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Article

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Weekly Report

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Weekly Report

Moving towards a "COAL-PEC"?

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Coal has for many years been considered as a resource of the past and as a result its importance has been underestimated. Yet coal still is the main pillar for generating electricity in most countries: A quarter of the worldwide primary energy consumption is provided by coal. While the world's largest coal producers, China, the USA and India, are at the same time the largest consumers of coal. Smaller producers and consumers of coal engage extensively in international trade. In particular the seaborne coal trade has increased significantly since the 1990's. In the past two years prices of import coal also have increased considerably. In September 2008, importers in Europe had to pay prices of more than 200 US dollars per ton, a price level many times higher than the historical average. In this context, fears have increasingly been voiced that the international coal market – analogous to the oil market which continues to be dominated by the OPEC—might witness the emergence of a supplier cartel, a "COAL-PEC".

A strong tendency towards the concentration of companies has in fact been observed in the international coal market in the past years. Increased prices could have resulted from the use of market power. Drivers for the price increase were the strong rise in demand, in particular from China and India, capacity bottlenecks in production and shipment as well as a lack of investments. In the future a tight market and high coal prices have to be expected.

At present, the importance of coal as an energy source is rapidly increasing worldwide. In particular in power generation coal is anything but a resource of the past, even in an era of increasing climate protection efforts. Global coal reserves will be available for another 133 years, considerably longer than the other fossil fuels (oil 42 years, gas 60 years).[1] Currently innovative technologies are being developed, which give reason for hope that coal utilization will be compatible with the climate policy objectives. In particular the technologies for carbon capture and sequestration are awaited with great anticipation. (Carbon Capture and Sequestration, CCS) (Box 1)

Unlike in the oil and gas sector, the largest producing nations for coal are at the same time the largest consumers (Figure 1). China is by far the most important coal country, followed by the United States and India. Other countries without major coal reserves are also consumers of considerable quantities. In particular, these are

1 BP: Statistical Review of World Energy. London 2008..

JEL Classification:
L11, L72, C69

Keywords:
Coal, Energy,
Market structure,
Simulation model

countries with few natural resources as the East Asian countries Japan, Korea, and Taiwan, as well as Germany and Great Britain in Europe. These countries have to import coal. The relatively smaller producing and consuming nations are more strongly dependent on international trade.

In recent years, the growth rates of the consumption of coal and of primary energy demand have taken a parallel course. The share of coal in primary energy demand has remained constant at a level of approximately 25 percent since 1995. Thus, coal is one of the most important energy sources. Moreover, a major portion of the global energy demand growth is covered by coal.

Boom in International Trade

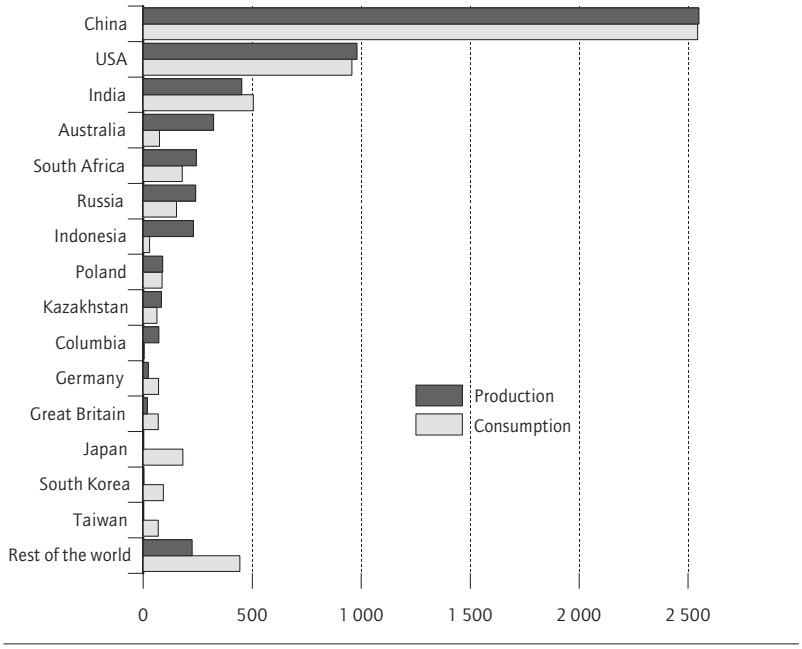
The quantities of steam coal—the type of coal utilized for power generation—which are traded internationally have continuously been increasing since the middle of the 1980's (Figure 2). At 357 million tons by the year 2000, the quantity had more than tripled. In the past few years, there has been an even stronger expansion: international trade is booming. Over 607 million tons of steam coal were traded in the seaborne market in 2007. Another 63 million tons were transported by road, rail or inland waterways.

Traditionally, there have been two major demand regions in the world coal market: Asia and Europe. In the past, these two regions were part of two separate

Figure 1

Hard Coal Production and Consumption in the Year 2007

in million tons

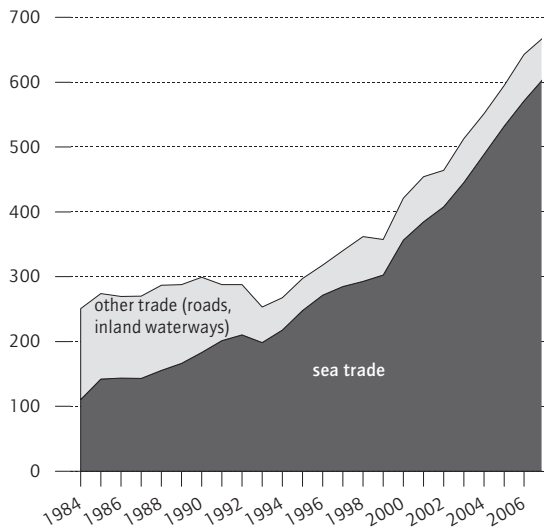


Source: DIW (German Institute for Economic Research). **DIW** Berlin 2008

Figure 2

International Trade with Steam Coal

in million tons



Source: IEA Coal Information 2008. **DIW** Berlin 2008

Box 1

Carbon Capture and Storage (CCS)

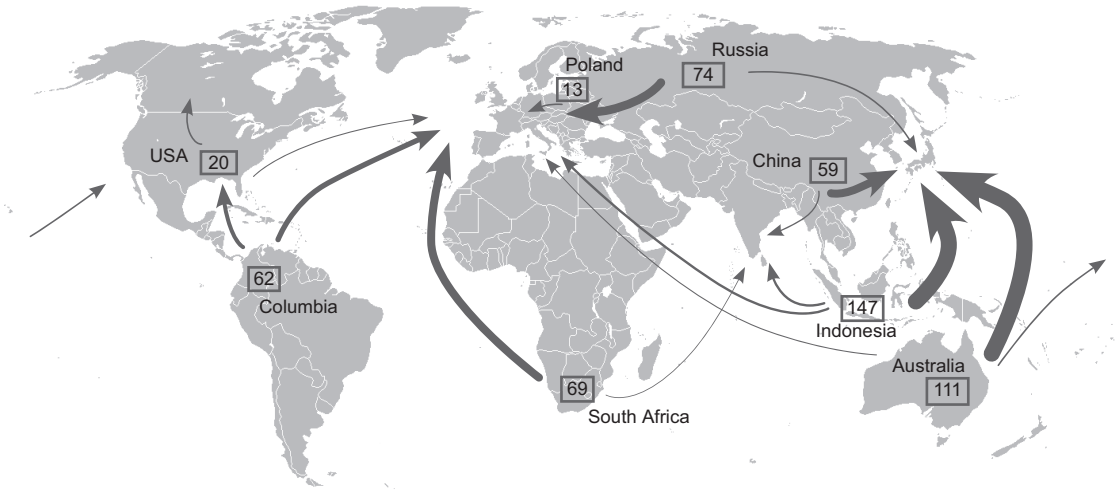
The development of carbon capture and storage for coal-fired electricity generation is particularly important in view of our current climate problems. In the future, these technologies could make it possible to separate a major portion of the carbon dioxide emitted by coal-fired power stations and to store it safely in geological repositories. In Germany, efforts are being made in this field. The first Vattenfall 30 MW_{th} pilot plant[1] in Schwarze Pumpe (Brandenburg) started operation at the beginning of September 2008. Moreover, Vattenfall is planning a 500 MW unit in Jänschwalde (Brandenburg). RWE has plans for a facility with CSS technology in Hürth (North-Rhine Westphalia). There are plans for further plants in Europe, for example in Great Britain. At the beginning of August 2008, the European Commission submitted a proposal for a directive establishing a legal framework for the dissemination of these technologies.[2]

1 MWth: Megawatt thermal: heat output capacity since this plant only generates process heat and not electricity.
2 European Commission, KOM 2008/18, Proposal for a Directive of the European Parliament and the Council on the geological storage of carbon dioxide. COD 2008/0015. Brussels 2008

Figure 3

Trade Flows of Steam Coal 2007

in million tons



Source: IEA Coal Information 2008. **DIW** Berlin 2008

markets: the Pacific market for Asia, and the Atlantic market for Europe and America. In the mean time, these markets have integrated[2] with trade flows occurring between the two basins (Figure 3). In 2006, for example, larger quantities were imported to Europe from Indonesia.

The volume and direction of the trade flows vary from year to year. Overseas transport costs play a significant role. The level of the freight rates which can amount to up to 40 percent of the import costs[3] determine whether shipping coal over long distances is profitable. The freight rates depend on the worldwide demand for transporting bulk cargo. On the shipping market, coal presently competes with other goods like metals and minerals, in particular iron ore, but also agricultural goods. Due to the steep increase in demand for iron ore in China, freight rates have also significantly increased in the last few years.

Rising Demand and Tight Supply

In the 1980's domestic coal production was gradually reduced in Europe, in particular in Germany and England, because it was no longer competitive. The existing structure of the power generation fleet has, however, not been altered because it remained favorable to generate electricity based on imported coal.

Parallel to the developments in Europe, demand in the then emerging Asian economies South Korea and Taiwan continuously increased in addition to Japan's stable import demand. These countries are only poorly endowed with resources. Imported coal, mainly from Australia, has offered them an affordable way of generating electricity.

Production and export followed the rising demand in the world market. Production in the traditional producing countries Australia and South Africa increased continuously and new suppliers like Indonesia and Colombia entered the international steam coal market. After a short price peak at the beginning of the 1980's the world market price for steam coal leveled off at approximately 40 US dollars per ton. Cyclical fluctuations were due to increased demand and an ensuing rise in the production capacities (Figure 4).

By the beginning of the new millennium, prices for steam coal followed a slightly decreasing trend which resulted in little willingness of producers to invest.[4] Insufficient production capacity along with strongly rising demand, particularly in China and

2 The integration of the regional markets has been confirmed by some econometric studies: Warell, L.: Market Integration in the International Coal Industry: A Cointegration Approach. In: Energy Journal. Bd. 27 (1), 2006, 99–118; vol. 27 (1), 2006, 99–118; and Li, R.: International Coal Market.

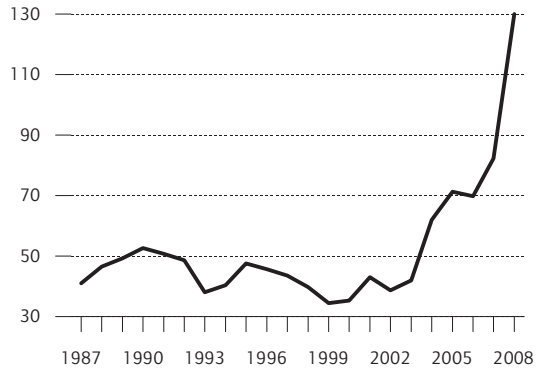
3 Cf. Ritschel, W., Schiffer, H.-W.: The World Market for Hard Coal. RWE, 2007.

4 Cf. Rademacher, M.: Development and Perspectives on Supply and Demand in the Global Hard Coal Market. In: Zeitschrift für Energiewirtschaft. Vol. 32 (2), 2008, 67–87.

Figure 4

Import Price for Steam Coal in the EU

in US dollars per ton



1 Cost Insurance Freight (CIF), first quarter of 2008: Estimation of DIW Berlin.

Source: IEA Coal Information 2008. **DIW** Berlin 2008

India, since 2003 and transportation problems are the main causes for the steep price increase since 2003/2004. Presently there is also a shortage in capital goods which are necessary to increase the production capacity.

Strong price spikes have been observed in 2007 and 2008. The steep rise in freight rates has also contributed to the rise of prices. By the end of August 2008 the reference import price in Europe (in Amsterdam-Rotterdam-Antwerp, ARA) reached values over 200 US dollars per ton.

Coal plays a significant role in the Chinese economy because 80% of electricity production is based on this fossil fuel. The consumption of steam coal has increased considerably in recent years due to the rapidly rising demand for electricity in China. In 2002, some 686 million tons of steam coal were used for electricity production; in 2006 this value reached 1,188 million tons. This trend will continue with an estimated demand for steam coal in electricity production of 2,710 m tons in 2010.[5] The total installed capacity of coal-fired power plants rose from 319 GW to 622 GW between 2002 and 2006.[6] This increase amounts to an annual capacity increase corresponding to the entire existing capacity in Great Britain.

In order to meet the increasing demand for coal, sector reforms have been introduced for the modernization and expansion of coal production in China. Nevertheless, domestic production is no longer sufficient. In 2003, China began to reduce its exports of coal and to import additional amounts. From 2004 to 2006 the export of steam coal decreased from 75 to 54 million tons per year, and the imports grew from 4 to 11 million tons. In the first half of 2007, China even became a net importer for the first time.

Likewise, in India coal consumption has risen more rapidly since 2003 than in the years before due to the increasing demand for electricity. As the domestic coal production could not close the supply gap that was emerging, coal was also imported in ever greater amounts. From 2002 to 2007 coal imports grew from 9 to 31 million tons per year.[7] It is anticipated that by 2030 imports will reach 168 m tons.[8]

Increased Concentration on the Export Side —a Looming COAL-PEC?

The structure of the international coal market has considerably changed over the last 15 years. Although the number of exporting countries has risen, the number of producing companies within these countries has declined. This consolidation process is not over yet. Four multinational mining companies have emerged and are active in the major exporting countries Australia, South Africa, and Colombia. These "Big Four" are BHP Billiton, Rio Tinto, Xstrata and Anglo American. In 2005, they produced one third of the total internationally traded coal.

The concentration of hard coal export companies in some specific countries is even higher than in the world market. In 2006, the "Big Four" accounted for 55% of Australia's hard coal exports. In South Africa, Anglo American, BHP-Billiton, and Xstrata accounted for 77% of hard coal exports; together with the two domestic companies SASOL and Exxaro they reached a joint export share of 86%. In Colombia, 97% of the hard coal exports were attributable to Anglo American, BHP-Billiton, Xstrata and the American company Drummond. The concentration is also high in Indonesia: six domestic companies supplied 67% of the hard coal exports of Indonesia in 2006.[9] In China, the National Commission for Development and Reforms intends to establish six to eight large coal companies.

The attempt of the largest mining company in the world, BHP Billton, to take over the number two,

5 Sagawa, A., Koizumi, K.: Present State and Outlook of China's Coal Industry. Institute of Energy Economics Japan, 2007, *eneken.ieej. or.jp/en/data/pdf/410.pdf*.

6 International Energy Agency: World Energy Outlook. Paris 2007.

7 International Energy Agency: Coal Information. Paris 2004 and 2008.

8 International Energy Agency: World Energy Outlook. Paris 2007.

9 Ritschel, W., Schiffer, H.-W.: The World Market for Hard Coal. RWE, 2007.

Rio Tinto, raises the question whether this company expects more from an increased market share than only efficiency gains. This merger would deteriorate the market structure of both the hard coal market as well as the iron ore market. The concentration process on the supply side—in a period of rising prices and rising demand—gives reason to fear an oligopolistic market structure with only a few providers. In an extreme case, similarly to the oil market, this could lead to a kind of COAL-PEC.

DIW Berlin has analyzed the international steam coal market with its COALMOD model (Box 2) and in particular has investigated the competitive situation and the possible abuse of market power. The table presents the results of the model for the case of perfect competition as well as for oligopolistic competition. Generally the reference data lies between the results of the two cases. This would indicate that today's market is not competitive; however, it also indicates that we are far from a cartel comparable to what exists on today's crude-oil market. It must be taken into consideration that in the hard coal market —unlike the crude oil market—the majority of players are privately owned multinational companies. However, the players can potentially exert regional market power due to the geographical separation of the markets and the high transport costs.

Table
Exported Amounts According to the COALMOD Model
in million tons

	2005			2006		
	Complete competition	Cournot competition	Reference data	Complete competition	Cournot competition	Reference data
Australia	66.06	54.08	109.58	62.40	51.97	104.53
Indonesia	92.98	62.80	82.52	110.55	68.08	100.42
South Africa	44.35	44.35	37.20	35.98	36.13	36.99
Russia	39.59	39.59	41.77	51.09	51.81	48.31
China	56.64	45.79	55.20	45.00	45.27	46.44
Colombia	63.05	59.94	30.42	50.92	51.06	34.62
USA	0.46	5.52	1.31	3.10	6.23	2.25
Average import price in US dollars per ton	59.07	88.72	62.50	68.61	95.23	61.24

Source: Calculations by DIW Berlin. **DIW** Berlin 2008

The attempts for vertical integration on the side of the consumers to secure mining assets abroad also somewhat counteract the concentration trend. Japanese companies already acquired shareholdings of Australian mines in the last decades; and companies from other countries like India and South Korea are increasingly pursuing such a strategy.

Conclusion

Coal will continue to play a crucial role in the global energy mix. It deserves greater attention by decision makers in energy, climate and economic policy. In order to achieve the currently discussed climate goals, electricity generation from coal should become CO_2 free.

To achieve these goals there must be an acceleration in the development of the technologies for carbon capture and storage (CCS), particularly in Europe and the USA. At the same time, the increasing demand for electricity in the rapidly growing Asian economies will primarily be covered by coal-fueled power plants. International coal trade will continue to rise, for which large investments will be necessary in mines and transport infrastructure.

The price of coal has risen dramatically in the last few years. This development can be linked to the process of the concentration of coal mining companies on the supply side in addition to the rise in demand and the bottlenecks in transportation capacities. Calculations with the COALMOD model indicate that the coal producers exert market power,

Box 2
The COALMOD Model of DIW Berlin

The numerical simulation model COALMOD developed at DIW Berlin depicts the trade flows of steam coal in the world market.[1] The following export countries or export regions are included: Australia, Indonesia, South Africa, Russia West, Russia East, China, Colombia, and the USA. These countries are selling to the following import countries: Japan, Taiwan, South Korea, the United Kingdom, Germany, the USA, Spain, Italy, India, and China.

The exporting countries are assumed to behave as profit maximization players. Two different market structures can be simulated: Cournot-Nash oligopoly or perfect competition. In the Cournot scenario the coal exporters exert market power, i.e. they can generate a margin (price mark-up) in addition to the marginal costs. By contrast, in the case of perfect competition the exporters cannot influence the prices; consequently, they have no market power. The model is a trade model in which the import demand and the export supply form the basis of the simulation.

In addition to a market-structure analysis the model identifies potential bottlenecks in production and in export capacity (port capacity).

1 Haftendorn, C., Holz, F.: Analysis of the World Market for Steam Coal Using a Complementarity Model. DIW Discussion Paper 818, Berlin 2008.

especially through geographical price discrimination. Therefore, the regulatory authorities in the producing and consuming countries should not only pay close attention to the potential emergence of a very concentrated market, but also actively take countermeasures if needed.

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