Energy

What’s in it for me? Discover the powerful history of power!

Energy is one of those things we all just take for granted. Whether we're switching on a light, turning up the heat, or starting up our car, we hardly ever stop to think about where the energy that fuels these machines comes from. But energy is a fascinating subject. The history of energy is a rich, interconnected tapestry – with each new invention and innovation paving the way for the next. These ideas were born out of necessity, competition, and plain old curiosity. These ideas were developed by brilliant minds like James Watt and Benjamin Franklin and shaped by forces like economics, war, and famine. What’s more, the same themes come up time and time again. For example, our modern concerns about the environmental impact of new sources of energy are nothing new. These blinks take you back in time, examining the people, places, and events that led to mankind's greatest scientific breakthroughs. It's an around-the-world journey full of fascinating characters and amazing ideas. And it all starts with one of the simplest forms of energy there is: wood. In these blinks, you’ll discover

what resource replaced wood as the world’s most prominent form of energy; how the rise of automobiles ousted horse-drawn carriages; and why adopting a new energy source takes so long.

England's wood shortage led to the widespread use of coal.

England in the 1500s was a country that ran on wood. Wood was used to construct buildings and homes. It was used as fuel for cooking and heating. It built the great ships of the Royal Navy. But, unfortunately for the English state, it wasn’t an endlessly available resource. As the English population increased, so did the demand for wood. As supplies close to the towns and cities ran out, wood had to be carted in from farther and farther away. Prices rocketed. Fears of a looming wood shortage grew stronger. A new, more affordable fuel source was needed. But what could it be? The solution finally arrived in the form of coal. The key message here: England's wood shortage led to the widespread use of coal. Coal was not a new discovery. It had been used industrially for centuries. But use of the fuel remained limited. Burning coal produced a foul, thick smoke that many believed was poisonous. Also, because of its stench and the fact that it was dug from the ground, some people thought coal was demonic. Things began to change in 1603, when the Scottish King, James VI, took the throne of England. Scotland had had a different experience with coal. Their wood supply was already scarce, and so they had converted to coal much earlier. And unlike England's soft sea coal, Scottish coal was harder and burned cleaner and brighter. When James took up residence at Westminster, he imported Scottish coal to heat his palace. Before long, the aristocracy began to do the same – followed by everyone else. The London skyline was soon dotted with chimneys. While coal was a much cheaper fuel than wood, the rapid conversion to burning coal introduced new problems. Pollution increased dramatically throughout the 1600s. The London air became full of soot and smoke. Despite the pollution, coal quickly became the primary fuel source for household use. Yet this brought another problem: supplies of easily-mineable coal quickly dwindled. To meet demand, mines had to be dug deeper. This was an extremely dangerous process, and flooding was common. Once a mine flooded, it would have to be abandoned. A new technology was needed to pump flooded mines.

Increased coal mining led to the development of steam power.

If coal were to remain a viable energy source, a method to protect the mine from water had to be invented. The key message in this blink is: Increased coal mining led to the development of steam power. Steam engines had been around for a while. In 1698, the English engineer Thomas Savery developed an engine based on the work of French inventor Denis Papin. But his machine had several problems. Most importantly, it lacked power. One engine wasn't sufficient enough to pump really deep mines. In 1712, Thomas Newcomen came up with an improved steam engine. It was far more successful. The Newcomen Engine became the standard used in mines throughout Britain and Europe. Newcomen’s steam engine did the job, but it wasn’t powerful enough to make a real impact. Its replacement, however, would change the world. In 1763, the Scottish engineer James Watt tweaked Newcomen’s design. He realized that by adding a separate condenser, he could create a much more efficient machine. The arrival of Watt’s efficient steam engines heralded an affordable, more flexible form of energy. Steam’s potential moved far beyond just pumping water from mines. Consider transport. Traditionally, horse-drawn wagons were used to move coal from mines to canal barges. To help the horses pull the heavy loads, wooden – later iron – rails were laid. It didn’t take engineers long to work out that steam locomotives could be used to pull the wagons along the iron rails. These steam locomotives proved themselves reliable and efficient. Enterprising businessmen quickly realized that steam could be used to transport people just as well as coal. In 1830, the Liverpool to Manchester railway was built. It was the first inter-city railroad to use steam locomotives only. It was a huge success. Soon there were thousands of miles of railways stretching across the United Kingdom. The introduction of passenger trains fundamentally changed the way we viewed the world. Travel was no longer limited to the distance you or your horse could comfortably walk in a day. It literally broadened our horizons.

The need for artificial lighting drove the discovery of oil and electricity.

Coal and steam worked together to create a newly industrialized world, but it was still a world we'd have a hard time recognizing today. For one, the early-industrial world was trapped in the dark ages. The key message here is: The need for artificial lighting drove the discovery of oil and electricity. The earliest forms of lighting, such as candles and oil lamps, could barely light a room – much less a city street. And as cities became more populous, walking the streets after dark became a dangerous proposition. It was William Murdoch – an engineer who worked for James Watt – who developed a practical, cost-effective solution to public lighting. At a huge public display in 1802, Watt's Soho foundry was lit up with Murdoch's gaslight. It was a sensation. Factory by factory and house by house, gaslight began to spread, and by 1815, the streets of London were glowing. But while gaslight was being adopted for civic and industrial use, most families still had to make do with oil lamps. Whale oil was the preferred fuel for a long time, until overhunting began to cut off the supply. The resulting rise in the price of whale oil pushed people to look for alternatives. One popular alternative fuel was camphine, a blend of turpentine, grain alcohol, and kerosene. It was the desire to cheaply produce the kerosene in camphine that led to our earliest steps into petroleum. For years, petroleum seeping up from the ground had been considered a nuisance. No one really knew how much there was down there or how to get it out, so there wasn't much interest in developing it. But when it was found to be a great source for producing kerosene, it finally became worth digging for. In 1859, Edwin Drake became the first person to successfully drill for oil. The world was beginning to change, even though we had yet to tap oil's full potential. The secrets of electrical power took even longer to unlock. We'd been experimenting with electricity for a while, but no one understood how to put its awesome power to use. This changed in 1831. Scientist Michael Faraday discovered that mechanical work, such as turning a crank, could be converted into electricity. And, if a hand crank could generate a small amount of electricity, then something larger like a waterfall could generate a great deal more. In 1882, the world's first hydroelectric plant began generating power along the Fox River in Wisconsin. What was this electricity used for? Well, partly to power artificial light. For example, the hydroelectric plant along the Fox River was designed to provide light for two local paper mills.

Breakthroughs often occur as a result of outside forces, from distribution headaches to war.

No new energy source is adopted overnight. Each new technology has to answer the same questions again and again: How do we get this fuel from its source to the end user? And what do we do when the resource runs out? The key message here is: Breakthroughs often occur as a result of outside forces, from distribution headaches to war. Transportation and distribution are some of the biggest problems facing any new technology. Take oil, for example. At first, no one even knew how to store it, much less transport it. The first oil fields transported their product in leaky wooden barrels stored on rafts that traversed raging rivers. It's impossible to say how much oil was lost due to this relatively inefficient method. Maintaining a supply of natural gas also proved a headache. Take Pittsburgh. In the 1880s, the city briefly converted from coal to natural gas and almost immediately saw an improvement in air quality. But it couldn't last. By 1892, local gas supplies were depleted, and they were forced back to coal. Natural gas wouldn't return to Pennsylvania until 1947. In that year, the Big Inch pipeline, which had been constructed to deliver oil to the northeast during World War II, was converted to supply natural gas. Pittsburgh had to wait over 50 years for natural gas because their own supply of the resource was severely limited. Before they could get it back, the technology to deliver it needed to be invented. This is a cycle that repeats again and again: a finite supply of natural resources spurs new advancements in technology. We can see this pattern in the development of the automobile. The earliest cars ran on a variety of different engines powered by steam, electricity, alcohol, or petroleum. Each technology battled the other to develop the most efficient engine. Eventually, petroleum engines won out and became the norm. But as soon as they did, fears grew about petrol supplies. As early as 1920, scientists expressed concern that the US was in danger of depleting their own oil reserves. And while some looked for alternative fuel sources, the oil industry developed new methods of drilling, including in places like Saudi Arabia – a decision that affects geopolitics to this day. Recent wars have taken place in the energy-rich Middle East. But armed conflict over resources isn’t a new phenomenon and has played a key role in shaping our energy needs from the beginning. The wood shortage that pushed England to develop coal as a fuel source was augmented by the loss of the American colonies and their imported timber. During the American Civil War, demand for petroleum went up after an alcohol tax intended to fund the war effort killed off alcohol-based burning fluids.

Each new energy source has a ripple effect on other, seemingly unrelated, industries.

The changes brought about by these new energy sources may not have happened all at once, but the impact they had was both profound and permanent. The key message here is: Each new energy source has a ripple effect on other, seemingly unrelated, industries. Consider labor laws. During the early years of coal mining in England, it was not uncommon to see entire families working together in the mines; even small children were employed in the mines. The work was dangerous, and the hours were long and arduous. It would take an act of Parliament, the Mines Act of 1842, to limit the awful conditions. The act prohibited women and children from working in mines. It was the start of a new approach to society, one which places rules and regulations on working conditions. Other similar acts followed soon after, and the rise of coal as an energy source changed the relationship between politics and labor going forward. Another area affected by new energy development was agriculture. For hundreds of years, horses had been a regular fixture in cities. As late as 1900, Manhattan alone was home to around 130,000 working horses. This required an enormous amount of hay and grain, which became the life's blood of thousands of farmers. Lots of horses also meant lots of horse manure – but an entire industry was supported by that, too. Clean-up crews would collect manure and sell it back to the farmers to be used as fertilizer. All this changed with the rise of the automobile. At first, horses and cars co-existed – in fact, automobile users were obliged to give right of way to horses. But as cars became more popular, the number of working horses declined. This meant that fewer crops were needed to feed the dwindling number of animals. As farmers reduced the amounts they were growing, they no longer needed as much fertilizer, which meant that horse manure went from being a profitable commodity to a public health hazard. As the industries that supported horses declined, a new infrastructure and support system was needed for the growing number of cars. Filling stations and repair shops began to pop up in areas that used to support farmland. One industry – agriculture – suffered while a new one – automotive – rose in its place.

The environmental impact of energy use is almost always an afterthought.

Only recently have we truly begun to understand and grapple with the concept of climate change. But environmental concerns about how we use energy are nothing new. Unfortunately, if history teaches us anything, it’s that environmental concerns are almost never taken as seriously as they should be. The key message here is: The environmental impact of energy use is almost always an afterthought. Smog is undoubtedly the most visible, obvious way energy impacts our environment. After the industrial revolution, it didn't take long for it to appear over coal-burning cities. Cities like London were shrouded in thick, black clouds, but very few people considered it to be a health hazard. The prevailing sentiment was that a smog-covered city was a civilized city, and smog was a mark of progress and scientific achievement. Air pollution was not taken seriously as a public health threat until after World War II. In 1948, a toxic fog descended on a small town called Donora, Pennsylvania, killing 20. A few years later, in London, another toxic fog resulted in 3,000 more deaths. In each case, an investigation revealed that the fog was contaminated by sulfur dioxide from coal smoke. But coal wasn’t always at fault. In the early 1950s, chemist Arie Haagen-Smit analyzed the Los Angeles smog and discovered it was primarily composed of oxidized hydrocarbons from cars and oil fields. This discovery did not sit well with the automotive or oil industries. They denied responsibility and tried to discredit Haagen-Smit's research. But Haagen-Smit continued his research. Eventually, he found irrefutable proof of both the cause of air pollution and its damaging effects. In 1970, President Richard Nixon created the Environmental Protection Agency. It was the beginning of the real fight against air pollution. It took decades from the first appearance of air pollution before the official fight against it began. Of course, by definition, the long-term effects of any new technology on the environment and public health take time to be truly understood. But it’s also very clear that environmental concerns are all too often ignored or neglected.

Future energy needs must supply reliable, affordable energy to a growing world population.

By the year 2100, the population of the world is estimated to be 10 billion people. That’s 25% higher than it was in 2017. But not only are the numbers going up, so are their energy needs. The global population is advancing from a subsistence level existence – consuming and producing enough without much added surplus – into prosperity en masse with a lot of excess. How can we complete this transition and not destroy our planet in the process? The key message here is: Future energy needs must supply reliable, affordable energy to a growing world population. Wind energy is a potential source of renewable energy with roots that date back a long time. The first wind turbine to generate electricity was built in Scotland in 1887! Wind power was especially popular in the first half of the twentieth century, especially in rural areas. However, it didn’t quite take off. The amount of power that wind is capable of generating is severely limited. By 2016, the total installed wind-electrical capacity reached 487 gigawatts. That's less than 1 percent of the world total. The use of solar power is increasing, but it, too, has its limitations. Solar was introduced in the 1950s after Bell Telephone developed the silicon photovoltaic cell. While these early cells were extremely expensive to produce, later refinements reduced the cost without decreasing efficiency. Research continues into solar technology, but currently, it still only generates between 1 to 4 percent of the world's electricity. The major hurdle of both wind and solar power is the capacity factor – that is, how much of the time they're actually generating electricity. Wind turbines only deliver power 34.7 percent of the time, while solar only delivers 27.2 percent of the time. Electricity must be generated in real time to meet demand and can only be stored temporarily. So what happens when the wind doesn't blow or the sun doesn't shine? Things are much more efficient in nuclear power plants. They operate on average at 92.1 percent efficiency. This is incredibly high. Even well established energy sources like coal and natural gas only generate electricity about half the time. So, while the costs of constructing, operating, and maintaining a nuclear power plant can be high, its high capacity factor makes it incredibly cost-effective. In the end, there is no one single solution to the problem of climate change. This is the greatest energy challenge the world has ever faced. Only a combination of energy sources working together can help stem the tide of the current crisis.

Climate change dictates a need for a combination of energy sources working together – renewable, nuclear, and future technologies.

As we look ahead to the energy challenges of tomorrow, it’s clear that changes will have to be made to our current systems. Even if climate change weren’t an issue, fossil fuels are still finite resources. One day, we will run out. Consequently, it’s imperative that new technologies continue to be developed, tested, and implemented throughout the world. The key message here is: Climate change dictates a need for a combination of energy sources working together – renewable, nuclear, and future technologies. The single most important thing we can do right now is decarbonize our energy sources. Any transition to a source that produces less carbon dioxide is considered "decarbonizing" and is a benefit to the planet. For example, natural gas produces about half as much carbon dioxide as coal. Nuclear and solar power both produce a fraction of the amount of carbon dioxide as natural gas. Even then, it's only during the construction and maintenance of the facility. So, while switching from coal to natural gas is a good first step, switching from either source to nuclear or solar would be even better. But there’s one thing to keep in mind as we enter the next stage of energy: adopting a new energy source takes time. Any energy source that grows to dominate half the market share takes about a century to get there. There are a number of reasons for this. One reason is that any new technology goes through growing pains. At first, it's enough that it works at all. After that, it needs to be refined, perfected, and made to work well. As we’ve seen, another reason is that each new technology requires a supporting infrastructure. This infrastructure often must be created from scratch. Take oil. Nowadays, oil needs pipelines, but before that, it needed barrels. And even before that, it had to be analyzed to figure out what exactly it could be used for. All of these things take time. Perhaps what takes longest of all is the human factor. People are slow to change their habits and adopt new ways of looking at the world. We know that fossil fuels will run out. We know that our reliance on them has contributed to climate change. But that knowledge runs up against centuries of ingrained use. This is proving a very hard habit to break. But we have to try. Only through a combination of decarbonized energy sources can we continue to meet the energy needs of our growing global population. We must continue to invent, to innovate, to learn from our mistakes, and to improve our technology. As long as we take these steps, we’ll be able to sustain ourselves on this planet for centuries to come.

Final summary

The key message in these blinks: The history of energy is a volatile mix of discoveries and inventions, each one building and feeding on the last. While the challenges that face us are large, they are not insurmountable. We can’t predict where the next energy source will come from. Science and technology are constantly evolving. When coal was introduced, no one could have predicted electricity or the internal combustion engine. In the early days of steam, no one predicted atomic energy. Innovation and invention are inevitable and necessary to meet our future energy requirements. Got feedback? We’d sure love to hear what you think about our content! Just drop an email to with the title of this book as the subject line and share your thoughts! What to read next: The Boom, by Russel Gold You’ve just learned about the history of energy and the rise and fall of industries that have come with our growing need for more and new power sources. It’s time to zoom in and look at one particularly interesting, and controversial, new energy extraction technique: fracking. Learn more about this hotly debated technology, how it progressed so quickly, and its potential consequences from energy policy expert Russel Gold in The Boom.