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Is nuclear energy necessary for sustainable energy production?

As society progresses, it is becoming increasingly more evident that alternate sources of energy will soon be necessary to sustain the demand for energy all across the world while reducing carbon emissions. Global temperatures are rising and oil prices are rising, all as a result of fossil fuels being pumped out of our earth's mantle. As we search for sustainable alternative energy, we must consider all paths. Could nuclear energy be the temporary solution until wind, solar, and hydroelectric energy have the capacity to take over?

To be able to discuss this properly, one must understand what nuclear energy is. Inside a reactor, certain atoms are split to heat water into steam which turns a turbine that can then generate electricity. The incredible part of this is that these reactions use uranium, meaning that it does not produce carbon dioxide, unlike fossil fuel-fired power plants. (USA EIA 2021) In turn, this means that increasing our use of nuclear energy can reduce global warming and greenhouse gases produced from other forms of energy. The more renewable energy that is produced, the less carbon-intensive energy sources we will be using and the better it will be for our planet.

In fact, many countries have started transitioning more and more of their energy production to nuclear. In 2019, 12 countries produced at least one-quarter of their electricity from nuclear power; France, Slovakia, Ukraine, Hungary, Belgium, Sweden, Slovenia, Bulgaria, Switzerland, Finland, and the Czech Republic. The United States, UK, Spain, Romania, and Russia trail behind, using nuclear energy as about 1/5 of their electricity source (World Nuclear

Association, 2021) As more and more countries begin incorporating nuclear power as part of their energy production, it becomes more important than just a green energy source. Nuclear power plants are actually used for many different things, such as space exploration, sterilizing medical equipment, providing potable water through desalination, power electric vehicles, supplying radioisotopes for cancer treatment, and more. So, in addition to the sustainable benefits, countries having lots of nuclear reactors can help keep their technology advanced.

Another reason why nuclear power plants are good for the environment is that nuclear energy produces more electricity on less land than any other clean-air source. This is beneficial because clean energy like solar farms can result in environmental degradation and habitat loss, inhibit local vegetation and cause damage to the natural ecosystem services that the area once provided. Wind energy might be another option because the land they occupy can also be used for other purposes like agriculture, unlike solar farms, but wind farms are often viewed as an aesthetic hazard and they can be harmful to some wildlife like birds. So for the amount of energy produced compared to the space nuclear power plants take up is actually better for the local environment. (Office of Nuclear Energy, 2021)

Furthermore, nuclear power plants are sustainable because the fission waste products are very dense and can be stored efficiently. In fact, all of the nuclear waste produced by the United States over the last 60 years could fit on a football field at a depth of fewer than 10 yards! (US EIA, 2021) Contradictory to popular belief, nuclear waste is generally in the form of small pellets, not green ooze. After the fission reaction, most of the energy is released immediately and carried off by the coolant to do useful work. The remaining energy is released from the waste for thousands of years after the atom splits, but decreases in toxicity over time, something unique to

nuclear waste. However, this waste is still highly radioactive and can cause problems if not handled properly. (Touran, 2021)

Finally, nuclear power plants can provide jobs for years, from construction to maintenance, to waste disposal. This would be good for the economy because the more available jobs and the more people working, the more likely people are to spend money!

In fact, construction jobs for nuclear power plants will be available for a long time after the start of building one...possibly too long. From the start of construction to the first day of production, it takes on average 14.5 years to build one nuclear power plant. And with the possibility that we could pass the threshold for dangerous warming, which is +1.5 degrees celsius, as soon as 2027, attempting to replace coal-burning and other carbon-intensive energy sources may not be a quick enough solution. (Cardenas, 2021)

In addition to the time, building a nuclear power plant is extremely expensive. On average, the range of cost is 6 to 9 billion dollars for one nuclear power plant. Compared to the cost of a wind or solar farm, this is astronomical. While the actual cost of operation is relatively low, this is not counting the cost of mining for uranium to fuel the reactions, not to mention the environmental impacts it has. Per pound, uranium costs \$67.10. Compared to natural ecosystem services like the tide, wind, and the sun, this is a big drain. Mining can also have a very severe impact on the surrounding environment. The three main mining techniques used for extracting uranium are surface mining, heap leaching, and underground mining. All three of these methods can disrupt topsoil, increase erosion, pollute groundwater, and expose radioactive gases. It is important to consider the health impacts that mining has on the workers as well as the people living in the nearby area. (Longstaff, 2017)

And of course, there is always the risk of a nuclear power plant meltdown. Although they are very rare, there are many famous ones in history, such as Chernobyl, Fukushima, and the Three-Mile Accident. A meltdown occurs in a reactor when the fuel isn't being adequately cooled, which can cause the majority of the water to boil off, exposing the fuel rods to the air, allowing for the uranium pellets to burn through their casing and the chamber floor, finally resulting in a widespread release of radiation. (Henderson, 2015) Although this is a worst-case scenario, waves of radiation can spread hundreds of miles, affecting humans and wildlife. Radiation cannot be seen, smelled, or tasted. Exposure has dangerous side effects such as hair loss, skin blisters, tumors, cancer, or even death. The effects can last for hundreds of years as the radiation slowly decays.

Overall, there are many pros and cons to nuclear energy, and only a certain amount of time left to decide if it is a feasible solution to begin shifting away from fossil fuels to more sustainable energy in the upcoming years. In my opinion, although nuclear energy isn't the best solution we could've hoped for, it might be the only one left. Because it is a carbon-free energy source, has so few waste products, and has seen so much success in other countries, I think that nuclear energy is the way to go to try and become more sustainable in our energy consumption efforts.

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