Steps Towards a Stable Climate: Nuclear vs. Fossil Fuels

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After the Industrial Revolution, the average temperature of the Earth has been steadily climbing, and many scientists believe this can be attributed to the amplification of a natural process called the Greenhouse Effect. [1] When the sun shines on the Earth, some of the energy is reflected, but most of it is absorbed by gasses called greenhouse gasses. These gases emit the absorbed solar energy as heat in all directions. Greenhouse gasses are an important part of the Earth's climate because they are responsible for maintaining a livable temperature. However, the percentage of greenhouse gasses in the Earth's atmosphere has increased almost in unison with the rising temperatures. This change in climate has resulted in rising sea levels, an increase in hurricanes and related weather events, changing precipitation patterns resulting in altered soil moisture, and the shifting of areas on Earth in which certain plants can grow.[2] To avoid these consequences, the world should make its best effort to avoid adding additional greenhouse gasses into the Earth's atmosphere.

More than a quarter of greenhouse gas emissions in the U.S. come from the creation of electricity, an important facet of modern life in the U.S. and other developed countries.[3] This is because the majority of U.S. energy comes from the burning of fossil fuels including coal, petroleum and natural gas.[4] These sources are formed when plants or zooplankton die, and their decayed remains are subjected to intense heat and pressure.[1] When these fossil fuels are burned, they release carbon dioxide-- one of the primary greenhouse gases along with water vapor, methane, nitrous oxide, and ozone. Since it is not practical to simply use less electricity, it would be advantageous to phase out the sources of electricity that contribute the most to greenhouse gasses in favor of renewable or sustainable sources of electricity.

Along with solar, hydro, and wind, one of the most promising candidates to sustainably replace fossil fuels is nuclear power, as it has many benefits over coal and natural gas.[5] Uranium is mined and enriched in centrifuges to increase the concentration of uranium-235, the isotope of uranium that can sustain a fission reaction. [3] The enriched uranium is made into pellets which are then loaded into metallic sleeves to make a fuel assembly to be put into a reactor. When the control rods (used to control the fission rate) are retracted, neutrons emitted from the uranium strike nearby uranium nuclei which results in the emission of additional neutrons. This process releases heat and radiation which heats up water that evaporates into steam to power turbines. Since there is no burning in the process of nuclear power, there are no greenhouse gas emissions from the process. In fact, nuclear power has prevented the creation of more than 100 billion tons of carbon dioxide from entering the atmosphere worldwide since 1975.[6] Nuclear energy is also highly efficient in its Energy Return on Investment (EROI), a way to measure how much energy it produces against how much energy is spent obtaining the resource. [7] The larger the EROI, the more efficient the method of electricity production is. An EROI of 1 would mean that an equal amount of energy was spent creating the energy source as the energy that was produced. Nuclear energy has an EROI of around 60-70, while coal and natural gas rarely pass 30. This efficiency proves the economic viability of nuclear power.

Nuclear power has the capability to significantly slow down the process of climate change, if it is used appropriately. For example, if every country in the world were to swap out its fossil fuel energy for nuclear energy, the world could save up to 240 billion tons of carbon dioxide from entering the atmosphere by 2050.[6] The atmosphere currently contains 830 billion tons of carbon dioxide-- 200 billion

tons of which results from fossil fuel burning. This does not even take into account the greenhouse gasses that are released into the atmosphere from the acquisition of fossil fuels through means such as hydraulic fracturing. In hydraulic fracturing, porous rock is fractured with water, sand, and chemicals to help natural gas escape to the surface where it can be collected and burned for electricity. Not only is this method associated with the contamination of water sources, but some of the gas is released in the process and enters the atmosphere to contribute to the greenhouse effect. Unconventional fossil fuels such as shale gas and tar sands require environmentally dangerous methods for extraction like the aforementioned hydraulic fracturing. Uranium mining, like all other mining, has its own consequences such as the pollution of groundwater, the destruction of the surface environment, or the potential for radon release.[8] However, uranium mining does not contribute to the release of greenhouse gasses, with the exception of the earth-moving vehicles used in open-pit mining.

It is essential that climate change is minimized in the coming years because of the potential economic and environmental impact it could have on the U.S. and the rest of the world. By 2090, the U.S. alone is projected to lose $26 billion dollars of American coastal property annually from rising sea levels and many more billions worth of road damages, cooling costs, flooding costs, and lost freshwater fishing. [9] If making more progress towards nuclear energy can limit the global increase in temperature to less than 5 degrees Fahrenheit, the U.S. economy would save a total of $10 trillion dollars in damages and perhaps more importantly, prevent the loss of thousands of lives to heat related deaths by 2090.

As the average global temperature rises, the ocean's temperature rises as well. This can be problematic because warm water currents are slower than cold water currents, so that when a hurricane forms, it has more time to build strength in open water before it makes landfall which can result in more powerful hurricanes and tropical storms. [10] When the air is warm, it can hold more water, which results in more rainfall during these storms. A significant issue with rising temperatures is the melting of permafrost, a layer of permanently frozen soil.[11] When the permafrost melts, it releases greenhouse gasses like carbon dioxide and methane that were frozen with it many years ago. This process results in a positive feedback loop where the greenhouse gasses released from thawed permafrost contribute to climate change which causes even more permafrost to be thawed.

When the selection of energy sources is made, it is important to consider not only the current global demands of energy, but also the ever-increasing demands of energy for third world countries as they continue to develop. The consequences associated with climate change have already resulted in losses of human lives and financial resources. This trend can only be expected to continue, so the choice of energy sources for the country is, now more than ever, a critical one. The decision should reflect both economic and environmental needs which is why nuclear energy is a powerful choice for the nation's and even the world's future energy compositions.

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