

Coal fuels 40% of global electricity demand and 25% of world primary energy needs.[†]

General Information

- Coal is formed from plant matter compacted and metamorphosed by heat and pressure over time.
- Coal is primarily composed of carbon, hydrogen, and oxygen in the approximate ratio of $C_{1.0}H_{0.8}O_{0.2}$, and also contains moisture, ash, sulfur, and numerous trace metals.

US Coal Classification System

Rank	Carbon (wt%)	Volatile Matter (wt%)	Energy (10^3 BTU/lb)
Anthracite	>86	<14	
Low Vol. Bituminous	86-69	14-31	
High Vol. Bituminous	<69	>31	>11.5
Sub-Bituminous			11.5-8.3
Lignite			<8.3

Proven Recoverable Reserves (2007)

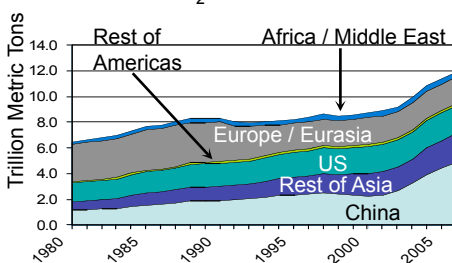
(10^3 Million Short Tons)

Country	Bituminous & Anthracite	Sub-Bit. & Lignite	TOTAL	Share (%)	R/P (Yrs)
US	112	130	243	28.6	234
Russia	49	108	157	18.5	>500
China	62	52	115	13.5	45
Australia	37	39	77	9.0	194
India	52	4	56	6.7	118
World	431	417	847	100	133

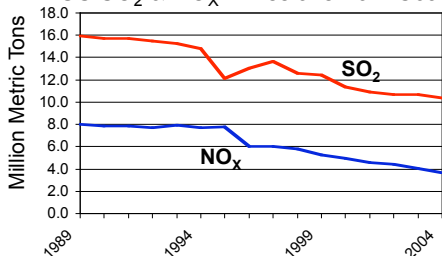
R/P = recoverable reserves / annual production
=time reserves will last at current extraction rates

Emissions from Coal

World CO₂ Emissions from Coal



US SO₂ & NO_x Emissions from Coal



US Coal Power Generators with Environmental Equipment (2005)

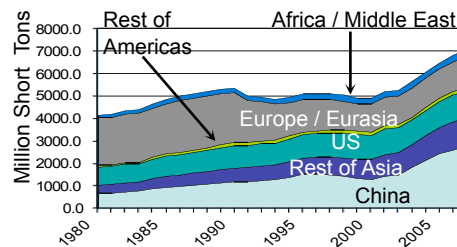
Particulate Collector	329 GW	(98%)
Cooling Towers	158 GW	(47%)
Scrubbers	101 GW	(30%)

Primary Coal Production (2006)

(Million Short Tons)

	Anthracite	Bituminous	Lignite	TOTAL
China	535.7	1984.2	100.7	2620.5
US	1.5	1075.7	84.2	1161.4
India	0	464.4	32.8	497.2
Australia	0	341.1	78.5	419.6
Russia	19.8	237.2	83.6	340.6
World	630.0	5152.2	999.4	6781.6

Primary Coal Production History



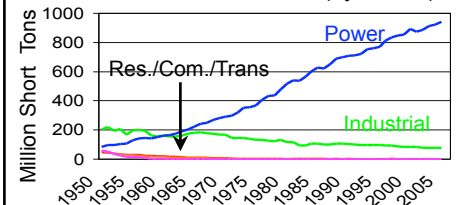
- In 2007, Asia accounted for 90% of the global consumption growth and 80% of production growth.

US Coal Mines and Employment (2007)

Operation	# of Mines	Employment	Productivity (ton/miner-hr)
Surface	1044	34450	10.25
Subsurface	795	46723	3.34
Refuse Recov.	20	105	5.77
Total	1859	81278	6.27

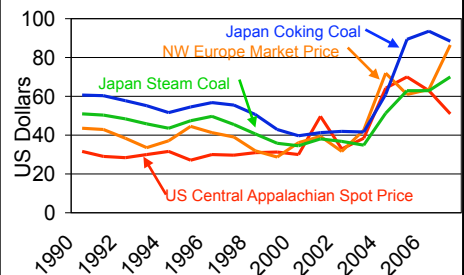
Consumption

U.S. Coal End Use (by sector)



- 75% (90%) of world (U.S.) coal usage is for power production. Coal generates 40% (50%) of world (U.S.) power.
- Steel and cement production use large amounts of coal. In some countries, coal is still used as a domestic fuel for home heating and cooking.

World Coal Prices



Key Issues & Future Prospects

Technologies: Conventionally, pulverized coal (PC) is burnt for power in boiler combustors. Efficiency is limited by materials, and has seen incremental improve in the past few years. Integrated Gasification Combined Cycle (IGCC) gasifies coal and burns the resulting syngas which allows for slightly higher efficiencies and easier emissions control.

Comparative Plant Efficiencies:

36-38%	Subcritical	PC:
39-41%	Supercritical	PC
43-45%	Ultra Supercritical	PC
38-44%		IGCC

Coal Use In China: Coal use in China's electricity sector is projected to increase

at an average rate of 4.1% per year. In comparison, coal consumption in the U.S. electricity sector is projected to grow by 1.1% annually.

Air Pollution: Coal contains many impurities emitted to the air during combustion, leading to smog (from NO_x), acid rain (from NO_x, SO₂), mercury deposition and particulate-induced respiratory diseases. In developed countries, most of these issues have been controlled by technologies, such as flue gas desulfurization and bag houses.

Global Climate Change: Coal is a very carbon intense per unit of useful energy and contributes approximately 35% of energy-related CO₂ emissions. Coal combustion (likely IGCC) with carbon capture and sequestration into geologic reservoirs offers a possibility to keep coal in the power supply mix with lower carbon emissions.

Key References

U.S. International Energy Agency projections to BP Statistical Review of World Energy 2007

General Information

• 2006 Coal Fact Card, World Coal Institute, 2006

For general coal information see
• <http://en.wikipedia.org/wiki/Coal>

Classification

Coal Resource Classification System of the U.S. Geological Survey
• <http://pubs.usgs.gov/circ/c891/index.htm>
• Table 1

Reserves

Proven Recoverable Reserves (2008)
• BP Statistical Review of World Energy 2008
• Proved reserves at end of 2007

Production

Primary Coal Production (2006)
• EIA International Energy Statistics 2006
• Anthracite – Table 52
• Bituminous – Table 53
• Lignite – Table 54
• Next Update, August 2009

Primary Coal Production History
• EIA International Energy Statistics 2008
• World production statistics

US Coal Mines and Employment
• EIA International Energy Statistics 2009
• US Department of Labor, Mine Safety and Health Administration

End Use

U.S. Coal End Use
• EIA US Energy Statistics 2006
• Next Update, September 2009

World Coal Prices
• BP Statistical Review of World Energy 2008
• Coal Prices Table

Emissions

World CO₂ Emissions from Coal
• EIA International Energy Statistics 2008
• Rest of Asia includes Oceania
• Next Update, August 2009

US SO₂ and NO_x Emissions from Coal
• EIA Annual Energy Review 2005
• Table 12.7a, Coal Figures

Environmental Equipment
• EIA Annual Energy Review 2005
• Table 12.8, Coal Figures

Key Issues & Future Prospects

Comparative Plant Efficiencies
• Coal-Related Greenhouse gas Management Issues, May 2003, The National Coal Council
• Figure 3-5

Coal Use in China
• EIA International Energy Outlook 2008

Other Coal Information Sources
• American Coal Council
• American Coke and Coal Chemicals Institute
• International Energy Agency
• Mine Safety and Health Administration
• National Mining Association
• New York Mercantile Exchange (NYMEX)
• Office of Surface Mining Reclamation and Enforcement
• The Coal Information Network
• U.S. Census Bureau, Foreign Trade Statistics
• U.S. Senate Committee on Energy and Natural Resources
• U.S. House Committee on Energy and Commerce
• U.S. Geological Survey
• World Coal Institute