

A Brief History of Oil Production

“In the longer run, unless we take serious steps to prepare for the day that we can no longer increase production of conventional oil, we are faced with the possibility of a major economic shock—and the political unrest that would ensue.”

Dr. James Schlesinger - former US Energy Secretary

In simplistic terms energy is the ability to do work. Energy may take on various forms such as thermal (heat), radiant (light), kinetic (motion), electrical, chemical, nuclear and gravitational. Animals as with humans derive most of their physical energy from sunlight. For much of human history, the principal form of energy was muscle power. This was made possible through the photosynthesis of plants, enabling animals and humans to convert plant based material into energy. Records show Early Stone Age people used fire to generate energy for heat, cooking and keeping predators at bay. Wind power propelled boats on the Nile from around 5,000B.C. The Persians used wind to pump water and drive sails, which helped grind grain between 500 and 900 B.C. Preceding this, other cultures used a loose mix of fossil fuels such as coal, oil and wood to generate heat and energy. In 1710, Thomas Newcomen invented the steam engine which was used for pumping water. In 1769, French inventor Nicolas-Joseph Cugnot, invented the world’s first self-propelled vehicle, better known as the automobile. The Scottish mechanical engineer and inventor, James Watt improved on Newcomen’s steam engine. He brought about efficiencies which contributed to alternative uses for the engine. Watt’s improvements occurred around 1775. This fundamentally changed the playing field, heralding the start of the Industrial Revolution. The Industrial revolution saw a transition away from manual production to automation and machine run processes.

Efficiencies in the use of steam power and chemical manufacturing increased during this time as did the use of metals. The Industrial Revolution was the impetus which allowed fossil fuels, such as coal, to be transformed into work more efficiently. While industry was moving ahead so to was the population of the United Kingdom. With a relatively stable population from 1700 to 1740, of around 6 million people, the population rose dramatically to 8.3 million by 1801. The global population at this point in time stood at 1 billion people.

The early 1800’s saw the development of steam powered locomotives which gained popularity providing transport across Britain and the United States. The construction of the railways connected larger cities to smaller rural areas. The railways provided the flexibility for populations to migrate to urban centres. Many rural people moved to cities in search of work and a potentially more prosperous lifestyle. In the 1830’s Michael Faraday discovered the principle of electromagnetic induction, diamagnetism and the laws of electrolysis. His discoveries formed the foundation for electric motors and helped in the practical use of electricity and other technological applications. In 1859, at Titusville, Pennsylvania, Edwin Drake an American oil driller successfully struck oil. He was widely credited with being the first to successfully drill for oil in the United States. In 1863, Nikolaus Otto, a German inventor was the first to produce an internal combustion engine which could efficiently burn fuel directly in a piston chamber. Otto, working with Gottlieb Daimler and Wilhelm Maybach developed the first four-cycle engine in 1876.²⁰⁷ By the 1880’s, commercial electricity

generation had been successfully integrated into parts of the U.S., thanks to the work by Nikolaus Tesla who invented alternating current.

Henry Ford developed his first prototype gasoline powered automobile in 1896 which was later refined by Edison. While others in Europe such as Daimler-Benz had the technology and the where-with-all to produce automobiles, it wasn't until 1914 things took off in the commercialization of automobiles. The Ford Motor Company significantly increased efficiencies enabling the production of a motor vehicle every fifteen-minutes. Ford's methods increased productivity eightfold. This reduced production time from 12.5 hours to 1 hour 53 minutes.²⁰⁸ Automobiles had existed for some time prior to Ford's production breakthrough. However, their mainstream acceptance had been limited, as they were considered a luxury item, out of the reach of the ordinary citizen. With increased efficiency, Ford could now deliver affordable automobiles to the general public on mass.

1901 saw the discovery of a huge oil resource in Texas (Spindletop), which produced more than 100,000 barrels a day. This marked a turning point in the United States. No oil field in the world had been so productive.²⁰⁹ With all these amazing technological developments occurring the population of England doubled from 16.8 million in 1850 to 30.5 million by 1901. The overall European population increased from 100 million in the 1700's to over 400 million by 1900.²¹⁰ The global population now stood at over 1.6 billion people. 1903 heralded a new era of transportation as the American brothers Orville and Wilbur Wright invented and successfully pioneered the first controlled manned flight. Over the next few years there were significant discoveries of oil resources in Persia (Iran), in 1908, and in Cushing Oklahoma in 1912.

The early 1900's saw chemist Fritz Haber and Carl Bosch develop a method of converting nitrogen from the atmosphere. The importance of being able to produce ammonia was significant. Ammonia is the building block for the production of nitrogen-containing compounds. Ammonia is used in the production of essentially all nitrogen compounds. Nitrogen is used in the production of artificial fertilisers which provides nutritional support for plant growth. The ability to fix nitrogen used to produce fertilisers allows plant yields to increase, providing food for rapidly growing populations. Hence, food production expanded dramatically. In conjunction with an increase in broad scale agricultural practices and the use of fertilisers, it is estimated the Haber Bosch process has been responsible for sustaining one-third of the Earth's population.

Vaclav Smil, the distinguished professor and scientist outlined the importance of Haber-Bosch process. "What is the most important invention of the twentieth century? Aeroplanes, nuclear energy, space flight, television and computers will be the most common answers. Yet none of these can match the synthesis of ammonia from its elements. The world might be better off without Microsoft and CNN, and neither nuclear reactors nor space shuttles are critical to human well-being. But the world's population could not have grown from 1.6 billion in 1900 to today's six billion without the Haber-Bosch process. Due to its dramatic impact on the human ability to grow food, the Haber process served as the "detonator of the population explosion."

By 1927 the World population reached 2 billion. With the onset of the depression in the late 1920's the Kingdom of Saudi Arabia suffered a decline in pilgrims on their way to the holy cities. The number of pilgrims fell from 100,000 to below 40,000 as people did not have the resources to afford the great journey. The impact on the Saudi economy was significant. This forced King 'Abd-al-'Aziz to

look for alternative sources of revenue for the Kingdom. King 'Abd-al'-Aziz meet with a New Zealand mining engineer, Major Frank Holmes in 1922. Holmes examined the geology and was convinced there would be much oil found in the Middle East. It took another sixteen years after these initial investigations to bring this premonition to reality. Ongoing setbacks plagued the drilling and it was only with much persistence drillers struck oil on the 3rd of March 1938. This discovery would turn out to be first of many, eventually revealing the largest source of crude oil on the planet.

In 1956, the American geophysicist by the name Marion King Hubbert, employed by Shell oil, sent shock waves through the geological and political community when he announces his theory of 'peak oil.' Also known as the Hubbert Peak or Hubbert Curve theory, he outlined how a typical geological formation which contained oil, eventually reaches a maximum rate of petroleum extraction before it tails off and enters terminal decline. Once exploited and drilled for a number of years, each oil field will follow the trend of a bell-shaped curve. This curve explains how production initially rises when first discovered, reaches a peak or point of maximum extraction, before entering on a downward trajectory. Initially used to explain individual production profiles of oil fields the theory can be used across multiple fields to help determine the overall production capacity of global production.

In 1959 the global population reached 3 billion. China enters the oil age with a significant find in northeast China, making the Daqing oilfield China's largest. OPEC is founded in 1960 to help coordinate policies for oil-producing countries. The overall aim of the organisation is to secure a stable income for member states and collude in establishing world oil prices for economic benefit. OPEC is an intergovernmental organization created at the Baghdad Conference and included Iraq, Kuwait, Iran, Saudi Arabia and Venezuela. Later it was joined by nine more governments: Libya, United Arab Emirates, Qatar, Indonesia, Algeria, Nigeria, Ecuador, Angola, and Gabon. OPEC was headquartered in Geneva, Switzerland before moving to Vienna, Austria, on September 1, 1965.

1965 sees the discovery of the largest oil field in Western Siberia, the sixth largest in the world. The Russian field, Samotlor, is developed in 1967 and starts producing in 1969.²¹⁵ In 1968, the Prudhoe Bay Oil field is discovered on Alaska's North Slope region. This becomes the largest oil field in both the United States and in North America.²¹⁶ In the early 1970's, North Sea oil came online. This proved to be a life line for the British economy and a boon for industry and investment.

1972 marked the release of the book, *The Limits to Growth*. The research for the book was undertaken by a team of MIT analysts, who used computer modeling to examine how exponential growth rates in populations and the use of finite resources might look under various scenarios. *The Limits to Growth* modeling, the first of its kind, highlighted how the five variables of world population, industrialisation, pollution, food production and resource depletion would influence and impact both the natural world and human society under various growth scenarios. Two of the scenarios recorded "overshoot and collapse" of the global system by the mid to latter part of the 21st century. A third scenario resulted in a 'stabilized world.'

In response to the United States involvement in the Yom Kippur War in 1973, the Organization of Arab Petroleum Exporting Countries, (OAPEC) decided to retaliate. It announced an oil embargo against Canada, Japan, the Netherlands, the United Kingdom and the United States. After the failure of negotiations with major Western oil companies, OAPEC members agreed to use their leverage over the price setting mechanism. In an effort to stabilise their real incomes they acted by raising the

world oil prices. The embargo had a significant impact on the countries as it occurred during a period when consumption was rising. This 'oil price shock,' saw the price of oil rise from \$3 a barrel to \$12 a barrel, over a period of around five months. The 1973 'oil price shock,' along with the 1973–1974 stock market crash, has been regarded as the first event since the Great Depression to have a persistent economic impact.²¹⁸ Apart from inflicting serious economic pain on the embargoed countries, the oil embargo demonstrated the financial power of Saudi Arabia and how valuable oil had become to Western nations.

American geophysicist, M. King Hubbert, predicted oil output in the lower 48 states of America would peak by around 1970. At the time Hubbert was ridiculed by his peers and the mainstream. His predictions became a reality in the early 1970's. Combined with the oil shock in 1973, the United States went on a monumental drilling spree to ensure oil supplies kept up with demand. Russian oil production peaked in 1988, and in 1991 we saw the first Gulf War emerge as Iraq invades Kuwait. The beginnings of the Iraq invasion were multifaceted; however the primary impetus for Saddam Hussein to invade was the long running dispute with Iran. With Iran attacking Kuwait oil tankers on their way to ports, Kuwait formed an alliance with Iraq who helped in protecting it from the Iranian attacks. Kuwait assisted in funding Iraq with a loan of \$14 billion. When Iraq tried to convince Kuwait to dissolve the debt, a rift occurred between the countries which hastened the conflict. Iraq approached OPEC members to reduce oil production, in an effort to increase the price of oil. This would enable Iraq to claw back revenues to help fund the debt. Kuwait refused to play ball by reducing production, doing the opposite and increasing production, further suppressing oil prices. Hussein claimed Kuwait was stealing Iraqi oil through slant drilling practices. The significant debt burden Iraq accumulated to fund the Iran-Iraq war, added to Hussein's motivation to invade Kuwait on the 2 August 1990.

In Canada, the Canadian 'Tar Sands,' also known as the Athabasca oil sands, have been known for their potential energy properties since the 1700's. It wasn't until the late 1970's any meaningful production started to occur after investor interest was raised after the 1973 oil price rises. By 2006 oil sands production had risen to approximately 1.126 million barrels per day, providing 47% of Canadian oil.²¹⁹ As of 2010 the production of the oil sands increased to 1.6 million barrels per day. The Alberta government believing production could reach 3.5 million barrels per day by 2020, and 5 million barrels per day by 2030.²²⁰ This makes the Tar Sands the third largest proven reserves in the world, after Saudi Arabia and Venezuela's Orinoco tar sands.

With the world population at just under 7 billion people, car ownership increases significantly during the 2000's. By 2010 there are over 1 billion motor vehicles in use globally. This is a significant difference from 1960's when there were approximately 127 million cars, light, medium and heavy duty trucks; and buses in use globally.²²² China overtook the U.S. (in 2009) as the number one market for new car sales, clocking up 13.6 million new vehicles sales, compared to 10 million in the U.S.²²³ As the global population hits 7 billion, China adds 15.1 million new cars to its overall fleet in 2012, more than it had in its entire fleet as of 1999. The total vehicle number reached 240 million in 2012, with 120 million being passenger vehicles.²²⁴ While China has one of the world's lowest per capita vehicle ownerships of 58 vehicles per 1000, the U.S. has the highest with 769 vehicles per 1000 people.²²⁵ This significant increase in the global fleet of vehicles has added upward pressure on demand for oil resources. In 2008 oil hits its highest ever prices of \$147.27 a barrel.

The above history of liquid fuels or petroleum, gives a quick overview of the some of the significant milestones achieved over the last few hundred years. While there are other significant non-renewable energy sources such as coal, gas and uranium, petroleum is a very special and unique fuel source which deserves special attention. To further illustrate the importance petroleum plays within the global economy we must understand the fundamental concept of Energy returned on Energy Invested, or EROEI.