**Resolved**: The use of nuclear energy should be significantly expanded.

|  |  |
| --- | --- |
| **Pro** | **Con** |
| Clean energy | Nuclear waste |
| Reduces pollution | Chance of meltdown |
| Reduces climate change | Other sources of clean energy |
| AT meltdown: improved technology | Fuel can be enriched for bombs |

**Pro 1: Clean Energy: ‘Renewables’ capacity too low**

#### **Forbes.com. (2019).** *Why The World Needs More Nuclear Power*. [online] Available at: https://www.forbes.com/sites/rrapier/2019/07/11/why-the-world-needs-nuclear-power/#29f014037bd6 [Accessed 6 Dec. 2019].

**Last year global consumption of coal, oil, and natural gas was nearly four times the growth in renewables. As a result, global carbon dioxide emissions set a new all-time high in 2018. Those trends are likely to continue for the foreseeable future. The world will experience a rapid growth rate for renewables, but even greater overall growth from fossil fuels.**

**Nuclear power could help solve that problem, because it is the only large-scale firm power source that doesn't generate carbon emissions during its operation**. But the general public has a fear of nuclear power. We must address and overcome this collective fear if nuclear power is to help displace fossil fuels. That can only be achieved by convincing the public that accidents like Chernobyl and Fukushima are no longer possible.

As I have written before, nuclear power plants must be designed to be fail-safe, if not fail-proof. To be fail-safe means that if an accident takes place, the system fails to a safe state. A simple example of this is an electrical fuse. If too much current tries to flow across the fuse, the fuse melts and stops the flow of electricity. Future nuclear plants must be designed in a way that provides the public with an absolute degree of confidence that they can't have catastrophic accidents.

Public expectations may be that nuclear designs need to be fail-proof, but there are many reasons why that metric will never be achieved. The most fundamental reason is that we simply can’t guard against every possible outcome. Thus, we try to mitigate possible consequences, and implement fail-safe designs.

**There are those who will still reject the idea of nuclear power under any circumstances. But there are consequences from such a stance. Some will idealistically believe that renewables will fill the world's growing power demands, but in reality that's just not happening.**

**Pro 2: Air Quality & Low Waste Production**

**Energy.gov. (2019).** *3 Reasons Why Nuclear is Clean and Sustainable*. [online] Available at: https://www.energy.gov/ne/articles/3-reasons-why-nuclear-clean-and-sustainable [Accessed 6 Dec. 2019].

**Nuclear is a zero-emission clean energy source.**

It generates power through fission, which is the process of splitting uranium atoms to produce energy. The heat released by fission is used to create steam that spins a turbine to generate electricity without the harmful byproducts emitted by fossil fuels.

**According to the Nuclear Energy Institute (NEI), the United States**[**avoided more than 14,000 million metric tons of carbon dioxide emissions**](https://www.nei.org/resources/statistics/emissions-avoided-by-us-nuclear-industry)**between 1995 and 2016. That’s the equivalent of removing 3 billion cars from the road.**

**It also keeps the air clean by removing thousands of tons of harmful air pollutants each year that contribute to acid rain, smog, lung cancer and cardiovascular disease.**

Nuclear fuel is extremely dense.

It’s about 1 million times greater than that of other traditional energy sources and because of this, the amount of used nuclear fuel is not as big as you might think.

**All of the used nuclear fuel produced by the U.S. nuclear energy industry over the last 60 years**[**could fit on a football field**](https://www.nei.org/fundamentals/nuclear-waste)**at a depth of less than 10 yards!**

**That waste can also be reprocessed and recycled, although the United States does not currently do this.**

**However, some advanced reactors designs being developed could operate on used fuel.**

Learn more about our [NICE Future Initiative](https://www.energy.gov/ne/nuclear-innovation-clean-energy-future) and other benefits of nuclear energy.

**Pro 3: Small Modular Reactors solve cost, size and safety**

#### *Rivera, Lizzie. Can eating meat ever be ethical?*. ***The Independent*. (2016).**  Retrieved 20 November 2019, from https://www.independent.co.uk/life-style/lifestyle-lowdown/can-eating-meat-ever-be-ethical-a6973261.html

CORVALLIS, OREGON—To a world facing the existential threat of global warming, nuclear power would appear to be a lifeline. Advocates say nuclear reactors, compact and able to deliver steady, carbon-free power, are ideal replacements for fossil fuels and a way to slash greenhouse gas emissions. However, in most of the world, the nuclear industry is in retreat. The public continues to distrust it, especially after three reactors melted down in a 2011 accident at the Fukushima Daiichi Nuclear Power Plant in Japan. Nations also continue to dither over what to do with radioactive reactor waste. Most important, with new reactors costing $7 billion or more, the nuclear industry struggles to compete with cheaper forms of energy, such as natural gas. So even as global temperatures break one record after another, just one nuclear reactor has turned on in the United States in the past 20 years. Globally, nuclear power supplies just 11% of electrical power, down from a high of 17.6% in 1996.

**Jose Reyes, a nuclear engineer and cofounder of NuScale Power**, headquartered in Portland, Oregon, says he and his colleagues can revive nuclear by thinking small. Reyes and NuScale's 350 employees have **designed a small modular reactor (SMR) that would take up 1% of the space of a conventional reactor. Whereas a typical commercial reactor cranks out a gigawatt of power, each NuScale SMR would generate just 60 megawatts**. **For about $3 billion, NuScale would stack up to 12 SMRs side by side, like beer cans in a six-pack, to form a power plant.**

But size alone isn't a panacea. "If I just scale down a large reactor, I'll lose, no doubt," says Reyes, 63, a soft-spoken native of New York City and son of Honduran and Dominican immigrants. **To make their reactors safer, NuScale engineers have simplified them, eliminating pumps, valves, and other moving parts while adding safeguards in a design they say would be virtually impervious to meltdown. To make their reactors cheaper, the engineers plan to fabricate them whole in a factory instead of assembling them at a construction site, cutting costs enough to compete with other forms of energy.**

Spun out of nearby Oregon State University (OSU) here in 2007, NuScale has spent more than $800 million on its design—$288 million from the Department of Energy (DOE) and the rest mainly from NuScale's backer, the global engineering and construction firm Fluor. The design is now working its way through licensing with the Nuclear Regulatory Commission (NRC), and the company has lined up a first customer, a utility association that wants to start construction on a plant in Idaho in 2023.

**NuScale is far from alone. With similar projects rising in China and Russia, the company is riding a global wave of interest in SMRs. "SMRs as a class have a potential to change the economics,"** says Robert Rosner, a physicist at the University of Chicago in Illinois who co-wrote a 2011 report on them. In the United States, NuScale is the only company seeking to license and build an SMR. Rosner is optimistic about its prospects. "NuScale has really made the case that they'll be able to pull it off," Rosner says.

**Con 1: Nuclear Energy Bad: Affordability, Waste, Proliferation**

#### **Moniz**, Ernst. (**2019**). *Why we still need nuclear power*. [online] Available at: http://energy.mit.edu/news/why-we-still-need-nuclear-power/ [Accessed 6 Dec. 2019].

*Ernest Moniz is Cecil and Ida Green Distinguished Professor of Physics and Engineering Systems and Director of the Energy Initiative at MIT. He served as Undersecretary of the U.S. Department of Energy in 1997–2001.*

At the same time, **new reactors under construction in Finland and France have gone billions of dollars over budget, casting doubt on the affordability of nuclear power plants. Public concern about radioactive waste is also hindering nuclear power, and no country yet has a functioning system for disposing of it**. In fact, the U.S. government is paying billions of dollars in damages to utility companies for failing to meet its obligations to remove spent fuel from reactor sites. **Some observers are also concerned that the spread of civilian nuclear energy infrastructure could lead to the proliferation of nuclear weapons—a problem exemplified by Iran’s uranium-enrichment program.**

If the benefits of nuclear power are to be realized in the United States, each of these hurdles must be overcome. When it comes to safety, the design requirements for nuclear reactors must be reexamined in light of up-to-date analyses of plausible accidents. As for cost, the government and the private sector need to advance new designs that lower the financial risk of constructing nuclear power plants. The country must also replace its broken nuclear waste management system with a more adaptive one that safely disposes of waste and stores it for centuries. Only then can the public’s trust be earned.

**Con 2: Waste**

#### **Moniz**, Ernst. (**2019**). *Why we still need nuclear power*. [online] Available at: http://energy.mit.edu/news/why-we-still-need-nuclear-power/ [Accessed 6 Dec. 2019].

*Ernest Moniz is Cecil and Ida Green Distinguished Professor of Physics and Engineering Systems and Director of the Energy Initiative at MIT. He served as Undersecretary of the U.S. Department of Energy in 1997–2001.*

If nuclear energy is to enjoy a sustained renaissance, the challenge of managing nuclear waste for thousands of years must be met. **Nuclear energy is generated by splitting uranium, leaving behind dangerous radioactive products**, such as cesium and strontium **that must be isolated for centuries.** **The process also produces transuranic elements, such as plutonium, which are heavier than uranium, do not occur in nature, and must be isolated for millennia.** There is an alternative to disposing of transuranic elements: they can be separated from the reactor fuel every few years and then recycled into new nuclear reactor fuel as an additional energy source. The downside, however, is that **this process is complex and expensive, and it poses a proliferation risk since plutonium can be used in nuclear weapons.** The debate over the merits of recycling transuranic elements has yet to be resolved.

What is not disputed is that most nuclear waste needs to be isolated deep underground. The scientific community has supported this method for decades, but finding sites for the needed facilities has proved difficult. In the United States, Congress adopted a prescriptive approach, legislating both a single site, at Yucca Mountain, in Nevada, and a specific schedule for burying spent fuel underground. The massive project was to be paid for by a nuclear waste fund into which nuclear power utilities contribute about $750 million each year. But the strategy backfired, and the program is in a shambles. Nevada pushed back, and the schedule slipped by two decades, which meant that the government had to pay court-ordered damages to the utility companies. In 2009, the Obama administration announced that it was canceling the Yucca Mountain project altogether, leaving no alternative in place for the disposal of radioactive waste from nuclear power plants. The Nuclear Waste Fund has reached $25 billion but has no disposal program to support.

**Con 3: Cost**

#### *Gibbens, Sarah. Eating meat has ‘dire’ consequences for the planet, says report*. **National Geographic. (2019).** *Nationalgeographic.com*. Retrieved 20 November 2019

**A 2014**[**analysis by the financial advisory firm Lazard**](http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf)**captures the economics holding back nuclear expansion.** Lazard pegs the cost of building nuclear capacity in the United States at $5.4 million to $8.4 million per megawatt. **Adding operating, maintenance, and fuel costs yields an average lifetime cost of $92 to $132 for every megawatt-hour generated. That is far above the *unsubsidized* costs of utility-scale solar power** ($72 to $86 per megawatt-hour**) and onshore wind** ($37 to $81 per megawatt-hour).

**Power from new natural-gas-fired plants is also far cheaper than nuclear** at $61 to $87 per megawatt-hour, according to Lazard, thanks largely to gas derived from fracking in U.S. deposits. **This makes natural-gas plants, rather than nuclear plants, the leading option for utilities that want to replace coal-fired power plants as a source of constant “base load” power.**

In the United States, four new reactors are under construction (in Georgia and South Carolina) thanks to loan guarantees from the federal government and additional financing support from state regulators. However, five U.S. reactors have shut down in just the past two years.