Should the US Swap to Nuclear Power?

Joseph Schendel

Department of English, ARCC

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Professor Chris McCarthy

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How dangerous is nuclear power? And what are the risks of storing nuclear waste? There are many myths about nuclear power, the foremost of which is the danger that it poses to society. Not many people would want to live next to a nuclear power plant. They associate nuclear energy with atomic bombs and glowing green goo that is so common in movies trying to explain supernatural phenomena. I just watched the new *Godzilla* movie and they had to evacuate everyone in a 20-mile radius due to the nuclear plant being destroyed. Nuclear power is everywhere in the media; ~~and~~ it is always portrayed as dangerous. I understand why people would be against nuclear power, especially given the media coverage~~.~~ Nuclear power serves as an effective global energy solution, mitigates climate change, and warrants promotion through education for widespread adoption.

One of the primary reasons people are afraid of nuclear power is the few famous disasters like Chernobyl and Fukushima. I do not think that the average person is informed about nuclear power, they just think of some strange powerful force. Nuclear power is one of the safest means of energy production. Chernobyl and Fukushima could have been avoided with some simple common sense. World Nuclear (2022) Concluded the following:

> There have been two major reactor accidents in the history of civil nuclear power – Chernobyl and Fukushima Daiichi. Chernobyl involved an intense fire without provision for containment, and Fukushima Daiichi severely tested the containment, allowing some release of radioactivity. These are the only major accidents to have occurred in over 18,500 cumulative reactor-years of commercial nuclear power operation in 36 countries. The evidence over six decades shows that nuclear power is a safe means of generating electricity. The risk of accidents in nuclear power plants is low and declining. The consequences of an accident or terrorist attack are minimal compared with other

commonly accepted risks. Radiological effects on people of any radioactive releases can be avoided.

In Chernobyl, which was the worst nuclear disaster ever, only thirty people died from the reactor, and only an estimated 433 people died total, while this is still tragic it is nothing compared to the thousands that die from fossil fuels every year. How often are coal and oil deaths in the news? In December there was an explosion at Conakry Oil Depot killing twenty-four and injuring 454. I certainly did not hear about it. Air pollution also causes millions of deaths every year along with general adverse health effects. According to Jos Lelieveld (2023), "An estimated 5.13 million of these excess deaths are specifically attributable to ambient air pollution resulting from fossil fuel use. This figure represents 82% of the maximum number of air pollution deaths that could be averted by controlling all anthropogenic emissions." Compared to the number of deaths caused by fossil fuels in one year Chernobyl would have to happen 12,000 times! Chernobyl was the result of incompetence to the highest level; there was no containment structure in the reactor to prevent radiation leaking in a disaster. The reactor was also outdated with a design that let steam build up in the pipes and cause an explosion. The failure occurred during a test where many of the control rods designed to slow the reaction were lifted. Chornobyl would never have happened even with the poor reactor design if the operators had not raised almost all the control rods during a low-power test.

Nuclear energy is one of the safest options for energy production, according to Hanna Richie (2020), compared to coal there are 820 times fewer deaths from nuclear per terawatt hour and 613 times fewer deaths than oil. Nuclear energy beats every energy source in safety except for solar (yes, this data includes Chernobyl, Fukushima, and 3-mile Island). Nuclear is also the cleanest energy source, beating even wind, solar, and hydroelectric. Nuclear power produces 8.9 times less greenhouse gases than solar, and 160 times less than coal. This is not to rag on

renewables, as they are also part of the solution, however solar and wind only work during certain times of day and those deficits can be handled by nuclear. Additionally, Wind power is bad for wildlife. The blades can strike birds and according to a meta-study by Joel Merriman (2021) this results in 366,000 bird deaths per year. Nuclear power takes up less land and rarely kills wildlife. Solar energy must also be mined and is hard to recycle, this causes adverse ecological impacts. According to Atasu from Harvard Business Review, "If early replacements occur as predicted by our statistical model, they can produce 50 times more waste in just four years than IRENA anticipates. That figure translates to around 315,000 metric tonnes of waste, based on an estimate of 90 tonnes per MW weight-to-power ratio." Renewables are part of the solution; however, it is nigh impossible for them to replace 100% of our energy usage. This is also much more waste than nuclear power plants produce.

Many people believe that nuclear waste is a big problem, on TV you always see science fiction nuclear waste that turns everything around it into mush or some alien creation. In the show *Chernobyl* where they are cleaning up the reactor one of the characters gets a cut in his hazmat suit and they act like it is the end of the world. In real life you would be completely fine. It takes about 5,000 Millisieverts to be fatal for 50% of people, according to The Chernobyl Gallery. (2013) The current background levels of radiation at Chernobyl are 0.9 - 11.5 Millisieverts per hour. A lethal dose of radiation would require staying in Chernobyl for 500 – 5000 hours (about 7 months). The biggest radiation risk is if you end up eating something radioactive. If you don't go to Chernobyl and start eating random rocks and dirt, you should be ok. Nuclear waste was solved years ago. There is not much waste, and the most common forms of radiation are beta and alpha decay. According to the US Army Corps of Engineers (N.D)

> Alpha particles are the largest and slowest atomic particles. They can travel only a few inches through air. They can be stopped by a sheet of paper or the outer layers of skin. Beta particles are smaller and faster than alpha particles but can travel only about 10 feet through air. They can easily be stopped by a thin shield such as a sheet of aluminum foil.

The radiation produced by nuclear waste is weak enough that it can be stopped by paper or skin in the case of alpha decay and tin foil for beta decay, even if you buried this in your backyard the increase in radiation would be almost unnoticeable. The media likes to scare people by saying, "Uranium has a half-life of 4.47 billion years!" This is not that scary, that means that for half of the material to emit an alpha particle it would take 4.47 billion years. The bigger number is not scary here, you would be fine in a room with a small amount U – 238, the enormous number sounds bad but it's a good thing. Radon is a dangerous gas. It has a half-life of 3.82 days, that is why it's so dangerous. The shorter the half-life the faster the decay and the more radioactive the material is.

The second reason nuclear waste is not a problem is the amount of nuclear waste produced is incredibly small and can be easily stored until it is inert. According to the World Nuclear Association (2021)

> Nuclear fuel is very energy dense, so very little of it is required to produce immense amounts of electricity – especially when compared to other energy sources. As a result, a correspondingly small amount of waste is produced. On average, the waste from a reactor supplying a person's electricity needs for a year would be about the size of a brick. Only 5 grams of this is high-level waste – about the same weight as a sheet of paper. The generation of electricity from a typical 1,000-megawatt nuclear power station, which would supply the needs of more than a million people, produces only three cubic meters of vitrified high-level waste per year if the used fuel is recycled. In comparison, a 1,000-

megawatt coal-fired power station produces approximately 300,000 tonnes of ash and more than 6 million tonnes of carbon dioxide, every year.

The reason that nuclear fuel is so dense is because of how nuclear power works. When neutrons and protons decay some of their mass is converted into energy, you heard that right, mass is directly converted into energy. It is doubtless you have heard of the equation E=MC^2. This is the formula for energy being converted into mass. C is the speed of light which is about 2.998*10^8 m/s. When converting mass into energy this already enormous number is squared then multiplied by the amount of mass. Nuclear energy converts mass directly into energy. This produces much more energy than the breaking of chemical bond when burning oil. Unlike oil and methane, nuclear power doesn't release any CO2 or greenhouse gases.

Why do we need to change from methane and coal / oil? There are many reasons that we need to stop using fossil fuels. One of the primary reasons is global warming and pollution. According to Katherine Blue (2019). "Risks If global temperatures rise above 3°C by 2050, global GDP could decrease by over 18%. Physical and transition risks include extreme weather events, chronic climate changes, shifting consumer preferences, increased regulation and expanded carbon markets, technological disruption". This decrease in GDP would make a massive difference in quality of life across the globe. In comparison during the 2008 financial crisis GDP only dropped by 4.3%. There is another reason that everyone should want less CO2 in the air; our bodies were not designed to function with that much CO2 in the air. According to Neuroscience news (2020), in concentrations as low as 1400 ppm (0.14%) Critical thinking is diminished by up to 50% and decision making is slowed down by 25%. In case your brain is currently fried by CO2 I will explain why this is a horrible disaster for humanity. This means that everyone will make slightly worse choices always. Imagine a world in which people think about

their actions even less than they do now, scary right? This could have an exceptionally large compounding impact on the future of humanity.

Given all this data why haven't we swapped entirely to nuclear? Nuclear power does have a downside when compared to fossil fuels, it takes much longer to Build a nuclear reactor than it does a coal or methane power plant. According to Real engineering (2020), it takes about 17 years for nuclear to make as much profit as an oil power plant, however, keep in mind that this is without any CO2 production and the cost of running an oil plant is larger due to the larger amount of fuel needed to run oil plants compared to nuclear plants. Nuclear power is also at its current lowest price per MWH ever. The price currently being 30.92 dollars per MWH compared to the 32.78 for solar and 55.28 for Hydroelectric Nuclear is more affordable than ever before and even beats out some renewables. It is important to note that fossil fuels still beat every renewable at a price of 13.2 dollars per MWH and this is the largest challenge for the adoption of renewables. The 3-4-fold price difference between renewables and coal needs to be closed. If coal and methane cost less than renewables or nuclear, it is going to be much harder to convince people to swap away from fossil fuels and to green sources of energy like nuclear.

Nuclear power has many advantages over other sources of energy. It is safer than most other energy sources and completely green. It is time to consider the evidence and change the tone around nuclear power. It is not something from science fiction that is very dangerous but one of the safest methods of energy production. This topic is very important to the future of humanity itself; this is the only inhabitable planet in our solar system. The correct choices need to be made to keep it that way. During this essay I learned how important it is to reduce our CO2 output, our energy production is a major way for us to reduce CO2 emissions. It is time for us to consider converting a large amount of our energy production away from fossil fuels and to cleaner sources like nuclear solar, and wind.

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