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In the world of energy production, nuclear energy is a hidden gem. While the public often perceives it in a negative light, nuclear power has many benefits. Nuclear power is a lot more reliable than other sources of energy, consistently supplying power for more than 75% of the year (Rhodes). Nuclear technology has aided space and oceanic exploration, and nuclear elements are used in the food and health industries to sterilize food and diagnose patients ("Beyond Electricity" and "The Many Uses of Nuclear Technology"). But the most prominent advantage nuclear power generation has over all other forms of electricity generation is that it has a low environmental impact.

The first important fact to note about nuclear power generation is that it helps reduce carbon emissions. As of November 2020, NASA reports that carbon dioxide (CO_2) emissions, a significant factor in climate change and global warming, are at 415 parts per million (ppm), exceeding their highest historical level by more than 100 million ppm. Nuclear power has strong potential as a future energy solution because it does not emit greenhouse gases like CO_2 (Rhodes). Reactors active in the United States are either pressurized-water reactors (PWRs) or boiling-water reactors (BWRs). Most, however, are PWRs. Both use nuclear fission, a controlled chain reaction that releases heat when neutrons split uranium atoms. The heat within the reactor heats up the water around the reactor. The main distinction between a PWR and a BWR is that the heated water is pressurized so that it does not turn into steam right away. Instead, the hot water is directed to a steam generator, where it heats up clean water and generates steam. In a BWR, the reactor heats water that turns into steam and rotates turbines, thereby generating electricity ("Nuclear explained - Nuclear power plants"). With nuclear energy production, "the United States avoided more than 476 million metric tons of carbon dioxide emissions in 2019.

That's the equivalent of removing 100 million cars from the road and more than all other clean energy sources combined" (Office of Nuclear Energy). Since 1995, United States nuclear power generation has kept more than 15,733 million metric tons of carbon dioxide out of the air (Nuclear Energy Institute). The only carbon emissions that can be associated with nuclear power production are from the construction of a nuclear plant (Rhodes).

In addition to cutting back on greenhouse gas emissions, nuclear energy limits its environmental impact with low land usage. Even though the Pew Research Center projects that the global population growth rate will taper off by the year 2100, they also project that Earth will have an estimated population of 10.9 billion people by that year. Efficient land management will be paramount to humanity's ability to sustain such a large population (Conniff). Nuclear power plants use 5-10 acres per megawatt, as compared to 19 acres per megawatt for coal plants (Office of Energy Efficiency & Renewable Energy). A Nuclear Energy Institute article reported that wind farms would need as much as 360 times more land area to generate the same amount of power as a 1,000-megawatt nuclear plant. A solar farm would need 70 times more land area. The article also noted that "no U.S. wind or solar facility generates as much [power] as the average nuclear plant." Recent innovations in nuclear reactor technology, such as the small modular reactor, may further decrease nuclear energy's land usage, as these reactors can be small enough to be transported by truck or train ("Nuclear explained - Nuclear power plants").

Some may point out the fact that nuclear power generation produces toxic waste despite its low carbon footprint and land usage. It's true; according to the Office of Nuclear Energy, "The U.S. generates about 2,000 metric tons of used fuel each year." Additionally, nuclear waste can retain its radioactivity for 1,000 to 10,000 years (World Nuclear Association). However, this position fails to put key facts into perspective. To begin with, 2,000 metric tons of nuclear waste

seems like a substantial amount, but this is actually quite small. The Office of Nuclear energy reported that "all of the used nuclear fuel produced by the U.S. nuclear energy industry over the last 60 years could fit on a football field at a depth of less than 10 yards!" The Nuclear Energy Institute noted that "coal plants generate that same amount of waste every hour." Furthermore, toxic waste is separated into two or three categories: low-level waste, intermediate-level waste, and high-level waste (Nuclear Energy Institute and World Nuclear Association). Most nuclear waste created by the nuclear energy industry "is classified as low- or intermediate-level waste" (World Nuclear Association). Waste that is typically classified as high-level waste is spent fuel, which can actually be reused and/or reprocessed (Nuclear Energy Institute and World Nuclear Association). In the US, high-level waste such as fuel rods are first cooled in a steel-concrete pool. After a few years, they are contained in reinforced-steel concrete casings housed in secure locations. When available, they are sent to a permanent disposal site (Nuclear Energy Institute). While nuclear waste may retain its radioactivity for thousands of years, this waste "has a finite radiotoxic lifetime," in comparison to other harmful waste materials like mercury, which is toxic for indefinite periods of time (World Nuclear Association).

In light of all of this evidence, it is clear that nuclear energy's limited effect on the environment is its strongest advantage over other sources of energy. Nuclear energy keeps harmful greenhouse gases like CO_2 out of the atmosphere, making it a viable climate change energy solution. It also uses less land area than other major sources of energy like solar and wind, generating more power with less resources. While it cannot be denied that nuclear energy creates waste, nuclear power does not generate as much harmful waste as other energy sources, and the toxicity of the waste naturally expires. Some waste can also be reprocessed so it can be reused as fuel.

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