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Barriers and Solutions  
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## Executive Summary

The expert meeting provided an opportunity for discussion on the issues that are restricting the development of carbon capture and storage (CCS) in North America from a financial perspective. The meeting enabled a discussion of the possible options to overcome hurdles as well as ways to facilitate and encourage more CCS projects. Numerous unresolved issues and potential difficulties in the use of CCS still exist, including insurance, viable financial incentives and the need for the establishment of a robust policy and regulatory framework.

An important outcome is that many of the speakers thought the difficulties and issues surrounding CCS can be resolved. However, from a private investment viewpoint CCS in North America was an unattractive financial option without Government incentives and a legal framework in place. There was also a general consensus that if the USA implemented an emission trading systems that the revenue would need to be targeted at CCS and relying on a market derived carbon price would still not be enough to make CCS a financially viable option in the near to medium term. The conference discussion provided the following points of note:

- The view from the investment banks was that there would be no major private investment in CCS in the USA until they can be offered a secure return on their investment, such as loan guarantees or tax credits.
- Development of CCS regulatory frameworks is well underway internationally in a number of regions. The speed of development may be enhanced with the launch of the IEA CCS International Regulatory Network.
- The Interstate Oil and Gas Compact Commission (IOGCC) recommends that in the USA that CO<sub>2</sub> storage should be regulated as a commodity to allow the application of oil and gas conservation laws to facilitate development of storage projects. The IOGCC has a Task Force that also produced a set of guidelines on permitting CCS projects.
- There are a number of CCS projects underway in North America and future possibilities through the restructuring of FutureGen. In Canada, the Government intends to have new coal fired plants capture ready by 2018.
- There is a perception that an emissions trading scheme will not be enough to accelerate deployment of commercial CCS projects in the future and that other incentives will be required.
- There are several proposals in the USA investigating how to facilitate the deployment of CCS. For instance the proposed bill by Lieberman-Warner has use of some of the revenues from sale of allowances to fund low carbon technology projects including CCS. Further proposals discussed at the meeting were the use of the Bond market and setting up a Trust Fund for CCS.
- There is a clear gap in the USA about information on CCS with the general public and within the financial sector and hence an urgent need to provide further information and educate people about the risk and benefits of CCS in an informed manner.

- Legal and environmental liability is seen as an issue. Insurance companies do currently have the business models to insure CCS projects during the operational phase but there is a lack of data to provide coverage for the long term liability that would exist post-injection. Development work in this area is critical.
- Quantifying the potential long term liability of CCS projects in dollar terms would allow insurance companies to assess the underwriting that is needed. Otherwise until more information is available for long term liability in CO<sub>2</sub> storage there is likely to be only limited insurance on a 1-2 year revolving contract.
- If financing of CCS is to occur from the private sector then the 30 trillion dollar bond market must be utilized. This is unlikely to occur until there is greater regulatory certainty from the US government and the States, and greater certainty of cost recovery approval and permitting allowed by the local public utilities commissions. Ultimately, the willingness of ratepayers to pay higher electricity bills to pay for CCS, as reflected in decisions by local public utilities, will be critical to the financing of such projects.

## **Introduction**

The CCS Expert Meeting on Finance took place over two days in New York. This meeting was a follow up to one that was held in London during 2007. The Meeting was by invitation and limited to 80 people that included representatives from Governments, industry, insurance, financial institutions, academia and research organizations.

The main purpose of the conference was to provide a clearer picture of the options available to finance CCS projects in North America and to increase the involvement of experts from the financial sector in discussion about possible financial instrument options for CCS. The ultimate outcome of this work will be to identify, encourage and develop world-wide collaboration and practical development of financial mechanisms to accelerate the progression of CCS projects from R&D to commercial reality.

The objectives of the meeting were to explore the options of:

- Identifying key drivers on financing CCS projects in North America by the financial sector.
- Contributing to building financial mechanisms for deployment of CCS projects
- Gaining access to financial information relevant for all major stakeholders such as industry, insurance companies, Government and investors in CCS projects
- Use of futures, derivatives and insurance markets to reduce financial risks of CCS deployment
- Improving the awareness of the status of CCS technology for the financial community.
- Use of insurance to address the financial risks of CCS demonstration plants

The IEA Clean Coal Centre (IEA CCC), IEA Greenhouse Gas R&D Programme (IEA GHG) and the World Coal Institute (WCI) have extensive global links and are in an excellent position to facilitate co-operation between leading research groups and industry on greenhouse gas (GHG) mitigation. IEA GHG already has experience in coordinating a number of international research networks. One option under consideration is the establishment of a new network to bring together existing expertise and experience of organizations at the forefront of research, development and demonstration into GHG mitigation technologies as well as financial institutions. To date, financial institutions have limited experience with CCS which was highlighted at the meeting with one speaker from the financial sector stating that his institution was not being asked to include CCS in the assessment of new coal fired plant in the USA. The objectives of this report are:

1. To pass on information about the CCS Expert Meeting on Finance;
2. Give an overview of each of the presentations, and
3. To outline the main outcomes of the meeting.

## Day One Sessions

The meeting opened with a welcome by Barbara McKee of the US Department of Energy. Ms McKee highlighted the importance of CCS as a major contributor to mitigation of CO<sub>2</sub> emissions and pointed out that in many countries there were other issues to consider. These issues included electricity deprivation, scarcity of clean water and food and legitimate aspirations for economic improvement in the lives of those with low per capita incomes.

The meeting was divided into six parts. **Session One** was on the worldwide status of CCS given the importance of fossil fuels which currently supply 80% of the global energy demand with a further 60% growth in energy demand expected by 2030. CCS after energy efficiency is the second biggest potential mitigation option and will be a key transformational technology. There are many barriers to CCS deployment including technology development, cost, legal and regulatory, public acceptance, international mechanisms and making it commercial. If the barriers are removed CCS could change the way the energy industry operates with opportunities for innovators. However, if this is to be achieved it is important to recognize that it is vital to develop and deploy CCS to use fossil fuel resources sustainably.

Kelly Thambimuthu the Chairman of the IEA GHG said that CO<sub>2</sub> emissions are expected to grow an additional 14.3 Gt by 2030 with more than half of the growth coming from power stations in India and China. This presents a dilemma with energy demand growing and being met more and more by fossil fuels. The Intergovernmental Panel on Climate Change Fourth Assessment (IPCC AR4) also discusses how mitigation efforts over the next 2-3 decades will have a large impact on the potential to achieve lower stabilization levels. There is also the risk of “carbon lock” in with new and replacement fossil fuelled power plants 2003-2030 expected to be 1,391 GW for coal, 1,883 GW for gas and 237GW for oil. This means the next 10 years will be very critical as this technology will be locked in and producing CO<sub>2</sub> emissions for 30-40 years at least.

The status of CCS in terms of maturity differs with injection, storage and transport. Some parts of the cycle are well established in the oil and gas industry, for example CO<sub>2</sub> transport as part of enhanced oil recovery (EOR) operations. International policy developments have seen CCS being increasingly accepted with it now being considered for inclusion within the EU ETS from 2013. However, there are still barriers preventing the inclusion of CCS within the Clean Development Mechanism (CDM).

There is currently no large scale coal fired demonstration projects to accelerate deployment of CCS technologies. However, there are several proposed integrated CCS projects in Europe, USA, Canada, Australia and plans for a project in China. Lastly, the amount of money to be invested in the power sector including transmission and distribution networks up to 2030 is estimated to be over US\$11 trillion according to the IEA WEO 2007.

Jonathan Pershing from the WRI outlined four key points. Climate science is robust and the urgency to undertake large scale change is strong. There is no silver bullet, so we need to undertake all options. CCS is challenging in cost and public acceptability. Scaling up globally will be critical. Finally the policy needed to make all this work needs to be in place. In the USA, coal makes up over 30 % of the energy mix and it would be impossible to shut the existing coal fired stations down as they are critical to meet energy demand.

**Session two** examined national and regional initiatives with many countries building and moving forward on existing legal/regulatory frameworks taking into account onshore and offshore CO<sub>2</sub> injection including:

- Australia: based on Offshore Petroleum Act of 2006: ETS in 2010
- Canada: action at both Federal and Provincial level (Alberta and BC)
- United Kingdom: storage offshore; government taking long term liability
- Japan: storage offshore with Environmental Ministry responsibility
- Norway: building on existing offshore oil and gas regulations

Tom Wilson, a Senior Technical Leader at the Electrical Power Research Institute (EPRI) discussed CCS activities in the USA asking the key question of who is going to pay for early deployment of new CCS technology? Is it going to be Government, industry, or a combination? CCS is a critically important technology to the USA with both its large coal reserves and large potential for geological storage. However, in the USA the cost of coal along with other generation technologies has doubled since 2000. CCS retrofit is being considered and the Lieberman-Warner bill, if enacted, could produce CO<sub>2</sub> price and incentives sufficient to spur CCS deployment. To make CCS commercial by 2020 will require investment in the technology to start immediately.

Eric Beynon from the ICO2N Group discussed several CCS initiatives in Canada. ICO2N is made up of 18 companies representing many of the major potential CCS players. The companies in his group produce over 100Mt of CO<sub>2</sub> emissions annually or 15% of Canada's emissions. This includes 95% of oil tar sands emissions and greater than 60% of Alberta's energy emissions. In Canada, there is potential for 3,762 MtCO<sub>2</sub> to be stored in oil and gas reservoirs alone.

Initially, it is expected that CCS will begin in Western Canada. ICO2N has completed several economic analyses identifying CCS as a critical component of Canada's GHG reduction strategy in coal and the oil tar sands in the long term. There is currently 150 billion Canadian dollars earmarked for investment to utilize tar sands up to 2015. From a regional perspective, Alberta views CCS as a means to reduce its emissions by 60%.

Lawrence Bengal is from the Interstate Oil and Gas Compact Commission (IOGCC) presented his work with the IOGCC Task Force. The IOGCC is made up of 30 members, associate states and several international affiliates and a Task Force has produced a set of

guidelines on permitting CCS projects. The IOGCC Resource Management philosophy on CCS is:

- Given the regulatory complexities of CO<sub>2</sub> storage. The Task Force strongly believes that geologically stored CO<sub>2</sub> should be treated under resource management frameworks as opposed to waste disposal frameworks. These regulatory complexities include environmental protection, ownership and management of the pore space, maximization of storage capacity and long term liability.
- Regulating the storage of CO<sub>2</sub> under a waste management framework sidesteps the public role in both the creation of CO<sub>2</sub> and the mitigation of its release into the atmosphere and places the burden solely on industry to rid the "waste" from which an "innocent" public must be "protected".
- Such an approach lacking citizen buy-in with respect to responsibility for the problem as well as the solution could well doom geological storage to failure and diminish significantly the potential of geologic carbon storage to meaningfully mitigate the impact of CO<sub>2</sub> emissions on the global climate.

Kai Tullius from the European Commission (EC) gave an overview of CCS policy developments in Europe. The aim in Europe is to build 10-12 coal and gas CCS plants by 2015 which is estimated to cost between 10-20 billion euros. The long term policy goal is to make CCS commercially feasible by 2020. The current CCS directive is proposing an enabling framework with Member States determining whether and where CCS will happen and companies deciding whether to use CCS on the basis of conditions in the carbon market. At the moment CCS is not mandatory. The overall strategy from the European Union (EU) includes in the third phase from 2013 to have full auctioning of CO<sub>2</sub> certificates for the power sector and to include CCS.

Marc Levinson from JP Morgan Chase spoke on CCS and investment. His first comment was that this meeting and the discussions on financing CCS are premature from a private sector perspective. He pointed out that none of their clients had approached JP Morgan Chase about CCS and that in his view that this is unlikely to change in the next five years. If there are going to be any projects in the USA it is likely that the coal and gas companies will go first to the Government for funding, such as FutureGen. He went on to point out that any government subsidies would not be necessarily be positive for facilitating CCS. This could artificially allow CCS to sell low cost electricity and discourage renewables and other low carbon technologies. He then went on to outline what an investor would need to know before lending:

- How will lenders and investors get their money back? The state has to decide that the utility can recover the costs from the rate payer. It needs to be determined that the additional expenditure is "prudent".
- No lending or investing in CCS until the legal and regulatory uncertainty is sorted out such as pore ownership and liability of leakage.

- They will want to see financial engagement from suppliers to overcome technology risk. There needs to be more suppliers involved in CCS as this will increase investor confidence that these technologies will work.

The discussion and questions on this session focused on the JP Morgan Chase presentation. Several questions were asked on how JP Morgan Chase viewed the future for CCS. Mr Levinson made it clear that if the Government was going to rely on private funding without loan guarantees then CCS projects were unlikely to proceed. A question was asked about what a deal on CCS would have to look like for investors to come to the table. A suggestion was made – “would it assist if the commodity risk was taken out with a 20 year rate price on fuel in a rate regulated environment”. Mr Levinson responded that a rate regulated market is one way to approach it and the other is to put a meaningful cost on carbon as in Europe. Basically CCS has no positive purpose, it only has a negative purpose to avoid another cost (putting CO<sub>2</sub> into the air) and currently this does not have a cost in the USA.

**Session three** discussed the financial industry and CCS. The session began with Mark Trexler from EcoSecurities Global Consulting Services presenting on the relationship between CCS and carbon markets and how they could assist in getting CCS off the ground. Several possible scenarios exist but the carbon market is complicated and not a typical commodity market with many variables including science, media and public opinion all influencing carbon credit price forecasting. Demand is based largely on policy decisions, on how strict the market is, and on how credits are defined. All of which are different from other commodity markets.

In order for CCS projects to proceed, it will need several elements in place including public acceptance, financial incentives, clarification of the permitting issues and demonstration projects to get underway as soon as possible. In order for CCS finance to be secured it will require subsidies and risk offloading. In the end, CCS is reliant on policy, expectations about policy and market demand. It is clear that the carbon market will not be a launch pad for CCS, more likely the carbon market will supply a cash flow.

Professor Edward Rubin argued that in an increasingly carbon constrained world, large reductions of CO<sub>2</sub> emissions from coal plants will be urgently needed and only CCS offers that reduction option. Deployment is needed to establish reliability and true cost of CCS in utility applications at commercial scale across different technologies, different types of coal (bituminous, sub-bit, lignite) and in different geological settings. To reduce costs, learning by doing and R&D is needed.

Professor Rubin then outlined a CCS Trust Fund option he is proposing funded by fees from the use of coal for power generation to pay the full additional cost of CCS for new coal fired plants. This option can raise large amounts of money via small fees. It also decouples the regulatory requirement to reduce CO<sub>2</sub> and can rapidly start deployment with well defined revenues. There are two reports on the Pew Centre website at [www.pewclimate.org](http://www.pewclimate.org) that give more details about the Trust Fund and further options to accelerate deployment of CCS.

Robert Sussman presented on proposals that could assist CCS. Until legislation in the USA is put in place clarifying the status of CCS there will remain uncertainty about the drivers and incentives amongst plant developers with it currently not in their economic interest to deploy CCS plants. One recently proposed climate change bill in the USA was the Lieberman-Warner Climate Security Act (S.2191) which could achieve emission reductions below 2005 levels of 17-19% by 2020, and 57-63% by 2050. It is a cap and trade program where sources that fall within the terms of the Act must hold allowances equal to their emissions. A key point is that US \$16 billion from auction revenues in the current Lieberman-Warner Bill would be made available for CCS projects. However, in the long term, cap and trade this is not enough to finance the wide scale deployment of CCS; additional incentives would be needed. One alternative approach that examined emissions trading could be linked to a performance standard requiring CCS for new plants plus a subsidy to close the cost gap from the revenues of auctioning allowances. The Bill was rejected but likely to be resubmitted at a later date.

Paul Zakkour presented on Financing CO<sub>2</sub> Infrastructure examining financial aspects of building CO<sub>2</sub> pipeline networks including backbone systems. His key messages were that:

- Integrated backbone pipeline networks may be most efficient long-term option but will need "guaranteed" capacity utilisation in order to be economically viable. Point-to-point pipelines on the other hand will be funded on a project-by-project basis by individual developers because of certainty over capacity utilisation.
- Public policy such as Government incentives, and loan guarantees will be needed to encourage development of optimised networks. In particular, Government support in first years when capacity is ramping up will be important for commercial viability

CO<sub>2</sub> pipeline projects, if they can be reduced in terms of carbon price risks, will become the same in terms of risks as any other oil & gas pipeline project. However, currently banks and financial institutions view such projects as having greater regulatory and market (carbon price) risks than oil and gas pipeline projects.

The audience asked several questions concerning the Trust Fund option, the Lieberman-Warner Bill that was being put forward and the political feasibility of the proposals. The panel responded that leadership has to come from countries that can implement CCS. The sooner CCS can be deployed and come down the learning curve it is likely the costs will come down as did with other technologies such as SO<sub>2</sub> control and NO<sub>x</sub> control.

Tom Kerr from the International Energy Agency (IEA) discussed the recently launched CCS International Regulatory Network on 13-14 May, 2008 and outlined what the IEA was doing in other areas of CCS including high-level recommendations for consideration at the G8 summit in Tokyo in June 2008.

## Day Two Sessions and Discussion

**Session four** began with Preston Chiaro from Rio Tinto Energy present on the Hydrogen Energy Abu Dhabi project and Carson project. He explained that the Hydrogen Energy Company is jointly owned by BP and Rio Tinto and was established to supply low carbon hydrogen fuel to the power sector by using fossil fuels and carbon capture and storage. The Abu Dhabi project could be operational by 2012 and will sequester 1.7Mt CO<sub>2</sub> with EOR as the main economic driver. The Carson project has actually been relocated to Bakersfield in California. Both projects aim to generate hydrogen for power and other uses and to use the CO<sub>2</sub> for EOR.

Anthony Tarr, the CEO from the Zerogen project in Australia, stated that with their ratification of the Kyoto Protocol, the Australian government also created a large clean coal technology fund. He went on to describe the Zerogen project in Queensland that will use IGCC and CCS with aims to complete the feasibility study in 2009 and have an 82MW plant operational by 2012 and a 400MW plant operational by 2017. The storage component will be in a saline aquifer with a goal of 75% - 90% CO<sub>2</sub> capture.

Bruce Braine from American Electric Power (AEP) discussed their activities on CCS including a project in New Haven, West Virginia which will be the first CCS demonstration plant for AEP using chilled ammonia for CO<sub>2</sub> capture. AEP sees technology development and deployment as a critical issue. AEP is focusing on IGCC and ultra supercritical (USC) technologies with AEP first to announce two 600MW IGCC commercial scale plants. A new generation plant using ultra supercritical steam conditions is being built in Arkansas for the first time in the USA with a temperature above 1100F. AEP is looking at all capture techniques.

Gary Loop from Dakota Gas discussed the Dakota Gasification plant that his company operates and which supplies CO<sub>2</sub> to the Weyburn CO<sub>2</sub>EOR project. These projects combine to form the largest capture and storage project in the world. 14 gasifiers operate to produce synthetic natural gas (SNG) or methane capturing 4.5 million tonnes of CO<sub>2</sub> and deliver 3 million tonnes of CO<sub>2</sub> per year for EOR operations in the Northern USA and Canada. To date, in Weyburn, Saskatchewan 13 million tonnes have been injected. The capture process costs in US\$8 per tonne of CO<sub>2</sub> (capital US\$4, O&M US\$4). To provide incentives for CCS a tax credit of \$15/ton CO<sub>2</sub> can stimulate sites to prove evolving technologies. A 30% investment tax credit for demonstration plant can stimulate sites as well.

Several questions were asked about the use of EOR. EOR can improve the amount of oil that can be recovered and with oil at \$130 barrel it makes EOR even more economically viable. EOR has positive revenue but other options need US\$20-30. Preston Chiaro pointed out these projects are long term investments and no one knows whether the price of oil will remain high. In addition, if CCS takes off then there will be a lot of CO<sub>2</sub> and thus high demand and a high CO<sub>2</sub> price may not be sustained for a long period.

**Session five** was a panel discussion on insurance and liability concerning CCS projects. The panel was moderated by Arthur Lee, Principal Advisor, Environment and Climate Change, Chevron Corporation. A presentation on risk and liability was given by Chiara Trabucchi a Principal at Industrial Economics. The Panel also included: Lindene Patton, Chief Climate Product Officer, Zurich Financial Services, Rick Hawkinberry, Senior Vice President, Willis Environmental Practice and Adrienne Atwell, Senior Vice President, Swiss Reinsurance America Corporation. Several questions were addressed in the session and they were:

**What are the risks? What risks are insurable?**

Adrienne Atwell discussed this from a life cycle viewpoint starting at the site selection then went on to the different phases such as operation, contamination by leakage, local environment damage and raised the link between surface leakage and removal of carbon credits and who is liable to make up any shortfall from a loss of containment. At the other end of the life-cycle is the post-closure phase and the risk of quantification or how much has been stored and who is liable in the long term. All the risks are insurable up to the post closure stage. Rick Hawkinberry added that there are several types of existing insurance to cover many aspects of the life cycle. However, the post-closure phase is the complicated issue as there is little actuarial data available currently to assess this risk. Adrienne Atwell said that the insurance industry needs to understand what you are insuring and what the risks are to be able to determine what is then insurable?

**What does the insurance industry need in order to formulate insurance products for CCS projects?**

Lindene Patton said that companies need to determine what business model is in play and whether it will be the utilities responsible for most of the project or whether parts will be sub contracted. The business model determines who bears the risk and what sort of risk is being structured. So every time a new party is inserted there is further contractual risk. It is insurable, but there are public policy decisions that will decide on how this will be managed. In terms of the Lieberman-Warner bill the insurance sector will send a price signals when the final structure is in place. The question to address is how to get projects off the ground and once completed what happens with the future liability?

**What kind of policy environment is needed to develop these insurance products?**

There is currently a lack of regulatory framework in the USA and this will influence the development and design of insurance products. Because of a lack of actuarial data, this type of insurance for CCS technology is specialty coverage. This could in the USA create anti-trust issues as there may only be a limited number of insurance companies willing to cover the risk. There is also the issue that company will not provide insurance, is it worth proceeding? A further issue is that if the Government meets any long term liability issues price it would send the wrong investment signals to companies investing in CCS as there would be no risk to them. The Panel pointed out this is the wrong message to send to

companies as it creates a false sense of security and courts may overturn this at a future date.

The final session of the day covered investment in CCS. Ross Willims, Chairman of the Australian Coal Association Low Emissions Technology Ltd (ACALET) spoke about the CCS activities that the Australian Coal Association undertakes in Australia. This work programme is called the Coal21 action plan with support from a voluntary fund provide from a levy on Australian coal production. It is estimated that the levy will over 10 years raise around A\$1 billion.

There are several projects being supported by the fund involving oxy-fuel research, IGCC Zerogen, PCC-CSIRO post combustion capture project and the Otway project by CO2CRC as well as regional storage assessments in Queensland and New South Wales. There are several key elements for success that include a robust political framework with support, effective collaboration, clear goal to aim for a commercial plant, financial incentives including emissions trading and supporting regulation. In Australia CCS is moving forward on clean coal technologies but it is just the beginning and decades of work will be needed.

Mark Taylor from New Energy Finance started by highlighting that there are 65 CCS projects announced worldwide with total costs exceeding \$42 billion and they could, by 2016, cumulatively inject around 67 MtCO<sub>2</sub>/yr. This figure represents a 0.25% reduction in annual CO<sub>2</sub> emissions from global fossil fuel usage.

Due to the need to build investor confidence, the first commercial scale plant is likely to be the catalyst to get several built. One commercial scale project would determine the actual cost for a project, contribute to public acceptance, help refine regulatory definitions, help prove technical feasibility and lastly contribute to investor confidence.

Andrew Paterson from Econergy said to finance large scale projects will need more than the carbon market and that the bond market is needed to make progress. In the USA, 15GW of coal plant is under construction, none of which include CCS. There are several challenges still to overcome for CCS in the USA and they are:

1. Retail electricity competition and merchant power mostly failed in the USA, with major bankruptcies and many states remain committed to rate regulation.
2. Consumers do not buy electricity based on price, anyway; it is an essential good – and many utilities mask the signals.
3. New electricity supply is heavily constrained due to natural resource limits (wind, sunlight) and regulations no matter the option.
4. Energy efficiency and demand side management can help, but are not sufficient with growth and cannot replace a lot of “old coal” units.
5. USA regional differences in electricity fuel mix, prices, and access to renewable resources are severe.
6. “Urgent” cap and trade (2012, 2020) in the EU is a mixed bag: emissions are not lower, and other measures (feed-in tariffs, regulations, direct subsidies, local tax policy) are in the mix.

7. Because of a huge USA budget deficit and national debt, federal fiscal options are limited and need risk-based incentives.

The key financial market for CCS is the bond market in the USA which is around US\$30 trillion and which annually issues US\$6-7 trillion in new bonds of which US\$80-100 billion is for power providers. With dependence in the USA on coal-based electricity (50% of supply), CCS is vital to reducing carbon emissions. It is also clear that CCS is not economic and subsidies will be needed for the first plants. Finally, financing is the key and ultimately without financing there will be no CCS deployment.

A question was asked on what length of time would there needed for bond markets to fund CCS projects? Andrew Paterson responded that it will depend on how much it will cost the consumers. A longer term cap up to 2040 would engage the bond market but also have a very long term pathway.

## **Conclusions**

Preston Chiaro the Chairman thanked the speakers and the World Coal Institute, IEA CCC and IEA GHG for organizing the meeting and Chevron for sponsoring. He said it was interesting to see how the discussion had matured since the meeting in London last year. It is important to recognize that there has been progress, but a lot is still needed to establish CCS projects built in terms of regulations, insurance and practical experience in stakeholders operating CCS plants.

It is also important to note that while there has been considerable work and interest in CCS. There are also a lot of players ready to move forward but there is a need for urgency and direction from Governments. Policy and regulatory regimes are still uncertain and CCS is largely unknown to policy analysts, planners, politicians, the general public and this is something that will need to be addressed. In particular, Governments will need to provide financial support for the first CCS projects.

In order to move forward Governments will also need to have robust CCS policies that provide certainty to investors and allow for the deployment of CCS projects. We need to keep our options open and not to select a winner as we do not know what will be the final answer.