Technology Box
Coal and Coal Mining Technology

Coal is one of three fossil fuels thought to have been formed by swamps that covered the earth millions of years ago. Sediment covered the carbon-based plant material in these swamps, and over time heat and pressure transformed it into coal, oil, and natural gas. Coal formed in seams of various thicknesses, ranging from inches to many feet, and comes in a variety of qualities. They are, in order of increasing quality (or carbon content) – lignite or brown coal, subbituminous, bituminous, and anthracite. The lower-quality coals contain more moisture and tend to be younger. Lignite and subbituminous coal come from the Cretaceous and Tertiary period (140 million years or less) whereas harder bituminous and anthracite are from the Pennsylvania period (300 million years ago)

Impurities in coal include inorganic materials that remain as ash after combustion. These include clay, quartz, potassium, sodium, and carbonates along with sulfur compounds. Sulfur in coal is the result of swamps that were covered with seawater rather than fresh water. Sulfur is a particular problem because it may get into mine runoff making the water acidic, and it creates sulfur dioxide when the coal is burned.

It takes four to seven years to develop coal reserves, including establishing ownership and mineral rights, determining the grade of coal and the market to sell it in, and choosing the technology for production, and transportation of the coal. There are two basic types of mines: surface mines, which contain deposits usually less than 200 feet deep, and underground mines, which have deposits usually more than 200 feet below the surface. Underground mines may have different types of entrance. A drift mine has a horizontal entrance; a slope mine has a downward sloping entrance, and a shaft mine has a vertical entrance with elevators delivering miners down to the deposits. Mines are categorized by exploitation technique. Room and pillar mines are popular when coal is deposited in layers between other materials, whereas block caving is popular when coal comes in huge solid blocks of reserves. Passages within the mine provide access to deposits and ventilation and are required by U.S. safety laws to be adequate for both ventilation and escape. Underground coal is exploited using a room-and-pillar technique, which is good to about 1000 feet. Coal is removed but pillars are left to support the roof until the area is abandoned. Conventional room and pillar techniques are labor intensive, requiring cutting, blasting, and removal of the coal.

Methane may be generated and collected in fractures in coal seams, if there is sufficient heat and pressure. It may be produced when coal seams are dewatered. The harder the coal, the more methane it tends to contain. Thus, methane tends to be more prevalent at greater depths. Coal bed methane is a nuisance in small quantities, because it can cause explosions, but in larger quantities it can be exploited, as in the Black Warrior basin, Alabama and the San Juan basin in Colorado and New Mexico. India, China and Australia all have prominent coal bed methane reserves.

Continuous techniques using machines that cut, drill and load without blasting are more capital intensive. If the seam is flat and thick, long wall mining can be used.

In this process, a machine moves back and forth in long strokes cutting coal that falls onto a conveyer for removal. A hydraulic portable roof support remains in place until the coal is removed. Then the machine moves on and the roof is allowed to collapse. Short-wall mining, designed for thinner seams or smaller reserves, is a variant of the long-wall technique using continuous mining equipment. However, the machines are smaller and coal is removed by shuttle cars.

Shallower deposits of coal (less than 200 feet) can be surface or strip mined by removing the overburden with draglines, shovels, excavators, and bulldozers. Power shovels, hydraulic shovels, and front-end loaders are used to load the coal. If the area is rather flat, the coal can be surface mined, with the overburden from one area deposited in an area already mined out. If coal is located on a hillside, contour mining is employed with coal being cut to make contoured areas or ledges up the hill. Although the equipment is similar to area mining, it is smaller to fit on these ledges.

In 2000, about 65% of U.S. coal was transported by rail, constituting about 40% of rail freight tonnage and 20% of rail revenues. About 14% percent was transported by water in barges and ships. Trucks, tramways, conveyers, and coal slurry pipelines transported the remainder. Forty-five to sixty days of coal are typically stockpiled by consumers in case of disruption from strikes, transport breakdown, and inclement weather, such as floods or coal frozen into coal cars.

Source: U.S. EIA/DOE (1996) and
http://www.yale.edu/ynhti/curriculum/units/1986/6/86.06.01.x.html#c