Bridging the Gap to Renewable Resources With Nuclear Energy

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Introduction

Climate change is a global problem that requires a global effort. It is defined as the long term shift in weather conditions by changes in temperature and other indicators such as precipitation (Government of Canada, 2019). Any factor that causes a sustained change to the amount of incoming or outcoming energy in the environment can lead to global climate change (GCC). Human activity is the dominant cause of GCC: ever since the beginning of the Industrial Revolution, people have burned more and more fossil fuels. Burning fossil fuels produces CO_2, a greenhouse gas, which in turn produces the greenhouse effect - the effect that makes Earth warmer. CO_2 emissions are the main cause of climate change because they stay in the atmosphere for a very long time, making our climate increasingly warmer. Global warming can only be stopped by eliminating global emissions of CO_2 from fossil fuel combustion to zero. The use of nuclear energy can significantly mitigate CO_2 emissions, and is the only form of energy that can achieve carbon mitigation in the long-run (Jin & Kim, 2018). Because renewable sources like wind power and solar radiance are intermittent and periodically variable, the capacity factors of these units are significantly lower than those of fossil fuels and nuclear energy (Michaelides & Michaelides, 2020). Therefore, nuclear energy would be the ideal substitution of fossil fuels, because nuclear power plants generate continuously and exhibit capacity factors very close to 100% (Michaelides & Michaelides, 2020).

Clean Energy and Electricity

Jacobson (2009) recognized the capacity of nuclear energy to achieve lesser carbon emissions globally and highlighted the potential of nuclear-generated electricity in the

transportation sector, in order to provide power to battery-operated electric vehicles (Michaelides & Michaelides, 2020). Nuclear fusion could produce an ideal long-term solution to GCC - because of the low generation cost, nuclear power plants can exhibit high capacity factors. Further, considering the environmental implications of carbon emissions in a large economy, a recent study for Mexico (Santoyo-Castelazo et al., 2014) determined that switching from the current fossil fuel mix of the country to a higher contribution of renewable energy sources (55–86%) and nuclear power (up to 30%) would result in 80% carbon emission reductions and would reduce significantly the impacts of GCC on the quality of life of the citizens (Michaelides & Michaelides, 2020).

A Comparison of Renewable and Nuclear Sources

Renewable sources such as solar and wind energy have been proven to be intermittent. Daily fluctuations caused by weather result in dissimilar amounts of energy produced in different intervals (Fares, 2015). Furthermore, solar panels are only functional during the day, which is unideal to rely upon as electricity is of utmost importance during the night. Wind and solar energy sources depend on backup power, specifically the combustion of fossil fuels (primarily natural gas) (Brook et al., 2014). Thus, utilization of renewable sources proves to be unsustainable, erratic, and an unsound investment in the generation, transmission, and backup power of these sources (Brook et al., 2014). Nuclear power plants produce continual electricity with capacity levels trailing closely behind 100% (Brook et al., 2014). In 2019, the Nuclear Energy Institute found that the U.S. nuclear reactors prevented more than 476 million metric tons of carbon emissions.

Counter-arguments

Despite the incredible potential that nuclear energy possesses, critics are quick to point out three main counterclaims: the safety concerns of nuclear technology and waste, economic barriers, and the unsustainability of uranium. First, the health risks of nuclear accidents and radioactive waste have been recognized and well documented, particularly in the Chernobyl and Fukushima incidents. However, these disasters may be attributed to the lack of safety, outdated technology systems, and improper waste disposal systems in these older nuclear power plants (AlFarra & Abu-Hijleh, 2011; Pampel, 2011). Thus, with newer designs and rapidly developing technologies, the likelihood of nuclear accidents decreases significantly (Clery, 2011). Another issue is the financial burden of implementing nuclear power. Although the initial cost of building a nuclear reactor is quite expensive, it surprisingly has a very low operational cost (AlFarra & Abu-Hijleh, 2011; Michaelides & Michaelides, 2020). It is important to mention that these statistics primarily apply to Western countries. Countries such as China, Russia, and South Korea, are building new reactors quickly and cost-effectively; although nuclear development in the West has been high-priced in the past, it does not necessarily imply that it will continue as such in the future (Lovering et al., 2015). Finally, the "unsustainability of uranium" argument must be addressed. Although the abundance of uranium-235 is limited (Muellner et al., 2021), the amount of uranium needed for fuel is small compared to fossil fuels (Was & Allen, 2020). Thus, it is estimated that there is enough uranium to supply nuclear power for approximately 130 years (Muellner et al., 2021).

Conclusion

Ultimately, nuclear energy strongly presents itself as the missing link needed to transition from fossil fuels to renewable resources. Because current renewables are inherently intermittent and lack production power, nuclear energy, as a robust, low-carbon and reliable resource, will provide an excellent alternative in the meanwhile. Finally, further research and development in nuclear technology will relieve the acknowledged concerns of safety, economy, and sustainability.

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