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FOREWORD

The coal sector has undergone two major changes in the last decade. One change is in the global demand structure: As of 2000 coal demand from developing countries started increasing in an unprecedented way, the bulk of the increase coming from steam coal demand for power generation. Coal has provided China, India and other emerging economies with affordable and dependable electricity supply and fuelled the economic growth in these countries.

The other change is the emergence of derivative coal markets. The OTC swaps markets for coal have been thriving since the 1990s. However, creation of coal futures exchanges, which have better transparency than OTC markets, came later than for the other commodity markets. In recent years, futures exchanges for coal have been established in the US, Europe and Australia and the role of futures exchanges is growing in the coal sector. This study examines pricing of internationally traded coal under these changing circumstances.

In 2008 the financial/economic crisis resulted in extreme volatility in the commodity market. All the commodity prices including coal and oil prices went up and came down sharply at a scale the commodity markets had never seen before. This report also looks into how coal prices went through this bubble period.

Coal comes with a substantially higher emission of CO$_2$ than other fossil fuels. To address the challenge of decarbonising the energy sector emission trading schemes were introduced recently, mainly in the European Union. CO$_2$ emission allowance prices already have an influence on coal markets, which will likely grow in the future.

In the Energy Charter discussion, coal was often in the shadow of gas and other grid-bound energies. However, coal including lignite, peat and coke is clearly covered by the Energy Charter Treaty under “Energy Materials and Products” in Annex EM. I hope that this report will help coal, which plays such an important role for economic development, to establish its rightful place in the Energy Charter discussion.

This report is made publicly available under my authority as Secretary General of the Energy Charter Secretariat and without prejudice to the positions of Contracting Parties or to their rights or obligations under the Energy Charter Treaty or the WTO agreements.

André Mernier
Secretary General
Brussels, April 2010
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Chapter 1 Introduction

1.1 International Coal Market

As an energy resource, coal has very different characteristics from those of oil or natural gas. Coal is the most abundant fossil fuel. According to BP Statistics, coal’s R/P ratio (remaining reserves divided by annual production) is currently 122 years, compared to 42 years for oil and 60 years for natural gas (Figure 1). While oil reserves are concentrated in the Middle East, coal reserves are more evenly split among Asia Pacific, North America and Europe and Eurasia (Figure 2). Consequently, the risk of a major supply disruption is less than for oil.

Many countries have adequate indigenous coal reserves, which are normally developed for domestic use. Less than 20% of the global hard coal production (and a very small volume of brown coal) is traded internationally.

Coal demand started rising in an unprecedented way in around 2000, with the bulk of demand growth taking place in developing countries. Coal has essentially provided these rapidly growing economies with dependable energy and affordable electricity during the last decade.

Another change in the coal sector during the 2000s is the evolution of electronic trading platforms, derivatives OTC markets and futures exchanges.

![Figure 1: R/P Ratios (2008)](image1)

![Figure 2: Coal Proved Reserves (2008)](image2)

Prices of coal have historically been much lower than those of oil and natural gas. In addition, coal prices were quite stable and were not linked to oil prices until recently. Figure 3 shows the relation among the US industrial sector end-user prices of natural gas, steam coal and coking coal as well as crude oil (WTI) prices in nominal terms. In the aftermath of the oil
crises coal prices show a rise in 1978-1984. But this is less than the increase in oil and gas prices. Coal prices remained stable at around $50-$60 per tonne for steam coal and at around $70-$80 per tonne for coking coal until around 2002.

Coal prices started diverting from the ranges described above and started rising in 2003-2004. This was the time when all commodity prices went up. While commodity index funds, which are often blamed for causing commodity price increases during the period from 2003 to 2008, do not normally invest in coal, there have been talks of investment by financial institutions in the paper coal market.

When WTI posted its record high of $147 in July 2008, coal prices also reached their peaks – spot coking coal was priced at as high as $350 per tonne while spot steam coal prices rose over $200 per tonne. Subsequently, like oil and other commodity prices, coal prices fell in the wake of financial crisis and economic recessions in autumn of 2008, and came down below $50 in early 2009. At the time of writing, ICE Rotterdam coal futures are traded at around $73-75 per tonne.

Figure 4 shows daily prices of coal and crude oil futures at the New York Mercantile Exchange (NYMEX) from January 2003 to August 2009. While coal futures prices are still not representative of the entire coal prices in the same way as oil futures prices are for all the oil prices, the graph suggests that coal and crude oil prices are getting more correlated in recent years. This issue will be further examined in Section 3.6 “Commodity Bubble in 2008”.

Figure 3: US End-User Prices (1978-2008)

Figure 4: NYMEX Coal and Crude Oil Futures Prices (2003-2009)
1.2 **Coal Quality and Classification**

Coal was formed out of plant remains accumulated in swamps and peat bogs. Over time, the chemical and physical properties of the remains were changed by high temperatures and pressures. This caused the vegetation to transform into peat and then into coal. The formation of today’s coal resources began during the Carboniferous period 360 million to 290 million years ago. The quality of coal is determined by temperature, pressure and time. There is a wide range of physical and chemical properties of coal (including heat value, volatile matter, carbon content, sulphur content, moisture, ash, etc.), and there are different coal markets according to coal qualities.

There are a number of standards available to classify coal with different qualities and usages. Different countries use different standards in producing their statistics. This is an issue when trying to produce regional or worldwide coal statistics. This report mainly uses the IEA statistics and criteria, which are originally the International Coal Classification of the UN Economic Commission for Europe (ECE). According to it coal is divided into hard coal and brown coal by carbon and moisture contents (Figure 5). Hard coal consists of coking coal and steam coal, while brown coal includes sub-bituminous coal and lignite.

Coal contains elements that are important particularly in view of environmental concerns. In addition to CO₂ emissions, which are discussed in Chapter 4 “CO₂ Emission Trading”, combustion of coal produces SOₓ and NOₓ. Furthermore, there are issues of tailings and land degradation from open cut mining. Needless to say, various technologies are developed and deployed to minimise these emissions, pollution and damages.

**Figure 5: Types of Coal**

![Diagram of Types of Coal](source)

Coking coal is used to produce steel. Around two thirds of steel production worldwide comes from iron made in blast furnaces fed by coke. Coke is made from coking coal, which has not only energy contents but also certain physical properties that are suitable to transform itself into hard but porous coke. Coke is produced by crushing and washing coking coal and then carbonising it in a coke oven in the absence of oxygen. Impurities and by-products are
removed through this process. Some furnaces use cheaper steam coal as a substitute, with technology called pulverised coal injection (PCI). Coking coal also needs to have low sulphur and phosphorous contents. Therefore, it is scarce and expensive, and is traded in a different market from that of steam coal.

Meanwhile, steam coal (also called thermal coal) is used to generate electricity. While the use of coal as a transport fuel has been long gone, the coal use for electricity generation has been growing drastically in the last decade. Heat and sulphur contents are considered the primary factors for steam coal, and ash as a secondary factor. The ash content of coal can vary very widely, and this results in a corresponding variation in the energy content of a tonne of coal. While many coal statistics and some prices are given in tonne of coal (as it is), for comparison purposes one should translate such statistics or prices into figures expressed in tonne of coal equivalent (tce). At coal-fired power stations, coal is first milled to a fine powder and the powdered coal is blown into a combustion chamber and burnt at high temperature. This is called pulverised coal combustion (PCC) systems, which accounts for over 90% of the coal-fired power capacity worldwide.

In the world primary energy mix, coal is the second largest source of energy, after oil and ahead of natural gas. It accounts for 27% of the global energy supply (Figure 6). Worldwide statistics on coal consumption by sector is not available at this time, but presumably electricity generation accounts for two thirds of the global coal demand. According to the IEA, 81% of the coal supply in OECD countries in 2007 was used for power generation and 10% by industry sector (including 3% by steel industry). At the same time, coal accounts for 41% of the world electricity generation (Figure 7), and is expected to remain a key component of the electricity generation fuel mix in the future.

**Figure 6: World Primary Energy Supply (2007)**

![Figure 6: World Primary Energy Supply (2007)](image)

**Figure 7: World Electricity Generation by Fuel (2007)**

![Figure 7: World Electricity Generation by Fuel (2007)](image)
1.3 **Brief History of Coal Use**

Humankind has been using coal as fuel for a long time. There are accounts of early coal use in various parts of the world. In China, coal use can be traced back to the 2nd century B.C. during the Han Dynasty, or even before according to some historians. More importantly, in the 12th century under the Song Dynasty, six centuries before the English Industrial Revolution, the Chinese started using coal to produce iron on an industrial scale. In Greece, the records go back to the 4th century B.C. when coal was used by blacksmiths. In Britain, coal mines were exploited by the Romans by the 2nd century and coal cinders dated back to the 4th century were found in ruins.

Coal use increased exponentially during the Industrial Revolution in the 18th and 19th centuries. There were two elements, steam engine and iron production, that affected each other and caused the drastic increase in coal use. Newcomen’s coal-fired steam engine was invented to pump water in England in 1712, followed by a much improved one by Watt in 1765. Watt’s engine was initially used for pumping water but was later applied to power textile manufacturing. The first steam boat was invented by Fulton and began operation in the US in 1807. Meanwhile, Stephenson built a steam-powered locomotive in England in 1814 and the first public steam railway started operation in England in 1825. These industrial developments were made possible by a new steel-producing technology, in which coke replaced charcoal in iron smelting. This was first applied to lead and copper refining and, then, to iron foundry work in the 1690s. The ample supply of steel helped in turn the development of boilers, steam engines and railways.

Coal was also used for gas lighting. To do so, coal needed to be first gasified in furnaces, then the resulting gas was stored and distributed. The first gas lighting infrastructure was built in London at the beginning of the 19th century. The first practical coal-fired power generation plant, developed by Edison, began operation in New York in 1882, supplying electricity for household lights.

In the middle of the 18th century, there were around 3,000 coal mines in Britain, with the country producing 60% of world production. By the start of the 20th century the US overtook Britain in coal production, and by the 1920s the US consumed about 50% of world production – as China does at the beginning of the 21st century.

On the eve of the World War I, Churchill converted the fuel of the British naval fleet from coal to oil, seen by many as the starting point of the change in the human race’s main energy source from coal to oil. Oil overtook coal as the biggest energy source in the 1960s, which has supported a rapid increase in overall energy use during the decade and onwards.

In one episode of history, coal took part in building the foundation of the European Union. In 1951 Belgium, France, Luxembourg, the Netherlands and West Germany signed the Treaty of Paris, to create a common market for coal and steel.
Chapter 2 International Coal Trade

2.1 Growing Demand

International coal trade began in the mid-19th century, dominated by the UK and South Africa. The present market was created in the aftermath of two oil crises in the 1970s. Global coal demand increased gradually in the 1980s (Figure 8). In OECD countries, this upward trend lasted until the end of the 1980s and resumed its course in the mid-1990s after a brief decline in the early 1990s. Meanwhile, in non-OECD countries coal demand continued to rise until the Asian financial crisis in 1997. In around 2000, coal consumption in developing countries started increasing in an unprecedented way. Between 2000 and 2008 world coal demand increased by more than 40% or at an annual rate of 4.4%. Coal demand in non-OECD countries rose by 75% or at an annual rate of 7.3%. In fact, only 5% of the global growth between 2000 and 2008 came from OECD countries and the rest from non-OECD countries. Coal costs less than other fuel sources after all, even taking extra pollution protection into account, and the resources are domestically available almost in every country. Coal has fuelled economic growth in China, India and other developing countries in recent years.

China leads this growth in coal consumption. Chinese coal consumption more than doubled between 2000 and 2008, growing at a rate of 9.8% per year. China accounted for 43% of world coal consumption in 2008 and for 85% of demand growth. Economic growth is behind this increase. Looking closer into the relation between the Chinese economy and its coal demand (Figure 9), the two grew steadily in tandem before 1997. Between 1997 and 2001, however, economic growth and coal demand went in different directions. Analysts think that this was a statistical anomaly which took place when the Chinese government was proceeding with the policy of closing illegal mines. On the graph, the economy restarted its growth in 2002, and since 2003 both coal demand and economic growth have been surging.

Coal is by far the largest primary energy source in China, meeting nearly 70% of the country’s growing energy needs (Figure 10). While oil consumption is increasing rapidly due to expanding vehicle ownership in the transportation sector, oil accounts for less than 20% of the total primary energy mix. By comparison, coal is widely used in power generation as well as the industry, commercial and residential sectors.
In China, coal accounts for around 80% of the electricity generation fuel mix, and over 90% of the newly installed generation capacity is coal-fired. Therefore, coal is expected to remain as the main power generation fuel in the future. Industrial coal consumption is also large, accounting for 59% of energy consumption in the industrial sector in 2005 or 25% of total energy consumption of the economy as a whole. The iron and steel, chemicals and non-metallic minerals industries are large-scale coal consumers. Coal is used for heating in the residential sector as well.

China’s heavy coal use has environmental implications. According to the World Bank\(^1\), twenty Chinese cities are among the top thirty most polluted cities in the world. The social costs for health damage resulting from local air pollutions are high. China became the largest CO\(_2\) emitter in 2007.

\section*{2.2 Development of International Coal Trade}

According to the IEA statistics, some 938 million tonnes of hard coal were traded internationally in 2008, accounting for 16% of the world hard coal production of 5,845 million tonnes. This percentage is much lower than those of oil and gas. International coal trade is essentially limited to high quality, expensive coking coal and steam coal due to coal’s

\footnote{\url{http://web.worldbank.org/WEBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/CHINAXEXTN/0,,contentMDK:20680895--pagePK:1497618--piPK:217854--theSitePK:318950,00.html}.}
lower calorific contents relative to oil and gas, high costs of transporting solid-state coal and competitions from domestic sources. International trade of lower-priced brown coal is almost nonexistent. Brown coal trade volumes amounted only to one fortieth of hard coal trade volumes in 2008. Out of the 938 million tonnes of internationally traded hard coal, seaborne trade accounted for over 90%. Seaborne trade volumes are increasing while overland trade volumes are declining (Figure 11).

Before the 1960s international coal trade was primarily land-based and between neighbouring countries. The main coal trade took place within Europe and the former Eastern bloc. Germany was the major exporter to Western Europe, while Poland and the Former Soviet Union were the major suppliers to Eastern Europe. In North America, there was also land-based coal trade from the US to Canada. The only major seaborne coal trade was from the US to Western Europe and Japan.

An international coking coal market was established in the 1960s – there was an increasing demand for coking coal in industrialised countries. Expensive indigenous coking coal was replaced with low-cost supplies from abroad, which led to considerable growth in seaborne trade. Japanese steel mills started receiving supplies under long-term contracts with Canadian producers in the late 1960s and with South African producers in the mid-1970s. Newly industrialised countries, such as Korea, Chinese Taipei and Brazil, followed the trend and became major importers of coking coal during the 1970s.

The first oil crisis of 1973 created an international steam coal market. As oil prices rose, there was an economic incentive to switch fuel from oil to coal at power plants and industrial complexes. Following the second oil crisis of 1979, the IEA banned its member countries from building new oil-fired power generation plants under the declaration of “Principles for IEA Action on Coal”.

With newly built coal-fired power plants starting operation, coal use in power generation accelerated. By the mid-1980s world hard coal trade doubled from the pre-oil crisis levels, and by mid-1990s seaborne trade accounted for 90% of international trade.

South Africa and Australia both expanded their market shares considerably during the 1980s. US exports fell under intense competition. While small in volume terms, China and Colombia also expanded their exports during the 1980s.

Figure 12 shows that it is steam coal trade for power generation that has been increasing since the mid-1980s, while coking coal trade for steel production has remained relatively unchanged.
For the ten years between 1990 and 2000 global coal consumption increased by only 4.7%. In the Former Soviet Union and Eastern Europe, coal demand started falling in the mid-1980s and decreased drastically in the 1990s due to social and economical turmoil. This trend was reiterated by the transition from communist-era energy infrastructure to more efficient one in later years. Coal demand kept falling in these regions until very recently. Conversely, global coal trade grew by 25% between 1990 and 2000 as industrialised countries continued to switch from their expensive domestic coal to cheaper imported sources.

The late 1980s and the early 1990s were a time when acid rain and CO₂ emissions caused by fossil fuel burning drew public attentions. To take measures against acid rain, the US Clean Air Act was amended in 1990. In 1992 the UN Earth Summit was held in Rio de Janeiro to discuss climate change and reducing CO₂ emissions, which led to conclusion of the UNFCCC in 1992, followed by the Kyoto Protocol in 1998. These events profoundly affected the use of fossil fuels in general and that of coal in particular (see Chapter 4). Coal is particularly problematic for climate change because it has the highest carbon content of any fossil fuel. Nonetheless, supported by the rapid demand growth, world coal trade has been expanding at a much faster pace since 2000. It grew by 46% from 2000 to 2007. This growth is converted into an annualised rate of 5.5%, even higher than 5.1% per year for global coal demand growth during the same period. While coal demand growth is led by non-OECD countries, this expansion in coal trade involves both OECD and non-OECD countries. Currently, imports by OECD countries account for two thirds of the global coal trade.

### 2.3 Major Exporters

In terms of proved coal reserves, the US has the largest ones, followed by Russia and China. These three countries hold more than 60% of the world’s coal proved reserves. Australia, the largest coal exporter, has the fourth largest reserves, accounting for 9% of world reserves, while Indonesia, the second largest exporter, has only 0.5%. As far as annual production volumes are concerned, China is the largest, accounting for more than 40% of the world’s production. The US is the second largest producer followed by Australia and Russia.

The IEA statistics shows that Australia exported 252 million tonnes of hard coal in 2008, holding a 27% share in the world hard coal trade. In particular, Australia dominates coking coal trade. The country’s coking coal exports in 2008 stood at 137 million tonnes, accounting for 52% of the world coking coal trade. Steam coal exports accounted for the remaining 115 million tonnes (18% of the world steam coal trade). The Asia Pacific region is Australia’s main coal export market, with 40% of its exports going to Japan. Other export destinations include Europe, the Americas and Africa.
As of 2007, there were 121 coal mines in production in Australia – 45 were underground mines and 76 open pit operations. Most mines are located in New South Wales and Queensland. Coal produced in these states is transported by rail or large trucks to loading terminals on the eastern coast of the country. There are nine of them located in the two states, including the Newcastle port with a 102-million-tonne-per-year capacity. Australia’s coal sector is dominated by the “Big Four” – BHP Billiton, Anglo American, Rio Tinto and Xstrata. The country is expected to continue its dominance in the world coal trade.

In Australia, the coal mining industry is regulated by states (essentially by the governments of New South Wales and Queensland). State governments issue mining leases and exploration licences, collect rents and royalties, and charge the use of transport infrastructure including port facilities. They also have considerable responsibilities for planning matters. Royalties are charged as a percentage of the value of production. In New South Wales, for example, the rates are 6.2% for deep underground mines, 7.2% for underground mines and 8.2% for open cut mines. On top of this, the Commonwealth government imposes a normal 30% company tax on the taxable income.

**Indonesia** is the second largest hard coal exporter, with 203 million tonnes of exports in 2008 or 22% of the global trade. Its exports continue to increase – the export volumes doubled between 2003 and 2008. Indonesian coal generally has low sulphur content, and more than 80% of the exports are steam coal. Surpassing Australia in 2005, Indonesia is currently the largest steam coal exporter. The country is ranked third in coking coal exports. But its coking coal has only marginal coking characteristics. Indonesia’s exports also go to the Asia Pacific countries, with Japan being the main destination. Indonesia exports three quarters of its coal production now, but there are concerns that the country may need more coal for its own coal-fired power generation and heavy industries in the near future.

Indonesia’s coal resources are located in South Sumatra, East Kalimantan and South Kalimantan. The deposits are relatively young, and lignite and sub-bituminous account for more than 80% of the reserves. Almost all of the mines are open-cast. They are typically located near tide water or river and coal is transported by river barge, rail and trucks to the sea port terminals. Along with state-owned PT Bukit Asam, private Indonesian companies and foreign-owned coal mining companies dominate production in volume terms. However, small-scale illegal mining is a widespread problem in the country’s coal sector.

In Indonesia coal mining projects are carried out under two types of licenses – Coal Contract of Work and mining authorisation. The Coal Contracts of Work are concluded between the Indonesian government and a private Indonesian company or a foreign company (called “contractor”). There are three generations of the Coal Contract of Work. The first generation contracts were concluded in the 1980s, the second generation contracts in 1994 and the third generation contracts between 1997 and 1999. Currently most coal mines are operated by the first generation contractors. The contracts require foreign contractors to transfer 51% of the equity interest to Indonesian companies ten years after the start of production. The contracts also stipulate two taxes which the contractors are subject to: income tax (45%) and the tax for coal production fund (13.5%). Meanwhile, mining authorisations are granted to Indonesian nationals or corporations for smaller projects.

**Russian** hard coal exports were falling until 1998 but rebounded afterwards. They have been increasing rapidly in recent years, showing a comparable growth to Indonesian exports. **Russia’s coal production** started increasing in the late 1990s, after restructuring of the

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2 For 1990 and onwards coal trading volumes between countries in the Former Soviet Union (e.g., Russia, Kazakhstan, Ukraine, etc.) are counted in the IEA statistics.
Putting a Price on Energy: International Coal Pricing

industry. Uneconomic coal mines were closed and the remaining mines were privatised. The coal sector saw the introduction of new investment and new technologies. These resulted in improved efficiency and competitiveness.

Figure 13: World Hard Coal Exports (1984-2008)

Russia exported just over 101 million tonnes of hard coal (15% coking coal, 85% steam coal) in 2008, ranked as the third largest exporter after Indonesia. While Russia has access to the Asia-Pacific market, the bulk of country’s exports goes to Europe. Its main coal producing regions are the Kuzbass basin in West Siberia and the Kansk-Achinsk region in Central Siberia. The distances from these mines to the main consumption centres of Urals and Moscow are thousands of kilometres and the distances to the main export terminals to Northwest Europe on the Baltic Sea are more than 6,000 kilometres. Coal is transported over these long distances via rail. Therefore, competitiveness of Russian coal exports depends on the domestic rail tariffs.

In 2008 Colombia was the fourth largest hard coal exporter, slightly ahead of the US. Colombia’s production and exports have been growing fast in the last decade and are likely to continue to increase in the future. Its exports entirely consist of steam coal. Colombia’s coal is relatively clean with low sulphur contents. The country’s largest Cerrejon coal mine is the world’s largest export open pit operation. It is located in the north-eastern part of Colombia and operated by a consortium composed of Anglo-American, BHP Billiton and Xstrata. Colombia’s coal export infrastructure is located on the Caribbean coast and its exports go to Europe, North America, and other Latin American countries.

The US holds the world’s largest coal reserves and is the second largest in both production and consumption. Its main coal producing regions are: the Appalachian basin, the Illinois basin, the Powder River basin (Wyoming and Montana) and the Western region (Arizona, New Mexico, Utah and Colorado). Coal is transported over long distances via rail and waterway transport to consumption centres and export terminals on East Coast, West Coast and the Gulf of Mexico. According to the US DOE/EIA, rail transportation accounted for 64% of the total coal delivered to domestic consumers in 2004. The US railway industry was deregulated in the early 1980s, and railway transportation rates for coal kept declining for a long period of time after the deregulation. However, the rates started rising in 2005 due to fuel surcharges and infrastructure investment to cope with growing demand.

US coal exports peaked at just below 100 million tonnes in 1991 and have been in decline since then. The US export volume stood at 74 million tonnes in 2008, with coking coal
exports marginally outweighing steam coal exports. The US is the third largest coking coal exporter after Australia and Indonesia. Canada is the main export market for US steam coal. US exports account for only a small portion of total production and the well-developed infrastructure can bring coal onto the international market fairly quickly. These underpin the US’s position as marginal supplier.

Coal accounts for just below 80% of South Africa’s primary fuel mix. This percentage is even higher than that of China. South Africa’s coal production is on a par with that of Indonesia, at 141 million tonnes oil equivalent in 2008 (BP Statistics). But the production volume increases only marginally in recent years. South Africa’s coal sector is highly concentrated with six companies (Anglo American, BHP Billiton, Sasol, Eyesizwe, Kumba and Xstrata) accounting for 90% of the production. Around two thirds of the country’s coal production is consumed domestically for power generation and Sasol’s coal-to-liquid production3, while the remaining one third is exported to Germany, Spain and Japan. Most South Africa’s coal exports are steam coal. Its quality is, however, at the lower end of internationally traded coal. The country’s main export terminal is Richards Bay.

China exported 47 million tonnes of hard coal in 2008, about a half of its peak in 2003. With 45 million tonnes of imports in the same year, the country barely remained as a net exporter. In fact, the country has become a net importer for the first time in 2009. The Chinese government has placed coal export restrictions in the form of taxes and quotas to secure coal supply to its domestic markets. At the same time, the government is cracking down on small, illegal coal mines on health and safety grounds. Currently, around 6,000 coal workers die each year due to accidents.

In addition to these countries, Canada, Kazakhstan, Poland, Venezuela and Vietnam are important suppliers in the international coal market.

2.4 Major Importers

Large coal importers look somewhat different from large coal consumers. With a few exceptions, large coal importers are OECD countries. OECD countries imported 65% of the global coal trade in 2008 while consuming 35% of the world production. Imports by non-OECD countries are, however, growing at a rate twice as much as that for OECD countries in recent years.

Large coal importers are concentrated in the Asia Pacific region and Western Europe. In the Asia Pacific market, Japan, Korea, Chinese Taipei and India are ranked in the top four and all together account for 45% of the global imports. In Western Europe, Belgium, France, Germany and the UK import large volumes of coal. OECD Europe imports 27% of the world’s traded coal. While being major producers and exporters, Canada, China, Russia and the US also import large volumes of coal due to mismatches in geography or coal qualities.

Japan is the world’s fourth largest consumer and the largest importer, accounting for 20% of the global hard coal trade. The country’s imports are expected to remain large in the future. Main exporters to the Japanese market are Australia (65% in 2008), Indonesia (15%) and China (8%). Although Japan produced enough coal for its consumption until around 1960, the country now relies almost entirely on imports. Most of its costly coal mines have been shut down and there are only eight small mines operating in the country, producing less than 1% of its consumption.

In 2007 coal was Japan’s second largest energy source after oil, accounting for 20% of primary energy supply. In terms of electricity generation, coal (23%) was the third largest

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3 In producing similar final products, coal-to-liquids plants have to emit much larger CO2 emissions than normal oil refineries would.
electricity generation fuel after nuclear (24%) and LNG (24%). Electric generation accounted for 47% of Japan’s coal use and steel production for 36% (the country is the second largest steel producer after China). Annual price negotiations under long-term supply contracts between Japanese steel mills and Australia’s BHP Billiton have a critical impact on the coking coal market as well as the international coal market in general.

**Korea** imported 100 million tonnes of hard coal in 2008. The country is the eighth largest consumer and the second largest importer, accounting for 11% of the world hard coal trade. Coal consumption has doubled during the last decade and is likely to continue to increase. Half of coal demand comes from electricity generation while coal use for steel and cement industries accounts for a third. Korea imports more than 95% of its consumption from Australia, China and other countries. In the 1990s the Korean government rationalised the country’s coal industry and, as a result, coal production fell from its peak of 24 million tonnes in 1988 to 3 million tonnes in recent years. Given how the positions in Japan and Korea have changed so quickly in relation to imports and domestic production of coal, similar things may happen in future, for example in China and India.

**Chinese Taipei** is the third largest importer, ahead of India, importing 66 million tonnes of hard coal in 2008. With no indigenous production, Chinese Taipei is totally dependent on imports. Coal is the country’s second largest energy source after oil, accounting for 36% of the country’s primary energy mix. Around 80% of the coal the country consumes is for power generation.

**India** is the fourth largest coal importer, importing 29 million tonnes of coking coal and 31 million tonnes of steam coal in 2008. Moreover, the country is the world’s fourth largest coal producer out of the fifth largest reserves. Coal accounts for more than 50% of its primary energy supply and for more than 70% of its electricity generation fuel. With relatively small indigenous oil and gas resources, coal is expected to remain as the dominant fuel in India’s future fuel mix.

India’s recent economic success has pushed up its coal demand for electricity generation and steel production, and domestic production cannot keep up with the pace of a rapid consumption increase. As a result, imports have increased by 90% in the last decade. Currently, around 80% of coal consumption is supplied from indigenous sources with the remaining 20% imported. The other factor for this increase is the poor quality of Indian coal. Its steam coal has low heating values and its coking coal is almost unsuitable for steel making. In addition, the average quality is declining with the depletion of good-quality deposits. Indian coal imports are expected to continue to rise in the future.

European coal consumption fell during the second half of the 1980s and throughout the 1990s, because power generation switched from coal to gas and as residential coal use declined. Coal consumption started recovering in around the year 2000 but has not returned to the previous levels. Currently coal is the third largest primary energy source (18% in 2007) after oil and natural gas. More than 80% of coal supply is used for power generation in Europe. The steel industry accounts for 5% and other industries and applications for 14%.

Coal production in Europe declined sharply due to competition from low-cost coal producing countries and reduction of subsidies. As a result, imports have been rising steadily. Imports accounted for just above 70% of hard coal consumption in OECD Europe in 2008. The largest exporter to the European market as a whole was Russia (24%), followed by South Africa (16%). With environmental concerns and emphasis on natural gas as a fuel for power generation, the US EIA/DOE forecasts that European imports will increase only slightly over the current levels to 2030.

**Germany** was the largest coal importer in Europe, with 46 million tonne of imports in 2008. The bulk of Germany’s imports are steam coal for power generation. The country’s import
sources are diversified – Australia, Poland, Colombia, South Africa and Russia hold a 10-20% share each in the market.

Germany is the world’s largest lignite producer and the second largest hard coal producer in Europe, after Poland. Coal (including both hard coal and brown coal) accounts for more than a quarter of the country’s primary energy mix and over two thirds of the coal the country consumes is produced domestically. Lignite and sub-bituminous account for more than two thirds of the country’s domestic production, while hard coal production accounts for the remainder. RAG is Germany’s largest producer. It is controlled by the RAG Foundation and its domestic coal mining activities are managed by Deutsche Steinkohle AG. While lignite production is economically viable and not subsidised, hard coal production costs more than the world market price and requires aid from the federal and state governments.

In 2007, however, the German government decided to phase out coal subsidies by 2018. Currently there are six coal mines and 27,300 workers in the country’s coal sector. The phase-out plan includes shutting down of these mines, compensation payments to these mine workers, and programmes to address the social and environmental effects of the coal mines, with a €22 billion budget to 2018. Separation of RAG’s non-mining activities, including power stations, real estate and chemicals production, took place in 2007, and these businesses are now managed by Evonik Industries.

The UK imported 44 million tonnes of hard coal in 2008, the second largest amount in Europe. Coal is the third largest primary energy source (17% in 2008) after natural gas (40%) and oil (37%) in the country. Over 80% of coal use is for power generation and this contributes to more than 30% of the UK’s electricity supply. Coal imports account for 70% of the country’s demand. Similar to Germany, a large percentage of the imports is steam coal. By source, half came from Russia. On the domestic production, there were 35 surface mines and six major deep mines in operation at the end of 2008, producing 17.5 million tonnes during the year.

![Figure 14: World Hard Coal Imports (1984-2008)](image-url)
Chapter 3 International Coal Pricing

3.1 Recent Price Developments

Prices of internationally traded coal are normally expressed in US dollars per tonne or tonne coal equivalent (tce) as a price which would refer to certain energy content. CIF (costs, insurance and freight) prices are used for coal imports and FOB (free on board) prices for coal exports. The FOB price is the price of coal itself plus domestic transport costs from a mine to a terminal in the exporting country. The CIF price includes, in addition to the FOB price, all the costs for international transportation up to a receiving terminal in the importing country. The US uses a term “free at shipside” or “FAS”, instead of FOB. The difference is that FOB includes the cost of loading but FAS does not.

Coal prices vary according to qualities, quantities, transportation costs, and other conditions. As explained in Chapter 1 “Introduction”, hard coal is divided into coking coal for steel production and steam coal for power generation. There are two distinct markets for steam coal and coking coal, although they interact and substitute for each other to a limited degree. Steam coal prices are commonly adjusted according to the calorific content measured in kilocalories per kilogramme (kcal/kg). The standard calorific content is 6,000 kcal/kg (net as received). Australia sometimes uses 6,700 kcal/kg (gross air dried) and China 5,800 kcal/kg (net as received). Furthermore, coal is sometimes priced on tonnage basis.

In the 1990s, coking coal prices played a leading role in pricing overall coal prices, and steam coal prices were often set by being discounted from more expensive coking coal prices. However, influence of steam coal prices in the market have increased significantly over the last decade, as demand for steam coal grows. Major spot and futures coal prices are ones for steam coal now. Coking coal would not compete with natural gas, or other energy sources but steam coal does.

Global coal demand started increasing in around 2000 and the growth was accelerated in around 2003. Coal is the fastest growing energy source and is fuelling the rapid economic growth of developing countries. The word “BRICS” refers to fast-growing developing economies of Brazil, Russia, India, China and South Africa. These countries are also large coal producers/consumers with the exception of Brazil.

Coal prices rose by 40%-50% in one year between 2003 and 2004. As buyers tried to secure supplies, excessive quantities of orders were placed, which was more than supply chains could manage at the time. Ships had to spend a long waiting time before entering a port for loading, especially in Australian ports due to some lagging behind in capacity expansion. As a result, coal prices increased and freight rates rose. Although the situation improved slightly in 2005, with stocks built up to adequate levels to buffer changes in demand, coal prices continued to increase. Price increases halted in 2006 but re-started in 2008. China’s coal export ban and floods in Australia contributed to further increases in coal prices.

The EU’s annual average import price for steam coal rose from $42 per tonne in 2004 to $138 per tonne for 2008. Other coal prices went up in the same way. Also, increasingly freight played a role, in view of some bottlenecks in shipping capacity (as a result of waiting times in some ports; as a result of bottlenecks in ship yards which focused on the construction of double-hull oil tankers following the Prestige accident and the resulting double-hull tanker regulations; and because of the resulting capacity problems from not being able to replace retired bulk carriers).

Prices fell drastically in the wake of economic downturns starting in autumn 2008. The economic downturns have affected both coking coal and steam coal markets. Automobile sales fell in the face of economic recession, which led to less steel production and less coking
coal consumption. Meanwhile, electricity consumption declined (for the first time in history) in this recession, which led to less steam coal consumption. Coal production and exports have been cut back and related infrastructure projects postponed.

As for domestic coal prices, there have been reforms towards the market-based pricing among large coal consumers. In China, coking coal prices are now set by international and domestic markets while steam coal prices are still partially administrated. India deregulated coal prices in 2000. But, in the absence of competitive markets in the country, the state-owned Coal India sets prices in practice. Rail freight, which is a critical factor in the competitiveness of coal end-user prices, is still regulated in many countries. In the US and Canada, coal prices are market-driven. Meanwhile, countries that rely almost entirely on imports, such as Japan, Korea and Chinese Taipei, practically do not have domestic prices.

![Figure 15: Hard Coal Prices (1987-2008)](image)

3.2 Freight

Coal is transported at sea by dry bulk carriers, which can carry coal, iron ore and wheat. Ocean freight rates account for a significant component of the final end-user prices, and affect coal demand and coal trade flows. The international coal market is divided into two regional markets – Atlantic and Asia Pacific – because of the transportation costs. The dry bulk carriers used for international coal transportation are the Panamax (60,000-80,000 DWT) and Capesize (above 80,000 DWT) carriers. Approximately 40% of the worldwide Capesize fleet are used to transport coal, with the remaining 60% carrying iron ore. Meanwhile, around 40% of the Panamax fleet carry coal and 30% are used for grains and 15% for iron ore. Freight rates change significantly in the market, reflecting macro-economic conditions in general and performance of coal, grain and iron ore markets in particular. The Baltic dry index (BDI)\(^4\) issued by the Baltic Exchange is the leading index for dry bulk carrier rates.

The graph below shows estimated freight rates of major seaborne coal trading routes (Australia to Japan, Australia to the EU, South Africa to Japan and South Africa to the EU), calculated out of CIF and FOB prices.

Freight rates rose in tandem with coal prices in 2003 and onwards. This was due not only to increases in seaborne coal trade but also to demand for dry bulk carriers to transport other

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\(^4\) The index covers worldwide international shipping rates for dry bulk cargoes, and is not restricted to the Baltic Sea area.
commodities. In particular, China’s surging demand for raw materials and strong US grain and soybean exports put pressure on freight prices. Higher oil prices pushed up bunker fuel costs, which in turn contributed to higher freight costs. Congestion and the resulting delays at Australian loading ports were another factor for the rise in freight rates. These logistical bottlenecks were somewhat reduced in 2005. But freight rates started increasing again in 2007. In the face of financial crisis and economic downturns in 2008, freight rates collapsed. Freight prices of these four routes fell to below $10 in autumn 2008 and winter 2009.

![Figure 16: Estimated Average Freight (1987-2008)](image)

Source: ECS

### 3.3 Bilateral Negotiations

Similar to the oil and gas sector, long-term contracts are widely used in the coal sector. This is partly because of large capital investment involved. Both sellers and buyers are likely to invest in large projects in the coal supply chain. In many cases, coal purchasers are the ones who operate a power generation plant while coal sellers are the ones who invest in developing a coal mine. In the midstream, transport infrastructure, such as railways, ports and ships, needs to be developed to transport coal. Long-term contracts provide guarantees to finance these projects.

Coal quality is another reason for wide use of long-term contracts in the coal sector. Quality is an important issue in coal trade. In particular, coking coal characteristics are critically important to steel mills, and, to a somewhat lesser extent, it is the same for steam coal for power plants. Standard specifications are only an approximate guide and buyers/users are required to implement extensive tests over a lengthy period to assess one coal brand. Once accepted, however, the relation between the seller and the buyer/user is likely to continue for a long time.

The pricing system under long-term contracts has gone through slow but steady transformation over time. In the late 1980s, Japan’s “Benchmark Prices” set between Australia’s BHP (then) and Japanese power utilities and steel companies became the reference price in the international coal market. The “Benchmark Prices” were FOB-based prices for major coal brands, and prices for the other coking coal brands were adjusted according to qualities and prices for the other steam coal brands according to calorific values.

This pricing system ended in the late 1990s, as deregulation proceeded in the Japanese power sector and utility companies started negotiating individually and diversifying their sources.

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5 Between 1998 and 2002, a “Reference Price System” was in place, whereby individual utilities followed the lead negotiator’s settlements.
While there are increasing quantities of coal transactions based on short-term contracts and spot transactions in the market today, the use of long-term contracts and the practice of bilateral contract price negotiations between suppliers and buyers are continuing. These long-term contracts are likely to have provisions on quantities of delivery over a span of time (one to three years or longer) with annual price review clauses.

Currently the international coal market is highly concentrated. The “Big Four” (Anglo American, BHP Billiton, Rio Tinto and Xstrata) account for more than 50% of the international steam coal market, while BHP Billiton alone has a 30% share in the international coking coal market. They hold their main production bases in Australia, South Africa and Colombia. However, there are other coal mining companies in Indonesia (Banpu, Adaro, KPC, Arutmin), South Africa (Sasol), Russia (Suek), Venezuela (Carbozulia) and China (China Coal, Shenhua) in the market. Also, Peabody and other US coal mining companies as well as metal mining (Vale) companies have a presence in the market.

After the rise and fall of coal prices, the coal mining sector is seeing a M&A boom involving US companies in 2009. Alpha Natural Resources and Foundation Coal completed their merger, creating the third largest coal producer in the country in July 2009, and Ukraine’s Metinvest acquired United Coal, the sixth largest coking coal company in the US, in May 2009.

On the buyers’ side, Italy’s ENEL in the Atlantic market and the Japanese utilities in the Asia Pacific market have considerable influence. Settlements between these companies and major producers in Australia and South Africa are important in the steam coal market. Meanwhile, negotiations between BHP Billiton and Japanese steel mills (Nippon Steel and JFE) are still critical in the coking market.

3.4 Spot Price

The concept of spot contracts is loosely defined in international coal trading. A spot contract can be a transaction of a single cargo, or part of a cargo, or a series of cargoes. Some spot contracts are used by small suppliers or purchasers which are not in a position to build a permanent relation, while other spot contracts are based on existing long-term relationship between sellers and buyers. Use of spot contracts has increased because buyers, who are under pressure to reduce costs, need flexibility in supply to match uncertainty in demand. It is also because of increases in the number of new suppliers and purchasers in international coal trade, as demand for steam coal from power generation plants grows in developing countries as well as developed countries.

Today, there are a number of well-established spot prices under standardised specifications at different locations. Two main spot prices for coal exports are the FOB spot price at Richards Bay, South Africa (serving as the basis for API4 indices [see the next section]) representing South African steam coal exports, and the FOB spot price at Newcastle, Australia (the basis for the Newcastle indices), for Australian steam coal exports. The prime one for importers is the CIF spot price at ARA (Amsterdam-Rotterdam-Antwerp) in Northwest Europe (the basis

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6 Merger deals among the “Big Four” did not go through. BHP Billiton’s plan to acquire the rival Rio Tinto was dropped in November 2008, while in October 2009 Xstrata announced that it had given up merging with Anglo American.

7 In March 2010 the media reported that Japan’s Nippon Steel and JFE Steel and Australian coal company BHP Billiton had agreed on coking coal price for April to June 2010 at $200 per tonne. Until 2009 the two sides had agreed on coal prices on an annual base. But this time they could agree only on the second quarter 2010 prices.
for API2 indices). Japanese import CIF spot prices are often a weighted average of imported coal prices, based on the country’s customs statistics. There are a number of published spot prices by region in the US, such as “Central Appalachia”, “Northern Appalachia”, “Illinois Basin”, “Powder River Basin” and “Uinta Basin” (see Figure 17).

Media companies, called reporting agencies, make surveys in the market and publish spot prices regularly. They include Argus, McCloskey Coal Information Service (MCIS), Platts and South African Coal Report (SACR).

Figure 17: US weekly Average Coal Spot Prices (Feb 2007-Aug 2009)

3.5 Futures and Derivatives Markets

One of the main subjects of this report is to look into fast-growing coal futures and derivatives markets and to examine their impacts on coal pricing. Over the last several years, like many other commodities, coal trading has undergone a major transition with the development of electronic trading and financial derivatives. This represents maturity of the coal market. Banks and financial traders participate in “financial” or “paper” coal markets, in addition to physical buyers (electricity utilities) and sellers (coal mining companies), and trading volumes in these markets have been increasing. This has changed the way coal is traded and priced. While there exist the distinctive Atlantic and Pacific markets in terms of physical trade flows, the difference between the two markets is disappearing quickly as far as pricing is concerned.

However, coal futures markets have not yet reached the same stage as oil futures markets. Currently coal futures contracts are settled in cash against published coal price indices (with exceptions of the NYMEX and the ASX where futures contracts are settled by delivery of the underlying asset). This hybrid mechanism shows that the current coal trading is still in transition from the one based on spot markets to the one driven by genuine futures markets. Coal futures markets are expected to shift to settling their contracts within their markets, as trading volumes increase.

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8 This is mainly because of (expected) low trading volumes in the coal futures exchanges. However, if the final settlement is done by spot prices or indices, futures prices are pulled towards the spot market as the settlement time nears. In addition, transparency in spot indices poses another problem.
The coal sector has seen a thriving OTC\(^9\) swap market since the late 1990s, before futures markets came into existence. Swaps are a versatile derivative product to hedge price risks. For example, a coal producer or an end-user can exchange a price of a particular coal brand with a fixed price, or one linked to a benchmark marker, or one linked to a composite index, for a period of time by entering into a swap arrangement with a financial institution. As an OTC derivative product, conditions and specifications of a swap can be tailor-made through negotiation between the two counterparties. Platts\(^{10}\) estimated that around 1.3 billion tonnes of coal derivatives were traded in 2006 (cf. the physical international hard coal trading volume: 866 million tonnes) and 2 billion tonnes in 2007 (cf. the physical international trading volume: 923 million tonnes).

The largest coal derivatives market is formed around API\(^2\) (All Publications Index number 2), a price index of CIF steam coal delivered to the ARA area\(^{11}\). According to Platts, trading volume of the API\(^2\) related derivatives was 900 million tonnes in 2006 (cf. OECD Europe’s physical steam coal imports: 206 million tonnes). The second largest is API\(^4\), a price index of FOB steam coal at the Richards Bay terminal in South African\(^{12}\). Platts estimated that around 400 million tonnes of the API\(^4\) related derivatives were traded in 2006 (cf. South Africa’s physical steam coal exports: 69 million tonnes).

In 2001 Global Coal was created by coal producers (Anglo American, BHP Billiton, Glencore and Rio Tinto), end-users (ENEL, EON and J-Power) and others. It is an electronic platform to trade both physical coal and financial products among its members. Global Coal is headquartered in London under the supervision of the UK Financial Services Authority (FSA). Global Coal publishes the Newcastle price index\(^{13}\). Introduced in 2002, the Newcastle index is based on FOB steam coal prices at the Newcastle terminal in Australia, aiming at establishing itself as the benchmark for the Asia Pacific steam coal market. An OTC swaps market has been formed around it in recent years.

Also in 2001, the NYMEX began trading coal futures. By then, US electric utilities were no longer eager to enter into long-term coal supply contracts and preferred more flexible short-term contracts. Against this background, both sellers and buyers needed a risk

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\(^9\) Over-the-counter (or OTC) trading takes place through the negotiation between two parties (e.g., two individuals, two companies, a financial institution and its client, etc) outside the exchange, whereas a futures or derivatives exchange is a financial institution where participants can trade standardised contracts under the exchange rule.

\(^10\) PLATTS.COM news feature “Coal Derivatives Market” 11 April 2008 (The subsequent Platts estimates come from the same source.)

\(^11\) In November 2008, Argus and McCloskey bought the trademark of API coal indices from the Tradition group. (The Tradition group is an inter-dealer broker in the OTC commodity derivatives market.) There are no changes due to the purchase as to how the API 2 and API 4 Indices are produced, nor as to when those indices are published or delivered. Barlow Jonker continues to contribute to the production of the API 4 indices.

API\(^2\) is, to be precise, the simple arithmetic mean of: the CIF ARA assessment published each Friday in Argus Coal Daily International and Argus Coal Media by Argus Media; and McCloskey’s NWE steam coal marker published every Friday in McCloskey’s Fax and fortnightly in McCloskey’s Coal Report.

API\(^4\) is the simple arithmetic mean of: the FOB Richards Bay assessment published each Friday in Argus Coal Daily International and Argus Coal Media by Argus Media; the FOB Richards Bay price as published every Friday in McCloskey’s Fax and fortnightly in McCloskey’s Coal Report; and the South African Coal Report Europe Spot Price Indicator as published every Friday in “From the Coal Face” and monthly in South African Coal Report.

\(^12\) The NEWC Index is derived from trading activity on the Global Coal electric platform. The calculation is based on a combination of: bids and offers of physical FOB Newcastle contracts posted on Global Coal’s platform; and transactions of these contracts executed on the platform.
hedging tool against price fluctuations. Futures markets provide an opportunity to lock in coal prices.\(^\text{14}\)

The NYMEX’s Central Appalachian coal futures contracts\(^\text{15}\) are traded in a unit of 1,550 tons and the underlying coal asset needs to have the minimum heat contents of 12,000 BTUs per pound, gross calorific value. The futures contracts are available monthly for the current year and the next four years. The physical Central Appalachian coal is not only supplied to the US domestic Mid-Atlantic market but also exported, and, therefore, the NYMEX futures market plays an important role in international coal pricing. The NYMEX settles its futures contracts by delivery of the underlying asset and does not rely on the outside price indices.

Following the NYMEX, a number of coal futures markets have been established. They include Intercontinental Exchange (ICE) based in London, Germany’s European Energy Exchange (EEX), Australian Securities Exchange (ASX) and Global Coal. In 2006 ICE and EEX launched two similar futures each. ICE Rotterdam futures and EEX ARA futures are settled in cash against the API2 index, while ICE Richards Bay futures and the one under the same name at EEX are settled in cash against the API4 index. While trading volumes of these futures suffered from the global financial crisis in autumn 2008, they recovered to the previous levels in early 2009 and are increasing again.

In 2008 Global Coal began Newcastle futures trading. The Newcastle futures contracts are settled in cash against Global Coal’s Newcastle index. Meanwhile, ASX has launched thermal coal (FOB Newcastle) futures trading in July 2009. As mentioned earlier, ASX’s thermal coal futures are settled by physical delivery. In addition, China is planning to establish a coal futures exchange in the coal producing province of Shanxi as of writing. Furthermore, coal options are traded at the NYMEX and the ASX.

### 3.6 Commodity Bubble in 2008

Figure 18 shows the correlation between oil and coal prices from January 2003 to August 2009. It uses the same NYMEX daily futures price data as Figure 4 does. There are some caveats that should be noted here. Firstly, there is a clear difference between the roles oil and coal futures exchanges play in pricing in the respective oil and coal markets. Oil futures prices, like ones at the NYMEX, are quoted in almost all the oil transactions. Meanwhile, as we have seen in the previous sections, there are other pricing mechanisms independent of futures exchanges (such as bilateral negotiations under the long-term contracts) at work in the coal sector. Nonetheless, futures exchanges are now influential enough to play a role, at least, in the coal market. Secondly, there is not much direct physical substitution of coal for oil, or vice versa, and coal contracts are normally not indexed to oil prices. The link to oil prices would come through natural gas out of the competition between coal and natural gas in the power sector. But the NYMEX’s WTI is the largest commodity market (bigger than the Central Appalachian coal futures market by more than 700 times in its trading volume in January 2010) and exerts huge financial influence on other commodity markets.

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\(^\text{14}\) For detailed explanations about hedging price risks by using futures contracts, see Chapter 3 “Oil Pricing” in Energy Charter Secretariat’s “Putting a Price on Energy: International Pricing Mechanisms for Oil and Gas (2007)”.

\(^\text{15}\) The contracts are priced at FOB on a barge at a terminal facility in a 12-mile stretch of the Ohio River and the adjoining Big Sandy River in the US.
Keeping these in mind and, if we look into the graph (Figure 18), there are periods when oil and coal prices are well correlated and not so well correlated. When oil prices go sideways or fall, the tie with coal prices becomes loose. We can see that in 2003, 2005 and 2006. Conversely, oil and coal prices are well correlated at the NYMEX in 2004 and 2007. In these years oil prices were steadily rising.

The year 2008 was an extraordinary year as far as financial/commodity markets are concerned. The 2008 data series needs to be divided into two parts – before and after the start of the financial crisis. During the two periods it looks that coal was traded almost exclusively in relation to the oil market. One year from the global financial crisis and the start of economic downturns, there are ongoing discussions as to whether fundamentals or speculation caused the commodity price increases in 2008. At a glance, one can see that oil and coal price movements in 2008 were very different from those in other years. In today’s business it is difficult to draw a clear line between fundamentals and speculation. There is much interplay between the two. But, if traders in the coal market were looking only to another commodity market and were trading according to another market’s performance there, instead of supply and demand developments in the coal market, it would be regarded as a sign of speculation.

Speculative funds and traders often employ a trading strategy called “spread trading” in the commodity market – buying one delivery month and selling another delivery month simultaneously, or buying one commodity and selling a different commodity simultaneously in the same exchange, or buying one commodity in one exchange and sell the commodity in another exchange simultaneously. This strategy tries to take advantage of changes in price relationships. Spread trading was frequently used during the rise and fall of the commodity prices in 2008. According to the US Commodity Futures Trading Commission (CFTC)\(^\text{16}\), spread trading accounted for about 40% of the NYMEX WTI futures market in March 2008. Given this and with unusually high correlation between the two prices in 2008, one can suspect that traders would have connected the two commodities markets through spread trading in 2008.

In fact, most commodity prices went up and came down violently in the same way in 2008. The financial and economic crisis of 2008 resulted in extreme volatility in the commodity markets. In summer of 2007 the sub-prime crisis started, which can be now seen as the first wave of the global economic and financial crisis. Stock markets started declining and the credit crunch began. The central banks in Europe, the US, Canada and Japan started pumping money into the banking market to try to improve liquidity. Meanwhile, commodity prices were on the rise throughout 2007. WTI, for example, surpassed the $100 line at the beginning of 2008 and kept increasing in the first half of 2008, before hitting the record-high of $147/bbl in July. Commodity markets are traditionally thought to move in the opposite direction to stock markets and commodity index contracts were hugely popular among institutional investors during this period.

When commodity prices continued its ascendancy in the first half of 2008, the US regulators and lawmakers launched regulatory reforms on the commodity markets. The US Congress discussed speculation in the commodity markets and the regulatory “loopholes” speculators exploited. The discussion of commodity market reforms is still continuing in Europe and the US at this time, together with re-regulation of the financial sector.

### 3.7 Conclusions

The coal sector has undergone two major changes over the last decade. One change is in the global demand structure. In around 2000 coal demand from developing countries started increasing in an unprecedented way. The bulk of the increase comes from steam coal demand for power generation. Coal has provided China, India and other emerging economies with affordable and dependable electricity supply and fuelled the recent economic growths in these countries. As a result, the central role in pricing overall coal prices which coking coal prices played in the 1990s has been taken over by steam coal prices.

The other change is the emergence of financial and derivative coal markets. Starting in the late 1990s swaps have been used as a tool to hedge price risks in the OTC market. Introduction of coal futures exchanges, which have better transparency than OTC markets, came into existence later than the other commodity exchanges did. Futures markets, which trade standardised contracts, were once thought as not suited to coal trading, because of wide range in coal quality and due to close relations between the producer and the end-user. However, as trading volumes, the number of export destinations and coal prices themselves increase, futures exchanges have been established in the US, Europe and Australia. Futures markets are taking over the role in coal price formation which bilateral negotiations between large producers and end users had before, and their influence on coal prices are growing.

As demand rose, coal prices started increasing in around 2003. At the same time, coal prices started reflecting influences from oil and other commodity markets. Coal prices were strongly correlated with oil prices in 2004 and 2007.
In 2008 in particular coal and oil prices went up and came down in a synchronised way. This may suggest that there was an element of speculation in the coal market, and the trend may continue in the future. In the aftermath of financial crisis in 2008 policy makers are discussing re-regulation of the commodity markets in the US and Europe at this time. Coal futures exchanges and OTC derivatives markets need to be discussed in the same framework.

**Box: Dark Spread**

Power producers’ profits depend on the margin between generation fuel costs and electricity sales. This margin can be locked in by combining futures contracts in different markets – a strategy called “spread”. Coal-fired power generators can lock in their margins by buying coal futures and selling electricity futures simultaneously – called “dark spread”. For gas-fired power generator, the combination is natural gas futures and electricity futures (called “spark spread”). When costs of CO₂ emissions (see Chapter 4 “CO₂ Emission Trading”) are taken into account, the strategy is called “dark green spread” (or “clean dark spread”) and “spark green spread” (or “clean spark spread”).

These spreads are calculated by the following formula:

\[
\text{Spread} \ (\$/\text{MWh}) = \text{Electricity Price} \ (\$/\text{MWh}) - \text{Fuel Price} \ ($/\text{MMBtu}) \times \text{Heat Rate} \ (\text{MMBtu/MWh}) - \text{CO₂ Allowance Price} \ ($/\text{CO₂ tonne}) \times \text{Carbon intensity factor} \ (\text{CO₂ tonne/MWh})
\]

There are media companies (such as Platts or Argus) which regularly report values of these spreads as an indicator. In addition, some exchanges trade spreads (e.g., crack spread futures and options at the NYMEX) and OTC derivatives for these purposes are widely available.
Chapter 4 CO₂ Emissions Trading

### 4.1 Coal and CO₂ Emissions

One of the issues surrounding increasing coal use is of course CO₂ emissions and their impacts on climate. The use of coal as a fuel generates about 30% more CO₂ emissions per unit calorific value than that of oil and around 70% more than that of natural gas (Figure 19). In 2007 coal was the second largest energy source in the global primary energy supply mix with a 27% share. But it generated some 42% of total CO₂ emissions from fuel combustion¹⁷, largest among fossil fuels (Figure 20).

If a power generator burns one tonne of steam coal in Europe, it is required to have 2.44 tonnes¹⁸ of CO₂ emissions allowances. At the time of writing, Rotterdam steam coal is traded at $71.20 per tonne at the ICE and CO₂ emissions allowance at €13.22 per CO₂ tonne (like fuel prices, CO₂ emissions allowance prices fell drastically from around €30 per CO₂ tonne to about €10 in autumn 2008). Conceptually speaking, power generators are required to pay an additional cost of $51.60 every tonne of coal they use. But, since generators are currently allocated CO₂ emissions allowances free of charge to cover most of their emissions under the EU ETS, they may not necessarily have to buy all the allowances at this time.

Nonetheless, carbon markets help to form an idea on how much CO₂ emissions would cost. In theory, CO₂ emissions allowance prices in the carbon market are the basis to measure the economics of CO₂ abatement facilities, if carbon markets function efficiently enough. At this time, however, carbon markets are still in their infancy and need to expand the coverage and trading volumes.

![Figure 19: CO₂ Emissions per Unit Calorific Value](source: 2006 IPCC Guidelines)

### 4.2 Internalising Externalities

A term “the tragedy of the commons”¹⁹ refers to a situation in which individuals act independently, pursuing their own self-interests, and end up destroying shared resources and

¹⁷ According to the IEA, CO₂ emissions from fossil fuel burning currently account for 69% of the total greenhouse gas emissions.

¹⁸ Based on conversion factors in the 2006 IPCC Guidelines.

the environment. Property rights on air, or water, or the general state of the environment are not well defined, which often leads to serious problems of environmental degradation. Since no one “owns” the air, for example, it can be used freely as a waste depository. Serious social problems arise from these externalities. Environmental pollution, such as dumping toxic chemicals or acid rain, cost the society large sums of money in the form of increased health care or reduced agricultural production.

Figure 20: CO₂ Emissions from Fuel Combustion by Fuel (2007)

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>38%</td>
</tr>
<tr>
<td>Coal</td>
<td>42%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>20%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: IEA

Since the environment itself does not have explicit exchange values, markets, unfortunately, cannot recognise these costs. One solution to this problem is to put a price on these externalities through the government’s power in the way markets can include these external effects in their prices. The government can impose prices through taxes, subsidies, fees and marketable emission permits. These are called market-based incentives (MBIs). The government can also use command-and-control (CAC) regulations (emission standards, technology-based standards, etc.) to protect the environment. While CACs may limit the discharge of certain pollutants and mandate the use of particular pollution abatement equipments, MBIs provide society with an opportunity to find an economically optimal solution through economic incentives.

The **marketable emission permit** is a policy instrument to internalise pollution externalities. The permit, which carries a price, allows the holder to release a specified amount of pollution. The holder can also sell it to a buyer at an agreed price. If there are enough buyers and sellers, a market can be established, and, if the market is large and fluid enough, the price is expected to reflect the marginal cost of pollution prevention.

One key question in the marketable permit system is how to initially allocate the permits – whether to auction them or distribute them without charge. Firms collect unearned “rents” if the permits are distributed for free, and create barriers to entry of new firms. When the government receives revenues from the permit distribution, there is another policy decision to make as to how the government redistributes these revenues. It is quite imaginable that tradable permit schemes that involve auctions would draw opposition from industry and that governments would find it difficult to introduce such schemes. Currently, more than 90% of the allowances are distributed for free to power generators and other large-scale CO₂ emitters in the European carbon market. Meanwhile, the Obama administration had initially called for 100% auctioning of the permits in the new US carbon trading scheme. However, the Waxman-Markey bill passed by the House of Representatives in June 2009 included free distribution of the permits to industry (the deliberations are continuing in the Senate as of writing).

### 4.3 US SO₂ Market

The **cap-and-trade** scheme involving marketable emission permits was first implemented under the US Clean Air Act of 1990. The Acid Rain Programme was created under the Act to
reduce the adverse effects of acid deposition through reductions in SO\textsubscript{2} and NO\textsubscript{x} emissions\textsuperscript{20}. The Act set a goal of reducing annual SO\textsubscript{2} emissions by 10 million tonnes below 1980 levels. To achieve this reduction, a market-based cap-and-trade programme was introduced.

SO\textsubscript{2} emission restrictions were placed on fossil fuel-fired power plants in two phases of the Acid Rain Programme. Phase I began in 1995 and covered over 100 mostly coal-burning electric utility plants in the eastern and mid-western states. Starting in 2000 Phase II tightened the emissions limits on large-scale emitting plants and expanded the coverage to smaller, cleaner plants fuelled by oil, natural gas and coal.

In 2005 the Clean Air Interstate Rule (CAIR) was finalised and promulgated. The CAIR requires the power sector in the eastern states to reduce SO\textsubscript{2} emissions by 70\% from 2003 levels, beginning in 2010. The CAIR will establish a cap-and-trade system based on the Acid Rain Programme. The SO\textsubscript{2} emission allowances under the Acid Rain Programme will continue to be used in the CAIR SO\textsubscript{2} trading programme.

Under the Acid Rain Programme, the affected power plants are allocated emission allowances based on their historic fuel consumption and a specific emissions rate. Each allowance permits the holder to emit one tonne of SO\textsubscript{2} during the specified year or afterwards.

In addition, the EPA holds an allowance auction annually. The auctions are aimed at ensuring that new entrants can obtain allowances from a public source and at providing price information to the OTC allowance market. Currently 2.8\% of the total allowances issued for the year are auctioned. Utilities, environmental groups, allowance brokers and anyone interested in purchasing allowances can participate in the auction.

Likewise, anyone can buy allowances and participate in trading. The US SO\textsubscript{2} market involves regulated power units as well as brokers, traders and environmental groups which have other purposes than regulatory compliance. In fact, environmental groups buy and “retire” allowances to prevent power plants from using them to cover their SO\textsubscript{2} emissions. The EPA has an official electronic recordkeeping and notification system (called the allowance tracking system) to track allowance transactions and accounts. The EPA determines compliance of the power plants with the data in the system.

Furthermore, there are such futures exchanges as the Chicago Climate Futures Exchange (CCFE) and the NYMEX that list futures contracts based on the EPA SO\textsubscript{2} emission allowances.

At the start of Phase I of the Acid Rain Programme SO\textsubscript{2} allowance prices were around $150 per tonne on the spot market. The allowance prices ranged between $100 and $200 during Phase I. In the more stringent Phase II, starting in 2000, prices remained generally below $200. The EPA attributes these lower-than-expected allowance prices to two factors: a) many power plants switched to low-sulfur coal, and b) the costs of scrubbers were reduced because of technological innovation. However, there were times when the market became volatile due to regulatory changes or uncertainty about them, such as the beginning of Phase I in 1995, the transition to Phase II in 2000 and deliberations and subsequent announcement of the CAIR in 2004 and 2005.

Figure 21 shows the EPA SO\textsubscript{2} emissions allowance futures prices at the CCFE for the last five years. The prices began rising in 2004 and peaked at $1,600 in December 2005. During this period the CAIR programmes were discussed and, then, issued. The EPA admitted that the CAIR with its new requirements and regulatory uncertainties had been “the first and most significant driver” of the price increase\textsuperscript{21}.

\textsuperscript{20} NO\textsubscript{x} reductions in the Acid Rain Programme relied on a traditional rate-based regulatory system. However, there is a NO\textsubscript{x} market under the NO\textsubscript{x} Budget Trading Programme in the US now.

Like any other commodity prices, the SO\textsubscript{2} emission allowance prices change according to market fundamentals. The major market force includes coal and natural gas prices, electricity demand, weather and technology. Figure 21 also exhibits impacts of the financial crisis and economic downturns in autumn 2008. The year 2009 is the last year for the Acid Rain Programme trading. At the time of writing the emission allowances (the December 2009 delivery) are traded at $81.10 per SO\textsubscript{2} tonne at the CCFE.

![Figure 21: US EPA SO\textsubscript{2} Emissions Allowance Futures Prices (Oct 2004-Oct 2009)](source)

Source: CCFE *prompt delivery contract prices

### 4.4 Kyoto Protocol Mechanisms

The Kyoto Protocol was adopted in 1997 and entered into force in 2005. The protocol is linked to the UNFCCC and sets binding targets for 37 industrialised countries and the European Community to cut greenhouse gas (GHG) emissions to an average of 5% below 1990 levels over a five-year period from 2008 to 2012. Under the Kyoto Protocol, these countries must meet their targets primarily through national measures. However, three market-based mechanisms – emission trading, clean development mechanism (CDM) and joint implementation (JI) – are provided as additional measures to meet the targets in an economically efficient way.

The emission trading scheme under the Kyoto Protocol has similar mechanisms to the preceding US SO\textsubscript{2} trading scheme. However, the Kyoto Protocol has two new features, CDM and JI, which the US SO\textsubscript{2} trading scheme does not have. There is a difference between the nature of SO\textsubscript{2} pollution and effects of CO\textsubscript{2} on the climate. SO\textsubscript{2} pollution is local and regional while CO\textsubscript{2} emissions from one place have a global effect. This global characteristic of CO\textsubscript{2} emissions effects is the reason for the Kyoto Protocol to have these flexible mechanisms.

For the same reason, it is important that carbon markets around the world be harmonised and linked with each other. Without harmonisation, schemes would have different rules. Then, tonnes of CO\textsubscript{2} are not really equal and they cannot be freely traded. There is a plan for a global carbon market by the EU – to create one among member countries of the Organisation for Economic Co-operation and Development (OECD) by 2015 and to expand it to big emerging economies from around 2020.

Targets of the countries which have accepted commitments for limiting or reducing emissions under the Kyoto Protocol (Annex B Parties) are composed of assigned amount units (AAUs). AAUs are transferable and each of them presents a permit to emit one tonne of CO\textsubscript{2}. 
CDM and JI are project-based mechanisms. CDM allows Annex B Parties to undertake emission-reduction projects in developing countries. Such projects can earn transferable certified emission reduction (CER) credits. Each CER is equivalent to one tonne of CO₂ and can be counted towards the Kyoto targets. Meanwhile, JI allows an Annex B Party to earn emission reduction units (ERUs) from an emission-reduction project in another Annex B Party. Like CERs, each ERU is equivalent to one tonne of CO₂ and can be counted towards the Kyoto target.

Transfers and acquisitions of all of these units are tracked and recorded through the registry systems under the Kyoto Protocol (called the international transaction log or ITL).

The Kyoto Protocol provides a framework for the emission trading, and governments can set up emission trading schemes at a national level or an international level. The EU Emissions Trading Scheme (ETS) starting in 2005 is the largest carbon market currently in operation.

4.5 European Carbon Market

To follow through commitments under the Kyoto Protocol, the EU issued a directive (2003/87/EC) to create an EU-wide carbon market. The EU ETS currently covers the EU 27 member states as well as Iceland, Liechtenstein and Norway. The ETS is implemented in three stages. Phase 1 from 2005 to 2007 was a three-year pilot phase of “learning by doing”. Phase 2 started in 2008 and will last until the end of 2012, corresponding to the Kyoto Protocol five-year period. At the end of Phase 2 the emissions allowances will be reduced to 6.5% below 2005 levels. Phase 3 will run for eight years from 2013 to 2020. The cap on emissions allowances will be reduced by 1.74% a year until 2020, which will result in a reduction of 21% below the 2005 levels by 2020.

The ETS directive requires that each member state makes a national allocation plan (NAP) before each trading period begins. NAPs have to reflect the country’s Kyoto Protocol targets and allocate allowances to both the sectors that are covered by the EU ETS and the ones that are not. NAPs have to be approved by the European Commission. At least, 50% of the CO₂ saving is expected to come from other national measures than emissions trading. From 2013 an EU-wide cap will replace the country targets under NAPs. One EU allowance (EUA) represents a permission to emit one tonne of CO₂. Under another EU Directive (2004/101/EC) one unit of the Kyoto Protocol emission credits (including CER from CDM and ERU from JI) can be traded as equivalent to one unit of EUA in the EU ETS.

At this time some 11,000 heavy energy-consuming installations in the power and manufacturing sectors⁴² are covered under the EU ETS. Emissions from these installations account for around 50 % of the EU’s total CO₂ emissions and for about 40 % of its overall greenhouse gas emissions. From 2012 the EU ETS will include CO₂ emissions from air flights to and from European airports. From 2013 the coverage of CO₂ emissions will be further extended⁴³. These changes are expected to increase the coverage from the current 40% of total EU greenhouse gas emissions to 43%.

So far, most emissions allowances have been allocated to these installations free of charge. Only a few countries have made use of the provision to auction emissions allowances up to 5% in Phase 1 and up to 10% in phase 2. From 2013, however, auctioning will become the basic principle for allocating allowances. More than 50% of the total allowances are expected

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²² Including combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp and paper.

²³ Installations undertaking the capture, transport and geological storage of greenhouse gases; CO₂ emissions from the petrochemicals, ammonia and aluminium sectors; and others will be included.
Putting a Price on Energy: International Coal Pricing

to be auctioned in 2013. Auctions will be held by national governments and will be open to buyers from anywhere in the EU.

The power generation sector will in principle have to buy all of its allowances, although under certain conditions some EU countries will have an option to exempt existing power plants from this rule temporarily. They will be able to grant such plants up to 70% of their allowances for free in 2013. But this percentage will be decreased to zero by 2020.

In other sectors 20% of the allowances will be auctioned and the percentage will rise to 70% in 2020, with a goal of full auctioning by 2027. The revenues from the auctioning are estimated at €30-50 billion per year, according to the European Commission. The governments agreed that they should use at least 50% of the revenue to combat climate change in both Europe and developing countries.

The carbon capture and storage (CCS) technology is still in the test stage, with a number of pilot facilities operating. The CO2 captured and stored in the CCS is regarded as not emitted under the EU ETS. The European Commission estimates that the first generation of CCS demonstration projects will likely have CO2 abatement costs between €60 and €90 per tonne of CO2. However, with continuous technological improvements, the costs can be halved by 2020 and CCS plants are expected to operate commercially under the environment set by CO2 markets. In the face of current low carbon prices (€10-€15 per CO2 tonne), however, there are already talks of the carbon floor price, or subsidies for CCS facilities, or introducing carbon performance standards.

Based on the framework above, companies and other market participants can trade bilaterally with each other in the OTC market. In addition, a number of derivatives exchanges have been established, trading futures and options contracts that have CO2 emissions allowances as underlying asset. The European carbon market has grown by more than seven times since the start of the market in 2005 (Figure 22). According to Energy Capital Management, total value of the European EUA and CER market was estimated at €75 billion in February 2009, larger than the estimated value of the API2 coal market of €60 billion.

Currently the ICE and the EEX trade spot, futures and options contracts of EUA and CER. The EUA futures prices, like many other commodity prices, peaked at €30 per tonne in June 2008 but declined drastically in autumn 2008 (Figure 23). The prices rebounded to around €13-15 in summer 2009 after falling to as low as €8 in February 2009. While CER prices are still at a discount to EUA prices, the gap between the two are narrowing. CO2 emission allowance prices are already a driver that influences coal markets, and the influence will likely grow in the future. However, in autumn and winter 2009 EUA prices were almost inelastic, remaining in a narrow range between €12-14, regardless of increases and decreases in coal prices.

Figure 22: EU ETS Trading Volumes (2005-2008)
4.6 Conclusions

The cap-and-trade scheme is created to reduce CO₂ emissions. However, in order for the scheme to function properly it is necessary to have involvement of financial investors whose incentives lie on financial merits and not on emissions compliance. Allowance prices are expected to change according to economic and other conditions. Through 2008 to 2009 CO₂ emissions allowance prices have gone up and come down reflecting the economic conditions, which is in a sense a proof that the market-based cap-and-trade system is working.

However, some analysts think that the volatility in the carbon market comes partly from inelastic supply of emissions allowances, which is preset by policy and is not dependent on economics at all, and partly from small trading volumes in the market, where power plants and other facilities receive the bulk of emissions allowances for free and need to buy or sell only a small portion of them. For the latter, problems would be solved, as allowance trading volumes increase in the next stage of the EU ETS and most allowances are distributed through auctions.

Following the EU ETS, there are a number of CO₂ markets emerging. Japan started its voluntary pilot emissions trading scheme in 2008 and is discussing the shift to a mandatory scheme. The Tokyo Stock Exchange and the Tokyo Commodity Exchange (TOCOM) are jointly preparing to establish a futures exchange. In Australia, the mandatory New South Wales Greenhouse Gas Abatement Scheme has been in place since 2003 while discussions are going on to create an emission trading scheme at a national level. In the US, many states have introduced or are preparing emission trading schemes. The CCFE has been trading a number of greenhouse gas related derivatives on a voluntary basis since 2003. Now the Congress is debating whether and how to create a carbon market at a national level. These emissions trading and carbon pricing are likely to influence supply/demand and prices for coal.

Currently discussions on the post Kyoto Protocol framework are continuing towards COP 16 in Mexico. One conclusion out of the scope of this study is that it is important that deliberations and policies be made in a way that would continue to build up investors’ confidence in the CO₂ market, since the CO₂ market is still in its infancy.
Appendices
Appendix A

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Appendix B

Abbreviations and Acronyms

AAU: assigned amount unit
AG: Aktiengesellschaft
API: All Publications Index
ASX: Australian Securities Exchange
BDI: Baltic dry index
BRIC: Brazil, Russia, India and China
BTU: British thermal unit
CAC: command-and-control
CAIR: Clean Air Interstate Rule (US)
CBOT: Chicago Board of Trade
CCFE: Chicago Climate Futures Exchange
CCS: carbon (dioxide) capture and storage
CFTC: Commodity Futures Trading Commission (US)
CDM: clean development mechanism
CER: certified emission reduction
CIF: costs, insurance and freight
COP: Conference of the Parties (UNFCCC)
DOE: Department of Energy (US)
ECE: Economic Commission for Europe (UN)
ECS: Energy Charter Secretariat
EEX: European Energy Exchange (Germany)
EIA: Energy Information Administration (US)
EPA: Environmental Protection Agency (US)
ERU: emission reduction unit
ETS: Emissions Trading Scheme (EU)
EU: European Union
EUA: European Union Allowance
FOB: free on board
FAS: free at shipside
FSA: Financial Services Authority (UK)
GHG: greenhouse gas
ICE: Intercontinental Exchange
IEA: International Energy Agency
ITL: international transaction log
JI: joint implementation
M&A: mergers and acquisitions
MBI: market-based incentive
MCIS: McCloskey Coal Information Service
MWh: Megawatt hour
NAP: national allocation plan
NYMEX: New York Mercantile Exchange
OECD: Organisation for Economic Co-operation and Development
OTC: over-the-counter
PCC: pulverised coal combustion
PCI: pulverised coal injection
SACR: South African Coal Report
tce: tonne coal equivalent
toe: tonne oil equivalent
TOCOM: Tokyo Commodity Exchange
UK: United Kingdom
UNFCC: The United Nations Framework Convention on Climate Change
US: United States