

Introduction to Oil and Gas

What is Petroleum?

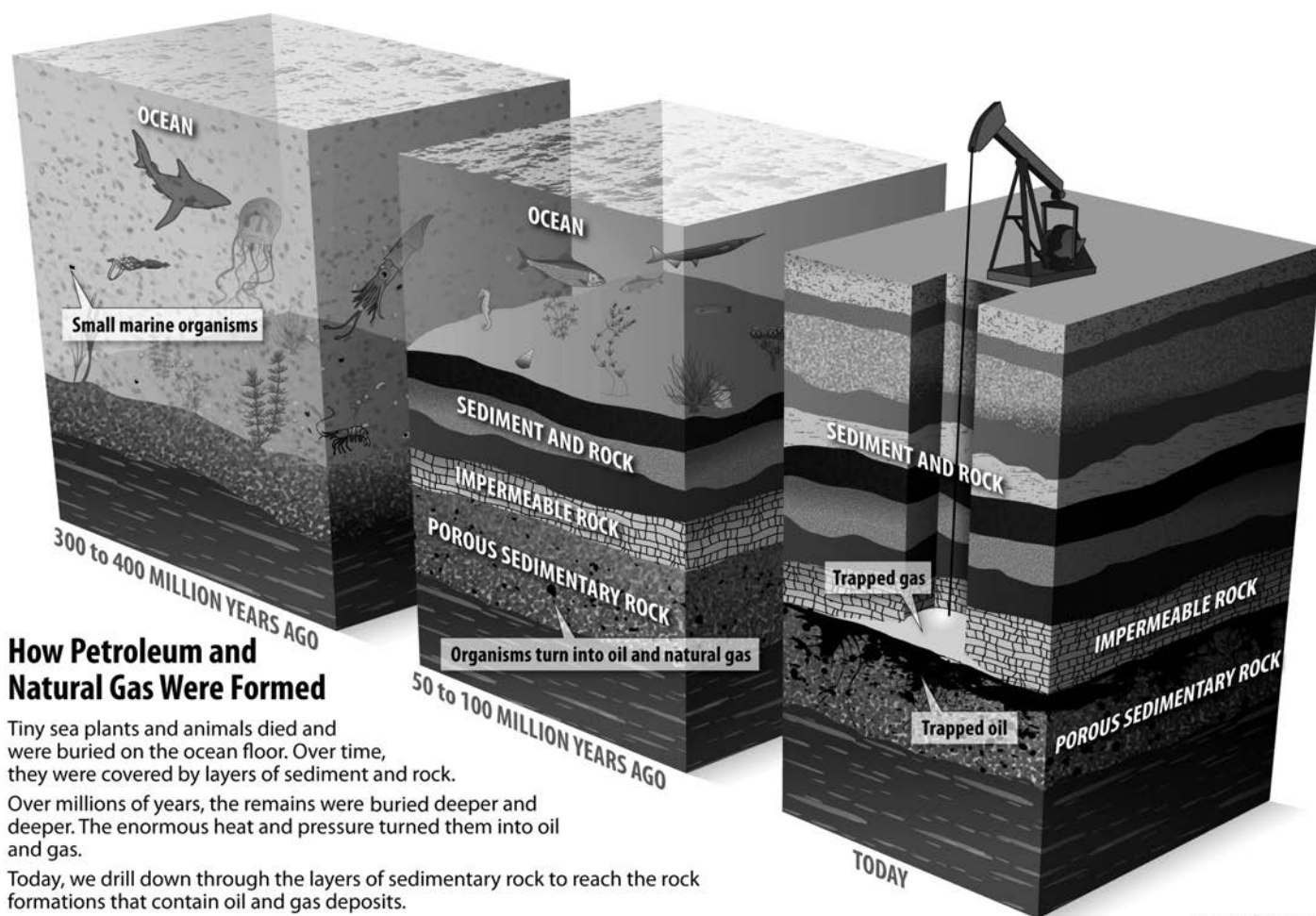
Petroleum is a fossil fuel. Petroleum is often called crude oil, or just oil. It is considered a fossil fuel because it was formed from the remains of tiny sea plants and animals that died millions of years ago. When the plants and animals died, they sank to the bottom of the oceans. Over time, they were buried by thousands of feet of sand and sediment, which turned into sedimentary rock. As the layers increased, they pressed harder and harder on the decayed remains at the bottom. The heat and pressure eventually changed the remains into petroleum. Petroleum is classified as a nonrenewable energy source because it takes millions of years to form. We cannot make new petroleum reserves in a short period of time.

Even though oil and natural gas come from ancient plant and animal matter, in geologic time, they are young. Most oil comes from rocks that are about 400 million years old or younger. Scientists believe the Earth is over four billion years old, with life existing on Earth for

about 3.7 billion years. Dinosaurs first roamed the Earth about 248 million years ago.

Like all living things, petroleum is a mixture made of several carbon compounds such as hydrogen butanes and olefins, and is an excellent source of energy. Because the living things that turned into petroleum did not have the opportunity to complete the decay process, there is a great deal of chemical energy in their molecular bonds.

Petroleum deposits are locked in porous rocks like water is trapped in a wet sponge. Petroleum, just out of the ground, is called crude oil. When crude oil comes out of the ground, it can be as thin as water or as thick as tar. The characteristics of crude oil vary in different locations. Some crude is very clear and moves like water. This is usually called light crude. Other crude is very dark and almost a solid at normal temperatures.



History of Oil

People have used petroleum since ancient times. The early Chinese and Egyptians burned oil to light their homes. Before the 1850s, Americans used whale oil to light their homes. When whales became scarce, people skimmed the crude oil that seeped to the surface of ponds and streams. Did you know that oil floats on water? The density of oil is less than the density of water, allowing it to float to the top.

The demand for oil grew and in 1859, Edwin Drake drilled the first oil well near Titusville, PA. At first, the crude oil was refined into kerosene for lighting. Gasoline and other products produced during refining were thrown away because people had no use for them.

This all changed when Henry Ford began mass producing automobiles in 1913. Everyone wanted automobiles, and they all ran on gasoline. Gasoline was the fuel of choice because it provided the greatest amount of energy relative to cost and ease of use.

Today, Americans use more petroleum than any other energy source, mainly for transportation. Petroleum provides almost 39 percent of the total energy we use. Nearly one-third of the oil the U.S. produces comes from offshore wells. Some of these wells are a mile under the ocean. Some of the rigs used to drill these wells float on top of the water. It takes a lot of money and technology to find, explore, produce, and transport oil from under the ocean.

Texas produces more oil than any other state, followed by Alaska, California, Louisiana, and North Dakota. Americans use much more oil than we produce. Today, the U.S. imports about two-thirds of the oil it consumes from foreign countries.

Oil and the Environment

Petroleum products—gasoline, medicines, fertilizers, and others—have helped people all over the world. Petroleum production and use are not without risk, however; environmental damage can result if oil and its products are not handled correctly. If drilling is not carefully regulated, it may disturb fragile land and ocean environments. Transporting oil may endanger wildlife if oil is spilled into rivers and oceans. Burning gasoline to fuel our cars pollutes the air. Even the careless disposal of motor oil drained from the family car can pollute streams and rivers.

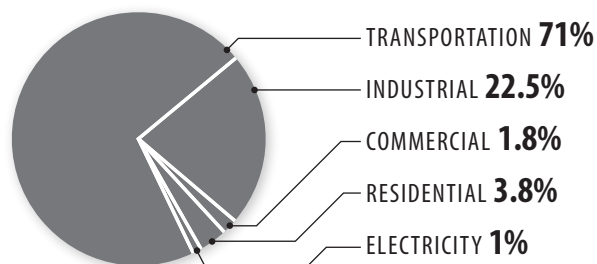
The petroleum industry works hard to protect the environment. Gasoline and diesel fuel have been processed to burn cleaner, and oil companies do everything they can to drill, process, and transport oil and its products as safely as possible.



Image courtesy of Doug Stewart, contributor to Wikimedia Commons

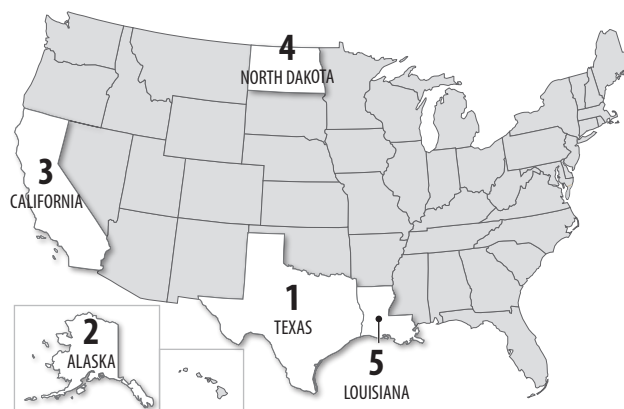
A replica of the Drake Well in Titusville, PA.

Petroleum Consumption by Sector, 2009



Data: Energy Information Administration

Top Petroleum Producing States, 2009



Data: Energy Information Administration

What is Natural Gas?

Natural gas is a fossil fuel like petroleum and coal. Natural gas is considered a fossil fuel because most scientists believe that it was formed from the remains of ancient sea plants and animals. When the plants and tiny sea animals died, they sank to the bottom of the oceans where they were buried by sediment and sand, which turned into sedimentary rock. The layers of plant and animal matter and sedimentary rock continued to build until the pressure and heat from the Earth turned the remains into petroleum and natural gas.

Natural gas is trapped in underground rocks, much like water is trapped in the pockets of a sponge. Natural gas is really a mixture of gases. The main ingredient is methane. Methane has no color, odor, or taste. As a safety measure, gas companies add an odorant, mercaptan, to the natural gas that we use in our homes and buildings so that leaking gas can be detected (it smells like rotten eggs). Natural gas should not be confused with gasoline, which is a petroleum product.

Natural gas from underground reservoirs is considered a nonrenewable energy source, which means we cannot make more in a short time.

History of Natural Gas

The ancient people of Greece, Persia, and India discovered natural gas many centuries ago. The people were mystified by the burning springs created when natural gas seeped from cracks in the ground and was ignited by lightning. They sometimes built temples around these eternal flames and worshipped the fire.

About 2,500 years ago, the Chinese recognized that natural gas could be put to work. The Chinese piped the gas from shallow wells and burned it under large pans to evaporate seawater to make salt.

In 1816, natural gas captured from a coal coking plant was first used in America to fuel street lamps in Baltimore, MD. Soon after, in 1821, William Hart dug the United States' first successful natural gas well in Fredonia, NY. It was just 27 feet deep, quite shallow compared to today's wells. Today, natural gas is the country's second largest source of energy, meeting over 23 percent of our total energy demand.

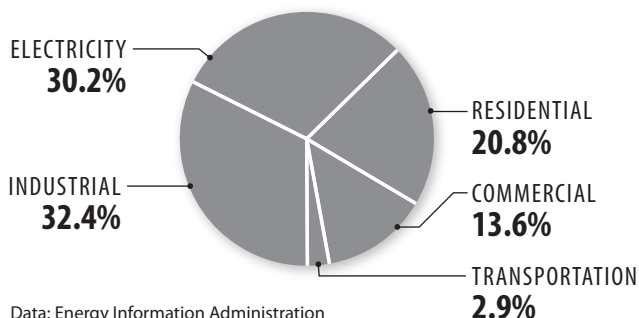
Who Uses Natural Gas?

Just about everyone in the United States uses natural gas. Industry is the biggest user. Industry burns natural gas to produce heat to manufacture many of the products we use every day. Natural gas is also used as an ingredient, or feedstock, in fertilizer, glue, paint, laundry detergent, and many other products.

Residences, or homes, are the second biggest users of natural gas. Five in ten homes use natural gas for heating, and many also use it for cooking and heating water. Commercial buildings use natural gas too. Commercial users include stores, offices, schools, churches, and hospitals.

Natural gas can also be used to generate electricity. Many utilities are building new power plants that burn natural gas because it is

Natural Gas Use by Sector, 2009



Natural gas is used to power some fork lifts.

clean burning and natural gas plants can produce electricity quickly when it is needed for periods of peak demand. A small amount of natural gas is used as fuel for automobiles. Natural gas is cleaner burning than gasoline, but vehicles must have special equipment to use it. Many of the vehicles used by the government in national parks operate on compressed natural gas.

Natural Gas and the Environment

Burning any fossil fuel, including natural gas, releases emissions into the air, as well as carbon dioxide, a greenhouse gas. Natural gas (and propane) are the cleanest burning fossil fuels because they have fewer carbon atoms to form carbon dioxide. Compared to coal and petroleum, natural gas releases much less sulfur, carbon, and ash when it is burned. Because it is a clean source of energy, scientists are looking for new sources of natural gas and new ways to use it.

Exploration

Geology

Oil and natural gas are buried beneath the Earth's crust, on land and under the oceans. To find it, geologists use their knowledge of land and rock formations, the geologic history of an area, and sophisticated technology. Combining all this information, geologists are more likely to be successful when they drill. Even with all this, not all wells produce oil or natural gas. Exploratory wells are drilled if scientists think an area has oil. For every 100 exploratory wells drilled, about 44 of them will find oil.

Forty-eight of every 100 exploratory wells drilled find natural gas. By the time production wells are drilled, the success rate has risen to about 85 percent. To increase the success of drilling, petroleum geologists must be knowledgeable in a number of areas.

Rock Formation

The field of stratigraphy is the study of rock layers (or strata) to determine the type of rock formation, the age of the layers, the radioactivity of the formations, and other information to determine the composition, origin, and location of rock strata.

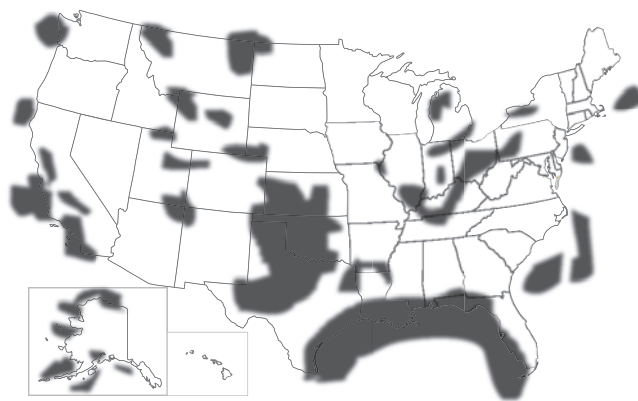
Compiling information on rock formations is an important part of oil and gas exploration. Different types of rock have varying potential for holding oil or gas in a reservoir. There are three different types of rock: sedimentary, metamorphic, and igneous. Every rock fits into one of these three categories.

Metamorphic rock began as either sedimentary or igneous rock that was exposed to increased pressure and heat that eventually transformed it into metamorphic rock. Usually metamorphic rock is found near other types of rock. It is also usually denser than sedimentary rock since heat and pressure have removed many of the pores from it.

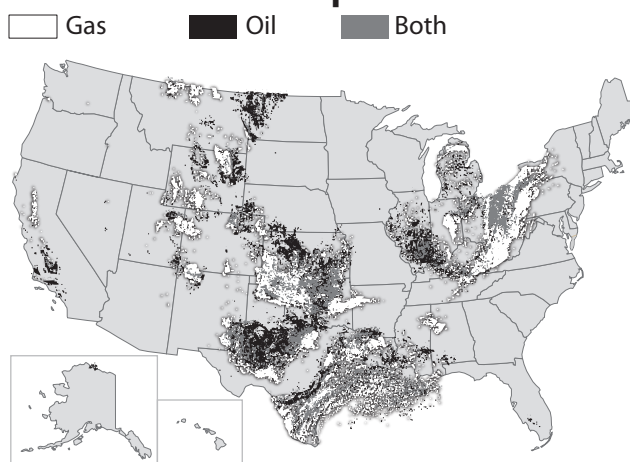
Igneous rock is formed from magma, or liquid rock, that exists in the Earth's core. Sometimes where cracks or faults occur in the Earth's crust, magma can seep up and cool, creating igneous rock. Igneous rock can also be created when magma makes its way to the Earth's surface in the form of lava. Igneous rock is usually the densest of the three rock types.

Sedimentary rock is formed by the build-up of layers of sand and sediment over time. These layers are created as materials on the Earth's surface are eroded and washed downstream. Over thousands of years, these particles are compressed to create rock. Most oil is found in sedimentary rock. Since sedimentary rock often has many pores, it is an ideal formation to contain oil and natural gas.

Oil and Gas Basins

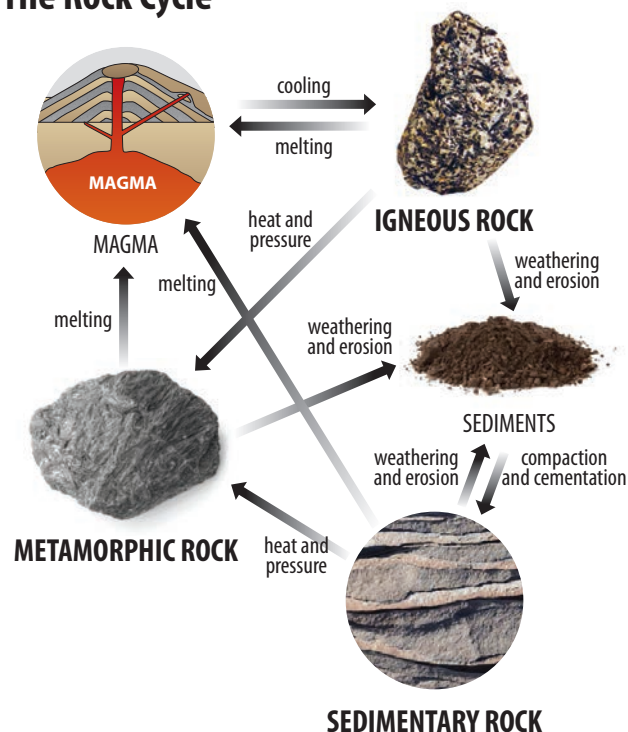


Oil and Natural Gas Exploration



Data: Energy Information Administration

The Rock Cycle



Permeability

Oil and natural gas occur naturally in the Earth's layers, inside of rocks. Rocks are not completely solid; they have tiny holes, or pores, in which air or other fluids were trapped during formation. The porosity of a rock formation is a measure of the number and kind of pores it has.

Fluids can move between rock pores in varying degrees. Permeability is a measure of the ability of a rock to move fluids through its pores. Permeability is a very important feature for finding oil and gas. Being successful at finding oil is partially determined by locating porous rock, as well as locating other fluids, such as water, that are contained in rock formations.

Geologic History

An important factor in finding oil and gas is understanding the environment that existed in an area millions of years ago. Since oil and natural gas are the remains of ancient sea life, the first step in locating oil is finding areas where ancient seas once existed.

Seismic Technology

Seismic technology uses sound waves to reveal what lies deep in the ground. Sound waves can travel through some materials more easily than others. When sound waves are directed into the ground and they hit something they cannot penetrate, they bounce back, returning to the surface. Equipment on the surface records the returning waves. Once the waves have all been recorded for an area, the information is taken back to a lab where geoscientists read the waves. A map can then be created of the underground terrain.

The first seismic instruments were used in the mid 1800s to detect earthquakes. Seismic equipment began being used in the oil fields in the 1920s. In those days, dynamite was used to create the sound waves. The data collected had to be read by hand. In the 1960s, digital technology allowed the information to be read by machine. Three-dimensional seismic data was first used in the late 1960s and changed the way seismographs were used. Today, machines called thumpers are used to create shock waves instead of dynamite. To create a 3D image of the layer of ground, not one, but many seismic instruments are used. They are placed in holes around a site. Each of these instruments records sound waves. Then scientists can combine all of these images to get a better understanding of what lies underground.

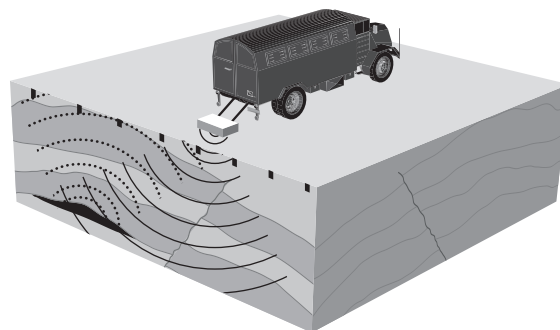
When searching for oil under the sea floor, seismic equipment must be adapted for the marine environment. Seismic systems are placed on ships and the listening devices are attached to long streamers. Many ships have four or five streamers, but some larger ships may have up to 16 streamers.

Another way scientists analyze the ocean floor is with ocean bottom cables. These cables are sent to the ocean floor from a stationary platform. Then, a ship towing air guns passes by. The air guns, directed down, are used to create the sound waves.

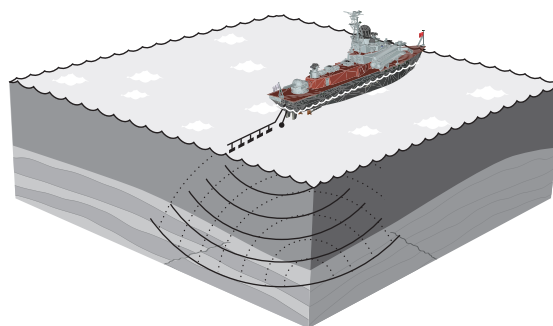
Interpreting Seismic Output

Today, seismic data is interpreted in high tech ways. 3D visualization puts seismic information into a three-dimensional format that people can more easily understand. One of the most advanced 3D visualization projects is known as the CAVE (Cave Automatic Virtual Environment). The CAVE is an entire room used for visualization. In this virtual reality environment, the walls and floor are used as projection surfaces, giving the appearance of filling the room and allowing scientists to walk into the data.

Land-based Seismic



Ocean-based Seismic



THE CAVE 3D SEISMIC VISUALIZATION ROOM



The newest type of seismic technology is 4D seismic. The fourth dimension is time. 4D seismic uses a number of 3D images taken over time to see how they change. This technology is often used in areas that are already producing oil to see how production is affecting the reserve.

Other surveying techniques include gravitational, magnetic, and radioactive processes, all of which measure physical properties of a site and use that information to determine whether oil or gas is present.

Retrieving the Oil

Permitting and Leasing Land

Once a site has the potential for oil extraction, companies must get permission to drill. In some areas, this means acquiring the needed permits from state government and leases from landowners to drill on private land. In other cases, the land is federal land and require leases and permits from the U.S. Bureau of Land Management (for onshore drilling) or the Bureau of Ocean Energy Management, Regulation and Enforcement (for offshore drilling). There are also environmental protection measures that must be in place before drilling can begin.

Drilling

Since the first oil well was drilled in 1859 by Edwin Drake, oil production has become an increasingly complex and precise process. The original methods of drilling for oil were based on ancient methods for finding water and salt. As wells have gotten deeper and more complex, drilling technology has also become more complex.

To drill a well, a large drilling rig is brought to the site. Once it is situated above the desired location, drilling can begin. Roustabouts work on the rig and handle many of the different elements of drilling.

Drill bits have sharp teeth that rotate to tear apart rock while the well is drilled. As the well gets deeper, lengths of 30-foot pipe are attached to the top of the drill. Each 30-foot section must be lifted above the last section into the sky and screwed onto the previous section. This is one of the reasons drilling platforms are very tall.

When drilling an oil well, the rock that is torn by the drill bit (called debris) does not come easily to the Earth's surface. As the hole gets deeper, debris can get in the way, blocking the hole. For this reason, drillers use mud to lift debris out of the well. Drilling mud originally was actual mud found on the drill site. Today, mud is a complex material specifically made for its purpose. Because it is so complex, mud is one of the biggest expenses in drilling.

Mud flow is controlled by the mud engineer. It is pumped down the hollow drilling pipe. It comes out near the drill bit, cooling the bit. The mud then carries debris up through the well as it is pumped, to be collected above ground. One of the reasons mud is so expensive is that it must be formulated with precise density. Since less dense materials float on top of more dense materials, the mud must have a greater density than the rock that is being cut. Drilling mud also keeps the formation, or walls of the well, from collapsing inward.

Once a well has been drilled to the depth of the oil reservoir, the workers move into the next stages—well completion and production. The drilling rig is removed from the site and the well is prepared to begin producing oil.

Well Completion

After a well is drilled, it must be completed before it can begin producing. There are three main steps in the completion process. The first step is allowing oil into the well so that it can be brought to the surface. The second is making sure that water does not get into the well, and the third is keeping underground rock out of the well.

Completion is not done the same way for all wells. Deciding what to do depends on a number of factors, including the size and shape of the oil reservoir, the surroundings of the reservoir, and the kinds of rocks and oil the reservoir contains.

DRILL PIPE



ROUSTABOUTS



Image courtesy of StatOil

Oil is contained within rock formations. The nature of these formations affects the way oil is pumped from the ground. There are two characteristics that are very important to predicting how the oil will flow. The first characteristic is porosity. Porosity pertains to the gaps, or pores, between the grains in the rock where oil is stored. Permeability is the second important characteristic; it measures how many of those pores connect to each other. Knowing if the pores connect is important, since these connections are what allow oil to flow to the well. Even though a rock formation is very porous, if it has no permeability, the oil will be difficult to extract.

Most oil formations also contain water, or saturation, near or mixed in with the oil. Producers must be sure to separate this water out of the formation. They must also be sure to avoid contaminating nearby ground water, land, and underground aquifers.

The amount of pressure in a formation is another factor that is very important. Since oil extraction removes mass from the Earth, the stability of the reserve is something that must be considered. While some formations can maintain their shape when oil is removed, others cannot. These formations must be stabilized, allowing them to remain open for fluids to flow.

The last issue to be considered is how well the reserves are connected. Compartmentalization is a situation in which the oil from one part of the reserve cannot flow to another part of the reserve. There may be faults in the ground that disconnect the layers, or pores from one section may not be connected to other sections because of low permeability. There can also be streaks of other types of rock that the oil cannot easily pass through between the well and the oil, or there may be other barriers in the way of the flow.

Once all these issues are taken into consideration, completing the well may begin. To start completion, the well must be open so that oil can flow into it.

Casing the Well

Drill pipe does not stay in the well after it is drilled. It is replaced with longer, wider casing pipe, which is used to line the well. Usually, casing a well begins before the end of the drilling process. Casing the top of the well occurs as the drill continues to dig deeper into the ground. The final and deepest casing is placed in the well after drilling is complete.

The rock around the well is crushed to allow the oil to flow freely. Shooting nitroglycerin and shattering the rock in the immediate area can crush the rock. The side of the well, or the casing, blocks oil from getting into the well itself. At the levels where oil is present, the casing is perforated to let oil flow. Perforating the casing is done by shooting a very thin, fast jet of gas to penetrate and perforate the casing.

Cementing

Once casings are in place, cement is used to fill in the gap between the casing pipes and the well wall. Drilling mud is pumped out of the well as cement is pumped in. As the cement is pumped in, the casing is slowly rotated to create a better bond with the cement.

Production

Once the wells have been completed, they can go into production. Production wells do not have the complex, above ground structures that are in place during drilling. Instead, the wells are capped with smaller units. Ideally, oil is extracted using natural drive, which means there is enough pressure in the well to move the oil and no pumping is needed. Wells with natural drive have christmas trees above ground. A christmas tree, in the petroleum industry, is a series of valves and gauges used to measure and control the flow and pressure of the well.

Other wells do not have enough natural drive to move oil out of the Earth. They must use pumps to lift the oil to the surface. Typically, this is done with a sucker-rod pump, sometimes called a horse head pump because of its shape. Using one-way valves underground near the oil formation, the pump draws, or sucks, oil to the surface. As the horse head pump above ground goes up and down, valves below lift the oil. Pumps may run for only a few hours each day to avoid distorting the way the fluids are distributed underground. Many wells produce only a few barrels of oil a day.

In a well that has a lot of pressure, a blow out preventer, or BOP, is used to avoid explosions. A BOP includes monitors to ensure the well is operating correctly and a set of controls that react to any unexpected pressure change. If there is too much pressure, the

CHRISTMAS TREE



HORSE HEAD PUMP



OFFSHORE RIG



man-made elements of the well could be forced out the top of the well or fire could occur.

To monitor a well's progress, comprehensive data logs are kept that track a number of different factors. Radioactive, electric, mechanical, and sonic tools are just some of the ways wells are studied. If monitors indicate unusual well behavior, engineers investigate and attend to the problem.

Subsea Operations

In offshore operations, well completion and production are similar to onshore, but they take place below hundreds or thousands of feet of water. Well caps must be resistant to corrosion by saltwater and must be able to withstand the pressure deep in the ocean. Well operators do not regularly visit the ocean floor to check on the well caps. Instead, sensors are placed on the well caps so that the wells can be monitored from the platform. Advanced technologies such as Remote Operating Vehicles, or ROVERS, can make robotic repairs to the well by operators on the platform using remote controls.

The oil is piped to an offshore processing platform where it is combined with oil from other wells before being cleaned and sent to a refinery. There is a limited amount of space on an offshore platform to store new oil, so all of the operations must be carefully coordinated. Production supervisors oversee the entire operation of an offshore rig to make sure operations are moving smoothly.

Cleaning the Oil

Once oil has been brought to the surface, it must be cleaned. Refineries have specific standards that they require suppliers to meet before they will accept the oil. Producers usually clean their oil on site, near the pump. If a producer has multiple wells near each other, there may be one processing facility for a number of wells.

Field processing is used to separate out oil, gas, and saltwater. All of these materials can come up through the well mixed together. The simplest way to separate out the different materials is in settling tanks. Oil from the ground is pumped into a tank through one pipe and allowed to settle. Each layer of oil, gas, and saltwater is then pumped out through its own pipe. The downfall of this method is that settling can take a long time.

Pressurized separators that have a higher capacity and separate more quickly can also be used. Inside these separators, pressure is used to collect liquids at the bottom, while oil and gas are piped out the side. Separators do a good job of separating oil and gas, but more processing is needed to remove all of the saltwater.

When oil and water are mixed together, they can be difficult to separate. This is true for household vegetable oil and tap water and it is true for crude oil and saltwater. Refineries require that the oil contain no more than one percent water.

To remove excess water, heat is applied with a heat-treater. The heat-treater causes the droplets of water that are suspended in the oil to come together, creating larger drops that can be more easily removed from the oil. Water-free oil is removed from the top.

Shipping Crude Oil

Oil wells are located above oil-bearing formations, wherever they are found. Refineries are usually near oil consumption markets, though many are located near major oil producing areas as well. There are different ways to get the oil from well to refinery.

Much of the oil we use is shipped via pipeline. Oil pipelines move crude oil from oil platforms offshore in the Gulf of Mexico to refineries onshore. Pipelines can also move petroleum products between regions of the U.S. Pumping stations along the pipelines are located every 60 to 100 miles to keep the oil flowing.

A pipeline must be kept clean. To clean the inside of a pipeline, an instrument called a pig is used. This instrument is shaped like a bullet and scrubs the wall of the pipeline. More advanced pigs, called smart pigs, use cameras to monitor the pipe for flaws.

For longer distances, oil is put in tanker trucks or moved by sea on oil tankers. Crude oil produced in Venezuela, for example, is carried to the U.S. in oil tankers. This oil is off-loaded at a refinery to be turned into useful products. Oil tankers have two hulls, or shells, to help prevent oil spills.

In most cases when oil is shipped by tanker, the crude oil travels through both pipeline and tanker. One example is crude oil produced on the Northern Slope of Alaska. This oil field is very far north, near the Arctic Ocean. Instead of building a port to bring tanker ships into these treacherous waters, a pipeline was built to carry the oil to a more easily reached port in the southern part of Alaska.

After transportation by oil tanker or pipeline to a refinery, much of the crude oil is placed in storage facilities or tank farms. These large cylinders hold the crude oil until the refinery is ready to process it.

OIL TANKER



OIL PIPELINES



Refining

Distillation

In its crude form, petroleum is of little use to us. To make it into products we know and use, petroleum must be refined—separated into its many parts. Those parts are what we use to fuel our world. Petroleum is made of hydrocarbons. Hydrocarbons are chemical compounds containing only hydrogen and carbon. These two elements combine in different ways to make hundreds of different compounds that we use to make thousands of products.

To separate petroleum products, oil is refined. The first and most important step in the refining process is distillation. Distillation has been around since ancient times. Stills were set up by many cultures to produce alcohol. The first distillation of oil was done at the world's first oil refinery in Romania in 1856.

Distillation is the separation of substances based on their boiling range. Petroleum is not the only thing that is distilled. The chemical industry and the beverage industry also distill their products. Basic distillation follows the same steps regardless of what is being separated.

A mixture is heated. As parts of the mixture begin to boil, they rise as gases. These gases are captured in a fractioning tower. While the bottom of the tower is very hot, the temperature at the top of the tower is cooler. Trays are placed at different levels inside the tower. These trays have holes in them so that gases can pass through. But as the gas meets a plate that is cooler than the temperature of that gas, it condenses, or turns back into a liquid. The condensed liquid that forms on each plate is sent to a pipe. Each plate has its own pipe that carries only the liquids collected on it. The separated liquids move to other machines for further processing.

OFFSHORE PRODUCTION PLATFORM



STORAGE TANKS



There are a number of products that come from the refining process. Hydrocarbons with simple molecular structures have lower boiling temperatures. As the molecular structures become more complex, the boiling temperature increases—more energy is required to break the intra-molecular forces between the molecules, which allows for the phase changes.

Once distillation is complete, the light, higher value products are cleaned and put to use. Heavy, lower value products are subjected to additional processes to either extract higher value products or alter their chemical make-up to produce higher value products.

Processing

These different parts are sent through chemical processing to be turned into useful products. There are three main types of processes. Cracking breaks long hydrocarbon chains into smaller ones. Unification combines small chains into longer ones. Alteration rearranges pieces of hydrocarbon chains to make different hydrocarbons.

Cracking can be done in a number of different ways. One method is thermal cracking. Thermal cracking uses very high temperatures to break apart long chains of hydrocarbons. This can be done using high temperature steam.

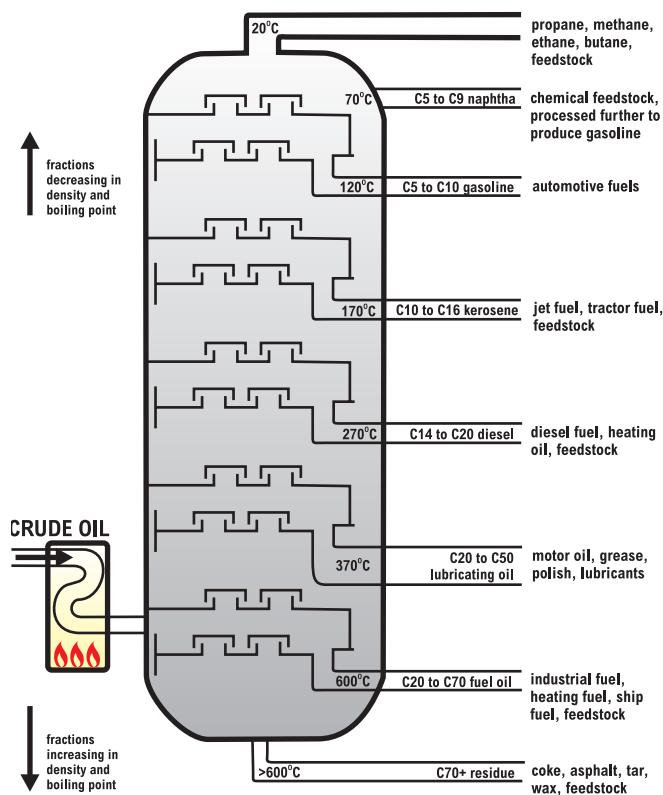
Cracking can also be done by heating the residue from distillation towers to very high temperatures until it separates into useful parts. This process is also known as coking, since the material that is left after all of the useful hydrocarbons are removed is coke, a hard, porous carbon material. Coke is used by heavy industry, such as iron and aluminum manufacturing.

Another way that long hydrocarbon chains are broken is through catalytic cracking. A catalyst is a material that increases the rate of reaction. Catalytic cracking is used to change heavy diesel oils into diesel oil and gasoline.

When smaller hydrocarbons are combined to make larger ones through unification, they usually undergo a process of catalytic reformatting, a process that converts naphtha into aromatics. Aromatics are cyclic hydrocarbons—meaning the carbons form a ring rather than the simpler straight chain of hydrocarbons. Aromatics are typically used to make chemicals and blend gasoline. The main by-product of catalytic reforming is hydrogen gas.

Alteration is the rearrangement of molecules in a hydrocarbon to create a more useful hydrocarbon. Usually this is done with

Fractionating Tower



alkylation, a process in which hydrocarbons are mixed with a catalyst and an acid to create hydrocarbons that are high in octane. These high-octane hydrocarbons are blended into gasoline.

Preparation to Market

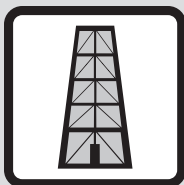
Once all the products have been separated from the crude oil that went into the refinery, the products must be prepared to go to market. This last step is known as treatment. Gasoline, for example, is treated with additives that help engines operate more smoothly and burn cleaner.

From the refinery, different petroleum products make their way to a variety of places. Almost half of every barrel of oil is made into gasoline. Another 10–15 percent is refined into other transportation products such as jet fuel, diesel fuel, and motor oil. Many of these products are produced by further chemical processing.

Shipping Petroleum Products

After the refinery, most petroleum products are shipped to markets through pipelines. Pipelines are the safest and most cost effective way to move big shipments of petroleum. Gasoline is transported around the country through pipelines, most of which are buried underground. There are about 230,000 miles of underground pipelines in the U.S. It takes about 15 days to move a shipment of gasoline from Houston, TX to New York City.

Special companies called jobbers buy petroleum products from oil companies and sell them to gasoline stations and to other big users such as manufacturers, power companies, and large farmers.



Petroleum Based Transportation Fuels

Driving is an important part of Americans' daily lives. In fact, Americans drive their personal vehicles about 3 trillion miles a year. Commercial trucks drive 145 billion miles, public transit buses drive 2.3 billion, and school buses drive nearly 6 billion miles. There are a lot of vehicles racking up that kind of mileage—249,000,000 personal vehicles, 9,000,000 commercial trucks, 83,700 public transit buses, and 480,000 school buses.

Gasoline as a Transportation Fuel

Today, gasoline is the fuel used by a vast majority of passenger vehicles in the U.S. There are about 249 million vehicles that use gasoline to travel an average of 12,000 miles per year. There are 162,000 fueling stations that provide convenient accessibility for consumers. The production and distribution infrastructures are in place. Most Americans consider gasoline the most sensible transportation fuel for today, even if it is not an ideal fuel.

Consumers are concerned about price fluctuations. During World War I, the cost of gasoline was about \$0.25 a gallon. The price of gasoline has averaged about \$2.00 a gallon in inflation-adjusted dollars for the last 80 years, until the shortages caused by Hurricanes Katrina and Rita, and the unrest in many oil producing areas, such as Iraq, Iran, and Nigeria. In 2009 the average cost for a gallon of gasoline was \$2.34.

Diesel as a Transportation Fuel

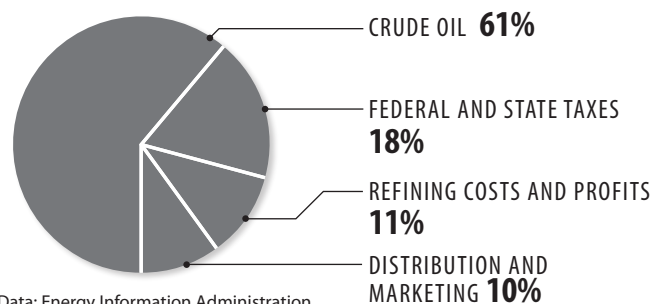
Diesel fuel plays a vital role in America's economy, quality of life, and national security. As a transportation fuel, it offers a wide range of performance, efficiency, and safety features. Diesel fuel contains between 18 and 30 percent more energy per gallon than gasoline. Diesel technology also offers a greater power density than other fuels, so it packs more power per volume. Since 2004 diesel prices have been higher than gasoline prices. Diesel is more expensive due to higher refining costs and higher federal taxes. In 2009 the average retail price for diesel was \$2.46 per gallon.

Diesel fuel has a wide range of applications. In agriculture, diesel powers more than two-thirds of all farm equipment in the U.S. because diesel engines are uniquely qualified to perform demanding work. The construction industry also relies heavily on diesel fuel to operate heavy machinery. Diesel power dominates the movement of America's freight in trucks, trains, boats, and barges; 94 percent of our goods are shipped using diesel-powered vehicles. No other fuel can match diesel in its ability to move freight economically. In addition, it is the predominant fuel for public transit buses, school buses, and intercity buses throughout the U.S.

Diesel fuel is not just for large vehicles. There are five million diesel cars, pickups, and sport utility vehicles (SUVs) on the road today. A new generation of clean diesel cars, light trucks, and SUVs are now available and offer consumers a new choice in fuel-efficient

Factors in Gasoline Pricing

In 2009, the average retail price for a gallon of regular grade unleaded gasoline was \$2.34. The biggest factor in the total price is the cost of crude oil that is used to produce the gasoline.



and low-emissions technology. Clean diesel is a proven technology that is clean, quiet, and fun to drive. Many new diesel options are available for car consumers in every state. Thanks to their inherent fuel efficiency, diesel engines also offer a viable and readily available strategy for reducing greenhouse gas emissions as they produce 20 percent fewer carbon dioxide emissions than gasoline vehicles. American drivers who purchase cleaner-burning diesel cars, trucks, and SUVs are eligible for similar tax incentives as purchases of gasoline-hybrid electric vehicles.

Characteristics and Environmental Impacts of Gasoline and Diesel Fuels

Gasoline is a nonrenewable fossil fuel that produces criteria air pollutants—carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide—when it is burned. Since the 1960s, stricter environmental standards have led to gasoline formulations and vehicle designs that have reduced vehicle exhaust emissions by 95 percent.

The Clean Air Act Amendments of 1990 mandated that reformulated gasoline be used in areas of the country that do not meet air quality standards, as well as reductions in nitrogen compounds (NO_x) and volatile organic compounds (VOCs). More than a dozen different formulations of gasoline are now required by law in the U.S. Blending ethanol with gasoline was originally targeted in areas that did not meet air quality standards. Now, it is common place to find up to 10 percent ethanol blended into gasoline.

Significant progress has been made in reducing emissions from diesel engines. With new clean diesel technologies, today's trucks and buses are eight times cleaner than those built just a dozen years ago. As of 2010, new trucks and buses have near zero emission levels.

Chemical Manufacturing

Petroleum goes into much more than just the tanks of our cars and airplanes. Petroleum is part of many of the products we use every day. It is well known that plastics are made from petroleum products, but that is only the beginning. Your toothbrush, toothpaste, shampoo, and even your contact lenses contain petroleum, as do carpeting, CDs, the ink in your pen, and medical devices such as prosthetic heart valves.

Chemical plants take refinery products and turn them into the products we use. There are many different kinds of chemical plants. Some are small and produce one or two items. Some are very large and produce a number of items. The largest plants can produce over 5 billion pounds of product each year. Large chemical plants operate all the time. They run 24 hours a day, every day of the year. Many of these plants are automated with new technology and need fewer people than in the past to run them.

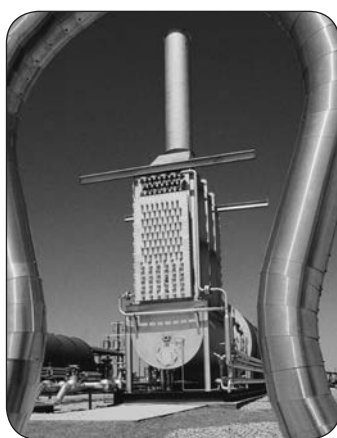
Plant Equipment and Processes

Cracking in a chemical plant is very similar to cracking in a refinery. Heat is used to break apart the chemical bonds of the hydrocarbon molecules in feedstocks. Feedstocks are the raw materials used to make products in chemical manufacturing plants.

Boilers and Furnaces

Both boilers and furnaces are important parts of chemical plants. Often feedstocks are brought to a chemical plant in solid form, such as powder or pellets. To work with these materials, they must be heated and melted into liquids or sometimes gases.

FURNACE



Cooling Towers

Cooling towers are used to return the water used in chemical processing back to normal temperature before it is returned to the river or lake from which it was taken. To do this, water is sent through a maze-like structure that allows as much air as possible to come into contact with the water. Gravity pulls the water down through this maze, cooling it as it goes.

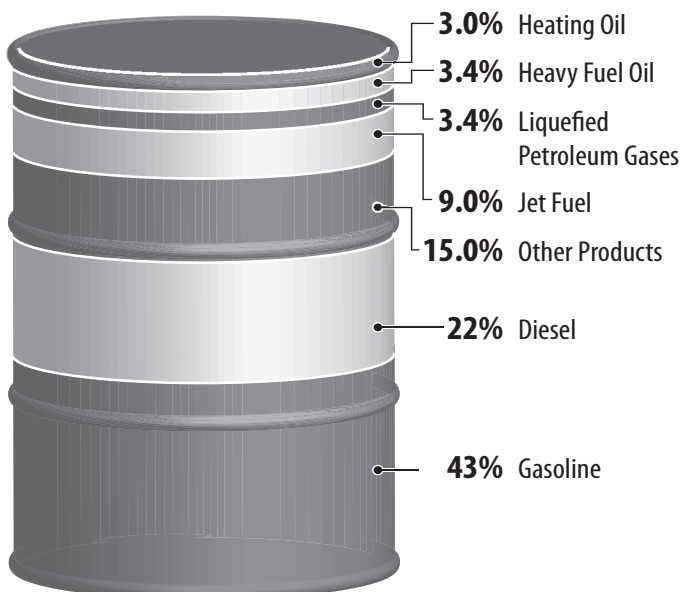
The air inside a cooling tower heats up as it comes into contact with the warm water being fed into the tower. The warming air rises, collecting a tiny bit of water vapor in the process, and is released from the top of the tower. As you drive by a chemical plant, you can sometimes see a cloud of water vapor rising from the cooling tower.

Heat Exchangers

Heat exchangers are devices that can speed up production and cut down on the need to process waste heat at the same time. Heat exchangers use fluids that contain waste heat, or heat that is no longer useful from a previous step, to heat materials that must be warmed in another step.

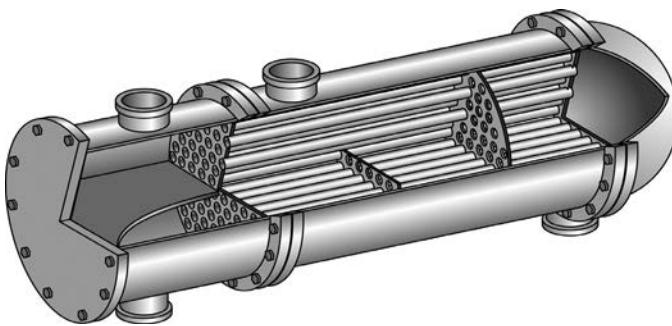
Heat exchangers are large pipes with smaller pipes inside. The small pipes carry cool liquids that need to be heated. The small pipes do

Products Produced From a Barrel of Oil



Data: Energy Information Administration

Heat Exchanger



not completely fill the large pipes, and the space around the small pipes is where the waste-heat fluid (liquid or gas) flows.

As the cool liquid and the hot fluid flow past each other, heat is transferred from the hot fluid to the cool liquid. At the end of the heat exchanger, the cool liquid has warmed in preparation for its next step. The hot fluid has cooled and requires less processing.

Wastewater Treatment

Processing chemicals can use large quantities of water. Water is present in nearly every step. Boilers, cooling towers, and heat exchangers all use water. To ensure that the water leaving the plant is as clean as the water coming into the plant, wastewater treatment facilities are located on site.

Laboratory

One important part of a chemical plant is the laboratory. Chemists constantly monitor the product at each step to make sure it meets the required specifications. If the chemistry is not just right, plastic bags could be too weak to hold groceries or nylon thread too brittle to sew. Chemists also monitor waste products to make sure the land and water is not being polluted.

Loading Station

Once the final product is complete, it is stored in a warehouse or storage tank, depending on the type of product. When needed, the product is taken from the storage facility to a loading station to be transported to market or to another chemical plant for further processing. Depending on the product, it may be transported by road, rail, air, water, or pipeline.

Transportation

Refineries and chemical plants are located all over the country and feedstock is often moved long distances between the two. Sometimes, chemicals are moved in small 50-pound bags or 400-pound drums. Feedstocks that must be transported in large quantities may be moved by barge, ship, or pipelines, which can carry larger quantities of product.

Products

To get the products that are familiar to us, feedstocks must be processed. Different products have different steps that are needed. Many products are made from more than one feedstock, which are combined in different ways to produce a variety of products.

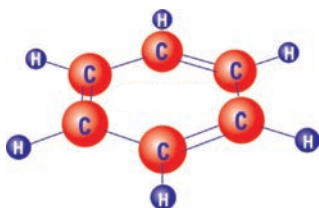
There are two general types of chemicals produced from petroleum that are used to create most everyday items—aromatics and olefins. Aromatics are a group of petrochemicals with a distinctive sweet smell that are characterized by ring structures, and are produced in refineries and petrochemical plants. The most common aromatics are benzene, toluene, and xylenes.

Aromatics are used for chemical production or as high-octane components for gasoline blending. Aromatics are used to make plastics and polymers. These go into products such as paint, textiles, building materials, and leather alternatives.

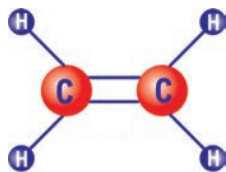
Olefins are a class of hydrocarbons recovered from petroleum that contain one or more pairs of carbon atoms linked by a double bond. Typical examples include ethylene and propylene. Olefins are obtained by cracking petroleum fractions at high temperatures. Another word for olefin is alkene.

The simplest olefins—ethylene, propylene, butylene, butadiene, and isoprene—are the basis of the petrochemicals industry. They are used to produce plastics, industrial solvents, and chemicals that are used in other applications. A number of familiar products come from these petrochemicals, including plastic bags, paint, tires, and plastic bottles.

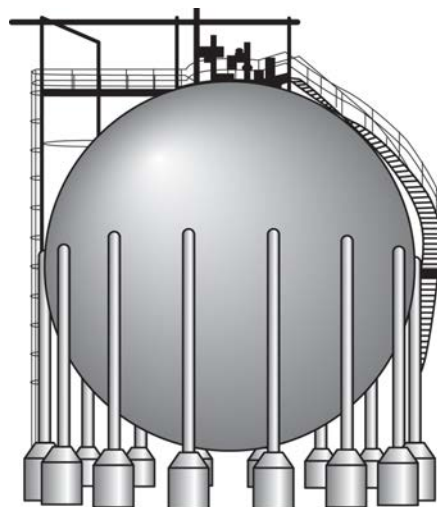
Benzene



Ethylene



Sphere Storage Tank



Products Made From Petroleum



Health and Safety

Worker health and safety are top priorities in all process industry facilities. To help ensure that workers are safe on the job, all manufacturing plants follow OSHA (Occupational Safety and Health Administration) rules and guidelines.

In many work settings, for example, OSHA guidelines require that workers wear hardhats, ear protection, eye protection, or other safety gear.

Chemical plants are continuously making their operations as safe as possible. Spill kits are located throughout a plant so that if there is a spill, clean-up can be accomplished quickly. Plants also work hard to replace any materials used in their processes that are toxic with alternatives that are safer for workers and for the environment.

One safety feature at a chemical plant is the fire pond. A pond of water is kept on site ready to be pumped if a fire were to erupt. There are usually a number of ponds scattered around each plant site so that one is never far away if it is needed. Since fire pond water does not need to be as clean as the water we use in our everyday lives, storm water is often collected to fill the ponds.

Into the Future

As the demand for petroleum products grows and the issues become more and more complex, energy companies are using advanced technologies to design and deliver next generation fuels and products. The skills used by all workers in the petroleum product industry are transferable to these new technologies. New opportunities are emerging every day.

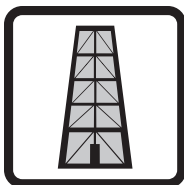
Consumers can make a real difference by recycling petroleum-based products and buying products that conserve energy.

To take a tour of a chemical plant, go to the Center for the Advancement of Process Technology's Virtual Chemical Plant at <http://capt.com.edu/virtualchemplant/>.

OIL WORKER



Image courtesy of StatOil



Careers in the Oil and Gas Industry

The oil and gas industry offers a variety of careers for individuals to work at its refineries, chemical plants, or on exploration and production onshore/offshore facilities. The following are an example of some of the career options available:

Process Technicians - member of a team of people that control, monitor, and troubleshoot equipment and focus on safety and environmental considerations.

Instrumentation Technicians - maintain, calibrate, adjust, and install measuring and control instruments necessary to ensure the safe, efficient operation of equipment.

Electricians - read blueprints that show the flow of electricity and maintain and repair the electrical and electronic equipment and systems that keep the facilities up and running.

Machinists - install, maintain, repair, and test rotating mechanical equipment and systems.

Geologists - explore the nature and structure of rock layers to piece together a whole picture of the subsurface in order to determine the best possible places to drill for oil and natural gas.

Petroleum Geologists - gather, process, and analyze seismic data and well data in order to locate drill sites for their companies.

Geoscientists - study the composition, structure, and other physical aspects of the Earth and are involved in exploration and production of oil and natural gas.

Petroleum Engineers - play a key role in determining the reservoir capacity (how much oil it might hold) and productivity (how much it produces) to design systems that move the petroleum from the wells (production process) through refining, where it gets cleaned up and converted into the energy we use.

Chemical Engineers - design chemical plant equipment and develop processes for manufacturing chemicals and products like gasoline, detergents, and plastics.

Mechanical Engineers - deal with the design, manufacture, and operation of the machinery and equipment used to improve oil drilling, and the processing of petroleum or chemical products.



Image courtesy of Shell

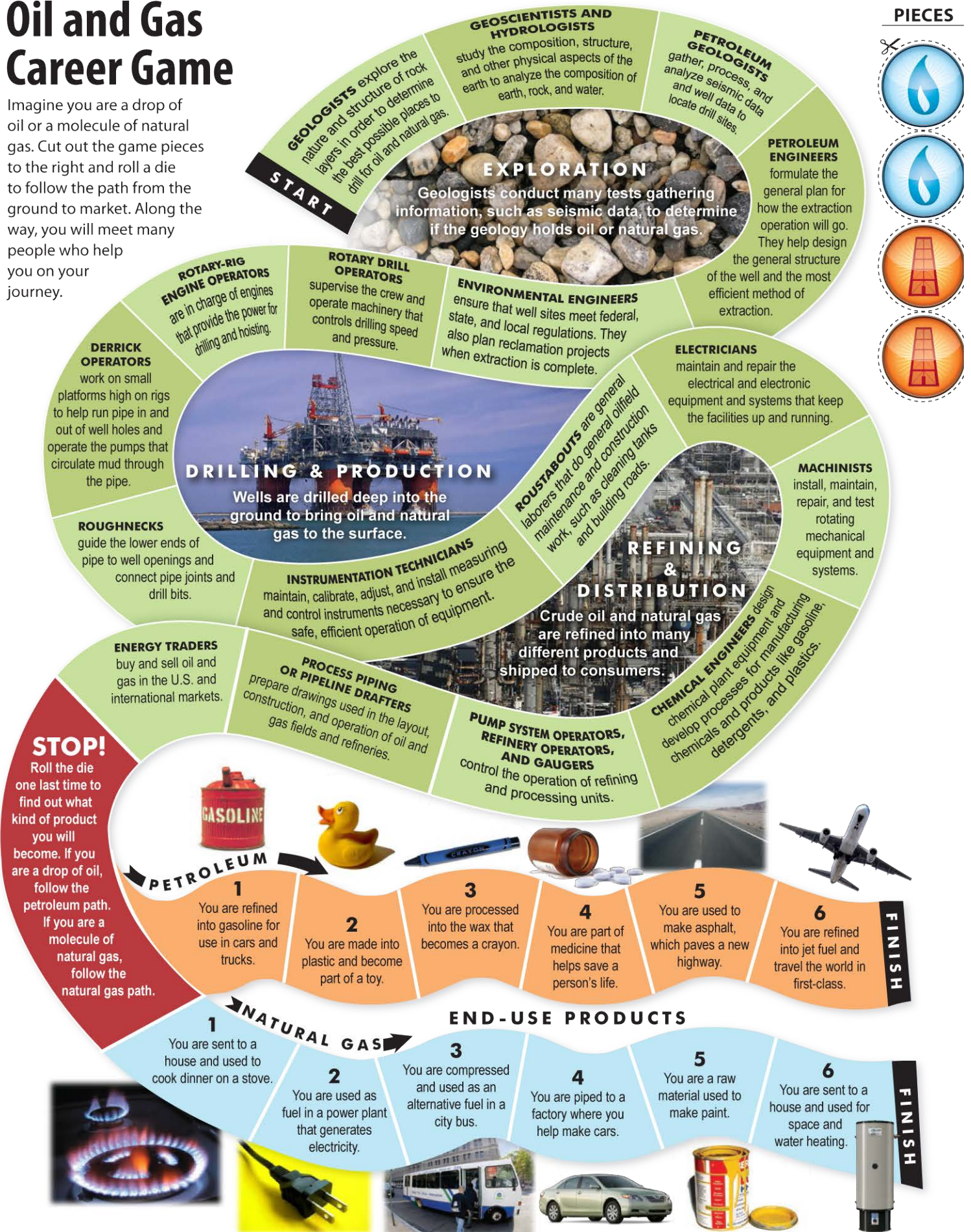


Image courtesy of Shell

Oil and Gas Career Game

Imagine you are a drop of oil or a molecule of natural gas. Cut out the game pieces to the right and roll a die to follow the path from the ground to market. Along the way, you will meet many people who help you on your journey.

PIECES



Q&A

NEED GETS TO KNOW INDUSTRY PROFESSIONALS

Adam Bell

Adam Bell is a Technical Engineer at Schlumberger. He started out as a Field Engineer Trainee with a Bachelor's degree in Chemical Engineering. Schlumberger develops their Field Engineers through several steps of operational and technical schools combined with field work in advance. He participated in a Co-Op/Internship program in college which he felt was especially useful in preparing for this challenging field.



TELL US A LITTLE ABOUT YOUR JOB AND WHAT YOU DO?

I focus on developing our laboratories, facilitates , and engineers in the Horseheads, NY district. I began my career working on field crews in South Texas, and moved into managing daily operations of well stimulation crews in Arkansas, Oklahoma, and New York. That included hiring and developing field crews, coordinating people, materials and equipment, and interfacing with clients both in preparation and following up on completed treatments.

HOW DID YOU DECIDE TO GO TO WORK IN THIS FIELD?

I have always been interested in math and science from a young age, which led me to wanting to become an engineer.

WHAT IS A TYPICAL DAY AT WORK LIKE FOR YOU?

When I worked in the field, I was at work before 5 a.m. preparing paperwork and then briefing the crew on the days job. From there I would lead a convoy of up to 20 trucks to a well-site where we would rig up the equipment, pump the job, rig the equipment down, and move to the next well-site. All of this would happen before 7 p.m. that same day. Now, my day begins at the office at 8 a.m. and usually ends around 7 or 8 p.m.

COULD YOU DO YOUR JOB ANYWHERE IN WORLD?

The majority of well cementing and stimulation is performed on the oil and gas wells drilled in the United States. This covers a significant portion of the U.S. from California, the Rocky Mountains, Texas, Arkansas, Oklahoma, Louisiana, all the way to the Appalachian Mountains.

WHAT IS THE MOST CHALLENGING PART OF YOUR JOB?

The "24/7" nature of this fast-paced industry pushes everyone involved to their limit. To ensure that risks are managed and the correct decisions are made to perform the job safely and correctly is a constant challenge. In the Northeast part of the United States, one of the key challenges is to educate the public about our industry as well as ensure that all operations are conducted in accordance with established best practices in order to justify the public's trust.

ANY ADVICE FOR YOUNG PEOPLE CONSIDERING A CAREER IN THIS INDUSTRY?

Be ready to work harder than you ever thought was possible. You will always continue to learn in an industry that will always be challenging and changing at a dramatic pace—you will never be bored. If you are considering a career in this industry you cannot be afraid to get your hands dirty!



IMAGE COURTESY OF CHESAPEAKE/STATOIL

I have been able to see the sun rise and set across the countryside of America ...

ANY OTHER COMMENTS ABOUT PURSUING A CAREER IN THIS FIELD?

I have been able to see the sun rise and set across the countryside of America and have been able to work with an incredibly diverse multi-national workforce. Abundant energy resources have enabled dramatic improvements in quality of life and advances in technology can never be predicted and should not be underestimated. Ensuring safe, reliable, and affordable energy for future generations is not only one of the greatest engineering challenges of today but also of primary concern for our society's future.

Q&A

NEED GETS TO KNOW INDUSTRY PROFESSIONALS

Pat Bond

Pat Bond is the Vice President of Sales for Drilling Tools and Remedial (DTR) at Schlumberger. Before and after graduating from The University of Texas with a B.S. in Petroleum Engineering, Mr. Bond spent years in the field working on rigs and running tools, building his understanding of the business literally from the ground up. That, along with his engineering degree, led to a technical career where he travels the world giving technical support and presentations.



HOW DID YOU DECIDE TO GO TO WORK IN THIS FIELD?

Growing up in Houston I was always around people in the energy business. I found the people to be daring and entrepreneurial (also known as “Wildcatters”) as they were taking risks and either hitting it big and driving fancy cars or going broke trying. That swashbuckling attitude was what first attracted me to the industry. From there I got hooked on the whole process of oil and gas extraction. We all use and depend on petroleum products so I figured the long term career prospects were good.

WHAT IS A TYPICAL DAY AT WORK LIKE FOR YOU?

Every morning I wake up thinking about how to get more business for my company. That includes calling on customers, evaluating new tools and processes that will assist our sales people, meeting with internal partners to discuss delivery, people, training, finances, and legalities. Fundamental questions we ask ourselves every day are “What do our customers need? What keeps them awake at night?” If you can solve those questions, and prove it, then sales will come.

HOW HAS YOUR FIELD CHANGED IN THE LAST 5-10 YEARS?

We are running tools in markets that did not exist 5-10 years ago. These new tools and markets now make up a large part of our annual revenue. The trick is adjusting to those needs and markets in time to capture a significant part of the business. If you stay still you will get run over in this industry. I think of it as—there are people who run the business and people who change the business. We always need a proper balance of people running today’s tools in today’s markets while we have people looking ahead at new tools and new markets.

WHAT IS THE MOST REWARDING PART OF YOUR JOB?

Like most competitive people I like to win. Gaining enough trust from our client so that they reward us with business is a fantastic feeling. Mentoring young or new team members is also very gratifying.

WHAT ARE SOME IMPORTANT ATTRIBUTES ONE MUST HAVE FOR THIS JOB?

Knowledge of the subject area and learning the art of public speaking have helped me tremendously in my role today. Obviously you never stop learning as I continue to take technical and leadership training classes to this day. I also have a personal objective on my annual performance review to take a certain amount of training classes every year.

WHAT CHALLENGES DO YOU FACE IN THE INDUSTRY?

Government regulations and negative public perceptions are constant challenges. In the aftermath of the oil spill in the Gulf of Mexico, these challenges have been magnified and of course in some ways justifiably so. But, regardless of perceptions and regulations the world still needs cars, trucks, planes, trains, ships, plastics, fertilizers, electricity, pharmaceuticals, cell phones, etc, made possible by petroleum products. I always wonder if the people who are down on the energy business know how much we contribute to society. And as a side note—I’m not sure how much more organic you can get than oil and gas—it comes from the EARTH.

WHAT ARE SOME BENEFITS TO WORKING IN THIS INDUSTRY?

Besides working with technology that rivals the space industry, there is camaraderie in this business that makes the whole thing fun to be in. On the technology side—think about drilling where the working platform is on water 2 miles above the sea floor and drilling a hole that is another 5 miles in length and hitting a target that is the size of a football field while dealing with all the challenges of pressure, temperature and mechanical issues. The level of technology is actually quite amazing and really should be seen to understand.

WHAT ADVICE WOULD YOU GIVE TO YOUNG PERSON WHO IS INTERESTED IN WORKING IN THE OIL AND NATURAL GAS FIELD?

I understand that there are some negative feelings about the energy business and relatively few people outside of the business truly understand what happens to get oil and gas out of the ground. I would say to anyone to take some time to understand the process and technology of oil and gas extraction and make up your own mind—don’t let outsiders who don’t know the business influence your decision.



Many people in the oil and gas industry, such as Mr. Bond, begin their careers in the field working as roughnecks or roustabouts before moving their way up through the company.

For those who are interested in a career in the energy industry there are plenty of opportunities for high energy people with or without a college degree. If in college, focus on math and science and take job shadowing and internships. These experiences and relationships will only help your career. If college is not in your plans, that's OK. Be flexible on where you want to live and work. There are oil and gas basins all over the world and all of them need good solid people to bring the oil and gas to surface, process it and get it to market.

For any person interested in a career in the oil and gas business I would say keep your integrity. It's really the only thing anyone really has. Who wants a smart person that you can't trust? Say what you are going to do, then do it. This business is all about trust. There are always safety and financial risks in this business and trust is a necessity for a successful career.

ANY OTHER COMMENTS ON CAREER OPPORTUNITIES IN THE OIL AND GAS FIELD?

After nearly 30 years in this business I still wake up excited about my job. There are always new technologies, new markets and challenges that keep this a very dynamic industry. On top of that, the industry is very social with plenty of technology conferences, industry associations, ties to universities and affiliations with



IMAGE COURTESY OF BP

charitable associations that constantly bring you in contact with customers and peers. I obviously have a very biased opinion, but I honestly don't see how people work in any other industry.

Q&A

NEED GETS TO KNOW INDUSTRY PROFESSIONALS

Galen Cobb

Galen Cobb is Vice President of Industry Relations for Halliburton and is responsible for the company's industry relations and global activities. As a graduate of Oklahoma Christian University with a degree in business, Mr. Cobb has been with Halliburton for over thirty-five years. Mr. Cobb serves on numerous industry, trade association, and civic boards throughout the industry, and was recently awarded the Spindletop Don E. Waggener-Butch Griffin Award as well as the NEED Distinguished Service Award.



TELL US A LITTLE ABOUT YOUR JOB AND WHAT YOU DO?

After working for Halliburton for almost 35 years I have had many different positions with the company. Currently I have broad responsibilities that include managing the company's industry relations, energy trade policy issues, executive client relations, and trade organizations oversight. Really my position is all of these things rolled into one. I am also very involved in our education component, which allows me to work with many K-12 schools and improve our relations with the future of our industry.

HOW DID YOU DECIDE TO GO TO WORK IN THIS FIELD?

Thirty-six years ago I was out of college, looking for a job and found Halliburton. I started as most people do in this industry, at an entry level position doing field service work, export shipping, then working up to export sales. I have had various executive management positions in operations, marketing, and sales and business development. I was also the Director CIS in China with oversight in establishing Halliburton's presence and operations in these emerging markets.

WHAT IS A TYPICAL DAY AT WORK LIKE FOR YOU?

There is a lot of variety in my daily work schedule. Serving on 15 Boards and 32 Industry Committees I find myself traveling a lot, and doing many breakfasts, luncheons, and dinners that are all related to our industry. I have been fortunate enough to be able to spend a lot of time in Houston, Texas where I reside as well as traveling extensively throughout the world. I also spend many days working with schools and education programs to improve our educational institutions as well as our industry.

WHAT IS THE MOST REWARDING PART OF YOUR JOB?

The opportunity to meet such a wide variety of people is very enjoyable. I also feel that getting to know the different industry trade issues and working through those with various different people makes my job exciting. Another very enjoyable part of my job is focusing on enhancing our education programs. The future of our industry is in our youth, and educating them to be successful not only in their careers but to make a difference in their country.

WHAT CHALLENGES DO YOU FACE IN THE INDUSTRY?

The biggest challenge I face in our industry is the mindset and perception of the oil and gas industry. It is very important that we keep the price of our resources at an affordable range for our country. The oil and gas industry really affects our economy, which in turn has a huge influence on the future. We are very big fans of

renewable energy sources, and work with those industries as well. Everyone that is associated with energy is on the same team, and we enjoy working together. Oil and gas is not something that can go away quickly, and it is something in which the U.S. is the leader. Focusing on needing every energy source and producing them in a clean manner are the biggest challenges we face. I am a big proponent of the facts, which The NEED Project does a super job of delivering to schools and institutions across the country.

WHAT ARE SOME BENEFITS TO WORKING IN THIS INDUSTRY?

Our industry has some tremendous benefits. The oil and gas industry is going to be very strong throughout the next 30, 40, even 50 years. The upward mobility of this career path is endless. If you have talent and a willingness to learn and get better, you will advance very quickly. No matter what specific part of the energy industry you work in, if you are willing to do what it takes, you will have wonderful personal, financial, and industrial benefits.

WHAT ADVICE WOULD YOU GIVE TO A YOUNG PERSON WHO IS INTERESTED IN WORKING IN THE OIL AND NATURAL GAS FIELD?

Pay your dues. Be willing to get dirty, start in the field, and work your way up. The industry is always looking for leaders that are looking to manage parts of the job, and increase their knowledge and duties. For a very fast payback on your education, a technical degree is the best. Getting your engineering degree and being willing to learn four to five years of technical work, you will really be set in a wonderful career in a great industry. I would also like to encourage young people to give the oil and gas industry a fair evaluation and not exclude it from the decision of a career. The demand for young people in our industry is huge, and it is like that every year. I believe Halliburton hired close to 15,000 people last year and are going to need even more in the next year or so.

ANY OTHER COMMENTS ON CAREER OPPORTUNITIES IN THE OIL AND GAS FIELD?

Halliburton has started some Petroleum Academies in Houston area schools. This takes juniors and seniors interested in this industry and allows them to earn advanced credits to apply to college when they graduate high school. This also gives students the opportunity to receive mentoring from professionals. In the summer they spend three weeks at Halliburton and other companies and get to see a live look at the industry, career outlook, and physically get to work in the field and simulate all aspects of this career. I am also a huge fan of The NEED Project and the information they provide as well as the opportunities.

Q&A

NEED GETS TO KNOW INDUSTRY PROFESSIONALS

Ashley Lantz

Ashley Lantz is an Operations Engineer for Encana in Colorado. She graduated with a Bachelor of Science in Petroleum Engineering from the Colorado School of Mines.



TELL US A LITTLE ABOUT YOUR JOB AND WHAT YOU DO

I work for our exploration team as an Operations Engineer. In our exploration group, operations engineers are involved in all aspects of well planning for new areas. We work with state and local officials to plan well locations, design and complete wellbores, and evaluate well performance when the wells begin producing. I spend one to two weeks per month in the field and at the well site during the drilling and completion phases. Field work is critical to the success of projects and the development of my engineering skills.

WHAT IS THE MOST REWARDING PART OF YOUR JOB?

I enjoy being involved in both the project planning and execution phases. It is exciting to be able to start with designing a project on paper and to also have the opportunity to implement designs and actually see the work take place.

WHAT IS THE HARDEST PART OF YOUR JOB?

One of the biggest hurdles is to anticipate future challenges and successfully design projects that mitigate or avoid those potential issues.

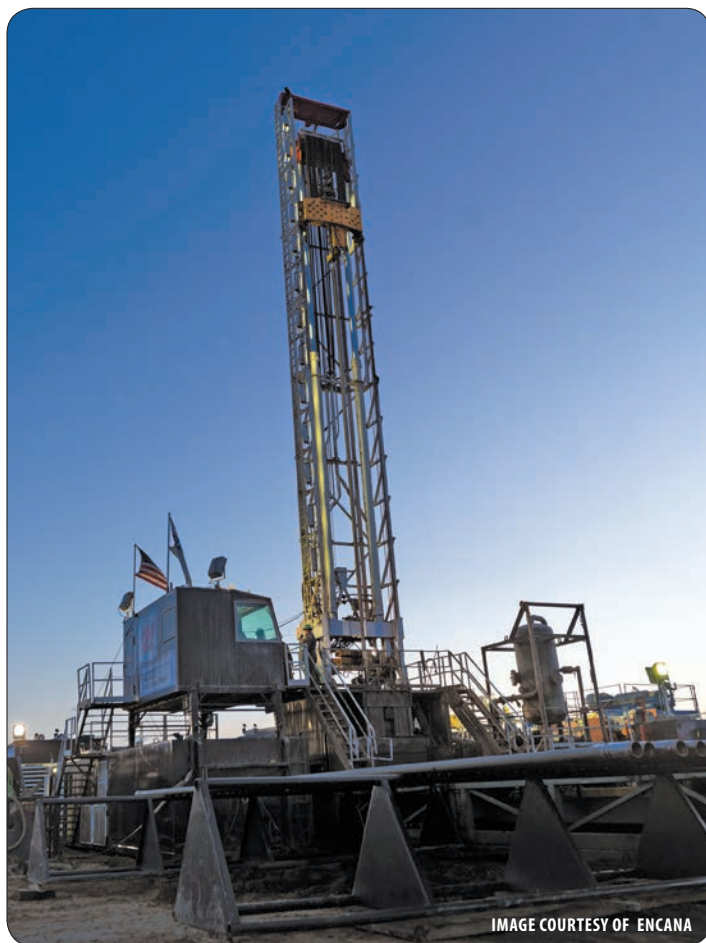
COULD YOU DO YOUR JOB ANYWHERE IN THE COUNTRY?

Our industry has both location and work schedule flexibility and as a result, engineers have many career path choices. Depending on the company, operations engineers typically have the opportunity to work from either corporate or field offices. Operations engineers also have flexibility in work schedules such as rotational work within the United States and throughout the world.

WHAT TYPE OF TRAINING OR EDUCATION IS REQUIRED?

Obtaining an engineering position at Encana required a Bachelor of Science degree; specifically I received a Bachelor of Science in Petroleum Engineering from the Colorado School of Mines. Even though I pursued a degree specific to the energy industry, engineers of other disciplines also qualify for various positions. In addition, many engineers elect to pursue graduate degrees; however, that is not required in most engineering disciplines.

While in college, I took advantage of the many internship opportunities our industry provides. I was fortunate to work three different summer internships in college. This was an excellent way to gain experience and find employment after college. My internships helped me secure a full time position with Encana early in my senior year of college.



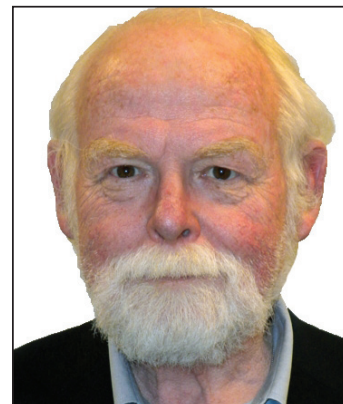
Much of Ashley Lantz's time is spent in the field at drilling sites.

Q&A

NEED GETS TO KNOW INDUSTRY PROFESSIONALS

William Pike

Dr. William Pike is currently a consultant within NISC, an IBM company, and works under contract in the National Energy Technology Laboratory (NETL), a division of the U.S. Department of Energy. Dr. Pike holds a Ph.D. from the University of Aberdeen. He has contributed to several books on oil and gas technology and energy economics and has authored technical papers on offshore drilling and production.



TELL US A LITTLE ABOUT YOUR JOB AND WHAT YOU DO?

I am an employee of IBM. I work under contract to the National Energy Technology Laboratory (NETL), a division of the U.S. Department of Energy. The Department of Energy conducts and funds research and development for the oil and gas, and other energy, industries through NETL. My work is undertaken, primarily, for the Strategic Center for Natural Gas and Oil (SCNGO) within NETL. SCNGO's mission is to conduct research that contributes directly to the enhancement of the nation's oil and gas supply in an environmentally safe manner.

HOW DID YOU DECIDE TO GO TO WORK IN THIS FIELD?

This field of work found me. A friend called to ask if I knew anyone who might be interested in the job. After he described it, I determined I was. The job allows me to bring my 20 odd years of experience in oil and gas exploration and production, plus a number of years as editor of technical publications, to bear on research and development that I believe is vitally important for our nation.

WHAT IS A TYPICAL DAY AT WORK LIKE FOR YOU?

In a typical day I will work at three to four tasks. These generally revolve around assessing research and development programs, enlisting acquaintances in the industry to review NETL programs, advising NETL on various issues and managing an outreach program to inform the industry and the public of the accomplishments of the NETL research and development program. To do this, I spend a good deal of time on the telephone and on e-mail.



IMAGE COURTESY OF THE PETROLEUM TECHNOLOGY RESEARCH CENTRE

Some of Dr. Pike's work with NETL focuses on researching new carbon capture and storage technologies.

WHAT TYPE OF TRAINING OR EDUCATION IS REQUIRED?

The job I do requires at least a bachelor's degree, preferably in engineering or the geosciences. More importantly, it requires a great deal of experience on the ground in the technical sector of the oil and gas industry.

WHAT IS THE BIGGEST CHALLENGE THAT YOUR INDUSTRY FACES?

I face the same challenge that everyone in our industry faces - the provision of energy to sustain and build the nation's economy and infrastructure in a prudent, safe and environmentally friendly manner.

WHAT ARE THE BIGGEST BENEFITS TO WORKING IN YOUR INDUSTRY?

The primary benefit of working in the upstream oil and gas industry is getting to work with people you like and respect. The upstream industry is global but the workforce is not large by most industry standards. Over the course of your career, you make lasting friendships around the globe. The second benefit that I have found in this industry is the knowledge that what you are working on is important to the entire global community.

WHAT ARE SOME OF THE OPPORTUNITIES YOU HAVE HAD THROUGHOUT YOUR CAREER?

Some opportunities that I have had include the ability to work at jobs I enjoy, the opportunity to advance in these jobs, and most importantly to me, the opportunity to live in foreign countries with my family and travel a good bit of the globe.

ANY OTHER COMMENTS OR ADVICE FOR THOSE INTERESTED IN A CAREER LIKE YOURS?

Despite a lot of rhetoric floating around today, the oil and gas industry will be a healthy industry for many decades to come. If you are interested in working in the industry, the first key to success is education. The technologies we use are extremely sophisticated. A bachelor's degree in a technical subject related to the industry is the entry card for a successful career. Past that, creating a successful career requires a lot of flexibility. There will be a lot of moves, a lot of travel and a lot of 16-18 hour days as you build your career in the industry. In the end however, it is worth it!