

SIGNIFICANT POINTS

- Most establishments employ fewer than 5 workers.
- About 71 percent of the onshore oil and gas extraction workforce is concentrated in California, Louisiana, Oklahoma, and Texas.
- Although technological innovations have expanded exploration and development worldwide, employment is expected to decline; however, workers with experience in oilfield operations are in demand.
- Earnings are relatively high.

Nature of the Industry

Oil and natural gas furnish about three-fifths of our energy needs, fueling our homes, workplaces, factories, and transportation systems. In addition, they constitute the raw materials for plastics, chemicals, medicines, fertilizers, and synthetic fibers. Petroleum, commonly referred to as oil, is a natural fuel formed from the decay of plants and animals buried beneath the ground, under tremendous heat and pressure, for millions of years. Formed by a similar process, natural gas often is found in separate deposits and is sometimes mixed with oil. Finding, developing, and extracting oil and gas are the primary functions of the oil and gas extraction industry. While some of these functions are done by the large oil companies, most are done by contractors working in the support activities for mining subsector, which is included in this industry.

Using a variety of methods, on land and at sea, small crews of specialized workers search for geologic formations that are likely to contain oil and gas. Sophisticated equipment and advances in computer technology have increased the productivity of exploration. Maps of potential deposits now are made using remote-sensing satellites. Seismic prospecting—a technique based on measuring the time it takes sound waves to travel through underground formations and return to the surface—has revolutionized oil and gas exploration. Computers and advanced software analyze seismic data to provide three-dimensional models of subsurface rock formations. This technique lowers the risk involved in exploring by allowing scientists to locate and identify structural oil and gas reservoirs and the best locations to drill. Four-D, or “time-lapsed,” seismic technology tracks the movement of fluids over time and enhances production performance even further. Another method of searching for oil and gas is based on collecting and analyzing core samples of rock, clay, and sand in the earth’s layers.

After scientific studies indicate the possible presence of oil, an oil company selects a well site and installs a derrick—a tower-like steel structure—to support the drilling equipment. A hole is drilled deep into the earth until oil or gas is found, or the company abandons the effort. Similar techniques are employed in offshore drilling, except that the drilling equipment is part of a steel platform that either sits on the ocean floor, or floats on the surface and is anchored to the ocean floor.

In rotary drilling, a rotating bit attached to a length of hol-

low drill pipe bores a hole in the ground by chipping and cutting rock. As the bit cuts deeper, more pipe is added. A stream of drilling “mud”—a mixture of clay, chemicals, and water—is continuously pumped through the drill pipe and through holes in the drill bit. Its purpose is to cool the drill bit, plaster the walls of the hole to prevent cave-ins, carry crushed rock to the surface, and prevent “blowouts” by equalizing pressure inside the hole. When a drill bit wears out, all drill pipe must be removed from the hole a section at a time, the bit replaced, and the pipe returned to the hole. New materials and better designs have advanced drill bit technology, permitting faster, more cost-effective drilling for longer periods.

Advancements in directional or horizontal drilling techniques, which allow increased access to potential reserves, have had a significant impact on drilling capabilities. Drilling begins vertically, but the drill bit can be turned so that drilling can continue at an angle of up to 90 degrees. This technique extends the drill’s reach, enabling it to reach separate pockets of oil or gas. Because constructing new platforms is costly, this technique commonly is employed by offshore drilling operations.

When oil or gas is found, the drill pipe and bit are pulled from the well, and metal pipe (casing) is lowered into the hole and cemented in place. The casing’s upper end is fastened to a system of pipes and valves called a wellhead, or “Christmas Tree,” through which natural pressure forces the oil or gas into separation and storage tanks. If natural pressure is not great enough to force the oil to the surface, pumps may be used. In some cases, water, steam, or gas may be injected into the oil-producing formation to improve recovery.

Crude oil is transported to refineries by pipeline, ship, barge, truck, or railroad. Natural gas usually is transported to processing plants by pipeline. While oil refineries may be many thousands of miles away from the producing fields, gas processing plants typically are near the fields, so that impurities—water, sulfur, and natural gas liquids—can be removed before the gas is piped to customers. The oil refining industry is considered a separate industry, and its activities are not covered here, even though many oil companies both extract and refine oil.

The oil and gas extraction industry has experienced both “booms” and “busts” over the years, illustrating the cyclical relationship between the price of oil and employment. During

periods of high oil and gas prices, the industry expands exploration and production and hires more workers. The opposite occurs during periods of low prices.

Working Conditions

Working conditions in the industry vary significantly by occupation. Roustabout jobs and jobs in other construction and extraction occupations may involve rugged outdoor work in remote areas in all kinds of weather. For these jobs, physical strength and stamina are necessary. This work involves standing for long periods, lifting moderately heavy objects, and climbing and stooping to work with tools that often are oily and dirty. Executives generally work in office settings, as do most administrators and clerical workers. Geologists, engineers, and managers may split their time between the office and the jobsites, particularly while involved in exploration work.

Opportunities for part-time work in this industry are rare. In fact, a higher percentage of workers in oil and gas extraction work overtime than in all industries combined. The average nonsupervisory worker in the oil and gas extraction industry worked 43.5 hours per week in 2004, compared with 33.7 hours for all nonsupervisory workers on private nonfarm payrolls.

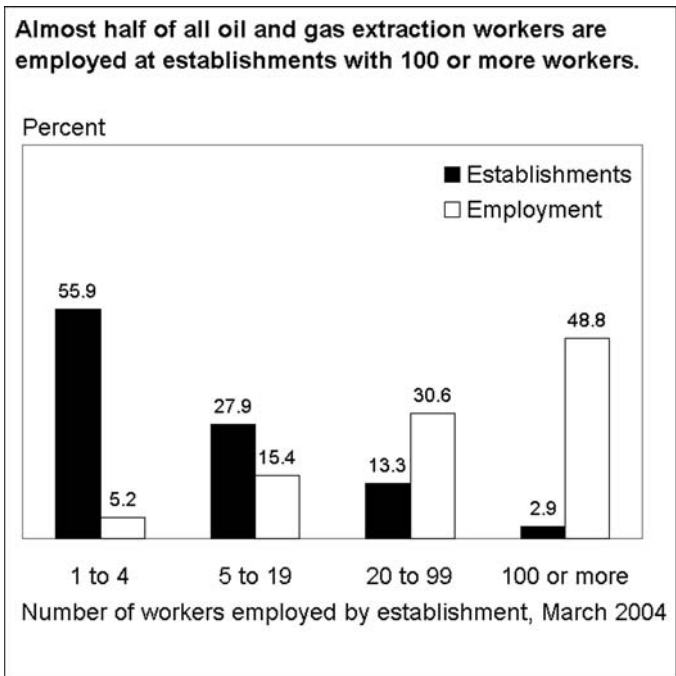
Oil and gas well drilling and servicing can be hazardous. However, in 2003 the rate of work-related injury and illness in the oil and gas extraction industry was 1.8 per 100 full-time workers and 2.7 for workers in support activities for mining, somewhat lower than the 5.0 for the entire private sector. Improvements in drilling technology and oil rig operations, such as remote-controlled drills, have led to fewer injuries.

Drilling rigs operate continuously. On land, drilling crews usually work 6 days in a row, 8 hours a day, and then have a few days off. In offshore operations, workers can work 14 days in a row, 12 hours a day, and then have 14 days off. If the offshore rig is located far from the coast, drilling crew members live on ships anchored nearby or in facilities on the platform itself. Workers on offshore rigs are always evacuated in the event of a storm. Most workers in oil and gas well operations and maintenance or in natural gas processing work 8 hours a day, 5 days a week.

Many oilfield workers are away from home for weeks or months at a time. Exploration field personnel and drilling workers frequently move from place to place as work at a particular field is completed. In contrast, well operation and maintenance workers and natural gas processing workers usually remain in the same location for extended periods.

Employment

The oil and gas extraction industry employed about 316,000 wage and salary workers in 2004. Of these, only 4 in 10 workers were employed directly by the oil and gas extraction companies. The rest worked as contractors in the support activities for mining sector, which also included workers who extract coal and minerals on a contract basis. Although onshore oil and gas extraction establishments are found in 42 States, almost 3 out of 4 of the industry's workers in 2004 were located in just four States—California, Louisiana, Oklahoma, and Texas. While most workers are employed on land, many work at offshore sites. Although they are not included in employment figures



for this industry, many Americans are employed by oil companies at locations in Africa, the North Sea, the Far East, the Middle East, South America, and countries of the former Soviet Union.

While slightly more than 50 percent of establishments employ fewer than 5 workers, the vast majority of workers are employed in establishments with 20 or more workers (chart 1). As more large domestic oilfields and gas fields are depleted, major oil companies are focusing their exploration and production activity in foreign countries. Consequently, smaller companies with less capital for foreign exploration and production are drilling an increasing share of domestic oil and gas. Technology also has significantly decreased the risk and cost for smaller producers.

Relatively few oil and gas extraction workers are in their teens or early 20s. About 56 percent of the workers in this industry are between 35 and 54 years of age.

Occupations in the Industry

People with many different skills are needed to explore for oil and gas, drill new wells, maintain existing wells, and process natural gas. The largest group, construction and extraction workers, account for about 37 percent of industry employment. Professional and related workers account for about 14 percent of industry employment, and managerial, business, and financial workers account for about 12 percent. Transportation and material moving workers make up about 10 percent, and production workers about 9 percent (table 1).

A *petroleum geologist* or a *geophysicist*, who is responsible for analyzing and interpreting the information gathered, usually heads exploration operations. Other geological specialists also may be involved in exploration activities, including *paleontologists*, who study fossil remains to locate oil; *mineralogists*, who study physical and chemical properties of mineral and rock samples; *stratigraphers*, who determine the rock layers most likely to contain oil and natural gas; and *photogeolo-*

Table 1. Employment of wage and salary workers in oil and gas extraction by occupation, 2004 and projected change, 2004-14^a

(Employment in thousands)

Occupation	Employment, 2004		Percent change, 2004-2014
	Number	Percent	
Total, all occupations	316	100.0	-6.1
Management, business, and financial occupations	38	12.0	-6.3
Top executives	11	3.6	-6.0
Accountants and auditors	7	2.2	-9.0
Professional and related occupations	43	13.6	-5.3
Computer specialists	6	1.8	-2.6
Marine engineers and naval architects ...	1	0.3	-10.5
Mining and geological engineers, including mining safety engineers	1	0.3	-10.4
Petroleum engineers	9	2.9	-3.6
Drafters, engineering, and mapping technicians	3	0.9	-1.7
Geoscientists, except hydrologists and geographers	6	2.0	-11.1
Geological and petroleum technicians	5	1.6	-5.7
Office and administrative support occupations	34	10.8	-16.2
First-line supervisors/managers of office and administrative support workers	2	0.7	-14.3
Bookkeeping, accounting, and auditing clerks	7	2.1	-16.6
Executive secretaries and administrative assistants	5	1.6	-12.4
Secretaries, except legal, medical, and executive	6	2.0	-20.5
Office clerks, general	7	2.1	-16.5
Construction and extraction occupation	118	37.4	-1.7
First-line supervisors/managers of construction trades and extraction workers	12	3.9	-2.2
Construction equipment operators	4	1.2	-0.4
Operating engineers and other construction equipment operators	4	1.2	-0.4
Derrick operators, oil and gas	14	4.5	-1.1
Rotary drill operators, oil and gas	13	4.2	-1.1
Service unit operators, oil, gas, and mining	15	4.9	-1.8
Earth drillers, except oil and gas	2	0.7	0.0
Explosives workers, ordnance handling experts, and blasters	1	0.2	0.0
Continuous mining machine operators	1	0.1	-2.7
Mine cutting and channeling machine operators	1	0.1	0.0
Roustabouts, oil and gas	28	8.8	-1.9
Helpers—Extraction workers	13	4.1	-0.7
Extraction workers, all other	6	1.9	-0.3
Production occupations	28	8.9	-6.6
Gas plant operators	2	0.5	-11.8
Petroleum pump system operators, refinery operators, and gaugers	14	4.4	-8.2
Transportation and material moving occupations	32	10.1	-14.1
Truck drivers, heavy and tractor-trailer	7	2.3	-0.9
Gas compressor and gas pumping station operators	2	0.6	-25.3
Pump operators, except wellhead pumps	3	1.0	-27.0
Wellhead pumps	10	3.0	-26.1

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

gists, who examine and interpret aerial photographs of land surfaces. Additionally, exploration parties may include *surveyors* and *drafters*, who assist in surveying and mapping activities.

Some geologists and geophysicists work in district offices of oil companies or contract exploration firms, where they prepare and study geological maps and analyze seismic data. These scientists also may analyze samples from test drillings.

Other workers involved in exploration are *geophysical prospectors*. They lead crews consisting of *gravity* and *seismic prospecting observers*, who operate and maintain electronic seismic equipment; *scouts*, who investigate the exploration, drilling, and leasing activities of other companies to identify promising areas to explore and lease; and *lease buyers*, who make business arrangements to obtain the use of the land or mineral rights from its owners.

Petroleum engineers are responsible for planning and supervising the actual drilling operation, once a potential drill site has been located. These engineers develop and implement the most efficient recovery method in order to achieve maximum profitable recovery. They also plan and supervise well operation and maintenance. *Drilling superintendents* serve as supervisors of drilling crews, overseeing one or more drilling rigs.

Rotary drilling crews usually consist of four or five workers. *Rotary drillers* supervise the crew and operate machinery that controls drilling speed and pressure. *Rotary-rig engine operators* are in charge of engines that provide the power for drilling and hoisting. Second in charge, *derrick operators* work on small platforms high on rigs to help run pipe in and out of well holes and operate the pumps that circulate mud through the pipe. *Rotary-driller helpers*, also known as *roughnecks*, guide the lower ends of pipe to well openings and connect pipe joints and drill bits.

Though not necessarily part of the drilling crew, *roustabouts*, or general laborers, do general oilfield maintenance and construction work, such as cleaning tanks and building roads.

Pumpers and their helpers operate and maintain motors, pumps, and other surface equipment that forces oil from wells and regulate the flow, according to a schedule set up by petroleum engineers and production supervisors. In fields where oil flows under natural pressure and does not require pumping, *switchers* open and close valves to regulate the flow. *Gaugers* measure and record the flow, taking samples to check quality. *Treaters* test the oil for water and sediment and remove these impurities by opening a drain or using special equipment. In most fields, pumping, switching, gauging, and treating operations are automatic.

Other skilled oilfield workers include *oil well cementers*, who mix and pump cement into the space between the casing and well walls to prevent cave-ins; *acidizers*, who pump acid down the well and into the producing formation to increase oil flow; *perforator operators*, who use subsurface “guns” to pierce holes in the casing to make openings for oil to flow into the well bore; *sample-taker operators*, who take samples of soil and rock formations from wells to help geologists determine the presence of oil; and *well pullers*, who remove pipes, pumps, and other subsurface devices from wells for cleaning, repairing, and salvaging.

Many other skilled workers—such as welders, pipefitters, electricians, and machinists—also are employed in maintenance operations to install and repair pumps, gauges, pipes, and other

equipment.

In addition to the types of workers required for onshore drilling, crews at offshore locations also need radio operators, cooks, ships' officers, sailors, and pilots. These workers make up the support personnel who work on or operate drilling platforms, crewboats, barges, and helicopters.

Most workers involved in gas processing are operators. *Gas treaters* tend automatically controlled treating units that remove water and other impurities from natural gas. *Gas-pumping-station operators* tend compressors that raise the pressure of gas for transmission in pipelines. Both types of workers can be assisted by *gas-compressor operators*.

Many employees in large natural gas processing plants—*welders, electricians, instrument repairers, and laborers*, for example—perform maintenance activities. In contrast, many small plants are automated and are checked at periodic intervals by maintenance workers or operators, or monitored by instruments that alert operators if trouble develops. In non-automated plants, workers usually combine the skills of both operators and maintenance workers.

Training and Advancement

Workers can enter the oil and gas extraction industry with a variety of educational backgrounds. The most common entry-level field jobs, such as roustabouts or roughnecks, usually require little or no previous training or experience. Applicants for these routine laborer jobs must be physically fit and able to pass a physical examination. Companies also may administer aptitude tests and screen prospective employees for drug use. Basic skills usually can be learned over a period of days through on-the-job training. However, previous work experience or formal training in petroleum technology that provides knowledge of oilfield operations and familiarity with computers and other automated equipment can be beneficial. In fact, given the increasing complexity of operations and the sophisticated nature of technology used today, employers now demand a higher level of skill and adaptability, including the ability to work with computers and other sophisticated equipment.

Other entry-level positions, such as engineering technician, usually require at least a 2-year associate degree in engineering technology. Professional jobs, such as geologist, geophysicist, or petroleum engineer, require at least a bachelor's degree, but many companies prefer to hire candidates with a master's degree, and may require a Ph.D. for those involved in petroleum research. For well operation and maintenance jobs, companies generally prefer applicants who live nearby, have mechanical ability, and possess knowledge of oilfield processes. Because this work offers the advantage of a fixed locale, members of drilling crews or exploration parties who prefer not to travel may transfer to well operation and maintenance jobs. Training is acquired on the job.

Promotion opportunities for some jobs may be limited due to the general decline of the domestic petroleum industry. Advancement opportunities for oilfield workers remain best for those with skill and experience. For example, roustabouts may move up to become switchers, gaugers, and pumpers. More experienced roughnecks may advance to derrick operators and, after several years, to drillers. Drillers may advance to tool pushers. There should continue to be some opportunities for entry-level field crew workers to acquire the skills that qualify them for higher level jobs within the industry. Due to the crit-

ical nature of the work, offshore crews, even at the entry level, generally are more experienced than land crews. Many companies will not employ someone who has no knowledge of oilfield operations to work on an offshore rig, so workers who have gained experience as part of a land crew might advance to offshore operations.

As workers gain knowledge and experience, U.S. or foreign companies operating in other countries also may hire them. Although this can be a lucrative and exciting experience, it may not be suitable for everyone, because it usually means leaving family and friends and adapting to different customs and living standards.

Experience gained in many oil and gas extraction jobs also has application in other industries. For example, roustabouts can move to construction jobs, while machinery operators and repairers can transfer to other industries with similar machinery. Geologists and engineers may become involved with environmental activities, especially those related to this industry.

Outlook

Although worldwide demand for oil and gas is expected to grow, overall U.S. wage and salary employment in the oil and gas extraction industry is expected to decline by 6 percent through the year 2014, compared to an employment increase of 14 percent in all industries combined.

In general, the level of future crude petroleum and natural gas exploration and development and, therefore, employment opportunities in this industry, remains contingent upon the size of accessible reserves available and the going prices for oil and gas. Stable and favorable prices are needed to allow companies enough revenue to expand exploration and production projects to keep pace with growing global energy demand, particularly by India and China. Rising worldwide demand for oil and gas is likely to cause higher long term prices and generate the needed incentive to continue exploring and developing oil and gas in this country, at least in the short run. Over the moderate term, fewer reserves of oil and gas in the U.S. will cause a decline in domestic production, unless new oil and gas fields are found and developed.

Environmental concerns, accompanied by strict regulation and limited access to protected Federal lands, also continue to have a major impact on this industry. Restrictions on drilling in environmentally sensitive areas and other environmental constraints should continue to limit exploration and development, both onshore and offshore. However, changes in policy could expand exploration and drilling for oil and natural gas in currently protected areas, especially in Alaska.

In addition, environmental emissions standards already in place or planned for the future are expected to significantly limit the amount of sulfur and carbon dioxide levels that can be emitted by power plants. Employment in the natural gas exploration and production industry normally would grow with the increasing demand for cleaner-burning fuels, such as natural gas. However, recent high natural gas prices are limiting demand and causing some planned future power plants to return to coal as a power source, which could hurt the long term natural gas outlook.

While some new oil and gas deposits are being discovered in this country, companies increasingly are moving to more lucrative foreign locations. As companies expand into other areas

around the globe, the need for employees in the United States is reduced. However, advances in technology have increased the proportion of exploratory wells that yield oil and gas, enhanced offshore exploration and drilling capabilities, and extended the production of existing wells. As a result, more exploration and development ventures are profitable and provide employment opportunities that otherwise would have been lost.

Despite an overall decline in employment in the oil and gas extraction industry, job opportunities in most occupations should be good. The need to replace workers who transfer to other industries, retire, or leave the workforce will be the major source of job openings as more workers in this industry approach retirement age, and others seek more stable employment opportunities in other industries. Employment opportunities will be best for those with previous experience and with technical skills, especially qualified professionals and extraction workers who have significant experience in oil field operations and who can work with new technology. More workers will be needed who are capable of using new technologies—such as 3-D and 4-D seismic exploration methods, horizontal and directional drilling techniques, and deepwater and subsea technologies—as employers develop and implement sophisticated new equipment.

Earnings

Average wage and salary earnings in the oil and gas extraction

Table 2. Median hourly earnings of the largest occupations in oil and gas extraction and support activities for mining, May 2004

Occupation	Oil and gas extraction	Support activities for mining	All industries
General and operations managers .	\$49.93	\$37.57	\$37.22
Petroleum engineers	47.24	36.68	42.55
First-line supervisors/managers of construction trades and extraction workers	27.44	24.90	24.25
Petroleum pump system operators, refinery operators, and gaugers ...	23.52	22.12	24.27
Wellhead pumpers	16.73	14.82	16.31
Rotary drill operators, oil and gas ...	16.17	17.34	17.11
Service unit operators, oil, gas, and mining	15.87	14.58	14.75
Derrick operators, oil and gas	15.26	16.18	16.11
Roustabouts, oil and gas	12.60	11.89	11.94
Helpers—Extraction workers	11.58	12.77	12.66

industry were significantly higher than the average for all industries. The average hourly earnings of non-supervisory workers in the oil and gas extraction sector were \$18.58, and \$16.92 for workers in the support activities for mining, compared with \$15.67 for all workers in private industry. Due to the working conditions, employees at offshore operations generally earn higher wages than do workers at onshore oil fields. College-educated workers and technical school graduates in professional and technical occupations usually earn the most. Earnings in selected occupations in oil and gas extraction and support services appear in table 2.

Few industry workers belong to unions. In fact, only about 5 percent of workers were union members or were covered by union contracts in 2004, compared with about 14 percent of all workers throughout private industry.

Sources of Additional Information

Information on training and career opportunities for petroleum engineers or geologists is available from:

- American Association of Petroleum Geologists, Communications Department, P.O. Box 979, Tulsa, OK 74101. Internet: <http://www.aapg.org>
- American Petroleum Institute, 1220 L St. NW, Washington, DC 20005-4070. Internet: <http://www.energyprofessions.org>
- American Geological Institute, 4220 King St., Alexandria, VA 22302. Internet: <http://www.agiweb.org>
- Society of Petroleum Engineers, P.O. Box 833836, Richardson, TX 75083. Internet: <http://www.spe.org>

Information on some occupations in the oil and gas extraction industry may be found in the 2006-07 *Occupational Outlook Handbook*:

- Construction equipment operators
- Construction laborers
- Engineering and natural sciences managers
- Environmental engineers
- Environmental scientists and geoscientists
- Material-moving occupations
- Petroleum engineers
- Structural and reinforcing iron and metal workers
- Surveyors, cartographers, photogrammetrists, and surveying technicians