

INTERNATIONAL ENERGY AGENCY
COAL INDUSTRY ADVISORY BOARD



31st PLENARY MEETING

DISCUSSION REPORT

IEA Coal Industry Advisory Board plenary meeting
IEA Headquarters in Paris, 12/13 November 2009

IEA – 9, rue de la Fédération – 75739 Paris Cedex 15

PROGRAMME – Thursday, 12 and Friday, 13 November 2009

SESSION 1: Greenhouse Gas Mitigation Measures – Implications for the Coal Industry in Developed and Developing Economies

Chaired by Mr Roger Wicks, Special Adviser, Anglo Coal, South Africa and CIAB Chairman

Post-Kyoto Greenhouse Gas Mitigation – key IEA messages
Amb Richard Jones, Deputy Executive Director, IEA

The Role of Coal in the Post-2012 Climate Agreement – a CIAB statement
Mr Roger Wicks, CIAB Chairman and Mr. Didier Houssin, Director, Directorate of Energy Markets and Security, IEA

Carbon Capture and Storage – a GCCSI perspective on progress and future priorities
Mr Bob Pegler, Deputy Chief Executive Officer, Global Carbon Capture and Storage Institute (GCCSI), Australia

Discussion

SESSION 2: Energy Sector Investment and the Coal Industry – Implications for Energy Security

Chaired by Dr Steve Lennon, Managing Director – Corporate Services, Eskom, South Africa

Effects of the Global Financial Crisis on Coal Sector Investment
Mr Ian Cronshaw, Head of Energy Diversification Division, IEA

An Equipment Manufacturer's Perspective on Energy Investment
Ms Joan MacNaughton CB, Senior Vice President, Power and Environmental Policies, Alstom, UK

A Case Study on Coal Sector Investment – Mongolia and its future supply prospects
Prof Gurjav Badamkhatan, Director General, Institute for Mineral Processing Technology, Mongolian Science Academy

Development Strategies of Shenhua Group and its Clean and Low-Carbon Energy Mission
Mr LU Bing, General Manager, Department of International Co-operation, Shenhua Group Corporation Limited, China

Discussion

SESSION 3: Carbon Pricing – Implications for Coal and the Migration of Industrial Activity

Chaired by Dr Don Elder, Chief Executive Officer, Solid Energy New Zealand Limited

The Cost of Carbon Pricing
Mr Hank Courtright, Senior Vice President, Electric Power Research Institute (EPRI), USA

Australian CO₂ Emissions Reduction Measures – a new era for world coal?
Mr Mick Buffier, Group Executive – Corporate Affairs, Government & Industry Relations and Sustainable Development, Xstrata Coal, Australia

Emissions Trading and Carbon Leakage
Mr Richard Baron, Head of Climate Change Unit, IEA

Discussion

Introduction

The aim of these sessions was to engage the IEA Secretariat, CIAB Members and invited guests in a debate on the major issues affecting the coal industry, including consumers (particularly the electricity industry and its customers), producers, and infrastructure/transportation providers. These issues, including energy security and efforts to mitigate climate change, affect both developed and developing countries.

he emphasised the importance of involving non-member countries in IEA work (joint statements with China, India and Russia had been released at the meeting), and the important role that technology will have in meeting future energy challenges.

He said that the recent IEA *World Energy Outlook 2009* Reference Scenario projected a 40% increase in global energy use and associated CO₂ emissions by 2030, which is not consistent with climate stabilisation, so a scenario limiting CO₂ in the atmosphere to 450 ppm (equivalent to a 2°C global temperature rise) had also been investigated.

The Reference Scenario had highlighted energy security risks that could add to price volatility, particularly if investment in energy production capacity lagged behind the USD 26 trillion required to 2030. He noted that an additional investment of USD 10.5 trillion would be needed to achieve the 450 Scenario.

On COP15 in Copenhagen, he said that, although there was now less confidence that the negotiations would lead to a binding agreement, a positive outcome could still be achieved before the Kyoto agreement expires in 2012. He said that China is moving rapidly to embrace new technologies and that the world should move forward on technology, independently of the COP15 negotiations. He highlighted the IEA work on carbon capture and storage (CCS) supported by the Global Carbon Capture and Storage Institute (GCCSI) and reminded the meeting that by 2030 10% of the CO₂ emissions reductions required to meet the 450 Scenario are expected to be delivered by CCS.

SESSION 1: Greenhouse Gas Mitigation Measures – Implications for the Coal Industry in Developed and Developing Economies

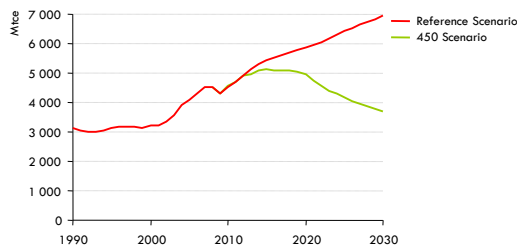
Session chaired by Mr. Roger Wicks, Special Adviser, Anglo Coal, South Africa and CIAB Chairman.

Mr. Wicks referred to the growing pressure on industry to reduce greenhouse gas emissions and invited Ambassador Jones to outline the IEA perspective on the extent of the challenge for the coal industry.

Post-Kyoto Greenhouse Gas Mitigation – key IEA messages

Amb. Richard Jones, Deputy Executive Director, IEA, said that sustainable development requires energy security, economic growth and environmental sustainability, which were the three pillars of IEA work. Referring to points made at the IEA Governing Board meeting at Ministerial level in October 2009,

World primary coal demand by scenario



In the 450 Scenario global coal demand plateaus by 2015 and declines progressively, returning to 2003 levels by 2030 - a level almost 50% lower than in the Reference Scenario

© OECD/IEA - 2009

He showed future projections of world primary coal demand, saying that the 3% decline evident in 2009 would be quickly recovered and growth would continue in the Reference Scenario. However, he said, the 450 Scenario shows coal use progressively declining from 2015 to reach 2003 levels by 2030, a level almost 50% lower than projected in the Reference Scenario. The actual extent of this decline would be dependent not only on how rapidly CCS is developed, but also on how efficiently coal is used, for example in combined heat and power and district heating plants. He added that these factors, together with potential technologies other than CCS to mitigate CO₂ emissions, provide a challenge for industry.

Mr. Clavarino remarked that the 450 Scenario shows coal as a “loser” and gas as a “winner”. **Amb. Jones** responded that this resulted from the economic modelling within given constraints of cost minimisation, but that the decline in coal use could be mitigated with faster implementation of CCS.

In response to a question from **Dr. Schiffer** on scenario probabilities, **Amb. Jones** explained that the Reference Scenario (which puts us on a path towards 1 000 ppm atmospheric CO₂ concentration) is the most likely on existing government policies, while an outcome in line with declared government intentions (but not firm plans) would give 550 ppm, and that the 450 Scenario may not be an achievable outcome if governments delay their response to climate change.

Mr. Nakagaki highlighted the necessity of rapidly deploying ultra-supercritical and integrated gasification combined cycle power generation technologies at the earliest opportunity in order to meet the 450 ppm target. He said that this policy is being followed in China and suggested that the IEA should promote it more widely. **Amb. Jones** responded that these technologies were incorporated into the IEA scenarios, adding that CCS retrofit at existing power plants would also be important.

The Role of Coal in the Post-2012 Greenhouse Gas Reduction Agreement – a CIAB statement

Mr. Roger Wicks, CIAB Chairman, explained that the CIAB recognised the importance of industry input to policy formulation and had therefore submitted to the Executive Director of the IEA, well in advance of the COP15 meetings in Copenhagen, a CIAB statement on [“The Role of Coal in the Post-2012 Greenhouse Gas Reduction Agreement”](#). This outlines the key elements that the CIAB believes governments must include in any new agreement if the world’s use of coal is to become compatible with greenhouse gas reduction objectives:

1. The post-2012 GHG reduction agreement must play a central role in delivering the technologies and best practices, and also the research and development, that enable deep

reductions in CO₂ emissions from coal use, while maintaining adequate coal supply.

2. Crediting mechanisms are needed to incentivise the deployment of high-efficiency coal-fired power plants.

3. Significantly increasing investment in the development and deployment of carbon capture and storage (CCS) technology should be an immediate priority and a key goal of the post-2012 climate agreement.

4. CCS must be incorporated into the post-2012 low-carbon technology crediting mechanisms.

5. A CCS deployment fund should be established to demonstrate commercial-scale coal-fired power plants with CCS in a variety of developing countries.

6. Mechanisms must be developed to allow the large number of coal-fired power plants currently being built in developing countries to be constructed as “CCS-ready”.

7. Capacity-building and knowledge-sharing programmes must be implemented to ensure that the operation and maintenance of plants and adaptation efforts follow international best practice, and that the implementation of CCS projects worldwide can benefit fully from the experience of early investments.

8. Clarity over crediting mechanisms for biomass sequestration and linked financial benefits for forest and eco-system protection and restoration could play a major role in driving additional CO₂ sequestration while contributing significantly to poverty reduction.

He emphasised that crediting mechanisms should be used to encourage high-efficiency coal-fired plants, expressed a very strong view that overarching RD&D support is needed, rather than just relying on a carbon price to deliver potential new developments, and highlighted the urgent need for a definition of “CCS-ready” in relation to new coal-fired power plants. The biomass point addressed a potential alternative to relying solely on CCS, he added.

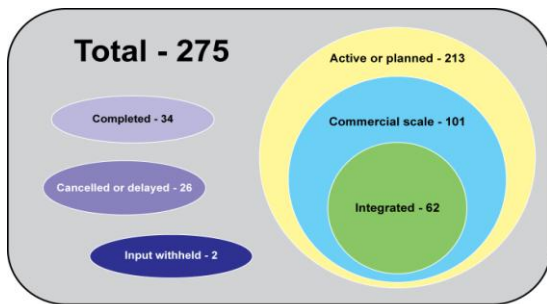
Mr. Wicks reported that he had presented these messages at a session of the recent IEA Governing Board meeting at Ministerial level, where it had become evident that there was genuine uncertainty regarding the achievability of the 450 Scenario, together with differing views from governments and industry on what practical steps are needed to secure a sustainable energy future.

Mr. Didier Houssin, Director, Directorate of Energy Markets and Security, responded that the IEA recognised and supported many of the messages included in the CIAB statement. He expressed support for mechanisms to encourage the deployment of CCS, emphasising the need to avoid “carbon lock-in” before CCS becomes fully commercialised by insisting that all new fossil-fired power plants are built in a way that does not prevent CCS retrofit at a later stage. He said that progress is being made with definitions of such “capture-ready” plant. He further emphasised the importance of improving coal-fired power plant efficiency, and of promoting these messages through outreach to countries such as China, Russia and India.

Carbon Capture and Storage – a GCCSI perspective on progress and future priorities

Mr. Bob Pegler, Deputy CEO, Global CCS Institute, said that the Global Carbon Capture and Storage Institute (GCCSI) is now a private corporation, with Australian government funding, whose role is to promote CCS. It has a membership of about 160, including 24 national governments. He said that the organisation endorsed the recent IEA [CCS Technology Roadmap](#), emphasising that CCS technology is proven but still needs to be demonstrated at commercial scale.

CURRENT STATUS OF CCS PROJECTS:



Prepared for the Global CCS Institute by WorleyParsons, 2009

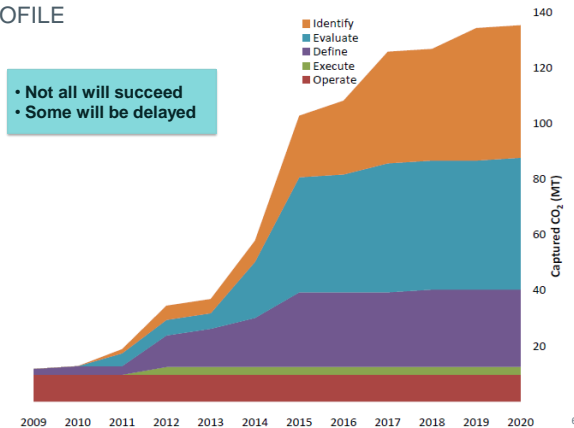
STRONG BASIS FOR FURTHER ACTION

He said that GCCSI has commissioned reports covering:

- *A Strategic Analysis of the Global Status of CCS* – a 1 000 page stock-take of CCS progress, including projects, regulatory frameworks and R&D, that aimed to identify gaps in global CCS deployment. The study had identified a total of 275 CCS projects; of which 101 are of commercial scale, 62 are integrated CCS projects, and 7 of those 62 are active. The key areas that need to be addressed to expedite the remaining 55 projects are storage (better site-specific data and clarity on regulatory liabilities), the business case (securing finance for demonstration to bridge the gap to commercialisation) and public acceptability.
- *Portfolio of CCS Projects* – identifying the ideal portfolio of CO₂ capture, transportation and storage projects to prioritise GCCSI spending.
- *CCS Ready* – to establish a clear definition of what it means to be “CCS-ready”

CCS '2009 STOCK TAKE' PROJECTS:

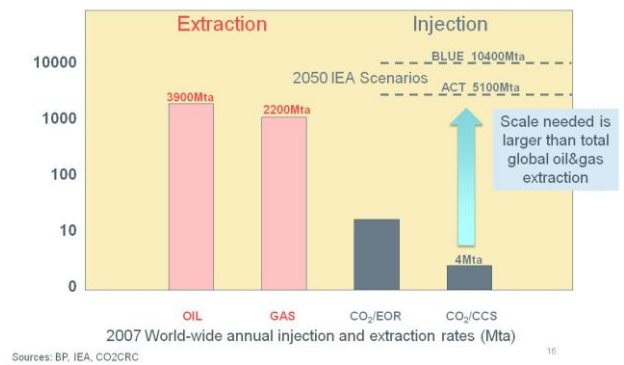
PROFILE



He said that, while power generation is a clear target for CCS, there are also opportunities in the iron and steel and cement industries; and that projects covering 26 combinations of fuel type, industry sector and geography are ideally needed. With China already making significant progress on CCS and power plant efficiency, **Mr. Pegler** identified this country as a priority, noting that CCS would be needed by energy-intensive industries as well as at coal- and gas-fired power plants. He reported that initial discussions with individual project developers had now begun and that strategic partnerships were being developed with financial institutions and other groups.

CCS SCALE CHALLENGE

A THOUSAND-FOLD GROWTH BY 2050



By 2050, the CCS industry will need to be as large as today's oil and gas industry, and 40% of the required CO₂ emissions reductions will be from coal. He concluded by saying that a key role for GCCSI was knowledge dissemination, and repeated the key challenges facing CCS development:

- demonstrating CO₂ capture and storage;
- taking concerted international action;
- addressing the commercial gap – market measures alone are insufficient for initial CCS project developments;
- establishing legal and regulatory frameworks; and
- raising public education and awareness.

Session 1 Discussion

Mr. Nakagaki emphasised that improving coal-fired power plant efficiency using current technology should be given priority, that coal-fired power plants (accounting for 30% of current CO₂ emissions) should be the initial focus for CCS development, and that while CO₂ capture is the highest cost component of CCS, more urgency should be given to determine CO₂ storage capacity. He said that CCS has a double commercial impact through the cost of CCS plant and the loss of power plant efficiency.

Mr. Pegler accepted that the bulk of costs are in capture, and that storage is the element most likely to delay progress. He said that the majority of the 101 commercial-scale non-integrated projects identified by GCCSI were capture projects; adding that while the oil and gas industry had been injecting CO₂ for many years, and there was much experience in capturing CO₂, the challenge would be to bring together the various players around integrated projects.

Several participants (**Ms. Belova and Messrs. Buffier and Stone**) explored the differences in coal demand between the IEA *World Energy Outlook 2009* Reference Scenario and 450 Scenario, raising the following points:

- Most of the coal use and emissions growth in the Reference Scenario originates from China and India. Had the IEA specifically considered the implications on those economies of restricting this growth in the 450 Scenario?
- Attention should be given to national and regional strategies for future coal production and use. These may prove to be a practical barrier to the worldwide adoption of CCS, regardless of the assumptions made on climate policy priorities.
- Reducing coal demand is not a practical option for reducing growth in greenhouse gas emissions in the event that CCS fails to deliver the targeted reductions.

Amb. Jones responded that:

- The IEA World Energy Model projects overall energy demand, optimises how that demand is satisfied, and then what policy measures are needed to achieve certain GHG emissions reduction targets.
- In the 450 Scenario it is assumed that emerging economies do not adopt cap-and-trade schemes until 2020, but that various emissions reduction agreements are in place, including with China.
- The IEA recognises that coal demand reduction is not an alternative in many regions, thus making CCS even more important – a message that needs further emphasis.
- The IEA does specifically consider national policies when formulating its scenarios, and is moving towards developing country-specific technology and energy roadmaps.

SESSION 2: Energy Sector Investment and the Coal Industry – Implications for Energy Security

Session chaired by **Dr. Steve Lennon**, Managing Director – Corporate Services, Eskom, South Africa.

Drawing on responses to a CIAB Member questionnaire, **Dr. Lennon** summarised the background to coal industry investment, saying that insufficient investment could result in supply-demand imbalances. Despite these energy-security concerns, resistance to new coal-fired power plant projects is very evident and, although there are opportunities for investing in new, efficient coal-fired power plants, such investment is being delayed by public opposition and financing issues, he said.

Effects of the Global Financial Crisis on Coal Sector Investment

Mr. Ian Cronshaw, Head of Energy Diversification Division, highlighted the IEA's interest in energy investment in light of the global financial crisis and the continuing growth in energy demand, particularly from developing economies. He mentioned the temporary slump in economic activity that had led to a dramatic fall in oil prices, after which oil prices had quickly recovered. Drawing on the IEA *World Energy Outlook 2009 Reference Scenario*, he said that non-OECD demand would drive future energy growth and that coal demand would decline marginally in OECD countries while experiencing massive growth in non-OECD countries.



Global upstream spending (excluding acquisitions) is budgeted to fall by over \$90 billion, or 19%, in 2009 – the first fall in a decade

He highlighted the investment required in gas production infrastructure, where new capacity equivalent to four times current Russian capacity is required by 2030. However, worldwide upstream oil and gas investment had declined by nearly 20% in 2009, the first fall in a decade. Coal sector

investment had also fallen, he said, but this is against the background of higher-than-average investment in 2007 and 2008



In the 450 Scenario, demand for fossil fuels peaks by 2020, and by 2030 zero-carbon fuels make up a third of the world's primary sources of energy demand

He characterised the Reference Scenario as unsustainable, particularly in light of greenhouse gas reduction targets. The 450 Scenario represented a best case of what could be achieved by 2030, based on a combination of policy measures that best reflect national circumstances and negotiating positions, he said. In this scenario, fossil fuel use peaks in 2020; subsequent falls in demand relative to the Reference Scenario are much greater for coal than for other fossil fuels. He illustrated this by reference to coal use in China, which reaches 2 400 million tonnes oil equivalent (mtoe) in the Reference Scenario but only 1 400 mtoe in the 450 Scenario by 2030. Contributions to GHG emissions reduction from efficiency improvements, including from coal-fired power plants, continue through the whole period and have a large cumulative effect by 2030. He said that achievement of the 450 Scenario projections would require an additional investment of USD 10.5 trillion compared to the Reference Scenario, and would likely require OECD support to non-OECD countries where annual investment in 2020 would need to approach USD 200 billion.



An additional \$10.5 trillion of investment is needed in total in the 450 Scenario, with measures to boost energy efficiency accounting for most of the abatement through to 2030

He summarised his key points as:

- The global financial crisis has halted the rise in fossil energy use, but this will soon resume, based on current policies.
- Tackling climate change and enhancing energy security require a massive decarbonisation of the power system.
- The 450 Scenario brings substantial benefits in terms of energy security, climate change mitigation and reduced air pollution.

- Natural gas can play a key role as a bridge to a cleaner energy future.

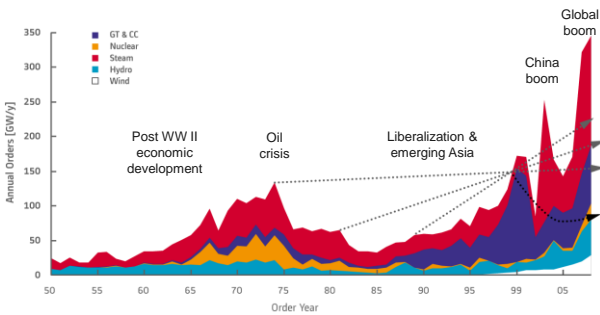
- The path to the 450 Scenario is costly and challenging, but energy efficiency and technology deployment are critical, and every year of delay would add USD 500 billion to mitigation costs between now and 2030.

Dr. Lennon pointed to the dichotomy between the massive additional investment needed to achieve a sustainable energy future and current market signals that discourage investment, inviting Ms. MacNaughton to give an equipment manufacturer's perspective.

An Equipment Manufacturer's Perspective on Energy Investment

Ms. Joan MacNaughton CB, Senior Vice President, Power and Environmental Policies, Alstom, expressed a desire for a global agreement on greenhouse gas reduction with clear and convincing guidance for future investment. She saw this as key to achieving the required energy sector investment. However, she doubted that agreement on actual targets, developing country participation, transfer of technology (while protecting intellectual property rights) and financing mechanisms would be reached at COP15 in Copenhagen, but expressed hope that a commitment to agree a post-2012 international climate change agreement would emerge from the negotiations. She suggested that the IEA should encourage industry input to the negotiations.

See what has happened in the past!



Source: Alstom
From 1978 exclude GT & ST industrial size
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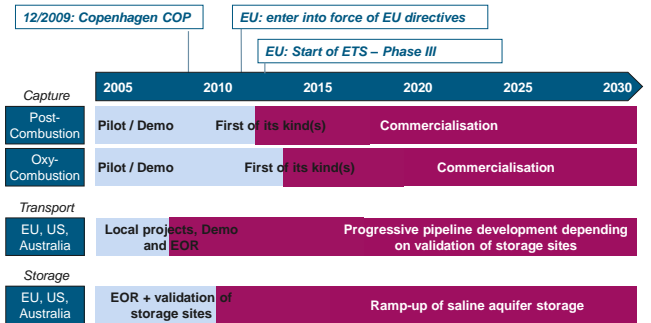
Turning to the equipment market, she said that in the first half of 2009, Alstom had experienced a drop in demand for new power generation equipment, while power plant projects continued to be postponed in the uncertain economic environment. However, the economic and social drivers exist for renewed orders from China and India, with Asia likely to account for more than 60% of the future power generation equipment market. The environment will also be a major future market driver and interaction here between government policies and industry action will be a key factor, she said.

She went on to explain that Alstom's strategy encompassed non-fossil power technologies (nuclear and renewables), improved fossil-fired power generation efficiency, and carbon capture and storage. Interestingly, she noted the fact that China's coal-fired power plant fleet is nearing the level where its average efficiency will be greater than that installed in Europe and North America. She warned that short-term investment in natural gas-fired power plants to reduce GHG emissions could be counter-productive because, although that plant is "cleaner" than coal-fired plant, it will still require further investment (CCS retrofit) to meet future GHG reduction targets.

She said that, although CCS costs are already competitive with wind power, early large-scale demonstration plants will need government support and CCS technology needs to be capable

of retrofitting to coal- and gas-fired power plants. Alstom is confident enough to give delivery and performance guarantees on CCS plant and is involved in ten major demonstration projects, she said, highlighting its chilled ammonia project at the AEP Mountaineer power plant that had begun storing CO₂ on 1 October 2009.

Roadmap: time-to market targets



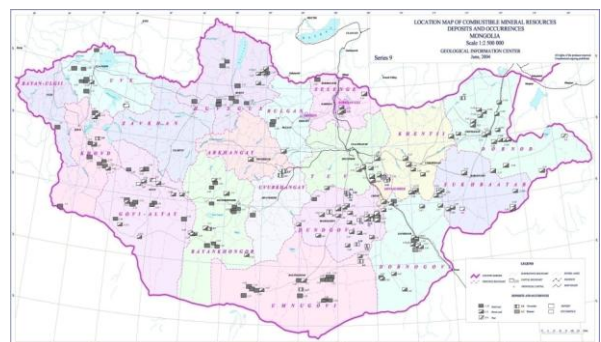
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In summary, she said that the world recession had delayed power sector investment, that the future market would be driven by climate change policy, CCS retrofit and replacement of existing power stations, and that coal's future lies with CCS but that CCS must also encompass gas-fired power plant and other industrial processes.

A Case Study on Coal Sector Investment - Mongolia and its future supply prospects

Prof. Gurjav Badamkhatan, Director General, Institute for Mineral Processing Technology at the Mongolian Science Academy, explained that insufficient oil and gas resources provided the driver for development of the country's coal deposits, which are estimated at 162 billion tonnes of which 20 billion tonnes have been confirmed by geological survey (11 billion tonnes brown coal, 7.2 billion tonnes bituminous coal and 1.8 billion tonnes coking coal). The 36 existing mines (all opencast and predominantly in private ownership) are expected to produce 18 million tonnes in 2009 (9.4 million tonnes in 2008), of which over 40% is exported to China and over 30% is used in Mongolia's thermal power plants.

Mongolia: overview of coal deposits



He described government policy as encouraging coal production efficiency, proving coal resource estimates, and increasing exports of competitive value-added products using indigenous coal. The government's Coal Program includes coking coal production, improving coal quality through washing, establishing

a coal processing laboratory, introducing coal gasification and producing synthetic petrol and chemical products for export.

established the National Institute for Clean and Low-Carbon Energy as part of its broader strategy of innovative scientific development to improve productivity and reduce its environmental footprint.

Major coal deposits in Mongolia that are active, soon to be active

Name of Deposits	Estimated deposit, in mln tons	coal classification	ash, %	moisture, %	Kcal/kg
Aduunchuluun	241	lignite	38.7	11.2	3452
Baganuur	511	lignite, brown coal	13.1	32	3200
Chandagana tal	122	lignite, brown coal	13.2	11	5700
Khavtgai	1000	lignite, brown coal	10.3	11	4360
Nariin Sukhait	358	bituminous and subbituminous	13.5	41.5	6500
Shivee Ovoo	564	lignite coking and bituminous	8.5	40.5	6500
Tavan tolgoi	6400	lignite	20	8.5	7100
Tevshiin Govi	587	lignite	20.9	11.2	5092
Ulaan Ovoo	209	bituminous	15	10.5	3000



In the next 10 years, Shenhua will complete its strategic transformation to gradually become a clean and low carbon developer, a world leader in clean and low carbon technologies, a supplier of clean and low carbon energy, a producer of clean and low carbon products, a clean and low carbon service provider and a promoter on clean and low carbon concept.

He said that the barriers to increasing coal exports are poor electricity supply and rail infrastructure, finance and the lack of a stable legal environment to encourage investment. He estimated that in the mid term, or in the next 3-5 years if current constraints are removed, Mongolia has the potential to increase annual coal exports to 40 million tonnes.

Development Strategies of Shenhua Group and its Clean and Low-Carbon Energy Mission

Mr. Lu Bing, General Manager, Department of International Co-operation, Shenhua Group Corporation Ltd., reported that Shenhua, now the world's largest coal company, produced 282 million tonnes of coal in 2008 and is following a development strategy to double turnover at its five core businesses (mining, power, transport, CTL and chemicals, and new energy) over the next five years. He added that, at the end of 2008, the company had commissioned the world's first large-scale direct coal liquefaction (DCL) project, with a capacity to produce one million tonnes of oil products per year.



On October 1, 2009, we started the running for the second time with feedstock in our DCL Project. As of October 21, 2009, the commissioning lasted for 20 days, producing 4,020 tonnes of LNG, 12,200 tonnes of naphtha and 19,000 tonnes of diesel.



Session 2 Discussion

Mr. Palmer questioned whether the increasing use of oil, increasing dependence on Saudi Arabian production, and LNG priced with reference to oil in the Reference Scenario was consistent with the IEA's initial rationale of reducing dependence on oil. **Mr. Cronshaw** explained that LNG pricing is a complex issue, partly driven by oil prices, but that the IEA sees production costs as being the fundamental driver in the longer term.

Mr. Nakagaki saw full-scale commercialisation of CCS as being more than 15 years away and warned that high-efficiency power plant is not being developed rapidly enough because: the incremental cost of such plant is often greater than the benefit of the reduced coal used; equipment manufacturing capacity is limited; and a high level of expertise is needed to keep such plant operating efficiently. He highlighted the need for clear policy direction from governments to incentivise investment in high-efficiency power plant. However, he said that in reality unclear policies meant that potential investors were delaying their decisions to replace old inefficient plant with more efficient modern plant.

He said that countries with a high dependence on coal use would benefit from an international policy promoting high-efficiency coal plant (for example through the Clean Development Mechanism) and that government subsidies, which would additionally aid recovery from the economic downturn, are needed. He added that reforestation and forestry management linked to energy production were important in any CO₂ reduction strategy.

Mr. Cronshaw agreed that coal-fired power plant investment in OECD countries is still very low due to policy uncertainties and public resistance, and agreed with the need to broaden the scope of the Clean Development Mechanism.

Dr. Elder pointed out that if government policies were to be only weakly effective, and with no growth in oil or gas supply, an increase in coal use to 15 billion or even 20 billion tonnes by 2030 is not an impossible scenario to be faced with.

Dr. Lennon remarked that we have short memories regarding energy security and that it is currently very difficult to make the investments that our energy projections show are needed, emphasising, as a priority, investment in high-efficiency power plant.



In Northern Shaanxi and Eastern Ningxia, Shenhua is working closely with local governments as it establishes large new coal mines, transport infrastructure and industrial complexes. At the same time, it is also investing overseas. Shenhua hopes to make a valuable contribution to global sustainable development, and is actively promoting technology exchange and collaboration to this end. It aims to attract talented professionals to China to help create a clean and low-carbon energy industry. To accelerate new energy R&D, Shenhua has

SESSION 3: Carbon Pricing – Implications for Coal and the Migration of Industrial Activity

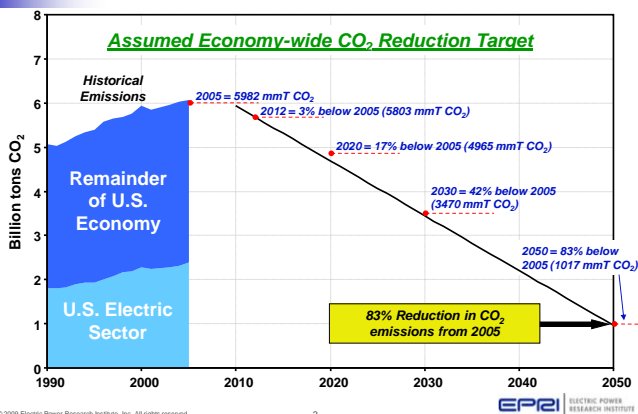
Session chaired by Dr. Don Elder, CEO, Solid Energy New Zealand Ltd.

Dr. Elder set the context for the carbon pricing debate by saying that, although just over one billion people live in OECD countries, there are another 5.5 billion people who aspire to OECD standards of living and it is these people who are driving the demand for coal, perhaps to 15 billion tonnes or more per year by 2030. At a carbon price of USD 50/tCO₂, the annual cost of emitting (or abating) CO₂ would be around USD 2 trillion, averaging close to USD 250 per year for every person on the planet. The investment cost to meet the 450 Scenario (USD 10.5 trillion) would cost USD 1500 per person. He wondered how these costs would be met over the period to 2030, given other priorities such as the need to double global food supply over the same period.

The Cost of Carbon Pricing

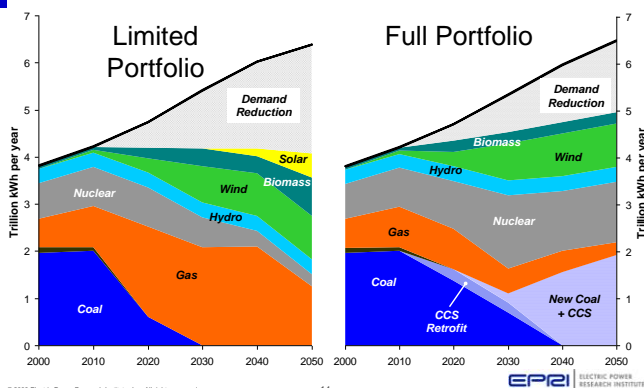
Mr. Hank Courtright, Senior Vice President, Electric Power Research Institute (EPRI), described the technology challenge for the US electricity industry as one of de-carbonising the electricity infrastructure to meet binding, economy-wide CO₂ reduction targets (83% reduction on 2005 levels by 2030). He addressed the question of what this would imply for the retail price of electricity in the USA, which has remained broadly constant in real terms over the last forty years.

The CO₂ Challenge



He described how EPRI had used its bottom-up PRISM model to assess the effect on projections of more aggressive adoption of CO₂ reduction technologies than assumed in the US Energy Information Administration's *Annual Energy Outlook*, and its top-down MERGE model to optimise energy use for a given level of economic activity.

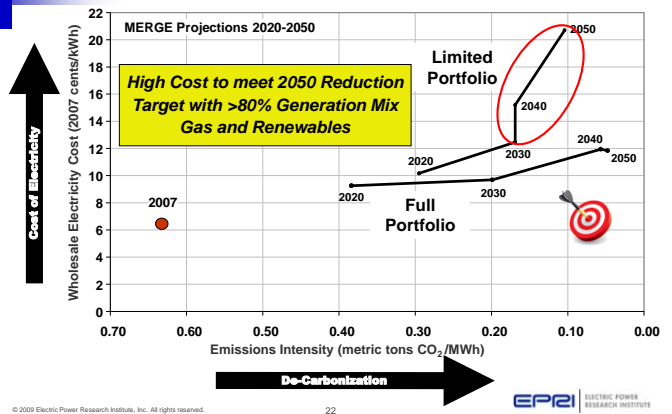
MERGE U.S. Electric Generation Mix



PRISM modelling in 2009 had shown that a 41% reduction in US electricity sector CO₂ emissions (between 2005 and 2030) is technically feasible if all technology options are used, resulting in 60% of electricity generation producing no CO₂ or low levels of CO₂ by 2030. The MERGE model had then been run up to the year 2050 for two cases, one with the "Full Portfolio" of technology options available for power generation and a "Limited portfolio" without CCS, nuclear expansion or plug-in electric vehicles.

Outlining the modelling results, he said that with the Limited Portfolio, natural gas use initially expands to cover base-load electricity generation but then declines after 2030 because gas-fired power plants would then require CCS to meet the CO₂ emissions reduction targets for 2050. This results in some expansion of nuclear and renewable electricity generation, but also a much larger restriction of electricity demand than in the Full Portfolio case. Wholesale US electricity costs are projected to increase in real terms on their 2007 level by 80% for the Full Portfolio case and by 210% in the Limited Portfolio case by 2050, he said, concluding that the challenge would be to deploy nuclear and CCS technologies and thus limit the increase in electricity prices.

MERGE De-carbonization Results



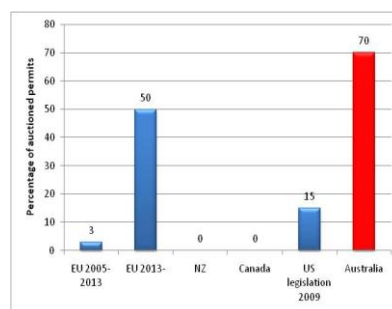
Australian CO₂ Emissions Reduction Measures – a new era for world coal?

Mr. Mick Buffier, Group Executive – Corporate Affairs, Government & Industry Relations and Sustainable Development, Xstrata Coal, outlined the major provisions of the Australian Carbon Pollution Reduction Scheme (CPRS), which will be effective from July 2011 (subject to Senate ratification), highlighting its effects on the Australian coal industry and economy. The emissions trading scheme requires that industry purchases 70% of its required CO₂ emission permits (30% will

Australia is out of step with other nations



Share of auctioned permits in international cap & trade schemes



- **Free Allocation of Permits**
- Australia – only 30% of permits allocated "free"
- USA – up to 85% permits allocated "free"
- EU – first phase up to 97% permits allocated "free" From 2013 up to 50% of permits to be auctioned
- **Impact - Australia**
- 90% per cent of minerals exports by value will receive no protection under existing EITE arrangements

be allocated at no cost), making it much more onerous than emissions trading schemes in other countries and regions. Uniquely amongst emissions trading schemes, the CPRS requires permits for fugitive methane emissions from mining and this imposes substantial costs directly on coal mining, particularly opencast mining where methane emissions measurement and capture are very difficult.

Quoting the results of a recent study by ACIL Tasman (16 premature mine closures, 10 000 job losses by 2021, 22 million tonnes per annum loss of coal production, AUD 14.5 billion cost to industry over the first 10 years), he said that the effects of the scheme on the Australian economy will be a loss of trade to economies with lower carbon emission costs. Moreover, he said that Australian coal would be substituted by coal from other sources, providing no net reduction in global greenhouse gas emissions. He pointed out that Australia generates 1.6% of global greenhouse gas emissions while producing 5% of the world's coal requirements and has been working to address the complex problems associated with fugitive emissions.

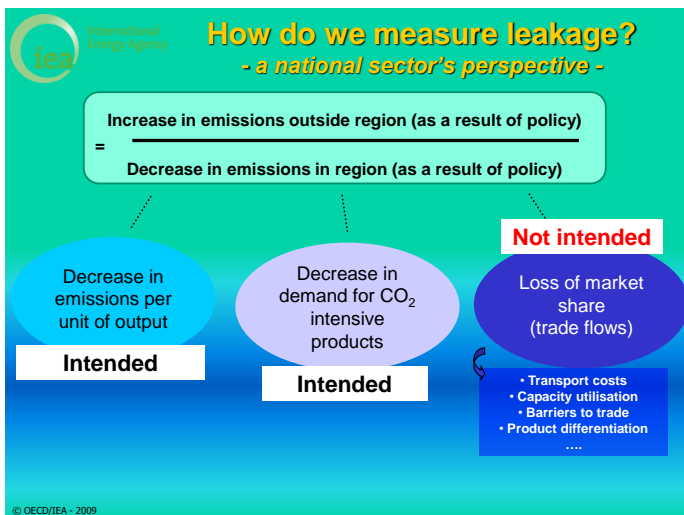


There are physical and technical limitations on treating fugitive emissions			
FUGITIVE EMISSIONS			
Carbon Dioxide (CO2)	Methane (CH4)		
No abatement options	Ultra Low Concentration <0.3%	Low Concentration 0.3 -2.0%	Medium to High Concentration >40%
	No viable abatement options	Ventilation Air Methane VOX Technology at R&D stage	Flares reciprocation engines (+45%) Turbines (+85%)
CO2	CO2 / CH4	Residual CO2 e	Residual CO2 e
Carbon Liability	Carbon Liability	Carbon Liability	Carbon Liability

He suggested that lessons for the future include the need for a unified mining industry lobby while greenhouse gas reduction proposals are being formulated to highlight the practical and economic implications of proposed legislation at an earlier stage.

Emissions Trading and Carbon Leakage

Mr. Richard Baron, Head of Climate Change Unit, IEA, said that global greenhouse gas abatement has the potential to reshuffle competitive advantage across industry sectors and geographical regions, resulting in "carbon leakage" through changed trade flows, particularly for greenhouse-gas intensive industries such as cement, iron and steel, and chemicals.



Several recent simulations had confirmed this potential, he said, although it was difficult to confirm this from experience with Phase 1 of the EU Emissions Trading Scheme. A possible reason for this is that many companies in the aluminium, steel, cement and refining sectors have long-term electricity contracts that may have masked electricity price increases stemming from the costs of emitting CO₂, and some benefited from over-allocations of CO₂ emission allowances.

Policy responses to CL
Free allocation

- EU, United States, Australia legislative proposals contain free allocation provisions to vulnerable activities
- European Commission's assessment: 164 industrial sectors and sub-sectors are at significant carbon risk of CL (EC, 2009)
 - Trade Intensity over 30% or
 - CO₂ cost (direct and indirect) over 30% of Gross Value Added or
 - Trade Intensity over 10% and CO₂ cost over 5% of GVA [EUR 30/tCO₂]
- Free allocation: sectors exposed to the risk of carbon leakage receive 100 % of allowances for free, up to a benchmark in the EU from 2013 onwards (EU, 2009)
- Ambitious benchmarks: the starting point shall be the average performance of the 10% most efficient installations in the sector or sub-sector in 2005-07
- Free allocation does not address electricity price increases
- Free allocation helps companies financially. Does it guarantee against relocation?

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Turning to possible policy responses to mitigate potential carbon leakage, he explored:

- Free allocation of permits to potentially vulnerable industry sectors, subject to specific plant efficiency benchmarks; and
- Border tax adjustments (BTA), evident in proposed US climate policy legislation, which would be more effective at avoiding carbon leakage but would raise many issues in practical application, together with the possibility of welfare-decreasing trade wars.

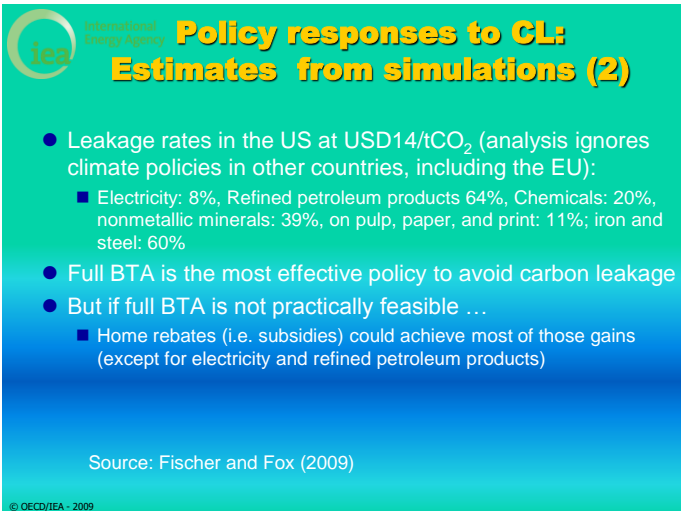
He summarised the key points from the IEA carbon leakage work as:

- carbon leakage is a concern for specific industries, but not for whole countries;
- the risk of leakage will be lower as more countries adopt climate policy measures;
- more specific statistical monitoring of the actual occurrence and effects of carbon leakage is required; and
- there is no perfect solution to counter measures, so continued monitoring and possible further work on global sectoral approaches are required.

Policy responses to CL:
Estimates from simulations (1)

- Leakage rates under full auctioning and without any "anti-leakage" policy in the EU in the 3rd phase:
 - EUR14/tCO₂: on steel: 39%, aluminium: 21% and cement: 20%
 - Overall (all EU ETS sectors, including electricity): 10%
- But offsetting measures may significantly reduce leakage...
 - Full BTA (on exports & imports) more than compensate leakage
 - BA on imports is sufficient to have ~0% leakage rate (results aggregated across sectors) but sectoral leakage rates might vary
 - on steel: ca. 3%, aluminium: ca. -150%, cement: ca. 8%
- Border Adjustments are more effective in reducing leakage than output-based free allocation:
 - Under the latter, EUR27/tCO₂: on steel: ca. 7%, aluminium ca. -50%, on cement: ca. 18%

Source: Monjon and Quirion (2009)
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**Policy responses to CL:
Estimates from simulations (2)**

- Leakage rates in the US at USD14/tCO₂ (analysis ignores climate policies in other countries, including the EU):
 - Electricity: 8%, Refined petroleum products 64%, Chemicals: 20%, nonmetallic minerals: 39%, on pulp, paper, and print: 11%; iron and steel: 60%
- Full BTA is the most effective policy to avoid carbon leakage
- But if full BTA is not practically feasible ...
 - Home rebates (i.e. subsidies) could achieve most of those gains (except for electricity and refined petroleum products)

Source: Fischer and Fox (2009)

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Session 3 Discussion

Dr. Lennon expressed concern that border tax adjustments could unhelpfully polarise emissions reduction discussions by taxing imports to developed economies from developing economies, a risk that **Mr. Baron** also recognised.

Mr. Slone questioned Mr. Baron's statement that a reduction in demand for carbon-intensive products in response to higher prices is an intended consequence of climate policy measures.

Mr. Baron responded that the desired effect is, for example, to substitute high-carbon cement with low-carbon cement rather than to reduce demand for cement *per se*. He added that OECD studies have reported little effect on economic growth of higher prices resulting from low-carbon measures.

Ms. Belova cautioned against relying on a seemingly sound intellectual model to test policies which may have unintended consequences when applied (e.g. tight constraints may compromise competitive energy markets and energy security). Also, the carbon leakage debate could polarise the positions of developing and developed nations. She added that continued discussion of scenarios with falling coal demand would be detrimental to the development of the coal-supply and coal-fired power generation infrastructure that is needed in the near term, as well as to the development and adoption of new clean coal technologies.

Mr. Palmer said that the deep concern in the USA over the potential for carbon leakage to reduce US industrial activity has contributed to the delay in climate legislation, adding that technology development must be the primary path to greenhouse gas reduction, as illustrated by the EPRI studies.

Dr. Elder concluded that the session had illustrated very well the difficulty of addressing climate change issues. Industry is driven by the wants of its customers, he said, and the primary desire of a large proportion of the world's population is for increased electricity supply at an affordable price, which often translates into an increased use of coal.

Summary of Key Messages

Mr. Roger Wicks, CIAB Chairman, thanked speakers, the IEA and CIAB Members for their contributions and identified a number of themes that had emerged from the discussions.

IEA World Energy Outlook 2009: The scenarios had illustrated that "business-as-usual" is unsustainable. He recognised that the 450 Scenario is a projection of a possible outcome designed to promote discussion, but said that its achievement would be very challenging and would incur costs much larger than suggested by previous IEA projections – a particular issue in the current financial climate. The discussion had highlighted the extent of the greenhouse gas emissions reduction challenge, made the point that there is no "silver bullet" solution to the issue, and raised the uncomfortable possibility of an actual outcome lying somewhere between the two scenarios. The view had emerged that COP15 in Copenhagen is not an end in itself but a stage in a journey and that a greenhouse gas emissions reduction agreement is still possible by 2012.

Fuel Mix, Energy Security and Unintended Consequences:

The discussions had highlighted the difficulties associated with seeking to reconcile energy supply security and greenhouse gas emission reductions, particularly with respect to the practical extent of natural gas supply infrastructure investment and the speed of required changes to the energy policies of individual countries. These challenges are particularly great for developing countries, where even the collection of energy statistics is a major challenge, and where it may be more cost-effective to address other priorities.

Energy Efficiency: Improving the efficiency of energy conversion and use is the obvious option to improve both energy security and greenhouse gas emissions, but maintaining the focus needed here appears difficult in the absence of significant incentives or the threat of a crisis.

Carbon Capture and Storage: It is clear that CCS is not just an issue for coal use, but for all fossil fuels, and a major equipment manufacturer had given cause for optimism that the industry can expand to meet future demand. However, there is still a major gap in the long-term business case for CCS.

A Significant Reminder: Mongolian coal development plans have provided a reminder that, where a country is endowed with abundant indigenous coal resources, these will be used to support economic and social development, these being much stronger drivers than global CO₂ emissions reduction.

The Reality Check: The costs of achieving CO₂ emissions reductions and secure energy supplies are substantial, as illustrated by the EPRI studies. A further illustration is the annual 45% increase in electricity prices required over the next three years to support South African infrastructure development to address recent electricity supply security issues.

The Role of the Coal Industry Advisory Board: A role of the CIAB is to advise the IEA Executive Director of the industry's perspective on these energy and greenhouse gas mitigation issues. To this end, its recent statement on "[The Role of Coal in the Post-2012 Greenhouse Gas Reduction Agreement](#)" outlined key elements that governments must include in the new agreement if it is to successfully enable the world's use of coal to be compatible with greenhouse gas reduction objectives – messages delivered to the IEA Ministerial Meeting in October 2009, well in advance of the COP15 negotiations in Copenhagen. Details of the current CIAB work programme, which includes a workshop in Moscow, can be obtained from the IEA (see back page).

Annex – Plenary Meeting Participants

CIAB MEMBERS:

Mr	Gregory H	BOYCE	Chairman & CEO, Peabody Energy Co Inc	USA
Mr	Preston	CHIARO	Group Executive – Technology and Innovation, Rio Tinto plc	USA
Mr	Andrea	CLAVARINO	Chairman, Assocarboni & Executive Vice President, Coeclerici Group, Assocarboni	ITA
Mr	Henry A	COURTRIGHT	Senior Vice President, Electric Power Research Institute (EPRI)	USA
Dr	Don	ELDER	Chief Executive Officer, Solid Energy New Zealand Ltd	NZL
Mr	Robert H	GENTILE	President & CEO, Leonardo Technologies Inc	USA
Mr	Bob	KAMANDANU	President Director, PT Berau Coal	IDN
Mr	Miroslaw	KUGIEL	President, Kompania Węglowa SA	POL
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Dr	Xolani H	MKHWANAZI	Chairman, BHP Billiton SA Ltd	ZAF
Mr	Michael J	MUDD	Chief Executive Officer, FutureGen Alliance Inc	USA
Mr	Yoshihiko	NAKAGAKI	Corporate Advisor, J-Power (Electric Power Development Company)	JPN
Mr	Petr	PAUKNER	Chairman of the Board, Coal Energy Ltd	CZE
Mr	Seppo	RUOHONEN	Managing Director, Helsinki Energy	FIN
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Mr	Robert H	STAN	President & CEO, Grande Cache Coal Corporation	CAN
Mr	Michael W	SUTHERLIN	President & CEO, Joy Global Inc	USA
Mr	Joost F M	VAN DIJK	Director – Board of Management, E.ON Benelux nv	NLD
Mr	Alain	VERRY	Operating Vice President of Fossil-Fired Generation & Engineering, EDF	FRA
Mr	Greg A	WALKER	Senior Vice President, General Counsel & Secretary, Alpha Natural Resources Inc	USA
Mr	Roger	WICKS	Special Adviser to CEO Anglo Coal, Anglo American plc	ZAF

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Ms	Anna	BELOVA	Deputy CEO, Strategy and Corporate Development Director, Siberian Coal Energy Company (SUEK)	RUS
Mr	Zygmunt	BORKOWSKI	Head of Foreign Relations, Kompania Węglowa SA	POL
Ms	Alison	BROWN	General Counsel & Company Secretary, Solid Energy New Zealand Ltd	NZL
Mr	Mick	BUFFIER	Group Executive – Corporate Affairs, Government and Industry Relations, Xstrata Coal Pty Ltd	AUS
Mr	Antonio	CANSECO	President, Fuelec SL	ESP
Mr	Stuart M	DALTON	Director – Generation Sector, Electric Power Research Institute (EPRI)	USA
Mr	Michael D	DANCISON	Director – New Generation Development, American Electric Power Inc	USA
Mr	Hans	DANIELS	Vice President – Market Analysis and Strategy, Alpha Coal Sales Co LLC	USA
Ms	Gina	DOWNES	Chief Advisor – Environmental Economics, Eskom	ZAF
Ms	Zara	FISHER	Finance and Mining Executive, Rio Tinto plc	GBR
Mr	Davide	GIULIANI	Coal Trader, Enel Trade SpA	ITA
Dr	John	GROOM	Safety and Sustainable Development Adviser, Anglo American plc	GBR
Ms	Meade	HARRIS	International Policy Manager, World Coal Institute	GBR
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Mr	Takenori	IWASAKI	Manager – Business Planning Department, J-Power (Electric Power Development Company)	JPN
Mr	Kauno	KAIJA	Director – Group Services, Helsinki Energy	FIN
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Mr	J Gordon (Skip)	STEPHENS	Washington Representative, Joy Global Inc	USA
Mr	L Cartan	SUMNER	Vice President – International Government Relations, Peabody Energy Co Inc	USA
Mr	Eric W O	VAN VLIET	Managing Director – Generation Section, EnergieNed	NLD
Dr	Martin	WEDIG	GVSt (Gesamtverband Steinkohle eV) – German Hard Coal Association	DEU
Mr	Ross H	WILLIMS	Vice President – Commercial Relations, BHP Billiton Mitsubishi Alliance	AUS

GUESTS:

Prof Gurjav	BADAMKHATAN	Director General – Institute for Mineral Processing Technology, Mongolian Science Academy	MNG
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Mr Johannes	TRÜBY	Research Assistant – Institute of Energy Economics (EWI), Cologne University	DEU

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Mr Robert	SCHNAPP	Head of Section – Coal, Renewables, Electricity and Heat Statistics, IEA	INT
Mr Richard	BARON	Head of Climate Change Unit, IEA	INT
Mr Pawel	OLEJARNIK	Researcher – Office of the Chief Economist, IEA	INT
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Mr Jung Woo	LEE	Energy Statistician – Monthly Electricity & Quarterly Coal, IEA	INT
Ms Kat	CHEUNG	Project Officer – Energy Technology Policy, IEA	INT
Ms Joana	CHIAVARI	Energy Analyst – Energy Technology Policy, IEA	INT
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Mr Rafał	FRĄC	Counsellor, Polish Delegation to the OECD	POL
Mr Kijune	KIM	First Secretary (Industry/Energy), Permanent Delegation of Republic of Korea to the OECD	KOR
Ms Lauren	SELBY	US Mission to the OECD	USA

**Coal Industry Advisory Board**

For more information about the IEA Coal Industry Advisory Board, please refer to www.iea.org/ciab, or contact Brian Ricketts at the IEA (brian.ricketts@iea.org) or Brian Heath, CIAB Executive Co-ordinator (mail@ciab.org.uk).

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