CIAB

COAL INDUSTRY ADVISORY BOARD

International Coal Market & Policy Developments in 2006/07

DECEMBER 2007

Contents

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The report has been compiled on behalf of the CIAB by Brian Heath, CIAB Executive Co-ordinator, and thanks are due to the following CIAB Associates, on whose contributions it is substantially based:

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The sections of this report reviewing world coal supply and demand draw on a consistent coal data set provided by the IEA. At the time of writing, the latest such data available refer to 2006 and are based on preliminary estimates made by IEA Member governments. Where firmer or more recent data are available from CIAB Members or other sources, any significant differences between these and IEA data are highlighted. Thanks are also due to *The McCloskey Group* for permission to use their coal price data and to the *Chicago Climate Exchange* for permission to use their trading data for Charts 9 & 10.

FORWARD FROM CIAB CHAIRMAN

The *Coal Industry Advisory Board* (CIAB) is a group of high level executives from coal-related industrial 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. There are currently 46 CIAB Members from 19 countries, typically Chief Executives or senior executives from coal mining, transportation and machinery companies, or from major power generation or other coal consuming companies.

The original task of the CIAB was to assist the IEA in the practical implementation of the "Principles for IEA Action on Coal" – measures aimed at ensuring a ready supply and trade of coal to underpin energy security. In recent years the CIAB has focused additionally on developments in the technology of coal use required to enable coal to contribute to energy security in this era of climate change concern; and on issues arising from increasingly liberalised energy markets, such as the restructuring and privatisation of coal and electricity industries in many countries.

The CIAB produces this report annually for the Governing Board, Standing Committees and Secretariat of the International Energy Agency and the opinions expressed in it are entirely those of CIAB Members and Associates.

It draws on contributions from Associates of CIAB Members to briefly describe developments in international coal markets over the last year and to highlight policy and other issues that CIAB Members regard as pertinent to the development of coal as a secure, clean and competitive energy source. We hope that it will also be of interest to a wider audience.

Steve Leer
CIAB Chairman

December 2007

1 HIGH LEVEL MESSAGES

1.1 CIAB Policy Advice

1. Growth in coal use continues to be substantial and there is still the incentive for industry to invest in coal production capacity when future demand is demonstrated.

2. 2007 has shown further evidence of temporary bottlenecks in international coal transport infrastructure and international price escalation as the demand for coal and shipping continues to increase. However, the international coal market continues to be fundamentally competitive.

3. Each successive year's experience reinforces the realisation that coal has a long-term role in a sustainable energy future, to fuel the rapidly developing electricity and energy needs of developing economies and to contribute to global energy security.

4. Against a background of rising global energy demand and a continued reliance on fossil fuels for the next twenty-five years, illustrated by future energy scenarios from the IEA's "*World Energy Outlook 2007"*, the CIAB draws attention to the additional challenge to future energy security created by the need to address climate change.

5. Moreover, switching away from the use of coal in developed economies is not an adequate response to global climate concerns: in the short term heavy industry and its associated CO_2 emissions may merely transfer to developing economies; and ultimately carbon capture and storage will be required to stabilize GHG concentrations in the atmosphere, whatever fossil fuel is used.

6. Faster and more dramatic improvement in coal's environmental performance is feasible now and should continue to be a high priority for industry and government. Developed and developing countries need to work together to ensure that existing and future clean coal technologies are deployed at an accelerated rate.

7. Governments and industry are increasingly supporting R&D on the technology of low emission coal plants, but much higher rates of investment are needed, and collaborative efforts between governments and industry to demonstrate at large scale the operation of these plants and reduce their costs need to be re-doubled. There is a continual need to reduce the efficiency penalty of carbon capture and storage (CCS) and to promote efficiency improvement through the whole energy value chain, including through the deployment of new, efficient, electricity generating technologies. Work on designing new plant to be carbon capture ready should be accelerated. Further clean coal technology discussion and policy recommendations can be found in the following Section 1.2.

8. The efficient deployment of these new technologies in both developed and developing economies is necessary to support the continued responsible use of coal globally. For developing countries, the incremental costs need to be addressed through post-2012 Kyoto mechanisms and the scope of the Clean Development Mechanism (CDM) must be widened to include abatement achieved through carbon capture, utilisation and storage as well as other advanced coal technologies.

9. The CIAB also stresses the need to address CO_2 emissions from the current build of conventional PF coal fired power plant, including mechanisms for incentivising developing countries, and supports the IEA position on the need to examine the potential for post combustion capture to be retrofitted to these plants as well as existing gas-fired generating units.

1.2 The Role of Coal in World Energy Markets

10. Over the last 30 years or so, world primary energy demand has grown by approximately 2% per year and, despite the rapid growth in use of oil and gas, coal demand has grown only marginally more slowly, at 1.8% a year on average. In its Reference Scenario[1], the International Energy Agency expects total world primary energy use to grow by 1.8% a year to 2030 and coal use to grow by 2.2% a year, reversing the relative long term historical trends. Historically, coal has accounted for 24-25% of world energy use: this is now expected to increase to over 28% in the Reference Scenario. Even in the Alternative Policy Scenario, which reflects future government policy initiatives to combat the rising consumption of fossil fuels, coal still supplies over 23% of energy needs in 2030 despite accounting for two-thirds of the projected primary energy demand reduction from the Reference Scenario.

11. Indeed, the historical trend of increased coal use has accelerated recently, growing by over 3% a year on average over the last ten years and by more than 5% on average over the last five years. Of course, the main source of this growth has been China, which serves to demonstrate the role that coal will play in developing economies with rapidly increasing demands for electricity and steel.

12. Given that coal is certain to remain a large and growing contributor to world energy supplies, carbon capture and storage is an indispensable tool in addressing climate concerns.

13. The responsible use of coal can enhance a nation's quality of life, its global competitiveness, its long-term energy security and its prospects for stable and sustained rates of economic growth. With appropriate policy and investment signals, coal has the ability to meet long term increases in demand and to enhance the security of world energy markets through the development of national coal resources and increased international trade.

14. Coal is safe and easy to transport and can be readily stored. The world's coal reserves are extraordinarily large and widely dispersed. In contrast, political instability in the world's largest oil-producing regions and bottlenecks in supply routes raise serious questions about the long-term reliability of global oil supplies.

15. The increasing recognition that coal needs to remain a part of sustainable energy systems must be accompanied by a wider appreciation of the need to improve its environmental performance; and of the need for urgent action in this area. Addressing climate concerns is the ultimate "public good" and, acting alone, the market place is unlikely to deliver the desirable outcome. Technology "step changes" of the type required to sustain the future use of coal, and indeed all fossil fuels, generally require public support.

16. Discussing the prospects for clean coal technologies (CCTs), and carbon capture and storage (CCS) in particular, at their November 2007 Plenary meeting, CIAB Members:

    - emphasised the need for government support in the early stages of CCT development and deployment;
    - reinforced the need for capital support, and for governments to assist in funding, particularly against the current backdrop of escalating capital costs;
    - supported cap and trade systems at the later stages of the CCT development and

[1] "World Energy Outlook 2007 – China and India Insights"

commercialisation process;

- saw participation of the emerging economies as crucial, with loan subsidies through the World Bank a possible means of encouraging this; and
- specifically requested that the IEA take all possible steps to ensure that CCS is included in the Kyoto Clean Development Mechanism.

17. Recognizing the crucial importance of balancing possible measures to mitigate green house gas emissions with growing energy demand and security of supply, Members also highlighted some of the wider CCS development issues facing industry and governments.

18. CCS needs to be deployed rapidly, but also needs to be sustainable. CCS operation makes additional demands on power station energy output and capacity; and on coal production and new mine development needs. Consequently, there is a requirement to continually focus on reducing the efficiency penalty of CCS and to promote efficiency improvement through the whole energy value chain, including through the deployment of new, efficient, electricity generating technologies. Given the significant efficiency penalty, the replacement of existing sub-critical coal plants with new, more efficient generating capacity greatly increases the potential for future retrofitting with CCS.

19. The workshop *"CO_2 CAPTURE & STORAGE - international progress & future prospects"* that followed the meeting, co-hosted by the Royal Society, the Royal Academy of Engineering and the IEA Coal Industry Advisory Board (CIAB), examined the future prospects for CCS, and progress with its demonstration as a pivotal climate change mitigation technology.

20. Against a background of rising global energy demand and a continued reliance on fossil fuels for the next twenty-five years, illustrated by future energy scenarios from the IEA's "*World Energy Outlook 2007"*, the need to address climate change creates an additional challenge to future energy security.

21. The necessary deep cuts in CO_2 emissions, as indicated by the IPCC and increasingly reflected in government policies, mean that urgent progress is needed on low carbon technologies for power generation and other industrial processes, including CCS for coal- and natural gas-fired plants. The significant progress reported at the workshop on the legal and regulatory frameworks to enable CCS is encouraging, and included the steps now being taken by the European Commission to incorporate CCS in the EU Emissions Trading Scheme.

22. However, to promote its rapid demonstration and deployment alongside other technologies, governments must also take positive steps to reduce investment risk. Many projects with the potential to demonstrate the viability of CCS for power generation were presented, with the common conclusion that these now require greater policy and financial support.

23. Indeed, the political desire to address climate change must be turned into actions that lead to public understanding and support for the necessary and substantial costs involved. Assessments have shown that CCS could reduce these costs, but commercial-scale demonstration of the various CCS technology options is required to do this and also to build the confidence that would enable their widespread deployment, including in the world's rapidly developing economies such as China and India. Many participants referred to the important role that the Kyoto Protocol's Clean Development Mechanism could play here, but only if CCS is made eligible for tradable credits.

24. A straw poll at the workshop revealed that the majority of those present believed that

non-commercial CCS could be demonstrated at large scale by 2014, with commercial operation achieved between 2016 and 2020. These remain challenging targets that can only be achieved if the urgency expressed by some spreads to become a demand of the majority. Experienced practitioners warned that the remaining technical, economic, policy, regulatory and legal issues must be addressed simultaneously and with determination. In particular, proving the safe storage potential for CO_2 is as urgent as demonstrating the capture technologies and potentially as challenging as developing major oil and gas fields.

25. Failure to succeed with CCS would force painful and perhaps unmanageable policy choices between pursuing energy security and addressing climate change. In this respect, CCS emerges as an indispensable part of the solution.

26. There is strong coal industry awareness of the importance of applying sustainable development principles to maximise business opportunities and to comply with government policies and regulations. But investments in technology to reduce the impact of coal use on climate change are accompanied by significant risks associated with uncertainty about the ability to capture economic value, large capital requirements, long development times and the potential for failure with any given new technology.

27. Similarly, coal producers continue to be wary of investing in advance of a demonstrated demand for coal; a particular issue for European markets where prospects for coal in the longer-term are especially uncertain. Investment has increased as coal prices have risen, but to date it has been mainly operational and transportation investment rather than capacity investment in long term coal production.

28. Governments are increasingly recognising the need to set long term targets for CO_2 emissions reductions; and for the need to set a value on CO_2 emissions. But, while cap and trade systems encourage the efficient use of existing mechanisms to reduce CO_2 emissions from fossil fuel use, they provide imperfect signals for long term investment.

29. Demonstration of emerging clean coal technology options at a size large enough to give some confidence on their use at commercial levels remains an urgent priority. Until these technologies are demonstrated at large scale, the massive investments by developing economies in new coal-fired electricity generating plant are not achieving their potential for mitigating CO_2 emissions from the use of coal.

30. Many global industry and government initiatives have emerged, including the G8 climate change agenda, the Carbon Sequestration Leadership Forum (CSLF), the Asia Pacific Partnership for Clean Development and Climate and the European Technology Platform for Zero Emission Fossil Fuel Power Plants. In some cases these have encouraged the development of national initiatives, such as the R&D funding provided by the Australian federal government's Low Emissions Technology Demonstration Fund and the Australian Coal Association's Coal 21 Fund, that provide substantial R&D support funding. The coal industry has demonstrated that it is willing to invest large sums of money in the clean coal technology R&D effort and these developments are to be applauded.

31. Beyond R&D, joint industry/government co-operation to <u>demonstrate</u> new low CO_2 emission technologies and to formulate policy frameworks that encourage investment in efficient coal-fired electricity generation technologies is essential if the goal of cleaner use of fossil energy is to be achieved within the necessary timescale.

32. FutureGen in the USA and the recent Callide A Oxy-fuel demonstration in Australia are examples of the sort of demonstration projects that need to be actively pursued elsewhere.

33. Many companies have announced plans for new coal-fired electricity generating plant incorporating modern, efficient technology and the potential for carbon capture and storage. However, appropriate incentives, public funding and/or predictability of government policy are pre-requisites for these projects to proceed.

34. Accelerating the development, demonstration and commercialization of clean coal technologies – and the deployment of such technologies around the world – is essential if the world is serious about stabilizing concentrations of carbon dioxide in the atmosphere.

35. Although developed countries are responsible for the vast bulk of historical CO_2 emissions, developing countries will be the main source of growth in greenhouse gas emissions from energy use over the coming decades. Thus it is in the best interests of the OECD countries to assist developing countries in using coal sustainably by facilitating the application of current best commercial technologies and by encouraging participation in international research and development of new coal technologies relevant to their needs.

36. Investments in clean coal conversion technologies are gaining momentum, particularly in China, where there is a target of meeting 10-15% of the forecast 450 million tonnes annual oil demand in 2020 using direct and indirect coal liquefaction plants. Given the dramatic rise in the price of both crude oil and natural gas and increasing competition for energy resources around the globe, it is increasingly likely that coal will be used in the near future as a feedstock for the production of synthetic natural gas, transportation fuels and chemicals. This development further underscores the need for increased investment in the next generation of clean coal technologies. In some countries, coal conversion technologies are viewed as a cost-effective source of concentrated carbon dioxide, which can be used for enhanced oil recovery purposes as well as to demonstrate the viability of carbon capture and storage on a large scale.

1.3 Synopsis of Coal Market Developments

37. World consumption of primary energy[2] grew by 2.4% in 2006, while consumption grew by 8.4% in China and 5.4% in India. World consumption of coal again grew more strongly (4.5%) than total energy use. Coal accounts for more than 70% of China's energy consumption.

38. Steam coal trade continued its relentless growth, expanding by nearly 5% in 2005 to reach over 590 million tonnes, of which 525 million tonnes was traded by sea. Over the last 8 years, seaborne steam coal trade has grown by nearly 80% in total, averaging 29 million tonnes/year.

39. The price of steam coal delivered to NW European ports was $51/tonne at the end of 2005, but prices increased steadily throughout 2006 and 2007, with rapid increases in Asian market prices from March 2007 leading the way and illustrating the effect that Chinese demand for coal, other commodities and shipping continues to have on world markets. Asian prices (delivered to ports) averaged nearly $92/tonne in August 2007, with NW Europe approximately $7/tonne lower. However, towards the end of the year, NW European prices recovered substantially to regain their more usual role of leading Asian prices. By November they were averaging almost $130/tonne with Asian prices over $20/tonne lower.

40. The tight supply/demand balance was reflected in high steam coal price volatility with, for example, disruption at the Australian port of Newcastle due to extreme weather conditions in June 2007 having an immediate and significant upward effect on international market prices.

41. Nevertheless, international coal markets remain fundamentally competitive, thereby continuing to contribute to world energy security. Australia remains by far the largest hard coal (thermal and coking coal) exporting country, followed by Indonesia. Russia's hard coal exports rose by 17% to 92 million tonnes in 2006, making it the third largest exporter. With the new EU Large Combustion Plant Directive coming into force in 2008, European buyers are favouring thermal coals with lower sulphur and nitrogen contents.

[2] Figures in this paragraph are derived from *"BP Statistical Review of World Energy June 2007"*

2 CIAB WORK PROGRAMME

42. During the G8 summit, held at Gleneagles on 6-8 July 2005, world leaders drew attention to why reliable and affordable energy supplies are essential for strong economic growth and poverty alleviation. In response to the accepted environmental challenge, the G8 communiqué focuses on energy efficiency and technological development through co-operation. In the case of coal, some specific actions were proposed:

    - Review, assess and disseminate information on the energy efficiency of coal-fired power plants with the aim of promoting the most cost-effective best practices in all countries, including developing countries.
    - Demonstrate the potential of advanced clean coal technologies through national and international research programmes and partnerships with industry.
    - Develop and commercialise carbon capture and storage technology, including a study of the "capture ready" plant concept and the role of economic incentives.

    CIAB work during 2007 has continued to be in support of the IEA G8 action plan.

Achievements in 2007

43. The IEA and the CIAB have worked to broaden and expand CIAB Membership to enhance the coverage of advice available to the IEA. 2007 has seen the appointment of new CIAB Members from China, Russia and Indonesia; and from EPRI and FutureGen in the USA.

44. CIAB work in 2007 has focused more on interaction with the IEA and other groups than on the publication of reports, although two pieces of work will be published as stand-alone reports or as components of IEA publications early in 2008 (see below).

45. Mr. Steve Leer, CIAB Chairman and CEO of Arch Coal, made a presentation at the CURC/EPRI conference *"The Power of Technology: Ensuring the Global Future of Coal"*, held in Washington DC in February 2007 and attended by several CIAB Associates. His presentation *"The Potential of Coal in Reducing Greenhouse Gas Emissions"* drew on CIAB work and policy advice.

46. A discussion session was arranged in Washington DC in February 2007. Jeff Jarrett (Assistant Secretary for Fossil Fuels, US DoE) and George Rudins (US DoE) joined CIAB Associates for an exchange of views on developments in the USA. The discussion centred on climate change mitigation; and progress with demonstration projects and R&D.

47. CIAB Associates made initial contributions to the IEA publication *"Tackling Investment Challenges in Power Generation"* and commented on draft text, resulting in several revisions prior to publication.

48. CIAB Members and Associates attended, and contributed to, the *"IEA/CSLF Assessment Workshop on Near-Term Opportunities for Carbon Capture and Storage"*, held in Oslo, Norway on 21-22 June 2007. The workshop was organised by the IEA and the Carbon Sequestration Leadership Forum and formed part of the IEA's G8 action plan. CIAB Associates have been involved in the formulation of recommendations to be submitted to the final workshop in Calgary, Canada on 26-27 November 2007; and CIAB Members also commented at their November 2007 Plenary meeting.

49. At their June 2007 meeting in Paris, CIAB Associates provided written submissions and verbal updates covering policy developments relative to coal in their home countries.

These were compiled into a paper that was made available to the IEA Secretariat.

50. In association with this meeting, CIAB Associates formed the majority of participants in the "IEA World Energy Outlook 2007 China and India Insights – Coal Trade Workshop". Input and comment was provided, prior to publication, on topics including coal production, consumption, trade, transport and mining technology.

51. A workshop *"CO_2 Capture & Storage: international progress and future prospects"* was held jointly with the Royal Society and the Royal Academy of Engineering on 7-8th November 2007[3].

52. In addition to the above activities, work has progressed in two CIAB working groups during 2007.

Clean Coal Technologies Working Group *(Chair – Deck Slone)*

53. The focus of this group includes:

- identifying potential commercial drivers for investment in Clean Coal Technology;
- articulating policy mechanisms that can support further progress;
- delineating where and to what extent these mechanisms are already effectively employed;
- sharing these effective practices with other countries; and
- accelerating the arrival of a cleaner future.

54. The group is preparing a report *"Accelerating Commercial & Policy Drivers for Deployment of Clean Coal Technologies"*. The report draws on the experience of CIAB Members and Associates to review commercial and policy drivers that have been used to create and promote deployment of clean coal technologies. It draws out key messages and provides advice on drivers that can reduce the time frame for achieving significant GHG emissions reductions. Publication is targeted for early 2008.

55. The report has been substantially drafted during 2007 and the key messages and recommendations were debated by CIAB Members at their November 2007 meeting. Significant points from this discussion are included in the final draft of the report.

56. The Zero Emissions Technologies Working Group had previously proposed the compilation of a global atlas of CO_2 sinks, as a unique project externally funded by the Australian Government with the work being carried out by Geoscience Australia. Project delivery has been delayed by the time taken to secure Aus$140,000 of funding from AP6, staff changes at the Australian Department of Industry, and the lack of early availability of the experienced personnel required to carry out the work.

57. As the project does not directly engage CIAB Associates, it was agreed early in the year to take it "offline" from the CIAB work programme. The Zero Emissions Technology Working Group has been disbanded and the CCT WG will continue to monitor progress with the work. It is understood that the project is targeted for completion before the 2008 G8 meeting.

Leading Practice Working Group *(Chair – Allan Jones)*

58. Following the completion of Preston Chiaro's term of office as CIAB Chairman in

[3] See Section 1.2 of this report for a brief summary of the workshop

November 2006, and Andy Lloyd's resignation as his CIAB Associate, Allan Jones took on responsibility for the working group's project on reconciling power station efficiency measurement. The work is in support of IEA work on the potential for improving world power station efficiency and complements studies carried out by the IEA Clean Coal Centre.

59. In order to promote power station efficiency improvements, it is essential to understand how efficiency is measured at power stations around the world. There are many potentially differing aspects of quoted efficiency estimates and there is a clear need for the derivation of a standard methodology to make data comparisons more meaningful.

60. Japanese CIAB Associates, VGB (Germany), EPRI (USA) and Affari Istituzionali e Internazionali (Italy) have all participated in the work; and the working group has worked closely with the IEA Secretariat and the IEA Clean Coal Centre.

61. During 2007, the working group has sought to define a methodology to benchmark power station performance, case by case over a long term average, to indicate CO_2 mitigation potential from the adoption of leading practice. It is anticipated that a report of the work will form part of the IEA report to the G8 in 2008 on a bottom-up assessment of electricity generating plant around the world and the costs of improving its performance.

62. Initial findings from the CIAB work are that a large number of factors contribute to differences in plant performance. The proposed methodology will adjust for the un-controllable factors (e.g. local climate, specific plant design parameters) to derive performance data for individual plants that can be compared to a leading practice plant.

63. It appears feasible to usefully normalise performance data, without disclosure of detailed commercially sensitive information; and to integrate basic data capture, expression of actual and normalised performance and comparison of leading practice within one co-ordinated international system. National reporting of the required data, with the IEA Clean Coal Centre acting as the data repository, is proposed.

Work proposed for 2008

64. In November 2007, the CIAB Plenary meeting and the subsequent meeting of the CIAB Executive Committee discussed with IEA representatives possible items of work during 2008. Items previously agreed include:

    - Completion of the CIAB report *"Accelerating Commercial & Policy Drivers for Deployment of Clean Coal Technologies"*. A final draft will be made available in January 2008, for publication in March/April 2008.
    - Completion of the work on power station efficiency reconciliation methodology. A final draft will be submitted to the IEA in February 2008, for integration with a wider report on power station benchmarking.
    - Preparation of the annual CIAB report *"International Coal Market & Policy Developments in 2007/08"*.
    - Support for other IEA coal initiatives as required.

65. The Executive Committee also agreed to further consider the option of holding an Associates meeting in Beijing in May 2008 as an alternative to the more usual June/July meeting in Paris.

66. Central to the consideration of further CIAB work is the issue of balancing energy supply security and significantly increased coal use with the need to slow the growth of CO_2 emissions, which has been brought into focus by the WEO2007 scenarios. There are two

areas where the CIAB could usefully contribute the expertise of its Members. These will be debated and specific work tasks agreed early in 2008.

67. **Energy Security** – the CIAB proposes development of a report that draws on CIAB member expertise and commentary to explore the related yet discreet ways in which coal use can and does enhance energy security in major geographic regions. We believe that the "real-world" views of leaders in the power generation industry, the coal industry (which is increasingly populated by producers with broad interests in metals, minerals and other commodities), and other energy-related fields would be valuable.

68. This work would also explore the important steps that governments must take to support coal's essential role in the future energy equation, for example by investing in infrastructure and by providing long-term clarity on the regulatory front. Without such support from policy makers, companies may fail to make the necessary investments to maintain coal's vital role.

69. **Carbon Capture and Storage** - During 2007, the CIAB prepared a report identifying and endorsing key commercial and policy drivers that can be instrumental in accelerating the development and deployment of clean coal technologies. With the continuing intensification of climate concerns, we believe that continued work in the area of carbon capture and storage is essential.

70. The CIAB can provide valuable insight into what has been accomplished so far in advancing the suite of CCS-related technologies towards commercialization and, far more importantly, what needs to happen in the future to ensure that CCS is available at the earliest practicable date. The results of this work could form the basis of a discussion between the IEA and a small number of Members representing the CIAB towards the end of 2008. Key themes include:

    - **Creating a robust legal framework** - The greatest challenge for the rapid deployment of CCS technologies is storage; and it is essential that governments move forward as quickly as possible to put the necessary regulatory regimes in place while at the same time addressing long-term liability concerns.
    - **Learning by doing** - Lengthy delays could result from a desire to ensure 100% permanent storage of CO_2 over geologic time. Where there is a reasonable level of confidence, society needs to move forward as quickly as practicable with the injection of large volumes of CO_2 into geological strata; achieving immediate climate-related benefits and greatly accelerating advances in critical technologies.
    - **Communicating a realistic timeline for CCS** – Realistic expectations for CCS need to be communicated, while at the same time reinforcing the message that the CCS timeline can be accelerated in a meaningful way if governments and policy makers provide strong support.
    - **Moving forward with what is achievable now** - We can and should begin the process of replacing existing coal-fired power stations with more efficient generating plants immediately. By doing so, society can substantially reduce CO_2 emissions per unit of energy produced, while at the same time creating a more realistic platform for CCS retrofitting when commercially available.
    - **Persuading government leaders and the public that CCS is essential** - investing in advanced coal-fired technologies that can be shared with the developing world and recognising that CCS is the "one indispensable technology" in addressing climate concerns.

3 OVERVIEW OF WORLD COAL MARKET DEVELOPMENTS

71. According to BP statistics, world consumption of **primary energy** grew by 2.4% in 2006 (2.9% in 2005). Within this total, the Asia Pacific region increased its energy consumption by 4.9% (6.1% in 2005). China grew by 8.4% and India by 5.4%, with both countries showing slightly higher growth in coal use. Primary energy consumption in the USA declined by 1%. Coal use again grew more strongly (4.5%) than total energy use (2.4%). Coal accounts for more than 70% of China's energy consumption.

3.1 Company Developments

United States of America

72. The major coal company sales, acquisitions and other industry activities in 2006 included:

- Alpha Natural Resources' acquisition of assets from Progress Fuels Corporation in May 2006;
- Arch Coal Company completion of the sale of its Hobet Mining, Apogee Coal Company, and Catenary Coal Company subsidiaries to Magnum Coal Company in January and the July acquisition of a one-third interest in Knight Hawk Holdings, an Illinois Basin Coal producer;
- Foundation Coal Holdings' acquisition of reserves and equipment adjacent to its operating affiliate Pioneer Coal Corporation Pax mine;
- General Dynamics offer for sale of its Freeman Energy Corporation in late 2006;
- the sale of Massey Energy Company's Falcon reserves to a private company in October;
- the offer for sale by Monterey Coal Company in the summer of 2006 of its Monterey No. 1 underground mine (the sale to the Carlin Acquisition group is pending);
- Murray Energy Company's acquisition of Andalex Resources properties in August;
- Peabody Energy Corporation's completion of its purchase of Excell Coal Ltd, Australia; and
- TransAlta Corporation's closure of its Centralia mine, the only operating mine in the state of Washington.

Australia

73. In September 2007 Xstrata Coal announced its purchase from Centennial Coal of the Anvil Hill Project for A$425M. The Anvil Hill coal project is located in the Upper Hunter Valley, New South Wales, with the mine plan envisaging production of up to 10.5Mt of both domestic and export grade thermal coal annually over a 20 year period.

South America

74. Glencore is reported to have completed the purchase of Carboandes in June 2007, giving it full control of the high quality La Jagua coal deposit with plans to increase total production of the La Jagua and Calenturitas mines by over 10 million tonnes towards 17

million tonnes/year by 2010.

75. Xstrata Coal purchased a one-third share of the Cerrejon coal mine in Colombia in 2006. Other shareholders are BHP Billiton and Anglo American. Cerrejon is the world's largest open cut coal mine supplying thermal coal to USA and European markets.

South Africa

76. Key developments in 2006/7 were:

- ***Xstrata and Total Coal SA settle deal*** - Xstrata bought Total Coal South Africa's (TCSA) 50 percent stake in the two companies' former joint venture at Arthur Taylor Colliery (ATC) and the associated Arthur Taylor Colliery Opencast Mine (ATCOM).

- ***Spanish utility buys Kangra*** - Spanish utility, Union Fenosa, has purchased 70% of South Africa's Kangra Coal from Graham Beck (45%) and Shanduka (25%). Both retain a 15% share in Kangra. Kangra operates Savmore Colliery in Mpumalanga, which produces 3Mt/a of saleable steam coal. Kangra is a shareholder of RBCT.

- ***Exxaro is born*** - Kumba Resources listed on the Johannesburg Stock Exchange (JSE) as Exxaro Resources on 27 November 2006. Exxaro comprises Kumba, Anglo American, the Industrial Development Corporation and Eyesizwe Mining Limited. Exxaro, South Africa's largest black-controlled company, is currently the fourth largest coal producer and is well positioned to grow. Its long-term strategy hinges on the advantage enjoyed in South Africa's Waterberg coalfield, where it has the only existing operating mine and high-quality reserves, and to satisfy growing domestic demand for power station coal, reductants and metallurgical coal. Exxaro Resources has suspended underground mining at New Clydesdale, but opencast and plant operations continue.

- ***Anglo's new South African BEE deal*** - Anglo Coal has announced the creation of Anglo Inyosi Coal, a BEE company to house current and future domestic and export-focused coal operations within South Africa. The company is valued at R7 Billion (US$975M). Anglo Coal will hold a 73% share. Anglo Inyosi Coal is to incorporate Kriel colliery, and the Elders, Zondagsfontein, New Largo and Heidelberg projects. The transaction has also been designed to secure Anglo Coal's future growth and to deliver on Anglo American's continuing commitment to South Africa.

- ***BHP Billiton completes Koornfontein sale*** - BHP Billiton finalised the sale of Koornfontein Mine, together with 1.5Mt per annum of RBCT entitlement to an entity controlled by a BEE consortium led by Siyanda Resources and AKA Resources Holdings. They paid R430M (US$60M).

Japan

77. In August 2006, Sojitz Corporation announced the increase of its interest in the Minerva Mine in Queensland, Australia from 30% to 45%. The mine started production of thermal and semi-soft coking coals in November 2005 at a scale of 2.5 million tonnes per annum.

78. Sumitomo Corporation announced in December 2006 that it had acquired a 1% share of each of the two Vietnamese coal companies, Cao Son Coal Company and Deo Nai Coal Company, each a subsidiary of Vietnam National Coal-Mineral Group (Vinacomin) through the tender by Vinacomin. The production capacities of the two anthracite mines

are 3 million and 2.5 million tonnes per annum, respectively.

79. In December 2006, Marubeni Corporation announced that it had acquired a 3.3% share of Resource Pacific Ltd., which owns and operates the Newpac No.1 Colliery in the Hunter Valley, New South Wales, Australia. The Newpac mine is being expanded to produce 4 million tonnes per annum of semi-soft coking coal from 2007. In May 2007, Marubeni purchased a further 10% of Resource Pacific shares and is now a 13.3% shareholder of the company.

80. In January 2007, Mitsubishi Corporation, J-POWER and Rio Tinto announced that its joint venture had approved the development of the Clermont Mine in Queensland, Australia. The Clermont Mine will start production of thermal coal in 2010 at a scale of 12 million tonnes per annum.

81. In February 2007, JFE Shoji Trade Corporation announced its acquisition of a 5% interest in the Sonoma Coal Project, Queensland, Australia from Q Coal Pty. Ltd. The Sonoma opencast mine will start production in Q4 2007 at a scale of 3.4 million tonnes per annum of coking and thermal coals.

82. Mitsui & Co., Ltd. announced in February 2007 the joint purchase with Anglo Coal Australia of the Collingwood and Ownaview exploration deposits in the Surat Basin, Queensland, Australia from Sennen Resources Ltd. and DJB Coal Pty. Ltd. Mitsui will hold a 49% interest in the deposits and Anglo Coal Australia 51%. Both deposits have thermal coal resources.

83. In March 2007, Northern Energy Corporation Ltd. announced that Sojitz will earn a 30% interest in the Yamala Coal Project, Queensland, Australia through a farm-in arrangement of the three-stage exploration and evaluation program, with the option for Sojitz to acquire a further 19% interest in the Yamala Project.

84. In July 2007, Sojitz announced its acquisition of a 10% interest in the Moolarben Coal Project, New South Wales, Australia from Felix Resources Ltd. The Moolarben opencast mine will start production of thermal coal in January 2009 and it is planned to expand production to 12 million tonnes per annum by opencast and underground mining.

Steel Industry

85. Steel industry consolidation has continued in 2006/07. The merger between Arcelor and Mittal in 2006 created the world's largest steel company with an annual steel production capacity of 120 million tonnes, i.e.10% of global steel production. The merger has been the catalyst for wider consolidation of the steel industry and was followed by a series of mergers & acquisitions in 2007:

    - at the beginning of 2007, Indian Tata Steel purchased the UK-Dutch group Corus for €10.6 billion
    - in April 2007, Indian steel maker Essar bought Canadian Agloma for US$1.7 billion and Arcelor-Mittal bought Mexican steel producer Sicartsa for US$1.44 billion;
    - in May 2007, Swedish SSAB purchased Canadian steelmaker Ipsco for US$7.7 billion;
    - in June 07, Austrian Voestalpine and Böhler-Uddeholm merged creating a new global player in the steel industry;
    - in July 2007, Brazilian Gerdau bought American Chaparral for US$4 billion;
    - in August 2007, US Steel announced the acquisition of Canadian Stelco for US$1.1 billion.

The world's largest iron ore company Companhia Vale do Rio Doce, CVRD, has also reinforced its position in the steel industry in Brazil and the coal industry in Mozambique,

86. This concentration trend is explained by a desire for critical mass in competitive markets and is linked to the high profitability of the sector and the rise in stock values of all steel companies to unprecedented levels. Despite this consolidation, the steel industry is still fragmented: the largest player represents only 10% of worldwide production and there are still hundreds of independent mills around the world.

3.2 Coal Consumption

3.2.1 Total Hard Coal Consumption

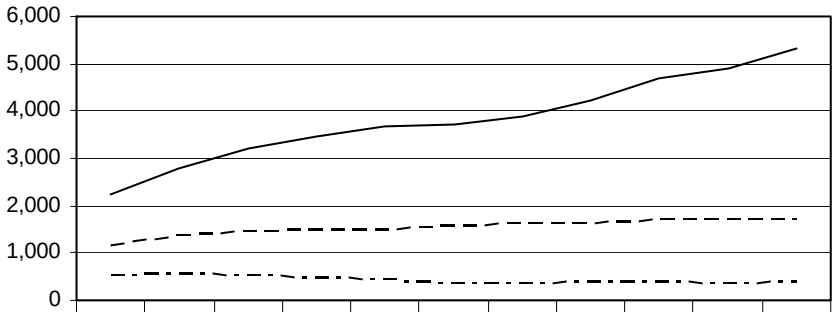
87. During 2006, IEA provisional data show that **World** consumption of hard coal grew by 8.6%. The IEA's previous estimate of over 7% growth in 2005 has now been revised to 5.2%, so it is possible the 2006 estimate may also be revised down. However, it still represents a strong indication of continued substantial growth in hard coal consumption every year in the recent past. ***World hard coal consumption has now increased by a total of about 40% in the six years since 2000.***

88. This growth is not abating; and each year it reinforces further the need for urgent action to mitigate the increase in CO_2 emissions that otherwise accompanies increased coal use.

Chart 1 - Hard Coal Consumption

(million tonnes)

Source: IEA Statistics



	1973	1980	1985	1990	1995	2000	2002	2003	2004	2005	2006e
EU (19)	497	543	527	480	408	354	345	361	362	348	363
OECD	1,143	1,334	1,438	1,463	1,458	1,576	1,592	1,623	1,678	1,689	1,693
World	2,247	2,777	3,197	3,473	3,656	3,723	3,888	4,236	4,670	4,915	5,339

89. Almost inevitably, **China** was again largely responsible for the increase in world hard coal demand during 2006, accounting for almost 85% of the 424 million tonnes growth. The Chinese economy is still very strong and China is now a net importer of coal. The government has lowered the export duty rebate on coal and the Chinese currency has appreciated, so users are looking for cheaper imports rather than indigenous supplies.

90. For the **USA**, the IEA estimates a 1.2% reduction in hard coal demand and a 0.9% reduction in brown coal demand during 2006. Brown coal accounts for only about 7% of total coal demand. According to the US Energy Information Administration, ***total*** (i.e. hard coal and brown coal) coal demand for use in the United States of America was 1,112 million short tons in 2006 (1,009 million tonnes). Exports were 49.6 million short tonnes (45.0 million tonnes), bringing total demand for US coals to 1,162 million short tons (1,057 million tonnes). The EIA short term forecast published in December 2007 estimated that in 2007 the US will use 1,137 million short tons (1,032 million tonnes) domestically and will export approximately 57.1 million short tons (51.8 million tonnes) of which 38.6 million short tons (35 million tonnes) will go to overseas destinations and 18.5 million short tons (16.8 million tonnes) to Canada. Included in the total figures for 2006 is production of 79.8 million short tons (72.4 million tonnes) of brown coal, all of which is used for power generation, and this is expected to remain approximately the same in 2007.

91. In **Canada, *total coal consumption*** in 2006 is estimated at 57 million tonnes, of which over 90% was used at its 21 coal-fired power generation plants. Canada's steel industry consumed about 4 million tonnes of coking coal. Of the total, 36 million tonnes was sourced domestically and 21 million tonnes was imported. Alberta consumed about 26 million tonnes of coal in 2006, Ontario 16 million tonnes, Saskatchewan 11 million tonnes of lignite for coal-fired electricity generation, Nova Scotia 2.4 million tonnes and New Brunswick 1 million tonnes of coal, both for coal-fired electricity generation. Quebec's annual coal consumption has remained at about 800,000 tonnes for the past 10 years, all for industrial purposes. Ontario has postponed the closure of all coal-fired generation plants due to electricity demand increases.

92. In **Japan**, total metallurgical coal, thermal coal and anthracite imports in FY2006 were 179.3 million tonnes, a slight increase of about 1.5 million tonnes on the previous year. The largest share of imports was from Australia (59%), while Indonesia accounted for 18% and China 11%.

93. In **Australia**, total coal consumption in 2006 is estimated at 136 million tonnes, of which nearly 70 million tonnes was brown coal consumed in Western Australia and Victoria. Over 92% of the total was used at Australia's coal-fired power generation plants. Australia's steel industry consumed about 5.8 million tonnes of coking coal. NSW consumed about 34 million tonnes of coal in 2006, Queensland 26 million tonnes, South Australia 3.6 million tonnes, Western Australia 6.3 million tonnes, Tasmania 0.4 million tonnes and Victoria 66 million tonnes of lignite for coal-fired electricity generation of coal.

94. In **France**, hard coal consumption declined by 3.4% to 20.5 million tonnes in 2006, due largely to a 17% fall in coal use by electricity generators to 8.7 million tonnes, 4.5% of the total energy mix and the lowest level since 2001. Power production from coal fell by more that 4TWh as a result of mild weather and increased hydro-electric production.

95. The winter of 2006/07 was again very mild in France and coal consumption fell to 5.3 Mt in the first three months of 2007, a 20% fall on the Q1 2006 figure of 6.5 Mt. Coal consumption in power stations dropped by 34% to only 2.2 Mt (3.4 in 2006), while the iron and steel industry maintained the high level of consumption observed in Q1 2006.

96. **Turkey**'s hard coal consumption in 2006 was 19.5 million tonnes. Of this, 16.3 million tonnes was imported and the major supplying countries were Russia and Ukraine, China, South Africa, Canada, USA and Australia. Hard coal was consumed by four sectors: electricity generation (27%), industry (45%) coke ovens (23%) and households (5%).

97. Since 1990, major hard coal consumption increases have occurred in the industrial sector (1.5 to 8.6 million tonnes) and in the electricity sector (0.5 to 5.3 million tonnes).

The main reason for the electricity sector increase has been the 1320MW Isken-Sugözü power station which started operating in 2004 and uses imported coal.

3.2.2 Steam Coal Consumption

98. **World** consumption of steam coal increased by over 8% (350 million tonnes) in 2006 according to IEA provisional estimates, a further significant increase on the 5.1% increase seen in 2005[4]. World steam coal consumption has increased by 40% since the year 2000. Recent growth has been driven by continued steam coal use in developed economies as well as very rapid growth in developing economies including China (17%, building on 2005 growth of 9%) and India (8%, building on 2005 growth of 5%). Growth in non-OECD countries in 2006 was over 13%.

Table 1 - Steam Coal Consumption (million tonnes)

	2004 m.tonnes	2005 m.tonnes	change	2006e m.tonnes	change
EU(19)	281	272	-3.2%	286	5.1%
OECD	1478	1499	1.4%	1485	-0.9%
World	4073	4280	5.1%	4633	8.3%

99. Steam coal demand in **South Africa** increased by 2% to 177 million tonnes in 2006. Local market consumption is 72 percent of the total output (of which bituminous coal is 99.4% and anthracite is 0.6%). The rest is exported mainly through the Richards Bay Coal Terminal (97%), Durban (2.0%) and Maputo (1.4%).

100. In FY2006 Japanese Power Utilities (JPUs) consumed 93.6 million tonnes of steam coal, a 1.3 million tonne decrease from the previous year due to mild weather during the period and increased regular safety inspections of generation units. Australia remained as the largest steam coal supplier for JPUs, with around a 60% share. China continued to reduce their share from 15% to 14% because of its robust domestic demand and policy change to encourage imports. Russia also reduced its share from 7% to 6% due to its increased exports to the EU, which substituted for supplies from South Africa and Columbia to the EU. As a result, Australia and Canada each took an additional 1% of supplies to JPUs.

101. In the **United States of America**, EIA preliminary estimates show that the electric power sector used 1,027 million short tons of coal (932 million tonnes) in 2006 for electricity generation. Just over 50.4% of all electricity produced during the year was coal fired. Total electricity generation increased in 2006 by 0.2%. Generation from coal declined by 1.1%. Due in part to low coal inventories in the first part of the year which forced an increase in natural gas use, in part to the 8 GW (approx.) of new natural gas capacity that came on line in 2006 and in part to slightly lower natural gas prices, generation from natural gas increased by 7.5% in 2006, building on a similar increase in 2005. Nuclear generation increased by 0.7% and generation from hydro power was up by 7.2% in 2006, due to increased precipitation in the principal hydro regions in the western United States.

102. Coal use by electricity generators in the United States of America will increase in 2007. The EIA short term forecast issued in December showed an expected 1,049 million short tons (947 million tonnes) will be burned to generate electricity. Coal's market share in electricity generation is expected to be flat at 50% in 2007.

[4] This may be an overestimate of growth – see discussion in 3.2.1 Hard Coal Consumption.

103. According to preliminary EIA estimates, the demand for electricity in January-September 2007 increased by 2.3%. Sharp increases in generation in cold winter months and electricity use for an early May air conditioning season, when weather was warmer than normal, accounted for most of the increase. Coal fired power increased by an estimated 2.0%. Generation from natural gas remained strong, primarily replacing hydro generation which was down due to drought conditions in many areas of the country. Data available from the Edison Electric Institute for 2007 suggests that growth in electricity demand was stronger in the last quarter of the year, in part due to a cold December. The EIA expects that generation growth in 2007 will be approximately 2.2%, somewhat lower than the EEI's data would indicate.

104. The utilities have more than replenished coal inventories and some utilities consider inventories to be at higher than desired levels. At the end of September 2007, inventories at coal fuelled plants were 13.4% higher than a year earlier but only 2.1% higher than at the end of 2006. Stock build at utilities over the first nine months of 2007 was just over 3 million short tons (2.7 million tonnes).

105. Industrial, commercial and retail use of coal for generation of steam and for other purposes totalled 62.7 million short tons in 2006 (56.9 million tonnes), slightly lower than in 2005. The EIA expects industrial use of coal to increase slightly in 2007.

106. **Australian** thermal coal consumption has remained in the range 130 - 132 million tonnes since 2004. Over 96% of thermal coal is used in electricity generation with the balance used for cement manufacture and other small industrial applications. Over 76% of Australia's electricity is produced from coal fired plant (56% black coal fired and 20% brown coal fired) with the balance distributed between gas (16%), hydroelectricity (7%) and other (1%)

107. In **France**, the 1.7 million tonne (17%) fall in steam coal demand for power generation in 2006 was mitigated to a large extent by a build-up in coal stocks. After three consecutive years of stock withdrawals (-0.7 million tonnes in 2005) coal stocks increased by 1.5 million tonnes in 2006 to 6.4 million tonnes. This was mainly steam coal for power stations and at the current rate of consumption power stations have more than six and a half months of stocks.

108. In **Spain**, coal supplied to the electricity sector in 2006 by the Spanish mines was 11.34 million tonnes, very similar to the previous year. In addition, the electricity sector consumed 6.9 million tonnes of lignite and 18.6 million tonnes of imported coal in 2006.

109. In 2006, the coal-fired plants accounted for 23% of total conventional electricity production, while natural gas combined cycle plants produced 30%. This is the first time that natural gas has contributed more than coal to electricity generation.

110. Total **United Kingdom** power supplied in 2006 was 405TWh (gross[5]), approximately the same level as in 2005. Within this total, 144TWh was generated from coal, 14TWh higher than in 2005, and 57 million tonnes of coal was used for electricity generation. This increase was balanced by lower gas generation (11TWh below 2005 levels at 139TWh) and was due to high oil and gas prices, together with some UK gas market disruption associated with the Rough gas storage facility. Coal stocks at power stations grew by nearly 2 million tonnes, to 14.5 million tonnes during 2006.

111. These trends were dramatically reversed in the first half of 2007, with electricity supplied from coal down 20% and electricity supplied from gas up 35% on first half 2006 figures.

[5] i.e. including power subsequently used within the power industry itself (aux power, T&D losses…)

112. The current low cost of CO_2 emissions permits has had limited impact on the running regime for gas and coal generation in the UK. Phase 2 of the EU Emissions Trading Scheme has seen a tightening of National Allocation Plan limits across the EU, leading to higher market prices for CO_2. This may deteriorate coal's position, although the seasonality of gas prices will remain an influence on the relative cost of coal and gas generation.

3.2.3 Coking Coal Consumption

113. Table 2 shows IEA statistics for coking coal demand in the major world regions.

Table 2 - Coking Coal Consumption (million tonnes)

	2004 m.tonnes	2005 m.tonnes	change	2006e m.tonnes	change
EU(19)	81	76	-6.2%	78	1.9%
OECD	200	190	-5.1%	208	9.7%
World	597	635	6.4%	706	11.2%

114. **World** demand for coking coal increased by approximately 11% in 2006, nearly twice the increase in the previous year. Over 60% of the world growth was accounted for by China, while OECD countries also showed a significant increase approaching 10%. Chinese crude steel production grew by 21% to 423 million tonnes in 2006 and China now accounts for 46% of world coking coal demand. As the following table shows, strong world growth in steel production continued through 2007, with growth in China moderating only slightly (nearly 16% in Jan-Nov 2007) and these trends will presumably be reflected in the demand for coking coal.

Table 3 - Primary Iron & Steel Production (11 months to November)

	Blast Furnace Iron (m. tonnes)			Direct Reduced Iron (m. tonnes)			Crude Steel (m. tonnes)		
	2006	2007	change	2006	2007	change	2006	2007	change
EU (19) total	101	102	1.0%				182	184	1.6%
OECD	261	265	1.5%				484	493	1.9%
World	794	861	8.4%	3	3	2.8%	1119	1205	7.7%

Source: International Iron & Steel Institute (IISI)

115. In **Japan**, crude steel production was 116 million tonnes in 2006, a 3.3% increase on 2005. This production increase is continuing, with the eleven months to November 2007 being 3.4% higher than in January-November 2006.

116. According to Japanese Trade Statistics, metallurgical coal (coking coal and PCI coal) imports in CY2006 were 80 million tonnes, a 3.8% increase on CY2005 and in line with the increase in crude steel production[6]. In CY2007, metallurgical coal demand is expected to increase marginally as steel production increases.

117. Coking coal use in the **United States of America** declined again in 2006 to 23.0 million short tons (metric: 20.9 million tonnes) despite an increase in steel production to 108.6 million short tons (metric: 98.5 million tonnes), 3.9% higher than in 2005. Nearly 57% of steel was produced in electric furnaces, where most of the increase occurred. The steel industry operated at an average 87.9% capacity throughout 2006. Apparent consumption

[6] IEA figures show Japanese coking coal consumption increasing by 30%, while steam coal consumption decreases by 11%. This is due to anomalies in the classification of coal in initial estimates for 2006.

of steel increased by 19% in 2006 and imports of steel, led by an increase in imports from China, reached an all time high. Imports in January-November 2007 were lower than last year but still well above 2005 levels. Although lower than in 2006, imports from China continue to be strong and China remains the number one offshore supplier of finished steel to the United States of America. Steel production in January-15th December was approximately 2.3% below 2006 levels. Steel production in 2007 is expected to be approximately 106 million short tons (96 million tonnes).

118. Through the first five months of 2007 estimated consumption of coking coal was 2.2% above 2006 levels. The EIA has forecast that coking coal use will increase by 600,000 short tons in 2007.

119. **Australian** steel production totalled 7.8Mt in 2006, primarily achieved via the blast furnace method which utilised 5.8Mt of metallurgical coal in 2006. Metallurgical coal demand in Australia is forecast to remain stable at current levels.

3.2.4 Total Brown Coal Consumption

Table 4 - Brown Coal Consumption (million tonnes)

	2004 m.tonnes	2005 m.tonnes	change	2006e m.tonnes	change
EU(19)	391	384	-1.7%	375	-2.3%
OECD Total	622	634	1.9%	629	-0.7%
World	908	920	1.3%	921	0.2%

120. World growth in demand for brown coal increased marginally in 2006 to 921 million tonnes, with significant increases in consumption in Turkey (+4.2 million tonnes), Russia (+2.6 million tonnes) and Romania (+2.2 million tonnes).

121. In **Germany,** brown coal use declined by 1.5 million tonnes to 176 million tonnes in 2006, the lowest level since the year 2000, but it remains by far the largest consumer of brown coal, with 19% of world demand. Lignite is mainly used for power generation, followed by utilisation in processing plants. Between 1990 and 1999, demand more than halved to 163 million tonnes, but has been at a level of around 180 million tonnes for each of the past six years. Germany has a lignite-based power plant capacity of some 20GW, one third of which went on stream in the second half of the last decade or in the first years of the current decade.

122. In **Turkey**, lignite is consumed mainly in thermal power stations, but is also used by households and industry. Lignite use increased by almost 35% between 1990 (45 million tonnes) and 2001 (61 million tonnes), but declined sharply to 51 million tonnes in 2002 as a consequence of natural gas volume commitments in supply agreements. The share of lignite in electricity generation reached its highest value of 47% in 1986, but had declined to just below 20% by 2006 as a consequence of the increased use of natural gas in electricity generation.

123. Lignite use increased sharply in 2005 (by over 20% to 56 million tonnes) and again in 2006 (by about 8% to 61 million tones). The main reasons for this increase were:

- two new lignite based power stations, namely Can 18 Mart and Elbistan B, started trial operations in 2004 and 2005 respectively and their lignite consumption increased further in 2006; and

- decreased operation at hydro-electric power stations resulting from water shortages.

In 2006, 83% of lignite was consumed in power stations, 10% by households and 7% by industry.

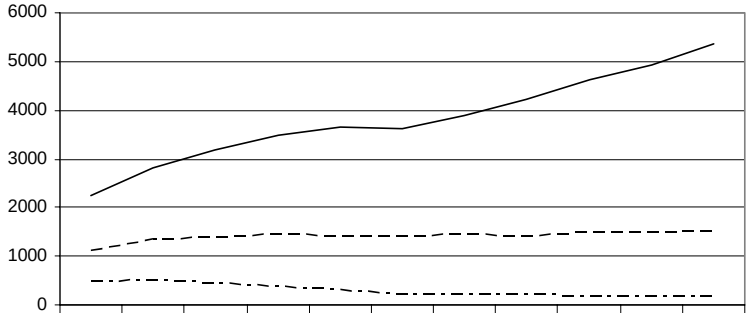
3.3 Coal Supply

3.3.1 Hard Coal

Chart 2 - Hard Coal Production

(million tonnes)

Source: IEA Statistics



	1973	1980	1985	1990	1995	2000	2002	2003	2004	2005	2006e
EU(19)	471	488	443	368	289	202	189	186	181	169	159
OECD	1117	1336	1381	1456	1405	1395	1433	1404	1462	1487	1510
World	2235	2802	3193	3498	3657	3623	3888	4220	4634	4934	5370

124. World production has continued to grow strongly over the last six years, with the 2006 level almost 50% higher than in 2000, a rate of growth averaging nearly 7% a year. Over 70% of this 1.75 billion tonne growth was in China.

125. According to IEA estimates, **China** produced 2,481 million tonnes of hard coal in 2006, accounting for 46% of the world total. Steam coal exports were 59 million tonnes in 2005, a 7 million tonne reduction on 2005, while imports grew by 10 million tonnes.

126. Small coal mines will continue to be closed and the government is encouraging consolidation of larger coal producers. China plans to close 4,000 dangerous and inefficient mines with a combined capacity of 100 million tonnes/year during 2007. Li Yizhong, head of the State Administration of Work Safety announced in March 2007 that 2,000 mines with a combined capacity of 30 million tonnes/year had already been closed. Over the three years to the end of 2007, China will have closed a total of 10,000 small mines.

127. **South African** hard coal production remained at 245 million tonnes (IEA estimate 244 million tonnes), with estimates of 177 million tonnes sold domestically to Eskom (109 million tonnes), Sasol (44 million tonnes) and others (24 million tonnes) and the major portion of the balance exported.

128. There are 27.8 billion tonnes of mineable reserves in-situ, although infrastructure weaknesses, especially rail and port, and the distance of reserves from ports constrain competitiveness in the export markets. However, increased domestic power station and export demand will once more create the opportunity for old and new coal mines to increase production.

129. There is a continuous search by economic empowerment entrepreneurs for viable blocks of reserves to establish new mines, assisted by the Mineral and Petroleum Resources Development Act and the Mining Charter. A number of large BEE mining companies, previously only involved in gold, diamonds and platinum mining, are exploring brown-field and green-field opportunities in coal. Some of these companies have made agreements with existing independents and are waiting for opportunities to grow.

130. In 2006, almost 90% of the saleable coal production was supplied by mines controlled by the five largest mining groups (Anglo Coal, BHP Billiton, Sasol, Exxaro and Xstrata). Coal mines discarded 70 Mt of waste or discard coal. With the establishment of bigger BEE mining companies such as Exxaro, Shanduka and African Rainbow Minerals (ARM), a greater shift to BEE ownership is expected.

131. 2006 saw **Indonesian** hard coal production grow by 11% to 169 million tonnes. Exports continue to grow at a rapid rate, with the 2006 level of 129 million tonnes showing an 18% increase on the previous year.

132. **Russia**n hard coal production grew by 30 million tonnes (15%) to 233 million tonnes in 2006, building on the previous year's 15 million tonne growth. Russian hard coal exports increased by 17% to 92 million tonnes, with the increase more than accounted for by steam coal. Coking coal exports declined by 2 million tonnes.

133. In the **United States of America**, **total coal production** attained a new record of 1,163 million short tons (1,056 million tonnes) in 2006, a 2.8% increase on 2005. Hard coal (bituminous and sub-bituminous) production totalled 1,083 million short tons (982.5 million tonnes) and brown coal (lignite) production was 79.8 million short tons (72.4 million tonnes). Production increased in most major coal producing states, with demand driven in large part by electricity utility efforts to rebuild inventories. Rail transportation, a problem that contributed to inventory depletion in 2005, was considerably improved in 2006. Although some track upgrading continues in 2007, production this year has not, in the main, been affected by transportation issues. Production has however been affected by slower demand for inventory build and for consumption at electric power plants. Preliminary EIA data show that at the end of 2007 production was down by 3.5% in the Appalachian states, by 0.2% in the western region and by 1.0% in the interior region. In total, production was down by 1.4% when compared to the record levels of 2006, end the year at approximately 1,146 million short tons (1,040 million tonnes).

134. In 2006, production of coal exceeded domestic demand and exports. Excess production plus yet another record year for imports - the U.S. imported 36.2 million short tons (metric: 32.8 million tonnes) - contributed to a 40 million short ton addition (metric: 36.2 million tonnes) to power plant inventories. At the close of 2006, power plant inventories were at their highest level since 2001.

135. Overall, imports in 2007 are forecast to be approximately equal to the record set in 2006. In the ten months to October 2007, imports were essentially equal to those in the first ten months of 2006. Imports from Colombia and Indonesia continue to increase, but imports from both Venezuela and Canada have declined. Several east coast ports are in the process of increasing their capacity to receive imported coal, indicating that over time imports will continue on an upward path.

136. In **Canada**, two new mines came on stream in British Columbia (B.C.) in 2006. The Trend Mine of Northern Energy and Mining Inc. (NEMI) started coal production in January 2006. The company has a mining permit to produce 2 million tonnes/year of metallurgical coal for export. The Wolverine Mine of Western Canadian Coal Corp. (WCC) began coal production in July 2006. The mine has a mining permit to produce 3 million tonnes/year of coking and PCI coal for export.

137. Canada's ***total coal production*** in 2006 was about 66 million tonnes, a slight reduction on 2005. Alberta produced 32 million tonnes, British Columbia 23.4 million tonnes and Saskatchewan 10.4 million tonnes. Twenty-five coal mines were in operation at the end of 2006, with most large-scale mines located in western Canada. Five companies produce coking and PCI coal for exports, two companies produce bituminous steam coal for exports and domestic use, and three companies produce sub-bituminous, lignite and bituminous coal exclusively for domestic coal-fired power generation.

138. Of the total coal production 26 million tonnes was coking coal, solely for export, and 40 million tonnes was steam coal, mostly for domestic coal-fired power generation use. A small portion of steam coal was also exported. The majority of the steam coal was sub-bituminous coal and lignite; and about 10% was a bituminous grade steam coal.

139. **Australian** production was 308 million tonnes in 2006, slightly higher than in 2005, of which 237.7 million tonnes or 77% was for export. 178 million tonnes (58%) of the production was thermal coal. More recently, the Australian Bureau of Agricultural and Resources Economics has estimated7 that Australian coal production increased by 3% in 2006-07 to 389 Mt. Of this, more than 80% was black coal (317 Mt) produced for both export and domestic consumption in the states of Queensland, New South Wales and Western Australia (domestic only) and the balance (72 Mt) was brown coal produced in Victoria and South Australia exclusively for electricity generation.

140. In **Germany**, according to IEA estimates, hard coal production declined by over 4 million tonnes (15%) to 23.7 million tonnes in 2006. Production in 2007 is expected to be similar. It was agreed at the beginning of 2007 that hard coal mining activity in Germany will be phased out by 2018, with a possible revision to this target in 2012. The Walsum mine (2.1 million tonnes production in 2006) is planned to be shut down by mid-2008 and the Lippe mine (1.5 million tonnes production in 2006) in 2009.

141. According to the Verein der Kohlenimporteure, coal imported into Germany totalled 46.5 million tonnes in 2006, an increase of 6.5 million tonnes over 2005. Of this, 29% was imported via German ports, 26% via rail and 45% via barges from the ARA ports. Estimated figures for the first half of 2007 are 21 million tonnes of steam coal and 6 million tonnes of coking coal.

142. In **Spain**, annual hard coal production was 11.7 million tonnes in 2006. There were 38 coal companies in Spain at the end of 2006 with a labour force of around 8,500 workers. Imports of steam coal have been about 20 million tonnes, plus around 4 million tonnes of metallurgical coal).

143. In the **United Kingdom**, indigenous hard coal production continued to decline during 2006 to 18.5 million tonnes, nearly 10% below the 2005 level (IEA provisional estimate was 17.8 million tonnes, a 13% reduction). Deep-mined production fell only marginally, while opencast production fell by 17%. Coal imports rose by 15% to 50.5 million tonnes. The production trends accelerated in the first half of 2007, with total production 20% lower and deep-mined production 32% lower than in the first half of 2006. Imports,

[7] Australian Commodities, vol. 14, no.2, June Quarter 2007.

however, were also 17% lower.

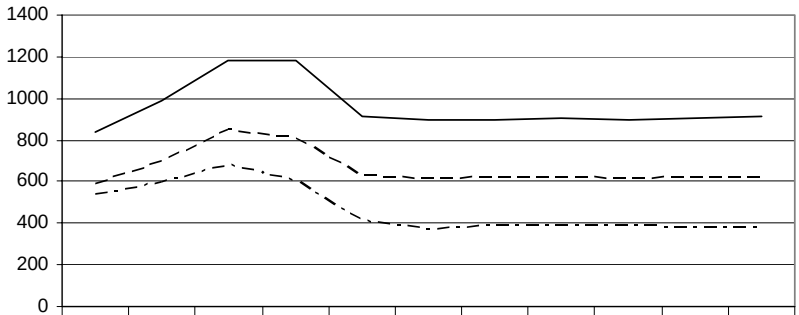
144. **Turkey** has approximately 1.3 billion tonnes of hard coal reserves (41% proved), managed by Turkish Hard Coal Enterprises (TTK). Existing production capacity is 5 million tonnes/year. Actual production in 2006 was 3.3 million tonnes, 50% higher than in 2005.

3.3.2 Brown Coal

Chart 3 - Brown Coal Production

(million tonnes)

Source: IEA Statistics



	1973	1980	1985	1990	1995	2000	2002	2003	2004	2005	2006e
EU(19)	537	592	682	605	407	373	390	387	388	381	374
OECD	590	699	849	807	626	614	622	616	613	621	620
World	836	986	1182	1178	914	894	894	903	894	906	914

145. World production of brown coal has remained broadly stable at about 900 million tonnes a year over the last ten years, with little variation in the regions from which it is produced.

146. **Germany** remains by far the world's largest producer of brown coal, accounting for almost 20% of world production. Lignite production in Germany was 176.3 million tonnes in 2006 (54.2 MTCE) and is expected be about 180 million tonnes (55 MTCE) in 2007.

147. **Spain**'s two lignite mines will be closed by the end of 2007 because of their high sulphur content.

148. **Turkey** produces both hard coal and lignite, but lignite is by far the more important of these, with production spread through almost all regions of the country. The key lignite producers are state owned; namely Turkish Coal Enterprises (TKI) and Electricity Generation A.S. (EUAS). The private sector produces about 10% of total annual production and has rights to some TKI and EUAS production through mechanisms including leasing, transfer of operating rights, and contractor mining methods.

149. In 1989 a process began of transferring some key lignite mines from TKI, previously the monopoly supplier of lignite to power plants, to the power generating company EUAS. Three large mines, Sivas-Kangal, Afsin-Elbistan and Cayirhan, were transferred to EUAS in 1989, 1995 and 2000 respectively, giving it control over the largest share of lignite reserves (4.7 billion tonnes). Subsequently, EUAS transferred to the private sector two of its lignite mines (Sivas-Kangal and Cayirhan). Reserves at private mines are now 2 billion tonnes and TKI, still regarded as the leading lignite producer, has reserves of

about 2.5 billion tonnes.

150. Production capacity for state-owned producers is 73.5 million tonnes. Actual production reached its highest value of 65 million tonnes in 1999, but decreased steadily between the years 2002 and 2004 to reach 43.7 million tonnes as power station demand for the fuel declined. However, production subsequently increased to 55.3 million tonnes in 2005 and 61 million tonnes in 2006.

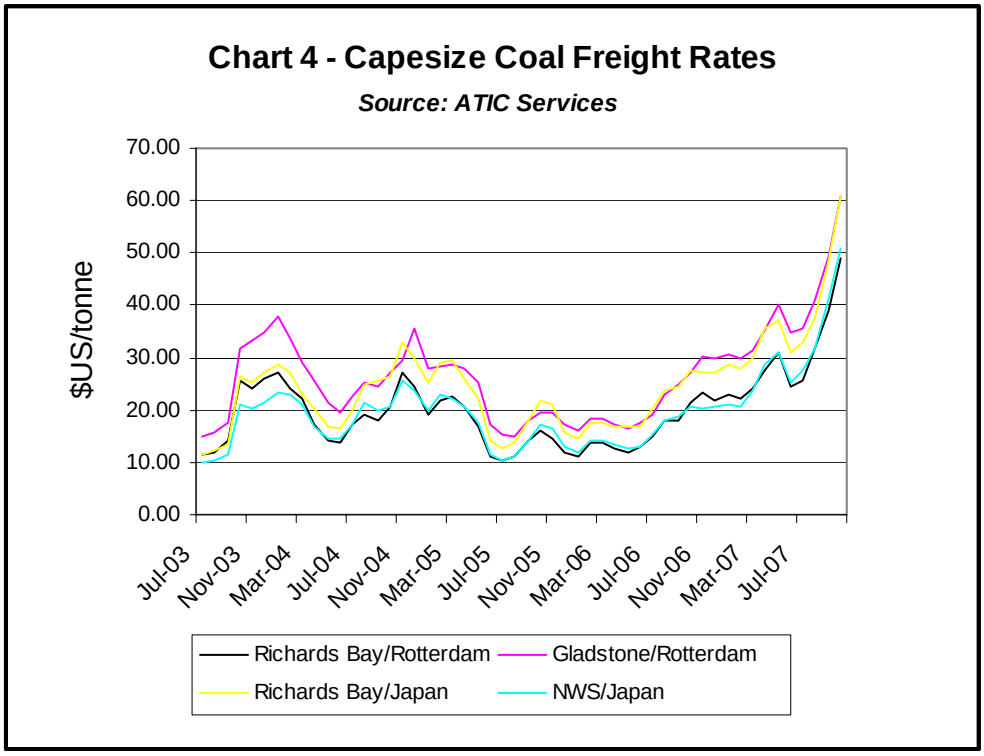
151. EUAS produces lignite entirely for its own power stations. TKI supplies nearly 80% of its coal production to power stations and sets market prices, with lower prices charged to its guaranteed lignite-fired power plant market. Lignite production is expected to increase in future years to meet Turkey's growing power requirements.

152. A Project on "the Development of Existing Mineral and Geothermal Reserves and Exploration of New Deposits" has been initiated to explore new lignite deposits within 20 regions. It will carry out research and prospecting studies over a total of 30.000 km2 and do 170,500 m of drilling studies between the years 2005 and 2010. According to unofficial figures, exploration studies done within the three regions of Elbistan, Soma and Trakya have discovered 840 million tonnes of new lignite resources since the project began in 2005.

3.4 Trade and Prices

3.4.1 Freight Market

153. Freight rates showed very strong growth again in 2007, boosted by the expansion of world trade mainly driven by China, reaching levels by November 2007 that were almost double previous peaks reached at the beginning of 2004 and 2005. Rates on the Richards Bay/Rotterdam route even reached $50/tonne. Chart 4 illustrates the recent trend in Capesize coal freight rates by reference to monthly averages on routes from South Africa (Richards Bay) and Australia (Gladstone and Newcastle) to Europe (Rotterdam) and Japan. These rates contrast markedly with the period of relative stability at about US$10/tonne seen in the late 1990s.



154. **On the demand side**, maritime dry trade represents a flow of approximately 4.9 billion tonnes in 2007[8], a rise of 37% on the year 2000. Goods transported in bulk carriers comprise:

- iron ore, steam and coking coal, cereals, bauxite and phosphate (1.9 billion tonnes in total, or 40% of goods transported in bulk carriers); and
- sugar, fertilizers, scrap and steel (930 million tonnes, 19%).

155. Coal (731 million tonnes[9]) and iron ore (772 million tonnes) dominate maritime dry bulk trade. The Pacific basin (flows between Australia and Japan, China and Korea) and the Atlantic basin (Brazil and Canada to Europe) trade flows govern freight market trends.

156. The major coal exporting countries are Australia (254 million tonnes), Indonesia (176 million tonnes), Russia (42 million tonnes), South Africa (69 million tonnes), China (49 million tonnes) and Colombia (60 million tonnes), together representing 650 million tonnes, or 89% of estimated world hard coal seaborne trade in 2007.

157. Australia and Brazil are the major exporters of iron ore, accounting for an estimated 580 million tonnes together in 2007. The main iron ore importing country is China, whose imports increased from 70 million tonnes in 2000 to 315 million tonnes in 2006, i.e. a 4.5 times increase and now accounting for about half of the iron ore transported.

158. The sharp increase in seaborne trade volume of iron ore, mainly to China as a result of expanding steel production, and increased coal demand for electricity generation and steel production in Asia resulted in the high rates observed in 2007. Although demand on the Atlantic basin remained flat, freight rates followed the high levels observed on the Pacific basin as some Asian buyers started to buy coal from traditional Atlantic suppliers.

[8] Of this, 2 billion tonnes is dry cargo not carried in bulk (containerised cargo and break-bulk).
[9] This figure relates to seaborne trade and excludes coastal trade

159. **On the supply side**, activity has continued its bullish trend. The aggregated tonnage of the total bulk carrier fleet increased by 8% in 2006, while new orders in 2006 for Panamax and Capesize carriers equated to an average of 23% and 36% of the existing fleet respectively. Although the delivery of a significant number of new ships and low levels of vessel scrapping in the last four years should have allowed a softening of the markets, congestion in major iron ore and coal handling ports has affected the market significantly. In Australia, carriers queued for 70 days off Newcastle at the beginning of 2007, effectively reducing available shipping tonnage by an estimated 10% and making the supply/demand balance very tight.

160. Forward freight agreements have increasingly become a tool for many companies wanting to manage their shipping risks and new entrants including banks and hedge funds have also entered the market. The paper freight market grew to US$50 billion in 2006 and is now considered to be approaching parity with physical volumes.

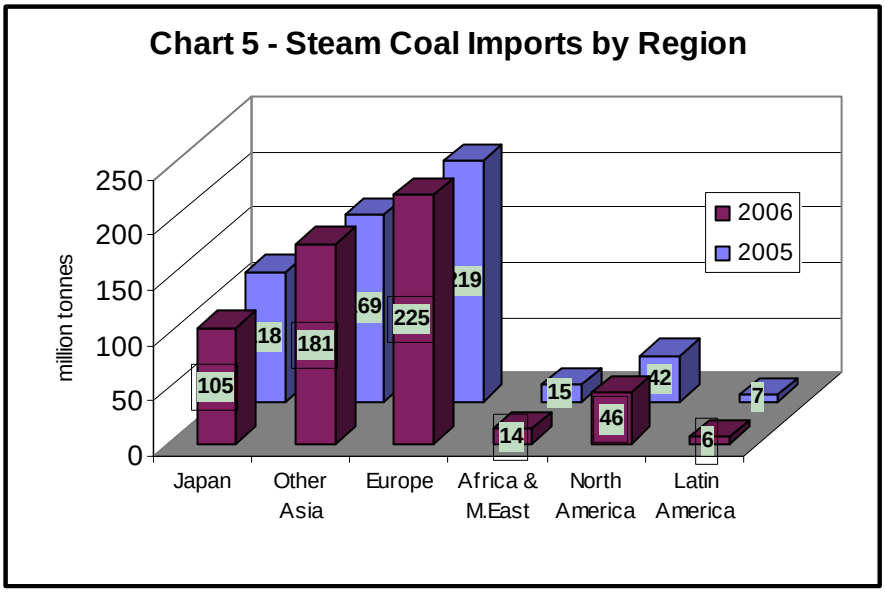
161. The dry bulk carriers order book now comprises almost 1900 vessels (over 160 million deadweight tonnes) for delivery in the next five years. This frantic activity has occurred despite a doubling in the prices of a new Capesize bulk carrier in the last six years, from US$35 million in 1999 to US$68 million in 2006. This increase has continued, and Capesize bulk carrier orders today are not executed at less than US$100 million.

3.4.2 Trade Volume

162. According to IEA statistics, world hard coal trade increased by about 2.6% (19 million tonnes) in 2006, with seaborne steam coal trade continuing its rapid growth (by over 27 million tonnes) while coking coal trade declined by 6 million tonnes to 222 million tonnes.

163. Global demand for **seaborne traded steam coal** grew by nearly 24 million tonnes (4.7%) to about 525 million tonnes in 2006, continuing its relentless growth. Over the last 10 years, seaborne steam coal trade has almost doubled.

164. Chart 5[10] illustrates the changes in 2006 steam coal trade by import region.



[10] The changes in imports by region shown in Chart 5 & Chart 6 do not equate to changes in total imports due to differences in the balancing item in the IEA trade matrices for 2004 and 2005, not shown in the charts.

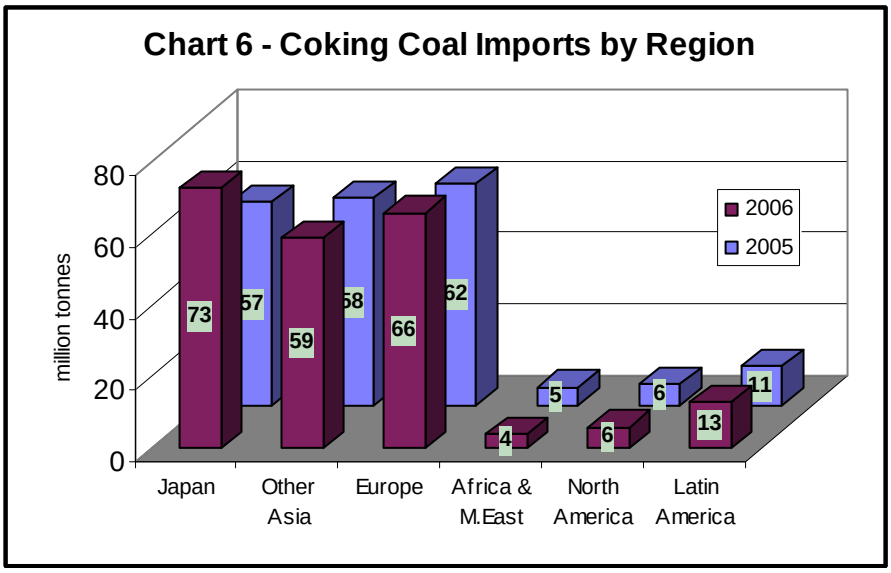
165. **Australian** coal exports rose by 5% to 243 Mt in 2006-07, with all of the increase being in metallurgical coal shipments, which rose by 9% to 132 million tonnes. Thermal coal exports remained static at 111 Mt. This constrained response from Australian suppliers to buoyant international demand was due mainly to continuing shortfalls in rail and port capacities in New South Wales and Queensland.

166. Steam coal exports from **South Africa** decreased to about 69 million tonnes in 2006 due to rail problems and other logistical constraints, a decrease of 2.6 million tonnes on 2005. 88% of exports were destined for Europe, 5% Middle East, 4% Africa and 2% each to Far East and South America. However, exports in the first half of 2007 have increased as a result of excellent performance by the junior coal mines. The high coal prices once more were reflected in increased coal export revenues of 21.7 billion Rand, 3% more than in 2005.

167. The demand for imported coal rose in **China**. The closure of some Chinese mines in response to safety concerns, together with wages pressure, resource taxes and environmental levies on other operations, combined to constrain domestic coal production and narrow the gap between Chinese and international coal prices.

168. **World coking coal trade** declined by 6 million tonnes to 222 million tonnes during 2006, the majority being a decline in seaborne trade, which reached 204 million tonnes. Exports from Indonesia increased by over 6 million tonnes, while all other exporters suffered declines.

169. In 2006, **Canada** exported 24.6 million tonnes of coking coal, lower than the 26.8 Mt exported in 2005. However, exports to Japan, Canada's largest market, increased by 15% to 8.7 million tonnes. About 90% of Canada's coal exports were seaborne and shipped through coal terminals in Vancouver and the rest was shipped through the Ridley Terminals in Prince Rupert, northern BC. Chart 6 illustrates the changes in 2006 coking coal trade by import region.



170. More recently, international coking coal markets tightened during 2006-07 due to a combination of demand and supply side factors. On the demand side, steel production was strong, including in India where new capacity came on line during the year and the utilisation of coke making capacity rose in response to higher Chinese export coke

prices. Several Indian coal tenders closed during the year with tonnage offers below the total amounts called for.

171. The following table shows **USA** coal exports in 2005, 2006 and for the first ten months of 2007:

Table 5 – USA Coal Exports (million short tons)

	2005	2006	Jan-Oct '06	Jan-Oct '07	change '07/'06
to Canada					
Metallurgical	4,464	4,666	3,861	3,209	-16.9%
Steam	14,910	15,223	12,749	12,204	-4.3%
TOTAL	**19,374**	**19,889**	**16,610**	**15,413**	**-7.2%**
to Overseas					
Metallurgical	24,215	22,941	18,935	23,223	+22.6%
Steam	5.916	6,482	4,853	7,951	+63.8%
TOTAL	**30,131**	**29,423**	**23,788**	**31,174**	**+31.0%**
Total Exports	**49,504**	**49,314**	**40,399**	**46,586**	**+15.3%**

Source: US Department of Commerce

172. US Exports were 49.3 million short tons in 2006, essentially equal to exports in 2005. There were shifts in the overseas market, with metallurgical coal shipments declining (notably to Asian destinations) and steam coal exports increasing (notably to the United Kingdom).

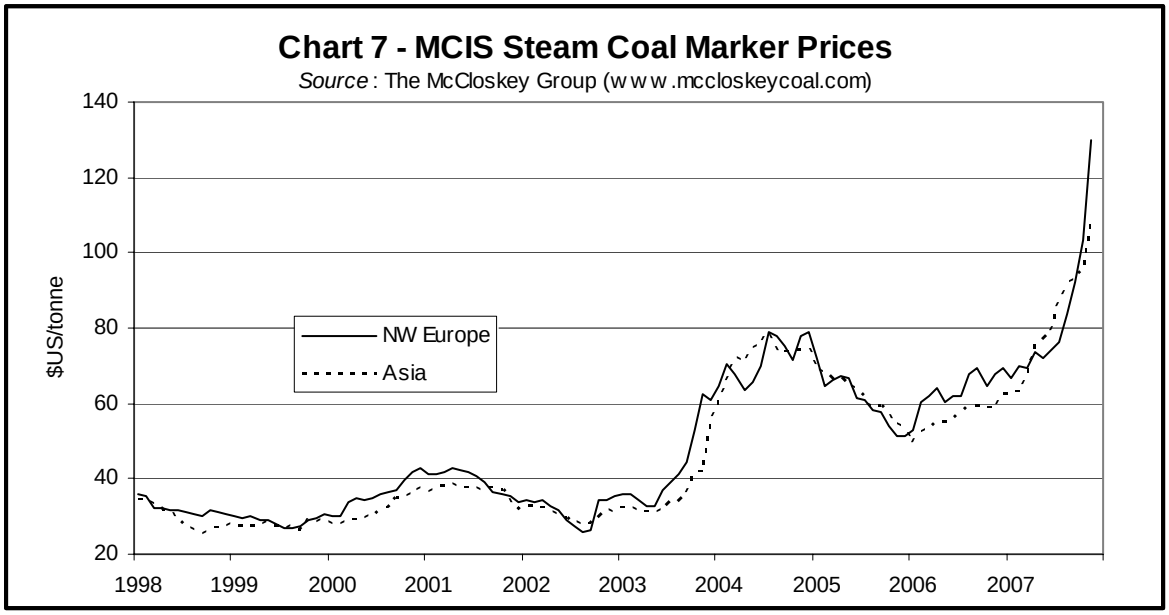
173. US shipments of both steam and metallurgical coal to Canada have declined in 2007. Conversely, US shipments of both metallurgical and steam coal to overseas destinations have increased sharply, due to the weaker US dollar increasing the value of US coal to overseas buyers and to strong Asian coal demand. Europe has increased its purchases of US coal due to transport bottlenecks in Australia and to problems with an extended rainy season in Indonesia that impacted its ability to ship steam coal.

3.4.3 Market Prices

174. World steam coal trade has developed rapidly over the last 25 years and market transparency has increased with the introduction of electronic trading systems and price indices. There seems little sign of this growth abating.

175. Although investments in supply and transport infrastructure are being made, the continuing rapid increases in coal demand from countries such as China in the last few years have inevitably put upward pressure on prices and have increased market price volatility.

176. 2007 has seen further evidence of market volatility driven by concern over a tight supply/demand balance. For example, extreme weather driven disruption at Newcastle during June 2007 had an immediate and significant upward effect on international market prices. Chart 7 illustrates the development of world steam coal prices.



177. Prior to 2007, international steam coal prices had peaked in the second half of 2004 with the ARA CIF delivered price reaching about US$79/t. Prices delivered to European distribution ports were on a declining trend during 2005 and the ARA CIF delivered price was down to $51/tonne by the end of the year, with Asian market prices apparently following the Atlantic market. However, prices increased steadily throughout 2006 and 2007, with rapid increases in Asian market prices from March 2007 leading the way and illustrating the effect that Chinese demand for coal, other commodities and shipping continues to have on world markets. In the second half of 2007, European spot prices again led the rapid increase in prices, driven by demand in that region and influenced by continuing infrastructure constraints affecting Australian exports. By November 2007. NW European prices were averaging almost $130/tonne with Asian prices over $20/tonne lower.

178. In the United States of America, limited information is available on spot prices for selected coal types in Central Appalachia, Northern Appalachia, the Illinois Basin, Power River Basin and the Colorado Uinta Basin. The information is prepared by “Platts Coal Outlook” and is available graphically, with permission, on the US Energy Information Administration (EIA) web site (http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html#spot).

179. The Powder River Basin spot coal price rose steadily during 2005, from the level of just over $5/ton seen for most of 2003 and 2004, and peaked at above $20/ton at the start of 2006. It then declined steadily again to reach $10/tonne in October 2006 and has remained at, or just below, that level through to August 2007. Central Appalachian spot prices fell dramatically from their previous level of $65/ton in August 2006 and fell again in January 2007 to $40/ton. Since then they have increased again to over $45/ton. Northern Appalachian coal prices increased from under $40/ton in mid 2006 to reach $45/ton in August 2007.

180. FY2006 metallurgical coal term contract prices for Japanese Steel Mills (JSM) decreased for the first time in three years, with the softening market resulting from coal suppliers increasing their production in response to previous high prices while major steel mills in Japan, U.S.A. and the EU reduced their steel output after summer 2005.

181. The JSM term price of hard coking coal for FY2005 was US$125/tonne FOBT but for FY2006 premium hard coking coal was settled between US$114–116/tonne FOBT, and

hard coking coal was settled in a lower price range. The term price of Australian semi soft coking coal was settled between US$53 and US$58/tonne FOBT, a US$20-25/tonne discount from FY2005. The term price of LV-PCI coal for FY2005 was around US$100/tonne FOBT, but settled around US$63-65/tonne for FY2006.

182. Canadian coal exporters received US$113/tonne, on average, for coking coal in the year to 31 March 2007 as a result of continuous demand increases and tight supply on global coal markets. However, global demand for coking coal started to slow down in the second half of 2006 and Canadian coal exporters settled various coking coal contracts for the year to 31 March 2008 at prices of US$94-97/tonne, lower than the previous year's contract prices of US$107-110/tonne.

4 ISSUES RELATED TO COAL

4.1 Sustaining the Role of Coal

183. The IEA has forecast that total energy demand over the next twenty five years will increase by 55%. In order to maintain a stable and affordable energy supply whilst keeping economic, social and environmental objectives in balance, it is essential that energy be obtained from a wide variety of sources.

184. A compelling economic and social case can be made for sustaining the role of coal in the future energy mix, given that it is an affordable, reliable and secure source of energy. All fossil fuels must address the challenge of climate change – most important for coal because it is the most carbon intensive fossil fuel. The following paragraphs highlight recent developments that reflect the challenge which has been accepted by the industry and governments to reduce the emissions from the use of coal in fulfilling its role in the future energy mix.

4.1.1 Policy and the Role of Coal

United States of America

Coal to Liquids and the Energy Bill of 2007

185. Interest in developing a coal to liquids industry in the United States of America remains strong despite the lack of positive Congressional action needed to accelerate the advancement of this new industry. Although there is bipartisan interest in using domestic coal to give the nation a greater degree of energy independence and thus more security from an energy and economic view point, partisan politics have dominated the debate throughout 2007. During Senate floor consideration of the CLEAN Energy Act of 2007, two amendments that would have encouraged the financing and construction of domestic coal to liquid facilities were lost. Although collectively one or both amendments were supported by 60 Senators, neither had enough votes to attain final passage and they were not included in the Senate passed energy bill. Leadership in the House refused to consider any substantive coal-related provisions in its version of the energy bill with concerns raised about the relationship of coal to liquids facilities and climate change policy.

186. The industry Coal to Liquids Coalition will continue to work with this Administration and with the Congress to secure passage of meaningful CTL incentives that do not include carbon capture and storage requirements that are technically and/or economically infeasible.

187. The Senate and House passed energy bills went to conference and passed in the last days of 2007. The final bill is oriented toward conservation, efficiency and renewables. Although the final bill does not include a renewable energy portfolio standard, it does little to support traditional fossil fuels. The legislation does not include any pro-coal provisions.

Energy Policy Act 2005

188. Full implementation of the 2005 Energy Policy Act, the most comprehensive energy bill in a decade, remains important for coal. Its provisions are designed to expand quantity and diversity of US energy supplies as well as enhance the efficiency with which energy is used. Coal specific provisions included authorisation for basic coal and coal combustion

research and development, for demonstration of advanced coal technologies and for carbon capture and sequestration research. Additionally the bill included tax incentives in the form of investment tax credits for advanced coal combustion plants and integrated gasification combined cycle plants (electric generators and industry) and introduced a loan guarantee program for new technologies including coal to liquids technologies.

189. Due to limitations on budget and monetary resources, actual Congressional appropriations for coal programs for the US Fiscal Years 2007 and 2008 will fall short of the amount envisioned by the energy bill. However, the funds that are available will allow continuation of the coal R&D program and an expansion of the carbon sequestration research program.

190. Implementation of the loan guarantee program has been very slow and is the subject of much criticism in both the House and the Senate. The DOE requested an indication of interest in the loan program in August 2006 and received 143 pre-applications requesting a total of $27 billion in loan guarantees. Nearly 70% of the requests were for fossil energy projects. The DOE expects to invite selected “pre-applicants” to submit applications for loans by December 2007. It has simultaneously conducted a notice of proposed rule making for the loan guarantees and is now reviewing comments. Congressional pressure to hasten full implementation of this program will continue.

191. Guidelines that will be used to qualify projects for investment tax credits have also been issued and the applications for the credits were oversubscribed by several billion dollars. The first round of awards was issued in late 2006 and applications for the second round are due in October of this year. Awards for the second round will be made by April 2008. Unlike the first round, the second round will favour projects that capture and sequester CO_2. The industry is working with Congress to extend the investment tax credit program but budgetary constraints will make this difficult.

Climate Change

192. Leadership of the Congress changed from the Republicans to the Democrats as of the beginning of 2007 and all expected fast action on climate. Congressional support for climate legislation was much stronger than in previous years. Indeed a number of proposals were introduced in the U.S. Senate during the first session of the 110th Congress (2007) ranging from an intensity based cap and trade program to proposals that would require mandatory absolute reductions of greenhouse gas emissions on a set time table. Hearings were held in the Senate Environment and Public Works Committee (EPW) throughout the year.

193. In mid-December EPW approved “The Lieberman-Warner Climate Security Act” after extensive debate. The bill would require electric power, transportation and manufacturing sectors to reduce greenhouse gas emissions to 15% below 2005 levels by 2020 and to 70% below 2005 levels by 2050. Under the bill, the Environmental Protection Agency would have the authority to assess and distribute emissions allowances in an amount that declines annually. The bill was reported out of committee before any economic analysis of its provisions could be completed. It is expected that the bill will be considered on the Senate floor sometime in 2008 but it is not expected to pass in its current form.

194. There will be a lot of activity on climate during 2008, but climate is expected to become a Presidential election issue and final legislation is not expected until into 2009.

195. The U.S. House of Representatives has not advanced as far as the U.S Senate in consideration of legislation.

196. States are taking independent action. In California, laws have been passed requiring that regulated utilities must meet a new standard of 1100 lbs/MWh (approx. 500kg/kWh) of CO_2 emissions in new long term agreements. Washington State recently enacted similar requirements. Firms in Interconnected States selling electricity into the California market are now looking at the implications for contracts.

197. Efficiency increases for existing and new electricity plant is in debate but not at the forefront. The main CCS focus is now on large scale projects (>1 million tons p.a.) in multiple geologies. Seven regional proposals to the DOE are pending.

198. Most language is not aimed just at IGCC, but at any process (e.g. pulverised fuel plus CCS, Oxyfuel firing etc.) that allows CCS. EPRI analysis indicates that to aggressively reduce CO_2 emissions will require use of all the technology options (increased end-use efficiency, renewable energy, nuclear power, increased coal-fired generation efficiency, CCS and hybrid vehicles) and that R&D plus demonstration and deployment support is inadequate.

199. An August 2007 EPRI study *"The Power to Reduce CO2 Emissions – The Full Portfolio"* (http://epri-reports.org/DiscussionPaper2007.pdf) concluded that a projected cost of $1.8 trillion to dramatically reduce CO_2 emissions by 2050 could be halved by spending $1.4 billion each year to 2030 for research and development on a range of technologies, with almost half the expenditure going towards research into advanced coal technology and carbon capture and storage.

Canada

200. Energy policy is market-based and oriented towards sustainable development. A major goal is to achieve both environmental and economic excellence in any energy project brought to market. Canada's Energy Policy has three main objectives:

- Security – ensure access to affordable, reliable and secure sources of energy;
- Prosperity - ensure that the energy industry contributes to the prosperity and quality of life for all Canadians; and
- Environment - ensure that environmental considerations are always considered when developing energy projects.

201. It is supported by four key principles:

- Reliance on the market to allocate resources - Prices are established and investment decisions must be governed by a competitive energy market under the auspices of the NAFTA framework.
- Respect for Jurisdiction - Energy and other resources are owned by the Provinces in which they are located. Each Province must develop its own Energy Policy. (Alberta, with its predominately carbon based economy, has its own Coal Policy).
- Regulation - Regulation as required to ensure that the markets work.
- Targeted Investment - Investment to supply necessities when the market will not respond to demand.

202. New challenges are emerging, with security concerns higher than they have ever been. A review is considering refocusing policy initiatives around at-home investment, energy efficiency and emergency preparedness.

203. New CO_2 emissions policies were introduced in the first half of 2006, involving a 6% per

year reduction in emission intensity over the period 2006 -15, and 2% per year thereafter. The policy applied to all enterprises producing more than 100,000 tonnes/year of CO_2 emissions; and this includes oil sands producers.

204. Canada is looking hard at CCS; the Genessee Phase 3 is on budget and schedule and Luscar and Sherritt are partners in a coal gasification project. New export coal mines being developed and the future looks bright for coal.

Australia

205. Escalating public concern about the risk of climate change, fuelled by persistent severe drought in much of the country, has focussed attention in Australia on coal use as a major contributor to greenhouse emissions and on the coal industry as a mainstay of the national economy.

206. Some prominent commentators and minor party politicians have questioned the coal industry's social licence to operate, and called for a quick and complete phasing out of coal production and coal-based power generation in the country in favour of lower carbon fossil and renewable energy resources. There also have been a number of high profile procedural challenges to the granting of permits to new coal mining operations on the grounds that project assessment have not adequately accommodated climate change impacts and/or should result in permit refusal.

207. However, as yet, such views appear to represent the extreme minority. Within the two major political parties – the Liberal/National Party Coalition and the Australian Labour Party – it is well appreciated that such an approach is unfeasible and undesirable. At both national and state (provincial) levels, each party espouses the need to find solutions to the energy/climate change dilemma that minimise the impact on economic growth and preserve the value of Australia's natural resource endowments, including coal.

208. Accordingly, current and prospective governments in Australia accept that coal should continue to be an important part of the country's energy mix for the foreseeable future, and that Australian coal production and exports will grow in response to increasing international demand.

209. It is also generally accepted, however, that fundamental changes in coal's greenhouse impacts are required and, to this end, low emissions coal technology is being widely promoted by governments as a key element of Australia's climate change response. The Australian Government along with the State Governments of NSW, Victoria and Queensland are proactively supporting the coal industry and the RD&D effort on clean coal technology development. Together, they are contributing some $700 million for clean coal technology development projects. During 2006-07, AU$275 million was granted to four clean coal projects under the Federal Government's Low Emissions Technology Demonstration Fund[11], and grants for these and complementary projects were made in the states of Queensland, New South Wales and Victoria.

210. Additional government funds are being directed to other low emission technology developments, principally solar and other renewables. The Australian Government has established a clean energy target. By 2020, 15% of Australia's energy is targeted to come from clean sources such as wind, solar and clean coal.

[11] CS Energy – Callide A Oxy-fuel Demonstration (AU$50M); International Power – Hazelwood 2030 A Clean Coal Future ($50M); HRL – Loy Yang IDGCC ($100M); Fairview Power – Zero Carbon from Coal Seams ($75M).

New Zealand

211. A comprehensive review of the options open to the government for meeting its Kyoto CO_2 emissions reduction targets was undertaken in November 2005 and a number of discussion papers listing a broad range of measures were put out to general consultation in December 2006:

    - New Zealand Energy Strategy
    - Transitional Measures to 2012
    - Post-2012 Measures
    - New Zealand Energy Efficiency and Conservation Strategy
    - Measures for Agriculture and Forestry

212. The government has recently announced that it is considering moving ahead with an emissions trading scheme to cover all sectors and all gases. The timing of the commencement of such a scheme, and when different sectors would be covered, is yet to be decided. Consultation is expected to continue through to the end of 2007 before firm decisions are made.

Japan

213. The "New National Energy Strategy" was issued in May 2006. It supports efforts for coal gasification, clean coal technology, CTL and technological transfer to Asia Pacific countries. The Ministry of Economy, Trade and Industry (METI) and the Ministry of Environment (MoE) are talking about climate issues and industry is concerned about energy security. Japan is, and will continue to be, actively involved in IGCC research.

214. On May 24th 2007, Prime Minister Abe released his ideas on post-Kyoto principles after 2013:

    - to increase the number of participant countries including the U.S., China and India; and
    - to decrease 2050 emissions to less than half of "present" emissions.

    He also mentioned the importance of R&D, including IGCC and CCS. The MoE has formulated schematic proposals for the 2008 G8 summit meeting based on this initiative. However, the means of achieving the quantitative goal remain unclear.

215. On March 23rd 2007, the MoE published figures for the carbon intensity of each electricity retailer. The published data are to be used for large business entities to calculate their CO_2 emissions from electricity consumption and to report GHG inventories to the MoE. This may threaten some power producers which are highly dependent on coal, because of a change in customers' preference, although power produced from coal is cost competitive in Japan. Power producers had been increasing their coal consumption, in response to Government's policies promoting competition in the power industry.

216. The Agency for Natural Resources and Energy (ANRE) advocates that Japan should continue to use coal in light of inter-fuel price competition for power sources. According to a report released by ANRE on March 22nd 2007, clean coal technology research and development, including IGCC, should be accelerated in order to overcome environmental concerns about coal in Japan. Japan expects to disseminate its generation technology, especially in terms of high efficiency or low emissions, to other countries including the U.S., China and India for tackling global warming. Also, the report proposes that international CCS employing CDM should be examined and that Kyoto mechanisms can

motivate R&D for environmentally benign technologies.

South Africa

217. A second draft of the Royalties Bill has been released and is under review.

218. An Inter-Ministerial Committee on Climate Change led by the South African Department of Environmental Affairs and Tourism (DEAT) has initiated the Long Term Mitigation Scenario (LTMS) process. This process will outline the range of scenarios of possible future climate action, notably long-term emissions scenarios and their cost implications. In addition, various national departments, provinces and cities are refining their sector plans in line with the National Climate Change Response Strategy. All this will inform the Long Term National Climate Policy which DEAT plans to publish during 2008/9.

France

219. French energy policy is defined by the Energy Act of 13 July 2005, defining energy policy priorities in the form of four major objectives:

- To contribute to national energy independence and guarantee security of supply.
- To ensure competitive energy prices.
- To protect human health and the environment, in particular by fighting against climate change.
- To guarantee social and territorial cohesion by ensuring access to energy for all.

220. In order to meet these objectives, four principal action areas were identified:

- to control energy demand, through a series of incentives and programmes, including an energy saving certificate scheme, standards and regulations, together with tax incentives;
- to diversify energy sources, by increasing the use of renewable energies, keeping the nuclear option open and, in general, by developing a high-performance energy production infrastructure;
- to increase research into energy, because this is essential in order to meet long-term challenges, for example for bio-energies, fuel cells, clean vehicles, energy-efficient buildings, solar energy, capture and underground storage of CO_2 , 4th-generation nuclear energy; and
- to provide methods of transporting and storing energy, adapted to requirements, in particular in order to guarantee the quality of the electricity supply, reinforce the security of the gas and electricity grids and, in general, improve the safety of France's energy supply.

221. Quantitative objectives laid down by the Energy Act are:

- a quartering of CO_2 emissions by 2050;
- average reduction of final energy intensity of at least 2% per year from 2015 and of 2.5% from 2015 to 2030;
- production of 10% of energy needs from renewable energy sources by 2010; and
- incorporation of bio-fuels and other fuels of renewable origin to a level of 2% in 2006, 5.75% by the end of 2008 and 7% in 2010.

222. Following the presidential election of 6 May 2007, a new ministry has been created

which combines sustainable development, environment, energy, regional development, infrastructure and transport.

223. A tax on coal consumption has been introduced, transposing European Directive 2003/96/CE into French legislation. The rate has been fixed at €1.19/MWh, applicable from 1 July 2007. In accordance with the EC Directive, several sectors (electricity generators, steel industry) are exempted from the tax.

Germany

224. High level energy policy talks are being held in Germany, chaired by Mrs. Merkel. A meeting held on 3rd July 2007 and involving all stakeholders considered energy security (Germany relies very heavily on energy imports, mainly from Russia), power prices and CO_2 mitigation policy, and energy efficiency and research. The aim of the talks is prepare a national energy programme – the previous Federal Level energy programme was launched in 1991, 16 years ago.

225. There is a lack of consensus on nuclear energy in Germany. The government is a coalition of the conservative party, led by Mrs. Merkel and in favour of life extension of nuclear plant, and the social democrats that are against life extension.

226. German industry hopes that the talks will result in a more reliable political framework that will limit investment risks, especially because power generation investment needs are high.

Netherlands

227. Growing concern about climate change has prompted European government leaders to resolve that the EU should unilaterally take substantial steps with a 20% CO_2 reduction in 2020 and be willing to increase this to 30% should international agreements be reached.

228. EnergieNed, the federation of energy companies in the Netherlands recognises the need for an ambitious climate goal and the sustainability of energy supply. All the following, in order of priority, are necessary to achieve this:

- upping the pace of energy savings and efficiency;
- increased use of renewable energy sources;
- cleaner use of fossil fuels; and
- a framework of conditions which allows for the use of nuclear energy.

229. With a view to achieving a sustainable and efficient energy supply, target values for energy savings and efficiency, renewable energy and CO_2 reduction were set out in the coalition agreement. The Dutch cabinet is currently working on detailing the policy guidelines and its work programme to achieve this ambition. EnergieNed supports the coalition agreement's pursuit of an energy transition and will cooperate with the cabinet in its development.

230. The Dutch cabinet Balkenende IV has three targets:

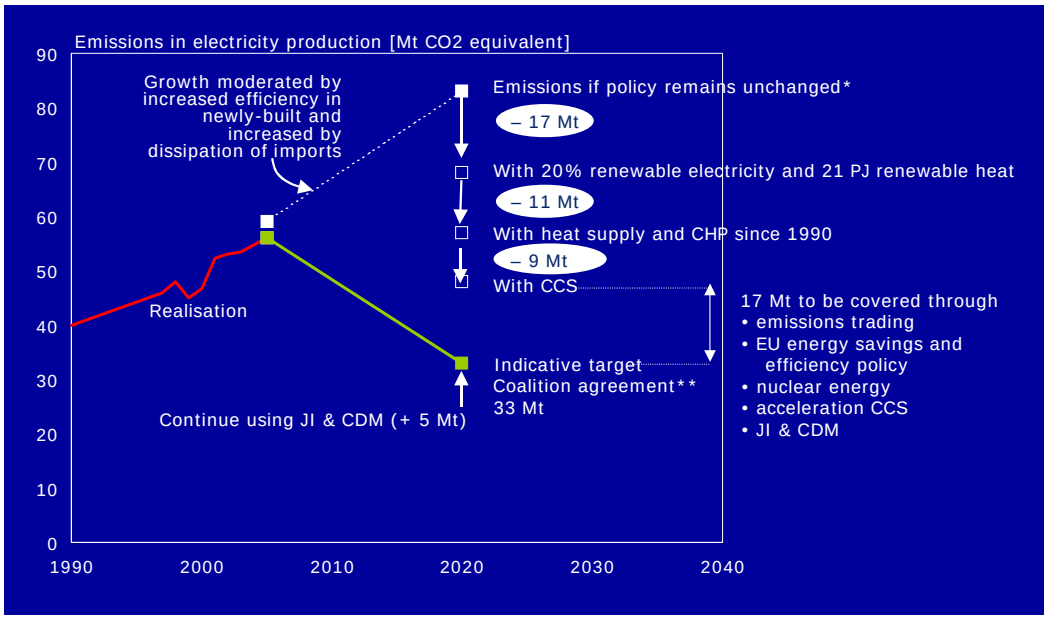
- 30% CO_2 reduction in 2020
- 20% renewable energy in 2020
- 2% conservation each year until 2020

231. A recent analysis by the Energy Research Centre of the Netherlands (ECN) and the Netherlands Environmental Assessment Agency (MNP) shows that the way in which achieving the cabinet's energy and environmental goals is outlined will have a major impact on the costs for Dutch society. Strict and complete achievement of all three targets will cost society well over €8-9 billion per annum in 2020. A flexible variant in which the climate goal is completely achieved and the targets for renewable energy and energy savings and efficiency are largely achieved will cost €3-4 billion per annum. A flexible approach is therefore more cost-effective and significantly cheaper; and consequently creates greater support for the transition.

232. According to ECN and MNP, a strict approach to the cabinet's goals could also have drastic consequences for security of energy supply. Such a strict approach does not allow for coal and certainly not for new coal-fired power stations, while the use of gas increases. From the security of supply perspective, this is an undesirable development.

233. The Energy Agenda describes the ambitions of the energy companies in the Netherlands to contribute to the acceleration of the energy transition in the area of heat supply, renewable energy and clean fossil. If the framework of conditions created by the government is properly outlined, the impact of these ambitions will contribute significantly to the cabinet's target of 30% CO_2 reduction.

Chart 8 - Energy transition contributes to climate goal of 30% reduction



Source: EnergieNed

* Demand increase, imports and emissions if policy remains unchanged based on GE scenario

** Should the EU target of 20% be followed, the emission allowance comes to 37Mt

234. The implications of this Energy Agenda for CO_2 Capture & Storage (CCS) are:

- the ambitions for CO_2 removal and storage (clean fossil or CCS) may in 2020 provide for a reduction of 9 million tonnes, based on the introduction of demos with appropriate scaling up to 2020.
- Reaching the desired level requires 17 million tonnes of additional reduction through a mix of measures, with among others the accelerated rollout of CCS.

Also, the Dutch cabinet allows for the construction of new (capture-ready) coal-fired

power stations.

235. The European Commission is currently contemplating the structure of emissions trading after 2012. The electricity production companies in the Netherlands are proposing, among other things, that CCS is recognised within the EU-ETS and that allocation and monitoring are properly organised.

236. The chart below shows expansion plans for coal-fired power stations. A gas-fired power station was also included in connection with specific local capture potential.

Table 6 – Planned Coal-Fired Power Stations in The Netherlands

Company	Location	Year	Capacity	Type	Indicative CO_2 emission	Indicative potential CO_2 capture
			MWe		Mt/a	Mt/a
Electrabel	Maasvlakte	2011	750	USC	3.9	3.5
NUON	Eemshaven	2011	1200*	IGCC	3.5	2.0 – 3.1
E.ON	Maasvlakte	2011	1080	USC	5.6	5.0
RWE	Eemshaven	2011	1600	USC	8.3	7.4
Eneco	Maasvlakte	2010	840	Gas	1.8 - 2.4	1.5 – 2.0
Essent	Geertruiden-berg/Borssele	2013	800-1100	USC	4.1 – 5.7	3.7 – 5.1
Total					28.0	25.0

* Multifuel: of which 720 MW is coal capacity Source: EnergieNed

237. In the Netherlands, the total capacity of the different types of CO_2 storage, excluding the Groningen field, is approximately 4,000 million tonnes. Only gas fields with a capacity higher than 4 million tonnes of CO_2 have been taken into account because storage would not be economically viable in smaller fields. Although it is still uncertain when and how much of this capacity will actually become available, it is theoretically sufficient to store the CO_2 produced by power plants in the Netherlands for a period of at least 50 years.

Spain

238. In March 2006 the Industry Ministry, the unions and the coal industry signed a new strategic plan for the coal industry, the “National plan for the coal strategic reserve 2006-2012 and new model of integral and sustainable development for the mining areas”. It will come into force following approval by the European Union, which is still pending.

239. The object of the plan is to organize the Spanish coal industry, maintaining a minimum domestic coal production, rationalising subsidies and promoting the re-industrialization of mining areas by improving infrastructure, promoting new jobs, improving education etc. All this, not forgetting that coal is a strategic resource that needs State support.

United Kingdom

240. The Government published the Energy Review White Paper in May 2007 in which it reinforced the key energy challenges facing the UK; namely ensuring secure, clean and affordable energy as the country becomes increasingly dependent on imported fuel, and the need to tackle climate change.

241. The strategy to meet these challenges requires action to

- secure reliable energy supplies at prices set in competitive markets;

- develop cleaner energy supplies; and
- save energy.

242. There is particular concern over oil and gas supplies, with prices in these markets rising rapidly in recent years reflecting economic factors and political uncertainties. The UK is set to become a permanent net importer of oil within a few years, it became a net importer of gas in 2004 and has been reliant on coal imports for some time. Indeed, in 2006, imported coal represented almost three-quarters of the UK's coal consumption and the surge in UK coal demand has drawn comment on the ability of UK port infrastructure to cope with further growth. This and other questions relating to the value of a UK indigenous coal industry were addressed by The Coal Forum, which published an overview report (http://www.berr.gov.uk/files/file41186.pdf) on 31st August.

243. As coal offers an alternative to gas/oil it is attractive from a security of supply perspective and is likely to remain an important part of the UK's energy mix for many decades yet. However, the Government requires coal to become cleaner too and efforts are underway to develop clean coal technology through improvements in power station efficiency, co-firing with biomass and development of carbon capture and storage (CCS).

Turkey

244. Turkey is a candidate for EU membership and is trying to increase its indigenous energy resources and harmonise Turkish legislation on coal with EU legislation. Currently, the coal sector is subject to a restructuring program. The early restructuring program was undertaken in the 1990s and accelerated with the adoption of the Electricity Market Law in 2001, designed to introduce more competition and the installation of new lignite washing plants.

245. In accordance with national energy policy, coal policy is based on developing the exploration and exploitation of coal and its economic, secure, reliable and environmentally friendly use as one of the country's main indigenous resources. The priorities are:
    - developing existing indigenous energy resources especially in the coal sector;
    - restructuring the coal mining sector;
    - privatising some inefficient and inactive coal mines; and
    - promoting the adoption of clean coal technologies in the utilisation of coal in thermal power plants, household and industry.

246. There are no legal restrictions on private sector operations and the coal sector is open to foreign investment. Turkish Coal Enterprises (TKI) has been in profit since 1995 and does not benefit from direct subsidies. It is being re-structured by consolidating its operational units and facilities to improve productivity. Operations at small, loss-making mines have ceased and the mines offered to the private sector. Inactive mine deposits which are suitable for electricity generation are being offered for lease to the private sector, but if this is not successful the licenses are transferred back to the government.

247. At the beginning of 2007, TKI had 47 licensed coal deposits (15 active, 13 leased, 19 inactive mines). Since 2002, production at eight small mines has ceased and they have been leased to the private sector, one inactive mine has been sold to the private sector and three mines have been leased to the private sector for electricity generation (two of these were leased to private undertakings in 2006).

248. Following of enactment of the 2004 Mining Law, Turkish Hard Coal Enterprises (TTK) is

also able to transfer its rights to private undertakings. Their new mines have been given to private undertakings under a royalty payment arrangement.

249. At least 10,000 MW of additional capacity is available for lignite-fired electricity generation. The Elbistan region also has big potential to install new power plants. In March 2007, the Elbistan Collolar Lignite Deposit was tendered to the private sector by EUAS to supply coal for Elbistan B Power Station.

4.1.2 Industry Actions to Sustain the Role of Coal

United States of America

250. The US coal industry continues to be an active participant in the Asia Pacific Partnership for Clean Development and Climate, Coal Mining Task Force (CMTF) The CMTF is implementing many of the elements of its work plan including elements that are focused on coal mine health and safety, coal beneficiation and methane recovery.

251. The US industry has been instrumental in advancing support for a new coal conversion industry, an industry that could increase coal demand by more than 300 million short tons by 2030 to produce synthetic gas and clean liquid transportation fuels. The effort to advance a “Coal to Liquids” industry has strong bi-partisan support in the Congress as evidenced by the many bills that have been proposed to accelerate construction of these facilities. Despite strong support however, no CTL proposal was included in the Energy Bill that is now working its way through the Congress. This is due primarily to concerns about the carbon footprint of such projects, with work ongoing to address such concerns. CTL continues to receive support in the states, as evidenced by the recently released Southern States Energy Board strategy to provide for expedited permitting and construction of these facilities.

252. In conjunction with the government, the utility industry and developers, the coal industry has revised a technology roadmap or strategy focusing on an accelerated program for research and development of technologies to advance the goals of electric production and near zero emissions. This road map will facilitate the demonstration and commercialization of advanced technologies and implementation of carbon capture and sequestration technologies.

253. In cooperation with the Department of Energy, universities, and other industry participants, various coal industry representatives are participating in seven regional carbon sequestration partnerships. Phase 1, completed in 2005, characterised domestic sources and sinks of carbon dioxide. Phase 2, which began in 2006 and will extend for four more years, is intended to be a period of technology validation through small-scale injections of CO_2 into various geologic strata to test techniques of monitoring, mitigation and verification.

254. The U.S. power generation industry is moving ahead with the demonstration of carbon capture and storage technologies. In March 2007, American Electric Power announced plans to install carbon capture technology on two coal-fired power plants. The Alstom chilled ammonia technology will first be installed at AEP’s Mountaineer plant in West Virginia, as a 30-megawatt product validation, in mid-2008. Up to 100,000 tonnes of carbon dioxide will be captured per year for geological storage in deep saline aquifers. Thereafter, AEP plans to install the system on a 450-megawatt coal-fired unit at its Northeastern Station in Oklahoma, to be operational in late 2011. The Oklahoma project is expected to capture approximately 1.5 million tonnes of CO_2 a year, for use in enhanced oil recovery applications.

Australia

255. In 2006-07, the Australian coal industry substantially expanded its commitment to activities designed to preserve the long-term sustainability of coal use; and done in conjunction with governments, power utilities, research providers and others. They are focussed on supporting the role of technological innovation in significantly reducing the greenhouse intensity of coal use, and coal-fired electricity generation in particular.

256. The Australian Coal Association (ACA) represents the interests of black coal producers in the states of Queensland and New South Wales, and is focussed mainly on COAL21 – an ACA-initiated coalition of coal producers, power generators, researchers and national and state governments dedicated to accelerating the development and commercialisation of clean coal technology.

257. In 2004, COAL21 produced an action plan for low emissions coal-fired electricity generation in Australia; and in 2006 Australian coal producers took a major step towards implementing the plan by committing to the creation of the COAL21 Fund. This fund, a world-first example of the whole-industry approach to the development of clean coal technologies, was initially set up to raise $300 million over five years. In early 2007 the industry decided to uncap contributions. It will be financed by a voluntary AU$0.20 per tonne levy on Australian coal production and is now set to raise $1 billion over the next 10 years for the demonstration of low emissions coal technologies and related research programs.

258. Of that total, $600 million is to be spent in the State of Queensland, on projects including the oxy-fuel demonstration plant; and in 2006 the State Government allocated $300 million to the clean coal RD&D effort in Queensland. A Clean Coal Council, chaired by the Premier and made up of government representatives and senior coal industry chief executives, has been established in Queensland to oversee the allocation of this $900 million, indicating the very high level commitment to greenhouse gas abatement. A key component of the Council's programme will be the development of a new generation IGCC power station.

259. $400 million of the COAL 21 Fund has been allocated to projects in the state of New South Wales. These will include a pilot post-combustion capture demonstration project using ammonia absorption technology that is expected to be operational by mid-2008.

260. ACA and a number of individual coal companies are contributors to a range of other clean coal/fossil energy programs, including:

- Centre for Low Emission Technology (cLET), which is a AU$26million, 4 year partnership of research providers and power utilities that is developing low emission electricity and hydrogen generation technologies (specifically coal gasification and gas cleaning/separation/ processing) and investigating the use of developed technologies and processes to improve the performance of existing coal fired power generation plants.
- Cooperative Research Centre for Coal in Sustainable Development (CCSD), which is a $AU60million, 7 year, joint venture between black coal producers and users and research organisations in Queensland, New South Wales and Western Australia conducting research into current and advanced power generation and steel making technologies.
- Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), a collaborative research organisation focused on carbon dioxide capture and geological storage. Participants in its AU$70million, 7 year, program include coal and oil/gas producers, researchers, government agencies and international

collaborators.

- The CO2CRC Otway Geosequestration Demonstration Project. This AU$40million project is underway and will inject up to 100,000 tonnes of CO_2 into a deep geological formation in south west Victoria, monitoring and verifying that the carbon dioxide is securely stored in a depleted gas reservoir. The project is the most extensive undertaken anywhere in the world and includes monitoring of the atmosphere, groundwater and sub-surface. It is an important step forward in demonstrating geological sequestration as a technology that could be used safely to make deep cuts in emissions of greenhouse gases to the atmosphere.

261. These activities are complemented by input to policy and outreach activities aimed at raising the awareness of governments and the public of the potential of low emissions coal technology to reconcile economic and environmental objectives, and gaining their acceptance of it as a key element of Australia's climate change response.

Japan

262. Japanese Power Utilities have been eager to participate in technological cooperation with developing countries. They have recently been active in a thermal efficiency improvement program under the framework of Asia Pacific Partnership; and have also initiated transfer of coal-fired power station maintenance technologies to China.

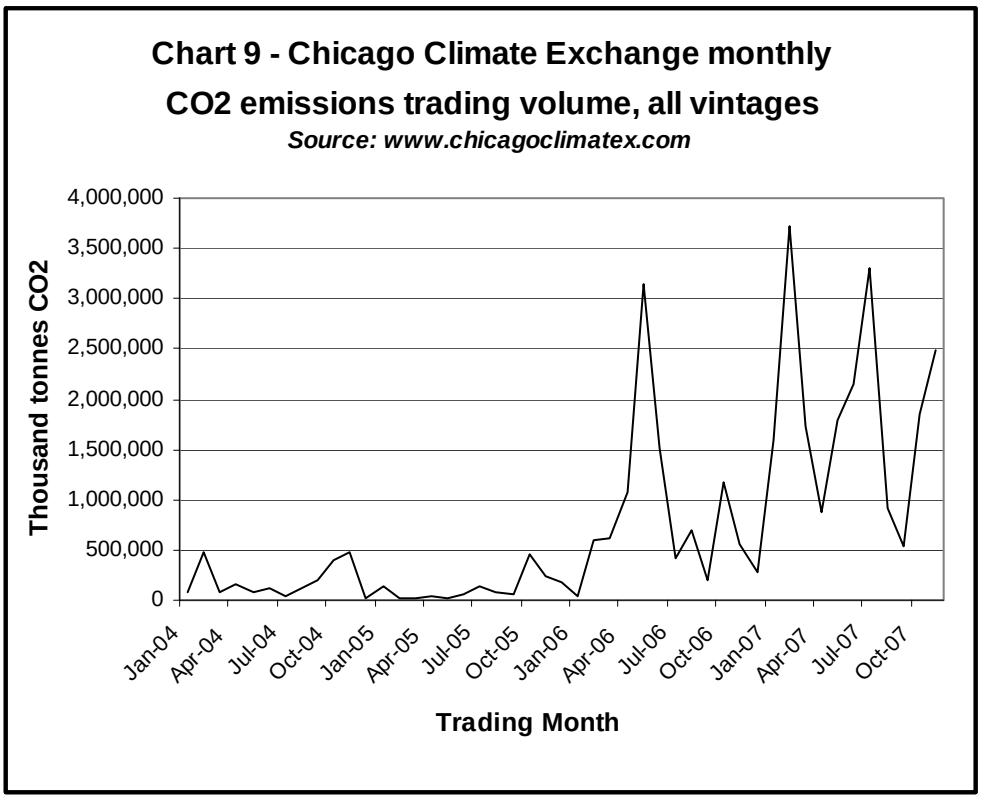
4.1.3 Emissions Trading

United States of America

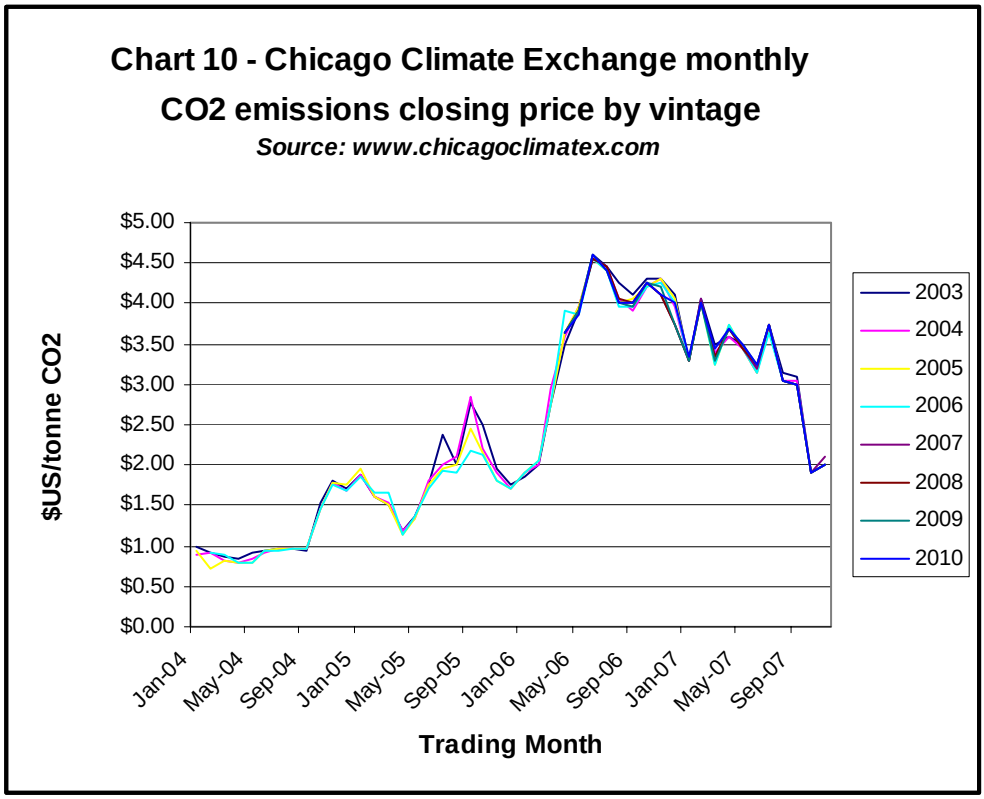
263. The United States of America has not, to date, adopted an official carbon emissions trading program although a number of companies are engaged in informal carbon trading programs and regional carbon trading programs are being proposed. Several legislative proposals that have been introduced in both the Senate and the House include requirements for emissions trading but legislation is unlikely to pass in 2007 or 2008.

264. The Chicago Climate Exchange was established as a private industry, self-regulatory, voluntary organization that manages a market for trading greenhouse gas emissions. Although located in the US, Chicago Climate Exchange participation is multi-national. The exchange began continuous electronic trading of greenhouse gas emission allowances in December 2003.

265. As can be seen in Chart 9, trading volumes have been very volatile but have increased substantially to average over 1,700,000 tonnes per month, with trading in some months reaching almost twice that level.



266. Allowance prices have declined steadily from their peak of over $4.50/tonne in June 2006 to about $2/tonne towards the end of 2007 (see Chart 10 below).



Australia

267. The Australian Government announced in June 2007 that it was committed to introducing a national carbon emissions trading scheme no later than 2012. This followed a commitment by the main opposition political party, in a federal election year, to implement trading within a similar time frame, and growing pressure from state governments and sections of the business community to begin the process of introducing a national scheme as soon as practicable.

268. The decision represented a major policy change by the Government, which previously insisted that emissions trading should not be adopted until such time as an Australian system could be part of a comprehensive international scheme encompassing all developed and major developing country emitters. It also followed a report by the Prime Ministerial Task Group on Emissions Trading, which recommended the introduction of a comprehensive, national cap and trade system linking to other country schemes as and when they were established.

269. The Government has endorsed the Task Group's report, which proposes an emissions trading regime with the following main elements:

    - Short and long term emission targets and carbon price paths.
    - Modest short term limits, building to 'aspirational' long term targets, with initial emissions penalties set at a level designed to act as a 'safety valve' against unintended economic impact.
    - Maximum practical coverage of all greenhouse gases, sources and sinks, with permit liability placed on direct emissions from large facilities and on upstream fuel suppliers for other energy emissions.
    - Initially excluding agriculture and land use emissions for practical reasons.
    - Allocation of time-dated single-year emissions permits, with:
        - a single, once-and-for-all, free allocation of permits to existing businesses identified as likely to suffer disproportionately from the introduction of a carbon penalty;
        - ongoing free allocation of permits to trade-exposed, emissions-intensive industries until their key international competitors face similar carbon constraints;
        - periodic auctioning of remaining permits.
    - Recycling of permit auction revenues to support low-emissions technologies and measures to improve energy efficiency.
    - Emissions offset credits for early action to abate emissions in advance of the advent of trading.

270. To complement emissions trading, the Government has announced the introduction, by 2010, of a national low-emissions energy target. The new Clean Energy Target will be 30,000 gigawatt hours of low-emissions energy generation by 2020, and will establish a scheme of tradeable certificates in generation emitting less than 200 kilograms of greenhouse gases per megawatt hour supplied.

271. At the recent APEC conference in Sydney, APEC leaders signed a Declaration on Climate Change, Energy Security and Clean Development which, among other things,

    - recognised the important role for low and zero emissions energy sources and technologies:
    - recognised that fossil fuels would continue to play a major role in regional and

global energy needs; and

- provided support for a post 2012 international climate change agreement to replace the Kyoto Protocol.

Japan

272. In 2005 the Japanese Cabinet approved the “Kyoto Protocol Target Achievement Plan”, which contains various specific measures to reduce GHG emissions from all kinds of activities nationwide. In order to reduce CO_2 originated from energy consumption, measures described in the Plan are reflected in the “Keidanren Voluntary Action Plan on the Environment”, formulated by Nippon Keidanren (Japan Business Federation). The government inspects and confirms annual CO_2 reductions achieved by each of thirty five industries, whose voluntary plans compose the Voluntary Action Plan.

273. In July 2007, the Ministry of Economy, Trade and Industry (METI) and the Ministry of Environment (MoE) disclosed the “Interim Report on Evaluation and Revision of the Kyoto Protocol Target Achievement Plan”. Recognizing difficulties in achieving the target, the Interim Report describes the pros and cons of national emissions trading, indicating only that the need for it should be continuously examined.

South Africa

274. The Designated National Authority (DNA), required to approve proposed Clean Development Mechanism (CDM) projects in South Africa, has been established in the South African Department of Minerals and Energy. Sustainable Development criteria have been developed and implemented.

275. To date, there are 53 CDM projects submitted to the South African Designated National Authority (DNA) - 34 Project Idea Notes (PINs) and 19 Project Design Documents (PDDs). Out of 19 PDDs, 9 have been registered by the CDM Executive Board as CDM projects, 2 are requesting registration and 8 are at the validation stage. Only 1 project was rejected by the DNA. The projects submitted to the DNA for initial review and approval cover the following types; bio-fuels, energy efficiency, waste management, cogeneration, fuel switching and hydro-power; and cover the manufacturing, mining, agriculture, energy, waste management, and housing and residential sectors.

Germany

276. The emission trading scheme rules in the National Allocation plan 2008-2012 for the Federal Republic of Germany are now clear. They define a benchmark system with one benchmark for coal and a second one for gas. 91% of the certificates are given free of charge in the second trading period, 2008 to 2012.

277. The total 453 million tonne/year CO_2 emissions cap is significantly reduced from the first trading period and power generators are obliged to purchase 40million tonnes/year of allowances, equivalent to 9% of the cap and 17% of their needs.

4.1.4 Power Station Emissions Control/Mining Regulations

Canada

278. On 19 October 2006 the Government of Canada tabled Canada's Clean Air Act to help protect human health and the environment by taking an integrated approach to reducing emissions of both air pollutants and greenhouse gases.

Japan

279. Power station operations have not been affected, although the emission standard for zinc in discharged water was strengthened in November 2006. The ambient air quality standard for mercury is under discussion among government officials, but no recommendations have yet emerged.

280. While no compulsory standard for CO_2 emissions has been introduced, each major industry is encouraged to formulate and disclose a quantitative reduction target. In April 2007, the Federation of Electric Power Companies of Japan (FEPC) adopted a revised target of reducing by almost 20% its FY1990 average CO_2 emission intensity between FY2008 and FY2012. In parallel, the Ministry of Environment (MoE) published the CO_2 emission intensity of each electricity retailer for the first time. The published data are used by large business entities to calculate CO_2 emissions from their electricity consumption and to report GHG inventories to the MoE. The CO_2 emission intensities and GHG inventories continue to be updated annually from 2007.

South Africa

281. In the last year, progress has been made in the roll out of the National Environmental Management Air Quality Act. A draft National Air Quality Framework document is currently under development.

United Kingdom

282. The new EU Large Combustion Plant Directive comes into force in 2008. Currently there is about 28GW of coal-fired power capacity in the UK and 20GW of plant with existing or planned FGD has ‘opted in’ to the scheme. The remaining 8GW of ‘opted out’ coal plant will close by 2016 and is still subject to environmental emission limits until that time. “Opted out” will tend to favour use of coals with lower sulphur and nitrogen contents, with potential impacts on the sources of coal imported into Europe from 2008.

4.2 Investment in Coal Supply, Transportation and Use

United States of America

283. According to a May 2007 report of the Department of Energy's National Energy Technology Laboratory (NETL), there is 46GW of proposed new coal fired power plant in the permitting or construction stage. Plants representing at least another 50GW of capacity have been announced but have not yet begun the permitting process. Most of these plants will come on line after 2010. The NETL report represents an indication of a high level of new interest in coal fired plants in the US, but it should be noted that a number of these announced units may not come on line as scheduled or may be dropped from generators' future plans altogether. The states with the greatest number of announced plants as reported by NETL are Illinois (16) and Wyoming (11). Although all of these plants will use advanced coal combustion technologies, several companies (including American Electric Power, Xcel, Basin Electric Power Cooperative, and Cinergy/Duke) have announced plans to construct commercial scale IGCC plants.

284. AEP has estimated that the cost of constructing its 629MW IGCC units will be high ($2.23 Billion), resulting in a cost of generated electricity that would be twenty to thirty percent greater than that from pulverized coal (PC) combustion technology. However, as more units are built, the costs of construction are expected to come into line with the cost of PC units. AEP is in the process of permitting and designing its two IGCC units and construction will start once traditional rate recovery is approved. The units will incorporate the space and layout for the addition of components for future capture of CO_2 for sequestration. AEP is also building two state-of-the-art ultra-supercritical power units in Oklahoma (950MW @ $1.8 billion) and Arkansas (600MW @ $1.3 billion).

Canada

285. Western Canadian Coal Corp's (WCC) Brule Mine in north eastern British Columbia (B.C.) received regulatory approval in July 2007 and construction is under way. It is designed to produce 2 million tonnes/year of PCI coal for export.

286. There are several coal projects currently awaiting environmental assessment approval from the B.C. government:

- Dehua International Mines Group Inc. applied for an environmental assessment for its Gething coal mine project in November 2006. The company proposes to construct an underground mine and a coal preparation plant in north eastern B.C., projected to produce 2 million tonnes/year of coking coal with a mine life of 40 years.
- In July 2006 WCC applied for an environmental assessment for its Hermann mine project, located in Tumbler Ridge adjacent to the company's Wolverine mine, north eastern B.C. WCC is applying for a certificate to allow the production of 0.8-1.1 million tonnes/year of coking coal with a mine life expectancy of 10 years.
- Cline Mining submitted an application for environmental assessment for its Lodgepole mine project in the Crowsnest Coalfield of south eastern B.C. in January 2006. The company is planning to produce 2 million tonnes/year of coking coal for export.
- The application for an environmental assessment for the Horizon mine project was originally submitted by Hillsborough Resources Limited in September 2005. The project is now managed by Peace River, a new partnership between Hillsborough (60%), Anglo Coal Canada (20%) and Northern Energy and Mining Inc. (20%). 1.6 million tonnes/year of coking coal production is planned.

- Fortune Minerals Limited applied for an environmental assessment for its Mount Klappan mine project in northern B.C. in October 2004. It includes an open pit mine and a preparation plant with an anticipated production of 1.5 million tonnes/year of anthracite.

287. In Alberta, Sherritt and the Ontario Teachers Pension Plan applied for an environmental assessment for a coal gasification project in early January 2007. The $1.5 billion Dodds-Roundhill Gasification Project southeast of Edmonton will be the first commercial application of coal gasification technology in Canada. The proposed project involves mining sub-bituminous coal and processing it into gas. Production will begin in 2011 and will reach its designed capacity of 320 million cubic feet of synthetic gas per day by 2012. Coal reserves and resources were estimated at 320 million tonnes in the project area and a 40-year mine lifespan is expected.

288. In Saskatchewan, a new 300-megawatt, $1.5 billion clean coal-fired power generation plant is under feasibility study by SaskPower Inc. The SaskPower Clean Coal Project will develop and adopt Oxyfuel CO_2 separation technology. SaskPower is also considering development of potential clean coal-fired generation units in the Estevan area and the Coronach/Willow Bunch area.

289. In eastern Canada, the Xstrata Donkin Mine Development Alliance (Alliance), selected by the Nova Scotia government, continued its feasibility study to develop the Donkin mine offshore of Cape Breton Island. The Alliance consists of Xstrata Coal (Australia, 66%), Kaoclay (Halifax, 20%) and Atlantic Green Energy (Savannah, Georgia, 14%). The Alliance will complete the study in 2007 and start coal production in 2008.

Australia

290. Australian export coal production capacity will continue to increase over the short to medium term as result of a number of new mining expansion projects recently completed or due for completion during 2007 and 2008. These include:

Table 7 – Australian Coal Mining Capacity Expansion

Project	**Company**	**Coal type**	**Capacity** (Mtpa)
Various opencut	BHP Billiton Mitsubishi Alliance	Coking	7.0
Poitrel	BHP Billiton Mitsui Coal	coking; PCI	3.0
Hail Creek (expansion)	Rio Tinto Coal	coking	2.5
Curragh North	Wesfarmers	coking	2.0
Isaac Plains	CVRD/Aquila Resources	coking; PCI	2.8
Carborough Downs	CVRD	coking; PCI	1.9
Dawson (expansion)	Anglo Coal	coking; thermal	5.7
Lake Lindsay		coking; PCI	4.0
Sonoma	QCoal	coking; thermal	2.0
Millennium	Peabody Energy	coking	1.5 – 3.0
Wilkie Creek		thermal	0.8
Wambo underground		thermal	2.2
Ashton	Felix Resources	thermal	2.4
Minerva		thermal	2.5
Moolarben		thermal	4.0
Newpac (expansion)	Resource Pacific	thermal	3.2
Tarrawonga	Whitehaven Mining/Idemitsu	thermal	1.5
Boggabri	Idemitsu	coking; thermal	1.5

Source: BHP Billiton

291. Whether the potential increase in coal volumes implied by these projects is fully realised will depend on the ability of Australian coal export infrastructure capacity to catch up and keep pace with demand. Recent and planned infrastructure expansions include the

following:

Table 8 – Australian Coal Export Infrastructure Capacity Expansion

Export Corridor	**Expansion Project**	**Completion Date**	**Capacity** (Mtpa)	**Corridor capacity** (Mtpa)
Goonyella (Qld)	Port (Dalrymple Bay)	Oct 06	+ 4.0 (to 60)	92
	Port (Dalrymple Bay)	Nov 07	+ 8.0 (68)	109
	Port (Hay Point Terminal)	Oct 06	+ 4.0 (to 40)	
	Port (Hay Point Terminal)	Sep 07	+ 4.0 (44)	
	Rail	Nov 07	+17.0 (to 109)	
	Port (Dalrymple Bay)	Nov 08	+17.0 (to 85)	
	Rail	Dec 09	+20.0 (to 129)	129
Blackwater/ Moura (Qld)	Port (Gladstone)	Dec 06	+13.0 (to 62)	60
	Rail		+10.0 (to 60)	
	Port (Gladstone)	Apr 07	+ 5.0 (67)	
		Jan 08	+ 8.0 (75)	
	Rail	Dec 07	+ 6.0 (to 66)	66
		Dec 08	+ 7.0 (73)	73
Newlands (Qld)	Port (Abbott Point)	Oct 07	+ 6.0 (to 21)	16
	Rail	Jan 08	+ 3.0 (to 19)	19
		Jun 08	+ 3.0 (to 22)	21
Hunter Valley (NSW)	Port Waratah Coal Services (PWCS)	Mar 07	+13.0 (to 102)	90
	Track	Dec 08	+20 (to >120)	
	Trains	Feb 08	+10 (to 110)	95
	PWCS	Dec 09	+13 (to 115)	
	Rail	Dec 09	+25 (to >145)	
	Newcastle Coal Infra-structure Group (NCIG)	Dec 10	+33 (to 33)	145

Source: BHP Billiton/Xstrata estimates

292. It appears that rail capacity in both the Goonyella and Blackwater corridors in Queensland will lag behind notional port capacities in 2007 and 2008. There is also uncertainty about the achievement in practice of some of the above headline capacities. Interest in additional infrastructure development – notably the proposed new Wiggins Island port terminal and railway project in the southern Bowen Basin, and the Northern Missing Link rail and Abbott Point expansion project in the Northern Bowen Basin – mat well build during the course of 2007/08.

Japan

293. Over the last year, Japan has continued to increase its investment in overseas coal supply, mostly but not exclusively in Australia. These investments include several projects that will increase coal supply (see section 3.1 “Company Developments” for details).

South Africa

294. The participants in the expansion of RBCT from 72 million tonnes capacity per annum to 91 million tonnes have been selected and are:

- South Dunes Coal Terminal 6.00Mt
- ARM Coal (Pty) Ltd 3.20Mt
- Exxaro Coal (Pty) Ltd 2.50Mt
- Umcebo Mining (Pty) Ltd 1.00Mt
- Tumelo Coal Mines (Pty) Ltd 0.60Mt
- Yomhlaba Resources Limited 0.50Mt

- Mbokodo Mining (Pty) Ltd 0.50Mt
- Mmakau Mining (Pty) Ltd 0.35Mt
- Worldwide Coal Carolina (Pty) Ltd 0.35Mt
- Quattro 4.00Mt

The 19 Mt capacity expansion is expected to be complete by H1 2009 and the project has resulted in the resurrection or birth of almost 30 coal projects.

295. Although the number of Black Economic Empowerment (BEE) mines has increased, their contribution in terms of total production is still very small. However, with the establishment of the bigger BEE mines, involving companies such as Exxaro, Shanduka, African Rainbow Minerals, Mvelaphanda and others, a greater shift to BEE ownership has occurred. A large number of BEE companies have acquired operating mines and new reserve blocks; and have opened a number of collieries.

296. Eskom has embarked on an extensive capacity expansion plan, and coal-fired generation will form part of the new investment in power plant. Three mothballed coal power stations, Camden, Grootvlei and Komati (combined total of 3 800MW), which were placed into reserve during a period of high excess capacity on the Eskom system, are being returned to service:

- Camden (1,580MW) - one unit was commissioned in 2006 (190MW) and four units in 2007 (772MW). Commissioning of the remaining 600MW is planned for March 2008;
- Grootvlei (1,200MW) - the first unit (200MW) will be commissioned at the end of 2007, with the balance to be commissioned by October 2009; and
- Komati (961MW) - due to be fully commissioned by 2011.

297. Two open cycle gas turbine stations are being constructed, Ankerlig at Atlantis near Cape Town (nine units) and Gourikwa at Mossel Bay south of Port Elizabeth (five units). They will have a combined total of 2,053MW and will be completed in two phases. Three units (441MW) were commissioned at Ankerlig and one unit (146MW) at Gourikwa in 2007, with full capacity expected to be commissioned by 2008.

298. Other projects include the upgrade and refurbishment of Arnot power station (300MW by 2010), construction of Medupi power station, a dry-cooled thermal base-load power station in Lephalale in Limpopo Province (six units totalling 4 500MW by 2015) and construction of the Ingula pumped storage power station near Ladysmith in KwaZulu-Natal (four units totalling 1,332MW by 2012).

Russia

299. The governmental programme “General Scheme of Energy Production Assets Location through 2020”, foresees the need for 130-180GW of new electricity generating capacity by 2020, 50GW of it by 2010, spread across all regions of Russia. The country has two electricity grids that are not interconnected.

300. Russia has traditionally generated only 17% of its power from coal, well below the world average of 29%. Gas used in thermal plants dominates the fuel mix and the country is looking to install more CCGT plant. But, building on the prospect of increasing Russian gas prices, some scenarios see coal providing 30-35% of electricity generated by 2020. Most new coal capacity will be installed in the 2011-15 period and will be power only, not CHP. Carbon capture is not planned for any new coal plant.

301. SUEK has 27 coal mining enterprises in 8 regions of Russia and produced 46.4 million

tonnes of hard coal (of which 26.3 million tonnes was exported) and 43.3 million tonnes of lignite in 2006. It is planning productivity increases at many mines and investments to address the increase in coal requirements implied by the new power station construction programme.

France

302. Although only 5% of electricity generating capacity in France is coal-fired, three new coal-fired power station projects (1000MW, 700MW and 800MW capacities) are awaiting authorisation and could commence generating in 2012-15. They will be CO_2 capture ready, with space allocated and a strategy to store CO_2. On Carbon Capture and Storage, Total has a project for a 13MW oxy-fuel demonstration plant.

303. Both POWEO and Endesa France have a project to build a coal-fired power station at Le Havre, northwest France. These projects have not yet been approved.

304. In 2006 a new company (Seren) was created to develop a mine in the Nievre department (Lucenay-Cossailles). The mine has estimated recoverable reserves of about 60 Mt of coal and would supply a 1000MW power station built on the site.

Spain

305. In recognition of the fact that coal use for electricity generation has reduced from 50% to 30% over the last few years, but that its continued use is necessary, the Spanish government is promoting two CCS demonstration plants. Spanish companies continue to invest in coal mines abroad, for example in South Africa.

United Kingdom

306. As a result of the European Large Combustion Plant Directive, some UK coal-fired electricity generating plant will in 2008 start the run down to closure. The U.K. needs 20GW of new plant in next 10 years, although it is still not clear what will be required in terms of carbon capture readiness for new plant.

307. All announced potential new coal-fired plant developments include plans for CCS to varying degrees: Powerfuel's 2 x 430MW IGCC units at Hatfield; E.ON's 450-500MW IGCC unit at Killingholme; E.ON's 2 x 800MW supercritical units at Kingsnorth; Centrica's 800MW IGCC unit at Teeside; SSE's 1-2 x 500MW supercritical units at Ferrybridge; RWE's 1600MW supercritical development at Tilbury; and RWE's 3 x 800MW supercritical units at Blyth.

308. Scottish Power announced in May 2007 that it is conducting a feasibility study with Alstom Power and Doosan Babcock to extend the life of its Longannet and Cockenzie power stations (combined capacity 3,390MW) by installing new supercritical boilers and turbines. If the proposal goes ahead, construction could start in 2009 with operations beginning in 2012. The refitted stations will be designed to incorporate carbon capture; with sequestration into deep coal seams.

4.3 Developments in Clean Coal/Near Zero Emissions Technology

309. The statement from the GLOBE G8+5 Legislators' Forum, held in Berlin on 3-4 June 2007, contained many recommendations which indicate a real desire to mitigate the effects of greenhouse gas emissions on climate change. Among these was a call to accelerate the demonstration and deployment of Carbon Capture and Storage for fossil fuel power generation.

310. The following paragraphs detail some of the developments and initiates taken towards that goal, and the goal of increasing the efficiency of coal-fired power plant, during the last year.

United States of America

311. Several coal companies and utilities are participants in FutureGen, a partnership between the Department of Energy and industry that is cooperating in construction, operation, and evaluation of technologies in a zero emission coal fired plant consisting of an integrated gasification combined cycle plant that is intended to produce hydrogen and electricity and sequester carbon dioxide in geological formations. The consortium has chosen Mattoon, Illinois as the location for the plant.

312. AEP has signed a memorandum of understanding (MOU) with Alstom for post-combustion carbon capture technology using its chilled ammonia system. It will be installed at AEP's 1300MW Mountaineer Plant in New Haven, West Virginia as a 30 megawatt (thermal) commercial performance verification project in mid to late 2008 and it will capture up to 100,000 tonnes of CO_2 per year. The Mountaineer site has an existing deep saline aquifer injection well, previously developed in conjunction with DOE and Battelle and this will be used, with others, to store and further study CO_2 injection into deep geological formations. Following the completion of commercial verification at Mountaineer, AEP plans to install Alstom's system on one of the 450MW coal-fired units at its Northeastern Plant in Oklahoma, by late 2011. This would capture about 1.5 million tonnes of CO_2 (50% CO_2 removal) a year, which will be used for enhanced oil recovery.

313. AEP has also signed a memorandum of understanding with Babcock and Wilcox to participate in an oxy-coal pilot project. This project will be used to refine the process and eventually determine if the combustion technology can be retrofitted to existing plants. AEP is working with B&W on a 30-megawatt (thermal) pilot project. The results of this project will be used to study the feasibility of a scaled up 100 – 200 MW(electrical) demonstration project, with CO_2 captured and stored in a deep saline geological formation or used for enhanced oil recovery.

314. In July 2007, the Coal Utilisation Research Council prepared a comprehensive review of current and proposed state initiatives benefiting clean coal and advanced coal technologies.

Canada

315. In January 2007 the Government of Canada announced a $230 million ecoENERGY Technology Initiative, which focuses on research, development and demonstration of clean energy technologies. The initiative will accelerate the development and market-readiness of technology solutions in clean energy and foster the next generation of clean technologies to break through emissions-free energy production and energy use. Projects such as clean coal, CO_2 storage and sequestration will be carried out by public-private partnerships.

316. In Alberta, the Genesee 3 coal-fired electricity generation unit continued to perform well.

The $695 million, 455MW unit is the most technologically advanced coal-fired power plant built in Canada. It uses a supercritical pressure boiler in which higher temperature, higher steam pressure, and an efficient steam turbine combine to increase energy conversion efficiency. The $90 million clean air technology reduces NOx emissions by 54%, SO_2 emissions by 60%, and CO_2 emissions by 18%. In total, greenhouse gas emissions have been reduced by 52% when compared to the emission levels of a standard coal-fired power plant.

Australia

317. The momentum established in 2006 by the announcement of industry and federal and state government support for low emissions coal technology development was sustained and enhanced in 2007.

318. A decision was made by the coal industry to extend the term of the COAL21 Fund and voluntary levy from five to at least ten years, with a concomitant increase in the estimated commitment to clean coal demonstration projects and related research from AU$300M to AU$1 billion.

319. The industry and the Queensland Government agreed on the formation of a Queensland Clean Coal Council to make recommendations on the application of COAL21 Fund monies to low emissions coal technology projects in that state and/or other projects of national significance (including at least the CS Energy Callide Oxy-Fuel project and an IGCC project).

320. Many new project proposals emerged, to encompass all key elements of the clean coal technology agenda, including:

- IGCC – National Gasification Pilot Plant proposal; Queensland IGCC project; HRL Integrated Coal Drying and Gasification Combined Cycle demonstration;
- Oxy-fuel – Callide A Oxy-Fuel demonstration. This project is undergoing detailed front end engineering and design work prior to the construction phase commencing in 2008. Power generation is expected by early 2010 with geosequestration to start the following year. The project is a collaborative effort between a State-owned generator, CS Energy and a Japanese consortium comprising JCOAL, JPower and IHI; the Australian Coal Association's COAL 21 Fund, Xstrata Coal, Schlumberger, the CO2CRC and the CRC for Coal in Sustainable Development. Australia's Low Emissions Technology Demonstration Fund is also providing funding for this $150 million project.
- Post combustion capture – New South Wales PCC demonstration; Hazelwood Brown Coal Drying Demonstration and PCC Pilot project; Fairview Zero Carbon Power from Coal Seams demonstration;
- Geological storage – Otway Geosequestration Trial; Queensland and New South Wales state-wide geological storage assessment proposals.

Finalisation of government and industry funding arrangements for a number of these projects is expected in late 2007/early 2008.

Japan

321. In Japan, most coal-fired power plants that have entered into operation after the mid-1990s have adopted Ultra Supercritical (USC) technology; and these twenty USC plants contribute to Japan having the highest average energy efficiency among developed countries.

322. A 250MW air-blown IGCC demonstration plant will start three year operation from this summer. This US$1 billion project is managed by the Clean Coal Power R&D Co., Ltd. (CCP), established by Japanese electric power companies.

323. The “EAGLE Project”, an integrated coal gasification fuel cell (IGFC) pilot-scale plant with a 150 tonne/day oxygen-blown coal feed had been successfully tested by the New Energy and Industrial Technology Development Organization (NEDO) and J-POWER before March 2007. It will continue capturing CO_2 for three years.

324. In his statement in May 2007 concerning post-Kyoto principles after 2013, Prime Minister Abe emphasizes the necessity of technology development, including “an innovative zero emission coal fired power plant technology” implying coal gasification and carbon capture and storage (CCS).

325. 700°C class advanced-USC R&D programs were funded by the government and feasibility studies began in 2007.

326. CCS related R&D programs are:

- demonstration of post-combustion CO_2 removal at J-POWER’s Matsushima coal-fired power plant, employing Amine absorption (Mitsubishi Heavy Industries, 2005-2006);
- demonstration of Oxy-fuel and CCS, which will begin this summer at the Callide coal-fired power plant, QLD, Australia, as the first project under the Japan-Australia joint program (Japan Coal Energy Center, IHI Corporation, J-POWER and other participants);
- geological sequestration into a saline aquifer of 10,000 tonnes of CO_2, where no leakage was observed even after an earthquake (Research Institute of Innovative Technology for the Earth (RITE), 2000-2007); and
- CO_2 injection and enhanced coal mine methane recovery (Japan Coal Energy Center, 2002-2007).

327. METI will provide the New Energy and Industrial Technology Development Organization (NEDO) direct coal liquefaction technology to China. The NEDOL technology derives from three liquefaction processes developed out of the national Sunshine Project following the 1974 oil crisis. NEDO will cooperate with two Chinese energy companies conducting feasibility studies of liquefaction processes; and these companies plan to start commercial operation of a liquefaction plant by about 2010.

328. METI is also discussing Coal-to-Liquids technology transfer with countries including Indonesia, India and the Philippines.

China

329. China is now involved heavily with Coal-to-Liquids (CTL). A deputy director of the industry department of NDRC is reported to have suggested at a conference in June that the government will not approve new CTL projects. This has not been confirmed as is being treated as rumour. Shenua has signed an agreement with Dow to look at coal-to-chemicals.

South Africa

330. South Africa is a member of the Carbon Sequestration Leadership Forum, a multilateral forum of 22-member countries with the Secretariat in the USA. South Africa is hosting the forum in 2008 and has been nominated as the deputy chair of the forum for two

years. Interdepartmental co-operation on CCS is also receiving the attention of the Department of Environmental Affairs and Tourism (DEAT), the Department of Science and Technology (DST), the Department of Trade and Industry (DTI) and the Central Energy Fund (CEF) through the South African Energy Research Institute (SANERI). There is potential for CCS in South Africa and follow up on the location and characterisation of such potential sites is underway.

331. Eskom has successfully commissioned an underground coal gasification pilot plant next to Majuba power station, following extensive studies and test work that started in 2001. The underground coal gasification process uses a matrix of wells drilled into the coal bed. Air is injected and the coal is ignited underground, producing a synthetic gas, which is harvested and then used as a fuel for either boilers or turbines. Gas from the pilot plant was successfully flared in January 2007, demonstrating that the process works.

332. As a continued contribution to the South African Government Department of Minerals and Energy's Energy Efficiency Strategy, industry has continued with the Energy Efficiency Accord.

333. Eskom is undertaking an aggressive national demand-side management (DSM) programme intended to effect permanent reductions in demand of approximately 3,000MW by 2012 and a further 5,000MW in the subsequent 13 years to 2025. The programme's objective is to alleviate imminent supply constraints and obviate the need for more costly supply options that are currently under consideration.

Germany

334. In August 2007 a new information centre IZ Klima (Informationszentrum klimafreundliches Kohlekraftwerk www.iz-klima.de) was set up in Germany to establish a platform for the exchange of information on the development of CO_2-free power plants as well as to research the technological and economic potential of this technology. IZ Klima was founded by seven companies: Alstom Power, EnBW, E.ON, Hitachi Power Europe, RWE Power, Siemens Power Generation, and Vattenfall Europe. Several ministries, and research institutes from Potsdam and Hamburg, are also represented on the advisory board.

335. The early 2007 EU Commission Energy Strategy paper requires 12 large scale demonstration power plants with CCS technology to be in place by 2020. To reach this goal, several German energy companies are already working on pilot projects and demonstration power plants - some including the whole CO_2 chain from combustion to storage.

336. Estimates made by energy institutes as preparation for energy programme talks in Germany suggest that a market driven breakthrough of CCS could happen at CO_2 emission permit prices above €36/tonne CO_2. RWE Power is taking a lead role in building a 450 MW IGCC CCS demonstration plant which will go on stream in 2014 and includes storage. A second project has been launched by Vattenfall, and E.ON is also planning to invest heavily in clean coal technology.

Spain

337. A CCS research platform involving the electricity and oil industries and several research institutions has been created in Spain. It is intended to develop a CO_2 capture and storage project at a 320MW ELCOGAS IGCC plant currently in commercial operation.

Turkey

338. In cooperation with universities, Research & Development studies on installing a pilot-scale Coal-to-Liquids plant at one of TKI's mines are continuing.

United Kingdom

339. BP has abandoned plans for a £500m UK carbon capture power plant at Peterhead in Aberdeenshire, citing government delays as the reason.

340. CCS is a vital strategic element in the plan to minimise the impact of coal combustion on climate change, but it is a costly process and current price signals from the traded carbon market are insufficient to support economic investment in this technology. A robust and enduring post 2012 carbon market framework will therefore be key to delivering the right investment signals for CCS. In the meantime, the UK Government will launch a competition later in 2007 to develop a commercial scale clean coal CCS demonstration which will be used to test the technological viability of the process. Simultaneously, the eligibility of CCS under the EUETS will be addressed from legal and regulatory perspectives.

341. On the R&D front, a new Energy Technologies Institute focusing on low carbon energy technologies is in the process of being established.

5 CONCLUDING REMARKS

342. The information given in the body of this paper has been compiled with the help of CIAB Associates and using some published sources. It describes developments over the last year in international coal markets and in environmental/energy policy in various countries from the perspective of individuals active in the coal, electricity and transport industries.

343. During the last year, the focus of CIAB work has been on supporting the IEA Secretariat in delivering responses to the G8 Gleneagles Summit action plan and the particular challenges for coal, bringing the expertise of CIAB Members and their Associates to the issues through meetings and workshops. Section 1 of this paper summarises the high level messages derived from this work, while other sections highlight relevant developments in international coal markets, policy and investment to sustain the necessary role for coal in world energy supply and use.

CIAB, December 2007