

**EMD 2008 Mid-Year Meeting**  
**November 6, 2008**  
**Coal Committee Report**  
**William A. Ambrose, Chair**

**1. Where are the active coal basins and which ones are the most likely to see future growth?**

The top 10 coal-producing countries in 2007, in descending order with approximate values of coal production in millions of short tons, were China (2,804), United States (1,146), India (529), Australia (428), Russia (347), and South Africa (283) Germany (228), Indonesia (180), Poland (162), and Kazakhstan (103). Future growth is anticipated in most of these countries (especially China and India), except in Germany, where the hard-coal industry is in serious decline (see following section “Basins in Germany”). Coal production in the U.S. remains flat, having declined slightly from 2006 to 2007 (see section 2 in this report).

Source: U.S. Department of Energy, Energy Information Administration (EIA)  
<http://www.eia.doe.gov/emeu/international/coalproduction.html>

**Basins in China:**

China currently has known coal reserves of about 1,031 billion tonnes and its predicted resources are 3,800 billion tonnes. Coal in China is geographically widespread and occurs in every stratigraphic interval from the Devonian to Tertiary. Some basins have coal seams >200 m (>650 ft) thick.

Sources:

Scott, A. C., and Bangzhuo, M., 2008, The coal geology of China: Geology Today, v. 9, p. 14-18.

Meta data for coal basins in China:

[http://geo-nsdi.er.usgs.gov/metadata/open-file/00-47/sed\\_basins.faq.html](http://geo-nsdi.er.usgs.gov/metadata/open-file/00-47/sed_basins.faq.html)

### **Basins in the United States:**

Coal basins are distributed throughout Alaska and the lower 48 United States. The Powder River Basin in northwest Wyoming and southeast Montana is the leading coal-producing basin in the U.S., recently accounting for >37% of total production.

Source:

<http://energy.er.usgs.gov/coalres.htm>

### **Basins in India:**

Most of India's coal reserves are relatively high-ash, bituminous coal and are located in Jharkhand, Orissa and West Bengal. Coal reserves in India are plentiful but low quality. India has 10% of the world's coal, at over 92 billion tones. At current rates of production, India has enough coal for the next 217 years.

Source:

[http://www.worldcoal.org/assets\\_cm/files/PDF/ecoal\\_focus\\_on\\_india.pdf](http://www.worldcoal.org/assets_cm/files/PDF/ecoal_focus_on_india.pdf)

### **Basins in Australia:**

Most of Australia's resources of black coal are in New South Wales (Sydney-Gunnedah Basin) and Queensland (Bowen Basin). New South Wales contains a total of 34,110 million tonnes (Mt) of resources, whereas Queensland has 28,380 Mt. Lesser amounts of black coal resources occur in South Australia, Western Australia, and Tasmania.

Source:

<http://www.australiancoal.com.au/resources.htm>

### **Basins in Russia:**

Russia produces coal from >20 coal basins. Most production is from 7 basins; three are west of the Ural Mountains and four are in Siberia. The 3 western basins are the Donetskii Basin (on the border between Russia and Ukraine), the Moscow Basin (west and southwest of Moscow), and the Pechora Basin (extreme northeast part of European Russia).

The Donetskii Basin has the longest history of production of Russia's coal basins and is the largest producer from underground mines. Production in the Donetskii Basin consists of bituminous to anthracite. The basin is a major source of metallurgical and thermal coal for Europe.

The Moscow Basin produces lignite whereas the Pechora basin produces higher-rank coal. Pechora Basin coals contain high ash content, making it more suitable for thermal rather than metallurgical coal.

The 4 Siberian Basins are the Kuznetski, Kansk-Achinsk, and the Irkutsk (south-central Russia) and the South Yakutsk Basin in the Russian Far East. The Kansk-Achinsk Basin produces lignite whereas the other basins produce bituminous and anthracite coal.

Russia also contains undeveloped coal basins, including the Tunguski and Lenski in north-central and northeast Russia and the Russian Far East, respectively. The Lenski, or Lena, Basin is considered to be the largest coal basin in the world. Much of Russia's long-term coal potential lies in these basins.

Source:

<http://www.mma1.com/company/pdf/papers/An%20Introduction%20of%20the%20Russian%20Coal%20Industry.pdf>

### **Basins in South Africa:**

Coal is mined in South Africa in several regions, mainly in the East Rand around Witbank, in the Vaal valley around the Vaal Triangle and at Dundee and Newcastle in the north part of Natal. There has been a recent discovery of >1 billion tonnes of bituminous coal in Limpopo province.

Sources:

<http://www.mbendi.co.za/indy/ming/coal/af/p0005.htm>  
[http://www\\_azom\\_com/News.asp?NewsID=11227](http://www_azom_com/News.asp?NewsID=11227)

### **Basins in Germany:**

German coal is open-cast mined at three major brown coal fields—in the Lower Rhine Bight, in Central Germany and in Lausitz. Hard coal mining in Germany is mined in the Ruhr, Saar and Ibbenbüren coalfields in the western part of Germany, centered on the Rhine River valley. Mining of hard coal in Germany is in decline, with subsidies to be phased out completely by 2018. Hard-coal mines produced 41.3 Mt in 1998, 39.2 Mt in 1999, 33.3 Mt in 2000 and 27.1 Mt in 2001. By 2006, their combined output had fallen to 20.7 Mt.

Sources:

Anonymous, 2007, Hydrocarbons: Cleaning browncoal – the green approach: Filtration+Separation: Elsevier Ltd., 7 [doi:10.1016/S0015-1882\(07\)70121-0](https://doi.org/10.1016/S0015-1882(07)70121-0)

<http://www.mining-technology.com/projects/germany/>

### **Basins in Indonesia:**

Most of Indonesia's coal basins are in Sumatra and Kalimantan in the Indonesian part of Borneo. According to EIA estimates, Indonesia has 5.5 billion short tons of recoverable coal reserves, of which 85 percent is lignite and sub-bituminous rank. Roughly two-thirds of the country's coal reserves are located in Sumatra, with the balance located in Kalimantan, West Java, and Sulawesi. Coal basins in Indonesia are geologically young. The presence of higher- rank coals near the present land surface is dependent upon uplift or the presence of igneous intrusions. These basins are either Paleogene intramontane and continental margin (or possibly retro-arc) in origin, or Neogene retro-arc. The coal seams were deposited in environments ranging from fluvial to deltaic, with little marine influence. Eocene coals from Kalimantan tend to have a much higher content of minerals compared with younger coals.

#### Sources:

[http://www.australiancoal.csiro.au/pdfs/cook\\_daulay.pdf](http://www.australiancoal.csiro.au/pdfs/cook_daulay.pdf)

<http://www.eia.doe.gov/emeu/cabs/Indonesia/Coal.html>

### **Basins in Poland:**

Poland has three major Upper Carboniferous coal fields with resources estimated at 16.6 billion tons. The primary coalfield (Gornoslaskie Zaglebie Węglowe) is in Upper Silesia and is one of the biggest (~4,500 km<sup>2</sup>) hard-coal fields in the world. To date, 9 billion tons have been produced. Hard coal is also located in the Bogdanka coal field (known as Lubelskie Zaglebie Węglowe). Within this coal field, coal seams are distributed from the Polish-Ukrainian border to Radzyn Podlaski. Hard-coal deposits are also present in Lower Silesia. However, they are difficult to exploit and all local mines were closed down by 2000. Poland's brown coal reserves are estimated at nearly 14 billion tons. They are located in eight regions, mainly in central Poland (coal fields at Konin, Belchatow and in Wielkopolska) and in west Poland (at Turoszow on the Polish side of the Lusatian Neisse). Poland is the world's sixth leading producer of brown coal, with 78 documented deposits, of which the exploited twelve contain 2.1 billion tons.

#### Source:

<http://www.poland.gov.pl/Natural,,Resources,310.html>

### **Basins in Kazakhstan:**

Coal in Kazakhstan is produced in the Karaganda region and along the northern border of the country where the Bogatyr and Severny coal fields are located. Russian firms are stakeholders in the Kazakh coal industry and roughly 16 Mmst are transited annually from Kazakhstan northward via rail to power plants in southern Russia.. Kazakhstan obtains >80% of its electricity production from coal. The country's largest power generator, AES-owned Ekibastuz No. 1, is located in north-central Kazakhstan

Source:

<http://www.eia.doe.gov/emeu/cabs/Kazakhstan/Coal.html>

### **Additional links for world coal basins:**

World Coal Institute

<http://www.worldcoal.org/pages/content/index.asp?PageID=104>

U.S. Department of Energy, Energy Information Administration (EIA)

<http://www.eia.doe.gov/emeu/international/coalproduction.html>

For a review of US coal production, refer to the following EIA website:

[http://www.eia.doe.gov/cneaf/coal/page/acr/acr\\_sum.html#fes1](http://www.eia.doe.gov/cneaf/coal/page/acr/acr_sum.html#fes1)

For a review of future projections of coal use and production, refer to EIA's International Energy Outlook 2007 report on coal, available at the following website:

<http://www.eia.doe.gov/oiaf/ieo/index.html>

<http://www.eia.doe.gov/oiaf/ieo/coal.html>

## 2. How much coal is currently being produced and what is the forecast for future production?

### Worldwide Coal Production:

The worldwide production of coal 2007 was approximately 7,036 million short tons (Energy Information Agency [EIA]). Asia and Oceania led the world with 4,069 million short tons, with the country of China accounting for approximately 2,804 million short tons. China and the United States are expected to continue to lead the world in coal production, with increased production also anticipated in India, which accounted for 528.50 million tons, and Australia which produced 428.40 million tons in 2007. Coal production in other areas of the world in 2007 in descending order, with chief country in parentheses, was:

North America 1,233.64 (United States 1,145.57)

Europe 814.20 (Germany 227.76)

Eurasia 537.23 (Russia 346.68)

Africa 288.74 (South Africa 282.56)

Central & South America 91.90 (Colombia 74.85)

Middle East 1.40 (Iran 1.40)

Source: U.S. Department of Energy, Energy Information Administration (EIA)

<http://www.eia.doe.gov/emeu/international/coalproduction.html>

### Coal Exporters:

The leading coal-exporting countries in 2007, including metallurgical and thermal-coal exports, combining ABARE and BP Statistical Review data, include:

Top Exporters*				2007 Reserves (BP)			Prod'n*	Hard Coal P/R and R/P**		
	Thermal	Met	Exp Total	Anthracite and Bit	Subbit and Lignite	Reserves Total		Hard coal prod	P/R (%)	R/P (years)
Australia	111.6	120.5	232.1	37,100	39,500	76,600	309	0.8%	120	
Indonesia	170.0		170.0	1,721	2,607	4,328	169	9.8%	10	
Russian Fed'n	81.7	15.8	97.5	49,088	107,922	157,010	233	0.5%	210	
South Africa	67.7		67.7	48,000		48,000	244	0.5%	196	
China	58.9	4.8	63.7	62,200	52,300	114,500	2,382	3.8%	26	
Colombia	59.7		59.7	6,578	381	6,959	64	1.0%	103	
United States	19.9	25.8	45.7	112,261	130,460	242,721	977	0.9%	115	
Canada	3.2	27.4	30.6	3,471	3,107	6,578	26	0.8%	132	
Poland	13.1	3.1	16.2	6,012	1,490	7,502	94	1.6%	64	

\* 2006 Exports and Production, ABARE

\*\*US prod incl subbituminous  
US ratios do not include subbit reserves

### **Coal Production in China:**

Coal in China continues to be the most important source of electric power in the country, accounting for ~80% of generation capacity. China's 30,000 coal mines produced more than two billion tons in 2005. However, China is trying to wean itself off coal by expanding its power-generating capacity from other energy sources, including natural gas, nuclear, and hydroelectric energy.

Source:

Finch, J., 2006, Beyond China's Coal Fields: Expanding Its Gas Resources: online publication: <http://ezinearticles.com/?Beyond-Chinas-Coal-Fields:-Expanding-Its-Gas-Resources&id=271034>

### **Coal Production in the United States:**

Coal production in the US continues to be high compared to other countries, although from 2006 to 2007 it declined 1.5% from 1,162.7 to 1,145.6 million short tons. However, U.S. total coal consumption increased in 2007. For example, coal consumption for generation of electricity increased by 1.9%; more than 300 gigawatts (GW) of electrical capacity in the U.S. are provided by coal from 1,493 power generators. U.S. coal exports were higher in 2007, although coal imports remained at about the same level. Coal stocks increased in 2007 as a result of rebuilding stockpiles that had become depleted in 2005.

Sources: U.S. Department of Energy, Energy Information Administration (EIA)  
<http://www.eia.doe.gov/cneaf/coal/page/special/feature.html>  
<http://www.eia.doe.gov/cneaf/electricity/epat2p2.htm>

### **Coal Production in India:**

Coal production in India was 375 Mt (million tones) in 2005. India has 565 coal mines, most of which are operated by Coal India and its subsidiaries, which produce approximately 86% of the country's coal. Most of the coal production in India comes from opencast mining, contributing >83% of the total production. Coal India is one the 5 largest companies in India and employs ~460,000 people. According to IEA projections, coal will remain the dominant fuel in India's energy mix to 2030. Demand is projected to grow from 391 Mt in 2002 to 758 Mt in 2030.

Source:

[http://www.worldcoal.org/assets\\_cm/files/PDF/ecoal\\_focus\\_on\\_india.pdf](http://www.worldcoal.org/assets_cm/files/PDF/ecoal_focus_on_india.pdf)

### **Coal Production in Australia:**

There were 118 producing black coal mines in Australia at the end of 2006, an increase of 105 by the end of 2005. Almost all of these mines are in New South Wales and Queensland. The proportion of open-cut mines has recently increased greatly; in 1997 there were 58 underground and 60 open-cut mines. At the end of 2006 the number of underground mines was 44. The number of open-cut mines increased by 74. Thirteen new coal projects were competed in New South Wales and Queensland in 2007.

Source:

<http://www.australiancoal.com.au/industrystats.htm>

### **Coal Production in Russia:**

Although Russia produced <350 Mt in 2006, the country holds the world's second largest recoverable coal reserves of 173 billion short tons (bn). Russia consumed about 260 Mt in 2006, leaving 61 Mt for export. According to the government's energy projections, Russia should produce between 441-496 Mt per year by 2020. After recent restructuring, almost 80% of domestic coal production now comes from independent producers. Russia's strategy to increase coal production and build more coal-fired power plants will help reduce demand for natural gas, thus allowing for more natural gas exports.

Source:

<http://www.entrepreneur.com/tradejournals/article/182660372.html>

### **Coal Production in South Africa:**

Approximately 77% of South Africa's primary energy needs are provided by coal. This is unlikely to change greatly in the near future, due to a lack of alternatives to coal as an energy source. Opencast mines provided 53% production during 2006, while room-and-pillar mining provided 38%, stoping 5%, and longwall 3%. The ten largest collieries, with an output of >12 million tons a year each, produced 204 million tons and 22 middle-sized mines produced 87 million tons. In 2006, mines controlled by the five largest mining groups, Anglo Coal, BHP Billiton, Sasol, Exxaro and Xstrata, supplied almost 90% of South Africa's saleable coal production. Coal mines discarded 70 million tons of waste or unsalable coal. Approximately 21% of the coal produced is exported, and 21% is used locally (excluding power-station coal). Coal is expected to maintain its share of the overall electricity generation market until 2020.

Sources:

<http://www.dme.gov.za/energy/coal.stm>

[http://www.miningweekly.com/article.php?a\\_id=115238](http://www.miningweekly.com/article.php?a_id=115238)

### **Coal Production in Germany:**

More than 97% of Germany's recoverable reserves of 7.4 billion short tons (Bst) are lignite (brown coal), with the remainder consisting of bituminous and anthracite (hard coal). Brown coal is Germany's most important domestic energy source. According to Statistik der Kohlenwirtschaft, brown coal production represents >40% of domestic energy production in Germany. German coal production has declined since 1990, mainly due to closing of older, inefficient mines in the former East Germany. Currently, >50% of Germany's lignite production is from the Rhineland region. Most of Germany's hard coal deposits are deeply buried and difficult and expensive to extract. Although the German government has been providing large subsidies to the industry to maintain production, there are only 8 hard-coal mines in operation, down from more than 100 at the industry's peak in the late 1950s. The last of those will close by 2018, when subsidies come to an end. Brown coal production, however, is mostly feasible without subsidies.

Sources:

<http://www.oilgasarticles.com/articles/47/1/Coal-Reserves-and-Coal-Consumption-in-Germany/Page1.html>  
<http://www.washingtonpost.com/wp-dyn/content/article/2007/07/29/AR2007072901078.html>

### **Coal Production in Indonesia:**

In 2004, Indonesia produced 142 million short tons (MMst) of coal, an increase of 68% since 2000. Coal consumption in Indonesia has remained stable, with consumption in 2004 at 24 MMst. According to EIA statistics, Indonesia was the second largest net exporter of coal in the world in 2004, with 118 MMst of apparent net exports.

Source:

<http://www.eia.doe.gov/emeu/cabs/Indonesia/Coal.html>

### **Coal Production in Poland:**

Poland's reserves of hard coal are estimated at 45.4 billion tons. With current annual production >100 million tons, these resources are projected to meet the country's demand for almost 500 years. However, due to Poland replacing some hard-coal with natural gas, by 2020 hard-coal production is anticipated to be reduced to 82 million tons a year, and by 2050 to ~40 million tons.

Source:

<http://www.poland.gov.pl/Natural.,Resources,310.html>

## **Coal Production in Kazakhstan:**

Kazakhstan contains Central Asia's largest recoverable coal reserves, with 34.5 billion short tons of mostly anthracite and bituminous coal. Kazakhstan produced 106 million short tons (Mmst) in 2006 and consumed 78 Mmst, resulting in 28 Mmst of net exports. Coal production in Kazakhstan has declined 35% since it became independent of Russia. Much of this decline is the result of mine accidents and difficulty in obtaining outside foreign investment. However, according to the Kazakh Ministry of Energy and Natural Resources, the country plans to be producing 100 to 105 Mmst annually by 2015.

Source:

<http://www.eia.doe.gov/emeu/cabs/Kazakhstan/Coal.html>

For additional information on world coal production and consumption see also the World Coal Institute 'Global Coal Market' section (PDF file) of the report: The Coal Resource - A Comprehensive Overview of Coal at:

[http://www.worldcoal.org/assets\\_cm/files/PDF/globalcoalmarket.pdf](http://www.worldcoal.org/assets_cm/files/PDF/globalcoalmarket.pdf)

### **Additional links for world coal production:**

U.S. Department of Energy, Energy Information Administration (EIA)  
<http://www.eia.doe.gov/emeu/international/coalproduction.html>

For International production statistics, see the following websites:

International Production (Country Analysis Briefs)  
<http://www.eia.doe.gov/emeu/cabs/index.html>

World Coal Institute  
<http://www.worldcoal.org/pages/content/index.asp?PageID=104>

For detailed information on US coal production, see the following website:  
EIA  
<http://www.eia.doe.gov/cneaf/coal/page/acr/table1.html>

For a review of US coal consumption by industry type see:  
EIA  
<http://www.eia.doe.gov/cneaf/coal/quarterly/html/t28p01p1.html>

The World Coal Quality Inventory: A status report  
[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V8C-4G65TXY-1&\\_user=10&\\_rdoc=1&\\_fmt=&\\_orig=search&\\_sort=d&view=c&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=324f0c316c826aa326a008622bbd1763](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V8C-4G65TXY-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_version=1&_urlVersion=0&_userid=10&md5=324f0c316c826aa326a008622bbd1763)

### **3. What are the sources of funding for current and planned activities?**

DOE continues to support research in clean-coal technology. New-generation, clean-coal power plants in the U.S. are expected to go online around 2010. Cambridge Energy Research Associates (CERA) estimates that at least 5 GW of new clean-coal power will be required to meet the growing demand for coal to fuel clean-coal energy. The National Coal Council estimates a new demand of 375 million tons/year for 100 GW of new clean-coal power in the U. S. (Beck, 2006).

Sources:

Beck, R. A., 2006, Coal: the cornerstone to America's energy future: Power, v. 150, p. 42-46.

[http://fossil.energy.gov/news/techlines/2008/08023-FutureGen\\_FOA Released.html](http://fossil.energy.gov/news/techlines/2008/08023-FutureGen_FOA Released.html)

<http://www.fossil.energy.gov/programs/powersystems/cleancoal/>

<http://fossil.energy.gov/programs/powersystems/futuregen/>

### **4. What kinds of research are taking place and who is doing it?**

Research in the microstructure of coal and its components is underway as a result of current interest in coalbed methane and CO<sub>2</sub> sequestration. Work is being conducted to document and model the processes affecting adsorption and desorption of gases in coal beds. In a recent report, the U.S. Geological Survey demonstrated that adsorption capacities for CO<sub>2</sub> can be up to 18 times higher than the adsorption capacities of methane in some subbituminous coals and lignites. This research implies that deeply buried, low-rank coal seams could be potential reservoirs for CO<sub>2</sub> sequestration, even with low methane contents.

Source:

[http://www.geotimes.org/july03/high\\_coal.html](http://www.geotimes.org/july03/high_coal.html)

**Numerous research organizations are actively involved in coal-related research. The following is a selected list, together with key research topics:**

#### **British Coal Utilisation Research Association**

Topics: flue gases from coal gasification, coal and biomass for low-emission, clean-coal facilities, carbon capture and storage

<http://bcura.org/>

**Coal Research Center, Southern Illinois University Carbondale**

Coal gasification, mining technology to reduce production costs, carbon capture and storage

<http://www.crc.siu.edu/>

**CSIRO, Commonwealth Scientific and Industrial Research Organisation of Australia**

Hydrogen from coal, carbon capture and storage, coal gasification for low-emission power generation, coalbed methane production enhancement

<http://www.csiro.au/science/Coal.html>

**European Coal and Steel Research**

Coal mining operations, mine infrastructure and management, coal preparation, coal conversion, coal combustion and gasification

<http://cordis.europa.eu/ecsc/home.html>

**The University of Kentucky Center for Applied Energy Research**

Mine mapping, ash, environmental and mercury analysis, coal petrology, separations, Fischer-Tropsch technology, syngas and hydrogen

<http://www.caer.uky.edu/>

**U.S. Department of Energy's Office of Fossil Energy**

Clean coal, carbon capture and storage, gasification technologies, advanced combustion systems

<http://www.fe.doe.gov/programs/powersystems/index.html>

<http://www.fossil.energy.gov/programs/powersystems/advresearch/index.html>

**Coal Ash Research Center at the University of North Dakota (UND) Energy & Environmental Research Center (EERC)**

Coal ash, mercury, IGCC by-products

<http://www.undeerc.org/carrc/>

**Max-Planck-Institut für Kohlenforschung (coal research)**

Organic chemistry related to coal and coal compounds

[http://www.mpi-muelheim.mpg.de/kofo/english/mpikofo\\_home\\_e.html](http://www.mpi-muelheim.mpg.de/kofo/english/mpikofo_home_e.html)

**National Energy Technology Center**

Clean-coal power generation, coal gasification technology (turbines, hydrogen generation, etc.), coal-utilization by products, emissions control, technical innovations for existing coal-fired power plants

<http://www.netl.doe.gov/technologies/coalpower/index.html>

<http://www.netl.doe.gov/technologies/coalpower/advresearch/ucr/main.html>

**National Research Center for Coal & Energy**

Coal-to-liquids technology, combustion by-products recycling, advanced separations technology, mine reclamation, zero-emissions technology

<http://www.nrcce.wvu.edu/>

**Ohio Coal Research Center at Ohio University**

Mercury removal using membrane-enhanced ESP, Vapor-grown carbon fibers from coal tailings, biosequestration of greenhouse gases, sulfides conversion

<http://www.ent.ohiou.edu/~ohiocoal/>

**Purdue University Energy Center**

Clean-coal energy, coal gasification and liquid fuel, coal-slurry deposits, coal-quality assessment, coal-transportation infrastructure

<http://www.purdue.edu/dp/energy/research/cleanCoal.php>

<http://www.purdue.edu/dp/energy/CCTR/>

**U.S. Geological Survey Energy Program**

Coal resources, coalbed methane, organic petrology, coal databases, coal assessments, coal and coke production

<http://energy.usgs.gov/coal.html>

**Virginia Center for Coal and Energy Research**

Environmental impacts of energy resources extraction and utilization; public policy issues related to energy, marketing, and transportation of coal; integration of high technology into systems design and education; international energy development; sustainable development issues; carbon management; and deregulation issues.

<http://www.energy.vt.edu/>

**The Center for Energy and Economic Development (CEED)**

Clean coal technology and economics

<http://www.ceednet.org/ceednet/>

## **5. Which companies are considered the leaders?**

Fifteen leading coal companies included on the Yahoo Finance list of top coal companies include Yanzhou Coal Mining Co (the only coal mining stock to be listed in both the Hong Kong, Shanghai, and New York Stock Exchanges), Westmoreland Coal Company, SGI International, Peabody Energy Corporation, Natural Resource Partners, Massey Energy Company, KFX Inc., Headwaters Incorporated, Foundation Coal Holdings, Fording Canadian Coal Trust, CONSOL Energy Inc., Beard Company, Arch Coal, Inc., Alpha Natural Resources, and Alliance Resource Partners. Details of economic profiles for each of these companies are posted at:

### **Yahoo Finance list of top coal companies:**

<http://biz.yahoo.com/p/ccoalconamed.html>

Most of the top producing mines in the US are in the Powder River Basin in Wyoming and Montana, with other mines in Pennsylvania and West Virginia in the Appalachian Basin. Production per mine in 2007 ranged from approximately 4 Mt to slightly more than 90 Mt. EIA has prepared a table of major coal-producing mines, along with companies:

<http://www.eia.doe.gov/cneaf/coal/page/acr/table9.pdf>

## **6. What is the focus of recent activity?**

Much recent activity in the field of coal resources and power generation from coal is currently focusing on clean-coal technology. New research institutions and governmental agencies, including the US Department of Energy (DOE), the International Energy Agency, are conducting research in clean-coal, coal gasification, FutureGen-type power-generating facilities, as well as sequestration and industrial application of gasification by-products.

For example, DOE is seeking to invest ~\$1.3 Billion to commercialize carbon capture and storage technology and is soliciting applications for the restructured FutureGen program. In June, 2008 DOE issued a Funding Opportunity Announcement (FOA) to invest in Integrated Gasification Combined Cycle (IGCC) or other clean-coal power plants with capture and storage (CCS) technology. DOE anticipates that \$290 million will be available for funding of selected projects through FY 2009 and an additional \$1.01 billion is expected to be available later.

Source:

[http://fossil.energy.gov/news/techlines/2008/08023-FutureGen\\_FOA\\_Released.html](http://fossil.energy.gov/news/techlines/2008/08023-FutureGen_FOA_Released.html)

The program performance goal of DOE in coal gasification is by 2010 to complete research and development for advanced power systems capable of achieving 45 to 50 percent electrical efficiency at a capital cost of \$1000 per kilowatt (in constant 2003 dollars) or less for a coal-based plant.

Source:

<http://www.fossil.energy.gov/programs/powersystems/gasification/index.html>

DOE also has a goal for the year 2015 to have ready an operating zero-emission, high-efficiency, co-production power plant that will produce hydrogen from coal. Partial oxidation of coal is a promising technology for co-production of hydrogen and electric power and hydrogen using IGCC technology. However, currently there are no commercial demonstrations of these joint power and hydrogen plants.

Source:

[http://www.fossil.energy.gov/programs/fuels/hydrogen/Hydrogen\\_from\\_Coal\\_R&D.html](http://www.fossil.energy.gov/programs/fuels/hydrogen/Hydrogen_from_Coal_R&D.html)

The Society for Organic Petrology (TSOP) provides a comprehensive list of links to current activity in coal and coal-related topics. The TSOP web site can be accessed at:  
<http://www.tsop.org/links/links.htm>

**Additional links:**

**International Energy Agency: Clean Coal Technology R, D&D**

<http://www.iea-coal.org.uk/content/default.asp?PageID=1194>

<http://www.iea-coal.org.uk/site/ieacoal/reportdetails?LogDocId=81775>

<http://www.iea-coal.org.uk/site/ieacoal/reportdetails?LogDocId=81104>

**World Coal Institute: Coal gasification**

<http://www.worldcoal.org/pages/content/index.asp?PageID=424>

**Coal to liquids**

**International Energy Agency: Clean fuels from coal**

<http://www.iea-coal.org.uk/site/ieacoal/reportdetails?LogDocId=81104>

**World Coal Institute: Coal to liquids**

<http://www.worldcoal.org/pages/content/index.asp?PageID=423>

**World Coal Institute: Hydrogen from coal**

<http://www.worldcoal.org/pages/content/index.asp?PageID=426>

**International Energy Agency: Prospects for hydrogen from coal**

[http://www.iea-coal.org.uk/publisher/system/component\\_view.asp?LogDocId=81106](http://www.iea-coal.org.uk/publisher/system/component_view.asp?LogDocId=81106)

## **7. What are the estimated U.S. and international resources/reserves, and what is the strategic impact of these resources?**

According to EIA, the United States leads the list of the top 10 countries with total recoverable coal (see Table below).

World Estimated Recoverable Coal (Million Short Tons)		Recoverable Anthracite	Recoverable Lignite and Subbituminous	Total Recoverable Coal
Region/Country	and Bituminous			
United States	123,746	143,808		267,554
Russia	54,110	118,964		173,074
China	68,564	57,651		126,215
India	99,302	2,601		101,903
Australia	42,549	43,982		86,531
South Africa	53,738	0		53,738
Ukraine	17,939	19,708		37,647
Kazakhstan	31,031	3,448		34,479
Former Serbia and Montenegro	10	18,279		18,288
Poland	15,432	0		15,432

Although volumes of recoverable coal reserves for China are reported to be lower than those in the United States, China exceeded the United States in coal productivity in 2007 (see section 1 of this report). Lower volumes of reserves in China may reflect great uncertainties estimating these coal reserves. As China's coal production continues to increase, much of which is already devoted to electric-power generation (approximately 80%), global impacts on air quality and atmospheric CO<sub>2</sub> levels will continue to be an issue. For example, in 2006 China led the world in CO<sub>2</sub> emissions from coal combustion with 4.9 Gt (billion tons), compared to 2.1 Gt from coal combustion in the United States.

Sources:

- <http://www.eia.doe.gov/emeu/iea/coal.html>
- <http://www.eia.doe.gov/pub/international/iealf/tableh4co2.xls>
- <http://www.eia.doe.gov/cneaf/coal/reserves/reserves.html>

## **8. What are the critical technology needs and how are these being addressed?**

The World Coal Institute is active in research related to critical technology needs. Their major research topics include improving combustion technologies to increase efficiency and to reduce emissions from coal combustion, carbon capture and storage, as well as coal-to-liquids and coal-gasification studies.

**Source:**

<http://www.worldcoal.org/pages/content/index.asp?PageID=236>

**For additional information, please refer to links under heading number 6 in this report.**

## **9. What are the critical environmental or geohazard issues and how are these being addressed?**

A variety of environmental issues related to coal mining, production, and combustion include land reclamation, coal-mine fires, mine safety, mining-related illnesses such as black lung disease, and potential contamination from ash and heavy metals, water quality issue, chromium, as well as CO<sub>2</sub> (greenhouse gas) emissions. For additional details, please refer to the following links:

**EPA's Clear Skies**

[http://www.geotimes.org/july03/high\\_coal.html](http://www.geotimes.org/july03/high_coal.html)

[http://www.geotimes.org/sept06/feature\\_HealthImpacts.html](http://www.geotimes.org/sept06/feature_HealthImpacts.html)

<http://www.worldcoal.org/pages/content/index.asp?PageID=412>

<http://www.worldcoal.org/pages/content/index.asp?PageID=414>

<http://www.acaa-usa.org/> <http://www.mii.org/recl.html>

<http://www.worldcoal.org/pages/content/index.asp?PageID=126>

## **10. What EMD technical sessions, publications, workshops etc. exist or are planned that are relevant to this commodity?**

### **EMD at the AAPG 2008 International Meeting**

October 26-29, 2008• Cape Town, South Africa

<http://www.aapg.org/capetown/tech.cfm>

Technical session: EMD Coal and Non-Traditional Energy Resources

Workshop: [Coalbed Methane Exploration and Development Strategies](#)

### **EMD at the AAPG 2009 Annual Meeting**

June 7-10, 2009• Denver, Colorado

<http://www.aapg.org/denver/technicalprogram.cfm>

Technical session: Coalbed Hydrocarbons

### **EMD/DEG/SEG at the AAPG 2008 Eastern Section Meeting**

October 11-15, 2008• Pittsburgh, Pennsylvania

<http://www.aapgspe2008.org/>

Technical Sessions:

AAPG/DEG: CO<sub>2</sub> Sequestration II

SPE: Carbon Sequestration, Coal, and Coalbed Methane

### **Also see:**

AAPG Conferences and Exhibitions

<http://www.aapg.org/meetings/endorsed.cfm>

American Geological Institute - Geosciences Calendar

<http://www.agiweb.org/calendar/index.html>

Coal Geology Division, Geological Society of America

<http://www.uky.edu/KGS/coal/GSA/>

International Energy Agency Clean Coal Center's listing of forthcoming coal conferences, meetings and workshops

<http://www.iea-coal.org.uk/content/default.asp?PageID=901>

International Energy Agency: Coal information

[http://www.iea.org/Textbase/subjectqueries/keyresult.asp?KEYWORD\\_ID=4101](http://www.iea.org/Textbase/subjectqueries/keyresult.asp?KEYWORD_ID=4101)

International Pittsburgh Coal Conference

<http://www.engr.pitt.edu/pcc/>

The Clearwater Coal Conference

<http://www.coaltechnologies.com/index.html>

The International Committee for Coal and Organic Petrology  
<http://www.iccop.org>

The Canadian Society for Coal Science and Organic Petrology  
<http://www.cscop.org/>

The Society for Organic Petrology  
<http://www.tsop.org/>

**See the following EMD website for information about the EMD publications listed below**

<http://emd.aapg.org/publications.cfm>

Atlas of Coal Geology  
AAPG Studies in Geology, No. 45  
by Alexander R. Papp, James C. Hower, and Douglas C. Peters

Geology in Coal Resource Utilization  
by Douglas C. Peters

Sequence Stratigraphy, Paleoclimate, and Tectonics of Coal-Bearing Strata  
AAPG Studies in Geology, No. 51  
by Jack C. Pashin and Robert A. Gastaldo

Unconventional Energy Resources of North America  
AAPG Poster  
by John R. Dyni