Chapter 7
Coal

Introduction

Coal is a combustible rock formed from prehistoric biomass. Like oil and natural gas, coal is considered a "fossil fuel" because it was formed from decaying plant material over hundreds of millions of years.

Coal is a combination of pure carbon and hydrocarbons with varying amounts of moisture, minerals and heavy metals. It was the first fossil fuel used extensively by humans, and is still vitally important today, generating 39 percent of the world's electricity, 49 percent of U.S. electricity and 36.5 percent of Texas' electricity in 2006.[1]

Coal is found on every continent and in some 70 countries. The U.S., Russia, China and India have the world's largest reserves. The World Coal Institute in London estimates proven world coal reserves at 984 billion metric tons (more than 1 trillion U.S. tons), enough to last for more than 190 years at current rates of consumption.[2]

In Texas in 2006, coal mining provided 2,241 jobs, earning an estimated $167.6 million in wages.[3] Other contributions of coal to the economy are indirect. Texas coal is mined at the surface, and the surface owner, usually large utilities, does not report the value of the coal nor does the owner owe state taxes on coal production, although federal taxes are owed.

History

Throughout recorded history, some degree of industrialization has accompanied the widespread use of coal. Some of the earliest archeological evidence of the human use of coal dates back to about 6,000 years ago in northeastern China. The Romans used coal they found in Britain both as jewelry and as fuel for their forts and blacksmiths' foundries until their exit from the islands in the fifth century A.D. Their knowledge of coal's fuel value was lost to their British subjects for almost seven centuries.[4]

By the 11th century, the Chinese were using charcoal and coke, a material derived from coal, to make iron.[5] Britain's use of coal in the eighteenth century led to the widespread availability of cheap iron and helped spur the Industrial Revolution.

In early America, English settlers reported an abundance of coal in the new country. Coal outcrops were found throughout the Appalachian Mountains and, in 1758, a new settlement named Pittsburgh was founded in an area of particularly abundant coal supplies. Within a few short years, Pittsburgh coal helped America begin its own industrialization.[6]

Today, the world consumes about 4.4 billion short tons annually, a 38 percent increase in 20 years. (A short ton is 2,000 pounds, the measure used in the U.S. and in this chapter. The metric "tonne" of 2,200 pounds is used by some sources cited in this chapter; these figures have been converted to short tons throughout.) The majority of this coal is used for electricity generation and steel production.[7]

Coal is one of the world's most widely used fuels.

Uses

Coal is one of the world's most widely used fuels. In the U.S., coal produces 22.5 percent of the British thermal units (Btu) consumed for all purposes from all sources — about the same as natural gas (22.4 percent), but less than petroleum (39.8 percent).[8]

Coal began as peat, a soft deposit formed by plant and animal matter collecting in boggy areas some 360 to 290 million years ago.[9] As the material aged, sank and became buried by sediments over eons — a process called coalification — ever-increasing overburden pressure and heat squeezed out moisture and impurities to create four "ranks," or grades, of coal. These are, in descending order of hardness and heat content, anthracite, bituminous coal, subbituminous coal and lignite. Each type of coal has specialized uses.

Of the four grades of coal, the hardest and rarest is anthracite, which is also geologically the oldest

and purest, with the lowest moisture and mineral content. As such, it burns hottest, producing about 25 million Btu per ton, and produces the lowest emissions of all coals. In the U.S., anthracite is found only in northeastern Pennsylvania, and is used almost exclusively for home heating.

Bituminous and subbituminous coals, the most abundant types in the U.S., are found in Appalachia, the Midwest, Wyoming and Montana. The Powder River Basin (PRB) in Wyoming and Montana is a major source of this coal in the U.S. In addition to having a higher moisture and mineral content than anthracite, these coals contain bitumen, a thick tar-like material used in steelmaking and road building.

In the U.S., bituminous coal is often used to generate electricity. Its heat content averages 24 million Btu per ton, only slightly lower than that of anthracite. Subbituminous coal ranks between bituminous and lignite in its hardness and moisture content, and has a higher mineral content than bituminous coal.[10] Its heat value averages 17 to 18 million Btu per ton. Bituminous coal is found in the eastern and midwestern U.S., while subbituminous is mined only in the western U.S., most prominently in the Powder River Basin.[11]

Lignite, the lowest-quality coal, is geologically the youngest and has the highest moisture and mineral content. It is used almost entirely for electricity generation. Lignite produces an average 13 million Btu per ton, with higher emissions of nitrous and sulphurous oxides (NO_X and SO_X) and carbon dioxide (CO_2) than the higher ranks of coals.[12] Texas lignite is mined in an area east of Interstate Highway 35 running from San Antonio to the Oklahoma border. Lignite is also found in North Dakota.

As of 2006, Texas had 11 coal-fired utility plants using coal as a main or backup fuel.

This lower-grade coal is most often used to fire boilers, either to generate electricity or to create heat for industrial processes such as smelting. It also can be transformed into coke, which has its own applications in industrial processes.

Coal in Texas

As of 2006, Texas had 11 coal-fired utility plants using coal as a main or backup fuel, seven in the Electric Reliability of Council of Texas (ERCOT) power grid and four in the Southern Power Pool. Combined, these plants had 19 generation units with a total nameplate (maximum) capacity of more than 11,000 megawatts (MW) of electricity.[13] In 2006, these plants generated 146.4 million megawatt-hours (MWh) of electricity, 36.5 percent of the state total. Nine of the plants burn subbituminous coal only, five burn both subbituminous and lignite coal and the remaining four burn only lignite. All but one used either diesel fuel oil or natural gas as a backup fuel.[14] (For more detail on electricity, see Chapter 27 of this report.)

Economic Impact

Coal production contributed 2,241 mining jobs to the Texas economy in 2006. Wages were estimated to be $167.6 million.[15] Texas has 13 active lignite mines, most supporting a nearby coal-fired electricity generation plant or industrial facility (known generally as "mine mouth" operations). Five other Texas mines are in reclamation, meaning that they are no longer in operation and the mine sites are being reclaimed for other uses. One is not operating but is not yet in reclamation (**Exhibit 7-1**).

Coal receives substantial financial subsidies from the federal government, but none from Texas state government. Coal extraction in Texas is taxed by the federal government, but not state government. For more information on subsidies and taxes, see Chapter 28 of this report.

Consumption

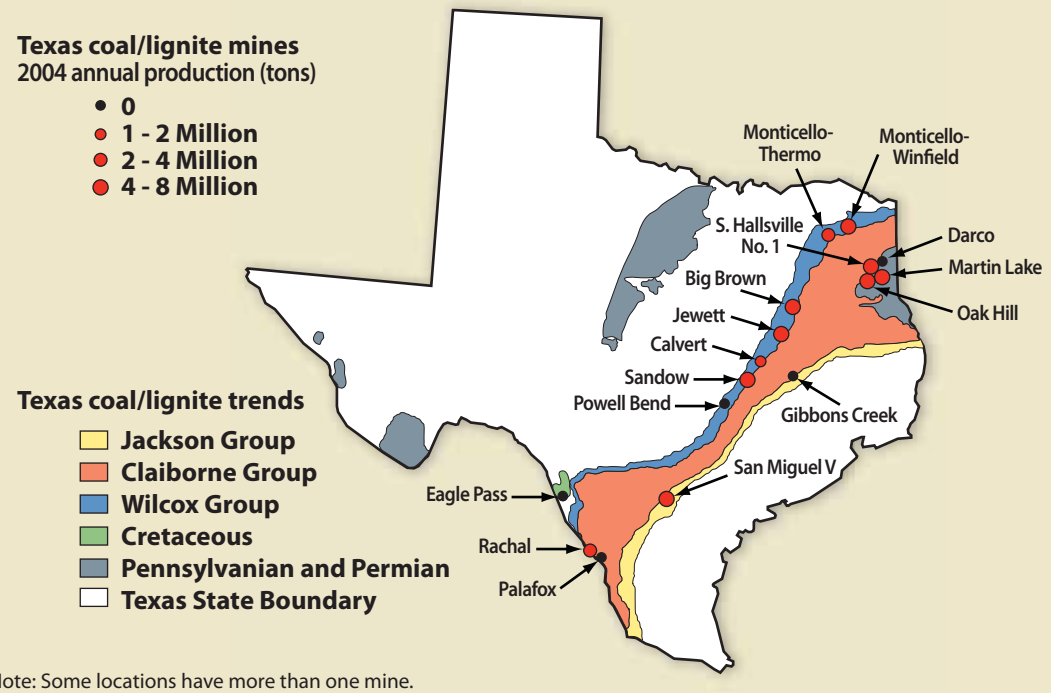
According to the federal Energy Information Administration (EIA), more than 96 percent of the coal consumed in Texas in 2006, or 99.6 million tons, was used to generate electricity. The remainder, about 4.1 million tons, was used for "other industrial" purposes.[16]

In 2006, U.S. imports of coal amounted to three-quarters of its exports of coal — 36.2 million tons versus 49.6 million tons. In that year, about 1 billion tons, or 92.1 percent of all U.S. coal consumption, was used for electricity generation. Industrial uses accounted for a relatively minor 83.5 million tons, or 7.5 percent of consumption. Residential use of coal was less than a tenth of 1 percent **(Exhibit 7-2)**. [17]

In the U.S., coal's share of all fuels used to produce electricity has declined slowly but steadily

EXHIBIT 7-1

Texas Coal Mine Locations



Note: Some locations have more than one mine.

Source: Railroad Commission of Texas.

Coal production contributed 2,241 mining jobs to the Texas economy in 2006. Wages were estimated to be $167.6 million.

over the past 10 years. As noted in **Exhibit 7-3**, Texas coal use follows a similar pattern after 1997.

Production

Coal is mined from surface or underground mines. Older coals, such as those in the Appalachian Mountains, usually are found in deeper formations, at depths between 600 and 2,000 feet.[18]

Lignite, the most common coal found in Texas, is found predominantly at shallower depths ranging from 40 to 120 feet beneath the surface, allowing for surface or "strip" mining.[19] Strip mining requires removal of topsoil and the "overburden," or underlying soil and rock, and storing the topsoil for later reclamation work. Coal is then mined with heavy surface mining equipment. After the coal is removed, the coal company is required by federal and state law to replace the overburden and plant vegetation to reclaim the land for other uses.[20]

In 2006, almost 70 percent of the U.S. coal produced in that year — 803.4 million tons out of 1.16 billion tons — came from surface mining.[21] Bituminous and subbituminous coal production accounted for more than 1.08 billion tons, or 92.6 percent, of all coal produced. Lignite mining, while prevalent in Texas, represented only 84.2 million tons or 7.2 percent of total U.S. production. The remainder, anthracite, was only 0.1 percent (**Exhibit 7-4**).

Because the combustion of lignite coal releases high levels of federal Clean Air Act "criteria pollutants" such as carbon dioxide (CO_2), nitrous oxides (NO_X), sulfuric oxides (SO_X) and particulate matter, four Texas electric generation plants mix it with cleaner-burning PRB coal from Wyoming and Montana.

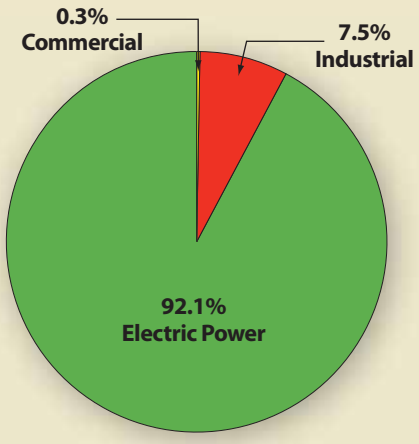
Transportation

Rail is the overwhelming choice for coal transportation in the U.S., shipping some 71 percent of the

nation's coal by weight in 2006, according to EIA. Eleven percent was shipped by truck, 10 percent by river barges, 7 percent by short-distance means, such as tramways, conveyers and slurry pipelines (pipelines carrying a mixture of water and finely ground coal), and 1 percent was undocumented (**Exhibit 7-5**).[22]

EXHIBIT 7-2

U.S. Coal Consumption by Sector, 2006



Note: Numbers may not total due to rounding.

Sources: U.S. Energy Information Administration and Texas Comptroller of Public Accounts.

Of the 680 million tons of coal shipped by railroad in the U.S., electricity generation plants received 93.7 percent; industrial plants received 4.5 percent; 1.5 percent went to coking plants; and the remainder went to other residential and commercial uses. More than 95 percent of the 85 million tons of coal shipped by conveyors or slurry pipelines went to electricity generation plants; 4.7 percent went to industrial plants; and the remainder went to other residential and commercial uses.[23]

Because tramways, conveyors and slurry pipelines are generally short-distance hauls, one can infer that the power plants they serve are mine mouth operations. Slurry pipelines carry either a paste made of equal parts pulverized coal and water, or a compressed "log" of coal using water for flotation. The slurry contains the same trace minerals of copper, lead and other metals as dry coal, so it must be dewatered and demineralized before it is suitable for burning.[24]

Until recently, the nation's longest slurry pipeline in operation was the Black Mesa pipeline, which

EXHIBIT 7-3

U.S. and Texas Net Electricity Production from Coal, 1995-2006

Year	U.S. Total Electricity Generation Percentage from Coal	U.S. Total Electricity Generation (Megawatt Hours)	Texas Total Electricity Generation Percentage from Coal	Texas Total Electricity Generation (Megawatt Hours)
1995	51.0%	3,353,487,000	39.3%	317,636,000
1996	52.1	3,444,188,000	41.3	328,949,000
1997	52.8	3,492,172,000	41.2	336,320,000
1998	51.8	3,620,295,000	38.1	355,320,000
1999	50.9	3,694,810,000	39.2	358,945,000
2000	51.7	3,802,105,000	37.2	377,742,000
2001	51.0	3,736,644,000	36.3	372,580,000
2002	50.1	3,858,452,000	36.8	385,629.000
2003	50.8	3,883,185,000	38.8	379,200.000
2004	49.8	3,970,555,000	38.1	390,299,000
2005	49.6	4,055,423,000	37.4	396,669,000
2006	49.0	4,064,702,000	36.5	400,583,000

Sources: U.S. Energy Information Administration and Texas Comptroller of Public Accounts.

EXHIBIT 7-4

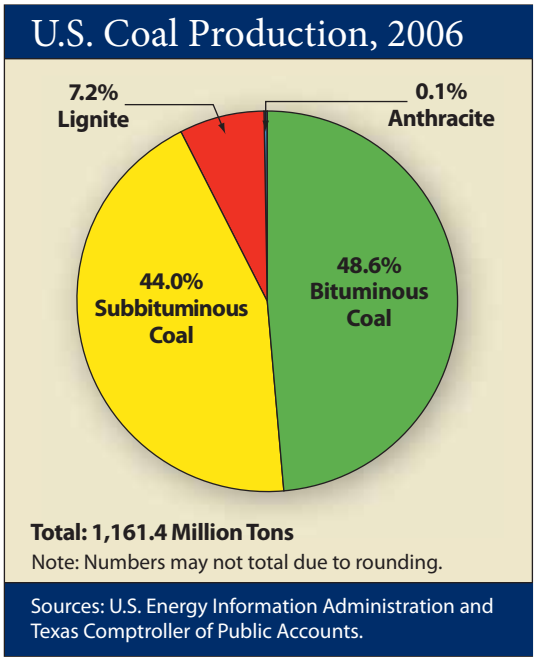
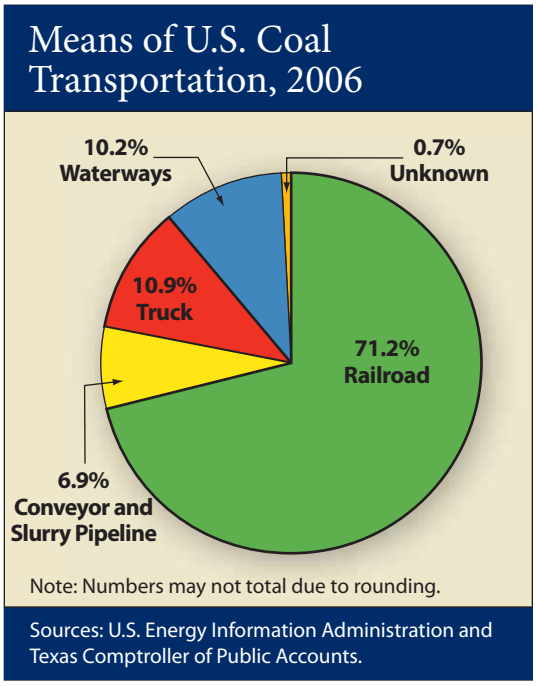


EXHIBIT 7-5



While strip mining is the most economical method of retrieving shallow deposits of Texas lignite coal, it is hardly inexpensive. On the spot market, the commodity cost of lignite (excluding transportation costs) can be two to three times the cost of higher-quality PRB. The reason is the expense of surface mining in Texas.

For example, at the Big Brown coal and electric generating plant owned by Luminant, operators must move 130 feet of overburden to mine a five to 10-foot coal seam, remove more overburden to mine another shallow seam below the first, and so on. At present, the Big Brown plant's mine is about 200 feet deep.

In addition, operators must be sure to separate the lignite from the surrounding soil (visually, the two are quite similar) because too much dirt in the lignite lowers boiler temperatures and increases slag, a waste product.

Also, lignite's lower Btu value (about 6,500 to 7,000 Btus per pound, compared to PRB's 8,500 to 9,500 Btus per pound) means that more lignite is required to get boilers to the required temperature than the same volume of PRB. PRB, on the other hand, is within 30 to 50 feet of the surface in seams 40 feet thick and can be mined much less expensively.[25]

ran for 273 miles from a mine in northeastern Arizona to an electric plant in southern Nevada. In early 2007, however, the pipeline and the power plant it served shut down.[26]

Texas lignite generally is not transported for significant distances because most of its major consumers — electric utilities, aluminum smelters and other industrial users — are located within a short distance of active mines. Because it is not shipped, the fuel's total cost usually is lower than that of other coals that must be transported.[27]

Generation

To generate electricity, coal can be burned directly or gasified and then burned more cleanly. If burned directly, the coal is ground into a very fine powder and then blown into large combustion chambers. The resulting heat either drives turbines directly or boils water to drive steam turbines, which then drive generators to create electricity (**Exhibit 7-6**). If the turbines can do both, the process is called "combined cycle."

Gasification is a different process that can use coal, biomass, petroleum coke, petroleum residues or other organic waste (**Exhibit 7-7**). Under high heat, high pressure and controlled amounts of

pure oxygen, most of the feedstock does not burn but instead breaks into its component parts.

The resulting synthetic natural gas, called "syngas," is primarily hydrogen and carbon monoxide. It can be burned to drive turbines, either directly or by boiling water or both. Mineral impurities can be removed before they combine with other elements to become regulated emissions such as NO_X, SO_X and H_2S. The burned coal is reduced to ash and removed.[28] The ash is either sold for use as an ingredient in concrete or as a roadbed material, or made into synthetic gypsum used in wallboard manufacturing. Occasionally, the ash is deposited in landfills.[29]

As of November 2007, Texas had only one coal gasification plant in the planning stages. Eastman Chemical is proposing to build a gasification plant near Beaumont.[30]

Availability

The U.S. has the world's largest known coal reserves, about 268 billion recoverable tons — enough to last the nation at least 236 years at current usage rates, according to EIA (**Exhibit 7-8**).[31] U.S. coal production in 2006 exceeded that of 2005, which in turn surpassed the prior record set in 2004. According to EIA, however, while coal production increased in 2006, it actually produced less overall energy due to the increased use of lower heat-value coals such as lignite.[32]

Texas has large, shallow lignite deposits in a band lying generally east of Interstate Highway 35. In 2006, Texas had 13 operating surface mines, fewer than 1 percent of the U.S. total, producing 45.5 million tons of coal, about 4 percent of the U.S. total.[33]

Costs and Benefits

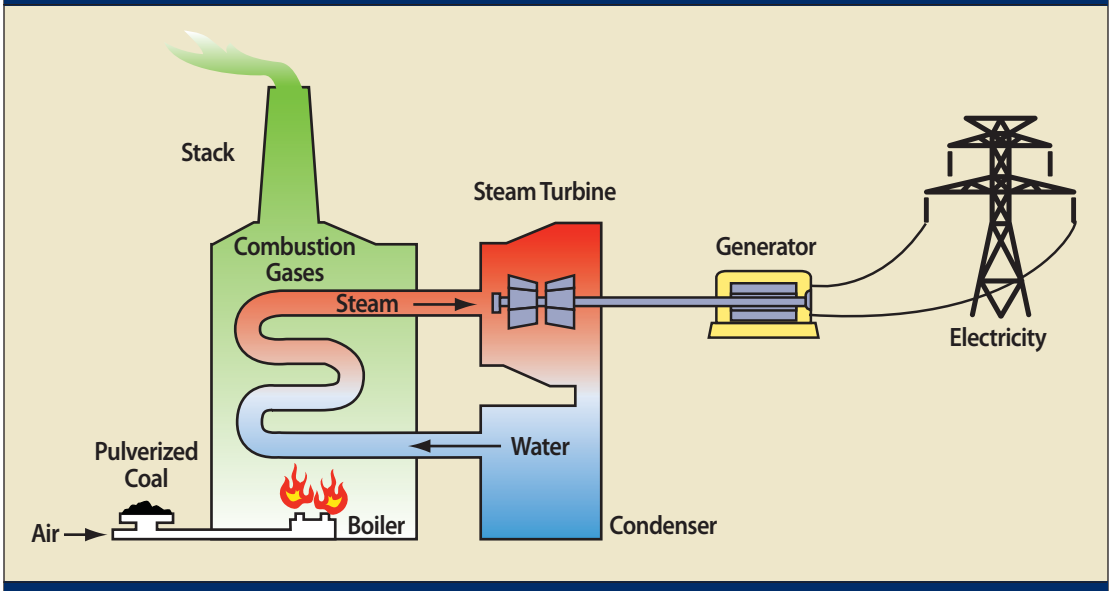
PRB coal must be transported to Texas by rail. Increased coal demand and rail shipment costs, combined with a rail system that in recent years has been prone to service disruptions, have raised questions as to the long-term reliability of PRB supplies.

An informal Comptroller survey of PRB coal-importing utilities in Texas indicated that rail costs constitute two-thirds to three-quarters of the final cost of the coal. The federal government has not collected data on coal rail transportation prices since 1999.

The U.S. has the world's largest known coal reserves.

Exhibit 7-6

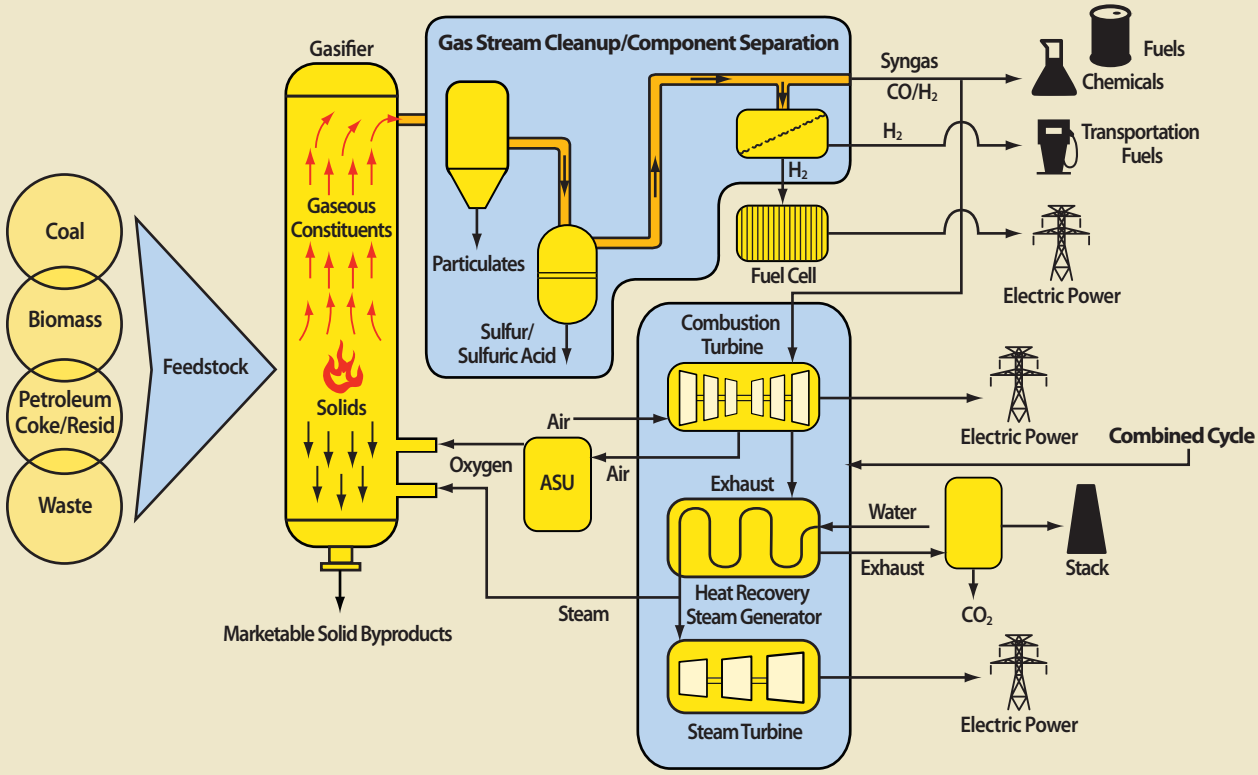
Schematic of a Coal-Fired Steam Turbine



Source: TXU Corporation.

EXHIBIT 7-7

Gasification-Based System Concepts



Source: U.S. Department of Energy.

The deputy general manager of Austin Energy, a municipally owned utility, said his utility buys 2 million tons of PRB per year, or about one trainload per day. Austin Energy pays about $20 million per year under its current contract with Union Pacific railroad. Soon, however, Union Pacific will move to a tariff system that will rely on posted, periodically updated prices rather than long-term contracts; this could double or triple Austin Energy's rail costs next year.

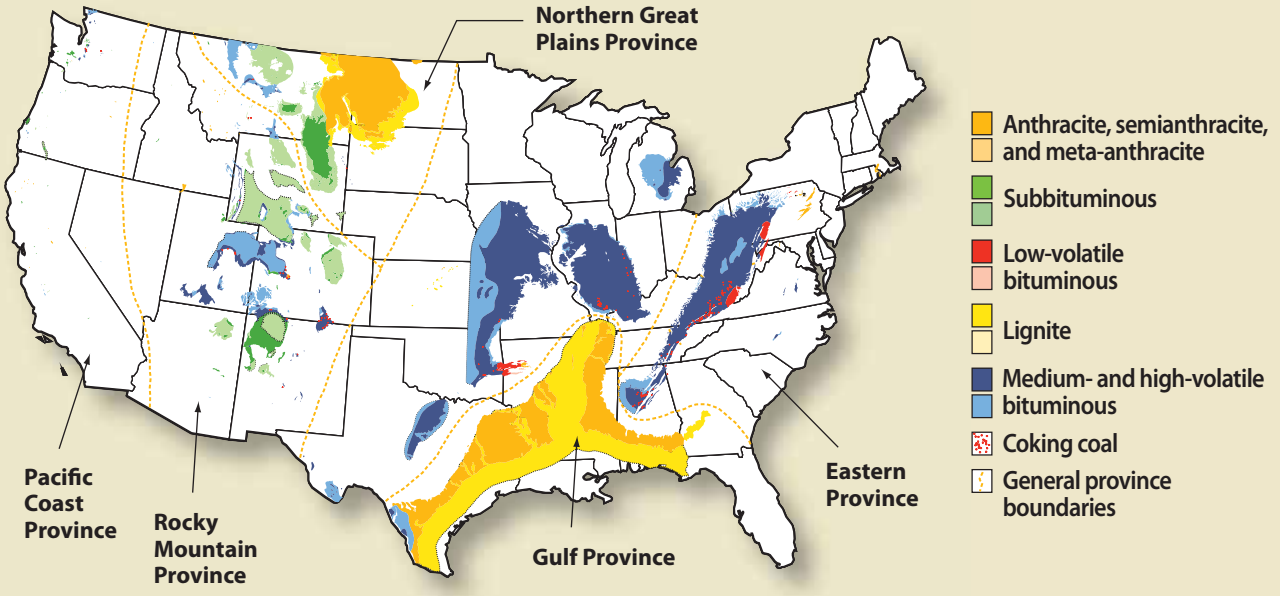
TXU Power imports PRB to co-fire with lignite from its own mine mouth operations; 75 percent of its PRB cost represents rail costs. In addition to these rates, railroads are adding on a surcharge to cover diesel's rising cost.[34]

According to 2005 EIA data, Texas imported 56.6 percent of its coal from out of state; 99.6 percent was shipped by rail, the remainder by rivers or trucks. In-state coal sources provided 42.7 percent; all of it was shipped via tramways, conveyors and slurry pipelines. The remainder was not documented.[35] Constraints on rail systems have required some power plants to make multiple arrangements with rail lines or to burn other fuels such as natural gas or fuel oils. The major railroad operators in Texas — Union Pacific/Southern Pacific and Burlington Northern-Santa Fe — are addressing these constraints by building more rail lines and increasing the use of existing lines.[36]

But railroad company construction efforts may not be adequate to meet demand. Rising rail prices for coal shipments, and shortfalls in those shipments, have prompted growing controversy in recent years.

EXHIBIT 7-8

U.S. Coal Mining Areas



Darker colors represent areas known to contain coal beds that are of commercial value at the present time or that may be of value to the future. In general the minimum thicknesses included are 14 inches for anthracite and bituminous coal, and 30 inches for subbituminous coal and lignite.

Lighter colors represent areas of doubtful value for coal. These may be divided into three classes- (1) areas containing thin or irregular beds, which generally have little or no value, but which locally may be thick enough to mine; (2) areas in which the coal is poor in quality; and (3) areas where information on the thickness and quality of coal beds is meager or lacking.

Source: U.S. Energy Information Administration.

The Federal Energy Regulatory Commission (FERC), which oversees the interstate electric and natural gas transportation systems, hosted a 2006 conference with utility and railroad representatives to address some utilities' concerns that unreliable and expensive coal shipments could impair their ability to generate electricity. As FERC stated in its 2006 *State of the Markets Report*:

> In 2005, major rail outages reduced deliveries of Wyoming's Powder River Basin (PRB) coal to electric generators. The resulting reductions in coal deliveries forced short-term changes in electricity markets and generation patterns. Over the longer term, markets responded as the railroads repaired damage and added new infrastructure, and customers devised ways to reduce their dependence on PRB coal.[37]

Coal shipped by conveyors and trucks is economical only for short-distance hauls, meaning that the almost 44 percent of coal consumed in Texas in 2005 came from nearby sources, as with mine mouth operations.[38]

Commodity Costs

The costs of producing Texas lignite coal are unknown, largely because nearly all of the coal is consumed at the point of production and its costs are embedded within the price of the resulting product, whether electricity, aluminum or chemicals. As noted earlier, rail costs for PRB coal make up two-thirds to three-quarters of its cost, although prices paid to ship coal by rail are not publicly available.

Due to increasing national demand, coal prices rose in 2006, according to EIA's 2006 *Annual*

Coal Report.[39] The average open-market commodity price of Texas coal in 2006 was $18.61 per ton, up from 2005's $17.39 per ton. At the same time, PRB coal cost an average of $9.03 per ton, up from 2005's $7.71 per ton. Spot prices at the end of 2007 for PRB coal was at $11.50, up from $9.95 per ton at the end of 2006. It should be noted, however, that very little Texas coal is sold in an open market, which may skew these prices. Furthermore, neither price includes transportation costs, which, again, can be substantial.

Environmental Impact

When burned, coal releases carbon dioxide, SO_X, NO_X and mercury compounds into the air. For this reason, the federal Environmental Protection Agency (EPA) requires coal-fired boilers to be equipped with emission control devices.[40] The residual ash also contains trace amounts of toxic heavy metals such as arsenic and mercury.

As of 2004, Texas' then-19 coal-fired plants accounted for 67 percent of the state's annual NO_X emissions from utility plants, and 66 percent of total NO_X emissions during the state's ozone season, which generally runs from April to November in the most populous areas.[41] The coal plants also emitted 99 percent of the utilities' annual SO_X emissions, 60 percent of their carbon dioxide emissions and 100 percent of their mercury emissions.[42]

According to EPA, NO_X emissions combine with volatile organic compounds in the presence of sunlight to create ozone, a ground-level pollutant regulated by the federal Clean Air Act.[43] SO_X emissions dissolve in water, creating a weak sulfuric acid that can become acid rain.[44]

Texas represents a meaningful portion of the nation's carbon dioxide (CO_X), sulphur dioxide (SO_2) and nitrous oxide (NO_X) emissions (**Exhibit 7-9**). EPA regulates the emissions of SO_2 and NO_X, so-called "criteria pollutants" under the Clean Air Act. Carbon dioxide is not yet regulated, but Congress is considering legislation to do so.

A coal plant's emissions are correlated with its age. Thirty- to 35-year-old coal-fired plants were built just as the Clean Air Act was becoming law. At that time, existing plants were "grandfathered" under the law and plant owners were not required to seek permits under the new law nor future permits for minor modifications. Over time, this situation spurred controversy in several areas of the country — including Central Texas — as some grandfathered plants received what many believed were more than minor modifications that led to an increase in emissions. Many of these grandfathered coal plants now are reaching the end of their useful lives, and also have more emissions than newer plants.[45]

Exhibit 7-9

Texas Electric Utility, Commercial and Industrial Air Emissions, 2006

2006	CO_2 (Metric Tons)	SO_2 (Metric Tons)	NO_X (Metric Tons)
Total U.S. Emissions	2,459,800,018	9,523,561	3,799,447
Total Texas Emissions	257,552,164	558,350	260,057
Percent of U.S.	*10.5%*	*5.9%*	*6.8%*
Coal in Texas	150,589,481	523,073	119,910
Percent of state	*58.5%*	*93.7%*	*46.1%*
Percent of U.S.	*6.1%*	*5.5%*	*3.2%*

Sources: U.S. Energy Information Administration and Comptroller of Public Accounts.

Coal plant emissions have been the source of considerable argument and debate for decades. In Texas, the debate reached new heights after the 2006 announcement by TXU (now Energy Future Holdings Corporation), the state's largest electricity generator and retailer, that it would build 11 lignite coal-fired electricity generation plants, some new and some representing retrofits of older plants that formerly burned natural gas.[46] A gubernatorial executive order issued prior to TXU's announcement required the Texas Commission on Environmental Quality, which reviews applications to build or make major modifications to utility plants, to hasten its review of any permit applications involving Texas energy resources.[47]

In early 2007, however, TXU announced that private investors would be purchasing the corporation for $45 billion and that the new owners would drop plans to build eight of the 11 coal-fired facilities.[48] As part of the deal, TXU announced it would bring 1,400 MW of "mothballed" (closed but not abandoned) natural gas-fired plants back into service.[49] TXU shareholders approved the buyout on September 7, 2007.[50]

China is now building the equivalent of two 500-megawatt coal-fired electricity plants every week.

In addition, coal power plants use some water. Depending on the plant type, electricity generation from coal requires withdrawals of between zero and 14,658 gallons per million Btu of heat energy produced. This is the amount of water extracted from a water source; most of the water withdrawn is returned to that source.

Water consumption refers to the portion of those withdrawals that is actually used and no longer available. Electric generation using coal consumes between zero and 150 gallons of water for each million Btu of heat energy produced.

Surface Reclamation

The Railroad Commission of Texas (RRC) is responsible for reclaiming abandoned mine lands under Title IV of the federal Surface Mining Control and Reclamation Act of 1977. Reclamation often includes soil recontouring; the burial or treatment of mine residues called spoil; the installation of erosion and water control structures; and revegetation of the landscape. Underground mine openings also must be sealed. [51] The act requires all current and future mine operators to post bond or to provide regulators with proof that they have the financial means to reclaim mines they abandon.[52]

RRC's Abandoned Mine Land (AML) program restores land and water resources damaged by mining before the law was passed. The program receives funding from the federal Office of Surface Mining Reclamation and Enforcement through a federal production tax levied on active coal mining operations. As of May 2005, Texas' AML program had reclaimed 2,411 acres of abandoned surface mines and closed 525 underground mine openings at a cost of $25 million.[53]

Transportation Emissions

The extensive use of diesel-fueled trains to move coal presents another challenge, since they often travel through or by highly populated areas that are being monitored for federal Clean Air Act compliance.[54]

Other Risks

The entire coal fuel stream, including mining, transportation and power generation, presents physical, logistical and financial risks.

Rail transportation of coal, as noted above, can be limited by several factors, including rail congestion and outages, labor disputes, diesel emissions and noise.

Furthermore, increasing public resistance to the use of coal to generate electricity because of its environmental effects, particularly in Texas, places financiers' potential investment in coal plants at risk.[55]

State and Federal Oversight

Coal mining comes under the purview of a number of federal and state agencies concerned with occupational and environmental health and safety. When used as a fuel for electricity generation, coal oversight extends to federal and state agencies such as the Federal Energy Regulatory Commission and, in the still-regulated areas of Texas' electricity grids, the Public Utility Commission.

Subsidies and Taxes

As noted in Chapter 3 of this report, the coal industry contributes to federal and state tax revenues through income taxes, franchise taxes, property

taxes and indirectly through taxes paid by coal power plant owners.

By far, the largest coal-related federal subsidy, worth more than $2 billion in 2006, is coal's share of the Alternative Fuel Production Credit. Companies that create synthetic fuel from coal are eligible for this subsidy. Chapter 28 contains information on subsidies related to coal.

Other States and Countries

The World Coal Institute predicts that global coal consumption will reach 7.7 billion tons by 2030, with China accounting for half the increase.[56]

China is now building the equivalent of two 500-megawatt (MW) coal-fired electricity plants every week. This is comparable to adding the total power capacity of the United Kingdom to China's electrical grid each year.[57]

China's exploding economy — and fuel consumption — is perhaps the biggest factor in world coal use. Coal provides fully two-thirds of the country's energy supply, more than 80 percent of its electricity, 50 percent of its industrial fuel and 60 percent of its chemical feedstocks (ingredients used to create fertilizers, plastics and other materials). China's coal production is double that of the U.S., and it consumes one-third of all coal used worldwide.[58]

Coal is the most widely used fuel for electricity generation in the U.S., and its status is unlikely to change dramatically.[59] Even as concerns grow about coal's high carbon dioxide, NO_X, SO_X and heavy metal emissions, new technologies such as Integrated Gasification Combined Cycle (IGCC) offer the potential to burn coal with reduced air emissions.

Texas has no IGCC plants either planned or operating at this time, although Austin Energy reviewed the possibility, ultimately concluding that the technology needs further refinement before it can be used economically.[60]

The U.S. Department of Energy (DOE), Southern Company and other partners recently began building an IGCC coal plant in Orlando, Florida that is expected to begin operations in June 2010. IGCC plants heat—but do not burn—coal so that it releases syngas, which is then burned to produce electricity. The Florida plant will generate 285 megawatts of electricity from the syngas derived from high-moisture, high-ash coals such as lignite, while generating 20 to 25 percent less emissions than lignite.[61] Construction on the plant began in September 2007.[62]

Another new clean coal technology is coal-to-liquids (CTL), also known as coal liquefaction. CTL produces syngas like that produced at an IGCC plant and then liquefies it via one of several methods. According to EIA, CTL can convert one ton of coal into two barrels of high-quality liquid fuel, such as a "CTL diesel" that can be used in place of regular diesel.

In the U.S., 14 CTL plant proposals are being evaluated for feasibility; none exist now. The world currently has only one operating CTL plant, the Sasol plant in South Africa, which produces 150,000 barrels per day of liquid fuel. China has six CTL plants in various phases of planning or construction; five others have been proposed in other parts of the world.[63]

CTL products are considerably cleaner than the fuels they replace. CTL diesel, for example, produces few of regular diesel's hazardous air pollutants and mercury when burned, although it releases similar quantities of CO_2.[64]

While CTL technology has been developing for decades, cost remains a nearly prohibitive factor. Estimates of Sasol plant capital costs are $70,000 to $90,000 per barrel per day. EIA suggests that conceptual plant designs now under review in the U.S. would cost at least that much per barrel per day, or $3.5 to $4.5 billion total.[65]

Outlook for Texas

Two coal-related issues prominent in Texas today are a microcosm of the worldwide debate over coal.

The first and probably the best known is then-TXU's effort to replace natural gas-burning electricity generation plants with plants that would burn lignite. Public opposition quickly emerged. Opposition came mainly from the Dallas, Waco and Houston metropolitan areas, whose leaders feared that prevailing winds would blow increased CO_2, NO_X and SO_X air emissions from the TXU plants into their area.

China's coal production is double that of the U.S., and it consumes one-third of all coal used worldwide.

In addition to the concerns for the general health of their citizens, the mayors of these cities recognized that increased coal plant emissions could jeopardize their struggles to meet federal air quality standards. At risk is the potential loss of future federal transportation funding for noncompliance. Some local businesses also were opposed because, if utility plants were allowed to increase emissions — even though there was considerable debate on whether the plants would in fact do so — other businesses and residents would be required to reduce their own pollution, if their areas are to meet federal standards.[66]

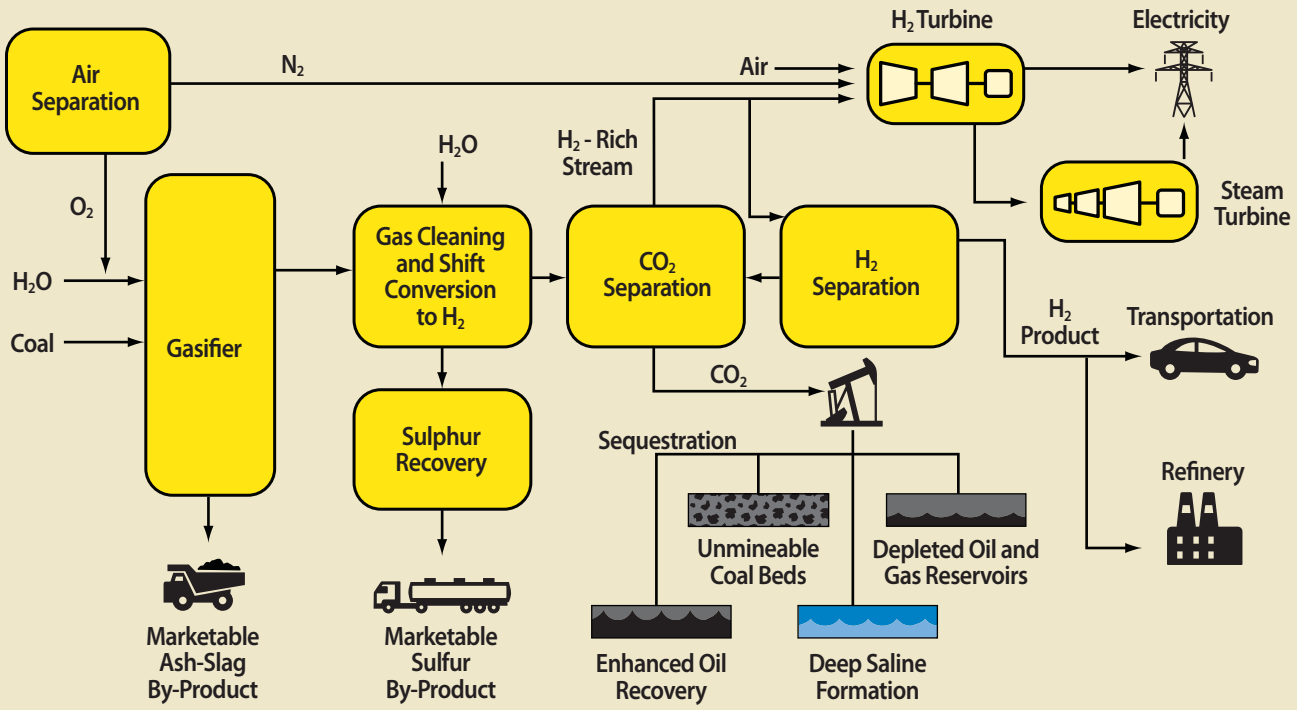
This issue is not just local; nations have been trying for years to agree on how to constrain these emissions, particularly CO_2, as concerns about climate change mount. The balance between environmental quality, economic viability, energy needs and quality of life is a challenge, and solutions have yet to be found.

The second prominent coal-related issue for Texas is FutureGen, a project by DOE and an alliance of private partners to create a "clean coal" demonstration and research plant. In December 2007, the alliance announced that a site in Mattoon, Illinois, was selected for the FutureGen project instead of two potential sites in Texas, one near Jewett and the other near Odessa. However, almost immediately after the alliance's announcement, DOE officials were saying publicly that FutureGen's escalating projected costs would demand DOE's reconsideration of the project.[67] In January 2008, DOE rescinded its support of the project, citing costs.[68]

DOE had touted FutureGen as "a first-of-its-kind coal-fueled, near-zero emissions power plant" (**Exhibit 7-10**). FutureGen costs exceeded $1.8 billion to develop. FutureGen would have gasified coal, captured and stored, or "sequestered," CO_2 and other potentially harmful emissions in underground salt domes or delivered them for use in

EXHIBIT 7-10

FutureGen Operations



Source: FutureGen Alliance.

depleted oil and gas fields to increase production through enhanced recovery methods.[69]

While neither Texas site was selected for the project, the Texas alliance that worked with DOE is still working on bringing this clean-coal technology to the state. In addition, news reports have indicated that the FutureGen project may be broken into several pieces, one of which could be sited in Texas.[70]

The siting of even a portion of FutureGen in Texas might be an economic and research boon, but the development of such a plant also has significant consequences for the use of coal in the future. Carbon capture, if proven to be economical on a large scale, may allow coal emissions to be cleaned enough to encourage its use as a fuel and simultaneously to help develop depleted oil and gas fields. (See Chapter 4.)

Tenaska Inc. of Omaha, Nebraska announced in February 2008 that it had applied for an air permit to build a 600 megawatt, conventional coal-fired electricity generation plant near Sweetwater, Texas. (Six hundred megawatts would provide power to more than 350,000 Texas homes, based on 2006 average residential electricity use.) The $3 billion "Trailblazer Energy Center," as Tenaska describes it, would burn PRB shipped in by rail and capture 85 to 90 percent of the CO_2 emissions for re-use in nearby oilfields. Depending on the coolant technology employed, the Center could also consume up to 10 million gallons of water daily. Tenaska estimates the plant could also provide up to 2,000 construction and 100 long-term jobs. Construction could begin as early as 2009.[71]

While coal will be an important fuel for the foreseeable future, it faces daunting challenges such as air emission controls, escalating transportation costs and, because of these challenges, the growing reluctance of corporate executives to plan major, capital-intensive industrial plants that rely on coal, particularly lignite. Another limitation on coal is that it has not adapted readily to seaborne transportation, meaning that it remains primarily a domestically produced fuel and that intercontinental imports or exports are, at best, stopgap measures until domestic supplies are restored. This may change if coal can be gasified and transported as liquified natural gas (LNG) economically. (See Chapter 5.)

Coal is readily available and can be shipped domestically. The environmental consequences of mining and burning coal, however, are challenges that must be addressed.

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