INTERNATIONAL ENERGY AGENCY
COAL INDUSTRY ADVISORY BOARD

35th PLENARY MEETING

DISCUSSION REPORT

IEA Coal Industry Advisory Board Plenary Meeting
IEA Offices, Paris, 13/14 November 2013

IEA – 9, rue de la Fédération – 75739 Paris Cedex 15
CIAB PLENARY DISCUSSION SESSIONS
Held on Wednesday 13th and Thursday 14th November 2013

The Coal Industry Advisory Board (CIAB) is a group of high level executives from coal-related enterprises, established by the International Energy Agency Governing Board in July 1979 to provide advice to the IEA from an industry perspective on matters relating to coal. The CIAB Plenary meeting is held annually and is one of the mechanisms by which CIAB Members provide advice to the IEA. The meeting also typically includes discussion sessions on topics of relevance to a wider audience, which include contributions from external speakers. This report covers the two such topics discussed at the CIAB’s 35th Plenary meeting.

**Multilateral Development Bank Financing of Advanced Coal Generation Projects**
*Chaired by Mr Godfrey Gomwe, Chief Executive Officer of Thermal Coal, Anglo American, South Africa*

**21st Century Coal and Global Energy Challenges**
*Mr Godfrey Gomwe, Chief Executive Officer of Thermal Coal, Anglo American, South Africa*

**Remarks from the Multinational Development Bank Perspective**
*Presentations by development bank executives regarding the energy lending strategy of their respective institutions, and their development bank’s perspective on the role of coal in meeting global energy challenges*

- Japan Bank for International Cooperation
- Mr. Fumio Hoshi, Chief Operating Officer and Senior Managing Director
- Asian Development Bank
- Ms. Naomi A. Chakwin, Resident Director General, European Representative Office

**Energy Sector Policies of Other Multinational Development Banks**
*European Bank for Reconstruction and Development*
*Mr. Benjamin Sporton, Deputy CEO, World Coal Association, UK*

- World Bank
- Mr. Fredrick D. Palmer, Senior Vice President Government Relations, Peabody Energy, USA

- African Development Bank
- Mr. Julian Beere, Head of Business Development and Strategy, Thermal Coal, Anglo Operations Ltd., South Africa

**Discussion**

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**Advanced Coal Generation and CCS Technology Update**
*Chaired by Mr. Yoshihiko Sakanashi, Executive Vice President, J-POWER, Japan and Mr. Ken Humphreys, Chief Executive Officer, FutureGen Alliance Inc., USA*

**Advanced Coal Generation Projects: Japan, South Korea and China – Progress, Challenges and Prospects**
*Mr. Yoshihiko Sakanashi, Executive Vice President, J-POWER, Japan*

**CCS Technology Projects – Progress, Challenges and Prospects**
*Mr. Ken Humphreys, Chief Executive Officer, FutureGen Alliance Inc., USA*

**Analysis of Global Policy Support for CCS**
*Mr. Justin Flood, Manager Sustainability, Delta Electricity, Australia*

**Discussion**
Mr. Boyce (CIAB Chairman) expressed the hope that this session will be the first step in regular engagement between the world’s leading development banks and the coal industry. He said that the term “21st Century Coal” was introduced by the governments of China and the United States in connection with the signing of Sino-U.S. clean energy initiatives in 2009; a term which applies to the entire coal value chain, from world class mining practices, to excellence in safety performance, to sustainability and award-winning land restoration, and to the deployment of advanced coal generation technologies.

He said that more than half the world’s population – 3.6 billion people – lack proper energy access; and that 1.3 billion people have no electricity at all, adding that broad energy access to reduce global poverty should be the world’s top priority.

Mr. Gomwe pointed out that coal has accounted for 45% of the growth in global primary energy demand between 2001 and 2011 and that it has a continuing role to play in the alleviation of global energy poverty, where the main challenges are in Asia and sub-Saharan Africa.
He said that earlier in the year the CIAB had produced a report “21st Century Coal: Advanced Technology and Global Energy Solution” to explore progress and future potential for coal to meet future energy supply challenges in the areas of; high efficiency and other advanced coal generation technologies; the key role of enhanced oil recovery in CCS development; and the flexibility of coal-fuelled power to ensure reliable electricity.

He summarised key findings from the report:

- Any plan for reducing greenhouse gas emissions significantly must include advanced coal generation with carbon capture and storage.
- Major advancements in coal generation technology are taking place today in terms of efficiency, emissions and costs.
- Higher efficiency is a key first step in lowering CO₂ emissions.
- CCS with enhanced oil recovery could transform the power industry, both in terms of emissions and energy security.
- Coal power plants are highly flexible, as demonstrated by a case study on the German electricity market, and this flexibility is critical to ensuring grid stability during extended use of intermittent wind and solar energy sources.

He said that there is currently no business case for CCS, but that the cost of meeting CO₂ targets without it increases significantly. Also, he emphasised the need to retain baseload coal-fired power generation capacity in South Africa because, unlike Europe, the country has limited electricity grid inter-connections and cross-border trade options to maintain stable electricity supplies.

In summary, the report recommended that:

- The International Energy Agency should undertake a special initiative to contribute to greater understanding of world energy among OECD policymakers.
- World leaders should be guided by the history of technological development in approaching the issue of coal and the CO₂ challenge.
- Energy Ministers from countries that use coal should promote the building of more efficient supercritical and ultra-supercritical coal-fuelled generation.
- Governments should collaborate with the petroleum industry to identify current and future demand for CO₂ for enhanced oil recovery to support the development of commercial-scale CCS demonstration projects.
- Stakeholders should engage with China on CCS demonstrations and enhanced oil recovery.

He drew attention to the recent Warsaw Communiqué produced by the World Coal Association. This emphasised that high-efficiency,
low-emissions, coal combustion technologies are commercially available; and that they allow coal to be used while minimising CO₂ emissions. This highlighted the need for action to increase the efficiency of coal-fired electricity generation, he said, and he called on development banks to support developing countries in accessing clean coal technologies, including high-efficiency low-emissions coal combustion technologies.

Finally, he emphasised that coal is essential for energy security, social development and economic growth in South Africa through its role in electricity generation. Drawing poignantly on his own personal experience, when he only had access to electric light for study once he attended university, he concluded by emphasising the vital role played by electricity in raising education standards in the country.

He illustrated investments in energy infrastructure projects totalling $70 billion over the last decade. These included 16 IPP projects in Asia totalling 22GW, of 6 were coal-fired projects totalling 5.8GW; 10 IPP/IWPP projects in MENA countries totalling 15.8GW, including a 700MW coal-fired plant in Morocco; and 10 IPP projects in the Americas totalling 5.6GW, of which one is a very recent 472MW coal-fired project in Chile. Other projects have included wind and solar power in Bulgaria and Canada, and coal mines in Russia, Canada, Vietnam, Australia and Colombia.

He said that JBIC is also supporting Japanese heavy electrical machinery manufacturers with joint ventures in India, and that Indonesia has coal-fired power projects at the core of its electricity system development.

He said that world energy consumption will increase by 56% in the next 30 years and that each country should assess the most appropriate energy supply options for its own needs. He noted that coal is more abundant, lower cost and has a more stable supply; but that it also has emissions issues. He saw a need to support mitigation of emissions, saying that JBIC will continue its dialogue with developing nations to minimise the environmental effects of the best electricity development option for their countries.

 Remarks from the Multinational Development Bank Perspective

Japan Bank for International Cooperation
Mr. Fumio Hoshi, Chief Operating Officer and Senior Managing Director

Mr. Hoshi outlined the four elements of the Japan Bank for International Cooperation (JBIC) mission:

- promoting the overseas development and securing of resources which are important for Japan;
- maintaining and improving the international competitiveness of Japanese industries;
- promoting overseas business having the purpose of preserving the global environment such as preventing global warming; and
- preventing disruption to international financial order or taking appropriate measures with respect to damages caused by such disruptions.

He said that JBIC is also supporting Japanese heavy electrical machinery manufacturers with joint ventures in India, and that Indonesia has coal-fired power projects at the core of its electricity system development.

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Asian Development Bank
Ms. Naomi A. Chakwin, Resident Director General, European Representative Office

Mr. Gomwe introduced Ms. Chakwin, who has 25 years international experience in Asia with the OECD, World Bank and the Asian Development Bank (ADB). Ms. Chakwin added that she returned to Europe two years ago and is now responsible for nineteen non-regional countries, having previously served in operations in Asia and set up ADB’s Australian office.
She described the ADB mission as “to help our developing countries reduce poverty, and improve living conditions and quality of life”, adding that the associated challenges are all in Asia.

Turning to ADB’s projections for energy growth in Asia and the Pacific, she projected 4.1% annual GDP growth in 2010-2035, higher than that achieved in 1990-2010, with China accounting for 55% of the expected growth. She expected annual GDP growth in China of 6% to 2025, tapering off from 2030, and more rapid growth in ASEAN countries from 2015. Annual primary energy demand growth of 2.1% in 2010-2035 is expected, with over 80% of that being fossil fuels, she said, adding that coal will grow at a slightly lower rate as a result of increasing power plant efficiency. The projections also include annual growth of 4% for natural gas, mostly for power generation, together with growth in nuclear power, hydro-electric power and renewable energy.

Ms. Chakwin went on to outline the Bank’s energy policy, which was approved in 2009, and is the basis of ADB engagement in the sector. In addition, she noted that ADB is the only multilateral agency that includes regional cooperation in its charter and investments in the energy sector have become an important part of these regional cooperation activities.

Specifically, she said that ADB does not finance nuclear energy, coal mining or oil field development, but that it will selectively support coal-based power projects if cleaner technologies (e.g. fluidised bed combustion, supercritical and ultra-supercritical boilers, and flue gas desulphurisation) are adopted and adequate mitigation equipment and measures are incorporated into the project design. She added that ADB is supporting a carbon capture and storage project in China.

Energy Sector Policies of Other Multinational Development Banks

European Bank for Reconstruction and Development
Mr. Benjamin Sporton, Deputy CEO, World Coal Association, UK

Mr. Sporton explained that the European Bank for Reconstruction and Development (EBRD) is the youngest of the development banks and was set up to support former communist countries’ transition to free market economies, for example Russia, Central Europe and Baltic states. EBRD has financed coal-fired electricity generation projects, including current ones in Kosovo and Serbia; and has supported coal mining projects, particularly metallurgical coal, he added.

He said that EBRD launched an energy policy consultation in May/June 2013, shortly after the World Bank launched its strategy. The EBRD draft strategy position on coal is slightly more favourable than that of the World Bank, emphasising high efficiency coal plant and its role in future CCS development, he said. EBRD focuses on upgrading existing coal-fired power plants to comply with the European Large Combustion Plant Directive; and will only support new coal-fired power generation projects if they are the least carbon intensive option for meeting a country’s energy needs, if emissions comply with the European emissions directive, and if they are CCS ready, he said. EBRD incorporates a shadow carbon price, higher than European prices, into project assessments, he added.

World Bank
Mr. Fredrick D. Palmer, Senior Vice President Government Relations, Peabody Energy, USA

Mr. Palmer said that the World Bank (WB) was formed in 1944, is based in Washington DC, and has 188 countries affiliated to it: in 2012 its energy sector funding was $8.2 billion, of which 44% was renewable energy funding, and funding for thermal electricity generation was $690 million, a reduction of over 80% on its 2010 level.
In line with its energy policy, WB announced in July 2013 that it will provide financial support for greenfield coal power generation projects only in rare circumstances. Finally, he emphasised that bringing people out of energy poverty should be the prime objective of energy policy, and that coal is part of the solution.

**African Development Bank**

Mr. Julian Beere, Head of Business Development and Strategy, Thermal Coal, Anglo Operations Ltd., South Africa

Mr. Beere said that the African Development Bank (AfDB) was founded in 1964, is based in Tunis, and its shareholders include 53 African countries and 24 non-African countries. In 2012 it approved nearly US$ 4 billion in loans and grants, a quarter of which were in the energy sector.

He described AfDB’s new Energy Sector Policy, approved in September 2012, which recognises the principles of energy security and energy access for all, and the continuing role that fossil fuels will play in power generation in Africa. He noted that the cost of energy services is high in Africa, their development is slower, and the challenges are great.

He highlighted the AfDB position on coal; which recognises that coal-fired power generation is likely to form part of an approach to increase access to modern energy at an affordable cost, and emphasises the need to use new technology to mitigate and environmental impact.

**Discussion**

**Dr. Lennon** described a practical example of the difficulties in securing funding for coal-fired power projects; ESKOM’s experiences with securing US$3.8 billion from the World Bank to support construction of its supercritical coal-fired power plant at Medupi. He cautioned that with the limitations on development finance institutions to fund clean coal projects, countries could resort to deploying less expensive coal-fired electricity generation projects with alternative financing mechanisms. He called for the UNFCCC Green Climate Fund to fund the premium for low carbon technologies, including clean coal projects.

**Mr. Slone** suggested that multilateral development banks’ reluctance to finance coal-fired power generation projects seems to be at odds with their stated objectives. He pointed out that increased access to electricity requires the development of new baseload generating plant, not intermittent renewable energy.

**Dr. Zhang** said that few countries have achieved high levels of per capita income without high levels of per capita electricity consumption; and that policies that restrict the use of coal threaten the ability of developing countries to grow their economies and eradicate poverty.

He suggested that, without bank involvement, less efficient, less environmentally friendly, but cheaper power plants would be constructed. He saw the role of multinational development banks as...
supporting government decisions on the appropriate fuel mix for their own countries.

Mr. Gomwe concluded by supporting Dr. Zhang’s remarks emphasising the importance of high efficiency electricity generation and the need for multilateral development bank support to enable developing countries to access clean coal technologies. He called for further coal industry engagement with the multinational development banks.

Advanced Coal Generation and CCS Technology Update

Chairled by Mr. Yoshihiko Sakanashi, Executive Vice President, J-POWER, Japan and Mr. Ken Humphreys, Chief Executive Officer, FutureGen Alliance Inc., USA

Introducing the discussion session, Mr. Boyce emphasised the relevance of technology by reference to the “21st Century Coal: Advanced Technology and Global Energy Solution” finding that higher efficiency power generation from coal is the first step in lowering CO₂ emissions; and the recommendation that “Energy Ministers should promote the building of more efficient supercritical and ultra-supercritical coal-fuelled generation”.

Mr. Sakanashi reinforced the role of technology in coal use for power generation; in his view competitively priced coal-fired power generation in the USA had put downward pressure on the price of shale gas now being developed in large quantities in that country. He saw a significant future role for coal in power generation if advanced coal technologies are used.

Advanced Coal Generation Projects: Japan, South Korea and China – Progress, Challenges and Prospects

Mr. Yoshihiko Sakanashi, Executive Vice President, J-POWER, Japan

Mr. Sakanashi pointed to the current role of coal in power generation, which had been supported by technology development, and said that the share of coal in power generation is greater in Asia than in the world as a whole.

He added that Asian economies accounted for 56% of world coal-fired power generation in 2011, although future prospects are uncertain due to the focus on CO₂ emissions; IEA scenarios project much lower future growth rates in coal consumption than those seen historically; and the Asian region will strengthen its position as a driver in the global coal market.

He said that Japan has struggled to balance energy mix in electricity generation for a long time and coal accounted for 28% of power generation in 2012; and that the future long term energy mix will require re-balancing following the Fukushima nuclear incident.

He noted that 50% of coal-fired electricity plant in Japan uses ultra-supercritical (USC) technology, giving Japan the highest thermal efficiency in the world; and that this has resulted from continued investment in advanced coal technology.

He illustrated this by reference to the Isogo power plant, which had been commissioned in 1967 with two 265MW sub-critical generating units achieving 38% (gross, HHV) efficiency. It has now been replaced with two 600MW USC units, commissioned in 2002 and 2009, achieving 43% efficiency and a substantial reduction in emissions including a 17% reduction in CO₂ emissions per unit generated. He said that J-POWER also has plans to replace the 250MW Unit 1 and the 350MW Unit 2 at the Takehara power plant with a 600MW USC generating unit planned to start operation in 2020.

He further described integrated gasification combined cycle (IGCC) power plant developments in Japan:
- Japan’s first IGCC at Nakoso, with a 250MW capacity and originally owned by 10 electric power companies, started demonstration operation in 2007 and commercial operation in 2013.
- A 170MW large scale oxygen-blown IGCC demonstration plant at Osaki being developed by J-POWER and Chugoku Electric Power Co. Ltd. is planned to start operation in 2017.

He added that the Japanese government requires use of Best Available Technology for new coal-fired power plant and that Japan will build more advanced coal-fired power plants.

For Republic of Korea, Mr. Sakanashi described plans to develop USC coal-fired power plant rapidly by 2020, including generating units of >1000MW capacity.

He also mentioned the Taean IGCC project, which will use sub-bituminous coal at a target efficiency of 42% and is due to be completed by the end of 2015.

For China, he pointed to the rapid development of USC electricity generating units, which totalled 233 in 2011 (155GW, 20% of total coal-fired electricity generating capacity). 194 of these units are 600MW capacity and 39 are 1,000MW; and China is also developing advanced USC technology for 2020 operation. Further, he mentioned the 250MW Green Gen IGCC project in Tiajin city, which started commercial operation in 2012.

He concluded that USC technology deployment is essential to pave the way for CCS, that its development in Asia is crucial, and that coal-fired power plants will continue to play a future role on electricity grids because coal-fired power plants are compatible with flexible operation and combustion of blended biomass fuel.

CCS Technology Projects – Progress, Challenges and Prospects
Mr. Ken Humphreys, Chief Executive Officer, FutureGen Alliance Inc., USA

Mr. Humphreys introduced himself by saying that his career has included roles in solar and renewable energy but that he is now responsible for the FutureGen 2.0 project, which is targeting 98% CO₂ capture. He drew on the GCCSI report on the global status of CCS in 2013 to conclude that other projects are facing the point of financial decision on whether or not to proceed, but in general there has been an unfortunate global slowdown in new CCS projects, except in China.

He identified the need for a number of policy enhancements, development of pipeline network infrastructure, and identification of storage capacity, which has a long lead time and requires urgent action.

He highlighted pertinent messages from the 2013 “IEA CCS Technology Roadmap”, adding that the IEA also recognises that progress has been slower than required and that there are technology integration issues that need to be addressed. He said that the target for an additional 30+ CCS projects that capture, transport and store CO₂ to be operational by 2013 appears potentially more attainable that the previous roadmap target of 100+ projects. He welcomed recognition that there are future significant roles for fossil fuels and that no climate friendly scenarios are realistically attainable in the long run without CCS.

He said that although only 1 of the 12 large-scale integrated CCS projects identified as operational by GCCSI, while 5 of the 6 now reaching the Financial Investment Decision stage and the large majority of the 41 total projects identified are coal projects.
He outlined key aspects of a number of coal-based CCS demonstration projects:

- **Saskpower’s 110MWe post-combustion retrofit Boundary Dam project** will have a 90% CO₂ capture rate and is expected on-line in early 2014. Capital cost is US$1.355 billion, of which $240 million is government supported, but the biggest cost uncertainty was associated with upgrading the original plant and replication costs would be 20-30% lower.

- **The Kemper County lignite-fired 582 MWe IGCC** will have a 65% CO₂ capture rate, matching the CO₂ emissions of gas-fired power plant, and is due on-line in late 2014. A $133 million operating cost tax credit will not be realised because a construction over-run resulted in the plant being unable to meet the specified operation date; providing a lesson that support for future projects should remain valid for longer time periods.

- **The Texas Clean Energy project** is a 400MWe polygen unit that will capture 2.2 million tonnes of CO₂ and produce 0.95 million tonnes of Urea a year for sale, with the ability to arbitrage between power and fertiliser markets. It benefits from $450 million support from the Department of Energy and $637 million of operating tax credits, again subject to meeting a specific target date for start of operation. Commercial project financing was complicated by the risks associated with supplying multiple markets. Also, this single plant will produce a high proportion of annual Urea requirements, so EOR is one of the few supplementary markets large enough to provide a sufficient revenue stream for future CCS projects.

- **FutureGen 2.0** is a 168MWe re-powering project in the state of Illinois and will be the world’s first oxy-combustion plant with fully integrated CO₂ capture (>90%). The $1.65 billion capital cost is part funded by the US Department of Energy, and power will be sold at market price on a 20 year power sales agreement with additional CCS costs recovered from all Illinois state utilities. CO₂ will be transported by pipeline and stored in a saline aquifer.

**Mr. Humphreys** added that 12 of the 41 projects identified by GCCSI are in China, with Shenhua having an interest in a quarter of those. He emphasised the importance of basic research and mentioned the Capture Test Centre Network, which includes 7 centres globally with a total of >$100 million over the next couple of years.

In conclusion, he observed that many CCS projects initiated over five years ago with government capital expenditure support are now maturing; that they will require a revenue stream to support operation; and that many are vulnerable to expiring government subsidies or cost caps. He said that government support for new projects is likely to be reduced and that few new projects are emerging, except in China. He suggested that governments could extend subsidy deadlines to ensure that at least some projects will succeed. Finally, he observed that the traditional energy project finance sector is not yet comfortable with CCS risks and financing, and called for more efforts to encourage public acceptance of CCS.

**Analysis of Global Policy Support for CCS**

*Mr. Justin Flood, Manager Sustainability, Delta Electricity, Australia*

**Mr. Flood** introduced a draft paper prepared by a working group of CIAB Associates for consideration by CIAB Members. He said that the objective of this work is to demonstrate the importance of CCS to the least-cost achievement of climate policy objectives and to demonstrate, by reference to renewable energy subsidy policy, how appropriate CCS policy support could encourage development of CCS technology.

He said that the IEA has estimated global renewable energy subsidies at $88 billion in 2011, with a total of $875 billion committed over the lifetime of subsidised projects: for comparison, total global CCS subsidies amount to $20 billion. He said that 20-30 year support is beyond the time horizon of technology development, so that public funding commitments will essentially support commercial operation and distort carbon markets.

He called for public support to be more specifically tailored to the timescales necessary to develop all
relevant technologies to the point of commercial deployment, with appropriate policy instruments used at each stage of development.

He added that the capture, transportation and storage elements of CCS are well understood; that CCS on coal-fired power plant is lower cost than many other carbon reduction alternatives; and that integrated demonstration projects are urgently needed, but initial project costs are very high relative to other technologies and policy uncertainty is the major risk for 70% of CCS projects.

**Discussion**

**Dr. Zhang** expanded on advanced coal-fired power generation and CCS developments in China. He reported that in 2012 the installed electricity generating capacity in China was 1,150GW, of which 758GW was coal-fired; that total generating capacity will exceed 1,600GW by 2020; and that over 60% of that capacity will be coal-fired.

On advanced coal technology, he said that China now has 54 USC electricity generating units of >1,000MW capacity, which have contributed to a 15% reduction in average coal consumption per unit of electricity generated over the last ten years. He added that the first IGCC power plant started operation in December 2012 and that, although the capital cost is 2-3 times greater than traditional plant, the operating cost of IGCC with CCS will be significantly lower than that of traditional plant with CCS.

He presented data showing that emission standards for generating plant in China are in many cases stricter than those in other world regions.

He said that most CCS demonstration projects cover CO₂ capture and use, but not storage, and that Shenhua has three CCS projects involving coal-to-liquids plants. Finally, he said that China is exploring the use of renewable energy sources integrated with coal-fired power generation, although improving power plant efficiency is the number one priority.

**Dr. Topper** applauded initiatives in China and Japan to develop 700°C USC technology, which is a significant technical challenge involving the use of nickel superalloys; and which would allow coal fired power plant efficiencies to reach 50% and more; and the successful efforts made by the technical community to improve the prospects for CCS technology, which he believed will develop further as costs are driven down.

**Dr. Bennett** thanked speakers for their representation of the IEA position on CCS and recognised the policy challenges of the technology, particularly now that the first demonstration projects are nearing final financial commitment. He commented that levelised cost are not always an ideal mechanism for comparison of electricity generation costs or development of policy support because they do not take into account the specific risk profiles and early support requirements of CCS. He saw the target of 30+ CCS projects by 2020 as a realistic estimate given the current level of progress, asking what further industry could do to support CCS, and whether Mr Humphreys agrees with the EPAs assertion that CCS is adequately demonstrated.

**Mr. Humphreys** replied that each company must make its own decision on supporting CCS; and that a forum such as the CIAB provides a useful focus on industry experience and the position of policy makers on CCS. He said that extension of deadlines for existing operational tax credit support commitments would be a useful no-cost
option for governments; and that companies need to consider CCS as a possible long term strategic commitment. He said that CCS technology has not yet been shown to be commercial, but that it is ready to deploy and needs to be demonstrated to the point that equipment manufacturers feel able to give the performance guarantees that project financers require.

Dr. Lennon expressed his view that commercial commitment to a technology requires 8-10 years of demonstrated operating experience, so CCS is still under-demonstrated. He added that the operability of the CCS plants and its effects on the operation of electricity generating plant are not yet known; suggesting that lack of progress so far may result in the window of opportunity for CCS being overtaken by other options such as renewable and nuclear energy. He noted that subsidies have been very successful in encouraging rapid development of renewable energy technologies, while CCS technologies do not yet benefit from similar subsidies.
Annex – Plenary Meeting Participants

CIAB MEMBERS:
Mr. Gregory H Boyce  Chairman and Chief Executive Officer, Peabody Energy Co. Inc. – USA
Mr. Milton Catelin  Chief Executive, World Coal Association – GBR
Mr. Andrea Clavarino  Chairman, Assocarboni and Chief Executive Officer, Coecleri Logisitcs – ITA
Mr. Peter Freyberg  Head of Coal Assets, Glencore – AUS
Mr. Robert H Gentile  President and CEO, Leonardo Technologies Inc. – USA
Mr. Godfrey Gomwe  Chairmen, Executive of Thermal Coal, Anglo American – ZAF
Mr. Kenneth Humphreys  Chief Executive Officer, FutureGen Alliance Inc. – USA
Mr. Bob Kamandanu  Chairman, Indonesian Coal Mining Association – IDN
Mr. Harry Kenyon-Slaney  Chief Executive Energy, Rio Tinto plc – AUS
Dr. Steve Lennon  Group Executive (Sustainability), Eskom Holdings Ltd. – ZAF
Dr. Xolani Mkhwanazi  Chairman, BHP Billiton South Africa Ltd. – ZAF
Mr. Wick Moorman  Chairman, President and Chief Executive Officer, Norfolk Southern Corporation – USA
Mr. Joachim Rumstadt  Chairman of the Board of Management, STEAG GmbH – DEU
Mr. Yoshihiko Sakanashi  Executive Vice-President, J-POWER – JPN
Mr. Hiroshi Seki  Managing Executive Officer and General Manager, Energy & Mineral Resources Dept., Idemitsu Kosan Co. Ltd. – JPN
Mr. Robert H Stan  Chairman, Spruce Bluff Resources Ltd. – CAN
Mr. Michael W Sutherland  President and Chief Executive Officer, Joy Global Inc. – USA
Mr. Joost Van Dijk  Chief Operating Officer, Steam, E.ON Kraftwerke GmbH – DEU
Mr. Jaroslaw Zagórowski  President of the Management Board, Jastrzębska Spółka Węglowa – POL
Mr. Fernando L Zancan  President, Brazilian Coal Association – BRA
Dr. Yuzhuo ZHANG  President & CEO, Shenhua Group Corporation Ltd. – CHN

CIAB ASSOCIATES:
Mr. Rick Axthelm  Vice President, Federal Government and External Affairs, Alpha Natural Resources Inc. – USA
Mr. Julian Beere  Head of Business Development and Strategy, Thermal Coal, Anglo American Operations Ltd. – ZAF
Mr. Karl Bindemann  Business Manager, Northern Europe and Africa, EPRI International Inc. – USA
Mr. Mick Buffier  Group Executive – Corporate Affairs, Government and Industry Relations and Sustainable Development, Xstrata Coal Pty Ltd. – AUS
Ms. Gina Downes  Corporate Consultant: Environmental Economics, Climate Change and Sustainable Development Department, Group Sustainability, Eskom – ZAF
Mr. Michael J. Flannigan  Executive Associate, Peabody Energy Company Inc. – USA
Mr. Justin Flood  Manager, Sustainability, Delta Electricity – AUS
Dr. François Giger  Strategy Manager, Thermal Generation and Engineering Division, Electricité de France – FRA
Ms. Ann Marie Hann  President, Coal Association of Canada – CAN
Mr. Naoki Kawamoto  Energy & Mineral Resources Dept., Idemitsu Kosan Co. Ltd. – JPN
Ms. Veronika Kohler  Director, International Policy, National Mining Association – USA
Mr. Roland Lübke  Economic Affairs, German Coal Association (GVSt) – DEU
Mr. Itaru Nakamura  Executive Managing Officer, J-POWER – JPN
Mr. Marko Nylund  Vice President, Pohjolan Voima Oy – FIN
Mr. Fredrick D. Palmer  Senior Vice President Government Relations, Peabody Energy Company Inc. – USA
Ms. Lucyna Patas  International Relations, Jastrzębska Spółka Węglowa – POL
Ms. Maggi Rademacher  Performance Improvement and Operational Excellence, Steam Global, E.ON Kraftwerke GmbH – DEU
Dr. Hans-Wilhelm Schiffer  Head, General Economic Policy/Science, RWE AG – DEU
Mr. Donald W. Seale  Executive Vice President and Chief Marketing Officer, Norfolk Southern Corporation – USA
Mr. Deck Slone  Senior Vice President, Strategy and Public Policy, Arch Coal Inc.  USA
Mr. Benjamin Sporton  Deputy Chief Executive, World Coal Association  GBR
Mr. J. Gordon Stephens  Washington Representative for Joy Global Inc.  USA
Mr. L. Cartan Sumner Jr. Vice President, Office of the CEO, Peabody Energy Co. Inc.  USA
Mr. Sergey Tverdokhleb  Adviser to CEO and Head of Corporate Policy and Special Projects Department, SUEK (Siberian Coal Energy Company)  RUS
Mr. Naoki Ueda  Assistant Manager, Energy Business Dept, J-POWER  JPN
Mr. Steven Winberg  Vice President, Research & Development, CONSOL Energy Inc.  USA
Mr. Alex Zapantis  Principal Adviser, Product Stewardship, Rio Tinto Energy  AUS

GUESTS & SPEAKERS:
Ms. Naomi Chakwin  Resident Director General, European Representative Office, Asian Development Bank  DEU
Mr. Ted Doheny  President and Chief Operating Officer, Underground Mining Equipment Division, Joy Global Inc.  USA
Mr. Shigeto Hashiyama  Chief Representative in Paris, Japan Bank for International Cooperation  FRA
Mr. Fumio Hoshi  COO & Senior Managing Director, Japan Bank for International Cooperation  JPN
Dr. Andrew Minchener  General Manager, IEA Clean Coal Centre  GBR
Mr. Tomohiko Nishiu  Power & Water Department, Japan Bank for International Cooperation  JPN

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Mr. Carlos Fernández  Senior Energy Analyst (Coal), Gas, Coal and Power Markets, IEA  INT
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