Nuclear Energy's Role in Decarbonization By Anonymous Student #1

Posed over a year ago, the Green New Deal called political attention to an issue that was already in the public's field of view: climate change. Its goal is to achieve net-zero greenhouse emissions in the United States; in other words, decarbonization. Decarbonization requires abandoning fossil fuels, quickly, and this is no easy task. The U.S. is already behind other countries in doing this, demonstrated most explicitly by our not being part of the Paris Climate Agreement. Moreover, fossil fuels are responsible for generating roughly sixty percent of the U.S.'s electricity per year, so abandoning them requires a robust alternative.

Renewable energies obviously come to mind, and they of course will play a large role in decarbonization, but they are not the only option when it comes to clean energy. Nuclear power has played a large role in the United States energy sector since the Cold War, and it has the power to help solve decarbonization. In order to meet the needs of swift decarbonization, the United States should expand nuclear power, both in scope and technology.

Currently, nuclear power is responsible for roughly twenty percent of the United States' total electric power generated in a year. Alternative energy sources make up another twenty percent, and the remaining sixty is provided by fossil fuels. As for where the nuclear power comes from, the U.S. has nuclear power plants in thirty states. Seventeen sites are in various stages of decommissioning, and the development of Yucca Mountain and research into other repository options have been halted.

Most current reactors operating in the US are light water reactors, which harness nuclear fission to heat and boil water to spin a turbine, much like fossil fuels do. However, nuclear power produces different waste. During nuclear fission, a fuel source (such as uranium) is bombarded with neutrons, which are absorbed by the fuel, causing the atom to split. This releases energy in the form of heat. The split releases more neutrons, and the reaction repeats until the fuel sample is spent. The resulting waste is stored in dry casks, which are robust concrete cylinders, and the dry casks

are stored to cool off. None of the waste is released into the atmosphere in this process.

As previously mentioned, renewable energy sources contribute about as much generated electricity as nuclear power currently, and also do not pollute the atmosphere. They largely produce electricity not by heating anything, but by spinning a turbine with wind or water or by turning solar energy into electricity. Renewables are undoubtedly the *most* environmentally friendly source of energy overall, but one must keep in mind effects other than the atmosphere. While solar panels may be 'fueled' by the sun, their construction requires rare earth minerals that must be mined like other fuel sources. However, renewable energy's greater and arguably more pressing drawback is its variability in production, i.e. solar panels don't produce energy at night or on cloudy days and wind turbines don't produce energy when it's not windy, etc. This, paired with the variability in demand throughout the day, creates the need for some consistent and constant energy source, or 'firm' energy source, to fill in the gaps.

Nuclear is the ideal source to stabilize the issue of variability. It can run almost constantly and produce a great deal of energy, like fossil fuels, but with a relatively minimal environmental impact. As discussed, nuclear power does not release greenhouse gases, the reduction of which is the goal of decarbonization. Yes, radioactive waste is produced, but safe and reliable storage of nuclear waste has been around for almost as long as nuclear power has been employed. In addition to being just as safe as other resources when regulated properly, nuclear power also can alleviate some of the cost of decarbonization. In studies of different plans for decarbonization, plans that included nuclear power as a firm low-carbon energy source were consistently lower-cost than those without. That's not to say that one cannot reduce cost without nuclear, as demand flexibility can reduce some of this cost, but demand flexibility also cannot reduce all of the cost.

In the process of expanding nuclear power, there are many opportunities to make the process more safe and efficient. Most current U.S. reactors are considered generation 3 reactors, while in places like South Korea there are generation 4 reactors.

The chief differences between generation 3 and 4 reactors are designs that improve cooling, allow for higher safe operating temperatures, use less fuel, and produce shorter-lived waste.

Swift decarbonization requires immediate, sweeping action to eliminate fossil fuels. There are many different possibilities for what exactly the future arrangement of low-carbon energy will be, but it should absolutely include modern nuclear power. It is a powerful and reliable source of energy that is safe and environmentally friendly. Sixty percent of our energy currently comes from fossil fuels. To change that, we need to know what our choices are and consider every angle. Only then can we attain a better, carbon-neutral world.

22.011 Nuclear Engineering: Science, Systems and Society
Spring 2020