Coal

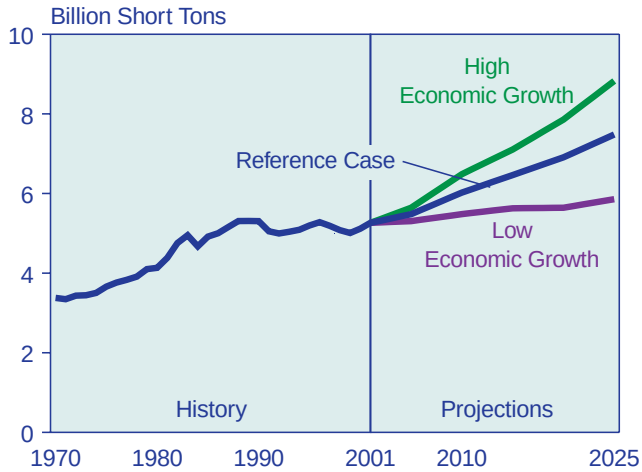
Although coal use is expected to be displaced by natural gas in some parts of the world, only a slight drop in its share of total energy consumption is projected by 2025. Coal continues to dominate many national fuel markets in developing Asia.

World coal consumption has been in a period of generally slow growth since the late 1980s, a trend that is projected to continue. Although total world consumption of coal in 2001, at 5.26 billion short tons,[12] was more than 27 percent higher than the total in 1980, it was 1 percent below the 1989 peak of 5.31 billion short tons (Figure 56). The *International Energy Outlook 2003* (*IEO2003*) reference case projects some growth in coal use between 2001 and 2025, at an average annual rate of 1.5 percent (on a tonnage basis), but with considerable variation among regions.

Coal use is expected to decline in Western Europe, Eastern Europe, and the former Soviet Union (FSU). Increases are expected in the United States, Japan, Australia, New Zealand, and developing Asia. In Western Europe, coal consumption declined by 30 percent between 1990 and 2001 (on a Btu basis), displaced in large part by the growing use of natural gas and, in France, nuclear power. A similar decline occurred in the countries of Eastern Europe and the former Soviet Union (EE/FSU), where coal use fell by 40 percent between 1990 and 2001 as a result of the economic collapse that followed the breakup of the Soviet Union, as well as some fuel switching. The projected slow growth in world coal use suggests that coal will account for a shrinking share of global primary energy consumption. In 2001, coal provided 24 percent of world primary energy consumption, down from 26 percent in 1990. In the *IEO2003* reference case, the coal share of total energy consumption is projected to fall to 22 percent by 2025 (Figure 57).

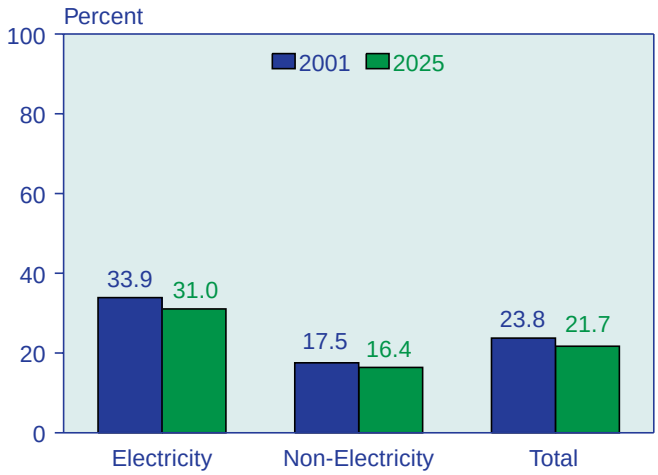
The expected decline in coal's share of energy use would be even greater were it not for large increases in energy use projected for developing Asia, where coal continues to dominate many fuel markets, especially in China and India. As very large countries in terms of both population and land mass, China and India are projected to account for 28 percent of the world's total increase in energy consumption over the forecast period. The expected increases in coal use in China and India from 2001 to 2025 account for 75 percent of the total expected increase in coal use worldwide (on a Btu basis); however, coal's share of energy use in China and India, and in developing Asia as a whole, still is projected to decline (Figure 58).

Figure 56. World Coal Consumption, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2003).

Figure 57. Coal Share of World Energy Consumption by Sector, 2001 and 2025



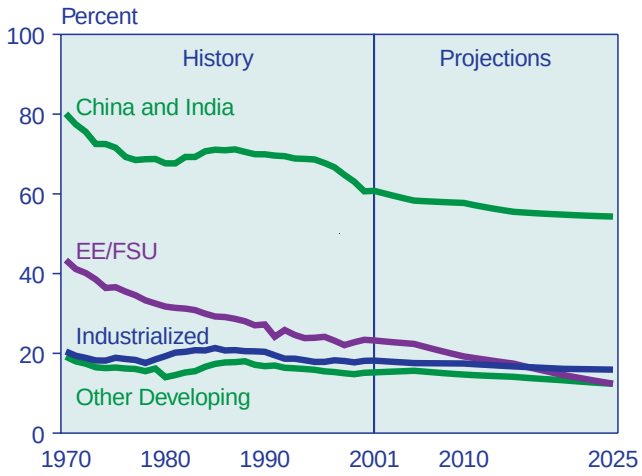
Sources: **2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **2025:** EIA, System for the Analysis of Global Energy Markets (2003).

[12] Throughout this chapter, tons refers to short tons (2,000 pounds).

Coal consumption is heavily concentrated in the electricity generation sector, and significant amounts are also used for steel production. Almost 55 percent of the coal consumed worldwide is used for electricity generation, and power generation accounts for virtually all the projected growth in coal consumption worldwide [***1***]. Where coal is used in the industrial, residential, and commercial sectors, other energy sources—primarily, natural gas—are expected to gain market share. One exception is China, where coal continues to be the main fuel in a rapidly growing industrial sector, reflecting the country's abundant coal reserves and limited access to other sources of energy. Consumption of coking coal is projected to decline slightly in most regions of the world as a result of technological advances in steelmaking, increasing output from electric arc furnaces, and continuing replacement of steel by other materials in end-use applications.

The *IEO2003* projections are based on current laws and regulations and do not reflect the possible future ratification of proposed policies to address environmental concerns. In particular, the forecast does not assume compliance with the Kyoto Protocol, which currently is not a legally binding agreement. The implementation of plans and policies to reduce emissions of greenhouse gases could have a significant effect on coal consumption. For example, in an earlier study, the Energy Information Administration (EIA) projected that the United States could meet its Kyoto emissions target only by reducing annual coal consumption by between 18 percent and 77 percent (on a Btu basis) by 2010, depending on the level of international emission trading and domestic offsets assumed [***2***].

Figure 58. Coal Share of Regional Energy Consumption, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2003).

Developments in international coal markets are also important to the coal outlook. World coal trade grew by 46 million tons between 2000 and 2001, increasing to 650 million tons. In 2002, international coal markets were characterized by reduced growth in world coal trade relative to 2000 and 2001 and rising freight rates and coal export prices during the latter part of the year.

Highlights of the *IEO2003* projections for coal are as follows:

- World coal consumption is projected to increase by 2.2 billion tons, from 5.3 billion tons in 2001 to 7.5 billion tons in 2025. Alternative assumptions about economic growth rates lead to forecasts of world coal consumption in 2025 ranging from 5.9 to 8.8 billion tons (see Figure 56).
- Coal use in developing Asia alone is projected to increase by 1.9 billion tons. China and India together are projected to account for 28 percent of the total increase in energy consumption worldwide between 2001 and 2025 and 75 percent of the world's total projected increase in coal use, on a Btu basis.
- Coal-fired generating capacity in China is projected to increase by 60 percent, from 232 gigawatts in 2001 to 371 gigawatts in 2025. In India, coal-fired generating capacity is projected to increase by 45 percent, from 66 gigawatts in 2001 to 96 gigawatts in 2025.
- The share of coal in world total primary energy consumption is expected to decline from 24 percent in 2001 to 22 percent in 2025. The coal share of energy consumed worldwide for electricity generation is also projected to decline, from 34 percent in 2001 to 31 percent in 2025.
- World coal trade is projected to increase from 650 million tons in 2001 to 826 million tons in 2025, accounting for between 11 and 13 percent of total world coal consumption over the period. Steam coal (including coal for pulverized coal injection at blast furnaces) accounts for most of the projected increase in world trade.

Environmental Issues

Like other fossil fuels, coal has played an important role in fueling the advancement of civilization, but its use also raises environmental issues. Coal mining has a direct impact on the environment, affecting land and causing subsidence, as well as producing mine waste that must be managed. Coal combustion produces several types of emissions that adversely affect the environment, particularly ground-level air quality. Concern for the environment has in the past and will in the future contribute to policies that affect the consumption of coal and other fossil fuels. The main emissions from coal combustion are sulfur dioxide (SO_2), nitrogen oxides

(NO_x), particulates, carbon dioxide (CO_2), and mercury (Hg).

Sulfur dioxide emissions have been linked to acid rain, and many of the industrialized countries have instituted policies or regulations to limit them. Developing countries are also increasingly adopting and enforcing limits on sulfur dioxide emissions. Such policies typically require electricity producers to switch to lower sulfur fuels or invest in technologies—primarily flue gas desulfurization (FGD) equipment—that reduce the amounts of sulfur dioxide emitted with coal combustion.

Environmental regulation influences interfuel competition (i.e., how coal competes with other fuels, such as oil and natural gas), particularly in the power sector, where the competition is greatest. For example, compliance with increasingly stringent restrictions on emissions could be increasingly costly and could lead to reduced demand for coal. On the other hand, improved technologies may provide cost-effective ways to reduce emissions from coal-fired power plants. Integrated gasification combined-cycle (IGCC) technology, which may soon be commercially competitive, can increase generating efficiencies by 20 to 30 percent and also reduce emission levels (especially of carbon dioxide and sulfur oxides) more effectively than existing pollution control technologies [***3***].

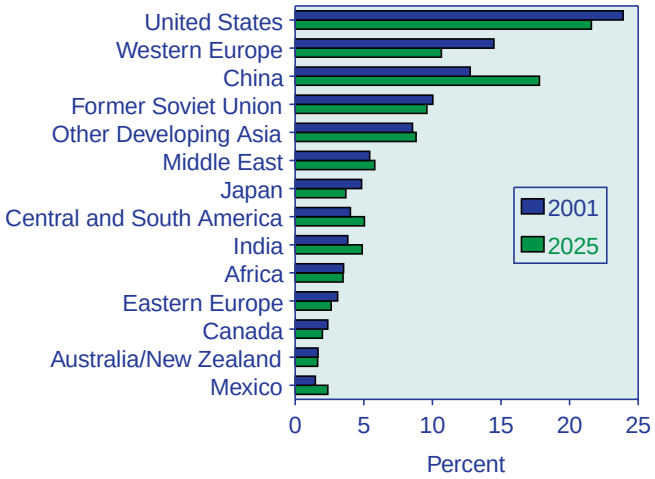
At the end of 1999, more than 280 gigawatts of coal-fired capacity around the world were equipped with FGD or other sulfur dioxide control technologies [***4***]. In the United States, 95 gigawatts of coal-fired generating capacity—30 percent of the U.S. total—was equipped with technologies to reduce sulfur dioxide emissions at the end of 1999 [***5***]. In the developing countries of Asia, only minor amounts of existing coal-fired capacity currently are equipped with desulfurization equipment. For example, in China, the world's largest emitter of sulfur dioxide, data for 1999 indicated that only about 2 percent of coal-fired generating capacity (at that time, less than 4 gigawatts out of a total of 207 gigawatts) had FGD equipment in place [***6***].

In addition to sulfur dioxide, increased restrictions on emissions of nitrogen oxides, particulates, and carbon dioxide are likely, especially in the industrialized countries. Although the potential magnitudes and costs of additional environmental restrictions for coal are uncertain, it seems likely that coal-fired generation worldwide will face steeper environmental cost penalties than will new natural-gas-fired generating plants. For nuclear and hydropower, which compete with coal for baseload power generation, the future is unclear. Proposals have been put forth in several of the developed countries to partially or fully phase out nuclear capacity. Countries where actual commitments have been made include Germany, Lithuania, and Sweden. In other countries, it has become difficult to site new capacity because of unfavorable public reaction. The siting of new large hydroelectric dams is also becoming more difficult because of increased environmental scrutiny. In addition, suitable sites for new large hydropower projects in the industrialized countries are limited [***7***].

By far the most significant issue for coal is emissions of carbon dioxide. On a Btu basis, the combustion of coal produces more carbon dioxide than the combustion of natural gas or of most petroleum products (combustion of petroleum coke produces slightly more carbon dioxide per unit of heat input than does combustion of coal). Carbon dioxide emissions per unit of energy obtained from coal are nearly 80 percent higher than those from natural gas and approximately 20 percent higher than those from residual fuel oil, which is the petroleum product most widely used for electricity generation [***8***].

In 2001, the United States and China were the world's dominant coal consumers and also the two top emitters of carbon dioxide, accounting for 24 percent and 13 percent, respectively, of the world's total emissions. Different economic growth rates and shifting fuel mixes explain in part why the U.S. share of world carbon emissions is projected in the *IEO2003* forecast to decline to 22 percent by 2025, while China's share is projected to increase to 18 percent (Figure 59). Worldwide, coal is projected to continue as the second largest source of carbon dioxide emissions (after petroleum), accounting for 34 percent of the world total in 2025.

Figure 59. Regional Shares of World Carbon Emissions, 2001 and 2025



Sources: **2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **2025:** EIA, System for the Analysis of Global Energy Markets (2003).

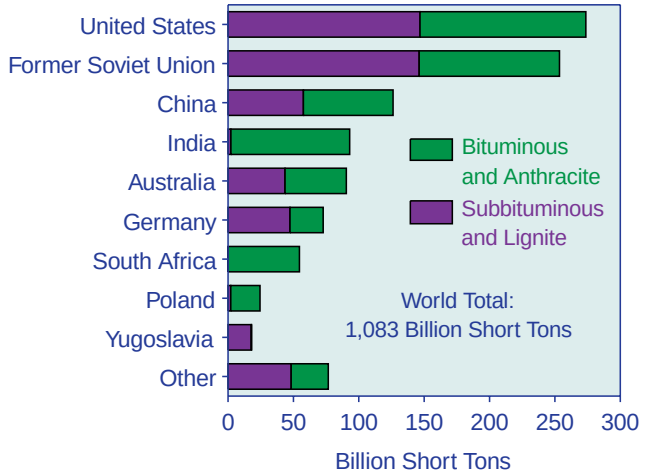
Reserves

Total recoverable reserves of coal around the world are estimated at 1,083 billion tons[13]—enough to last approximately 210 years at current consumption levels (Figure 60). Although coal deposits are widely distributed, 60 percent of the world's recoverable reserves are located in three regions: the United States (25 percent), FSU (23 percent), and China (12 percent). Another four countries—Australia, India, Germany, and South Africa—account for an additional 29 percent. In 2001, these seven regions accounted for 80 percent of total world coal production [***9***].

Quality and geological characteristics of coal deposits are other important parameters for coal reserves. Coal is a much more heterogeneous source of energy than is oil or natural gas, and its quality varies significantly from one region to the next and even within an individual coal seam. For example, Australia, the United States, and Canada are endowed with substantial reserves of premium-grade bituminous coals that can be used to manufacture coke. Together, these three countries supplied 84 percent of the coking coal traded worldwide in 2001 (see Table 19 on page 89).

At the other end of the spectrum are reserves of low-Btu lignite or "brown coal." Coal of this type is not traded to any significant extent in world markets, because of its relatively low heat content (which raises transportation costs on a Btu basis) and other problems related to transport and storage. In 2001, lignite accounted for 18 percent of total world coal production (on a tonnage basis) [***10***]. The top three producers were Germany (193 million tons), Russia (110 million tons), and the United States (84 million tons), which as a group accounted for 41 percent of the world's total lignite production in 2001. On a Btu basis, lignite deposits show considerable variation. Estimates by the International Energy Agency for coal produced in 1999 show that the average heat content of lignite from major producers in countries of the Organization for Economic Cooperation and Development (OECD) varied from a low of 4.7 million Btu per ton in Greece to a high of 12.3 million Btu per ton in Canada [***11***]. In comparison, premium coal supplied to United States coke plants is estimated to have a content of 27.4 million Btu per ton [***12***].

Figure 60. World Recoverable Coal Reserves



Note: Data for the U.S. represent recoverable coal estimates as of January 1, 2001. Data for other countries are as of January 1, 2000.

Source: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), Table 8.2, web site www.eia.doe.gov/iea/.

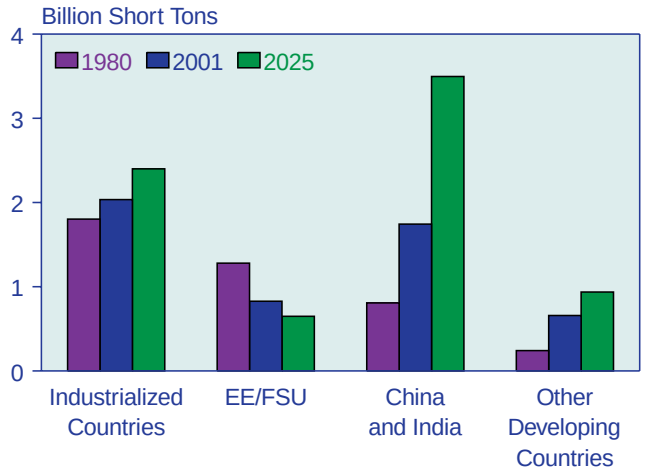
Regional Consumption

Developing Asia

The countries of developing Asia accounted for 40 percent of the world's coal consumption in 2001. Primarily as a result of substantial growth in coal consumption in China and India over the forecast period, developing Asia, taken as a whole, is projected to account for a 53-percent share of total world coal consumption by 2025.

The large increases in coal consumption projected for China and India (Figure 61) are based on an outlook for strong economic growth (6.2 percent per year in China and 5.2 percent per year in India between 2001 and 2025) and the expectation that much of the increased demand for energy will be met by coal, particularly in the

Figure 61. World Coal Consumption by Region, 1980, 2001, and 2025



Sources: **1980 and 2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **2025:** EIA, System for the Analysis of Global Energy Markets (2003).

[13]Recoverable reserves are those quantities of coal which geological and engineering information indicates with reasonable certainty can be extracted in the future under existing economic and operating conditions.

industrial and electricity sectors. The *IEO2003* forecast assumes no significant changes in environmental policies in the two countries. It also assumes that necessary investments in the countries' mines, transportation, industrial facilities, and power plants will be made.

In China, 62 percent of the coal demand in 2001 occurred in the non-electricity sectors, for steam and direct heat for industrial applications (primarily in the chemical, cement, and pulp and paper industries), and for the manufacture of coal coke for input to the steelmaking process. Although China's coal demand in the non-electricity sectors is expected to increase by 12 quadrillion Btu over the forecast period, the non-electricity share of total coal demand is projected to decline to 52 percent by 2025. In 2000, China was the world's leading producer of both steel and pig iron [***13***].

Coal remains the primary source of energy in China's industrial sector, primarily because China has limited reserves of oil and natural gas. In the non-electricity sectors, most of the projected increase in oil use comes from rising demand for energy for transportation. Growth in the consumption of natural gas is expected to come primarily from increased use for space heating in the residential and commercial sectors.

With a substantial portion of the increase in China's demand for both oil and natural gas projected to be met by imports, the government recently has signed an agreement with Hydrocarbon Technologies, Inc., to build a direct coal liquefaction plant in China beginning in 2003, with an expected startup in 2005. The $2 billion facility will be located in Inner Mongolia and will have an ultimate capacity of 50,000 barrels per day produced from local coal. The agreement is for three units, which together will consume 5 million tons of coal annually [***14***]. Compared with South Africa's most recently constructed coal liquefaction plant (built by SASOL at Secunda, South Africa, in 1982), which is capable of producing more than 25 million barrels of coal liquids annually, China's first plant will be smaller, with an annual production capacity of approximately 18 million barrels.

In China's electricity sector, coal use is projected to grow by 4.2 percent a year, from 9.8 quadrillion Btu in 2001 to 26 quadrillion Btu in 2025. In comparison, coal consumption by electricity generators in the United States is projected to rise by 1.2 percent annually, from 20.9 quadrillion Btu in 2001 to 27.7 quadrillion Btu in 2025. One of the key implications of the substantial rise in coal use for electricity generation in China is that large financial investments in new coal-fired power plants and in the associated transmission and distribution systems will be needed. The projected growth in coal demand implies that China will need to build approximately 140 gigawatts of additional coal-fired capacity by 2025.[14] At the beginning of 2001, China had 232 gigawatts of coal-fired generating capacity [***15***].

The debate as to whether China will become a major coal exporter (because of its relatively inexpensive mining costs) or a major coal importer (because of anticipated growth in its coal use over time) has yet to be determined. In either case, however, the completion of two major non-coal infrastructure projects near the end of the decade should reduce domestic coal demand and free up more production for export. The first infrastructure improvement, a new west-to-east transmission line that will allow hydropower from the Three Gorges Dam complex to be wheeled to load centers in eastern and southern China, will in all probability result in the displacement of coal-fired generation at small older plants. The second infrastructure improvement, a new pipeline that will bring natural gas from northwest China to eastern and southern provinces, will likely displace coal used in industrial boilers and some utility generation [***16***].

In India, projected growth in coal demand occurs primarily in the electricity sector, which currently accounts for almost three-quarters of India's total coal consumption. Coal use for electricity generation in India is projected to rise by 2.1 percent per year, from 4.1 quadrillion Btu in 2001 to 6.7 quadrillion Btu in 2025, implying that India will need to build approximately 30 gigawatts of additional coal-fired capacity.[15] At the beginning of 2001, India's total coal-fired generating capacity amounted to 66 gigawatts [***17***].

India's state-owned National Thermal Power Corporation (NTPC) is the largest thermal power generating company in India. At present, it has 16,220 megawatts of coal-fired capacity that rely almost exclusively on India's state-owned coal producer, Coal India Limited (CIL), for its supply of coal. Later in this decade, however, demand from the power sector is expected to outstrip CIL's production target level, with the result that NTPC and the other utilities in India will begin supplementing domestic coal supplies with additional shipments from the international market [***18***].

[14]Based on the assumption that, on average, coal consumption at China's fleet of coal-fired power plants will rise to a level of 70 trillion Btu per gigawatt by 2025. Higher average utilization rates (or capacity factors) for coal plants, taken as a whole, would increase the amount of coal consumed per unit of generating capacity, while overall improvements in conversion efficiencies would have the opposite effect. In EIA's *Annual Energy Outlook 2003* reference case forecast, U.S. coal-fired power plants are projected to consume an average of 73 trillion Btu of coal per gigawatt of generating capacity in 2025, based on a projected average utilization rate of 83 percent and an average conversion efficiency of 33.5 percent.

[15]Based on the assumption that, on average, coal consumption at India's coal-fired power plants will rise to a level of 70 trillion Btu per gigawatt by 2025. See previous footnote for discussion of the factors that affect the amount of coal consumed per unit of generating capacity.

In the remaining areas of developing Asia, a considerably smaller rise in coal consumption is projected over the forecast period, based on expectations for growth in coal-fired electricity generation in South Korea, Taiwan, and the member countries of the Association of Southeast Asian Nations (primarily Indonesia, Malaysia, the Philippines, Thailand, and Vietnam). In the electricity sector, coal use in the other developing countries of Asia (including South Korea) is projected to increase by 0.3 percent per year, from 2.2 quadrillion Btu in 2001 to 2.4 quadrillion Btu in 2025.

The key motivation for increasing use of coal in other developing Asia is diversity of fuel supply for electricity generation [***19***]. This objective exists even in countries that have abundant reserves of natural gas, such as Thailand, Malaysia, Indonesia, and the Philippines. In the *IEO2003* forecast, coal's share of fuel consumption for electricity generation in the region is projected to decline from 22 percent in 2001 to 13 percent by 2025.

Some of the planned additions of coal-fired generating capacity in other developing Asia for 2003 and later include 5,400 megawatts of new coal-fired capacity for South Korea by 2015, 4,900 megawatts for Malaysia by 2006, and 1,400 megawatts for Thailand by 2009 [***20***]. In addition to planned capacity additions, a number of new coal-fired units have come on line in the region between 1999 and 2002, adding a combined total of more than 15,000 megawatts of electric power supply in South Korea (4,600 megawatts), Taiwan (4,215 megawatts), Indonesia (2,450 megawatts), Malaysia (1,700 megawatts), and the Philippines (2,040 megawatts) [***21***]. In Indonesia, however, several large coal-fired plants that have been completed recently or are near completion (Paiton I, Paiton II and Tanjung Jati-B) await new transmission capacity, which will not be fully completed until 2005 [***22***].

Because of environmental concerns and abundant natural gas reserves, there is considerable opposition to the addition of coal-fired capacity in Southeast Asia, particularly for countries such as Thailand and Malaysia. A number of individuals and environmental groups argue that reliance on local supplies of natural gas for electricity generation is a wiser and probably a more economical choice than constructing new coal-fired power plants that will rely on imported fuel and produce more pollution than gas-fired plants [***23***]. Recently, the Electricity Generating Authority of Thailand (EGAT) decided to delay purchasing power from three coal-fired plants for 3 years. This decision will delay the startup of a 1,364-megawatt project constructed by BLCP Power (a consortium of energy companies) until 2009 and may also significantly affect the development of the Bo Nok and Hin Krut plants, both of which have faced heavy opposition from local residents and environmental groups [***24***].

Industrialized Asia

Industrialized Asia consists of Australia, New Zealand, and Japan. Australia is the world's leading coal exporter and Japan is the leading coal importer in the world. In 2001, Australian coal producers shipped 214 million tons of coal to international consumers, and another 144 million tons of Australian coal (both hard coal and lignite) was consumed domestically, primarily for electricity generation. Coal-fired power plants accounted for 77 percent of Australia's total electricity generation in 2001 [***25***]. Over the forecast horizon, coal use in Australia is expected to increase slightly. At present, Australia's Queensland district has three new coal-fired power projects in various stages of completion: Callide C power plant (840 megawatts of capacity brought on line in 2001), Millmerran plant (840 megawatts of capacity brought online in 2002), and Tarong Power plant (450 megawatts scheduled for early 2003) [***26***]. In addition, Australia's Griffin Group plans to construct a 350-megawatt coal-fired plant near the existing Collie A power plant in Western Australia [***27***].

Japan, which is the third largest coal user in Asia and the seventh largest globally, imports nearly all the coal it consumes, much of it originating from Australia [***28***]. Japan's last two underground coal mines, Ikeshima with an annual production capacity of 1.1 million tons and Taiheiyo with a capacity of 2.2 million tons, were closed in late 2001 and early 2002 [***29***]. Currently, slightly more than one-half of the coal consumed in Japan is used by the country's steel industry (Japan is the world's second largest producer of both crude steel and pig iron) [***30***]. Coal is also used heavily in the Japanese power sector, and coal-fired plants currently generate approximately 25 percent of the country's electricity supply [***31***]. Japanese power companies plan to construct an additional 16 gigawatts of new coal-fired generating capacity between 2001 and 2010 [***32***].

Western Europe

In Western Europe, environmental concerns play an important role in the competition among coal, natural gas, and nuclear power. Recently, other fuels—particularly, natural gas—have been gaining economic advantage over coal. Coal consumption in Western Europe has fallen by 36 percent since 1990, from 894 million tons to 574 million tons in 2001. The decline was smaller on a Btu basis, at 30 percent, reflecting the fact that much of it resulted from reduced consumption of low-Btu lignite in Germany.

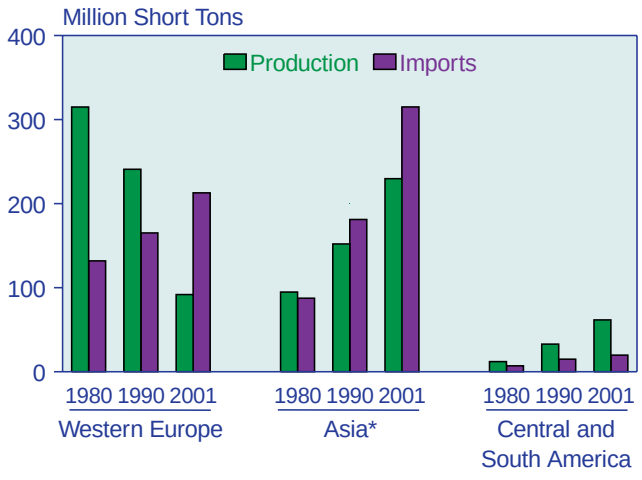
Over the forecast period, coal consumption in Western Europe is projected to decline by an additional 22 percent (on a Btu basis), reflecting a slower rate of decline than was seen during the previous decade. Factors contributing to further cutbacks in coal consumption include continued penetration of natural gas for

electricity generation, environmental concerns, and continuing pressure on member countries of the European Union to reduce subsidies that support domestic production of hard coal.

The European Commission has proposed that a new state aid scheme for coal be established to allow for the continuation of subsidies for hard coal production in member states through December 31, 2010 [***33***]. In essence, the Commission wants to establish measures that will promote the development of renewable energy sources as well as maintain a minimum capacity of subsidized coal production in the European Union for the purpose of establishing an "indigenous primary energy base." Under this new scheme, the guiding principle for coal will be that subsidized production will be limited to that which is strictly necessary for enhancing the security of energy supply (i.e., to maintain access to coal reserves, keep equipment in an operational state, preserve the professional qualifications of a nucleus of coal miners, and safeguard technological expertise).

The recent trend in the consumption of hard coal[16] in Western Europe is closely correlated with the trend in the production of hard coal, primarily because coal imports have increased by much less than production has declined (Figure 62). Following the closure of the last remaining coal mines in Belgium in 1992 and Portugal in 1994, only four member states of the European Union (the United Kingdom, Germany, Spain, and France) continue to produce hard coal [***34***], and all have seen their output of hard coal decline since 1990. In the near future, the proposed enlargement of the European Union would add two additional producers of hard coal, Poland and the Czech Republic [***35***].

Figure 62. Production and Imports of Hard Coal by Region, 1980, 1990, and 2001



*Data for Asia exclude Australia, China, India, and New Zealand.

Note: Production and imports include data for anthracite, bituminous, and subbituminous coal.

Source: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), Table 8.2, web site www.eia.doe.gov/iea/.

Hard coal production in the United Kingdom decreased from 104 million tons in 1990 to 35 million tons in 2001, a decline of 69 million tons [***36***]. During the same period, coal consumption fell by 48 million tons. Most of the decline in coal consumption resulted from privatization in the electricity sector, which led to a rapid increase in natural-gas-fired generation at the expense of coal.

The massive switch to natural gas and its adverse impact on the country's coal industry prompted the British government, in mid-1998, to place a moratorium on the construction of new gas-fired plants and, at the same time, request that a study be completed to assess the state of the country's electric power industry [***37***]. The two key issues to be investigated were the design, operation, and structure of the country's wholesale electricity market and the diversity and security of fuel supplies for electricity generation. As a result of the study, revisions in the setup of the country's wholesale electricity market were introduced, primarily aimed at introducing competition into the market for electricity generation.

The revised electricity market, referred to as the New Electricity Trading Arrangements (NETA), went into effect on March 27, 2001, and the moratorium on the construction of new gas-fired generating plants was lifted in November 2000 [***38***]. As of early 2003, NETA has been successful to the extent that the United Kingdom has realized substantial declines in both wholesale and retail electricity prices [***39***]. Under the country's former electricity market, referred to as the Electricity Pool, wholesale electricity prices failed to fall despite an estimated 50-percent decline in generation costs between 1990 and 2000. On the other hand, coal-fired generators have faired somewhat poorly under NETA, with lower cost generation effectively forcing the mothballing of several older coal-fired plants during 2002. Some UK generators indicate that wholesale electricity prices have essentially fallen to a level that is below the cost of production, while others argue that NETA has allowed the market to work and that what is occurring now is simply a weeding out of the most inefficient, high-cost electricity plants [***40***]. (For further discussion on NETA, see pages 149-151 in the Electricity chapter.)

Currently, the United Kingdom's remaining coal mines are by far the most productive hard coal operations in Western Europe. Substantial improvements in the country's mining operations in recent years have led to an

[16]Internationally, the term "hard coal" is used to describe anthracite and bituminous coal. In data published by the International Energy Agency, coal of subbituminous rank is classified as hard coal for some countries and as brown coal (with lignite) for others.

increase in average labor productivity from 1,190 tons per miner-year in 1990 to 3,200 tons per miner-year in 1999 [***41***]. Despite this achievement, the price of coal from domestic mines is essentially at parity with the price of coal imports, and it is likely that production from domestic mines will continue to be sensitive to changes in international coal prices [***42***]. In fact, following several years of sharp declines in international coal prices in 1998 and 2000, the UK government reinstated coal production subsidies for 2000 through 2002 in an effort to protect the country's remaining coal operations (Table 18) [***43***].

In Germany, Spain, and France, subsidies continue to support the domestic production of hard coal,[17] even though there is no hope that their production will ever be competitive with imports. The European Commission authorized coal industry subsidies for 2001 of $4,643 million in Germany, $1,194 million in Spain, and $1,073 million in France [***44***]. In each of the three countries, the average subsidy per ton of coal produced exceeds the average value of imported coal (Table 18), and all three are currently taking steps to reduce subsidy payments, acknowledging that some losses in coal production are inevitable.

Germany's hard coal production declined from 86 million tons in 1990 to 32 million tons in 2001 [***45***]. In late 1999, the Supervisory Board of RAG Aktiengesellschaft—an international mining and technology group based in Essen, Germany—agreed to speed up the pace of restructuring, because declining prices for hard coal in the world market and the severe drop in coal demand for steel production resulted in additional costs for the company beyond those covered by the existing subsidy granted by the German government. The revised restructuring agreement calls for an additional reduction in Germany's coal production to 26 million tons by 2005, to be achieved by further mergers. The net result of all planned mergers: a capacity reduction of 8.2 million tons and the loss of over 10,000 jobs [***46***]. The closure of three coal mines in 2000 (with a combined production capacity of approximately 6.7 million tons) leaves Germany with only 10 remaining hard coal mines in operation [***47***].

Between 1990 and 2001, German lignite production declined by 234 million tons, primarily as a result of massive substitution of natural gas for both lignite and lignite-based "town gas"[18] in the eastern states following reunification in 1990 [***48***]. The collapse of industrial output in the eastern states during the same period was a contributing factor. In the *IEO2003* reference case, Germany's coal consumption is projected to remain steady until 2005, after which it begins falling again, although not as dramatically as in recent years. By 2025, coal use in Germany is projected to be 203 million tons, a drop of 62 million tons from the 2001 level of 265 million tons.

In Spain, hard coal production declined from 22 million tons in 1990 to 16 million tons in 2001 [***49***]. Spain has adopted a restructuring plan for 1998 through 2005 that provides for a gradual decline in production to 12 million tons [***50***]. In addition to hard coal, two lignite mines in Spain, which produced 9 million tons in 2001, are earmarked for closure within the next 3 to 4 years [***51***]. Currently, the two generating plants that burn the lignite produced by the mines also rely in part on imports of subbituminous coal. Both plants are expected to increase their take of imported coal over the forecast, as lignite production from the two mines is ramped down.

In France, production of hard coal declined from 12 million tons in 1990 to 2 million tons in 2001 [***52***]. A modernization, rationalization, and restructuring plan submitted by the French government to the European Commission at the end of 1994 foresees the closure of all coal mines in France by 2005 [***53***]. The coal industry

Table 18. Western European Coal Industry Subsidies, Production, and Import Prices, 2001

Country	Coal Industry Subsidies (Million 2001 U.S. Dollars)	Hard Coal Production (Million Tons)	Average Subsidy per Ton of Coal Produced (2001 U.S. Dollars)	Average Price per Ton of Coal Imported (2001 U.S. Dollars)
Germany	4,643	32.4	144	43
Spain	1,194	15.9	75	40
France	1,073	2.2	494	47
United Kingdom	91	34.7	3	47

Sources: **Coal Production Subsidies:** Commission of the European Communities, *Report From the Commission on the Application of the Community Rules for the State Aid to the Coal Industry in 2001* (Brussels, Belgium, July 2, 2002), p. 10, web site www.europa.eu.int; and U.S. Federal Reserve Bank, "Foreign Exchange Rates (Annual)," web site www.federalreserve.gov (January 6, 2003). **Production:** Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Average Price of Coal Imports:** International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), and *Energy Prices & Taxes, Quarterly Statistics, Fourth Quarter 2002* (Paris, France, January 2003).

[17] In Spain, subsidies support the production of both hard coal and subbituminous coal.

[18] "Town gas" (or "coal gas"), a substitute for natural gas, is produced synthetically by the chemical reduction of coal at a coal gasification facility.

restructuring plan was based on a "Coal Agreement" between France's state-run coal company, Charbonnages de France, and the coal trade unions.

Coal use in other major coal-consuming countries in Western Europe is projected either to decline or to remain close to current levels. In the Scandinavian countries (Denmark, Finland, Norway, and Sweden), environmental concerns and competition from natural gas are expected to reduce coal use over the forecast period. The government of Denmark has stated that its goal is to eliminate coal-fired generation by 2030 [***54***]. In 2001, 47 percent of Denmark's electricity was supplied by coal-fired plants [***55***]. Coal consumption in Italy is projected to decline from 22 million tons in 2001 to 18 million tons in 2025 in the *IEO2003* forecast, although an increase of 3 to 5 million tons per year is possible if Enel, Italy's dominant electricity company, completes its plan to boost coal use to 20 percent of its power generation by 2005-2006, by switching high-cost oil plants to lower cost coal plants [***56***].

Partially offsetting the expected declines in coal consumption elsewhere in Europe is a projected increase in consumption of indigenous lignite for power generation in Greece. Under an agreement reached by the countries of the European Union in June 1998, Greece committed to capping its emissions of greenhouse gases by 2010 at 25 percent above their 1990 level—a target that is much less severe than the emissions target for the European Union as a whole, which caps emissions at 8 percent below 1990 levels by 2010 [***57***].

Eastern Europe and the Former Soviet Union

In the EE/FSU countries, the process of economic reform continues as the transition to a market-oriented economy replaces centrally planned economic systems. The dislocations associated with institutional changes in the region have contributed substantially to declines in both coal production and consumption. Coal consumption in the EE/FSU region has fallen by 548 million tons since 1990, to 828 million tons in 2001. In the future, total energy consumption in the EE/FSU is expected to rise, primarily as the result of increasing production and consumption of natural gas. In the *IEO2003* reference case, coal's share of total EE/FSU energy consumption is projected to decline from 23 percent in 2001 to 12 percent in 2025, and the natural gas share is projected to increase from 45 percent in 2001 to 57 percent in 2025.

The three main coal-producing countries of the FSU—Russia, Ukraine, and Kazakhstan—are facing similar problems. The three countries have developed national programs for restructuring and privatizing their coal industries, but they have been struggling with related technical and social problems. Between 1990 and 2001, coal production declined by 72 million tons (19 percent) in Russia, by 79 million tons (47 percent) in Ukraine, and by 42 million tons (32 percent) in Kazakhstan [***58***]. Although both Kazakhstan and Russia have shown considerable progress in terms of closing uneconomical mining operations and selling government-run mining operations to the private sector, Ukraine has made considerably less progress in its restructuring efforts. In Kazakhstan, many high-cost underground coal mines have been closed, and its more competitive surface mines have been purchased by, and are now operated by, international energy companies [***59***]. In Russia, the World Bank estimates that 77 percent of the country's coal production in 2001 will originate from mines not owned by the government, and that percentage was expected to increase to more than 90 percent by the end of 2002 [***60***].

In Ukraine, a coal restructuring program initiated by the government in 1996, with advice and financial support provided by the World Bank, has been mostly unsuccessful in rejuvenating the industry. Key problems that continue to plague the Ukrainian coal industry are that: (1) most of the country's mines continue to be highly subsidized, government-run enterprises; (2) dangerous working conditions prevail (several catastrophic mine disasters have occurred in the past several years); (3) wage arrears continue to be a serious problem, with miners currently owed back wages of approximately $3.5 billion; (4) productivity is very low due to antiquated mining equipment and the extreme depths at which coal is extracted (only three of Ukraine's active coal mines are surface operations); and (5) nonpayment for coal by customers is rampant [***61***].

The World Bank has focused its efforts in Ukraine on trying to convince the government that it needs to close additional unprofitable mines [***62***]. In 2001, a spokesperson for the World Bank expressed his belief that an additional 50 to 60 of the country's remaining coal mines need to be closed [***63***]. Others indicate that problems with the Ukrainian coal industry will not be solved simply through the closure of the least economical mines. They point to delays in privatization of coal mining operations, widespread corruption and abuse in the coal sector, worsening geological conditions, and misdirection of government subsidies (e.g., not enough of the government subsidies have been directed toward equipment upgrades at existing mines). Most recently, the Ukrainian government indicated that it would not formally present a plan to privatize the coal industry until after 2003 [***64***].

Recent data showing a slight resurgence in coal production in the FSU since 1998, particularly in Russia and Kazakhstan, in combination with draft energy strategies for Russia and Ukraine, indicate an optimistic long-term outlook for both coal production and consumption [***65***]. The *IEO2003* outlook for FSU coal consumption, however, is for an increase until 2005 and then a declining

trend over time. Natural gas and oil are expected to fuel most of the projected increase in energy consumption for the region.

In Eastern Europe, Poland is the largest producer and consumer of coal; in fact, it is the second largest coal producer and consumer in all of Europe, outranked only by Germany [***66***]. In 2001, coal consumption in Poland totaled 151 million tons, 47 percent of Eastern Europe's total coal consumption for the year [***67***]. Poland's hard coal industry produced 113 million tons in 2001, and lignite producers contributed an additional 66 million tons. Coal consumption in other Eastern European countries is dominated by the use of low-Btu subbituminous coal and lignite produced from local reserves. The region, taken as a whole, relies heavily on local production, with seaborne imports of coal to the region summing to a little more than 3 million short tons in 2000 [***68***].

Poland's hard coal industry operated at a slight loss in 2001, but it is expected to operate in the black in 2002 [***69***]. Over the past several years, a number of coal industry restructuring plans have been put forth for the purpose of transforming Poland's hard coal industry to a position of positive earnings, eliminating the need for government subsidies. The most recent plan for Poland's final phase of coal industry reorganization was announced in November 2002. Under the 3-year plan, employment would be reduced to 100,000 workers by 2006, and seven coal mines would be scheduled for closure. That would leave Poland with 31 mines capable of producing 87 million tons of coal per year, eliminating the traditional surplus (3 million tons in 2002) along with a large portion of the heavily state-subsidized coal export business, which receives more than $10 for each ton of coal exported [***70***]. The 13 trade unions involved in Poland's coal industry are opposed to the proposed final phase, however, and now the Polish government has agreed to defer its decision on pit closures and to maintain the coal miners' traditional social benefits [***71***].

The Polish government projects that sales of hard coal from domestic mines will decline from 100 million tons in 1998 to 77 million tons by 2025. As of August 2001, the World Bank had approved a total of $400 million in hard coal sector adjustment loans in support of the Polish government's restructuring program. The most recent loan, in the amount of $100 million (referred to as the Second Hard Coal Sector Adjustment Loan, or SECAL 2) was designed to support the implementation of the Polish government's Revised Hard Coal Sector Reform Program. It will support capacity and financial restructuring, environmental improvements, privatization, and social monitoring [***72***].

North America

Coal use in North America is dominated by U.S. consumption. In 2001, the United States consumed 1,060 million tons, accounting for 92 percent of the regional total. By 2025 U.S. consumption is projected to rise to 1,444 million tons. The United States has substantial supplies of coal reserves and has come to rely heavily on coal for electricity generation, a trend that continues in the forecast. Coal provided 51 percent of total U.S. electricity generation in 2001 and is projected to provide 47 percent in 2025 [***73***]. To a large extent, EIA's projections of declines in both minemouth coal prices and coal transportation rates are the basis for the expectation that coal will continue to compete as a fuel for U.S. power generation. Increases in coal-fired generation are projected to result from both greater utilization of U.S. coal-fired generating capacity and the addition of 65 gigawatts of new coal-fired power plants by 2025. Over the forecast period, the average utilization rate of coal-fired generating capacity is projected to rise from 69 percent in 2001 to 83 percent by 2025.

In Canada, coal consumption accounted for approximately 14 percent of total energy consumption in 2001 and is projected to decline slightly over the forecast period. In the near term, the restart of six of Canada's nuclear generating units (four at Ontario Power's Pickering A plant and two at Bruce Power's Bruce A plant) over the next few years is expected to restrain the need for coal in eastern Canada. A committee of the provincial legislature on alternative fuel sources recently recommended that Ontario eliminate all coal-fired generation within the next 13 years. The Ontario government appeared to support this proposal by vetoing the sale of Ontario Power's Thunder Bay and Antikokan coal facilities in Northern Ontario, which now account for 25 percent of the Province's electricity output, and hinting that they could be mothballed after 2015 [***74***]. The leader of Ontario's Liberal Party has been even more aggressive, pledging to replace all coal-fired power with natural gas and renewable energy within 5 years if his party wins the next election, scheduled to be held in late 2003 or early 2004 [***75***].

In western Canada, increased demand for electricity is expected to result in the need for some additional coal-fired generation [***76***]. Canada's lead exporter of metallurgical grade coal, Fording, is currently in the process of building two 500-megawatt coal-fired generation units in the Province of Alberta, approximately 110 miles southeast of Calgary [***77***]. The first unit is expected to be on line at the end of 2005 and the second in 2006. Additional coal-fired capacity in Alberta is being added by TransAlta at its Keephills coal facility (900 megawatts), scheduled for operation in 2005, and by a joint EPCOR-TransAlta investment in EPCOR's Genesee Phase 3 project (450 megawatts), scheduled for operation in winter 2004-2005 [***78***]. In Saskatchewan, SaskPower is currently rebuilding its coal-fired Boundary Dam Unit 6 at Estevan, extending its life by an additional 20 to 25 years. The rebuild, which will include a

new scrubber system to reduce sulfur dioxide emissions, should be complete by July 1, 2003 [***79***].

Mexico consumed 15 million tons of coal in 2001. Two coal-fired generating plants, Rio Escondido and Carbon II, operated by the state-owned utility Comision Federal de Electricidad (CFE), consume approximately 10 million tons of coal annually, most of which originates from domestic mines [***80***]. In addition, CFE has recently switched its six-unit, 2,100-megawatt Petacalco plant, located on the Pacific coast, from oil to coal. The utility estimates that the plant will require more than 5 million tons of imported coal annually. Late in 2002, CFE awarded a contract for 2.5 million tons to a supplier of Australian coal after encountering problems with a Chinese coal supplier [***81***]. A coal import facility adjacent to the plant, with an annual throughput capacity of more than 9 million tons, serves both the power plant and a nearby integrated steel mill [***82***].

Although natural gas is expected to fuel most new generating capacity to be built in Mexico over the *IEO2003* forecast period, some new coal-fired generation is also expected. Several manufacturing companies, such as Kimberly Clark and steelmakers Ispat and Altos Hornos de Mexico, are exploring the possibility of constructing some coal-fired plants near their production facilities [***83***]. The plants would be developed under Mexico's new self-supply provisions, which allow private power producers and large industrials the option of bypassing state-owned CFE as long as the industrial end users hold equity stakes in the projects [***84***]. In addition, based on authorization granted by the government's energy authority in 2001, the CFE is considering the possibility of constructing a new coal-fired plant on Mexico's Pacific coast [***85***].

Africa

Africa's coal production and consumption are concentrated heavily in South Africa. In 2001, South Africa produced 250 million tons of coal, representing 97 percent of Africa's total coal production for the year. Approximately three-quarters of South Africa's coal production went to domestic markets and the remainder to exports [***86***]. Ranked third in the world in coal exports since the mid-1980s (behind Australia and the United States), South Africa moved up a notch in 1999 when its exports exceeded those from the United States, then slipped back to third in 2001 when its export total was surpassed by China's. South Africa is also the world's largest producer of coal-based synthetic liquid fuels. In 1998, about 17 percent of the coal consumed in South Africa (on a Btu basis) was used to produce coal-based synthetic oil, which in turn accounted for more than one-fourth of all liquid fuels consumed in South Africa [***87***].

For Africa as a whole, coal consumption is projected to increase by 103 million tons between 2001 and 2025, primarily to meet increased demand for electricity, which is projected to increase at a rate of 3.0 percent per year. Some of the increase in coal consumption is expected outside South Africa, particularly as other countries in the region seek to develop and use domestic resources and more varied, less expensive sources of energy.

The Ministry of Energy in Kenya has begun prospecting for coal in promising basins in the hope of diversifying the fuels available to the country's power sector [***88***]. In Nigeria, several initiatives to increase the use of coal for electricity generation have been proposed, including the possible rehabilitation of the Oji River and Markurdi coal-fired power stations and tentative plans to construct a large new coal-fired power plant in southeastern Nigeria [***89***]. Also, Tanzania may move ahead on plans to construct a large coal-fired power plant. The new plant would help to improve the reliability of the country's power supply, which at present relies heavily on hydroelectric generation, and would promote increased use of the country's indigenous coal supply [***90***].

A recently completed coal project in Africa was the commissioning of a fourth coal-fired unit at Morocco's Jorf Lasfar plant in 2001. With a total generating capacity of 1,356 megawatts, the plant accounts for more than one-half of Morocco's total electricity supply and is the largest independent power project in Africa and the Middle East [***91***].

Central and South America

Historically, coal has not been a major source of energy in Central and South America. In 2001, coal accounted for about 3.8 percent of the region's total energy consumption, and in years past its share has never exceeded 5 percent. In the electricity sector, hydroelectric power has met much of the region's electricity demand, and new power plants are now being built to use natural gas produced in the region. Natural gas is expected to fuel much of the projected increase in electricity generation over the forecast period.

Brazil, with the ninth largest steel industry worldwide in 2001, accounted for more than 65 percent of the region's coal demand (on a tonnage basis), with Colombia, Chile, Argentina, and to a lesser extent Peru accounting for much of the remainder [***92***]. The steel industry in Brazil accounts for more than 75 percent of the country's total coal consumption, relying on imports of coking coal to produce coke for use in blast furnaces [***93***].

In the forecast, Brazil accounts for most of the growth in coal consumption projected for the region, with increased use of coal expected for both steelmaking (both coking coal and coal for pulverized coal injection) and electricity production. With demand for electricity approaching the capacity of Brazil's hydroelectric

plants, the government recently introduced a program aimed at increasing the share of fossil-fired electricity generation in the country, primarily promoting the construction of new natural-gas-fired capacity. The plan also includes several new coal-fired plants to be built near domestic coal deposits [***94***]. In addition, serious consideration is being given to the construction of a large coal-fired power plant at the port of Sepetiba, to be fueled by imported coal [***95***].

In November 2002, the construction of Puerto Rico's first coal-fired power plant was completed as part of a long-range plan to reduce the country's dependence on oil for electricity generation [***96***]. The 454-megawatt circulating fluidized bed (CFB) plant, located in Guayama, will require approximately 1.5 million tons of imported coal annually [***97***].

Middle East

Turkey accounts for almost 86 percent of the coal consumed in the Middle East. In 2001, Turkish coal consumption reached 81 million tons, most of it low-Btu, locally produced lignite (approximately 6.8 million Btu per ton) [***98***]. Over the forecast period, coal consumption in Turkey (both lignite and hard coal) is projected to increase by 40 million tons, primarily to fuel additional coal-fired generating capacity. Projects currently in the construction phase include a 1,210-megawatt hard-coal-fired plant being built on the southern coast of Turkey near Iskenderun, to be fueled by imported coal, and a 1,440-megawatt lignite-fired plant (Afsin-Elbistan B plant) being built in the lignite-rich Afsin-Elbistan region in southern Turkey [***99***]. When completed between 2003 and 2005, the two plants could add more than 10 million tons to Turkey's annual coal consumption.

Israel, which consumed 11 million tons of coal in 2001, accounts for most of the remaining coal use in the Middle East. In the near term, Israel's coal consumption is projected to rise by approximately 3 million tons per year following the completion of two 575-megawatt coal-fired units at Israel Electric Corporation's Rutenberg plant in 2000 and 2001 [***100***]. Israel obtains most of its coal from South Africa, Australia, and Colombia and has, in the past, also obtained coal from the United States. Recently approved plans for an additional 1,200 megawatts of coal-fired generating capacity near the Rutenberg site in 2007 should result in another increase in consumption of approximately 3 million tons of coal per year [***101***].

Trade

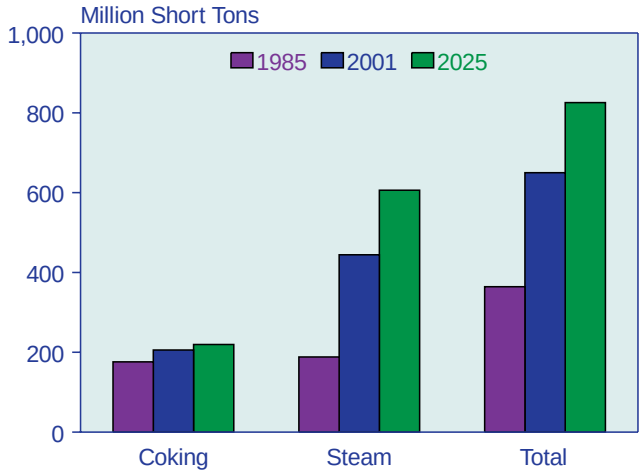
Overview

The amount of coal traded in international markets is small in comparison with total world consumption. In 2001, world imports of coal amounted to 650 million tons (Figure 63 and Table 19), representing 12 percent of total consumption. By 2025, coal imports are projected to rise to 826 million tons, accounting for an 11-percent share of world coal consumption. Although coal trade has made up a relatively constant share of world coal consumption over time and should continue to do so in future years, the geographical composition of trade is shifting.

In recent years, international coal trade has been characterized by relatively stable demand for coal imports in Western Europe and expanding demand in Asia (see Figure 62). Rising production costs in the indigenous coal industries of Western Europe, combined with continuing pressure to reduce industry subsidies, have led to substantial declines in production there, creating the potential for significant increases in coal imports; however, environmental concerns and increased electricity generation from natural gas, nuclear, and hydropower have curtailed the growth in coal imports. Conversely, growth in coal demand in Japan, South Korea, and Taiwan in recent years has contributed to a substantial rise in Asia's coal imports.

Most recently, in 2001 and 2002, international coal markets have undergone some significant changes on both the supply and demand sides. In 2001, international coal markets were affected by several factors, including a sharp decline in ocean freight rates from 2000, further

Figure 63. World Coal Trade, 1985, 2001, and 2025



Sources: **1985:** Energy Information Administration (EIA), *Annual Prospects for World Coal Trade 1987*, DOE/EIA-0363(87) (Washington, DC, May 1987). **2001:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, UK, September 2002); Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121(2001/4Q) (Washington, DC, May 2002); and Statistics Canada, *Coal and Coke Statistics—December 2001*, Catalogue 45-002-XIB, Vol. 80, No. 12 (Ottawa, Canada, March 2002). **2025:** Energy Information Administration, National Energy Modeling System run IEO2003.D033103A (March 2003).

Table 19. World Coal Flows by Importing and Exporting Regions, Reference Case, 2001, 2010, and 2025
(Million Short Tons)

Exporters	Importers											
	Steam[a]				Coking				Total			
	Europe[b]	Asia	America	Total[c]	Europe[b]	Asia[d]	America	Total[c]	Europe[b]	Asia	America	Total[c]
	2001											
Australia	9.5	85.2	2.0	**97.1**	31.4	78.9	6.6	**117.1**	40.9	164.1	8.6	**214.2**
United States	6.4	2.8	14.0	**23.3**	15.7	0.4	9.3	**25.4**	22.1	3.2	23.3	**48.7**
South Africa	62.4	8.5	2.1	**74.7**	0.7	0.1	0.3	**1.5**	63.1	8.6	2.4	**76.2**
Former Soviet Union	18.5	7.1	0.0	**25.8**	0.7	2.8	0.0	**3.6**	19.2	9.9	0.0	**29.4**
Poland	18.1	0.0	0.6	**18.7**	2.1	0.0	0.0	**2.1**	20.2	0.0	0.6	**20.8**
Canada	0.0	2.3	1.1	**3.5**	7.3	16.6	5.1	**30.1**	7.3	18.9	6.2	**33.6**
China	5.3	80.4	1.8	**87.5**	0.3	11.6	0.8	**12.7**	5.6	92.0	2.6	**100.2**
South America[e]	29.5	0.0	20.4	**49.8**	0.0	0.0	0.0	**0.0**	29.5	0.0	20.4	**49.8**
Indonesia[f]	12.0	49.5	2.3	**63.8**	0.1	13.0	0.0	**13.1**	12.1	62.5	2.3	**76.9**
Total	**161.8**	**235.8**	**44.3**	**444.3**	**58.2**	**123.4**	**22.1**	**205.7**	**220.0**	**359.2**	**66.4**	**650.0**
	2010											
Australia	11.1	120.7	0.4	**132.2**	33.5	83.9	9.5	**127.0**	44.6	204.6	10.0	**259.2**
United States	3.8	2.2	7.6	**13.7**	10.3	1.3	9.5	**21.1**	14.2	3.5	17.1	**34.8**
South Africa	73.6	6.8	2.6	**83.0**	1.3	0.3	0.0	**1.7**	74.9	7.1	2.6	**84.7**
Former Soviet Union	22.4	6.8	0.0	**29.2**	0.2	4.3	0.0	**4.5**	22.6	11.1	0.0	**33.7**
Poland	9.1	0.0	0.0	**9.1**	1.1	0.0	0.0	**1.1**	10.3	0.0	0.0	**10.3**
Canada	6.0	0.0	0.0	**6.0**	12.4	7.8	8.4	**28.6**	18.4	7.8	8.4	**34.5**
China	0.0	113.5	0.0	**113.5**	0.0	15.8	0.0	**15.8**	0.0	129.3	0.0	**129.3**
South America[e]	38.6	0.0	32.6	**71.2**	0.0	0.0	0.0	**0.0**	38.6	0.0	32.6	**71.2**
Indonesia[f]	13.7	68.6	0.0	**82.3**	0.0	11.8	0.0	**11.8**	13.7	80.4	0.0	**94.1**
Total	**178.3**	**318.7**	**43.3**	**540.3**	**58.9**	**125.2**	**27.4**	**211.5**	**237.3**	**443.9**	**70.7**	**751.8**
	2025											
Australia	2.9	146.9	1.0	**150.8**	32.2	90.3	13.3	**135.9**	35.1	237.2	14.3	**286.6**
United States	0.0	2.3	6.1	**8.4**	7.2	0.4	5.6	**13.1**	7.2	2.7	11.7	**21.5**
South Africa	70.4	14.8	3.8	**89.0**	0.8	0.3	0.0	**1.1**	71.1	15.1	3.8	**90.1**
Former Soviet Union	23.7	8.5	0.0	**32.2**	0.2	5.0	0.0	**5.2**	23.9	13.4	0.0	**37.3**
Poland	4.4	0.0	0.0	**4.4**	0.6	0.0	0.0	**0.6**	5.0	0.0	0.0	**5.0**
Canada	1.5	0.0	0.0	**1.5**	8.9	9.0	9.7	**27.7**	10.4	9.0	9.7	**29.2**
China	0.0	121.3	0.0	**121.3**	5.3	16.3	2.7	**24.3**	5.3	137.6	2.7	**145.5**
South America[e]	59.0	0.0	42.6	**101.5**	0.0	0.0	0.0	**0.0**	59.0	0.0	42.6	**101.5**
Indonesia[f]	0.0	97.1	0.0	**97.1**	0.0	11.8	0.0	**11.8**	0.0	108.9	0.0	**108.9**
Total	**161.9**	**390.7**	**53.5**	**606.1**	**55.0**	**133.2**	**31.4**	**219.6**	**216.9**	**523.9**	**84.8**	**825.7**

[a]Reported data for 2001 are consistent with data published by the International Energy Agency (IEA). The standard IEA definition for "steam coal" includes coal used for pulverized coal injection (PCI) at steel mills; however, some PCI coal is reported by the IEA as "coking coal."

[b]Coal flows to Europe include shipments to the Middle East and Africa.

[c]In 2001, total world coal flows include a balancing item used by the International Energy Agency to reconcile discrepancies between reported exports and imports. The 2001 balancing items by coal type were 2.5 million tons (steam coal), 1.9 million tons (coking coal), and 4.4 million tons (total).

[d]Includes 12.0 million tons of coal for pulverized coal injection at blast furnaces shipped to Japanese steelmakers in 2001.

[e]Coal exports from South America are projected to originate from mines in Colombia and Venezuela.

[f]In 2001, coal exports from Indonesia include shipments from other countries not modeled for the forecast period. The 2001 non-Indonesian exports by coal type were 2.3 million tons (steam coal), 1.3 million tons (coking coal), and 3.6 million tons (total).

Notes: Data exclude non-seaborne shipments of coal to Europe and Asia. Totals may not equal sum of components due to independent rounding. The sum of the columns may not equal the total, because the total includes a balancing item between importers' and exporters' data.

Sources: **2001:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, UK, September 2002); Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121(2001/ 4Q) (Washington, DC, May 2002); and Statistics Canada, *Coal and Coke Statistics—December 2001*, Catalogue 45-002-XIB, Vol. 80, No. 12 (Ottawa, Canada, March 2002). **2010 and 2025:** Energy Information Administration, National Energy Modeling System run IEO2003.D033103A (March 2003).

recovery in coal export prices (FOB port of exit) from lows reached in 1999 and early 2000, a continuation of strong growth in coal import demand, and a continuing surge in coal exports from China [***102***].

World coal trade increased by 7.7 percent in 2001, compared with increases of 10.0 percent in 2000 and 0.4 percent in 1999. All the major demand regions (Europe, Asia and the Americas) posted increases for the year. In Europe, the overall increase in coal imports in 2001 was largely the result of a 13-million-ton (52-percent) increase in imports by the United Kingdom. In the Americas, a 7-million-ton (58-percent) increase in imports by the United States boosted the overall total for the region [***103***].

Increased imports of coal to the United Kingdom in 2001 were attributable to a combination of strong growth in electricity demand during the year, high natural gas prices, and limited availability of domestic coal supply [***104***]. In the United States the record-breaking level of coal imports was due to both heightened demand for low-sulfur coal by U.S. electricity producers to meet sulfur emission requirements and a tight domestic coal supply market for most of the year [***105***].

On the transportation side, ocean freight rates declined substantially in 2001, despite strong growth in international coal trade. Declining freight rates were attributable in part to a displacement of medium coal export hauls in the Asian market, originating from countries such as Australia and South Africa, with considerably shorter hauls out of China and Indonesia [***106***].

Relative to 2001, the year 2002 was marked by a much smaller gain in world coal trade (increasing by less than 2 percent), a continuation of low ocean freight rates through the first half of the year, and declining coal export prices through much of the year [***107***]. During the latter half of 2002, however, both freight rates and coal export prices were on the rise. Higher freight rates toward the end of 2002 were attributable primarily to increasing international demand for iron ore and coal, and higher coal export prices were primarily due to increasing coal import demand. A continuation of favorable exchange rates against the U.S. dollar continued to benefit several key exporting countries, including Australia, South Africa, and Russia [***108***].[19]

Between 1998 and 2001 coal exports from China expanded by a remarkable 178 percent, from 36 million tons in 1998 to 100 million tons in 2001. Preliminary data indicate that China exported 97 million tons of coal during 2002, maintaining its position as the second leading coal export country in the world, ahead of South Africa and Indonesia [***109***]. The United States, which was the second largest coal exporter in the world from 1984 through 1998, was surpassed by South Africa and Indonesia in 1999 and by China in 2000.

Recent actions by the Chinese government to encourage coal exports include an increase in coal export rebates and a reduction in the export handling fees charged by China's four official coal export agencies [***110***]. A recent forecast from the Chinese government places coal exports at 132 million tons by 2005 [***111***].

Asia

Despite setbacks that resulted from the region's financial crisis in 1998, Asia's demand for imported coal remains poised for additional increases over the forecast period, based on strong growth in electricity demand in the region. Continuing the recent historical trend, Japan, South Korea, and Taiwan are projected to account for much of the regional growth in coal imports over the forecast period.

Japan continues to be the world's leading importer of coal and is projected to account for 24 percent of total world imports in 2025, slightly less than its 2001 share of 26 percent [***112***]. Although playing a less dominant role than in the past, Japanese industries, primarily steel mills and electric utilities, continue to exert considerable influence in the Asian coal market via their annual price negotiations with major coal export suppliers (see box on page 91). Declining gradually over time, Japan's share of total Asian coal imports has fallen from 85 percent in 1980 to 60 percent in 1990 and to 48 percent in 2001.

In 2001, Japan produced slightly less than 4 million tons of coal for domestic consumption and imported 171 million tons [***113***]. The closure of Japan's last two underground mines, Ikeshima and Taiheiyo, in late 2001 and early 2002 leaves virtually all of Japan's coal requirements to be met by imports [***114***].

China and India, which import relatively small quantities of coal at present, are expected to account for a significant portion of the remaining increase in Asian imports. Imports by China and India have the potential to be even higher than projected, but it is assumed in the forecast that domestic coal will be given first priority in meeting the large projected increase (1.8 billion tons) in coal demand. In addition, coal imports by Malaysia and the Philippines are also projected to rise substantially over the forecast period, primarily to satisfy demand at new coal-fired power plants. Diversification of fuel

[19]The exchange rate for the Australian dollar was US$0.56 in December 2002, 29 percent below its recent historical peak of US$0.80 in May 1996. The exchange rate for the South African Rand was US$0.11 in December 2002, 59 percent below its recent historical peak of US$0.27 in January 1996. Between August 1998 and December 2002, the Russian ruble lost 79 percent of its value compared with the U.S. dollar.

Japanese Benchmark Coal Prices and the Asian Coal Market

As the world's leading importer of coal, Japan has been influential in the international coal market. Historically, contract negotiations between Japan's steel mills and coking coal suppliers in Australia and Canada established a benchmark price for coal that was used later in the year as the basis for setting contract prices for steam coal used at Japanese utilities.[a] Other Asian markets also tended to follow the Japanese price in settling contracts.

Japan's influence has declined somewhat over the past several years, however, and the benchmark pricing system that was so influential in setting contract prices for Japan's steel mills was revised substantially in 1996. The revisions reflected a move away from a system which, in effect, averaged coal prices (with minor adjustments for quality) to a regime with a broad spectrum of prices, where high-quality coking coals received a substantial premium relative to lower quality coals.[b]

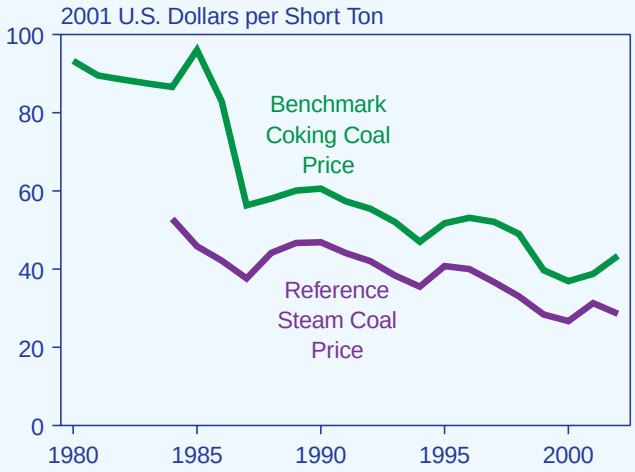
Changes have also occurred in the annual price negotiations between Japanese electric utilities and Australian steam coal suppliers. Traditionally, Japanese utilities have met most of their coal requirements through the use of long-term contracts that are subject to annual price reviews. Annual negotiations to adjust the price, quantity, and quality components of long-term coal contracts with foreign suppliers evolved during the oil price shocks of the 1970s and remain a key feature of this market.[c] The Japanese power utilities would approach the Australian suppliers as a single entity, with one or two individual utilities appointed by the others as the lead or "champion" negotiators. The annual negotiations established what was referred to as a "benchmark" or "reference" price for Australian thermal coal (see figure), a price that was more or less accepted by all the individual Japanese utilities and Australian coal suppliers and served as the basis for setting contract prices in other Asian countries.[d]

While a "reference" contract price continues to be negotiated and widely noted in industry news and publications, several factors have contributed toward a recent decline in the share of total Australian imports by Japan's electric companies that is priced at this level. One key factor has been a trend by Japanese electric utilities to satisfy increasing amounts of their annual coal requirements with spot-market purchases. Rising from approximately 5 percent of total coal purchases in 1995, spot purchases of coal by Japanese electric utilities have grown considerably in recent years, accounting for an estimated 30-percent share of total import requirements in 2001.[e]

A second factor contributing to the reduced importance of the "reference" price for thermal coal has been the ongoing liberalization of the Japanese electricity market. In essence, increasing competition is placing cost-cutting pressure on Japan's electricity producers, making each individual utility less inclined to accept a

(continued on page 92)

Japanese Benchmark/Reference Coal Prices, 1980-2002



Sources: **Coking Coal:** 1980-2001: International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Table 2.11; 2002: A. Tilbury, "Coal Giants Fire Up for Price Talks," *The Age* (January 13, 2003). **Steam Coal:** International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Table 2.6. **GDP Deflators:** U.S. Department of Commerce, Bureau of Economic Analysis.

[a]International Energy Agency, *International Coal Trade: The Evolution of a Global Market* (Paris, France, January 1998).

[b]B. Jacques, "High Turnover, Low Returns," *Financial Times* (July 8, 1996), p. 1.

[c]Productivity Commission, *The Australian Black Coal Industry, Inquiry Report, Volume 1: Report* (Canberra, Australia, July 3, 1998), Appendix D, web site www.pc.gov.au; "Japan Power / Coal: Less Need for Chubu Electric as Benchmark," *DowJones Newswires* (December 11, 1996).

[d]Productivity Commission, *The Australian Black Coal Industry, Inquiry Report, Volume 1: Report* (Canberra, Australia, July 3, 1998), Appendix D, web site www.pc.gov.au; "J-Power, Kosep and Taipower Want to Keep a Reference Price," *Platts International Coal Report*, No. 589 (November 25, 2002), p. 8.

[e]"Japan's Utilities May Boost Share of Spot Market Steam Coal Imports," *Platts International Coal Report*, Vol. 17, No. 5 (February 12, 1996), p. 2; "Australian Spot Steam Coal Prices Out of Sync With Atlantic Market, Fall Likely Near Term," *Platts International Coal Report*, No. 555 (April 1, 2002), p. 1.

supply for electricity generation is the key factor underlying plans for additional coal-fired generating capacity in these countries. In Thailand, strong environmental opposition to coal has appeared to have prevailed over the desire for diversification of fuel supply leading to the government's cancellation of two large coal-fired generation projects [***115***]. This leaves only one planned coal plant for Thailand, the 1,364-megawatt Rayong plant being built by BLCP Power (a consortium of energy companies), which is scheduled to come on-line in late 2006 [***116***].

During the 1980s, Australia became the leading coal exporter in the world, primarily by meeting increased demand for steam coal in Asia. Considerable growth in exports of coking coal also occurred, however, as

Japanese Benchmark Coal Prices and the Asian Coal Market (Continued)

price negotiated by one of the other utilities. As a result, Japanese power utilities have largely discontinued collective negotiations in favor of individual bargaining with suppliers and increasing reliance on spot-market purchases.[f]

A third factor contributing to the reduced importance of Japan's "reference" coal price in Asia, and to an overall reduction in electricity fuel costs as well, is an increasing ability or willingness by plants in the region to purchase a wider range of coals, reducing their dependence on any one specific supply region or mine.[g] This trend not only is the result of newer power plants being technically capable of burning a wider range of coals than older plants in the region but also is attributable to a greater flexibility in fuel procurement by operators of older plants. Industry experts point to South Korea's stock of relatively modern plants as a key factor underlying that country's increasing use of Chinese coals, whose higher calcium content, for example, can cause problems at older coal plants.[h] Japanese utilities, however, continue to adhere to somewhat stricter coal quality requirements than other Asian utilities, citing factors such as their country's extreme focus on reliability of electricity supply and slagging and fouling problems encountered at some Japanese plants in the past with the use of certain types of Chinese coal.[i]

The shift to more competitive coal markets in Asia implies that coal producers in Australia and other exporting countries will be under increased pressure to reduce mining costs in order to maintain current rates of return. It also means that more distant suppliers, such as the United States and Canada, will find it increasingly difficult to increase or maintain export sales to the region.

On the supply side, however, there has been a movement toward increasing consolidation, with several coal-producing companies garnering an increasing share of total world export capacity. Industry consolidation has the potential to give coal export suppliers greater pricing power, based on their ability to control the quantity of coal available for export, which, in turn, diminishes to some extent the ability of coal importers to negotiate lower prices. During 2001, nearly 40 percent of international steam coal shipments originated from mines owned by just four companies: Anglo American, Glencore/Xstrata, BHP Billiton, and Rio Tinto.[j] By major exporting country in 2001, those four companies, taken as a whole, controlled an estimated 70, 60, and 45 percent of the steam coal exports originating from South Africa, Colombia, and Australia, respectively.

The ability of a group of major coal export suppliers to exert significant control over international export prices remains to be seen. Factors working against such an outcome are that coal resources are plentiful and widely distributed throughout the world, and only a small proportion of the world's total annual production is traded.[k] Thus, while short-term increases in coal export prices are plausible as a result of limited supply, in the medium to long term the capability to expand existing mines and to bring new low-cost mines on line in the world's major coal-exporting countries, combined with continuing improvements in coal mining productivity, should continue to exert downward pressure on coal export prices.

[f]"Reference Price Lives On," McCloskey's Coal Report, No. 50 (December 13, 2002), pp. 1-3; "Smaller Japanese Utilities Lower Contract Prices Pushing Asian Market Down," *Platts International Coal Report*, No. 574 (August 12, 2002), p. 1; "Chinese Suppliers Finally Get Invited to Japan Spot Tenders," *Platts International Coal Report*, No. 566 (June 17, 2002), p. 4; Productivity Commission, *The Australian Black Coal Industry, Inquiry Report, Volume 1: Report* (Canberra, Australia, July 3, 1998), Appendix D, web site www.pc.gov.au.

[g]"Cheaper Coal Could Give South Korea a Competitive Edge," *Platts International Coal Report*, No. 581 (September 30, 2002), p. 3; "Japanese Utility to Expand Coal Specs for More Flexible Buying," *Platts International Coal Report*, No. 571 (July 22, 2002), p. 11; "Japan's EPDC to Burn Trial Coal in JFY 2002, But Imports Will Decline," *Platts International Coal Report*, No. 544 (January 14, 2002), p. 6.

[h]A. Roberts, "Price Volatility Persists," *Petroleum Economist* (October 2, 2002).

[i]"Cheaper Coal Could Give South Korea a Competitive Edge," *Platts International Coal Report*, No. 581 (September 30, 2002), p. 3; "Some Utilities Ready For Open Trading With China," *Platts International Coal Report*, No. 569 (July 8, 2002), p. 12.

[j]A. Roberts, "Price Volatility Persists," *Petroleum Economist* (October 2, 2002).

[k]International Energy Agency, *International Coal Trade: The Evolution of a Global Market* (Paris, France, January 1998), p. 75.

countries such as Japan began using some of Australia's semi-soft or weak coking coals in their coke oven blends. As a result, imports of hard coking coals from other countries, including the United States, were displaced. Australia's share of total world coal trade, which increased from 17 percent in 1980 to 33 percent in 2001, is projected to increase slightly over the forecast period, reaching 35 percent by 2025 [***117***]. Australia should continue as the major exporter to Asia, with its share of the region's total coal import demand projected to remain at or near its current level of 46 percent (Figure 64).

Recently, coal from China has been displacing some Australian tonnage in several of Asia's major coal-importing countries, such as South Korea, Japan, and Taiwan [***118***]. Factors contributing to China's expanding coal export position in Asia include: (1) the recent completion of projects and further commitments by the Chinese government to improve rail links to ports and to construct new coal export facilities; (2) continuing support for China's coal export industry through state subsidies; (3) aggressive pricing of coal exports, emphasizing market share rather than profits; and (4) the relatively short transport distances from China's coal-exporting ports to Asia's major coal-importing countries, ensuring low shipping costs [***119***]. Over the forecast period, China is expected to increase slightly its share of the region's overall coal import market.

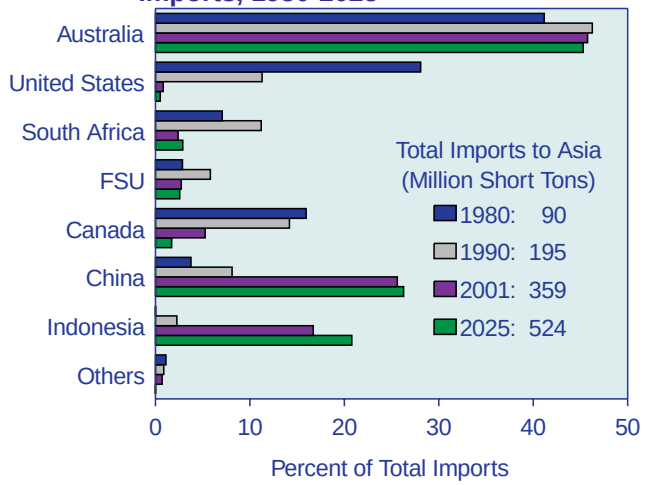
The United States, once a major supplier of coal to Asia, is currently only a minor participant the Asian market. As shown in Figure 64, the U.S. share of total coal imports by Asia has declined from 28 percent in 1980 to less than 1 percent in 2001. An additional setback in U.S. coal exports to this region occurred during 2002 as Alaska's Usibelli coal mine was unable to renegotiate a long-term sales contract with Korea East-West Power Company, Ltd [***120***] (formerly part of the Korea Electric Power Company). Beginning with shipments in 1984, the Usibelli mine typically exported between 700,000 and 800,000 tons of subbituminous coal annually to South Korea for use at the Honam coal-fired power station [***121***]. Usibelli Coal has since submitted a new contract proposal to Korea East-West Power Company and is looking at other potential markets for its product, such as coal plants that may eventually be built on the west coasts of the United States or Mexico [***122***].

Europe, Middle East, and Africa

Coal imports to Europe, the Middle East, and Africa taken as a whole are projected to fall by approximately 2 percent over the forecast period (Figure 65). Projected declines in overall imports to the countries of Western Europe are offset by small increases projected for Turkey, Romania, Morocco, and Israel.

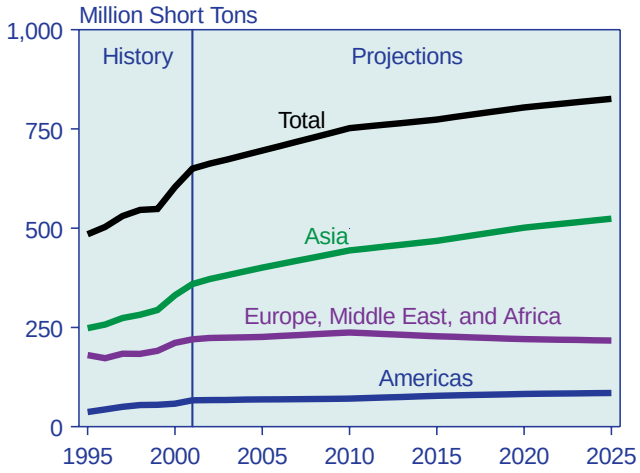
In Western Europe, strong environmental lobbies and competition from natural gas are expected gradually to reduce the reliance on steam coal for electricity generation, and further improvements in the steelmaking process will continue to reduce the amount of coal required for steel production. Strict environmental standards are expected to result in the closure of some of Western Europe's older coke batteries, increasing import requirements for coal coke but reducing imports of coking coal.

Figure 64. Foreign Supplier Shares of Asian Coal Imports, 1980-2025



Sources: **1985-2001:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, UK, September 2002). **2025:** Energy Information Administration, National Energy Modeling System run IEO2003.D033103A (March 2003).

Figure 65. Coal Imports by Major Importing Region, 1995-2025



Note: Data exclude non-seaborne shipments of coal to Europe and Asia.

Sources: **History:** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, UK, September 2002); International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), and previous issues; Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121(2001/4Q) (Washington, DC, May 2002), and previous issues. **Projections:** Energy Information Administration, National Energy Modeling System run IEO2003. D033103A (March 2003).

Projected reductions in indigenous coal production in the United Kingdom, Germany, Spain, and France are not expected to be replaced by equivalent volumes of coal imports. Rather, increased use of natural gas, renewable energy, and nuclear power (primarily in France) is expected to fill much of the gap in energy supply left by the continuing declines in the region's indigenous coal production.

In 2001, the leading suppliers of imported coal to Europe were South Africa (29 percent), Australia (19 percent), South America (13 percent), and the United States (10 percent). Over the forecast period, low-cost coal from South America (primarily from Colombia and Venezuela) is projected to meet an increasing share of European coal import demand, displacing some coal from such higher cost suppliers as the United States and Poland.

Despite expected gains in South America's foothold in Europe, South Africa is projected to maintain its position as the leading supplier of coal to Europe. Currently, plans call for an 11-million-ton expansion in South Africa's Richards Bay Coal Terminal, increasing the facility's annual throughput capacity to 90 million tons [***123***]. The estimated completion date for this project is sometime in 2005.

The Americas

Compared with European and Asian coal markets, imports of coal to North and South America are relatively small, amounting to only 66 million tons in 2001 (see Table 19). Canada imported 36 percent of the 2001 total, followed by the United States (30 percent) and Brazil (25 percent) [***124***]. Most (77 percent) of the imports to Brazil were coking coal, and a majority of the remaining import tonnage was steam coal used for pulverized coal injection at steel mills [***125***].

Over the *IEO2003* forecast period, coal imports to the Americas are projected to increase by 18 million tons, with most of the additional tonnage going to Mexico, the United States, and Brazil. Coal imports to the United States are projected to increase from 20 million tons in 2001 to 28 million tons by 2025 [***126***]. Coal-fired power plants located along the eastern seaboard and in the southeastern part of the country are expected to take most of the additional import tonnage projected over the forecast period, primarily as a substitute for higher priced coal from domestic producers. Brazil and Mexico are projected to import additional quantities of coal for both electricity generation and steelmaking.

Partly offsetting the projected growth in coal imports elsewhere in the Americas, Canadian imports are expected to decline over the next few years as six nuclear generating units at the Pickering and Bruce plants gradually are returned to service [***127***]. While generation from some of these units is crucial for averting expected near-term shortages in the Province's electricity supply [***128***], the return to service of all six units over the next few years should ultimately displace some of the generation from Ontario's coal-fired power plants. Coal plants in Nova Scotia, however, are expected to increase their take of imports after the closure of Canada's Phalen and Prince underground mines in 2000 and 2001 [***129***]. During 2000, Nova Scotia Power purchased 0.8 million tons of domestic coal (primarily from the Prince mine) and 2.3 million tons of imports [***130***].

Coking Coal

Historically, coking coal has dominated world coal trade, but its share has steadily declined, from 55 percent in 1980 to 32 percent in 2001 [***131***]. In the forecast, its share of world coal trade continues to shrink, to 27 percent by 2025. In absolute terms, despite a projected decline in imports by the industrialized countries, the total world trade in coking coal is projected to increase slightly over the forecast period as a result of increased demand for steel in the developing countries. Increased imports of coking coal are projected for South Korea, Taiwan, India, Brazil, and Mexico, where expansions in blast-furnace-based steel production are expected.

Factors that contribute to the decline in coking coal imports in the industrialized countries are continuing increases in steel production from electric arc furnaces (which do not use coal coke as an input) and technological improvements at blast furnaces, including greater use of pulverized coal injection equipment and higher average injection rates per ton of hot metal produced. Each ton of pulverized coal (categorized as steam coal) used in steel production displaces approximately one ton of coking coal [***132***].[20] In 2000, the direct use of pulverized coal at blast furnaces accounted for 16 percent and 14 percent of the coal consumed for steelmaking in the European Union and Japan, respectively [***133***].

[20] Approximately 1.4 tons of coking coal are required to produce 1 ton of coal coke. However, according to information provided by the World Coal Institute, each ton of coal injected to the blast furnace through pulverized coal injection (PCI) equipment displaces only about 0.6 to 0.7 tons of coal coke. As a result, each ton of PCI coal displaces approximately 1 ton of coking coal. Steel companies are able to reduce their operating costs, however, because coal used for pulverized coal injection is typically less expensive than the higher quality coals required for the manufacture of coal coke.

References

1. Energy Information Administration, System for the Analysis of Global Energy Markets (2003).
2. Energy Information Administration, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, SR/OIAF/98-03 (Washington, DC, October 1998), Table B1.
3. East-West Center, *Interfuel Competition in the Power Sector: Fuel Price Comparisons in the Asia-Pacific Region*. Report to the Energy Information Administration (May 2000).
4. IEA Coal Research, *Developments in FGD*, CCC/29 (London, UK, March 2000), pp. 12 and 74.
5. Energy Information Administration, Form EIA-767, "Steam-Electric Plant Operation and Design Report," Form EIA-860A, "Annual Electric Generator Report—Utility," and Form EIA-860B, "Annual Electric Generator Report—Nonutility."
6. Standard & Poor's, *Asia/Pacific World Energy Global Energy Market Research & Analysis 2001* (Lexington, MA, 2001), p. 72, Table 28.
7. Directorate-General XVII—Energy, European Commission, *Energy in Europe: European Union Energy Outlook to 2020* (Brussels, Belgium, November 1999), pp. 44-45.
8. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000*, DOE/EIA-0573 (2000) (Washington, DC, November 2001), Table B1.
9. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Table 2.5.
10. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4.
11. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), pp. II.21-II.23.
12. Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384 (2001) (Washington, DC, November 2002), Table A5.
13. Web site www.worldsteel.org.
14. Web site www.htinj.com.
15. DRI-WEFA, Inc., *Asia/Pacific World Energy Global Energy Market Research & Analysis 2001* (Lexington, MA, 2002), p. 75, Table 28.
16. "China: New Port and Rail Capacity Scheduled to Come On Line," *International Coal Trade*, No. 1378 (April 15, 2002), p. 4.
17. DRI-WEFA, Inc., *Asia/Pacific World Energy Global Energy Market Research & Analysis 2001* (Lexington, MA, 2001), p. 105, Table 28.
18. "India's NTPC: Could It Become an Importer In the Future?" *International Coal Trade*, No. 1378 (April 15, 2002), p. 5.
19. "Asia Won't Yet Kick the Coal Habit," *Petroleum Intelligence Weekly* (July 9, 2001), p. 4; S. Johari, "Tenaga Seeks To Delay Two Coal-Fired Plant Projects," *Business Times* (Malaysia) (July 4, 2001), p. 4; Z. Abdullah, "TNB To Rely More on Coal," *The New Straits Times* (August 25, 2001), Section 2, p. 21; Y. Praiwan, "Plants Essential To Avoid Serious Fall in Reserves," *Bangkok Post* (September 28, 2001).
20. "Korea: 5th Long-Term Power Development Plan," *International Market Insight Reports* (February 10, 2001); "Malaysia To Raise Coal Generation Despite Gas Deposits, Says TNB Head," *Coal Week International* (January 8, 2001), p. 8; D. A. Bakar, "TNB Gives Approval for Relocation of Coal-Fired Plant," *The New Straits Times* (August 25, 2001), Section 2, p. 1; "Coal Imports To Grow as Thailand Brings on New Power Plants," *Coal Week International* (March 12, 2001), p. 5; "BLCP To Begin Work on Thai Coal Plant Next Year," *Coal Week International* (August 20, 2001), p. 3; Y. Praiwan, "Plants Essential To Avoid Serious Fall in Reserves," *Bangkok Post* (September 28, 2001).
21. "Korea: 5th Long-Term Power Development Plan," *International Market Insight Reports* (February 10, 2001); "Formosa Plastic Says Tender Filled 9 Million MT Coal Needed for 2001," *Coal Week International* (January 22, 2001), p. 8; "Taiwan's Ho-Ping Power To Start Test Runs in 1st Unit Wednesday," *Dow Jones Newswires* (July 31, 2001).
22. "IPP Jawa Power Seeks $0.05/kWh Rate From Indonesia's PLN," *Dow Jones Newswires* (September 25, 2001); D.J. Smith, "The Re-Awakening of the Asian Tiger," *Power Engineering* (August 1, 2000), pp. 46-49; J. McBeth, "Indonesia," *Far Eastern Economic Review* (March 29, 2001), p. 14.
23. "Asia Won't Yet Kick the Coal Habit," *Petroleum Intelligence Weekly* (July 9, 2001), p. 4; N.B. Srinivasan, "Gas Versus Coal: It's No Contest," *The Bangkok Post* (October 25, 2001), p. 1; "Thai New Power Development Plan To Focus on Natural Gas," *Dow Jones Newswires* (March 15, 2001).
24. "Thai Government Postpones Construction of Two Coal-Fired Power Plants," *International Coal Trade*, No. 1383 (May 20, 2002), p. 10; "Power Generation – Egat Puts Hold On New Projects," *The Nation (Thailand)* (August 28, 2002); "Egat Delay Will Affect Banpu Unit," *Bangkok Post* (October 22, 2002); "Banpu Unit Gets Nod for Coal-Fired Plant," *Bangkok Post* (June 26, 2002), p. 12.
25. International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Table 3.3a.

26. "Queensland Premier Opens First of Three New Coal-Fired Stations," Coal *Week International* (July 9, 2001), p. 3.
27. "Griffin Group Will Build Coal-Fired Plant in Australia," *International Coal Trade*, No. 1383 (May 20, 2002), p. 6.
28. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Table 1.4.
29. "Japanese Coal Mine To Cease Operation," *International Coal Trade*, No. 1351 (October 8, 2001), p. 17; "Ikeshima Coal Mine Closed After 42 Years in Business," *Kyoda News* (November 28, 2001); K. Hall, "Ending Era, Japan's Last Coal Mine Shuts Down," *Associated Press Newswires* (January 30, 2002).
30. Web site www.worldsteel.org; and International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), Tables 3.9 and 3.10.
31. International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Table 3.3a.
32. H. Tagawa, Manager, Coal Fuel Department, Tokyo Electric Power Company, "Coal-Fired Power Generation in Japan and Expectations Toward U.S. Western Coal." Paper presented at the Western Coal Council's 2001 Spring Pacific Coal Forum (Park City, UT, June 4-6, 2001).
33. Commission of the European Communities, *Proposal for a Council Regulation on State Aid to the Coal Industry* (Brussels, Belgium, July 25, 2001), web site www.europa.eu.int.
34. Directorate-General XVII—Energy, European Commission, *The Market for Solid Fuels in the Community in 1996 and the Outlook for 1997* (Brussels, Belgium, June 6, 1997), web site www.europa.eu.int.
35. Commission of the European Communities, *Proposal for a Council Regulation on State Aid to the Coal Industry* (Brussels, Belgium, July 25, 2001), p. 17, web site www.europa.eu.int.
36. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4.
37. UK Department of Trade and Industry, *Conclusions of the Review of Energy Sources for Power Generation, and Government Response to Fourth and Fifth Reports of the Trade and Industry Committee Energy Review White Paper*, CM 4071 (London, UK, October 1998).
38. S. Barker, "UK Suppliers Will Keep the Lights On," *The Daily Telegraph* (February 5, 2001), p. 25; C.J. Levesque, "On the Origin of the Markets: Electricity Evolution in the U.K.," *Public Utilities Fortnightly* (July 15, 2001), pp. 48-54; G.T. Smith, "What Happened?—Lessons From Across the Seas: Deregulation Is Working Pretty Well in Britain; But It Has Taken a Long Time," *Wall Street Journal* (September 17, 2001), p. R.9.
39. "UK: Dark Days Ahead in the UK Power Sector," World Markets - Energy Sector Analysis, web site www.worldmarketsanalysis.com; E. Ewart, "The European Coal Industry: Hard Times for Coal," *Coal Age* (September 2001), p. 31.
40. D. Brower, "Get Used to It," Petroleum Economist (January 1, 2003).
41. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), Table 6.13.
42. Commission of the European Communities, *Proposal for a Council Regulation on State Aid to the Coal Industry* (Brussels, Belgium, July 25, 2001), pp. 24-25, web site www.europa.eu.int.
43. "Coal Industry Receives Additional Funds as EU Drafts New Aid Plan," *Financial Times: International Coal Report*, No. 530 (July 31, 2001), pp. 8-9.
44. Commission of the European Communities, *Report From the Commission On the Application of the Community Rules For State Aid To The Coal Industry In 2001* (Brussels, Belgium, October 4, 2002), p. 10, web site www.europa.eu.int.
45. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4.
46. International Energy Agency, *Coal Information 1998* (Paris, France, July 1999), p. I.210.
47. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), pp. I.199-I.201; RAG Aktiengesellschaft, *Annual Report 2000* (Essen, Germany, June 2001), pp. 48-49, web site www.rag.de; H. Schiffer, "The Role of Coal in Germany's Energy Supply," *World Coal* (October 2002).
48. Directorate-General XVII—Energy, European Commission, *Energy in Europe: European Union Energy Outlook to 2020* (Brussels, Belgium, November 1999), p. 47.
49. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4.
50. Commission of the European Communities, *Proposal for a Council Regulation on State Aid to the Coal Industry* (Brussels, Belgium, July 25, 2001), p. 25, web site www.europa.eu.int.
51. "Spain Promises Import Bonanza," *McCloskey Coal Report, No. 19* (September 21, 2001), pp. 21-22.
52. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4.
53. International Energy Agency, *Coal Information 1998* (Paris, France, July 1999), p. I.210.

54. E. Ewart and R. Marston, "Marketwatch: World Coal Trade and the Impact of Global Environmental Regulation," *Coal Age* (September 1, 2001).

55. International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Table 3.3a.

56. "Enel to Switch From Oil to Coal," *McCloskey Coal Report, No. 42* (August 23, 2002), pp. 1; "Enel's CEO Wants More Coal," *International Coal Trade, No. 1397* (August 26, 2002), p. 8.

57. United Nations Framework Convention on Climate Change, *Report of the Conference of Parties on Its Third Session, Held at Kyoto from 1 to 10 December 1997, Kyoto Protocol to the United Nations Framework Convention on Climate Change*, FCCC/CP/1997/L.7/Add.1 (December 10, 1997), web site www.unfccc.de.

58. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), Tables 6.1 and 6.3.

59. J. Chadwick, "CIS Coal," *The Mining Journal* (June 1998); PlanEcon, Inc., *Energy Outlook for Eastern Europe and the Former Soviet Republics* (Washington, DC, October 1999), pp. 13-14.

60. Igor Artimiev and Michael Haney, "The Privatization of the Russian Coal Industry: Policies and Processes in the Transformation of a Major Industry." World Bank Working Paper #2820 (April 2002), web site www.worldbank.org; "World Bank Approves Coal-Privatization Loan to Russia," *BBC Monitoring Former Soviet Union—Economic* (November 23, 2001).

61. H. van Zon, "The Reform of Ukraine's Energy Complex as a Precondition for Eliminating Ukraine's Energy Dependence." Paper presented at the Conference 2001 Confronting Change: North East England and Eastern European Coal Fields (Newcastle upon Tyne, United Kingdom, November 12-13, 2001), web site www.sunderland.ac.uk; "Ukraine: Country Profile," *Europe Review World of Information* (September 13, 2001); "Deadly Explosion in Ukrainian Mine Highlights Industry Collapse," *Agence France-Presse* (August 19, 2001); "Ukraine Mines Eye Entrepreneurial Future," *China Daily: North American Edition* (March 23, 2000), p. 6; and World Bank: Public Policy for the Private Sector, "Coal Industry Restructuring in Ukraine, The Politics of Coal Mining and Budget Crises," Note No. 170 (Washington, DC, December 1998), web site www.worldbank.org.

62. "Ukraine Turns to West for Mine Safety Funding: Ten Miners Still Missing After Sunday's Disaster," *Financial Times: USA Edition* (August 21, 2001), p. 3.

63. "Ukraine Industry in the Spotlight as Rescue Program Is Opposed," *Coal Week International* (October 15, 2001), p. 3.

64. "Ukrainian Coal-mines' Privatization To Start After 2003," RosBusiness Consulting News Release (November 29, 2002), web site www.rbcnews.com.

65. "Coal Consumption in Ukraine To Rise 1.8 Times by 2010 and 2.7 Times by 2030," *Interfax (Moscow)* (November 27, 2001); "Ukrainian Paper Analyses Opposition to Reforms in Coal Sector," *BBC Monitoring Former Soviet Union—Political* (September 27, 2001); "Ukraine To Close 39 Mines," *World News Connection* (September 12, 2001); "Putin Visit to Urengoy Gas Field Seen Linked to Falling World Oil Price," *World News Connection* (November 20, 2001); "Russia Aims To Generate More Power With Coal, Leave Gas, Oil for Export," *Coal Week International* (January 22, 2001), p. 3.

66. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Table 2.5.

67. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Table 1.4.

68. SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, United Kingdom, September 2002).

69. "Coal Mining Improves Financial Performance in 2001," *Financial Times: International Coal Report*, No. 535 (October 9, 2001), pp. 9-10.

70. "The Market View", *Coal Americas*, No. 5, (December 2, 2002), p. 2; "Miners Vote to Strike," *McCloskey's Coal Report*, No. 50, (December 13, 2002), p. 11.

71. "The Market View, "Coal Americas," No. 5 (December 2, 2002), p. 2.

72. Reuters, "World Bank Urges Faster Privatization in Poland," (November 14, 2001); World Bank, "Poland: World Bank Continues Support for Hard Coal Industry Restructuring," News Release No. 2002/050/ECA (Washington, DC, August 2, 2001), web site www.worldbank.org.

73. Energy Information Administration, *Annual Energy Outlook 2003*, DOE/EIA-0383 (2003) (Washington, DC, January 2003), Table A8.

74. "McCloskey's News Round-up," *McCloskey's Coal Report*, No. 48, (November 15, 2002), p. 21; "Ontario To Eliminate All Coal-Fired Stations Over Next 13 Years," *International Coal Report*, No. 566, (June 17, 2002), p. 10.

75. "Liberal Party Candidate Wants To Eliminate Coal-Fired Generation," *International Coal Report*, No. 579 (September 16, 2002), p. 9.

76. "Ontario's IMO Forecasts Province's Electricity Supply Secure for Next 10 Years," *Foster Electric Report* (September 5, 2001); M. Mittelstaedt, "New Life for Old Reactors Fans Fears for Safety," *The*

Globe and Mail (May 28, 2001), p. A1; Energy Information Administration, *Nuclear Power Generation and Fuel Cycle Report 1997*, DOE/EIA-0436 (97) (Washington, DC, September 1997), Table D1.

77. "Brooks Power Project Makes It Official With Alberta Govt," *International Coal Trade*, No. 1350 (October 1, 2001), p. 10; "Fording Inc. Lays Groundwork for Coal-Fired Units in Alberta," *Coal Week International* (October 1, 2001), p. 4.
78. "TransAlta Receives Green Light For Plant Expansion," *International Coal Trade*, No. 1370 (February 18, 2002), p. 7; S. Thomas, "TransAlta Buys Half Of EPCOR Genesee Phase 3 Proj," *Dow Jones Newswires* (January 13, 2003).
79. "SaskPower To Rebuild Coal-Fired Plant," *Coal Americas*, No. 1 (October 7, 2002), p. 15; "McCloskey's News Round-up," *McCloskey Coal Report*, No. 45 (October 4, 2002), p. 25; SaskPower, "Upgrades at Boundary Dam Power Station Worth $80 Million," News Release (Regina, Saskatchewan, Canada, October 1, 2002), web site www.saskpower.com.
80. F.G. Jáuregui D., "Steam Coal Requirements of CFE." Paper presented at the Western Coal Council's Pacific Coal Forum (Park City, UT, June 23-26, 1997).
81. R. Brindal, "Xstrata Coal Australia Wins US$75M Mexico Supply Contract," *Dow Jones Newswires* (December 4, 2002).
82. "International Market Report," *King's International Coal Trade*, No. 1194 (September 11, 1998), pp. 2-3.
83. "Iberdrola's $7.7-Billion Expansion Plan Targets Spain, Latin America," *Electric Utility Week* (May 14, 2001), p. 20; and "Market Chatter," *International Coal Trade*, No. 1328 (April 30, 2001), p. 16.
84. "Iberdrola's $7.7-Billion Expansion Plan Targets Spain, Latin America," *Electric Utility Week* (May 14, 2001), p. 20.
85. A. Harrup, "Mexico's State Utility Plans New Coal-Fired Power Plant," *Dow Jones Newswires* (July 3, 2001).
86. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), pp. III.37-III.38.
87. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), pp. III.36; Energy Information Administration, "Country Analysis Brief: South Africa," web site www.eia.doe.gov (December 2000).
88. "Kenya: Energy Ministry Sets Aside Money for Coal Prospecting," *BBC Monitoring Africa—Political* (November 20, 2000).
89. C. Akunna, "Ezeife Urges Igbo To Produce Coal-Fired Electricity," *Africa News Service* (December 14, 2001); K.U. Kalu, "Future of Coal Industry," *Africa News Service* (October 5, 2001); E. Imisim, "Government Gets $100m World Bank Credit for NEPA Reforms," *Africa News Service* (August 2, 2001).
90. "Tanzania: Government Plans To Develop Coal-Fired Power Station," *BBC Monitoring Africa—Political* (September 7, 2000).
91. "Largest IPP in Africa, Middle East Is Completed," *Power*, Vol. 145, No. 5 (September/October 2001), p. 16.
92. Web site www.worldsteel.org.
93. International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), pp. I.88 and I.97; AME Research, web site www.ame.com.au.
94. "Tractabel's Gerasul Advances 350-MW Jacui; Will Boost Capital by $65-Million," *Global Power Report* (July 20, 2001), p. 12; D. Clifford, "Brazil—A Modern Mining Giant," *Mining Magazine* (July 1, 2001), p. 6.
95. "Brazil's Inepar To Exit Distributor's Celpa, Cemat, and Maybe Generation," *Electric Utility Week* (May 7, 2001), p. 21.
96. "AES 454MW Guayama Project Starts Commercial Operations," *Dow Jones Newswires* (December 2, 2002).
97. "AES Looks for 3-Year Supply," *McCloskey Coal Report*, No. 19 (October 4, 2001), p. 18; B.K. Schimmoller, "Fuel and Materials Handling: Moving It Without Losing It," *Power Engineering* (March 1, 2001), pp. 44-48.
98. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, March 2003), Tables 2.5 and 5.4; International Energy Agency, *Coal Information 2001* (Paris, France, September 2001), p. II.23.
99. "Sugozu Coal-Fired Thermal Plant in Turkey To Start Operating in Second Half of 2003," *Turkish News Digest* (October 22, 2001); "Construction Underway at Iskenderun," *Modern Power Systems* (May 1, 2001), p. 39; M. Woof, "Coal Power," *World Mining Equipment* (September 1, 2001), p. 12; S. Atalay, "Turkish Govt Signs $1.62 Bln Loan for 1400MW Power Project," *Dow Jones Newswires* (October 15, 1999).
100. "New Plant On Line," *Coal Week International* (February 26, 2001), p. 9; "Israel Looking to Asia, U.S., To Meet Growing Steam Coal Need," *Coal Week International* (November 13, 2000), p. 4.
101. "1,200-MW Ashkelon Plant On Line in 2007," *International Coal Report*, No. 594 (January 6, 2003), pp. 1,6; T. Muscal, "Gov't Okays New Coal Power Plant," *The Jerusalem Post* (December 30, 2002).
102. SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, UK, September 2002); and "The MCR Data Page – Physical

Prices," McCloskey's Coal Report, No. 50 (December 13, 2002), p. 5.

103. UK Department of Trade and Industry, *Energy Trends – December 2002 Publication*, (London, UK, December 2002), Table 2.1, web site www.dti.gov.uk; Energy Information Administration, *Quarterly Coal Report, October-December 2001*, DOE/EIA-0121 (2001/4Q) (Washington, DC, May 2002).
104. "UK Imports in Reverse," *Monthly Shipping Review SSY* (May 10, 2002), p. 4.
105. F. Freme, Energy Information Administration, "U.S. Coal Supply and Demand: 2001 Review" (Washington, DC, May 22, 2002), web site www.eia.doe.gov.
106. "Fingers Crossed for Tonne-Mile Improvements," *Monthly Shipping Review SSY* (February 11, 2002), p. 4.
107. Monthly Shipping Review SSY (December 6, 2002), p. 5; "Coal Price Lows," *Monthly Shipping Review SSY* (August 12, 2002), p. 4; "2002 – The Year of the Bear," *Platts International Coal Report*, No. 594 (January 6, 2003), pp. 2-3; A. Roberts, "Price Volatility Persists," *Petroleum Economist* (October 2, 2002).
108. U.S. Federal Reserve Bank, "Foreign Exchange Rates (Monthly)," web site www.bog.frb.fed.us; International Monetary Fund, International Financial Statistics Yearbook (Washington, DC, various issues).
109. "China Exports 85.75 Million Tons of Coal in 2003," *Interfax China Business News* (February 18, 2003).
110. "China's Coal Exports Up in Jan-Jun," *Xinhua News Agency—CEIS* (July 17, 1999); Z. Shaoqun, "Gov't To Increase Coal Exports," *China Daily* (July 9, 2000).
111. "China Seen Grabbing More Market Share in East Asia," *Platts International Coal Report*, No. 582 (October 7, 2002), p. 7.
112. SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, United Kingdom, September 2002); Energy Information Administration, National Energy Modeling System run AEO2003.D110502C.
113. Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, March 2003), Table 2.5; SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, United Kingdom, September 2002).
114. "Japanese Coal Mine To Cease Operation," *International Coal Trade*, No. 1351 (October 8, 2001), p. 17; "Ikeshima Coal Mine Closed After 42 Years in Business," *Kyoda News* (November 28, 2001); K. Hall, "Ending Era, Japan's Last Coal Mine Shuts Down," *Associated Press Newswires* (January 30, 2002).
115. "Prime Minister Rules Out Coal for Controversial Power Plants," *Organization of Asia-Pacific News Agencies* (March 15, 2003).
116. "EGAT Approves Construction of Two 1,00 MW Power Plants," *Thai News Service* (February 25, 2003); B. Treerapongpichit, "Banpu Unit Gets Nod for Coal-Fired Plant," *Bangkok Post* (June 26, 2002), p. 12.
117. Energy Information Administration, *Annual Prospects for World Coal Trade 1991*, DOE/EIA-0363 (91) (Washington, DC, June 1991), Table 1.
118. "Negative Influence From Tonne-Miles," *Monthly Shipping Review SSY* (September 10, 2001), p. 4.
119. S. Wyatt, "China Stakes Claim As Asia's Coal King," *Australian Financial Review* (May 16, 2001), p. 22; "China Rampant," *Monthly Shipping Review*, Vol. 554 (June 8, 2001), p. 4; "Increased Competition Forecast by ABARE," *Coal Week International* (June 25, 2001), p. 6.
120. J. MacPherson, "Mine, Railroad Workers Hurt by End of Coal Shipments," *Alaska Journal of Commerce*, Vol. 26, No. 37 (September 15, 2002), p. 8; "Alaskan Plans Move Slowly," *International Coal Report* (September 30, 1996); and Korea East-West Power Co., Ltd., web site www.kewp.com.
121. Bureau of the Census, U.S. Department of Commerce, "Monthly Report EM 522"
122. M.K. Garner, "Trying to Resurrect Seward Coal Export," *Peninsula Clarion* (March 13, 2002); P. Jones, "Usibelli Coal Mine Battles Changing Market, Low Rank Coal Resource," *Petroleum News Alaska*, Vol.7, No. 27 (July 7, 2002).
123. "Terminal Optimistic About R700m Project," *All Africa* (December 13, 2002); "Still No End to Discussions on Coal Terminal," *All Africa* (November 8, 2002).
124. B. Boyd and K. Stone, Natural Resources Canada, *Canadian Minerals Yearbook, 2001: Coal* (Ottawa, Canada, July 2002), web site www.nrcan.gc.ca; SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, United Kingdom, September 2002); Energy Information Administration, *Quarterly Coal Report, October-December 2001*, DOE/EIA-0121 (2001/4Q) (Washington, DC, May 2002).
125. SSY Consultancy and Research Ltd, *SSY's Coal Trade Forecast*, Vol. 11, No. 4 (London, United Kingdom, September 2002); "Brazilian Steel Mills Look to China to Boost Coking Coal Supplies," *Platts International Coal Report*, No. 547 (February 4, 2002), p. 11.
126. Energy Information Administration, National Energy Modeling System run AEO2002.D110502C.

127. S. Brissette, "Bruce Power Begins Refueling Unit 4," Bruce Power (January 15, 2003), web site www.brucepower.com; C. Perkel, "Bruce Power Wins Key Approval to Refuel Two Nuclear Reactors," *The Canadian Press* (January 14, 2003); "Ontario on Track to Return Four Pickering Nukes," *Reuters News* (September 13, 2002).

128. J. Spears, "Power Problems Loom, Agency Warns," *The Toronto Star* (December 24, 2002), web site www.thestar.com.

129. "Reverberations," *Canadian Geographic* (January/February 2000), p. 15; J. Wong, "Blue Christmas," *The Globe and Mail* (December 22, 2001), p. F1; Emera, Inc., *2001 Annual Report*, p. 28, web site www.emera.com.

130. "Facts About NSPI Coal Supply," *Nova Scotia Power* (May 16, 2001), web site www.nspower.ca.

131. Energy Information Administration, *Annual Prospects for World Coal Trade 1987*, DOE/EIA-0363(87) (Washington, DC, May 1987), Tables A2 and A3.

132. Energy Information Administration, *Coal Data: A Reference*, DOE/EIA-0064 (93) (Washington, DC, February 1995), pp. 33-35; World Coal Institute, "Coal in the Steel Industry," in *Coal: Power for Progress*, Fourth Edition, web site www.wci-coal.com (March 2000).

133. International Energy Agency, *Coal Information 2002* (Paris, France, September 2002), Tables 3.9 and 3.10; Commission of the European Communities, *The Market for Solid Fuels in the Community in 2001 and the Outlook for 2002* (Brussels, Belgium, July 22, 2002), Table 9, web site www.europa.eu.int.