

The Age of Fossil Fuels Part I: The Middle Ages through 1973

Humanities 161 New Global Crisis: Energy and Water Resources for the 21st Century

by Jonathan Gilligan
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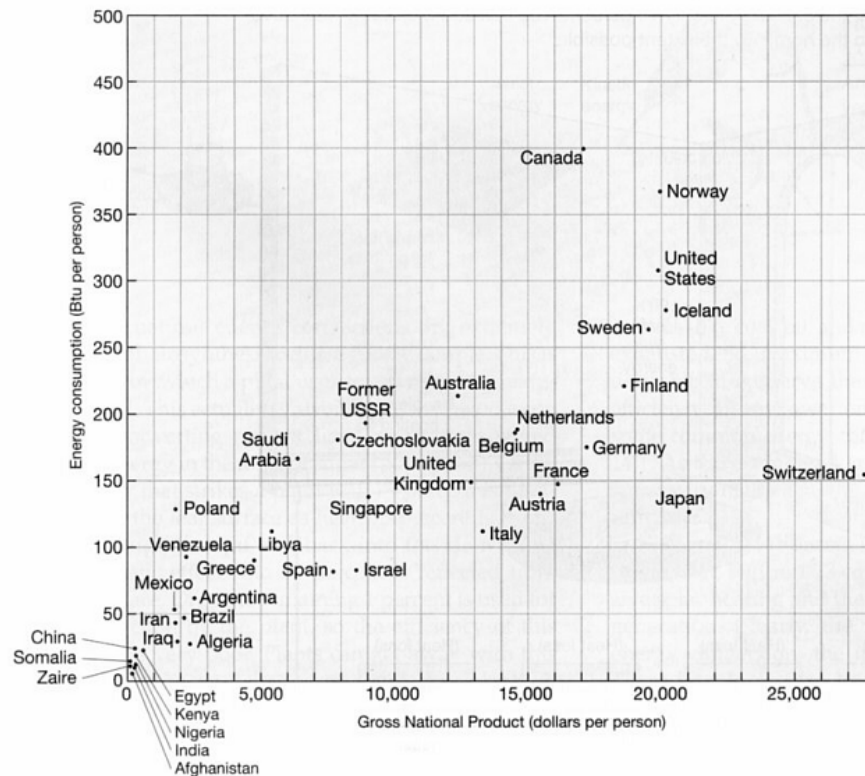


Figure 1: Importance of energy to wealth. This graph plots the per-capita energy consumption, measured in BTU per person per year² versus per capita gross domestic product, measured in dollars per person per year for a number of nations around the world. While there are exceptions, for the most part the wealth of a country is roughly proportional to the amount of energy that it uses.

1 Introduction

Energy is both the source of our wealth and also a large part of what we spend our wealth on both to sustain our lives and to enjoy our leisure. Figure 1 demonstrates that for the most part, countries that use more energy are wealthier than countries that use little energy and that their wealth is roughly proportional to their energy consumption. This correlation does not demonstrate causality—we can't tell from this graph whether wealthier nations are wealthier because they use more energy or whether they use more energy simply because their greater wealth lets them afford it. It is likely that both causal relationships are true to some extent. Using energy makes us wealthier, and as we become richer we choose to spend more of our money on energy, which can make our lives safer and more enjoyable.

Almost everything we do in our daily lives relies on a plentiful and cheap supply of energy: driving a car or riding a bus, turning on a light to read in a dark room, listening to recorded music, watching television, cooking and refrigerating food, shopping in stores that stock goods from all over the world. Before electricity was as cheap as it is today, aluminum was not something in which you wrapped leftovers; it was a semi-precious metal. Despite bountiful reserves of bauxite ore around the world, it simply took too much energy to purify aluminum for this metal to be part of daily life.

This handout will sketch an outline of the history of human use of fossil fuels. A thorough treatment of this subject would take many hundreds of pages and the history of oil alone could be the



Figure 2: Sea coal scattered on the beach at Blackhall, England.

subject of a busy semester's course. If you are curious to learn more, I can recommend highly Daniel Yergin's book, *The Prize: The Epic Quest for Oil, Money & Power*.^[8] In fact, I have drawn much of this history almost verbatim from Yergin's account. The book is wonderfully written and well worth reading, but at almost 900 pages is far too long for us to read for this class.

We will begin our exploration of energy and fossil fuels with a curious surplus. By the late 13th century, London had so much coal it was running out of places to put it.

2 The Birth of Coal

All the coal smoke was infuriating King Edward I of England. The year was 1271. Edward was about to issue one of the first antipollution laws and the penalties were far beyond anything today's Environmental Protection Agency might consider.

As the population of the British Isles grew from around half a million in 500 C.E. to around 5 million in 1300,^[1] and as available firewood was consumed both for heat and for primitive industry, such as smelting and forging metals, demand grew for other sources of heat. Since Roman times, people had scavenged bits of coal, called *sea coal*, from veins exposed when the ocean eroded land near the coasts. At first, this worthless mineral, combined with sand, was used as ballast in ships.^[2] Ships sailed from remote parts of the British isles to London, empty save for sea-coal ballast, and dumped their ballast as they took on cargo.

Over time huge mounds of sea coal piled up around the port city and simply finding places to put all the coal became a problem. As firewood became scarce, Londoners turned for fuel to the supplies of sea coal readily at hand. Sea coal was of a low grade³ and produced large amounts of sulfurous

³Low-grade means that the coal produced less heat, pound-for-pound, than higher grade coal, such as anthracite. Lower grades of coal contain higher quantities of water and sulfur and less carbon than higher grades. Anthracite, the highest grade of coal, is almost pure carbon. However, significant quantities of anthracite did not become available until the mid-

smoke when it was burned.

By the late 13th century, the inhabitants of London were burning so much sea coal that in 1247, Queen Eleanor was driven from Nottingham Castle by the fumes after her attempts to ban the burning of sea coal proved futile.[3] By 1271, coal smoke had become so bad that Edward I banned selling or burning of sea coal on pain of torture and death. The next person caught burning sea coal was indeed put to death, but executions did little to stop the use of sea coal and in 1285 a Royal commission was established to find a way to remedy the situation. Even three centuries later, in 1590, Queen Elizabeth complained that she was “greatly grieved and annoyed” by coal smoke in Westminster Palace.

As unpleasant as it was, coal smoke in the 13th–17th centuries was nothing compared to conditions in the 19th and 20th. From the 1860s through the 1950s, dozens of “smog” disasters occurred, each killing hundreds or thousands of people. The worst, on December 5–9 1952, killed over 3000 people in less than a week.

Deadly episodes of coal smog have occurred elsewhere in Europe and in the United States, but nowhere has the problem been nearly as persistent or as deadly as in London during the century from 1860–1960. Today the use of coal is still controversial because of coal’s contribution to smog, acid rain, and the emission of toxic metals, such as mercury.

3 The Steam Engine and the Age of Coal

While the use of coal grew in England from the 13th to the 18th centuries, there were limits both to the amount of coal people needed to burn for heating or for forging iron and other metals. Moreover, as people mined more coal from the easily accessible veins near the surface, they began to dig ever deeper mines, but quickly ran into an insurmountable problem: water. As mine shafts and tunnels were dug below the water table, the mines would flood. If the water seeped slowly into the mines, men or animals might drive pumps to remove the water, but eventually the water would flow faster than the pumps could keep up.

By the mid-17th century, mine owners were clamouring for a mechanical pump that might allow them to remove water faster than men or horses could do. Around 1650 there was a flurry of inventions attempting to use steam to power pumps, and in 1702, Thomas Savey demonstrated a practical pump that used steam power to extract water from mines.[4] Savey’s engine was not automatic—it required someone to open and close valves in rhythmic synchronization with the pump’s operation, but it enabled its operator to turn valves and stoke fires rather than supply the work to drive the pump.

Savay’s engine was a remarkable device, but the steam engine really came into its own when Thomas Newcomen invented the fully automatic steam engine in 1712.[5] Newcomen’s engine turned its own valves, eliminating the need for an operator to carefully watch the machine and open and close the valves in time with the engine’s strokes. Newcomen’s engine allowed miners to lift water from far greater depths than had been possible previously and thus increased dramatically England’s supply of coal.

Newcomen’s steam engine quickly spread to mines throughout Europe and was adopted for other uses: first, for pumping water for other purposes, such as supplying the city of Paris, and then for operating machinery in textile and metalworking factories. In 1774 Catherine II of Russia ordered the largest Newcomen engine in the world, to pump the naval drydocks at Kronstadt. Previously, giant windmills 100 feet tall took an entire year to pump the water from the drydocks. The new steam powered pump did the job in two weeks![6]

Newcomen’s engine was awesomely powerful, but terribly inefficient. It was said that “it took an iron mine to build a Newcomen engine and a coal mine to keep one going.”[7]. Less than one percent of the heat produced burning coal was converted into work by the Newcomen engine. James Watt, a Scottish engineer, began perhaps the first systematic study of energy efficiency and beginning in 1769

19th century

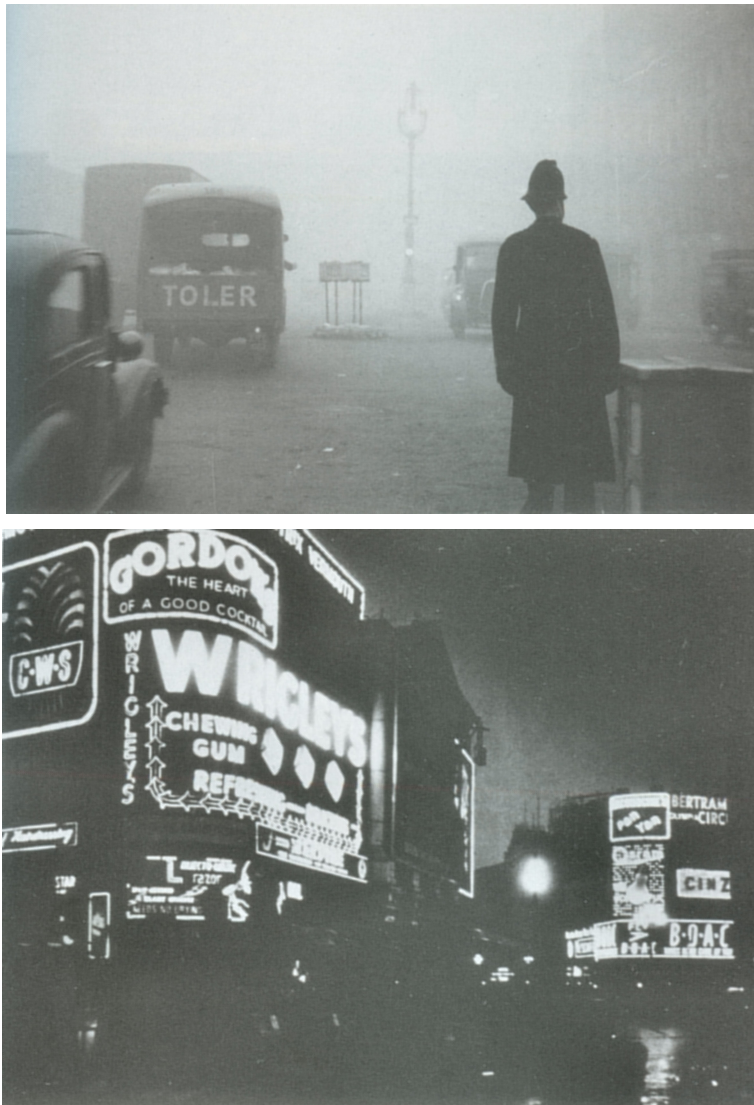


Figure 3: **Longon smog, 1950s.** **Top:** December 1952, midday. When this photo was taken, visibility was less than 30 ft. At the worst point, people could not see their hands when they stretched their arms out, nor their feet beneath them. **Bottom:** Piccadilly Circus, Jan. 16, 1955, midday.

he made a steady stream of discoveries and inventions that revolutionized the use of steam. By 1800 Watt had sold over 500 steam engines.

For marketing his engines, Watt needed a standard way to describe the power his engines could produce, so he conducted careful measurements of the work horses were able to do and in 1783 he created the first standard definition of the “horsepower.” It was not possible to compare the output of Watt’s engines with those of Newcomen. Watt’s engines were dramatically more efficient, producing three times or more the amount of work a Newcomen engine did for each pound of coal burned.

Throughout the 19th century, the science of thermodynamics advanced and its application to the efficiency of engines allowed steam engines to improve by great leaps and bounds over their primitive predecessors.

As steam engines improved, they became the dominant source of power for industry and rail and sea transportation, and eventually for generating electricity, demand for coal soared and consumption of coal rose by a factor of roughly 30 from 1800–1900 in Britain alone.

In the early 20th century, though, oil began to replace coal as the dominant fossil fuel and it is to oil that we will next turn our attention.

4 The Birth of Oil⁴

In *The Prize*, his masterful history of the oil industry, Daniel Yergin sets the birth of the age of oil at the year 1854, when a group of entrepreneurs hired Yale chemistry professor Benjamin Silliman, Jr., to research whether a substance known as “rock oil”—also called *petroleum*, which is Greek for rock oil—might be converted into kerosene, which could be burned in oil lamps to light homes and offices.[8] At that time, the best source of illumination was lamps that burned sperm whale oil, but whales were becoming scarce and a new fuel was needed. When Silliman told his clients that it looked promising to refine kerosene from rock oil for use in lamps, the age of oil was born.[9]

4.1 Finding Oil

All that remained was to find a source of oil. Since ancient times, people had found small quantities of petroleum where it spontaneously leaked from the ground. The first records of petroleum, a tar-like substance known as *bitumen*, date from 3000 BCE in a region of Mesopotamia near modern Baghdad. However, for nearly 5000 years no one could find a better way to collect petroleum than to mop it up with rags in those few places where it seeped to the surface.[10]

The businessmen who hired Silliman were looking for oil on a far grander scale, but had not definite idea that there were any large supplies of oil anywhere on earth. What they did have was a vision born of an observation and a lucky guess. For 1500 years, the Chinese had been obtaining salt by drilling wells as deep as 3000 feet and pumping brine up to the surface. When Americans began to use this Chinese technique to mine salt in the United States, they often found their brine contaminated with oil. This oil would usually be separated and sold by local druggists as patent medicine.[11]

In 1852, George Bissell—a self-made man who had put himself through college at Dartmouth and subsequently worked as a journalist, a professor of Classics, a lawyer, and superintendant of schools for New Orleans—decided that he would make his fortune by mining oil the way others mined salt, extracting kerosene, and selling it for use in lamps. Bissell hired Silliman to research the feasibility of refining kerosene from petroleum and, after receiving Silliman’s favorable report, set out to find large quantities of oil in Western Pennsylvania, where he had once seen people soaking up oil from natural seepages.[12]

Bissell’s project led to the small town of Titusville PA, pop. 125. However promising Titusville seemed, the hard realities of drilling for oil were daunting. It was difficult to find competent drillers.

⁴This section and the remainder of this handout is essentially a summary of the history of the oil industry presented in Daniel Yergin’s excellent book, *The Prize*. [8]

Drilling itself was slow and expensive. As months passed without oil, investors in the company grew skittish and began to pull out. Finally, James Townsend, the banker who had invested the most money—from his own pocket—into this venture, decided to pull the plug. In late August 1859 Townsend wrote Edwin Drake, his head man in Titusville, telling him to pay off his workers and stop drilling. On Saturday, August 27, while the letter was in transit, the drill at Titusville dropped into a crevice in the rock and drilling had to be halted for the rest of the day. On Sunday the head driller noticed oil in the drill pipe. On Monday, a hand-pump was set up and oil was pumped directly from the ground. Later that day, the letter from Townsend arrived telling Drake to shut down the operation.[13]

The discovery of oil in Titusville created an oil rush. speculators bought up land at astronomical prices and even the whiskey barrels in which the oil was stored and transported were bid up until they sold for twice the price of the oil they would hold. In a little more than a year, 75 wells were producing oil in the vicinity of Titusville and twenty refineries had been established to extract kerosene from the crude oil.

4.2 Civil War, Boom, and Bust

By April 1861, the month the Civil War broke out, thousands of barrels of oil were being produced each day. Inexpensive kerosene was available and was driving other lamp fuels out of the market. Petroleum was so successful, in fact, that by the end of 1861, the supply of kerosene so outstripped demand that the price of crude oil fell by a factor of 100, from \$10 to 10¢ for a barrel.[14]

However, the Civil War together with increasing industrial demand soon drove oil prices back over \$7 per barrel and by the end of the war, the price had almost doubled again to over \$13 per barrel. The next few decades were marked by booms and busts in the oil business. New oil fields would spring up; speculators would bid up land and supplies to astronomical heights. Sometimes oil would flow and bring wild profits. Other times, the wells would peter out and prices would come crashing down, ruining investors and leaving ghost towns.

Eventually, order came to the oil industry, but at a high price.

4.3 Standard Oil

In 1865, a twenty-six year old businessman named John D. Rockefeller, bought out his partner for \$72,000⁵ and became sole proprietor of the largest oil refinery in Cleveland, OH. Rockefeller was not content to hold just this refinery. In fact, the split with his partner occurred because the two disagreed over Rockefeller's desire to expand the business rapidly. Within a year, Rockefeller had built a second refinery and established a new company in New York to manage shipping and selling the kerosene from his refineries throughout the East Coast.

Rockefeller was not alone in expanding his refineries. The rapid growth of the oil industry led, by 1870, to the supply of kerosene exceeding the demand by a factor of three, which caused prices to fall to half what they had been a few years previously. Rockefeller's response was to expand his business even more, but to protect it from wild price fluctuations by exerting greater control over the market. His first act was to enter into a clandestine agreement with other oil refiners as well as the railroads to increase the prices charged to ship oil from the wells to the refineries. This would cut the supply and hence increase the price the largest refiners could charge for their kerosene. This scheme failed when the oil producers boycotted the large refiners as well as the railroads and publicized their objection to the "forty thieves," as they called the refiners' cartel. Although Rockefeller lost this battle, it was a taste of more sophisticated games he would play in years to come.

Through the 1870s, oil surpluses became so severe that prices dropped to 48¢ a barrel—less than the price of water—and farmers' fields in oil regions were often flooded with oil that overflowed from storage tanks.

⁵This would be equivalent to about \$800,000 today.

Rockefeller took advantage of his strong position as one of the largest refiners to manipulate the markets—covertly cornering the market on supplies refiners needed, such as barrels. He would buy up failing refiners and use his market share to coerce others to either play ball with him or face price wars that would ruin them. By 1879, Rockefeller's Standard Oil Company controlled over 90 percent of the refining capacity in America.

Now Rockefeller essentially controlled oil production in the United States. The United States was the only major oil producer in the world, so for all practical purposes, the entire world's oil supply was controlled by a single man.

5 Worldwide Oil Discovery Boom

In the 1870s, the prospect of oil anywhere else than Pennsylvania and Ohio was of little more than academic interest. The Pennsylvania Geological Report of 1874 stated that while it was possible that “the drill in other countries . . . would find oil” eventually, this was only a remote possibility “that some day may interest us.”[15] But as the Geological Report was writing this, it did not know that day had already dawned.

Immanuel Nobel, a Swedish inventor and businessman living in Russia, had three sons: Robert, Ludwig, and Alfred. Alfred, who later became the most famous, lived in Paris, where he managed a worldwide business selling his invention, dynamite. Ludwig and Robert remained in Russia, where Robert worked for Ludwig, who owned an armaments company that did business with the Russian government. In 1873, while on a business trip to Baku, Georgia, Robert observed a rapidly growing oil industry. Ludwig had sent Robert to Baku with money to buy wood to make stocks for rifles, but Robert spent the money instead on a small oil refinery.

Within a few years, the Nobel brothers dominated the Russian oil business. They built the world's first tanker ship for transporting oil by sea and hired the first full-time professional petroleum geologist. By the early 1880s, Russian oil production had grown to one third of America's. In 1886, a second major oil company set up business in Baku: The Caspian and Black Sea Petroleum Company, owned by the French banking family Rothschild.

Through most of the 1880s, the Nobels and the Rothschilds posed little direct competition to Rockefeller's Standard Oil. Standard Oil did most of its business in America and England and the cost of shipping oil from Baku was too great for Russian oil to pose a great threat. This changed in 1888 when both the Rothschilds and the Nobels established shipping and importing companies based in London and developed cheaper ways of transporting their oil. For the first time in over a decade, Rockefeller had to worry about serious competition.

In 1892, the threat from Russian oil became even more acute as an English merchant Marcus Samuel acquired rights to ship oil from Baku through the Suez Canal. Samuel had commissioned new tanker ships that could carry enormous quantities of oil more safely and more efficiently than previous designs. Rockefeller responded by warning the British government of the dangers involved in giving so much of its business to a business so dominated by “Hebrew influence” (both Samuel and the Rothschilds were Jewish), but the English saw their interests more closely aligned with the Rothschilds consortium than with the Americans and gave Samuel rights to ship his oil through the Suez Canal. As the newspaper *The Economist* wrote, “Whether it is true, as its opponents insinuate, that it is purely of Hebrew inspiration, we are not concerned to inquire; nor does it appear why such a circumstance should count against it. . . . [T]he scheme certainly seems full of promise.”[16]

Nor was Russian oil the only source of competition for Standard Oil. Between 1885 and 1891 yet another major oil company, Royal Dutch, was founded. Royal Dutch's oil came from the Dutch East Indies, principally Sumatra. During the early 1890s Royal Dutch and Marcus Samuel became close, eventually merging into a single enterprise Royal Dutch/Shell (Marcus had named his oil business “Shell” in honor of his father who had sold decorative boxes covered in sea shells).

5.1 The 20th Century

At the twilight of the 19th century, there were three major oil reserves in the world: Western Pennsylvania and Ohio; Baku; and the Dutch East Indies. In the United States, Standard Oil controlled the market and everyone agreed that oil was largely an Eastern phenomenon. All of this changed in the 1890s, when major oil finds took place near Los Angeles. In 1893 California produced only a little oil—less than half a million barrels. By 1903 California was producing over 24 million barrels per year. Texas also was discovered to have bountiful supplies of oil. In 1900, a well drilled on a hill called Spindletop in Beaumont Texas produced oil. The drillers thought it might yield as much as 50 barrels a day. On January 10 1901, further drilling on this well produced a large gusher—an uncontrolled fountain of oil that destroyed the drilling rig, tossed rocks hundreds of feet into the air, and produced 75,000 barrels of oil per day.

The Spindletop gusher produced an even more riotous oil rush than the original find in Titusville, and within a year produced a greater crash when the oil was depleted. However, this was only the beginning of Texas and Oklahoma oil, which soon made Pennsylvania quite insignificant and threatened Standard Oil's power. Both Gulf Oil and Texaco were founded in this period. By 1911, Standard Oil's share of the petroleum market in the United States had declined from 90% to around 60%.

Standard Oil was running into greater obstacles. In 1906, President Theodore Roosevelt had filed antitrust charges against Standard Oil in federal court and in 1911, the final verdict was delivered by the Supreme Court, which upheld a ruling by a lower federal court that Standard Oil must be dissolved.

6 The Automobile

During the 19th century, gasoline was a byproduct of petroleum refining that was practically junk. Gasoline was used for cleaning grease off things but for very little else. All this changed with the rise of the automobile. In 1910 for the first time, gasoline sales exceeded those of kerosene. Now refineries raced to find ways to extract more gasoline from petroleum. In natural crude oil, gasoline makes up 15–18 percent. This had not been a problem when gasoline was a waste product, but now that it was the most valuable constituent of oil, refineries wanted more. The modern refinery was born when a chemist working for Standard Oil discovered a process called “thermal cracking” that used heat to break long, heavy, sticky molecules in crude oil into short, light, fluid gasoline. By heating crude oil to temperatures of 650 degrees Fahrenheit or more, under great pressure, it was possible to more than double the yield of gasoline from crude oil to 45%.

This had a significant impact for Standard Oil because it meant that even after the dissolution of the monopoly, Standard Oil held all the patents for synthetic gasoline.

Automobile use and ownership grew at a phenomenal rate. Despite a world war, the number of automobiles in the United States grew to over 23 million by 1930—one car for every five people in the nation. Oil now accounted for 25% of the nation's energy consumption and gasoline and diesel fuel represented about 85% of the oil consumption. Kerosene, which had kicked off the oil boom was now only a tiny fraction.

The early years of the automobile boom also brought the first taste of oil shortages. Oil consumption was growing rapidly, but discoveries of new petroleum reserves were not keeping pace. The price of oil almost tripled between 1916 and 1920. There were widespread fears that the world might run out of oil just as people were becoming dependent on it.

6.1 Deep oil exploration

All of this changed in 1923 when the oil industry discovered a technique called “refraction seismography” that used explosions set off on the surface to map layers of rock deep within the earth. These techniques allowed geologists at oil companies to search for oil far below ground in places they would not otherwise have thought to look. During the following decade many other applications of geology

to the search for oil revolutionized the industry and allowed a much more systematic approach to finding oil.

The speed with which these new techniques discovered oil led to the amusing coincidence that the Federal Trade Commission warned in 1923 that “the supply of crude petroleum in this country is being rapidly depleted,” just as new discoveries caused U.S. crude oil production to exceed demand for the first time in a decade.[17]

6.2 Mexico and Venezuela

In the early 20th century, several U.S. oil entrepreneurs with experience in Texas and California began to look south to Mexico as another source of oil. In 1910 a major oil reserve was discovered by the English explorer Sir Weetman Pearson. Pearson’s find quickly became the largest oil well in the world, producing over 100,000 barrels per day. Additional finds advanced Mexico by 1921 to the position of the world’s second largest oil producer, behind only the United States. In 1922, a well in Lake Maracaibo Venezuela began producing over 100,000 barrels a day and by 1927, Venezuela had overtaken Mexico for the number two spot.

Mexican and Venezuelan oil came at an important time because US demand was rising beyond domestic producers’ ability to supply. In the early 1920s the US was importing about 20% of its oil from Mexico and the politics south of the border had become crucially important to the United States’s energy needs. This made relations between the two nations particularly fraught both during the years of the Mexican Revolution from 1911–17 and during subsequent developments, such as President Lázaro Cárdenas’s decision in 1927 to nationalize the Mexican oil industry.

7 Oil in the Middle East

Oil was first discovered in large quantities in the Middle East in Iran in 1908 by Anglo-Persian Oil, a British firm owned by William Knox D’Arcy. D’Arcy turned a profit of almost £900,000 (equivalent to about \$55 million in today’s money), but did not make as much as he had hoped to by his find, for he had gone so far into debt financing the expedition that he had needed to turn over almost all of his interest to the Scottish firm Burmah Oil. Under Burmah’s management, Anglo-Persian Oil became a crucial piece of the British oil strategy.

Other nations, such as Germany, were converting their warships from coal to oil. Burning oil allowed the ships to produce more power, which let them accelerate and maneuver more quickly. Coal fired warships required a large fraction of their crews to shovel coal into the boilers, so during battles much of the crew was tied up in the coal bunkers instead of manning guns. A shift to oil, which could be automatically pumped to the engines, would allow more efficient use of the crew. Winston Churchill described the problem: “As a coal ship used up her coal, increasingly large numbers of men had to be taken, if necessary from the guns, to shovel the coal from remote and inconvenient bunkers to bunkers nearer the to the furnaces or to the furnaces themselves, thus weakening the fighting efficiency of the ship perhaps at the most crucial moment in the battle. . . . The use of oil made it possible in every type of vessel to have more gun-power and more speed for less size or less cost.”[18]

But England was blessed or cursed with large supplies of coal and no oil. Many leaders of the British admiralty worried that switching the navy from coal to oil would make Britain vulnerable to foreign supplies of fuel. Besides, according to Lord Seldon, the first lord of the Admiralty in 1902, “The substitution of oil for coal is impossible, because oil does not exist in this world in sufficient quantities.”[19] In 1911 Winston Churchill was named the first lord of the Admiralty and proceeded, with the assistance of Admiral Jacky Fisher, to press for the immediate conversion of the British Navy to oil. Lord Hardinge, the Viceroy of India, looked at a conversion to oil as absurd, declaring that “it is rather as though the owners of the *premier cru* vineyards in the Gironde went about preaching the virtues of Scotch whiskey as a beverage.”[20]

Churchill recognized that “The oil supplies of the world were in the hands of vast oil trusts under foreign control. To commit the navy irrevocably to oil was indeed to take arms against a sea of troubles,” but that “If we overcame the difficulties and surmounted the risks, we should be able to raise the whole power and efficiency of the navy to a definitely higher level; better ships, better crews, higher economies, more intense forms of war power—in a word, mastery itself was the prize of the venture.”[21]

Indeed, Churchill noted, oil was to become the foundation of the British economy. “If we cannot get oil, we cannot get corn, we cannot get cotton, we cannot get a thousand and one commodities necessary for the preservation of the economic energies of Great Britain.”[22] Moreover, since “the open market is becoming an open mockery,” the British government should not rely on the market, but should become “the owners or, at any rate, the controllers at the source” of the oil needed to run the navy. With this in mind, the British admiralty took a controlling interest in Anglo-Persian Oil, thus ensuring a reliable supply of oil at a reasonable price.

Oil turned out to be key to the First World War. Not only in naval battles, but in transportation on land. Previous wars had relied on trains to transport troops, and once off the trains, the troops had to march on foot. Horses might draw artillery and supplies, but the movements of troops were largely limited to walking pace. World War I introduced both trucks for transportation, tanks as fighting vehicles, and airplanes as well. Modern warfare now depended on vehicles that burned oil and thus on the ability to supply them with fuel.

In World War II, the problem of fuel supplies became even more acute. The war in the Pacific was dominated by Japan’s desire to obtain oil. After invading China in 1937, Japan sought to obtain fuel to support its war effort by demanding that the Dutch East Indies supply ever greater amounts of oil. By 1940, Japan was threatening war against Holland, Britain, and other nations with presence in the Pacific if they did not supply war materials, particularly oil. The United States responded by issuing an embargo against increasing the amounts of oil or other war materials that we would sell to Japan. By the middle of 1941, tensions had escalated to the point that the United States froze all Japanese financial assets in the US, which had the effect of making the oil embargo against Japan complete. While Japan’s decision to attack Pearl Harbor was a complicated one, influenced by many factors, there is no question but that the politics of oil played an enormous role.

As the United States went to war in 1942 oil was needed for the war effort and strict rationing was implemented on the home front. Even so, it was difficult to obtain enough oil to supply our troops. Fortunately for the war effort, the kingdom of Saudi Arabia was facing a financial crisis. The war had interrupted the pilgrimages to Mecca and Medina that brought money to the kingdom. Moreover, a drought crippled the agricultural economy. King Ibn Saud came to the British and the Americans, saying, “The Arabs have the religion, but the Allies have the money.” President Roosevelt did not want to aid a tyrant, even if he might help the war against Hitler, but the British were more open minded and provided subsidies beginning with a cash payment of \$2 million to the king.

7.1 After the war

After WWII ended and oil rationing was lifted in the US, Americans began driving as never before. Between 1945 and 1950 the number of cars in use grew from 26 million to 40 million and gasoline sales grew by 42%. By 1950 oil was, for the first time, supplying more energy than coal. Oil companies jumped headlong into major exploration campaigns and for a time were able to discover oil faster than they pumped it from the ground. Proven reserves of oil in the US grew by 21% between 1945 and 1950: despite burning almost half again as much oil as in 1940, America’s supplies of oil were growing rather than shrinking. It seemed as though we would never run out.

However, even though we had more supplies of oil in the ground, extracting it, refining it, and transporting it were difficult and supplies to gas stations lagged, creating shortages. In 1948, for the first time in American history, the US began to import more oil than it exported. We were now dependent on foreign oil.

America's ties to Saudi Arabia from World War II came into play. Although it was the British, not the Americans, who subsidized Ibn Saud, Americans in the oil business claimed that the subsidies really came from the U.S. but were simply passed through the UK. More importantly, the US firms had the ready money and the technical expertise to help the Saudis quickly develop their oil resources. In this climate, a new company was formed: ARAMCO—the Arabian-American Oil Company, a joint venture between Saudi Arabia and two US oil firms: Socal (Standard Oil of California), and Texaco.

Other oil companies struck similar deals with the other Arab oil states: Gulf and Shell in Kuwait and Anglo-Iranian Oil together with two U.S. firms (Jersey and Socony) in Iran.

The subsequent political, economic, and military activities in the Middle Eastern oil states are sufficiently complicated to merit their own course. We will pass over them, but I would highly recommend reading *The Prize* if you would like to learn more about how oil politics contributed to the mess the region finds itself in today. Water also played a significant role in Middle-Eastern conflicts and continues to do so today. We will learn more about this when we study water resources later this term.

7.2 Oil Embargoes as Political Weapons

From the mid-1950s on the Arab oil states have threatened or attempted to use their oil resources as political weapons. In the 1960s, Gamel Abdel Nasser, the dictator of Egypt, had attempted to unite the Arab states to boycott selling oil to nations that opposed them. In May 1967, he attempted to prevent Israel from obtaining oil imports through naval blockades. The following month, these blockades, together with conflicts between Israel, Syria, and Jordan over water, and Israel's fear that its neighbors were preparing to invade, set off the six-day war.

The day after the war broke out, Arab oil ministers began discussing oil embargoes against nations that supported Israel. Saudi Arabia, Libya, Iraq, Kuwait, and Algeria all banned exports of oil to the United States and Britain. However, despite the fact that the U.S. response was so disorganized that officials came to refer to it as a "floating crap game," the oil producers were even more disorganized. There were so many non-Islamic oil states in the world that fairly quickly, oil imports and exports reorganized: embargoed states (principally the U.S. and Britain) increased their imports from non-Arab producers, such as Mexico and Venezuela, while non-embargoed states increased their imports from the Arab states and cut their imports from non-Arab states. Within a few weeks, oil shipments had been re-arranged and the embargo had short-circuited. Moreover, the economic damages the Arab states had endured at Israel's hands during the war left them in dire need of foreign revenue and this too undercut support for the embargo.

A more severe embargo took place beginning in 1973. By this time, things had changed dramatically. The U.S. was far more dependent on oil imports than it had been in 1967—oil imports had doubled since 1969—and Saudi Arabia had achieved a much more central role in the world oil economy. Despite previous predictions that the U.S. would not depend significantly on Arab oil until 1985, by 1973 as Yergin describes it, "Saudi Arabia had at last graduated to the position once held by Texas; the desert kingdom was now the swing producer for the entire world." [23]

The US was running out of oil. Production was lower in 1973 than it had been in 1970, and consumption was up. We were now importing about 45% of our oil. Meanwhile Saudi Arabia had increased its oil production dramatically and now supplied 21% of the world export market.

On October 6 1973, several Arab states, dominantly Egypt and Syria, attacked Israel on the Holy day of Yom Kippur. To dissuade other nations from coming to Israel's aid, Egypt's president Anwar Sadat persuaded Saudi Arabia to threaten an oil embargo against friends of Israel. On October 21, Saudi Arabia declared an oil embargo and called on Aramco, the private-sector Arabian-American Oil Company, to enforce the embargo.

Within weeks gasoline prices in the US had shot up and gas stations had lines that snaked around the block. The United States discovered that it was vulnerable to the use of oil as a weapon by our enemies.

Part II of this handout will pick up with this embargo and give a brief history of energy in the United States in the years since.

References

- [1] J.C. Russel, "Population in Europe," in Carlo M. Cipolla, Ed., *Fontana Economic History of Europe, Vol. I: The Middle Ages* (London: Collins Fontana, 1972), p. 26.
- [2] Devra Davis, *When Smoke Ran Like Water: Tales of Environmental Deception and the Battle Against Pollution* (New York: Basic Books, 2002), p. 33.
- [3] *When Smoke Ran Like Water*, p. 34.
- [4] by R. S. Kirby et al., *Engineering in History* (New York: Dover, 1990), pp. 156-9.
- [5] *Engineering in History*, pp. 162-6.
- [6] *Engineering in History*, p. 167.
- [7] *Engineering in History*, p. 166.
- [8] Daniel Yergin, *The Prize: The Epic Quest for Oil, Money & Power*, (New York: Free Press, 1991).
- [9] *The Prize*, pp. 20-2.
- [10] *The Prize*, pp. 23-4.
- [11] *The Prize*, p. 25.
- [12] *The Prize*, pp. 20-6.
- [13] *The Prize*, pp. 26-8.
- [14] *The Prize*, pp. 28-34.
- [15] *The Prize*, p. 57.
- [16] *The Prize*, p. 67.
- [17] *The Prize*, p. 220.
- [18] *The Prize*, p. 156.
- [19] P.K. Kemp, ed., *The Papers of Admiral Sir John Fisher*, Vol. 1 (London: The Navy Records Society, 1960), p. 81; quoted in Erik J. Dahl, "Naval Innovation: From Coal to Oil," *Joint Forces Quarterly*, Winter 2000-1, pp. 50-6.
- [20] *The Prize*, p. 163.
- [21] Winston S. Churchill, *The World Crisis*, Vol. 1 (New York: Scribners, 1923), pp. 133-36; quoted in "Naval Innovation," *op cit*.
- [22] *The Prize*, p. 160.
- [23] *The Prize*, p. 606.