What is coal? Coal is a dull to shiny, gray, brown, or black combustible material made of decomposed plant material that has been solidified into rock. A coal bed is essentially a fossil peat swamp—plant debris that decayed in ancient mires or bogs. This decayed material, or peat, was altered under heat and pressure over millions of years to form coal. Many factors affect the content, quality, and rank of coal, including temperature, pressure, depth of burial, time, the presence of fresh water or salt water, the acidity of the swamp, the types of plant debris, and the types of sediment that covered the peat.

Coal in Kentucky: Dr. Thomas Walker was recorded as the first person to discover and use Kentucky coal, in 1750. Although coal was reported to have been mined as early as 1790, the first commercial mine in the state was opened in Muhlenberg County in 1820. By 1880, coal-mining machines had come into general use. In 1843, coal production in Kentucky had reached 100,000 tons. By 1963, coal production had exceeded 100 million tons. The record production for Kentucky was 179 million tons, in 1990.

The markets and destinations for Kentucky coal during 2014 were concentrated in 17 states, with a small market for international exports. Approximately 33 percent of the coal mined in Kentucky during 2014 was consumed in the commonwealth—primarily by electric utilities—making Kentucky the largest single market for Kentucky coal. The vast majority of Kentucky coal—63.5 million tons or 82 percent—was shipped to 130 electric power plants in 17 different states, including Kentucky, principally located in the Southeast. Following Kentucky, the states of Florida, South Carolina, Georgia, North Carolina, Virginia, and Ohio were the largest consumers of Kentucky coal during 2014 (Kentucky Coal Facts, 2015). In 2014, 92 percent of the electricity generated in Kentucky was produced by coal-fired power plants.

Kentucky's Coal Fields: Coal occurs in 57 of Kentucky's 120 counties, including 20 counties in the Western Kentucky Coal Field and 37 counties in the Eastern Kentucky Coal Field (Fig. 1). The coal in both fields is Pennsylvanian in age (300 to 320 million years old). Kentucky coal is high-volatile C to high-volatile A in rank, which is higher than Wyoming's subbituminous coal, but not as high as Pennsylvania's anthracite coal. Higher-rank coals generate more heat (measured in Btu/lb). Table 1 summarizes information about each coal field.

Table 1. Summary information for the Eastern and Western Kentucky Coal Fields.

Western Kentucky Coal Field (2014)	Eastern Kentucky Coal Field (2014)
Illinois Basin	Appalachian Basin
Area: 6,400 square miles	Area: 10,500 square miles
Remaining resource: approx. 36 billion tons	Remaining resource: approx. 54 billion tons
Topography: flat or gently rolling	Topography: hilly to mountainous
Mining techniques: surface mining and underground shaft mines	Mining techniques: drifts into hillsides, surface contour, and mountaintop-removal
Number of mines: 22	Number of mines: 239
Leading producing county: Union	Leading producing county: Pike
Coal mine workers: 4,401	Coal mine workers: 7,185

The Western Kentucky Coal Field had original in-place resources (coal in the ground greater than 14 inches thick) of 41 billion tons, and the Eastern Kentucky Coal Field had original in-place resources of 64 billion tons, for a total resource of 105 billion tons for the entire state. Tables 2 and 3 show remaining resources greater than 28 inches thick for the principal coal beds in Kentucky—the resource with the highest potential for future development.

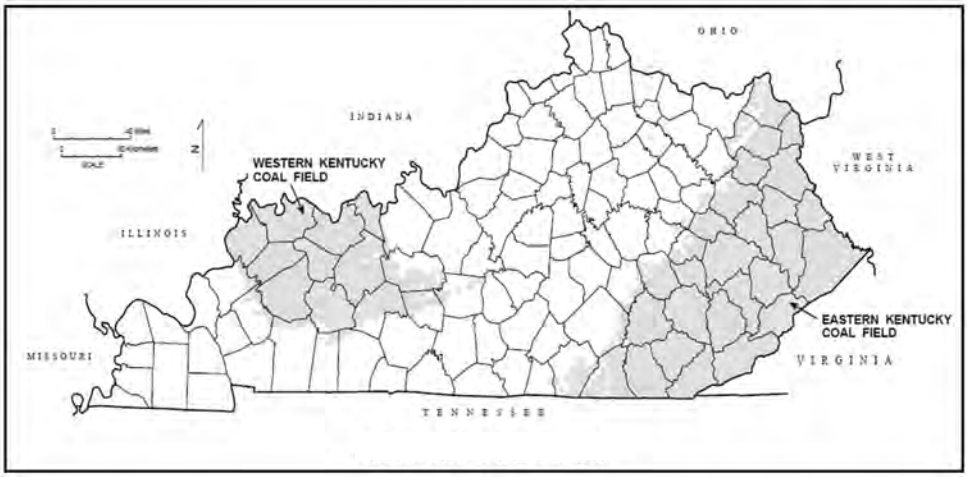

Figure 1. Kentucky coal fields.

Because of its flat or gently rolling topography, the Western Kentucky Coal Field was originally noted for large-area surface mines and similarly large slope and shaft mines. Today, most production in western Kentucky is from a small number of large underground mines. Increasing demand for high-sulfur coal from power plants having pollution control devices has resulted in a resurgence of

production of western Kentucky coal since 2004. Most of this production comes from only three coal beds.

Because of the hilly to mountainous topography in eastern Kentucky, the Eastern Kentucky Coal Field is characterized by contour surface mines, multiseam area mines, and drift underground mines. Eastern Kentucky has many more mines compared to western Kentucky, but they are smaller and less productive. Market and environmental factors have resulted in lower demand for the high quality, but expensive coal of eastern Kentucky. This has caused a marked decline in mining in the region.

Table 2. Original and remaining coal resources as of 2014 for coal greater than 28 inches thick in the 12 most productive coal beds in eastern Kentucky (in million tons). *Limited to Pike County.

	Original	Mined	Remaining
Fire Clay rider	553	136	417
Fire Clay	2,745	1,688	1,057
Amburgy	1,998	571	1,428
Upper Elkhorn No. 3B	890	464	427
Upper Elkhorn No. 3A	3,571	1,759	1,812
Upper Elkhorn No. 2	1,595	680	915
Upper Elkhorn No. 1	2,977	1,180	1,798
Lower Elkhorn	2,737	1,687	1,050
Cllintwood	463	187	275
Glamorgan*	221	80	141
Hagy*	99	20	79
Splashdam*	73	34	39
Total Eastern Kentucky	17,923	8,485	9,438

Table 3. Original and remaining coal resources as of 2014 for coal greater than 28 inches thick in the six most productive coal beds in western Kentucky (in million tons).

	Original	Mined	Remaining
Baker (No. 13)	2,715	225	2,490
Herrin (No. 11)	3,666	1,338	2,327
Springfield (No. 9)	10,208	3,451	6,757
Dekoven (No. 7)	1,457	1	1,456
Davis (No. 6)	4,210	95	4,116
Total Western Kentucky	22,256	5,111	17,146

Production Activity and Revenue: For more than 50 years, Kentucky has been one of the top three coal producers in the United States. Coal has been the state's most important mineral resource throughout this century. The coal industry has provided employment, fuel, tax revenue, and economic growth. In 2014, the coal industry employed 11,586 people directly in coal mining jobs and indirectly provided approximately 36,000 jobs across the state. Kentucky ranks second nationally in number of employed miners. Recent declines in demand for eastern Kentucky coal, however, have resulted in steep reductions in employment in that region.

Future Prospects: Despite more than 200 years of continuous production, Kentucky still has more than 30 billion tons of remaining coal resources that could sustain mining well into the future. Declining production over the past two decades has been attributed, by some, to resource depletion, but it is more likely that complex market and regulatory factors have been at play. The greatest of these factors post-2005 is fuel switching to natural gas accelerated by the availability of cheap natural gas. New and anticipated regulation of carbon dioxide emissions at power plants is also having a marked impact on decisions to close coal-fired generators and consequently having a marked impact on coal mining. The future demand for coal will depend on the development of new technologies for mining, processing, and utilizing this fuel, as well as our capacity to mitigate the environmental effects of its use.

Mining Technology: Several different mining methods are used in Kentucky, each one designed to mine coal in different terrain and at different depths (Fig. 2). There are two main methods of surface mining (mountaintop-removal or area mining, and contour mining) and three methods of underground mining (drift, slope, and shaft mining). A hybrid method, highwall mining, uses aspects of both surface and underground extraction.

Underground mines generally require greater capital investment to develop and have higher operating costs. Surface mines are cheaper to develop and have higher recovery rates, but have greater environmental footprints. In 2014, 261 mines were in operation in Kentucky (163 surface mines and 98 underground mines), producing 77.4 million tons of coal. Sixty-eight percent (52.8 million tons) was produced by underground-mining methods and 32 percent (24.6 million tons) was produced by surface-mining methods.

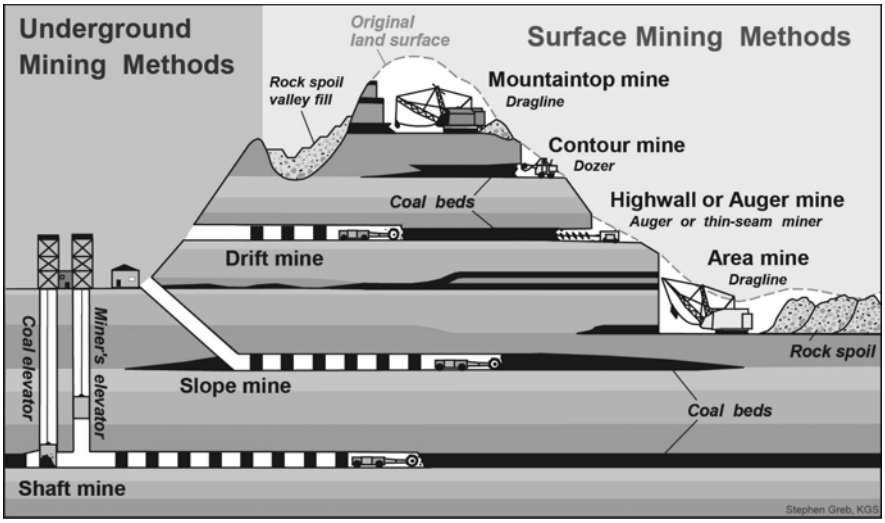

Figure 2. Mining methods

Sources: Kentucky Coal Council Coal Education website, www.coaleducation.org; 2015 Kentucky Coal Facts (energy.ky.gov/Pages/CoalFacts.aspx); U.S. Department of Energy–Energy Information Administration website (www.eia.doe.gov); Straus, C.M., Thompson, E.C., and Haywood, C.F., 1996, The effects of the Kentucky coal industry on the economy of the commonwealth: University of Kentucky Center for Business and Economic Research, 14 p. For more information about coal, visit our Web page at www.uky.edu/kgs.