Humans and Energy: Crash Course World History 207

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Hi! I'm Stan Muller, this is Crash Course World History, and today we're going to talk about energy.

I don't mean crystal energy or pyramid power or even Red Bull. I mean the energy that humans use to build pyramids or synthesize crystals or to manufacture energy drinks.

-Hey, hey! Where's Mr. Green?
-Mr. Green is out today and I am the substitute.
-A sub? Can we watch a video?
-This is a video.

So today we're going to talk about *Children of the Sun* by Alfred Crosby who you might remember from our episode on the Columbian Exchange. This is Crosby's book about energy and in it he says-

"Modern civilization is the product of an energy binge... but humankind's unappeasable appetite for energy makes the solutions ephemeral and the challenge permanent."

which is not that hopeful.

But before we start looking at the history of human energy use, let's talk about what we mean by energy. For our purposes here, energy is the power to do work.

For more than 99% of human history, the main source of energy to do work was muscle, either human or animal. And the fuel for that muscle was food, usually plants, and plants ultimately get their energy from the sun.

So, almost all the energy that humans use comes from the sun in one way or another. Hence the book's title, *Children of the Sun*.

Humans are a lot of things, but efficient energy converters isn't one of them. That's why you need a lot of humans to do a lot of work. It took a lot of power to build the pyramids, for example, and it couldn't have happened without some technological advances using energy.

The first great energy technology was fire. It enabled us to cook which gave us a greater variety of available food and thus more fuel for our muscles. Fire also led to metal work and improvements in tools.

Another notable advance in energy was the domestication of plants and animals. By domesticating plants, humans redirected the sun's energy to create more nutritious and energy-producing food. The sun also indirectly fueled domesticated animals like horses and oxen, which were harnessed to do even more useful work.

After the invention of agriculture, developments in human energy kind of plateaued for a while. The only energy that we had that didn't derive from the sun was water power, since wind technically comes from the sun's heating the air so sailing ships and wind mills are kind of solar power. There were some minor advances, like concentrating the energy density of wood by converting it to charcoal, and adding oxygen to fires using bellows, but for the most part, energy was still generated by muscle.

The next big change in energy use came with industrialization. Let's go to The Thought Bubble.

So industrialization utilized new forms of fuel in coal, and later oil and natural gas. These fuels are just really, really old forms of fossilized plant and animal matter, so again, they're originally from the sun, but we don't think of it this way. Nobody calls coal "solar power."

While the Chinese were using coal during the Song Dynasty to work iron, for example, England was where coal use really took off, thanks to the steam engine. Newcomen's Steam Engine was, according to Crosby, "The first machine to provide significantly large amounts of power not derived from muscle, water, or wind."

Coal powered industrialization was a pretty big deal. It allowed Britain to dominate the textile industry, and industrially produced weapons, and steam powered ships enabled Europeans to penetrate and dominate Africa, and parts of Asia. According to Crosby, fossil fuels "created the political and economic landscape we recognize today."

After steam powered manufacturing, it was a short chronological leap to electricity, which was used to power machines, and for illumination. Electric light was a really big deal because it provided a clean and efficient way to allow people to work after dark.

Thanks, Thought Bubble. Although we might think of coal as the fuel of the 19th century, we still use a lot of it today. Especially for generating electricity, but coal is much less efficient than oil. Oil was revolutionary because it could power not only electricity plants, and ships, and trains, but also the internal combustion engine, which makes cars and trucks possible. Crosby maintains that "the internal combustion engine powering the automobile, truck, and tractor has for a century been the most influential contrivance on the planet."

By the end of the 20th century, there were half a billion cars in the world, and humans were using 70 million barrels of oil each day. Manufacturing and driving all those cars has had a huge impact on the environment.

From an energy use perspective, the world since 1900 is a totally new era in human history. We use electricity for everything in the West. It powers our gadgets, it lights our homes, it gets us around on trains, or buses, or cars. Crosby puts it like this: "Humanity's primary energy use has increased twenty times over since 1850 and nearly five times over since 1950."

In the U.S., each individual consumed 2000 kilowatt hours of electricity in 1950, and 32,700 in 2000. Oil and natural gas are the most important fuels for this electricity boom, although as of 2006, 40%-50% of humans, most of them living in the tropics, still rely on wood for fuel. So, when the world will run out of oil is a topic of heated debate, but scientists have been looking for other forms of fuel for decades.

One alternative is nuclear power, which has not been a total success. The first nuclear plant providing power for homes opened in the Soviet Union in 1954, and some countries, notably France, still rely heavily on nuclear energy.

Despite initial enthusiasm from scientists, and science fiction writers, nuclear power never caught on in the U.S. partly because it's really expensive. Another problem is that no one can figure out what to do with the radioactive waste that nuclear energy produces. But the biggest reason nuclear power fails to catch on is because people think nuclear power is dangerous, believing that nuclear plants can easily turn into huge bombs, or that malfunctioning reactor cores will melt all the way through the earth to China, or something. Actually, it would probably melt all the way through to Australia or something, but you know what I mean.

Nuclear accidents have happened, though, notably and Windscale in England in 1957, and at San Loren in France in 1969, but neither of these was catastrophic. The U.S. had a nuclear scare in 1979 with and accident at Three Mile Island in Pennsylvania. Although there were no immediate casualties, thousands of people in the vicinity were forced to evacuate, and the cleanup took years, and

cost millions.

The disaster at the Soviet nuclear plant at Chernobyl in 1986 was much worse, with a release of radiation that was hundreds of times greater than that given off at Hiroshima and Nagasaki, and fallout that will be lethal for 2400 years.

A few countries still use nuclear power, but it never really caught on. Overall, nuclear power has never accounted for more than 5% of the world's energy supply.

In recent years, rising concerns over climate change have led to increased calls for humanity to find cleaner, more renewable forms of energy. The alternative, that we significantly reduce our energy consumption, seems unlikely, especially since it would seem like a historical step backward.

History is often presented as a story of progress and growth and increasing complexity and a future in which we use is kind of hard to imagine. But historically speaking, the world we live in is new, it's unsustainable, and it's not normal.

Crosby offers us this reminder "Most of us in the richer societies can only recall times of immediate access to abundant energy. That abundance tempts us, successfully, to believe that having energy flow down lines from far away and illuminate our rooms when we flip the switch is normal rather than miraculous."

In the end, how we reconcile our desire to continue our history of growth and rising complexity with the fact that such growth is unsustainable with current technology is one of the biggest challenges facing humanity today.

Whether and how we rise to that challenge will determine what kind of world we live in tomorrow.

Thanks for watching, we'll see you next time.

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