Mining

(NAICS 212)

SIGNIFICANT POINTS

- Employment is projected to decline; however, job opportunities should be favorable for construction and extraction, and production workers in coal mining and nonmetallic mineral mining.
- While most mining jobs can be entered directly from high school, the increasing sophistication of equipment and machinery requires a higher level of technical skill.
- Working conditions can be dangerous.
- Earnings are higher than the average for all industries.

Nature of the Industry

Mining has played an important role in the development of the United States. In the past, the discovery of minerals such as gold and silver resulted in population shifts and economic growth. Extraction of minerals and coal continues to provide the foundation for local economies in some parts of the country. Products of this industry are used as inputs for consumer goods, processes, and services provided by all other industries, including agriculture, manufacturing, transportation, utilities, communication, and construction. Uses of mined materials include coal for energy, copper for wiring, gold for satellites and sophisticated electronic components, and a variety of other minerals as ingredients in medicines and household products.

Besides mining coal and metallic and nonmetallic minerals, employers in this industry explore for minerals and develop new mines and quarries. *Metallic minerals* include ores, such as bauxite—from which aluminum is extracted—copper, gold, iron, lead, silver, and zinc. *Nonmetallic minerals* include stone, sand, gravel, clay, and other minerals such as lime and soda ash, used as chemicals and fertilizers. This industry also includes initial mineral processing and preparation activities, because processing plants usually operate together with mines or quarries as part of the extraction process. (A separate section in the *Career Guide* covers careers in oil and gas extraction.)

Mining is the process of digging into the earth to extract naturally occurring minerals. There are two kinds of mining, *surface mining* and *underground mining.* Surface mining, also called open-pit mining or strip mining, is undertaken if the mineral is near the earth's surface. This method usually is more cost-effective and requires fewer workers to produce the same quantity of ore than does underground mining. In surface mining, after blasting with explosives, workers use huge earthmoving equipment, such as power shovels or draglines, to scoop off the layers of soil and rock covering the mineral bed. Once the mineral is exposed, smaller shovels are used to lift it from the ground and load it into trucks. The mineral also can be broken up using explosives, if necessary. In quarrying operations, workers use machines to extract stone used primarily as a building material. Stone, such as marble, granite, limestone, and sandstone, is quarried by splitting blocks of rock from a massive rock surface.

Underground mining is used when the mineral deposit lies deep below the surface of the earth. When developing an underground mine, miners first must dig two or more openings, or tunnels, deep into the earth near the place where they believe coal or minerals are located. Depending on where the vein of ore is in relation to the surface, tunnels may be vertical, horizontal, or sloping. One opening allows the miners to move in and out of the mine with their tools and also serves as a path for transporting the mined rock by small railroad cars or by conveyor belts to the surface. The other opening is used for ventilation.

Entries are constructed so that miners can get themselves and their equipment to the ore and carry it out, while allowing fresh air to enter the mine. Once dug to the proper depth, a mine's tunnels interconnect with a network of passageways going in many directions. Long steel bolts and pillars of unmined ore support the roof of the tunnel. Using the room-and-pillar method, miners remove half of the ore as they work the ore seams from the tunnel entrance to the edge of the mine property, leaving columns of ore to support the ceiling. This process is then reversed, and the remainder of the ore is extracted, as the miners work their way back out. In the case of longwall mining of coal, self-advancing roof supports, made of hydraulic jacks and metal plates, are moved ahead, allowing the ceiling in the mined area to cave in as the miners work back towards the tunnel entrance.

Once all the minerals or coal have been extracted, the mine and its surrounding environment must be restored to the condition that existed before mining began. In surface mining, the layers of topsoil, or overburden, that were removed in order to reach the mineral are used to fill in the mine and reshape the land. This ensures that native plants and animals will be able to thrive once again. Underground mining does not require as extensive a reclamation process; however, mine operators and environmental engineers still must ensure that ground water remains uncontaminated and that abandoned mines will not collapse. The reclamation process is highly regulated by Federal, State, and local laws, and reclamation plans often must be approved before mining permits will be granted.

During the 1990s, production of both minerals and coal increased. Given the more volatile price of metal, its production fluctuated more than that of nonmetallics. However, employment in both sectors declined significantly, as new technology and more sophisticated mining techniques increased productivity, allowing growth in output while employing fewer workers. Most mining machines and control rooms are now automatic or

computer-controlled, requiring fewer, if any, human operators. Many mines also operate with other sophisticated technology such as lasers and robotics, which further decrease the number of workers needed to mine materials.

Working Conditions

The average production worker in the mining industry worked 45.0 hours a week in 2002. Work environments vary by occupation. Scientists and technicians work in office buildings and laboratories, while miners and mining engineers spend much of their time in the mine. Geologists who specialize in the exploration of natural resources may have to travel for extended periods to remote locations, in all types of climates, in order to locate mineral or coal deposits.

Working conditions in mines and quarries can be unusual and sometimes dangerous. Underground mines are damp and dark, and some can be very hot and noisy. At times, several inches of water may cover tunnel floors. Although underground mines have electric lights, only the lights on miners' caps illuminate many areas. Workers in mines with very low roofs may have to work on their hands and knees, backs, or stomachs, in confined spaces. In underground mining operations, dangers include the possibility of an explosion or cave-in, electric shock, or exposure to harmful gases.

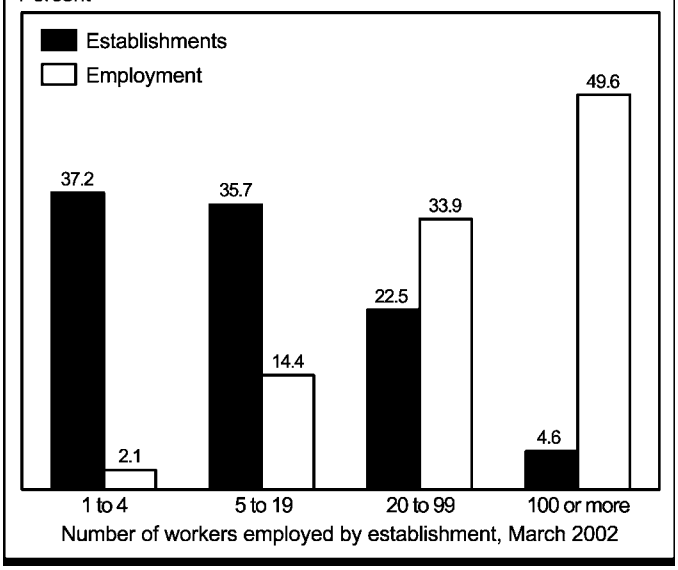
Workers in surface mines and quarries are subject to rugged outdoor work in all kinds of weather and climates. Some surface mines shut down in the winter, because snow and ice covering the minesite makes work too difficult. Physical strength and stamina are necessary, because the work involves lifting, stooping, and climbing. Surface mining, however, usually is less hazardous than underground mining.

In 2002, the rate of work-related injury and illness was 4.1per 100 full-time workers in metal mining, 3.8 in nonmetallic minerals, and 6.8 in coal mining, compared with 5.3 for the entire private sector. Mining illnesses and injuries have steadily declined over the years because of stricter safety laws and improvements in mining machinery and practices. Although mine health and safety conditions have improved dramatically, dust generated by drilling in mines still places miners at risk of developing either of two serious lung diseases: Pneumoconiosis, also called "black lung disease," from coal dust, or silicosis from rock dust. The Federal Coal Mine Health and Safety Act of 1969 regulates dust concentrations in coal mines, and respirable dust levels are closely monitored. Dust concentrations in mines have declined as a result. Underground miners have the option to have their lungs x-rayed when starting a job, with a mandatory follow-up x-ray 3 years later, in order to monitor any development of respiratory illness. Additional x-rays are given every 5 years, on a voluntary basis. Workers who develop black lung disease or silicosis may be eligible for Federal aid.

Employment

There were approximately 212,000 wage and salary jobs in the mining industry in 2002; around 74,000 in coal mining; 29,000 in metal mining; and 107,000 in nonmetallic mineral mining. According to the Energy Information Administration, there were around 1,400 coal mining operations in 26 States in 2002. Over half of all coal miners are employed in three States-Kentucky, Pennsylvania, and West Virginia. Other States employing large numbers of coal miners are Alabama, Illinois, Indiana, Virginia, and Wyoming. Metal mining is more prevalent in the West and Southwest, particularly in Arizona, Colorado, Nevada, New Mexico, and Utah. Nonmetallic mineral mining is the most widespread, as quarrying of nonmetallic minerals, such as stone, clay, sand, and gravel, is done in nearly every State. In many rural areas, mining operations are the main employer. About 73 percent of mining establishments employ fewer than 20 workers (see chart).

Nearly 3 out of 4 establishments in mining employ fewer than 20 workers



Occupations in the Industry

The mining industry requires many kinds of workers. In 2002, 7 out of 10 workers were in *construction and extraction, production*, or *transportation and material-moving* occupations (table 1).

Mining occupations. The majority of jobs in the mining industry are in construction and extraction occupations. Though most of these jobs can be entered into directly from high school, or after acquiring some experience and on-the-job training in an entry-level position, the increasing sophistication of equipment and machinery used in mining means a higher level of technical skill is now required for many positions.

Underground mining primarily includes three methods—conventional, continuous, and longwall mining. Conventional mining, which is being phased out, is the oldest method, requiring the most workers and procedures. In this method, a strip or "kerf" is cut underneath the ore seam to control the direction in which the ore falls after it has been blasted. *Cutting-machine operators* use a huge electric chain saw with a cutter from 6 to 15 feet long to cut the kerf. Next, *drilling-machine operators* drill holes in the ore where the *shot firers* place explosives. This potentially dangerous work requires workers to follow safety procedures, such as making sure everyone is clear of the area before the explosives are detonated. After the blast, *loading-machine operators* scoop up the material and dump it into small

rubber-tired cars run by *shuttle-car operators,* who bring the coal or ore to a central location for transportation to the surface.

The continuous mining method eliminates the drilling and blasting operations of conventional mining through the use of a machine called a continuous miner. Traditionally, a *continuous-mining machine operator* sits or lies in a machine's cab and operates levers that cut or rip out ore and load it directly onto a conveyor or shuttle car. However, the use of remote-controlled continuous mining machines-which have increased safety considerably-now allows an operator to control the machine from a distance.

In longwall mining, which is similar to continuous mining, *longwall-machine operators* run large machines with rotating drums that automatically shear ore and load it on a conveyor. At the same time, hydraulic jacks reinforce the roof of the tunnel. As ore is cut, the jacks are hydraulically winched forward, supporting the roof as they move along.

Many other workers are needed to operate safe and efficient underground mines. Before miners are allowed underground, a *mine safety inspector* checks the work area for such hazards as loose roofs, dangerous gases, and inadequate ventilation. If safety standards are not met, the inspector prohibits the mine from producing until conditions are made safe. *Rock-dust machine operators* spray the mine walls and floor to hold down dust, which can interfere with breathing.

Roof bolters operate the machines that automatically install roof support bolts to prevent roof cave-ins, the biggest cause of mining injuries. *Brattice builders* construct doors, walls, and partitions in tunnel passageways to force air into the work areas. *Shift bosses,* or *blue-collar worker supervisors,* oversee all operations at the worksite.

In surface mining, most miners operate huge machines that either remove the earth above the ore deposit, or dig and load the ore onto trucks. The number of workers required to operate a surface mine depends on the amount of overburden, or earth, above the ore seam. In many surface mines, the overburden is first drilled and blasted. *Overburden stripping operators* or *dragline operators* then scoop the earth away to expose the coal or metal ore. Some draglines are among the largest land machines on earth.

Next, *loading-machine operators* rip the exposed ore from the seam and dump it into trucks to be driven to the preparation plant. *Tractor operators* use bulldozers to move earth and ore and to remove boulders or other obstructions. *Truckdrivers* haul ore to railroad sidings or to preparation plants and transport supplies to mines.

Construction, maintenance, and *repair occupations.* Other workers, who are not directly involved in the extraction process, work in and around mines and quarries. For example, skilled *mechanics* are needed to repair and maintain the wide variety of mining machinery, and skilled *electricians* are needed to check and install electrical wiring. Mechanical and electrical repair work has become increasingly complex, as machinery and other equipment have become computerized. *Carpenters* construct and maintain benches, bins, and stoppings (barricades to prevent airflow through a tunnel). These workers generally need specialized training to work under the unusual conditions found in mines. Mechanics, for example, may have to repair machines while on their knees, with only their headlamps to illuminate the working area.

Quarrying occupations. Workers at quarries have duties similar to those of miners. Using jackhammers and wedges, *rock splitters* remove pieces of stone from a rock mass. *Dredge operators* and *dipper tenders* operate power-driven dredges, or dipper sticks of dredges, to mine sand, gravel, and other materials from beneath the surfaces of lakes, rivers, and streams. Using power-driven cranes with dragline buckets, *dragline operators* excavate or move sand, gravel, and other materials.

Processing-plant occupations. Processing plants often are located next to mines or quarries. In these plants, rocks and other impurities are removed from the ore, which is then washed, crushed, sized, or blended to meet buyer specifications. Methods for physically separating the ore from surrounding material also include more complex processes, such as leaching—mixing the ore with chemical solutions or other liquids in order to separate materials. Most processing plants are highly mechanized and require only a few workers for the washing, separating, and crushing operations. *Processing-plant supervisors* oversee all operations. In plants that are not heavily mechanized, *washbox attendants* operate equipment that sizes and separates impurities from ore, and *shake tenders* monitor machinery that further cleans and sizes ore with a vibrating screen. Most jobs in the processing plant are repetitive and, as a result of highly computerized mechanization, are becoming more automated.

Management, business, and financial and *professional* and *related occupations* also are important to the mining industry. Administrative workers include top executives, who are responsible for making policy decisions. Staff specialists (such as *accountants, attorneys,* and *market researchers*) provide information and advice for policymakers.

Professional and related workers in mining include engineering, scientific, and technical personnel. *Environmental scientists and geoscientists* search for locations likely to yield coal or mineral ores in sufficient quantity to justify extraction costs. Using sophisticated technologies and equipment, such as the Global Positioning System (GPS)—a satellite system that locates points on the earth using radio signals transmitted by satellites—*surveyors* help to map areas for mining. *Mining and geological engineers* examine seams for depth and purity, determine the type of mine to build, and supervise the construction, maintenance, and operation of mines. *Mechanical engineers* oversee the installation of equipment, such as heat and water systems; *electrical engineers* oversee the installation and maintenance of electrical equipment; *civil engineers* oversee the building and construction of minesites, plants, roads, and other infrastructure; *safety engineers* direct health and safety programs; *chemical engineers* develop the chemical processes for transforming mined products into consumer goods, such as medications and fertilizers; and *materials engineers* determine the usefulness of mined ore and also develop processes for transforming the minerals into products.

Environmental engineers play an increasingly important role in mining, given environmental concerns and stringent Federal, State, and local regulations imposed on all operations. Restrictions imposed by environmental regulations make obtaining permits for new mine development projects increasingly difficult.

Table 1. Employment of wage and salary workers in mining and quarrying by occupation, 2002 and projected change, 2002-2012
(Employment in thousands)

Occupation	Employment, 2002 Number	Employment, 2002 Percent	Percent change, 2002-2012
All occupations	212	100.0	-15.0
Management, business, and financial occupations	12	5.6	-11.9
Top executives	5	2.4	-10.8
Professional and related occupations	8	3.8	-17.4
Office and administrative support occupations	15	6.9	-17.0
Office clerks, general	3	1.2	-15.8
Construction and extraction occupations	66	31.1	-16.9
First-line supervisors/managers of construction trades and extraction workers	8	4.0	-16.7
Operating engineers and other construction equipment operators	16	7.8	-14.1
Electricians	4	1.9	-18.1
Continuous mining machine operators	8	3.7	-20.0
Mine cutting and channeling machine operators	4	2.0	-21.3
Roof bolters, mining	4	2.0	-28.0
Helpers—Extraction workers	6	2.9	-18.6
Extraction workers, all other	3	1.2	-24.6
Installation, maintenance, and repair occupations	29	13.6	-17.3
First-line supervisors/managers of mechanics, installers, and repairers	3	1.2	-21.8
Mobile heavy equipment mechanics, except engines	7	3.4	-18.9
Industrial machinery mechanics	4	1.8	-11.8
Maintenance and repair workers, general	8	3.7	-15.0
Maintenance workers, machinery	3	1.6	-19.9
Production occupations	28	13.2	-14.0
First-line supervisors/managers of production and operating workers	4	1.7	-14.1
Welders, cutters, solderers, and brazers	3	1.3	-12.9
Crushing, grinding, and polishing machine setters, operators, and tenders	6	3.0	-15.3
Miscellaneous production workers	4	1.7	-22.1
Transportation and material moving occupations	52	24.4	-11.9
Truck drivers, heavy and tractor-trailer	14	6.5	-0.1
Conveyor operators and tenders	3	1.4	-15.9
Excavating and loading machine and dragline operators	12	5.7	-10.1
Loading machine operators, underground mining	3	1.2	-19.1
Industrial truck and tractor operators	4	2.0	-10.3
Laborers and freight, stock, and material movers, hand	5	2.1	-26.5
Shuttle car operators	3	1.4	-35.7

NOTE: May not add to totals due to omission of occupations with small employment.

Mine owners and operators face substantial penalties should they fail to abide by current regulations. In addition, both Federal regulations, such as the Surface Mining Control and Reclamation Act (SMCRA), and State laws require that land reclamation be part of the mining process. Reclamation plans usually must be approved by both government officials and local interest groups. When a mining operation is closed, the land must be restored to its premine condition, which can include anything from leveling soil and removing waste to replanting vegetation.

Exploration, mine design, impact assessment, and restoration efforts can depend on computer analysis. In addition, rapid technological advancements, particularly in processing-plant operations, are the result of increased computerization. This has led to a growing reliance on computer professionals, such as *systems analysts, computer software engineers,* and *computer scientists*.

Training and Advancement

Workers in mining production occupations usually must be at least 18 years old, in good physical condition, and able to work in confined spaces. A high school diploma is not necessarily required. Most workers start as helpers to experienced workers and learn skills on the job; however, formal training is becoming more important, as more technologically advanced machinery and mining methods are used. Some employers prefer to hire recent graduates of high school vocational programs in mining or graduates of junior college or technical school programs in mine technology. Such programs usually are found only at schools in mining areas.

Mining companies must offer formal training in either classrooms or training mines for a few weeks before new miners actually begin work. The Federal Mine Safety and Health Act of 1977 mandates that each U.S. mine have an approved worker training program in health and safety issues. Each plan must include at least 40 hours of basic safety training for new miners with no experience in underground mines, and 24 hours for new miners in surface mines. In addition to new miner training, each miner must receive at least 8 hours of refresher safety training a year, and miners assigned to new jobs must receive safety training relating to their new task. The U.S. Mine Safety and Health Administration (MSHA) also conducts classes on health, safety, and mining methods, and some mining machinery manufacturers offer courses in machine operation and maintenance as well. The MSHA has recently put interactive training materials on its Web site, and also has translated many of the training materials into Spanish. Increasingly, mines are employing more high-tech tools for miner training, such as machinery simulators and virtual reality simulators. By simulating actual mine conditions and emergencies, mine workers are better prepared and companies can instantly assess a mineworker's progress and skills.

As production workers gain more experience, they can advance to higher paying jobs requiring greater skill. A mining machine operator's helper, for example, might become an operator. When vacancies occur, announcements are posted, and all qualified workers can bid for the job. Positions are filled on the basis of seniority and ability. Miners with significant experience or special training also can become mine safety, health, and com-

pliance officers, whose duties include mine safety inspection. According to MSHA, a mine safety, health, and compliance officer needs at least 5 years' experience as a miner, or a degree in mining engineering.

For professional and managerial positions in mining, a master's degree in engineering, one of the physical sciences, or business administration, is preferred. A number of colleges and universities have mining schools or departments and programs in mining or minerals. Environmental positions require regulatory knowledge and a strong natural science background, or a background in a technical field, such as environmental engineering or hydrology. To date, most environmental professionals have been drawn from the ranks of engineers and scientists who have had experience in the mining industry.

Universities and mining schools have introduced more environmental coursework into their programs, and mining firms are hiring professionals from existing environment-related disciplines and training them to meet their companies' needs. Additionally, specialized mine technology programs are offered by a few colleges. Enrollment in these programs can lead to a certificate in mine technology after 1 year, an associate degree after 2 years, or a bachelor's degree after 4 years. Courses cover areas such as mine ventilation, roof bolting, and machinery repairs.

Earnings

Average wage and salary earnings in mining were significantly higher than the average for all industries. In 2002, production workers, earned $20.57 an hour in coal mining, $20.54 an hour in metal mining, and $16.57 an hour in nonmetallic minerals mining compared to the private industry average of $14.95 an hour (table 2). Workers in underground mines spend time traveling from the mine entrance to their working areas, so that their paid workday is slightly longer than that of surface mine workers, 8 hours versus 7 1/4-hour shifts. Earnings in selected occupations in specified mining industries appear in table 3.

Around 21 percent of mineworkers are union members or are covered by union contracts, compared with about 15 percent of workers throughout private industry. About 23.7 percent of workers in coal mining and 29.2 percent in metal mining were union members in 2002, compared with about 13.8 percent of workers in nonmetallic mineral mining. Union coal miners are primarily represented by the United Mine Workers of America (UMWA). The United Steelworkers of America, the International Union of Operating Engineers, and other unions also represent miners.

Workers covered by UMWA contracts receive 11 paid holidays, 12 days of paid vacation each year, 4 additional floating holidays, and 5 days of sick leave; however, coal miners generally must take their vacations during 1 of 3 regular vacation periods, to assure a continuous supply of coal. As length of service increases, UMWA miners get up to 13 extra vacation days after 18 years of continuous employment. Union workers also receive benefits from a welfare and retirement fund.

Table 2. Average earnings of nonsupervisory workers in mining, except oil and gas, 2002

Industry segment	Weekly	Hourly
Total, private industry	$506	$14.95
Mining	837	18.62
Coal mining	934	20.57
Metal ore mining	879	20.54
Nonmetallic mineral mining and quarrying	749	16.57

Table 3. Median hourly earnings of the largest occupations in coal mining and nonmetallic minerals, except fuels, 2002

Occupation	Mining, except oil and gas	All industries
General and operations managers	$34.91	$32.80
First-line supervisors/managers of construction trades and extraction workers	26.16	22.92
Mobile heavy equipment mechanics, except engines	18.43	17.29
Maintenance and repair workers, general	18.05	14.12
Continuous mining machine operators	16.93	16.75
Operating engineers and other construction equipment operators	16.23	16.94
Excavating and loading machine and dragline operators	15.21	15.58
Helpers—extraction workers	15.09	12.12
Crushing, grinding, and polishing machine setters, operators, and tenders	14.77	12.83
Truck drivers, heavy and tractor-trailer	14.59	15.97

Outlook

Wage and salary employment in mining is expected to decline by 15 percent through the year 2012, compared with 16 percent growth projected for the entire economy. This continuing long-term decline is due to increased productivity resulting from technological advances in mining operations, consolidation, stringent environmental regulations, and international competition. However, employment in nonmetallic mineral mining should grow slightly—2 percent—because of continued demand for crushed stone and gravel used in construction activities.

Despite declining employment, job opportunities should be favorable for construction, extraction, and production workers in coal mining and nonmetallic mineral mining. Many miners are approaching retirement age and younger miners will be hired to replace the retirees. Job turnover rates also are high in nonmetallic mineral mining because most mines are small and operate only during warm months; therefore, these mines tend to hire workers as they are needed. Jobs in nonmetallic mineral mining attract many migrant workers and those looking for summer employment. Job opportunities for professional workers, such as scientists and engineers, will be best in operations that provide exploration and mine construction services. Opportunities outside the United States will be more numerous because mining companies are shifting mining activities abroad.

Environmental concerns will continue to affect mining operations. Increasingly, government regulations are restricting access to land and restricting the type of mining that is performed in order to protect native plants and animals and decrease the amount of water and air pollution. As population growth expands further into the countryside, new developments are competing for land with mine operators, and residents are increasing their opposition to nearby mining activities.

Uncertainty over access to U.S. land to mine coal and minerals is forcing many mining operations to expand internationally, shifting jobs abroad. Often, lower labor costs and fewer environmental restrictions mean lower production costs. However, many U.S. mining companies must compete with international competitors. Increasing competition causes consolidation among mining operations, which usually leads to job cuts.

Advances in mining technology will also adversely affect employment in mining as new machinery and processes increase worker productivity. New mining machines that are computer-operated and can self-diagnose mechanical problems require fewer workers to operate and maintain. Advances in longwall and surface mining, which are less labor intensive, also have increased productivity, as have improvements in transportation and processing. Additionally, innovations such as roof bolting, self-advancing roof supports, and continuous mining machinery have led to safer, more efficient operations.

Although demand for coal should remain high, employment will decline by about a third through 2012. The products of the coal mining industry are used to produce electricity and steel products. Although production of coal is expected to increase, employment should continue to decline, as more efficient and automated production operations require less labor, and increased competition leads to further consolidation in the industry.

The long-term outlook for coal depends on how electric utility companies—the major consumers of coal—respond to provisions of the Clean Air Act Amendments of 1990, which attempt to limit the emission of sulfur dioxide and other harmful pollutants. Phase I of the Amendments, which took effect in 1995, requires reductions in sulfur emissions from coal combustion. Phase II took effect in 2000, and not only imposes stricter reductions in emissions, but targets the smaller coal-burning plants, not just the largest ones as in Phase I. Compliance involves the installation of costly cleaning and monitoring equipment or increased use of low-sulfur coal. The largest industrial nations also have been pressuring each other to decrease emissions of harmful gases into the atmosphere. As energy plants seek cleaner burning fuel, many new powerplants are being built to run on natural gas. If the demand for coal contracts as a result of stricter environmental regulations, employment in mines will decline further, as mine operators are forced to decrease production.

Despite the trend towards cleaner burning fuel, the United States still is highly dependent on coal as a source of energy. Coal accounts for half of the electricity production in this country because it is the cheapest and most abundant fossil fuel. The rising demand for cleaner burning fuel has resulted in regional shifts in coal production and markets. Because of this, lower sulfur Western coal now accounts for an increasing share of output. This trend is resulting in a gradual regional shift in employment from the Eastern States to the West. Improvements in clean coal technologies also may help the industry cope with increasingly restrictive regulations through projects such as the Integrated Gasification Combined Cycle (IGCC). This technology combines traditional coal gasification with gas-turbine and steam power to generate electricity more efficiently and reduce carbon and sulfur dioxide emissions.

As in coal mining, continuing productivity increases and industry consolidation are expected to cause employment in the metal ore mining industry to decline through 2012. Because metals are used primarily as raw materials by other industries, such as telecommunications and steel, chemical, drug, aerospace, and automobile manufacturing, the strength of the metal ore mining industry is greatly affected by the strength of the industries that consume its products. The strength of these industries usually reflects the state of the U.S. and global economies. Thus, the strength of the economy over the next decade will influence employment in the metal mining industry.

Metal ore mining is also the sector most vulnerable to international competition. Many nations have mineral resources and, for some developing countries especially, mineral resources are one of the few goods they export. Therefore, mineral resources are being exploited faster than demand for them grows, which is driving down world commodity prices. Because production costs are often higher in the United States than in other countries, it is harder for U.S. companies to remain competitive. As commodity prices drop, many mines merge or reduce their workforce.

Like the metal mining industry, the nonmetallic mineral mining industry is influenced by the strength of the industries that use nonmetals in the manufacture of their products; these are industries in which employment is impacted by swings in the economy. Nonmetallic minerals are used to make concrete and agricultural chemicals and also are used as materials in residential, nonresidential, and maintenance construction. The nonmetallic mineral mining industry experienced slight employment growth over the past decade, largely attributable to construction. The demand for crushed stone and gravel should remain strong over the next few years because of demand for residential housing, roads, and airports.

Sources of Additional Information

For additional information about careers and training in the mining industry, contact:

- American Geological Institute, 4220 King St., Alexandria, VA 22302. Internet: **http://www.agiweb.org**
- Mine Safety and Health Administration, 1100 Wilson Blvd., Arlington, VA 22209-3939. Internet: **http://www.msha.gov**
- National Mining Association, 101 Constitution Ave. NW., Suite 500 East., Washington, DC 20001. Internet: **http://www.nma.org**
- Society for Mining, Metallurgy, and Exploration, Inc., 8307 Shaffer Parkway, Littleton, CO 80127. Internet: **http://www.smenet.org**
- United Mine Workers of America, 8315 Lee Highway, Fairfax, VA 22031. Internet: **http://www.umwa.org**

Information on the following occupations in mining may be found in the 2004-05 *Occupational Outlook Handbook:*

- Chemical engineers
- Civil engineers
- Electrical and electronics engineers, except computer
- Environmental engineers

- Environmental scientists and geoscientists
- Industrial machinery installation, repair, and maintenance workers
- Material-moving occupations
- Materials engineers
- Mechanical engineers
- Mining and geological engineers, including mine safety engineers
- Surveyors, cartographers, photogrammetrists, and surveying technicians
- Systems analysts, computer scientists, and database administrators
- Truckdrivers and driver/sales workers