THE AGE OF OIL

AS THE THIRST FOR OIL CONTINUES TO GROW, PRODUCTION EFFORTS AROUND THE WORLD HAVE JUMPED INTO OVERDRIVE

BY ROBERT RAPIER

MOST PEOPLE would have a difficult time imagining life without oil.

Oil petroleum is used to produce the pesticides and herbicides that farmers use to grow crops, which are then transported to market in vehicles that contain numerous plastic and synthetic rubber parts, made from oil. These vehicles are powered by oil, and probably driven on roads made of oil-derived asphalt. Oil is also used to produce detergents, medicines, paints and nylon clothing.

Air transport is practically 100 percent dependent upon oil, while the entire U.S. transportation sector depends on oil for around 95 percent of its energy. We grew up in an age of abundant petroleum, and this is reflected in the cars we drive, the layout of our cities and our commutes to work.

Around the world, the thirst for oil continues to grow in many countries, particularly those in developing regions. Between 2011 and 2012, oil consumption in Africa, China, India and the former Soviet Union jumped by some 5 percent. The Middle East also saw a jump (4.5 percent), as did the Asia Pacific region, where consumption grew by just more than 3.7 percent—an increase of approximately 1 million barrels per day (bpd).

To feed this insatiable thirst, oil production around the world has jumped into overdrive. In 2012, global oil production reached an all-time high of 86.2 million barrels per day, according to the 2013 *BP Statistical Review of World Energy*. The United States posted the largest production increases in the world, accounting for 53 percent of the total global increase.

For the past 150 years, we have lived in the Age of Oil. We have to look back to the 1850s to see a society that did not yet benefit from this slick substance.

But how did we get to this point?

Humans have been using petroleum as an energy source and for medicinal purposes for thousands of years. Petroleum had long been collected in some locations from oil pits similar to the La Brea Tar Pits in California, but the Chinese are reported to have drilled for oil as early as 347 AD Until the 19th century, however, oil usage around the world was minor and sporadic.

That changed in the mid-19th century when several commercial oil wells were drilled in Europe and North America. While there are competing claims about who drilled the world's first commercial oil well, a well drilled in Titusville, Pennsylvania, in 1859 is widely credited with kicking off the American petroleum industry.

The story starts with George Bissell, whom many consider to be the father of the American oil industry. Bissell had an idea that so-called rock oil (petroleum) that seeped naturally from the ground in many places could be produced commercially and refined into a fuel for oil lamps. After commissioning an analysis of a local sample of petroleum that showed that the kerosene fraction indeed made an excellent fuel for oil lamps, Bissell formed the Pennsylvania Rock Oil Company, which later became the Seneca Oil Company.

Seneca hired Edwin Drake to search for oil around Titusville. Drake noticed that salt well drillers often had unwanted oil associated with the salt water they were attempting to extract, and he decided to use the same drilling technique in an effort to produce oil. In August 1859, he succeeded. An oil rush began in Pennsylvania.

Pennsylvania quickly became the most important oil-producing region in the world. As oil production rose, one casualty was the whaling industry. Prior to the commercialization of petroleum, whale oil was commonly used as fuel for oil lamps and as a lubricant for moving parts. By 1859, many whale species had been driven nearly to extinction.

But kerosene proved to be a superior option for consumers, and demand for whale oil soon plummeted. Thus the rise of the oil industry was a major factor leading to the decline of the

Drilling bit and positive displacement motor in front of a drilling rig.

This 1861 photograph shows Edwin Drake (foreground, top hat) at the original 1859 Drake oil well in Titusvile, Pennsylvania, the first commercial oil well drilled in the United States.

whaling industry, and to the recovery of many whale species.

The oil industry rapidly grew in the Appalachian Basin, with new discoveries in western New York, Ohio, Kentucky and West Virginia. The oil that was produced was transported to refineries that distilled the kerosene, while disposing of undesirable fractions like gasoline—often in nearby rivers.

A young man named John D. Rockefeller sensed a great opportunity, and began acquiring refineries and making deals with the railroads. In 1870, Rockefeller formed the Standard Oil Company, which quickly established itself as one of the world's first multinationals, and the first major U.S. business trust. The company bought out competitors, or undercut them and put them out of business. By the turn of the century, Standard Oil would control about 90 percent of the U.S. oil industry.

Standard Oil's business practices attracted a great deal of criticism, especially after a journalist named Ida Tarbell published a series of critical articles that broadly turned public opinion against the company. The federal government investigated and concluded that Standard Oil built its dominance by engaging in unfair business practices.

In 1909, the U.S. Department of Justice sued Standard under the Sherman Antitrust Act, and in 1911 the Supreme Court ruled that Standard Oil had to be split. The resulting companies went on to become Exxon and Mobil (now back together as ExxonMobil), Chevron, Marathon and Amoco (which ultimately merged with BP).

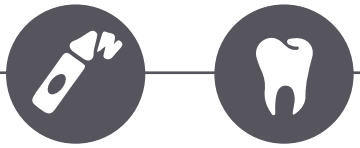
While the initial growth spurt of the oil industry was driven by kerosene demand, the late 19th century brought the invention of the automobile. Prior to that time, gasoline was a highly volatile and generally undesirable by-product of kerosene distillation. But gasoline turned out to be a very good fuel for the internal combustion engine, and the rapid growth in the early 20th century of affordable automobiles created a greater demand for oil production. In the United States, demand for Henry Ford's Model T grew rapidly, and expanding oil production provided the fuel for these cars, enabling a level of personal mobility that had never been experienced in human history.

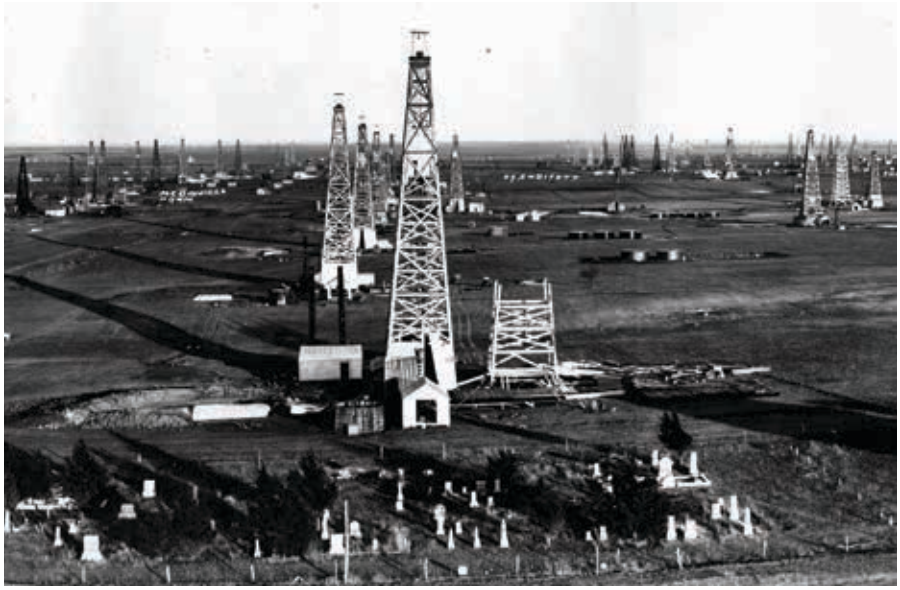
Diesel, a heavier petroleum fraction than gasoline, soon became the preferred fuel for an engine patented by Rudolf Diesel in 1892. The diesel engine would become a favored mode of transport for heavy trucking and commercial ships. And the kerosene that initially kick-started the oil industry would ultimately prove to be an ideal fuel for commercial jets. This worked out well for the oil industry since the invention of the electric light greatly diminished the demand for kerosene lighting.

Thus, the rise of the oil industry both enabled, and was enabled by, the rise of the most mobile civilization in the history of the world.

BEYOND

Americans consume petroleum products at a rate of 3.5 gallons of oil per day. But, as shown here, petroleum is not just used for fuel. Among the many uses for refined crude oil:





From left: A 1949 photo of a Standard Oil Company station in San Francisco, from the book *The Gas Station in America*, from the Johns Hopkins University Press. Three Sands Oil Field, Tonkawa, Oklahoma, in 1921.

Fueling Success of the Allies

By 1900, U.S. production had risen to 175,000 barrels per day, with production still centered in Pennsylvania and neighboring states. Ultimately, however, oil fields—and oil-producing regions in general—will reach a production peak and then begin to decline. As Appalachian Basin oil production began to decline, the oil industry moved first to Indiana and Illinois. But then major oil discoveries in Oklahoma, Texas and California shifted the heart of the oil industry to the West, a situation that continues today.

The most famous of the new round of oil discoveries took place in Texas in 1901. Outside Beaumont, Texas, near the Gulf Coast, mining engineer Anthony Lucas had been drilling unsuccessfully on a hill known as Spindletop. In January 1901, he drilled into an oil formation that blew the pipe right out of the well, which then gushed uncontrollably for nine days. This iconic image of the gusher at Spindletop would define the beginning of the oil age in Texas.

Spindletop was to that point the largest gusher the world had ever seen, but other large finds followed in Texas. In 1930, the East Texas Oil Field was discovered, and would remain the largest oil field in the United States until the discovery of Prudhoe Bay in Alaska in 1968. By the mid-1930s, Texas oil production had reached 1 million bpd, around half of total global oil production.

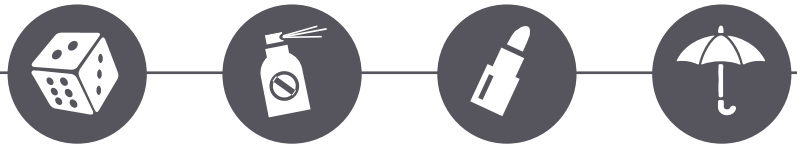
American oil would contribute to the success of the Allies in World War I, and by World War II, oil had become an indispensable strategic commodity for both sides. Oil played a role in Japan's decision to attack Pearl Harbor (an American oil embargo had caused a crisis in Japan, which relied on the U.S. for 80 percent of its oil), as well as Hitler's decision to invade Russia. The victory for the Allies was fueled by American petroleum.

The U.S. supplied 6 billion of the 7 billion gallons of oil consumed by the Allies during World War II. This was enabled by construction of a pair of pipelines that allowed shipment of crude oil and finished products from Texas to the East Coast. Further, the conversion of U.S. oil into synthetic rubber spared the Allies a rubber shortage following Japan's occupation of the Netherlands East Indies (source of 90 percent of the world's natural rubber supplies).

During the war, the U.S. government rationed gasoline and controlled prices. For the first time, the government and American consumers were confronted with the impacts of insufficient oil supplies, a lesson they would experience again in the 1970s. Nevertheless, U.S. oil production continued to grow, and continued cheap petroleum fueled the growth of suburbs following the war. Cheap oil also ensured that fuel

GASOLINE

- Antifreeze
- Crayons
- Dentures
- Deodorant
- Dice
- Floor Wax
- Hair Coloring
- Hand Lotion
- Insect Repellent
- Lipstick
- Panty Hose
- Rubbing Alcohol
- Shaving Cream
- Toilet Seats
- Toothpaste
- Umbrellas
- Yarn



Source: http://www.ranken-energy.com/Products%20from%20Petroleum.htm

BY THE NUMBERS

OIL AROUND THE WORLD

Shaybah, Saudi Arabia

Airdrie, Alberta, Canada

LEADING OIL PRODUCERS

(barrels per day in 2012)

- Saudi Arabia: 11.5 million
- Russian Federation: 10.6 million
- United States: 8.9 million
- China: 4.2 million
- Canada: 3.7 million

LEADING OIL EXPORTERS

(barrels per day in 2012)

- Saudi Arabia: at 8.9 million
- Russia: 7.2 million
- United Arab Emirates: 2.6 million
- Kuwait: 2.4 million
- Nigeria: 2.3 million

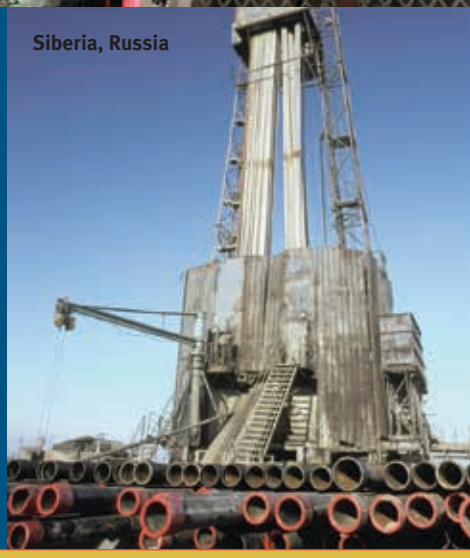
Shenyang, China

Bakersfield, California, U.S.

LEADING OIL IMPORTERS

(barrels per day in 2012)

- United States: 7.4 million
- China: 5.9 million
- Japan: 4.6 million
- India: 2.6 million
- South Korea: 2.2 million



Siberia, Russia

Photo by the Texas Energy Museum/Newsmakers

efficiency was a low priority for those shopping for a new automobile.

Oil production continued to rise through the 1950s and 1960s, and scientists continued to figure out ways of turning oil into useful products. The range of oil-based products grew, and included synthetic herbicides and pesticides that helped enable a revolution in crop production that greatly expanded agricultural output around the globe. The global population grew rapidly due to an abundance of food, and this in turn helped further increase the demand for oil.

The 1970s would begin to usher in a major geopolitical shift around global oil supplies. While U.S. oil production would continue to grow until 1970, demand for oil in the U.S. had outstripped production for decades. The U.S. had become a net importer of petroleum in 1949. When President Richard Nixon took office in 1969, U.S. oil production was nearing a peak after more than 100 years of expanding production. In 1970, U.S. oil production reached 9.6 million bpd—then began a long, steady decline.

Consumption Up, Production Down

When Nixon began his second term in 1973, oil production had declined to 9.2 million bpd while oil consumption continued to grow. As a result, oil imports would more than double during Nixon's presidency, and American citizens soon learned about the increasing geopolitical risks from growing oil imports.

From left: The Lucas Gusher blows out oil on January 10, 1901, on Spindletop Hill in Beaumont, Texas. A portion of the Trans-Alaska Pipeline in the Alaska mountain range.

The defining energy event for the Nixon administration took place in October 1973. In that month, various members of the Organization of the Petroleum Exporting Countries (OPEC) dramatically increased the posted price of oil in response to U.S. support for Israel during the Yom Kippur War, and announced an oil embargo against the United States.

from Nixon's first year in office. Oil consumption was at an all-time high, and domestic production was down 14 percent from the 1970 peak. Only three months into office, Carter delivered a major speech in which he described the energy situation as "the greatest challenge our country will face during our lifetimes" outside of preventing war.

42 : THE NUMBER OF GALLONS IN 1 BARREL OF OIL

The embargo was ultimately expanded to a number of other countries, and the result was a rapid quadrupling of the price of oil. In response, Nixon instituted additional price controls and began rationing oil to states based on 1972 levels of consumption. On November 7, 1973, Nixon announced Project Independence, the stated goal of which was energy independence for this country by 1980. To reach that goal, he signed legislation that authorized the Trans-Alaska Pipeline, opening access to Prudhoe Bay in Alaska, the largest oil field ever discovered in the United States.

When President Jimmy Carter was sworn into office in 1977, oil imports had increased by 370 percent

During Carter's administration domestic production reversed a six-year decline, after completion of the Alaska Pipeline allowed the Prudhoe Bay oil field to begin production in 1977. Excluding Alaska, however, production in the lower 48 states declined by more than 10 percent during Carter's term.

Increased production from the Prudhoe Bay oil field continued during the early 1980s and President Ronald Reagan's first term. But U.S. production began to decline during the mid-1980s. Years of high oil prices had brought online substantial oil capacity outside of OPEC. An oil glut developed, and oil prices fell more than 50 percent between 1985 and 1986. Low oil prices provided a disincentive for

WHAT IS FRACKING?

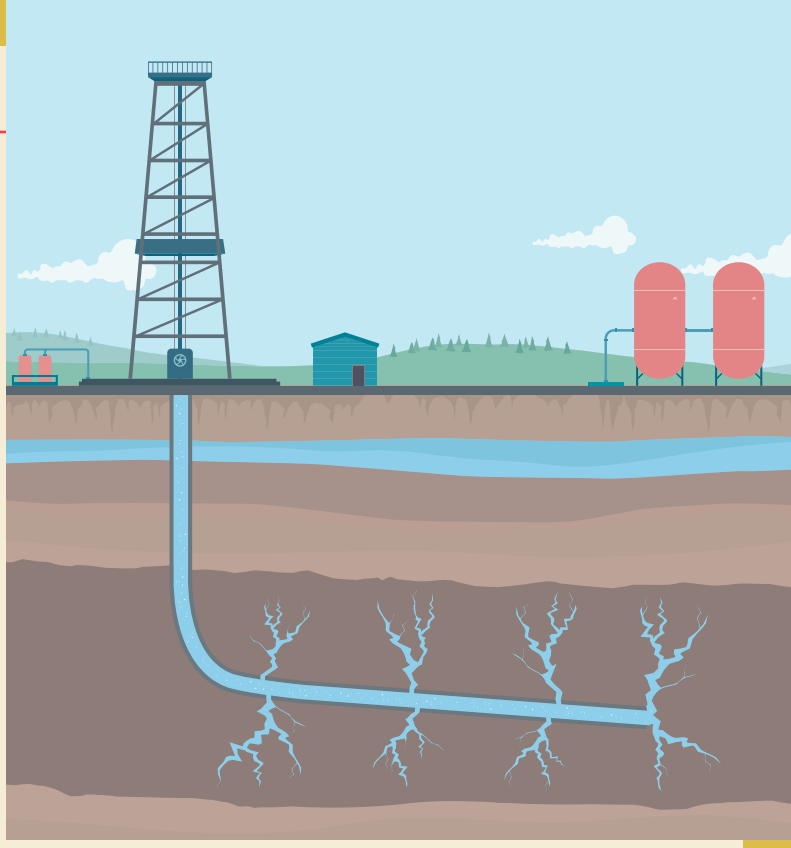
TO PRODUCE OIL, a hole is drilled into the zone where the petroleum deposit is located. The hole is lined with sections of pipe—the casing—that are then cemented into place. The casing prevents sections of the drill hole from collapsing, and also presents a barrier against contamination of aquifers that may be above the petroleum deposit.

After the casing has been cemented into place, drilling continues both vertically and then horizontally, sometimes for several miles. Inserted pipe lines the casing and the entire length of the well bore, and then must be perforated to allow oil to flow. This is done by lowering explosive charges into the oil production zones and setting them off, creating holes (of predetermined size and frequency) through the pipe. The explosions also create cracks in the reservoir rock around the pipe, which enables oil to flow into the well bore.

The cracks may be further opened by hydraulic fracturing, or "fracking," the formation. This involves pumping water, sand, gel and chemicals down the well under high pressure to open the fissures by breaking open channels in the reservoir rock. The sand (proppant) is there to hold those channels open to allow the oil (or natural gas) to flow to the well bore.

Fracking has become a controversial issue in recent years, primarily owing to misinformation around the technique. For example, a memorable scene from the Oscar-nominated film *Gasland* (2010) shows a man lighting his tap water on fire. The implication is that this was caused by fracking, but in fact the gas in the water was determined to be a natural phenomenon. Nevertheless, an image was created of a dangerous process that could contaminate groundwater.

But fracking is not new. Fracking was first commercially introduced in the oil and gas industry in 1949, and application of the technique grew rapidly in the oil and gas fields of Oklahoma and Texas. It has been carried out in some locations for more than 60 years. In recent years, fracking has been applied to wells that have been drilled horizontally.



A diagram of hydraulic fracturing, a method of extracting natural gas or oil from below the earth's surface.

Aerial view of frac sand washing sediment ponds at a Wisconsin mine.

The technology of horizontal drilling and hydraulic fracturing has created a new oil and gas boom in the United States, primarily in Texas, North Dakota and Pennsylvania, resulting in this country's once more becoming the fastest growing oil and gas producer in the world.

Fracking has been applied more than 1 million times in the United States and more than 2.5 million times worldwide; it is carried out on around 60 percent of all oil and gas wells drilled in the world. The process does carry some environmental risk. A well casing can be improperly cemented and leak into an aquifer, and cases of this happening have been documented. It is also possible to leak fracking fluids before or after the fracking job has been carried out.

But the U.S. Environmental Protection Agency (EPA) administrator has testified that the agency is unaware of any incidents of water contamination caused by fracking. The thousands of layers of solid rock that generally separate aquifers from production zones where fracking takes place present a formidable barrier against migration of fracking fluids.

A drilling rig sits on a fracking site in a Colorado farmer's field.

domestic production, and Prudhoe Bay production peaked in 1988. Thus, the decline in U.S. production that had reversed itself as Prudhoe Bay ramped up continued, and it would not reverse direction again for the next 22 years.

U.S. oil production continued to decline throughout the 1990s and from about 1999 oil prices began to climb in response to growing demand, particularly in developing countries. In turn, higher oil prices spurred innovations, such as a combination of a decades-old technique called hydraulic fracturing (see "What Is Fracking?") with horizontal drilling. Higher oil prices made application of these techniques economical for the first time, and in 2008, U.S. oil production once more began to rise, and has now risen every year since.

Just how far this new fracking revolution may take U.S. oil production is hotly debated, with some suggesting that the potential is overstated. Others claim that the U.S. will once more retake the crown as the world's leading oil producer. The U.S. has fallen to the No. 3 oil producer globally, behind Saudi Arabia and Russia, but U.S. oil production is currently rising faster than in any country in the world.

There have been many surprises since Edwin Drake drilled that well in Titusville, Pennsylvania, in 1859, but the U.S. resurgence in oil production ranks among the biggest. It just goes to show that it is too early to begin writing an obituary for U.S. oil production because even after 150 years, the industry is still going strong.

DIXON PRODUCTS IN OIL INDUSTRY

- Rotary Couplings
- Holedall Couplings
- Hydraulic Quick Disconnects (VEP, WS, W, N, P Series)
- Frac Hose Fittings
- Flange Adapters (Hammer Union x Flange, Weld x Flange)
- Two-Piece Hammer Union Nuts
- King Combination Hose Fittings (Grooved & NPT)
- Cam & Groove Couplings
- Hammer Unions
- Cam & Groove Dry Disconnects
- Rail Car Unloading Assemblies
- Swivel Joints (Load Arms, Terminal Tanks)