What You Need to Know About Nuclear Power

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This article is the fourth in a six-part series that explores how we get our electricity and what we need to know about how renewable — and non-renewable — electric power is generated.

Electricity use is a major component of Americans' ecological footprint. But we tend to pay it less attention than other areas, like recycling and plastic use, where it feels like we have more control. After all, we can't shop for electrical utilities like internet providers. Yet it's important to understand where your energy comes from and how it affects your ecological footprint.

Nuclear Power in America

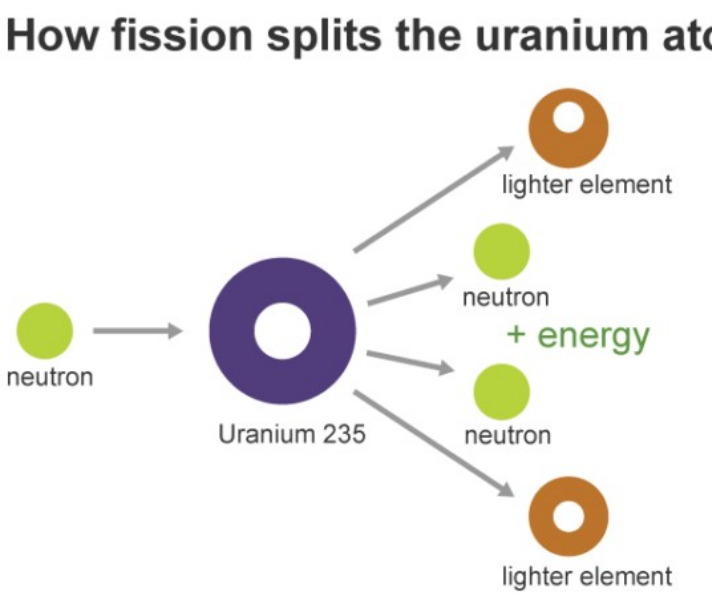
Knowing the impacts of your own energy source can help you decide where to focus your own actions to make the biggest difference. Nuclear power plants provide an average of 19 percent of the electricity in the U.S. In some parts of the country the rate is as high as 40 percent.

Many nations are more dependent on nuclear energy than the United States. France gets around three-quarters of its electricity from nuclear energy. But U.S. reliance on nuclear power is still higher than the global average of 10 percent, and, at roughly 805 terawatt-hours, the U.S. is the largest consumer of nuclear energy in the world.

How Nuclear Power Works

Nuclear power is generated by a technology called nuclear fission, or atom-splitting, in which the nucleus of a uranium atom is struck by a neutron. This breaks the nucleus apart, freeing its component particles and releasing the energy of the bonds that held the atom together. (*Note: The word nuclear comes from the word nucleus. It is pronounced "new-clear" rather than "new-cu-lar."*)

The freed neutrons strike other nuclei, creating a chain reaction that releases energy in the form of heat and radiation. This energy, which is expressed as heat, is used to produce steam, which turns turbines to power a generator, creating electricity in much the same fashion as hydropower.



Source: Adapted from National Energy Education Development Project (public domain)

Environmental Benefits of Nuclear Power

In fact, nuclear power has many of the same benefits as hydropower. It has the added benefit that the construction of nuclear reactors does not require the massive habitat destruction that hydropower does.

Nuclear reactors do not produce air pollution or greenhouse gases like coal or other fossil fuel energy sources. Relatively cost-effective, they provide baseline energy production independent of variables like wind or sun exposure. For these reasons, the number of nuclear reactors in the world reached 438 in 2002.

The Negative Environmental Impacts of Nuclear Power

Unlike hydropower, nuclear power is not renewable. Nuclear energy's dependence on uranium is its biggest flaw. By some estimates, there is only enough uranium to continue producing current levels of nuclear power for another 80 years.

The naturally occurring radioactive element is obtained by mining or *in situ* leachings, in which strong solvents are pumped into groundwater. Both extraction methods involve significant environmental impacts from habitat destruction, groundwater contamination, and hazardous and radioactive waste generation. More than 200 pounds of tailings are produced for every pound of uranium.

Radioactive waste is also generated by the reactors themselves. Every year in the United States, Europe, and Russia over 50,000 tons of depleted uranium joins the 1.6 million tons already stockpiled at reactor sites and storage facilities like Hanford, which has a record of environmental failures. Despite the Nuclear Waste Policy Act of 1982, the U.S. still has no permanent storage facility for waste that will remain dangerous for hundreds of thousands of years — as long as the human species has existed on Earth.

Permanent and safe storage of radioactive waste is an ongoing concern. Image: Adobe Stock

Risk of Disaster

More people are concerned about the immediate type of nuclear disaster. Unfortunately, their fears are not ungrounded. In a field where a mostly safe operating record is insufficient, failures have already occurred.

In 1979, a partial meltdown at the Three Mile Island Nuclear Power Plant in Pennsylvania led to new safety regulations for the industry, but also to nationwide protests and a general slowing of growth for the industry. Three Mile Island remained in operation until 2019.

A reactor in Chernobyl, Ukraine, exploded and burned in 1986 — ironically, during a safety test — rendering the surrounding 19-mile-wide area uninhabitable indefinitely. Delayed evacuations resulted in the deaths of 28 people. Long-term fatalities resulting from radiation exposure may still be climbing. The United Nations' (disputed) estimates place the death toll so far around 6,000.

On March 11, 2011, the Tohoku earthquake triggered a tsunami, whose 130-foot-tall waves swamped the Fukushima Daiichi nuclear power plant, causing all three reactors to meltdown. Radiation from the meltdown was later detected as far away as the American West Coast.

Completely separating the impacts of the tsunami and the meltdown may be impossible. But as at Chernobyl, survivors demonstrated elevated rates of thyroid cancer. Again, the findings were contested. In 2017, about 50,000 evacuees were still living in temporary housing and an area twice the size of Washington, D.C., still remains off-limits. Cleanup of the reactor site continues, where more than 1 million

tons of contaminated water has accumulated. When tank space runs out in 2022, the contaminated water will be dumped in the ocean.

Fukushima convinced many people that it is not a question of if, but when, a nuclear power plant will fail. After Fukushima, new reactor construction ground to a halt, and some countries began dismantling existing nuclear facilities.

Cleaner, Safer Nuclear?

Thorium has the potential to replace uranium as a nuclear reactor fuel. It generates much less radioactive waste and may operate much more safely. However, thorium requires its own specially constructed reactors. And nuclear fusion — which fuses nuclei together instead of splitting them apart — is both safer and more powerful than nuclear fission. However, commercial-scale fusion reactor technology remains elusive.

No matter what your energy source, the most sustainable choice is to use less of it. If you aren't sure where you could improve, start with a home energy audit and prioritize changes based on the results. Many local utility companies also have efficiency programs to help customers reduce their energy use.

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