects of delivering this technology; discuss what is needed to accelerate its development; and highlight financial, legal and safety issues; as well as the need to engage the public as this technology is developed and deployed. The meeting will have a strong international involvement, drawing on expertise from across Europe, Japan, North America, Australasia, South Africa, China and India.

A number of CCS demonstration project proposals have been put forward, but progress on their delivery is slow and the market alone is unlikely to be able to deliver these technologies at the scale needed. There is a substantial amount of learning needed to reduce project risks and costs, and to develop the necessary technical expertise – issues that will be explored with Members of the IEA Coal Industry Advisory Board.

Issues to be discussed at the workshop

- Role of CCS in mitigating climate change
- Geological potential to store CO₂, including interaction with holders of mineral rights
- Capture technologies, including the definition of “capture-ready” power plants
- Legal and regulatory issues, including the question of permanence
- Incentives, including international mechanisms, fiscal measures and carbon pricing
- Public acceptability
- Technology transfer

Aims of the workshop

To consider the science, technology, engineering, commercial, regulatory and policy challenges to deploying carbon dioxide capture and storage (CCS) technologies. Participants representing key international stakeholders will also consider the timescales on which these technologies can be deployed and other issues such as the public acceptability of CCS.

Key questions for participants:

Is the development of CCS for fossil fuels progressing with sufficient urgency?

Are there any residual technological barriers to the implementation of CCS?

Can we rely on commercial markets to deliver CCS technologies without further action?

If not, what measures do governments and regulatory authorities most urgently need to deliver and what more should industry itself be doing?

How can CCS be encouraged in emerging economies where new coal-fired plants are being installed on a massive scale?

How will high and volatile coal prices affect the uptake of CCS?

Will progress with other low-emission technology options make CCS more or less important?

What role can bio-fuels play in conjunction with CCS?

The focus is on power generation with CCS, but what of other sectors, e.g. iron and steel, cement and transport?

WORKSHOP PROGRAMME

Wednesday, 7 November 2007

12:30–13:30	Registration of participants and buffet lunch
13:30–13:40	<p>OPENING SESSION: Setting the Scene</p> <p><i>Chair for day: Mr Steven F Leer, Chairman and Chief Executive Officer, Arch Coal & CIAB Chairman</i></p> <p><i>Welcome address: Prof Richard Macrory, Barrister, Professor of Environmental Law & Director – Centre for Law and the Environment, University College London</i></p>
13:40–15:00	<p>SESSION 1: The Compelling Case for CCS in CO₂ Mitigation Strategies <i>Chaired by Lord Oxburgh, President, Carbon Capture and Storage Association</i></p> <p>The world cannot continue to use fossil fuels at the rate needed to satisfy energy needs without adversely affecting the Earth's climate and the environment. Despite important steps taken by government and industry to mitigate greenhouse gas (GHG) emissions, carbon dioxide (CO₂) emissions have increased by over 20% over the past decade. If the future is in line with present trends, as illustrated by the IEA's <i>World Energy Outlook 2006 Reference Scenario</i>, CO₂ emissions will continue to grow rapidly over the next 25 years, even after taking account of energy efficiency gains and technological progress that can be expected under existing policies. Greater reliance on coal for power generation, together with increased emissions from the transport sector, mean that CO₂ emissions are forecast to be almost two and a half times the current level by 2050. A portfolio of existing and emerging mitigation technologies form key components in the global response to address climate change: energy efficiency, renewable energy, advanced bio-energy, advanced hydrogen production, nuclear power generation, and CO₂ capture and storage.</p> <p>The Stern Review (15 min) <i>Ms Hannah Ryder, International Climate Change Division, UK Department for Environment Food and Rural Affairs and co-author of The Stern Review (tbc)</i></p> <p>CCS in the IEA's Energy Technology Perspectives (15 min) <i>Mr Neil Hirst, Director – Energy Technology and R&D, International Energy Agency</i></p> <p>The Power to Reduce CO₂ Emissions (15 min) <i>Mr Henry A Courtright, Senior Vice President, Electric Power Research Institute</i></p> <p>The Need for and Benefits of EU-wide Policies to Stimulate Early CCS Demo (15 min) <i>Mr Jan Panek, Head of Unit – Coal & Oil, DG TREN, European Commission</i></p> <p>20-minute discussion to set the workshop agenda</p>
15:00–15:30	tea break
15:30-16:30	<p>SESSION 2: CCS Technology Status <i>Chaired by Mr Nick Otter OBE, Director – Technology and External Affairs, Alstom</i></p> <p>CCS technologies can significantly reduce CO₂ emissions from power generation, industry and the production of synthetic transport fuels. In the IEA <i>Energy Technology Perspectives</i> report, under scenarios that assume accelerated technology deployment, CCS contributes 20-28% of total CO₂ emissions reductions below the expected baseline by 2050 – the second largest contributor to emissions reduction after energy efficiency. CCS involves three distinct stages:</p> <ul style="list-style-type: none"> • capturing CO₂ from power plants, industrial processes or fuel processing, conditioning and compression; • transporting the CO₂ by pipeline or by other means, such as by ship; • injecting and monitoring the stored CO₂ in different geological formations, including deep saline aquifers, depleted oil and gas reservoirs, and un-mineable coal seams. <p>These technologies have been in use for decades, albeit not in combination with the purpose of reducing CO₂ emissions. Capture technologies are being further developed to reduce costs and to reduce the associated energy penalty before they can be considered for application at a commercial scale. In the case of storage, robust regulatory frameworks demand a better understanding of the characteristics of potential storage sites so that the suitability of sites can be determined prior to licensing.</p>

	<p>CO₂ Capture Technologies (15 min) <i>Dr Malcolm Wilson, Director – Office of Energy and Environment & Adjunct Professor of Engineering and Graduate Studies, University of Regina</i></p> <p>CO₂ Transport and Infrastructure – from strategy to commercial projects (15 min) <i>Ms Trude Sundset, Vice President of Environment and Climate, StatoilHydro</i></p> <p>Global CO₂ Storage Potential (15 min) <i>Dr John Bradshaw, Chief Scientist – Carbon Dioxide Capture and Storage, Geoscience Australia</i></p> <p>15-minute discussion</p>
16:30-17:45	<p>SESSION 3: Public Policy Perspectives and Commercial Drivers <i>Chaired by Mr Noé van Hulst, Director – Long-term Co-operation and Policy Analysis, International Energy Agency</i></p> <p>The main challenges for the future adoption of CCS include technology and costs; law and regulation; international support, such as the Kyoto Protocol mechanisms; risk and financing; and public acceptance. CCS technologies are not expected to be deployed in the absence of a CO₂ incentive, except for cases with substantial benefits from enhanced oil recovery or enhanced coalbed methane production. The same reasoning applies to other low-carbon electricity production options, such as the wider use of renewable and nuclear energy. CCS has the potential to be a low-cost option to mitigate CO₂ emissions, especially in countries that rely heavily on coal for power generation.</p> <p>European Policy Perspective – how to deliver 10-12 CCS demonstrations? (15 min) <i>Mr Charles Soothill, Vice President Technology, Alstom & Vice Chairman of European Technology Platform on Zero Emission Fossil Fuel Power Plants Advisory Council</i></p> <p>Asia-Pacific Partnership and Technology Transfer (15 min) <i>Mr Stuart Dalton, Director – Generation, Electric Power Research Institute</i></p> <p>Public Policy in China (15 min) <i>Dr YANG Fuqiang, Vice President, The Energy Foundation and Chief Representative – Beijing Office</i></p> <p>Public Policy in India (15 min) <i>Dr Malti Goel, Adviser/Scientist 'G' and Member Secretary IS-STAC, Ministry of Science and Technology (tbc)</i></p> <p>15-minute discussion</p>
19:30	<p>Dinner for invited guests at Salle George Marshall, Chateau de la Muette with an address by <i>Lord Oxburgh</i>, introduced by <i>Mr Noé van Hulst, Director, IEA and Secretary General designate of the International Energy Forum, Riyadh</i></p>

Thursday, 8 November 2007

09:00-09:10	<p>Introductory remarks <i>Chair for morning: Mr Philip Ruffles CBE FREng FRS, Chairman of workshop organising committee</i></p>
09:10–11:00	<p>SESSION 4: CCS Demonstration Projects <i>Chaired by Dr Don Elder, Chief Executive Officer, Solid Energy New Zealand</i></p> <p>In order to achieve substantial emissions reductions, CCS needs to be deployed on a large scale – estimated to be 3,600 times the CO₂ that is currently being stored at the Sleipner project in the North Sea (MIT, 2007). Many CCS projects will be needed to prove the technologies and many are planned. Each will face a unique set of challenges, including technical, financial, legal and political issues. A number of storage projects are already underway around the world, including around 70 where enhanced oil recovery is achieved using CO₂. This session aims to examine progress and challenges at demonstration projects around the world.</p> <p>CCS at SaskPower in Canada (15 min) <i>Mr Max Ball, Project Manager, SaskPower Clean Coal Project</i></p> <p>FutureGen – progress and prospects (15 min) <i>Mr Michael J Mudd, Chief Executive Officer, FutureGen Alliance</i></p>

	<p>Japanese CCS Projects (15 min) <i>Mr Yoshihiko Nakagaki, President, Electric Power Development Company (J-Power)</i></p> <p>Co-firing of Biomass – an early CCS opportunity (15 min) <i>Ir Sjaak van Loo, Director, Procede Group BV, The Netherlands and Chair of IEA Bioenergy Task Force on Co-firing</i></p> <p>CCS Projects in China: GreenGen and nZEC (15 min) <i>Dr SU Wenbin, General Manager, GreenGen Co Ltd (tbc)</i></p> <p>35-minute discussion, including progress updates from CIAB Members <i>Mr Bob Taylor, Board Member for Distribution & Technology, E.ON UK</i> and <i>Mr Matthias Hartung, Executive Board Member, RWE</i> on their European demonstration project activities.</p>
11:00-11:30	coffee break
11:30-12:45	<p>SESSION 5: Impact of Legal, Regulatory and Public Perception Issues on Investment <i>Chaired by Mr Bill Koppe, Development Manager, Anglo Coal Australia</i></p> <p>Where CO₂ storage occurs completely within territorial land and waters, national and sub-national laws apply. However, if project activities take place offshore, in international waters, a variety of international marine environment protection instruments apply. Contracting parties to these instruments have worked to develop appropriate amendments to the London Protocol and OSPAR Convention to allow for regulation of sub-seabed CO₂ storage. Creating new property rights – the right to store CO₂ – will be of concern to those holding coincident rights, such as owners of oil and gas rights. A key challenge is the issue of underground storage; in particular monitoring and modelling to provide the proof that CO₂ will be retained over the long term. All storage options need this proof at large scale to gain wider public acceptance.</p> <p>Legal Aspects of Storing CO₂ in the International Marine Environment (15 min) <i>Mr Tim Dixon, AEA Energy & Environment and consultant to Carbon Abatement Technologies Unit, UK Department for Business, Enterprise & Regulatory Reform</i></p> <p>Public Perception and Market Deployment (15 min) <i>Mr James J Dooley, Senior Staff Engineer, Joint Global Change Research Institute, Pacific Northwest National Laboratory</i></p> <p>Climate Policy Uncertainty and Investment Risk (15 min) <i>Dr William Blyth, Associate Fellow of Chatham House, Sustainable Development Programme & Director of Oxford Energy Associates.</i></p> <p>30-minute discussion</p>
12:45-14:00	buffet lunch
14:00-15:30	<p>SESSION 6: Formulating an International Strategy for CCS <i>Chaired by Mr Steven F Leer, Chairman and Chief Executive Officer, Arch Coal & CIAB Chairman</i></p> <p>CCS is a unique technology; it offers the prospect of becoming an important means to mitigate CO₂ emissions from fossil fuel use, but, to be effective, it must be widely adopted in both developed and developing countries. The challenges to deployment are substantial and are explored in previous workshop sessions. In this final session, panellists will be invited to share their views on what shape an international strategy for CCS deployment might take.</p> <p>Panel discussion with:</p> <p><i>Dr Steve Lennon, Managing Director – Resources & Strategy, Eskom</i> <i>Mr Jan Panek, Head of Unit – Coal & Oil, DG TREN, European Commission</i> <i>Dr Jim Smitham, Deputy Director, CSIRO, Australia</i> <i>Mr Roger Wicks, Head of Energy, Anglo American</i> <i>Dr ZHANG Yuzhuo, Chairman, Shenhua Coal Liquefaction Corporation & Vice President, Shenhua Group Corporation Limited</i></p> <p>Panellists will offer their own, short commentary (5 min) in response to the questions posed in the box on page 2, and to any other key issues emerging from the workshop. Participants will then be invited to join an open discussion to draw out key messages from the workshop, followed by concluding remarks from the chair.</p>

The Royal Society

The Royal Society, the national academy of science of the UK and the Commonwealth, is at the cutting edge of scientific progress. It supports many top young scientists, engineers and technologists. It influences science policy, it debates scientific issues with the public and much more. It is an independent, charitable body which derives its authoritative status from its 1400 Fellows and Foreign Members.

The Royal Academy of Engineering

The Royal Academy of Engineering brings together the UK's most eminent engineers from all disciplines to promote excellence in the science, art and practice of engineering. Its strategic priorities are to enhance the UK's engineering capabilities; to celebrate excellence and inspire the next generation; and to lead debate by guiding informed thinking and influencing public policy.

IEA Coal Industry Advisory Board

The IEA Coal Industry Advisory Board (CIAB) comprises a group of 40-50 members, typically senior executives of coal mining companies or major power utilities. It brings advice to the IEA on, for example, the continued use of coal as a secure source of energy and on measures to mitigate the environmental impact of coal use. The CIAB holds occasional workshops on topics of particular importance to the industry and IEA.

For further information on this event, please contact Brian Ricketts at the International Energy Agency (brian.ricketts@iea.org), Richard Heap at the Royal Society (richard.heap@royalsoc.ac.uk) or Alan Walker at the Royal Academy of Engineering (alan.walker@raeng.org.uk) who can also arrange invitations for those wishing to attend.

Organising Committee: Philip Ruffles (co-chair) / Deck Slone, Arch Coal (co-chair) / Keith Batchelor, Foster Wheeler / Stu Dalton, EPRI / Mike Dancison, AEP / Jon Gibbins, Imperial College / Richard Heap, Royal Society / Brian Heath, CIAB / Allan Jones, E.ON UK / Bill Koppe, Anglo Coal Australia / Ned Leonard, CEED / Nick Otter, Alstom / Brian Ricketts, IEA / Nick Riley, British Geological Survey / Hans-Wilhelm Schiffer, RWE Power / Alan Walker, Royal Academy of Engineering / Martin Wedig, Coal and Minerals / Colin Whyte, Xstrata Coal.

IEA – International Energy Agency

9, rue de la Fédération
75739 Paris Cedex 15
FRANCE

tel: +33 (0)1 40 57 65 00/01

fax: +33 (0)1 40 57 65 59

www.iea.org / info@iea.org

Access by public transport:

- Metro Line 6: Bir-Hakeim
- RER C: Champs de Mars
- Bus Line 42: Docteur Finlay or Duplex

**PLEASE CARRY YOUR PASSPORT
OR OTHER OFFICIAL PHOTO ID TO
GAIN ENTRY TO THE IEA BUILDING**

17 October 2007

