Resolved: The United States should increase its use of nuclear energy for commercial energy production.

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PRO- INCREASE NUCLEAR ENERGY PRODUCTION

Methods to increase

Cardwell- Bush offered loan guarantees and tax credits (like those offered to other sources of energy)

NYT, Diane Cardwell, 2-18-2017 The Murky Future of Nuclear Power in the United States,
Nuclear construction had all but disappeared in the United States, particularly after the partial meltdown at Three Mile Island in Pennsylvania in 1979. Concerns over climate change led to renewed interest in building new plants under the administration of George W. Bush, however. **The Bush-era energy policy acts authorized $18.5 billion in loan guarantees, plus tax credits like those available for wind and solar.**

Cardwell- regulators designed a faster regulation process (decrease unnecessary delays while maintaining same rigorous standards)

NYT, The Murky Future of Nuclear Power in the United States, By Diane Cardwell, Feb. 18, 2017
Determined to avoid the delays and ballooning costs that were common as plants were built in the 1970s and ’80s, **federal regulators had devised a new licensing process.**Under the old system, companies received construction permits based on incomplete plans and then applied for an operating license, often leading to rebuilding and lengthy delays. The idea for the new system was that companies would submit much more complete design plans for approval, and then receive their operating licenses as construction started. That way, as long as they built exactly what they said they would, **the process could move more quickly.**

Increasing nuclear energy decreases emissions

Delbert- shutting down a plant increases fossil fuel production by 2 million metric tons in the first year, opening a nuclear plant does the opposite

Caroline Delbert, Jan 27, 2020, The #1 Thing Preventing Nuclear Development Is Still Public Fear, Popular Mechanics, https://www.popularmechanics.com/science/energy/a30676167/nuclear-development-public-fear/
Economists have analyzed two decades of data to find how well nuclear power replaces traditional fossil fuel power plants, especially as part of an overall goal of reducing carbon emissions. The series of event studies, published in the February issue of Resource and Energy Economics, considers data from the 1970s and '80s and contextualizes them around the disaster at Three Mile Island in 1979. The researchers found that although the carbon emissions from fossil fuel plants are huge, the very small risk of very big disasters at nuclear plants has caused them to fall out of favor among investors.The research team from Carnegie Mellon University, led by Edson Severnini, says its study is the first to synthesize

data from the entire U.S.. The "event" in the event study was when a nuclear power plant opened in the '70s and '80s. **The team looked at the electric grid before and in the year after a nuclear plant went online, comparing how much fossil fuel electricity was displaced by nuclear power in the local grid. For each gigawatt hour (GWh) of nuclear power, the researchers found a corresponding 0.8 GWh reduction in fossil fuel power.** Although the replacement isn't a clean 1:1 ratio of nuclear for fossil, the effect is still dramatic. "**Solely by displacing coal-fired electricity generation, the average nuclear plant opening results in nearly 2 million metric tons less CO2 emissions, 5,200 metric tons less SO2, and 2,200 metric tons less NOx within the first year,**" the researchers write. As a second project, **the team looked at output data from forced closures between 1999 and 2014.** (Anyone who grew up near a nuclear plant knows the spooky feeling when cooling towers on the horizon are offline.) **The researchers found that fossil fuel power then re-replaced nuclear at the same average rate**, and this was the same for the calendar month and the utility bill month. So what's the point here? Well, these **researchers conclude that while public perception against nuclear power makes it unlikely that sundowned plants will be replaced, what will likely replace them is much dirtier fossil fuel power.** Both the perception barrier and the regulatory cost of nuclear power is likely too high for nuclear to ever wage a comeback without pretty comprehensive reforms in place. "Nuclear power generation has lower fuel prices in comparison to coal, but faces higher operations and maintenance costs that are likely driven by the increased regulatory scrutiny after the Three Mile Island reactor accident," the researchers conclude. The public fear of nuclear, which has translated into a stifling of nuclear development since Three Mile Island more than 40 years ago, seems to pale in comparison to the medium-level constant risk posed by much higher emissions from fossil fuels. What that means, the researchers say, is that it would take "a substantial amount of regulatory pressure on fossil fuels (in the form of an emissions tax, regional emissions standards, etc.)" to push the public imagination back toward cleaner nuclear power. If their analysis is correct, it will be interesting to see how cutting-edge modular reactors—which claim to be much safer and more containable in the event of an emergency—could reduce perceived risk and let cleaner nuclear power back into our hearts.

Emissions kill people

Bethge- 800,000 people die each year from cancer or disease caused by coal fired power plant, while nuclear energy has killed far fewer

Philip Bethge, Der Spiegel, 1-7-2020, "Can Nuclear Power Offer a Way Out of the Climate Crisis?," No Publication, https://www.spiegel.de/international/world/can-nuclear-power-offer-a-way-out-of-the-climate-crisis-a-06a8a27f-d492-45d3-8134-30187eefbdf3

But how justified are the concerns? Nuclear power supporters are quick to sing the technology's praises. "As best we can tell, nuclear energy is the safest available source of energy," says Harvard psychologist Pinker. **In the three most serious accidents in the history of nuclear energy, he argues, only Chernobyl saw fatalities** from direct exposure to radiation. There were 31 of them. "And, according to estimates, a few thousand to a few tens of thousands of cancer deaths," he says. "**However, this figure fades compared to the many, many people who die prematurely every year from respiratory disease or cancer caused by dirty air from coal-fired power plants**," Pinker argues. **An estimated 800,000 people die each year as a result of exposure to coal smoke and its pollutants, including sulfur dioxide, nitrogen oxide, mercury and arsenic.** And when it comes to storing waste, retired solar panels also pose a problem. Furthermore, argue nuclear advocates, the amount of highly radioactive waste that Germany will have to store indefinitely – a total of around 10,000 tons – would fit inside a largish furniture store.

Nuclear energy reduces emissions

Payne - 1% increase in nuclear energy decreases emissions by 0.5%

N Apergis, JE Payne, K Menyah, Y Wolde-Rufael - Ecological Economics, 6-2010, "On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth"
https://www.sciencedirect.com/science/article/abs/pii/S0921800910002399
The empirical evidence indicates that there is a long-run relationship between emissions, nuclear energy, renewable energy, and economic growth. In the long-run nuclear energy reduces emissions, with **a 1% increase in nuclear energy consumption associated with a 0.477% decrease in emissions.** The causality results also show that nuclear energy plays an important role in reducing CO2 emissions where nuclear energy consumption has a negative and statistically significant impact on emissions. In contrast, renewable energy did not contribute to reductions in emissions. Nevertheless, there is bidirectional causality between renewable energy consump- tion and economic growth suggesting that the expansion of renewable energy not only can reduce the dependence of foreign energy sources for import-dependent economies, but it can minimize the risk associated with volatile oil and natural gas supplies and prices.

Sato - Emission levels cannot be reduced without nuclear energy

O. Sato, K. Tatematsu, T. Hasegawa, 1998, Progress in Nuclear Energy, "Reducing future CO2 emissions - the role of nuclear energy"
https://www.sciencedirect.com/science/article/pii/S0149197097000929
The analytical procedures were as follows. First, a reference energy system was established by incorporating all important energy sources, energy carriers, and energy technologies that existed already or that might be introduced during the above time horizon. Second, future demand for energy services was estimated based on the two economic growth scenarios, high and low. Also, assumptions were made about the evolution of imported fuel prices, availability of energy resources, and so on. Third, under the above assumptions, the optimum energy and technology options were selected by minimizing a discounted system cost under different carbon tax schemes, and thereby the potential of reducing CO2 emissions was analyzed. The following results were obtained by the analysis. **Without utilization of nuclear energy, the CO2 emissions can be hardly stabilized at the 1990 emission level even in the case of the low economic growth and large scale deployment of CO2 recovery and disposal assumed.** A significant amount of fossil fuels will be used for power generation in order to meet the rapidly growing demand for electricity. Nuclear energy, by substituting fossil fuels for electric power generation, is expected to contribute to the reduction of CO2 emissions. In addition, the average cost of reducing the emissions will be substantially lowered compared with a non nuclear scenario.

Zwaan- Nuclear energy produces much less GHG than coal-based energy

Van der Zwaan - Nuclear energy produces 200% less GHG emissions than coal
Bob van der Zwaan, Energy Strategy Reviews, 5-2013, "The role of nuclear power in mitigating emissions from electricity generation"
https://www.sciencedirect.com/science/article/pii/S2211467X12000521
This article presents an updated overview of recent literature on the role of nuclear power in mitigating greenhouse gas (GHG) and particulate matter (PM) emissions from electricity generation. Emission intensities are strongly dependent on the country of operation and type of technology used in each category of power production options, but robust observations can be made with regards to the average emission

intensity of each main alternative. The majority of emissions from nuclear energy is associated with parts of its overall life cycle other than the operation of nuclear power plants. Technological progress in especially uranium enrichment has recently yielded energy intensity reductions that have significantly lowered the GHG footprint of nuclear power, which at present amounts to 5–17 gCO2eq/kWh. As a result, **average GHG emissions are today around two orders of magnitude lower for nuclear energy than for conventional coal-based power production.** This article also addresses the feasibility of potential deployment scenarios for nuclear power and their implications in terms of global GHG emissions mitigation

Bethge- Nuclear produces some of the lowest levels of GHG, including for construction and demolition

Philip Bethge, Der Spiegel, 1-7-2020, "Can Nuclear Power Offer a Way Out of the Climate Crisis?," No Publication, https://www.spiegel.de/international/world/can-nuclear-power-offer-a-way-out-of-the-climate-crisis-a-06a8a27f-d492-45d3-8134-30187eefbdf3

Biello- speediest drop came when France implemented nuclear and reduced emissions by 2% per year

David Biello on December 12, 2013, How Nuclear Power Can Stop Global Warming, Scientific American, https://www.scientificamerican.com/article/how-nuclear-power-can-stop-global-warming/

When the Atlantic Navigator docked in Baltimore harbor earlier this month, the freighter carried the last remnants of some of the nuclear weapons that the Soviet Union had brandished in the cold war. During the past 20 years more than 19,000 Russian warheads have been dismantled and processed to make fuel for U.S. nuclear reactors. In fact, during that period more than half the uranium fuel that powered the more than 100 reactors in the U.S. came from such reprocessed nuclear weapons. In addition to reducing the risk of nuclear war, U.S. reactors have also been staving off another global challenge: climate change. The low-carbon electricity produced by such reactors provides 20 percent of the nation's power and, by the estimates of climate scientist James Hansen of Columbia University, avoided 64 billion metric tons of greenhouse gas pollution. They also avoided spewing soot and other air pollution like coal-fired power plants do and thus have saved some 1.8 million lives. And that's why Hansen, among others, such as former Secretary of Energy Steven Chu, thinks that nuclear power is a key energy technology to fend off catastrophic climate change. "We can't burn all these fossil fuels," Hansen told a group of reporters on December 3, noting that as long as fossil fuels are the cheapest energy source they will continue to be burned. "Coal is almost half the [global] emissions. If you replace these power plants with modern, safe nuclear reactors you could do a lot of [pollution reduction] quickly." **Indeed, he has evidence: the speediest drop in greenhouse gas pollution on record occurred in France in the 1970s and '80s, when that country transitioned from burning fossil fuels to nuclear fission for electricity, lowering its greenhouse emissions by roughly 2 percent per year.** The world needs to drop its global warming pollution by 6 percent annually to avoid "dangerous" climate change in the estimation of Hansen and his co-authors in a recent paper in PLoS One. "On a global scale, it's hard to see how we could conceivably accomplish this without nuclear," added economist and co-author Jeffrey Sachs, director of the Earth Institute at Columbia University, where Hansen works.

Carl- CA abandoning nuclear energy increased emissions 250%

Keeping the Lights on at America's Nuclear Power Plants, National Review, JEREMY CARL, August 3, 2017, https://www.nationalreview.com/2017/08/nuclear-power-plants-united-states-strategic-dimensions-russia-china/

And contrary to the claims of many greens, when nuclear plants shut down, they are being replaced by fossil fuels, not renewables, This is in large part because nuclear remains our only source of

low-emission baseload power. A recent report by Environmental Progress, an environmental group that has advocated nuclear power, finds that **California's decision to abandon nuclear technology has caused emissions to be 250 percent higher than they otherwise would have.** This makes it incongruous, to say the least, that so many greens oppose nuclear. One might suspect that they are more concerned with virtue-signaling and purity spirals than emissions and the environment.

(don't read - contradicts case) Nuclear solves emissions better than renewables

Sullivan- switching to renewables decelerate decarbonization, despite investment (Germany, France)

Andrew Sullivan, March 1, 2019, A Radically Moderate Answer to Climate Change, https://nymag.com/intelligencer/2019/03/andrew-sullivan-a-radically-moderate-climate-solution.html
The point is that this is achievable with current technology. And **renewables are not cost-free. Switching entirely to them, without nuclear, can actually decelerate decarbonization: Germany's carbon emissions have been flat since 2009, despite an investment of $580 billion by 2025 in a renewables-heavy electrical grid, and a 50 percent rise in electricity cost. Meanwhile, France produces one-tenth the carbon emissions per unit of electricity as Germany and pays little more than half for its electricity. How? Through nuclear power. Then, under pressure from Germany, France spent $33 billion on renewables, over the last decade. What was the result? A rise in the carbon intensity of its electricity supply, and higher electricity prices, too.**

Lives: Emissions outweigh nuclear risks

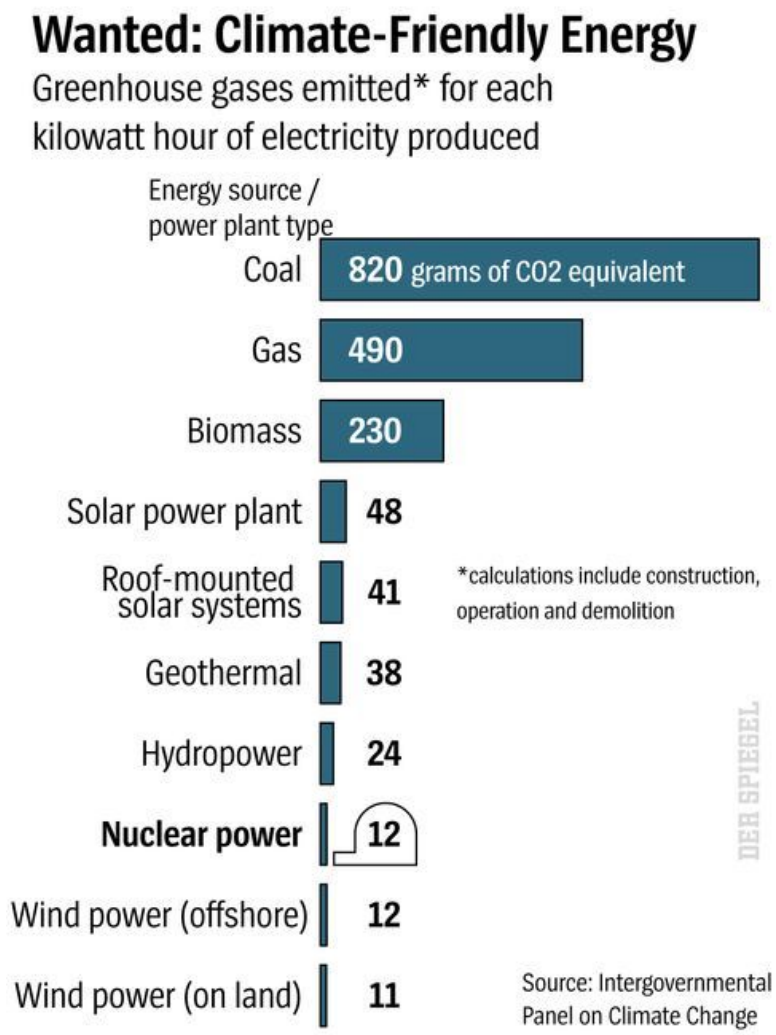
NASA - Nuclear power prevented 1.8 million deaths

James Hansen, Pushker Kharecha, NASA, 4-2013, "Coal and Gas are Far More Harmful than Nuclear Power" https://www.giss.nasa.gov/research/briefs/kharecha_02/
Using historical electricity production data and mortality and emission factors from the peer-reviewed scientific literature, we found that despite the three major nuclear accidents the world has experienced, **nuclear power prevented an average of over 1.8 million net deaths worldwide between 1971-2009** (see Fig. 1). This amounts to at least hundreds and more likely thousands of times more deaths than it caused. An average of 76,000 deaths per year were avoided annually between 2000-2009 (see Fig. 2), with a range of 19,000-300,000 per year.

Sullivan- disaster small compared to 17,000 reactor-years in 33 countries, especially given the few deaths relative to carbon-based fuels

Andrew Sullivan, March 1, 2019, A Radically Moderate Answer to Climate Change, https://nymag.com/intelligencer/2019/03/andrew-sullivan-a-radically-moderate-climate-solution.html
Renewables require huge amounts of land mass, require costly transfers of energy across long distances, are not without their own environmental damage, and are dependent on wind and sun that wax and wane independently of human needs. The problem of what's called "the duck curve" — matching energy supply and demand throughout the day and night — remains. Nuclear power, in contrast, can be concentrated, consistent, and relied upon, rain or shine, windy or calm. **Safety? We've had three major crises — Three Mile Island, Chernobyl, and Fukushima (caused by a tsunami). But that's out of over 17,000 cumulative reactor-years of commercial nuclear power operation in 33 countries. Much of the damage in those cases to the environment was contained — and the human impact has been trivial compared with the massive damage caused by carbon-based fuels.**

Resolved: The United States should increase its use of nuclear energy for commercial energy production.



Nuclear energy produces less GHG than solar or hydroelectric.

Biello- nuclear avoids 64 billion metric tons of GHG, avoided soot that would kill 1.8 million people

David Biello on December 12, 2013, How Nuclear Power Can Stop Global Warming, Scientific American, https://www.scientificamerican.com/article/how-nuclear-power-can-stop-global-warming/

When the Atlantic Navigator docked in Baltimore harbor earlier this month, the freighter carried the last remnants of some of the nuclear weapons that the Soviet Union had brandished in the cold war. During the past 20 years more than 19,000 Russian warheads have been dismantled and processed to make fuel for U.S. nuclear reactors. In fact, during that period more than half the uranium fuel that powered the more than 100 reactors in the U.S. came from such reprocessed nuclear weapons. In addition to reducing the risk of nuclear war, U.S. reactors have also been staving off another global challenge: climate change. The low-carbon electricity produced by such reactors provides 20 percent of the nation's power and, by the estimates of climate scientist James Hansen of Columbia University, **avoided 64 billion metric tons of greenhouse gas pollution. They also avoided spewing soot and other air pollution like coal-fired power plants do and thus have saved some 1.8 million lives.** And that's why Hansen, among others, such as former Secretary of Energy Steven Chu, thinks that nuclear power is a key energy technology to fend off catastrophic climate change. "We can't burn all these fossil fuels," Hansen told a group of reporters on December 3, noting that as long as fossil fuels are the

cheapest energy source they will continue to be burned. "Coal is almost half the [global] emissions. If you replace these power plants with modern, safe nuclear reactors you could do a lot of [pollution reduction] quickly." Indeed, he has evidence: the speediest drop in greenhouse gas pollution on record occurred in France in the 1970s and '80s, when that country transitioned from burning fossil fuels to nuclear fission for electricity, lowering its greenhouse emissions by roughly 2 percent per year. The world needs to drop its global warming pollution by 6 percent annually to avoid "dangerous" climate change in the estimation of Hansen and his co-authors in a recent paper in PLoS One. "On a global scale, it's hard to see how we could conceivably accomplish this without nuclear," added economist and co-author Jeffrey Sachs, director of the Earth Institute at Columbia University, where Hansen works.

Stocktown- 7,500 US deaths per year from coal power plants particulate matter, much worse than even Chernobyl

Nick Stockton, 04.03.16, Nuclear Power Is Too Safe to Save the World From Climate Change

In terms of full blown nuclear disaster, there is really only one data point: Chernobyl. Which was horrifying. But in terms of real risk? T**he World Health Organization estimates the disaster will claim 4,000 lives, a figure that includes everything from direct victims to people born with genetic mutations well after the meltdown in 1986. By comparison, particulate matter from coal power plants kills about 7,500 people in the US every year.** Radiation is the shark attack of environmental danger: An awful way to go, but far less likely than, say, a car wreck.

Walker- costs from the climate crisis will amount to $360B, and public health costs from pollution totaled $360B in 2015.

Federal Energy Subsidies: What Are We Getting for Our Money?, Grant Smith, Senior Energy Policy Advisor and Bill Walker, Vice President and Editor in Chief, WEDNESDAY, JULY 17, 2019, https://www.ewg.org/energy/22777/federal-energy-subsidies-what-are-we-getting-our-money

U.S. costs from the climate crisis – caused by the burning of coal, oil and natural gas – will soon climb to $360 billion a year, according to the Universal Ecological Fund. The International Monetary Fund estimates that in the U.S., **public health costs from air pollution caused by fossil fuel emissions were $300 billion in 2015**. And Oil Change International notes: The cost of federal fossil fuel subsidies to American taxpayers is equivalent to the projected 2018 budget cuts from [Trump administration] proposals to slash 10 public programs and services, including supports for America's most vulnerable children and families. Misplaced priorit ies, not a scarcity of resources, are driving this administration's efforts to balance the national budget at the expense of the most vulnerable.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Nuclear energy produces less radiation than other sources

Rhodes- coal contains uranium and thorium and produces most radioactive releases

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

Third, **nuclear power releases less radiation into the environment than any other major energy source.** This statement will seem paradoxical to many readers, since it's not commonly known that non-nuclear energy sources release any radiation into the environment. They do. The worst offender is **coal**, a mineral of the earth's crust that **contains a substantial volume of the radioactive elements uranium and thorium. Burning coal gasifies its organic materials, concentrating its mineral components into the remaining waste, called fly ash. So much coal is burned in the world and so much fly ash produced that coal is actually the major source of radioactive releases into the environment.**

Nuclear energy operates at capacity more often

Rhodes- operate at capacity 92% of the time, as opposed to other sources like solar (25%)

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

Second, **nuclear power plants operate at much higher capacity factors than renewable energy sources or fossil fuels**. Capacity factor is a measure of what percentage of the time a power plant actually produces energy. It's a problem for all intermittent energy sources. The sun doesn't always shine, nor the wind always blow, nor water always fall through the turbines of a dam.

In the United States in 2016, **nuclear power plants**, which generated almost 20 percent of U.S. electricity, **had an average capacity factor of 92.3 percent**, meaning they operated at full power on 336 out of 365 days per year. (The other 29 days they were taken off the grid for maintenance.) In contrast, U.S. hydroelectric systems delivered power 38.2 percent of the time (138 days per year), wind turbines 34.5 percent of the time (127 days per year) and **solar electricity arrays only 25.1 percent of the time** (92 days per year). Even plants powered with coal or natural gas only generate electricity about half the time for reasons such as fuel costs and seasonal and nocturnal variations in demand. Nuclear is a clear winner on reliability.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Three mile island, Fukushima, Chernobyl not bad/ exaggerated

Rhodes- three mile island released minimal radiation and didn't affect people or the environment

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

The partial meltdown of the **Three-Mile** Island reactor in March 1979, while a disaster for the owners of the Pennsylvania plant, **released only a minimal quantity of radiation to the surrounding population.** According to the U.S. Nuclear Regulatory Commission: "The approximately 2 million people around TMI-2 during the accident are estimated to have received an average radiation dose of only about 1 millirem above the usual background dose. To put this into context, exposure from a chest X-ray is about 6 millirem and the area's natural radioactive background dose is about 100-125 millirem per year... In spite of serious damage to the reactor, **the actual release had negligible effects on the physical health of individuals or the environment."**

Rhodes- the worst possible case, Chernobyl, only affected children who drank radioactive milk, leading to 15 deaths

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

The explosion and subsequent burnout of a large graphite-moderated, water-cooled reactor at **Chernobyl in 1986 was easily the worst nuclear accident in history.** Twenty-nine disaster relief workers died of acute radiation exposure in the immediate aftermath of the accident. In the subsequent three decades, UNSCEAR **— the United Nations** Scientific Committee on the Effects of Atomic Radiation, composed of senior scientists from 27 member states — has observed and reported at regular intervals on the health effects of the Chernobyl accident. It **has identified no long-term health consequences to populations exposed to Chernobyl fallout except for thyroid cancers in residents** of Belarus, Ukraine and western Russia who were children or adolescents at the time of the accident, **who drank milk contaminated with 131iodine**, and who were not evacuated. By 2008, UNSCEAR had attributed some 6,500 excess cases of thyroid cancer in the Chernobyl region to the accident, with **15 deaths**. The occurrence of these cancers increased dramatically from 1991 to 1995, which researchers attributed mostly to radiation exposure. No increase occurred in adults.

"The average effective doses" of radiation from Chernobyl, UNSCEAR also concluded, "due to both external and internal exposures, received by members of the general public during 1986-2005 [were] about 30 mSv for the evacuees, 1 mSv for the residents of the former Soviet Union, and 0.3 mSv for the populations of the rest of Europe." A sievert is a measure of radiation exposure, a millisievert is one-one-thousandth of a sievert. A full-body CT scan delivers about 10-30 mSv. A U.S. resident receives an average background radiation dose, exclusive of radon, of about 1 mSv per year. The statistics of Chernobyl irradiations cited here are so low that they must seem intentionally minimized to those who followed the extensive media coverage of the accident and its aftermath. Yet they are the peer-reviewed products of extensive investigation by an international scientific agency of the United Nations.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Rhodes- Fukushima radiation limited beyond facilities, no major exposure

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

The accident in Japan at **Fukushima** Daiichi in March 2011 followed a major earthquake and tsunami. The tsunami flooded out the power supply and cooling systems of three power reactors, causing them to melt down and explode, breaching their confinement. Although 154,000 Japanese citizens were evacuated from a 12-mile exclusion zone around the power station, radiation exposure beyond the station grounds was limited. According to the report submitted to the International Atomic Energy Agency in June 2011:
"No harmful health effects were found in 195,345 residents living in the vicinity of the plant who were screened by the end of May 2011. All the 1,080 children tested for thyroid gland exposure showed results within safe limits. By December, government health checks of some 1,700 residents who were evacuated from three municipalities showed that two-thirds received an external radiation dose within the normal international limit of 1 mSv/year, 98 percent were below 5 mSv/year, and 10 people were exposed to more than 10 m**Sv… [There] was no major public exposure, let alone deaths from radiation."**

Jaworowski- Chernobyl was a minor event that killed 31, lower than most other sources

CHERNOBYL: THE FEAR OF THE UNKNOWN, Zbigniew Jaworowski, MD PhD DSc, is a Professor Emeritus of the Central Laboratory for Radiological Protection, Warsaw and former Chairman of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). He is a member of the Scientific Committee of EFN (Environmentalists For Nuclear Energy - www.ecolo.org) since 2001 and a member of the Board of EFN-POLSKA (Poland), Central Laboratory for Radiological Protection, Warsaw, Poland, http://ecolo.org/documents/documents_in_english/cherno-zbigniew_fear-06.htm

On the night of 25-26 April 1986, an enormous quantity of radioactive dust was released into the air from the melting reactor core of the badly-built and poorly-maintained Soviet reactor at Chernobyl, in the Ukraine. It put out as much radioactivity as 0.5% of all previous 543 nuclear explosions in the atmosphere. The Chernobyl dust covered all Europe and Northern Hemisphere. It penetrated up into the lower stratosphere and fell even at the South Pole. Nothing worse could happen with a power reactor: a total meltdown of its core, and a ten days free release of radioactive material into the open air.Surprisingly, however, the worst harm was caused not by radiation, and not to the flesh, but to the minds. **In terms of human losses (31 early deaths), the accident in the Chernobyl nuclear power plant was a minor event compared with many other man-made catastrophes.** In 1984, about 15,000 died from the eruption of a fertilizer factory in Bhopal in India; the collapse of a Chinese dam on the Banqiao river in 1975 caused some 230,000 fatalities. **Counted per electricity units produced,** which is the only practical comparison, **fatalities in Chernobyl were lower than from most other energy sources: three times lower than oil-fired power stations, 13 times lower than liquefied gas, and 15 times lower than hydroelectric stations.** But the political, economic, social and psychological impact of Chernobyl was enormous. Let us have a look at what happened, starting with my personal experience.

Rhodes- Chernobyl death rate is per gigawatts per year is lower than most energy sources- 47 times lower than hydroelectric

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

They indicate that **even the worst possible accident at a nuclear power plant — the complete meltdown and burnup of its radioactive fuel — was yet far less destructive than other major industrial accidents across the past century**. To name only two: Bhopal, in India, where at least 3,800 people died immediately and many thousands more were sickened when 40 tons of methyl isocyanate gas leaked from a pesticide plant; and Henan Province, in China, where at least 26,000 people drowned following the failure of a major hydroelectric dam in a typhoon. **"Measured as early deaths per electricity units produced by the Chernobyl facility** (9 years of operation, total electricity production of 36 GWe-years, 31 early deaths) **yields 0.86 death/GWe-year)**," concludes Zbigniew Jaworowski, a physician and former UNSCEAR chairman active during the Chernobyl accident. "**This rate is lower than the average fatalities from [accidents involving] a majority of other energy sources. For example, the Chernobyl rate is nine times lower than the death rate from liquefied gas… and 47 times lower than from hydroelectric stations."**

Zbigniew- Chernobyl didn't unleash much radiation, but the Soviet Union ignored scientific consensus and overreacted- areas with below natural radiation defined as contaminated

CHERNOBYL: THE FEAR OF THE UNKNOWN, Zbigniew Jaworowski, MD PhD DSc, is a Professor Emeritus of the Central Laboratory for Radiological Protection, Warsaw and former Chairman of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). He is a member of the Scientific Committee of EFN (Environmentalists For Nuclear Energy - www.ecolo.org) since 2001 and a member of the Board of EFN-POLSKA (Poland), Central Laboratory for Radiological Protection, Warsaw, Poland, http://ecolo.org/documents/documents_in_english/cherno-zbigniew_fear-06.htm this was a terrible shock. It is curious that all my attention was concentrated on this enormous rise of "total beta activity" used to detect radioactivity, although I knew that the actual dose rate of external radiation penetrating our bodies was only three times higher than the day before and was similar to the average natural radiation dose which we all receive from the ground and cosmic radiation. **This "Chernobyl" dose was more than 100 times lower than the natural radiation level in some other areas of the world, where no adverse health effects among inhabitants have ever been observed.** But in 1986 the impact of a dramatic increase in atmospheric radioactivity dominated the thinking of me and everybody else. This state of mind led to immediate consequences. First there were various hectic actions, such as ad hoc setting of different limits for radiation in food, water etc. These limits varied between countries by a factor of many thousands, reflecting the emotional state of decision-makers and political and mercenary factors. For example, Sweden allowed for 30 times more radioactivity in imported vegetables than in domestic ones and Israel allowed less radioactivity in food from Eastern than from Western Europe. The limit of cesium-137 concentration in vegetables imposed in the Philippines was 8,600 times lower than in the more pragmatic United Kingdom.**Most of these restrictions were meaningless from the point of view of human health but their costs were enormous. As an example, Norwegian authorities introduced a limit for cesium-137 concentration in reindeer meat and game that was about 200 times**

lower than the natural dose in some regions of Norway. The costs of this false protection climbed to over US$51 million. Other countries were no better. Professor Klaus Becker from the German Institute for Standards estimated recently that this kind of practice, together with its consequences for nuclear industry, meant that the costs of the Chernobyl accident in Western Europe probably exceed US$100 billion. **The most nonsensical action, however, was the evacuation of 336,000 people from the contaminated regions of the former Soviet Union, where the radiation dose from Chernobyl fallout was about twice the natural dose. Later, the officially acceptable limit was set below the natural level and was five times lower than radiation at Grand Central Station in New York. "Contaminated regions" were defined, using a level of radioactive cesium-137 in the ground ten times lower than the level of natural radioactive matter in the soil. The evacuation caused great harm to the populations of Belarus, Russia and Ukraine. It led to mass psychosomatic disturbances, great economic losses and traumatic social consequences. According to Academician Leonid A. Ilyin, the leading Russian authority on radiation protection, the mass relocation was implemented by the Soviet government under the pressure of populists, ecologists and self-appointed "specialists", against the advice of the best Soviet scientists.**

Zbigniew- no increase in mortality rate or cancer, says UN, except thyroid cancer from increased testing

CHERNOBYL: THE FEAR OF THE UNKNOWN, Zbigniew Jaworowski, MD PhD DSc, is a Professor Emeritus of the Central Laboratory for Radiological Protection, Warsaw and former Chairman of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). He is a member of the Scientific Committee of EFN (Environmentalists For Nuclear Energy - www.ecolo.org) since 2001 and a member of the Board of EFN-POLSKA (Poland), Central Laboratory for Radiological Protection, Warsaw, Poland, http://ecolo.org/documents/documents_in_english/cherno-zbigniew_fear-06.htm

Besides the 28 fatalities among rescue workers and the employees of the power station due to extremely high doses of radiation, and three immediate deaths due to other reasons (the UN's Chernobyl Forum gives "less than 50" by adding in some later deaths from causes not related to radiation, such as lung tuberculosis, fat thrombosis, car accident, suicide etc. **In fact, the mortality rate of survivors of the acute radiation sickness, at 1.09%, was much lower than the mortality rates for the whole population of Belarus of 1.4%, Russia's 1.38%, and Ukraine's 1.65%)**, the only real adverse health consequence of the Chernobyl catastrophe among about five million people living in the contaminated regions is the epidemic of psychosomatic diseases. These diseases were not due to irradiation with Chernobyl fallout but were caused by "radiophobia", an irrational fear of radiation, aggravated by wrong administrative decisions. **These decisions made several million people believe that they are "victims of Chernobyl", although the average dose they receive from Chernobyl radiation is only about one third of the average dose from Nature**. This was the main factor behind the economic losses caused by the Chernobyl catastrophe, estimated to have reached US$148 billion by 2000 for the Ukraine, and to reach US$235 billion by 2016 for Belarus. Psychological factors, and neglect of radiological protection in the curriculum of medical students, led to some 100,000 to 200,000 wanted pregnancies aborted soon after the accident in Western Europe, where physicians wrongly advised patients that Chernobyl radiation posed a health risk to unborn children.

In 2000 the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the most authoritative body in these matters, and in 2006 also the UN Chernobyl Forum, **stated that, except for thyroid cancers, in the highly contaminated areas no increase in the incidence of solid cancers and leukemia was observed. As for the thyroid cancers,** I believe that **the**

increased discovery is due to a screening effect. In normal populations there is a very high incidence of "occult" thyroid cancers (with no clinical symptoms), which is up to 28% in Japan and 35% in Finland, and a hundred to a thousand times higher than the incidence of "Chernobyl" cancers. After the accident more than 90% of children in contaminated areas started to be tested for thyroid cancers every year. It is obvious that such vast screening resulted in finding the normally undetected occult cancers. What is really surprising, however, is that **data collected by UNSCEAR** and the Forum **show 15% to 30% fewer cancer deaths among the Chernobyl emergency workers and about 5% lower solid cancer incidence among the people in the Bryansk district (the most contaminated in Russia) in comparison with the general population. In most irradiated group of these people (mean dose of 40 mSv) the deficit of cancer incidence was 17%**. Nor did the incidence of hereditary disorders increase. These epidemiological data should be used as a proper basis for realistic projection of the future health of millions of people officially labeled "victims of Chernobyl", rather than an assumption (LNT) on linear no-threshold relationship between irradiation and medical effect. This assumption tells that even near zero radiation dose can lead no cancer death and hereditary disorders. LNT assumption was used by Chernobyl Forum to estimate 4000 to 9336 future cancer deaths among people who received low radiation doses, lower than lifetime natural doses in many regions of the world. Greenpeace had less hesitations and in its report of April 2006 calculated six million cancer deaths due to Chernobyl event. Dr. Lauriston Taylor, the late president of the U.S. National Council on Radiological Protection and Measurements deemed such practice to be "a deeply immoral use of our scientific heritage". UNSCEAR's sober conclusion is that the people living in "contaminated regions of Belarus, Russia and Ukraine "need not live in fear of serious health consequences", and forecasts that "generally positive prospects for the future health of most individuals should prevail." In centuries to come, the catastrophe will be remembered as a proof that nuclear power is a safe means of energy production.

Meltdown will not happen

Business Insider - Chernobyl will never happen in the US

Sarah Kramer, Business Insider, 4-26-2016, “Here's why a Chernobyl-style nuclear meltdown can't happen in the United States”
https://www.businessinsider.com/chernobyl-meltdown-no-graphite-us-nuclear-reactors-2016-4
Like reactors used in the States today, water passes through the RBMK's core and is heated up by the energy released by fission. This boils the water into steam to drive turbines that generate electricity. **Chernobyl's reactor design isn't used in the US.** The similarities begin and end there. US nuclear power plants use pressurized water reactors (PWR) and boiling water reactors (BWR), neither of which use graphite — instead, water works as both the coolant and the moderator for fission. "The problem with the RBMK is that the tips of each control rod were made out of graphite, an incredibly foolish decision," Leatherbarrow wrote. Basically, Chernobyl's design put a material that promotes fission at the ends of its control rods — not a material that slows down a nuclear reaction. You might be able to see where this is going. At 1:23 am on April 26, the nuclear reactions the engineers had been trying to encourage by raising the control rods started surging out of control, and the reactor began to overheat. Too many control rods had left the core. The operators tried to shut off the plant, rapidly lowering the rest of the rods. Not a single US reactor uses graphite. All use water, which Leatherbarrow noted "is far safer." "**There's absolutely no way the accident at Chernobyl could have happened at any American commercial power reactor**," he concluded.

Stockton- Nuclear reactors safer than three mile island

Nick Stockton, 04.03.16, Nuclear Power Is Too Safe to Save the World From Climate Change

But you aren't afraid of routine releases. You're terrified of another Three Mile Island, Fukushima, or Chernobyl. These disasters were the result of a meltdown, which occurs when something impedes a reactor's ability to cool the fuel. The US, where nearly 20 percent of electricity comes from 99 nuclear plants, uses uranium. Older reactors—which is every reactor in the US, including Watts Bar Unit 2—use electric pumps to move water through the system. **The Fukushima disaster showed what happens it you have pumps but no power to use them. Newer generations rely on gravity instead, draining cooling water from elevated storage tanks to send it through the reactor core.**

Those updates mean serious nuclear accidents are becoming ever more rare. Since Three Mile Island in 1979, the Nuclear Regulatory Commission found that **the rate of shut-down-the-reactor-level problems has dropped from 2.5 per plant per year to around 0.1** (One such happened on March 29 in Washington). Even Three Mile Island wasn't the disaster it could have been, because of that plant's layers of redundant protection.

Rhodes- waste is currently stored on the grounds of facilities, can be reused

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

The accident in Japan at Fukushima Daiichi in March 2011 followed a major earthquake and tsunami. The tsunami flooded out the power supply and cooling systems of three power reactors, causing them to melt down and explode, breaching their confinement. Although 154,000 Japanese citizens were evacuated from a 12-mile exclusion zone around the power station, radiation exposure beyond the station grounds was limited. According to the report submitted to the International Atomic Energy Agency in June 2011:

"No harmful health effects were found in 195,345 residents living in the vicinity of the plant who were screened by the end of May 2011. All the 1,080 children tested for thyroid gland exposure showed results within safe limits. By December, government health checks of some 1,700 residents who were evacuated from three municipalities showed that two-thirds received an external radiation dose within the normal international limit of 1 mSv/year, 98 percent were below 5 mSv/year, and 10 people were exposed to more than 10 mSv... [There] was no major public exposure, let alone deaths from radiation." Nuclear waste disposal, although a continuing political problem in the U.S., is not any longer a technological problem. **Most U.S. spent fuel, more than 90 percent of which could be recycled to extend nuclear power production by hundreds of years, is stored at present safely in impenetrable concrete-and-steel dry casks on the grounds of operating reactors, its radiation slowly declining.**

Rhodes- New Mexico plant stores military waste and can store all of world's commercial for next thousand years

Richard Rhodes, Jul 19, 2018, "Why Nuclear Power Must Be Part of the Energy Solution," Yale E360, https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate

The U.S. Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico currently stores low-level and transuranic military waste and could store commercial nuclear waste in a 2-kilometer thick bed of crystalline salt, the remains of an ancient sea. The salt formation

extends from southern New Mexico all the way northeast to southwestern Kansas. It could easily accommodate the entire world's nuclear waste for the next thousand years.

Finland is even further advanced in carving out a permanent repository in granite bedrock 400 meters under Olkiluoto, an island in the Baltic Sea off the nation's west coast. It expects to begin permanent waste storage in 2023.

National Review- nuclear genie is out of the bottle, cannot uninvent (safest way forward for 33 nations and existing plants is to increase so improve the tech)

Jeremy Carl, 8-3-2017, "Keeping the Lights on at America's Nuclear Power Plants," National Review, https://www.nationalreview.com/2017/08/nuclear-power-plants-united-states-strategic-dimensions-russia-china/

This is not an argument for throwing unlimited amounts of taxpayer money at nuclear plants. But more than any other form of electricity generation, nuclear has substantial strategic dimensions. Before we decide whether the U.S. wants to have nuclear power in its future, it is essential that our policymakers understand everything that is at stake. And even if we exit the civilian nuclear business, the rest of the world is not likely to follow suit. The nuclear genie is out of the bottle for good. The only question is whether we want the genie to obey our commands — or those of Beijing and Moscow.

Solar waste is worse than nuclear waste

Institute for Energy Research- no plans for disposing the enormous amount of waste

https://www.instituteforenergyresearch.org/uncategorized/will-solar-power-fault-next-environmental-crisis/. AUGUST 15, 2017, Will Solar Power Be at Fault for the Next Environmental Crisis?, Institute for Energy Research

Solar panel waste will become a major issue in the coming decades as old solar panels reach the ends of their useful lifespans and require disposal. Last November, Japan's Environment Ministry issued a warning that the amount of solar panel waste Japan produces each year is likely to increase from 10,000 to 800,000 tons by 2040, and the country has no plan for safely disposing of it.[i] China has more solar power plants than any other country, operating roughly twice as many solar panels as the United States and also has no plan for the disposal of the old panels. In China, there could be 20 million metric tons of solar panel waste, or 2,000 times the weight of the Eiffel Tower, by 2050.[ii]

California, another world leader in deploying solar panels, likewise has no plan for disposal, despite its boasts of environmental consciousness. Only Europe requires solar panel manufacturers to collect and dispose of solar waste at the end of their useful lives.[iii] While nuclear waste is contained in heavy drums and regularly monitored, very little has been done to deal with solar waste. Solar waste outside of Europe tends to end up in a large stream of electronic waste.

A report determined that it would take 19 years to recycle all of the solar waste that Japan is expected to produce by 2020. By 2034, the annual waste production will be 70 to 80 times larger than that of 2020. (See graph below.) The projected annual peak of 810,000 tons of solar waste in Japan is equivalent to 40.5 million panels. To dispose of that amount of solar waste in a year would mean getting rid of over 110,000 panels per day.[vi]

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Institute for Energy Research- solar panels produce 300x more waste than nuclear, compounded by their shorter lifespans

https://www.instituteforenergyresearch.org/uncategorized/will-solar-power-fault-next-environmental-crisis/. AUGUST 15, 2017, Will Solar Power Be at Fault for the Next Environmental Crisis?, Institute for Energy Research

Regardless, the waste disposal issues regarding solar panels are enormous. According to an analysis by Environmental Progress, **solar panels create about 300 times more toxic waste per unit of electricity generated than nuclear power plants.** For example, if solar and nuclear produce the same amount of electricity over the next 25 years that nuclear produced in 2016, and the wastes are stacked on football fields, the nuclear waste would reach 52 meters (the height of the Leaning Tower of Pisa), while the solar waste would reach 16 kilometers (the height of two Mt. Everests).

Further, while nuclear units can easily operate 50 or 60 years, solar panels have relatively short operational lifespans (20 to 30 years), so their disposal will become a problem in the next few decades.

Nuclear more cost effective

Oberhaus- (Germany) closing nuclear increases emissions, killing 1,000 and driving up healthcare costs, costing $12B, dwarfing costs of nuke.

Daniel Oberhaus, 1-23-2020, "Germany Rejected Nuclear Power—and Deadly Emissions Spiked," Wired, https://www.wired.com/story/germany-rejected-nuclear-powerand-deadly-emissions-spiked/
Research cited in this article: https://www.nber.org/papers/w26598, sci hub: https://scihub.bban.top/https://www.nber.org/papers/w26598, katherine's downloads: file:///Users/kcassese/Downloads/10.3386@w26598.pdf

On New Year's Eve, while the rest of the world was preparing to ring in a new decade, employees of the German energy company EnBW were getting ready to pull the plug on one of the country's few remaining nuclear power plants. The license to operate the two reactors at the Philippsburg nuclear facility expired at midnight after 35 years of providing carbon-free power to Germans living along the country's southwestern border. The Philippsburg plant was the 11th nuclear facility decommissioned in Germany over the past decade. The country's remaining six nuclear plants will go dark by 2022. Germans have always had a complicated relationship with nuclear power, but the radioactive cloud that swept over Germany following the Chernobyl disaster in the mid-1980s gave new life to the antinuclear policies supported by the country's Green Party. Following Japan's Fukushima Daiichi plant meltdown, Germany's antinuclear lobby kicked into high gear, and tens of thousands of people took to the streets in protest. The German government quickly passed legislation to decommission all of the country's nuclear reactors, ostensibly to keep its citizens safe by preventing a Fukushima-style disaster. But a study published last month by the nonprofit National Bureau of Economic Research suggests that Germany's rejection of nuclear power was an expensive and possibly deadly miscalculation

To uncover the hidden costs of denuclearizing Germany, economists used machine learning to analyze reams of data gathered between 2011 and 2017. The researchers, based at UC Berkeley, UC Santa Barbara, and Carnegie Mellon University, found that **nuclear power was mostly replaced with power from coal plants, which led to the release of an additional 36 million tons of carbon dioxide per year, or about a 5 percent increase in emissions. More distressingly, the researchers estimated that burning more coal led to local increases in particle pollution and sulfur dioxide and likely killed an additional 1,100 people per year from respiratory or cardiovascular illnesses. Altogether, the researchers calculated that the increased carbon emissions and deaths caused by local air pollution amounted to a social cost of about $12 billion per year. The study found that this dwarfs the cost of keeping nuclear power plants online by billions of dollars, even when the risks of a meltdown and the cost of**

nuclear waste storage are considered. "People overestimate the risk and damages from a nuclear accident," says Akshaya Jha, an economist at Carnegie Mellon and an author of the study. "It's also clear that people don't realize **the cost of local air pollution is pretty severe**. It's a silent killer." Germany is unlikely to reverse course, but the study's conclusions provide an important lesson for the United States, where the future of nuclear energy is increasingly uncertain The US fleet of nuclear reactors is rapidly approaching the end of its regulatory lifetime—almost all were built before 1990—and the only two new reactors under construction have gone way over budget. Cost overruns end up driving up the price of the plant's already expensive electricity. In many energy markets in the US, nuclear energy struggles to compete with the glut of cheap natural gas and heavily subsidized renewables. Attempts to extend the lifetime of existing reactors, meanwhile, also run into economic and political hurdles. Other than California, no states are aiming to phase out nuclear power entirely, but some plants may close down in the future simply because operators can't afford to stay in business. The question, then, is whether the closure of these plants in the US will ultimately drive up carbon emissions, as it did in Germany.Jonathan Cobb, a senior spokesperson at the World Nuclear Association, says the only way to close nuclear plants without increasing carbon emissions is to shut down coal or other fossil fuel plants at the same time. **"When you have around a third of your electricity generation coming from coal, as the US does, choosing to close any nuclear plant ahead of a coal plant is just not environmentally responsible on any level,"** Cobb says. The UN has stated that nuclear power will have to be a part of the energy mix to keep global temperatures from rising more than 2 degrees Celsisus. Last year, the International Energy Agency said that not keeping nuclear power at its current levels will make hitting our climate goals "drastically harder and more costly." To make nuclear power more competitive, the country could subsidize nuclear plants directly or through credits that reward clean energy generation. Politicians recently proposed such programs in Illinois and Ohio, but they remain contentious. "Subsidizing nuclear plants is clearly not the sign of a healthy industry," says Jonathan Lesser, president of the energy consultancy Continental Economics and author of a recent paper on nuclear energy for the Manhattan Institute. Instead, he suggests cutting subsidies for renewable energy generation to make nuclear more competitive in deregulated energy markets. Others have proposed carbon taxes on fossil fuel generation. Both options have detractors: Renewable companies don't want to lose their subsidies, and fossil fuel companies don't want carbon pricing. Amory Lovins, cofounder of the Rocky Mountain Institute, a nonprofit energy research organization, suggests nuclear subsidies are not the best way to lower CO2 emissions. According to Lovins' calculations, redirecting those subsidies to energy efficiency programs instead could "indirectly save more CO2 than closing a coal-fired power plant." But all hope isn't lost for atom splitting in the US. Even if America's massive legacy nuclear reactors shut down, a new generation of small, modular nuclear reactors is expected to come online before the end of the decade. These reactors promise to be cheaper and safer than existing reactors and have several applications outside of electricity generation that might make them more politically attractive. "If reducing CO2 is the most important thing to you, above all else you should be embracing them," Lesser says. But in the US, as in Germany, that may still be a hard sell.

Renewables will not solve the crisis

Bethge- wind and sun account for 2% global energy, decarbonizing the world will take more than a century with renewables alone

Philip Bethge, Der Spiegel, 1-7-2020, "Can Nuclear Power Offer a Way Out of the Climate Crisis?," No Publication, https://www.spiegel.de/international/world/can-nuclear-power-offer-a-way-out-of-the-climate-crisis-a-06a8a27f-d492-45d3-8134-30187eefbdf3

And perhaps most importantly: Instead of using the plants to exclusively produce electricity, as has been the case up until now, their heat in the future will also be used to produce hydrogen for cars, trains and industry, to supply heat for heating systems or the power for the energy-intensive chemical and oil industries. All of it climate neutral. Transportation, buildings and industry are responsible for around 40 percent of today's total greenhouse gas emissions. **Only a far-reaching decarbonization -- not just of the electricity sector but of the entire energy sector -- will enable us to reduce global CO2 emissions by 90 percent by 2050, the long-term goal that has been set by the international community. Another sobering figure lends even greater clarity to the enormity of the task: So far, the wind and the sun have provided less than 2 percent of total global energy supplies.**

Given such realities, is it wise to eschew the possibilities of nuclear power altogether? It's a question that is particularly urgent for Germany, where the country's last remaining nuclear power plants are slated to go offline in 2022. Yet Germany is already failing to meet its climate targets. **A comparison with France and Sweden, shows the burden Germany is incurring with its decision on the phaseout. The two countries continue to use nuclear energy, and as a result, the CO2 footprint of people living there is only half as large as that of the Germans.** Indeed, despite its decision to go "all-in for renewables" and to abandon nuclear power, Germany "has seen little reduction in carbon emissions," prominent Harvard psychologist Steven Pinker, Swedish engineer Staffan Qvist and political scientist Joshua Goldstein wrote in an April op-ed contribution for the New York Times. **With renewable energies alone, they wrote, it would take "more than a century to decarbonize" the world.** "Psychology and politics can change quickly," the experts wrote. "As the enormity of the climate crisis sinks in and the hoped-for carbon savings from renewables don't add up, nuclear can become the new green."

Renewables are bad for the environment

Payne - Renewable energy increases emissions

N Apergis, JE Payne, K Menyah, Y Wolde-Rufael - Ecological Economics, 6-2010, "On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth"
https://www.sciencedirect.com/science/article/abs/pii/S0921800910002399
This paper examines the causal relationship between CO2 emissions, nuclear energy consumption, renewable energy consumption, and economic growth for a group of 19 developed and developing countries for the period 1984–2007 using a panel error correction model. **The long-run estimates indicate that there is a** statistically significant negative association between nuclear energy consumption and emissions, but a **statistically significant positive relationship between emissions and renewable energy consumption.** The results from the panel Granger causality tests suggest that in **the short-run nuclear energy consumption plays an important role in reducing CO2 emissions whereas renewable energy consumption does not contribute to reductions in emissions**. This may be due to the **lack of adequate storage technology to overcome intermittent supply problems as a result electricity producers have to rely on emission generating energy sources to meet peak load demand**

Institute for Energy Research- constructing solar panels emits Nitrogen trifluoride, 17,000x more potent than CO2.

https://www.instituteforenergyresearch.org/uncategorized/will-solar-power-fault-next-environmental-crisis/.
AUGUST 15, 2017, Will Solar Power Be at Fault for the Next Environmental Crisis?, Institute for Energy Research
Solar panels are manufactured using hazardous materials, such as sulfuric acid and phosphine gas, which make them difficult to recycle. They cannot be stored in landfills without protections against contamination. They contain toxic metals like lead, which can damage the nervous system, as well as chromium and cadmium, known carcinogens that can leak out of existing e-waste dumps into drinking water supplies. **A study published last December** **determined that the net impact of using solar panels actually temporarily increases carbon dioxide emissions, because of the amount of energy needed in the construction process.** But, because newer solar panels have a smaller adverse environmental impact than older models and as their time of operation increases to mitigate the construction effects, some scientists believe the solar industry could develop a net positive environmental impact by 2018.[iv]

According to federal data, however, **building solar panels significantly increases emissions of nitrogen trifluoride (NF3), which is 17,200 times more potent than carbon dioxide** as a greenhouse gas over a 100-year time period.[v] NF3 emissions increased by 1,057 percent over the last 25 years. In comparison, U.S. carbon dioxide emissions only increased by about 5 percent during that time period.

Fossil fuels obsolete

Funkhouser- all but 13 states have clean energy requirements

David Funkhouser, 3-16-2018, "How Much Do Renewables Actually Depend on Tax Breaks?," State of the Planet, https://blogs.ei.columbia.edu/2018/03/16/how-much-do-renewables-actually-depend-on-tax-breaks/
Many states now require that a certain percentage of their electricity has to come from renewable sources, usually by a certain date. These "renewable portfolio standards"vary: New York and California aim for 50 percent by 2030; Vermont targets 75 percent by 2032. Thirteen states have no standard.

S&P Global: forecast that natural gas consumption in the power sector will fall 3.2% in 2021 after witnessing slower growth in 2020.[1]

Nuclear energy is not the status quo

Bethge - nuclear energy cannot compete, especially with subsidized industries, without subsidies

Philip Bethge, Der Spiegel, 1-7-2020, "Can Nuclear Power Offer a Way Out of the Climate Crisis?," No Publication, https://www.spiegel.de/international/world/can-nuclear-power-offer-a-way-out-of-the-climate-crisis-a-06a8a27f-d492-45d3-8134-30187eefbdf3
The optimistic scenario touted by fans of nuclear power is reminiscent of the 1950s, when nuclear fission triggered similar dreams of liberating people of all their worries about energy. Walt Disney even dedicated the 1957 film "Out Friend the Atom" to championing the cause of nuclear energy. But the euphoria didn't last long. Three Mile Island, Chernobyl, Fukushima: The history of the use of nuclear energy has been marked by

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1 https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/011420-eia-forecasts-declining-gas-consumption-in-us-power-sector-in-2021

setbacks, accidents and catastrophe. The unresolved issue of a final repository for nuclear waste, the danger of proliferation and the spread of atomic material for military purposes has also fueled skepticism about the energy source. The primary problem with nuclear power, though, is its price tag. **Conventional plants are simply too expensive and nuclear power cannot be profitable without government subsidies.** Currently, a kilowatt hour of nuclear power costs more than 10 cents to produce in Germany, whereas electricity from onshore wind turbines and gas- or coal-fired plants costs only four to eight cents. As such, the construction of nuclear power plants has long been considered a risky investment. Some 449 reactors are currently in operation around the world, with 53 under construction. In 2018, the average construction time for a plant was eight and a half years. The two reactors that make up Britain's Hinkley Point C are a prime example of misguided nuclear policy. The units are on track to becoming the most expensive construction projects ever, with costs having skyrocketed to around 26 billion euros. Construction is eight years behind schedule. Three governments (those of the United Kingdom, France and China) as well as two energy companies have invested in the project. **Without the guaranteed feed-in tariffs, the plants would never pay off.** "The construction of nuclear power plants makes no sense economically," says Christoph Pistner of the Institute for Applied Ecology in Darmstadt.

Bethge - nuclear energy as a percent of global energy is down from 17%, and it will decline by ⅔ by 2040 without government intervention

Philip Bethge, Der Spiegel, 1-7-2020, "Can Nuclear Power Offer a Way Out of the Climate Crisis?," No Publication, https://www.spiegel.de/international/world/can-nuclear-power-offer-a-way-out-of-the-climate-crisis-a-06a8a27f-d492-45d3-8134-30187eefbdf3

In some cases, he says, **nuclear plants are being decommissioned even before the end of their planned operating life because of competition from cheap wind or solar power, and without state subsidies, the technology would never be profitable. "New construction is only happening now in places where the state finances it or at least subsidizes it massively -- in Russia, China or India, for example," he says. The problems associated with nuclear power are reflected in the fact that nuclear power now supplies only 10.2 percent of the global energy mix, down from 17 percent in 1997. Just when the world could use more carbon-neutral electricity, use of nuclear energy is in decline. The International Energy Agency estimates that by 2040, total output from nuclear power plants could fall by a further two-thirds because a growing number of plants are becoming uneconomical to operate, are too old or are no longer desired by society.**

Fivethirtyeight - 12 reactors closed in past 2 decades, 12 will close by 2025

Maggie Koerth, 6-14-2018, "Nuclear Power Won't Survive Without A Government Handout," FiveThirtyEight, https://fivethirtyeight.com/features/nuclear-power-wont-survive-without-a-government-handout/

Meanwhile, new nuclear power plants are looking even less fetching. Since 1996, only one plant has opened in the U.S. — Tennessee's Watts Bar Unit 2 in 2016. **At least 10 other reactor projects have been canceled in the past decade.** Morgan and other researchers are studying the economic feasibility of investment in newer kinds of nuclear power plants — including different ways of designing the mechanical systems of a reactor and building reactors that are smaller and could be put together on an assembly line. Currently, reactors must be custom-built to each site. Their **research showed that new designs are unlikely to be commercially viable in time to seriously address**

climate change. And in a new study that has not yet been published, they found that the domestic U.S. market for nuclear power isn't robust enough to justify the investments necessary to build a modular reactor industry. Combine age and economic misfortune, and you get shuttered power plants. **Twelve nuclear reactors have closed in the past 22 years. Another dozen have formally announced plans to close by 2025**. Those closures aren't set in stone, however. While President Trump's plan to tell utilities that they must buy nuclear power has received criticism as being an overreach of federal powers, **states have offered subsidies to keep some nuclear power plants in business** — and companies like Exelon, which owns 22 nuclear reactors across the country, have been happy to accept them. "Exelon informed us that they were going to close a couple plants in Illinois," McIntyre said. "And then the legislature gave them subsidies and they said, 'Never mind, we'll stay open.'"

Union of Concerned Scientists- 35% of plants are at risk, will be replaced by natural gas and increase emissions 6%

Union of Concerned Scientists, October 9, 2019, The Nuclear Power Dilemma, https://www.ucsusa.org/resources/nuclear-power-dilemma

Nuclear power is the single largest source of low-carbon electricity in the United States. In 2017, some 99 nuclear reactors operating at 60 plants provided 20 percent of the nation's electricity. But the numbers are changing. Cheap natural gas and renewable energy, diminished demand, rising operational costs, and safety and performance problems are all threatening the profitability of nuclear power plants—and increasing the likelihood that reactors might close. If natural gas or coal replaces them, emissions will rise—and our ability to fight climate change will become that much weaker. To better understand these pressures, the Union of Concerned Scientists (UCS) assessed the economic viability of the US nuclear fleet. We analyzed which reactors were most at risk of early retirement and analyzed the impact of their retirement through a range of scenarios. We also assessed each reactor's safety and performance. We found that **nearly 35 percent of the country's nuclear power plants, representing 22 percent of US nuclear capacity, are at risk of early closure or slated to retire.** To help avoid the worst consequences of climate change—and avoid costly overreliance on natural gas—we need carbon-reduction policies that better reflect the value of low-carbon electricity. Major findings Using projections from S&P Global Market Intelligence, UCS estimated the annual operating margins (revenues minus cost) for 92 reactors at 55 plants. We then classified reactors as unprofitable, marginal, or profitable, and analyzed the impacts of early plant retirements and how clean energy policies could help. We found:

- More than one-third of US nuclear plants are unprofitable or scheduled to close. **On average, it would cost $814 million annually to bring unprofitable plants back to a breakeven point**. Plants owned by merchant generators that sell power into competitive wholesale markets face a higher risk of closure than regulated utilities that recover their costs from ratepayers.
- Without new policies, natural gas and coal will fill the void**. Closing unprofitable and marginal at-risk plants early could result in a 4 to 6 percent increase in US power sector emissions.**
- Carbon-reduction policies would diversify our nation's electricity mix, while preventing early closures. Nuclear generation would stay near reference case levels and renewable energy generation (primarily wind and solar) would more than triple by 2035.
- Carbon-reduction policies work—and they're affordable. A national carbon price and/or low-carbon electrify standard (LCES) would help avoid an overreliance on natural gas, while costing the average US household only $0.74 to $1.03 per month.
- Benefits exceed the costs. The public health and economic benefits of carbon-reduction policies are twice as high as the costs. Between 2018 and 2035, total net benefits would exceed $230 billion under the carbon price and $60 billion under the LCES.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Given the unique safety and security challenges associated with nuclear power, we also evaluated the safety and performance of US nuclear reactors since 2000 based on data from the Nuclear Regulatory Commission (NRC). We found that today's nuclear reactors achieved the NRC's top safety rating 80 percent of the time. When a reactor dropped out of the top category due to performance issues, it took an average of one year to remedy the shortcomings.

Recommendations

If the current situation continues, more nuclear power plants will likely close and be replaced primarily by natural gas, causing emissions to rise. Policymakers should consider the following recommendations as they think about how to respond:

Small reactors (modular reactors) are the future

Delbert- newer nuclear reactors are smaller, can be built easier, and can be built in the service area for local energy (less energy lost in transmission)

Caroline Delbert, Dec 13, 2019, The Tiny, Simple Nuclear Reactor That Could Change Energy, Popular Mechanics, https://www.popularmechanics.com/technology/infrastructure/a30225278/tiny-nuclear-reactor/

An energy startup in Oregon wants us to rethink our reluctance to embrace nuclear energy, Wired reports. NuScale Power studies new reactor technology from a lab on the Oregon State University campus—the same university where the 2019 climate crisis petition began. Their cutting-edge reactor is tiny and, its proponents insist, much safer than our existing notions of nuclear energy lead us to believe. The oldest operating U.S. nuclear power reactor opened in 1969, and **even the newest powered on in the mid-1990s.** One completed in 2016, started construction back in 1973. "Only two new reactors are under construction in the U.S., but they're billions of dollars over budget and years behind schedule," Wired reports. Like our aging and increasingly dangerous infrastructure, these nuclear plants need to be comprehensively updated or replaced, and soon. Even so, nuclear power accounts for two-thirds of the United States's total renewable power output, meaning any reactor that reaches end of life can significantly reduce our amount of renewable energy. NuScale's next generation nuclear reactor is tiny by comparison to today's operating reactors in the U.S. It's safe to install in clusters according to the power needs of a specific area, and because of its tiny size, these reactors are much easier to encase in safety devices and contain in the event of an emergency. There are regulatory differences, too. **A demonstrably safer nuclear plant wouldn't need to be built ten miles or more outside of its service area**. In fact, the existing regulatory process and paradigm is based on huge reactors that are all going to age out of the system soon. Once new technologies begin to receive approval, regulators can begin to convert or even sundown existing plants and reduce the overall risk. In the NuScale reactor, a core is kept cool by circulating normal fresh water, as happens in today's operating nuclear plants on a much, much larger scale. Inside huge nuclear towers, most of the space is dedicated to cooling. The NuScale reactor uses gravity and buoyancy to naturally circulate the cooling water. The size difference is staggering: "About the size of two school buses stacked end to end, you could fit around 100 of them in the containment chamber of a large conventional reactor," Wired reports. The reactor technology itself isn't completely different than before, it's just wildly more efficient and up to date. The Byron plant generates 2,450 megawatt electrical (MWe) with two gigantic traditional towers. The largest reactors in the world top out at about 8,000 MWe. Each NuScale reactor rates 60 MWe, which sounds small because the reactor is small by design**. Plants can install dozens at a time.** Or, even better, **our army of about 100 nuclear plants around the U.S. can be turned into 1,000 small plants that provide more local power with less distance to travel. The Byron plant supplies millions of people up to 100 miles away, which has been fine, but local power bleeds less energy in storage, transit, and other overhead energy costs.** The modular nuclear reactors have 12,000 pages of technical information wending its way through the Nuclear Regulatory Commission. In the meantime, they're promising a clean, plentiful, cutting-edge energy source they say is just as good as wind and solar without the pitfalls. Only time will tell.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Cho- New smaller reactors will be cheaper, smaller, and competitive with natural gas if given the right government assistance- 2023 complete

Adrian Cho, Feb. 21, 2019, Smaller, safer, cheaper: One company aims to reinvent the nuclear reactor and save a warming planet,
https://www.sciencemag.org/news/2019/02/smaller-safer-cheaper-one-company-aims-reinvent-nuclear-reactor-and-save-warming-planet

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. NuScale's **design** would **reduce** such **risks** in multiple ways. First, in an accident the small cores would produce far less decay heat. NuScale engineers have also cut out the pumps that drive the cooling water through the core, relying instead on natural convection. That design eliminates moving parts that could fail and cause an accident in the first place, says Eric Young, a NuScale engineer. "If it's not there, it can't break," he says. NuScale's new reactor housings offer further protection. A conventional reactor sits within a reinforced concrete containment vessel up to 40 meters in diameter. Each 3-meter-wide NuScale reactor nestles into its own 4.6-meter-wide steel containment vessel, which by virtue of its much smaller diameter can withstand pressures 15 times greater. The vessels sit submerged in a vast pool of water: NuScale's ultimate line of defense. For example, in an emergency, operators can cool the core by diverting steam from the turbines to heat exchangers in the pool. During normal operations, the space between the reactor and the containment vessel is kept under vacuum, like a thermos, to insulate the core and allow it to heat up. But if the reactor overheats, relief valves would pop open to release steam and water into the vacuum space, where they would transfer heat to the pool. Such passive features ensure that in just about any conceivable accident, the core would remain intact, Reyes says. NuScale expects other customers to follow. "There are many companies that don't want to be first but would clearly like to be second in line," says Tom Mundy, NuScale's chief commercial officer. According to a 2014 report by the National Nuclear Laboratory in Sellafield, U.K., by 2035 SMRs could provide 65 to 85 gigawatts of power globally, a building spree worth between $320 billion and $510 billion. Engineers in Argentina, China, Russia, and South Korea have all developed SMR designs. However, because of the quality of its design, "internationally, NuScale is going to be a formidable competitor," Rosner predicts. To succeed, NuScale will have to compete with cheap natural gas. **The company aims to produce electricity at a total cost, including construction and operations, of $65 per megawatt-hour.** That's about 20% higher than the current cost of energy from a gas-powered plant. However, Rosner says, "The price of gas isn't going to stay low forever." Countries also could put a price on carbon emissions, which would drive

up the cost of fossil-fuel power. In fact, a September 2018 report from MIT indicated that a carbon tax could make nuclear competitive with gas.

National Security Business- New Reactors Cost Less than Coal or Renewables

NS Energy Business Review. 2019.
https://www.nsenergybusiness.com/news/stable-salt-reactor-nuclear/

"We can't build renewables fast enough to meet energy demands and nuclear power is the only carbon-free alternative, but it's unaffordable. "The resulting gap can only be filled by fossil fuels, meaning we have no hope of slowing climate change. "We believe **there is a technology that solves the problem – our reactor design, which will generate electricity at one-third of the cost of Hinkley Point C and is cheaper than coal or gas.** "As well as delivering cheap electricity, **stable salt reactors can help nuclear plants replace coal and gas capacity, addressing the existential problem of climate change.** "The government is still focused on old nuclear, and should do more to embrace an active future for simpler, cheaper advanced reactors developed in the UK."

Forbes- building faster than expected, complete sept. 2020

James Conca, May 15, 2018,
NuScale's Small Modular Nuclear Reactor Passes Biggest Hurdle Yet,
https://www.forbes.com/sites/jamesconca/2018/05/15/nuscales-small-modular-nuclear-reactor-passes-biggest-hurdle-yet/#542f2d625bb5

NuScale Power is on track to build the first small modular nuclear reactor in America faster than expected. Two weeks ago, **NuScale's small modular nuclear reactor design completed the** Phase 1 review of its design certification application (DCA) by the U.S. Nuclear Regulatory Commission. That's a huge deal because Phase 1 is the **most intensive phase of the review**, taking more hours and effort than the remaining five phases combined. The NRC's review of NuScale's DCA only began in March 2017 and the **NRC's final report approving the design is expected to be complete by September 2020**. NuScale is the first and only SMR to ever undergo an NRC review. After sailing through Phase 1 so quickly, **the company really is on track to build the first SMR in America within the next few years.** The first customer is certainly ready. Utah Associated Municipal Power Systems (UAMPS) will own the first NuScale plant, a 12-module SMR, and place it at the Idaho National Laboratory. It will be operated by the experienced nuclear operator Energy Northwest. This first application will take advantage of the SMR's specific ability to completely load-follow UAMPS wind farms. 'We are thankful for the rigorous review of our revolutionary nuclear design and greatly appreciate the government recognizing the importance of furthering NuScale's advancement,' said NuScale Power Chairman and Chief Executive Officer John Hopkins. 'Our technology means significant economic and job benefits for the country and it's positioned to revitalize the domestic nuclear industry by virtue of NuScale's affordable, flexible, and safe solution to providing zero-carbon energy.' NuScale's reactor is also America's best chance to compete in the global SMR market as it gets started, and puts the U.S. on a path to beat foreign competitors like Argentina, China, Russia and South Korea who are developing their own SMR designs. Conservative estimates predict between 55 and 75 GW of electricity will come from operating SMRs around the world by 2035, the equivalent of more than 1,000 NuScale Power Modules, and will bring the market up towards a trillion dollars. And America should lead that effort. The U.S. Department of Energy agrees and, on April 27th, awarded NuScale Power $40 million in cost-sharing financial assistance to support bringing this SMR to market. NuScale is the only SMR selected for this award with a solid plan, backed up by design, testing, licensing, and commercialization sufficiently substantive to achieve commercial operations in the 2020s. SMR developers expect modular designs and

construction processes will generate economies of series and open up multiple supply opportunities. NuScale has estimated its first plant will cost just under $3 billion to build, giving an overnight capital cost of $5,078/kWe. But the real power of SMRs are the fact that they can't melt down. This is a big deal. It means the reactor just won't melt down or otherwise cause any of the nightmares people think about when imagining the worse for nuclear power. It just shuts down and cools off. The brain-child of Dr. Jose Reyes, NuScale's Chief Technology Officer and nuclear engineering professor emeritus at Oregon State University, this modular reactor takes advantage of the small in small modular. **The small size and large surface area-to-volume ratio of NuScale's reactor core, that sits below ground in a super seismic-resistant heat sink, allows natural processes to cool it indefinitely in the case of complete power blackout. No humans or computers are needed to intervene, no AC or DC power, no pumps, and no additional water for cooling. A couple of additional features are: 1) no one can hack this reactor and 2) refueling of this reactor does not require the nuclear plant to shut down.** The components of the NuScale reactor can all be manufactured in a factory prior to shipping and assembly at the site, removing a major cost issue with building new nuclear plants. The reactor vessels and other large components can be manufactured with medium-sized forges, something we still have here in the United States. Traditional large reactors need extremely large forging facilities, of which only a few exist in the world - none in America. Traditional nuclear reactors are between about 600 and 1,200 MW, but these small power modules are about 50 MW each and 12 of them can be put together to make a power plant up to 600 MW - a 12-pack. These modules use standard 17x17 PWR fuel assemblies, also making them cost-effective, at only half the height, with an average U-235 enrichment of 3.8%. A single NuScale nuclear power module is 76-feet tall and 15-feet in diameter, and would sit in a plant covering less than a tenth of a square mile or about 60 acres. **In comparison, it takes at least 130,000 acres, or about 200 square miles, of wind farms to produce the same amount of energy as one NuScale 12-pack is designed to. These innovative designs bring the total life-cycle cost to produce electricity with this SMR to below that of most other energy sources, just slightly above hydro and natural gas. This SMR can also be constructed in about half the time of traditional nuclear plants.** It's possible to see all of the application documents for the NuScale design at NRC, and one can see the actual criteria for the DOE award as well, noting that DOE wanted projects focused on the development of 'industry-driven reactor designs and accompanying technologies with high potential to advance nuclear power in the USA.' NuScale is headquartered in Portland, Oregon and has offices in Corvallis, Or, Rockville, Md, Charlotte, N.C., Richland, WA, Arlington, Va., and London, UK.

International Atomic Energy Agency- Small modular reactors already in place in Russia, China, and Argentina, will open by 2022

Irena Chatzis,, 8-8-2019, "Small Modular Reactors: A Challenge for Spent Fuel Management?," International Atomic Energy Agency,
https://www.iaea.org/newscenter/news/small-modular-reactors-a-challenge-for-spent-fuel-management

Small modular reactors (SMRs) have been the talk of scientists and researchers in the nuclear industry for many years — but to what extent will their debut, expected next year, create challenges in spent fuel management? It depends, say experts, on the particular SMR design and a country's existing spent fuel management practices.

SMRs are relatively small and flexible: they have a power capacity of up to 300 MW(e) and their output can fluctuate in line with demand. This makes them particularly attractive for remote regions with less developed grids, but also for use as a complement to renewables and for non-electric applications of nuclear power. SMRs can be manufactured and then shipped and installed on site, so they are expected to be more affordable to build.

Globally, there are about 50 SMR designs and concepts at different stages of development. Three SMR plants are in advanced stages of construction or commissioning in Argentina, China and Russia, which are all scheduled to start operation between 2019 and 2022.

Uranium mining is fine

Biello- half of fuel comes from recycled and diluted Russian and American weapons

David Biello January 26, 2009, Finding Fissile Fuel, https://www.scientificamerican.com/article/finding-fissile-fuel/

When the Atlantic Navigator docked in Baltimore harbor earlier this month, the freighter carried the last remnants of some of the nuclear weapons that the Soviet Union had brandished in the cold war. During the past 20 years more than 19,000 Russian warheads have been dismantled and processed to make fuel for U.S. nuclear reactors. In fact, during that period more than half the uranium fuel that powered the more than 100 reactors in the U.S. came from such reprocessed nuclear weapons.

Roughly half of the nearly 20 percent of U.S. **electricity that nuclear power plants supply comes from old Russian warheads.** The same company responsible for enriching natural uranium at Paducah also **dilutes the highly enriched uranium**, or HEU, (90 percent U^{235}) c**ontained in more than 14,000 Russian nuclear warheads.** So far, 350 metric tons of Russian HEU has been converted into 10,160 metric tons of the more diluted stuff, suitable for nuclear reactors. (The U.S. government, for its part, has down-blended roughly 100 metric tons of HEU it no longer requires, according to the National Nuclear Security Administration, the branch of the DoE charged with oversight of the nation's nuclear weapons.)

Biello- many countries recycle spent fuel

David Biello January 26, 2009, Finding Fissile Fuel, https://www.scientificamerican.com/article/finding-fissile-fuel/

In addition, nuclear engineers have uncovered ways to coax more heat out of fissile uranium fuel before it inevitably fizzles out. Pavel Hejzlar of the Massachusetts Institute of Technology invented a ring-shaped configuration for the fuel that boosts the power output of the plant by 50 percent by enabling it to operate more efficiently and at much lower temperatures.

The U.S. government is also interested in recycling the spent nuclear fuel, as France, Japan, Russia and the U.K. do, under the terms of the Global Nuclear Energy Partnership, a consortium of 21 foreign countries as well as domestic nuclear technology firms formed to promote nuclear power. As proposed, **spent fuel would be "reprocessed" at new plants to remove plutonium and render the fissile material useable as a reactor fuel**, according to the DoE, though critics charge this is both expensive and dangerous.

Crowding out doesn't exist

The Hill- most subsidies are directed to a specific industry, like the Price-Anderson Act for nuclear

Andrew Fales,, 9-23-2017, "All energy is subsidized, so why single out renewables?," TheHill, https://thehill.com/opinion/energy-environment/351728-federal-energy-subsidies-go-to-far-more-than-nuclear-and-coal

Furthermore, only "mineral or natural resource" businesses such as oil, natural gas and coal (but not wind or solar energy) are able to use a government-subsidized financing structuring called a "master limited partnership" (MLP). These publicly-traded vehicles are not subject to corporate taxation and are extremely tax efficient, which allows those privileged businesses to access investment capital at low rates for large infrastructure projects. This implicit tax subsidy lowers the cost of gas-fired electricity, in addition to other implicit subsides available only to oil and natural gas.

Finally**, the nuclear industry is the beneficiary of the Price-Anderson Act, which became law in 1957 (and is regularly renewed—most recently in 2005 for 20 years) as an incentive for the private production of nuclear power.** In short, because investor-owned utilities cannot acquire insurance in the marketplace to cover its potential exposure in case of a nuclear disaster, the act covers liability from nuclear incidents above $13.6 billion—with the remaining cost covered by taxpayers. The Japanese government has estimated the cost of the Fukushima nuclear disaster to be $188 billion. Should such a tragedy befall a nuclear plant in the United States, in addition to the untold social and emotional loss, the Price-Anderson Act means taxpayers would be on the hook for $174.4 billion.

AT: nuclear stagnant

Ford- lagging nuclear is a result of lack of R&D money from Dept. of Energy, not something inherent about nuclear power

Michael J Ford, Summer 2018, "Nuclear Power Needs Leadership, But Not From The Military," Belfer Center for Science and International Affairs, https://www.belfercenter.org/publication/nuclear-power-needs-leadership-not-military

Indeed, the nuclear power industry now faces unprecedented—arguably existential—challenges. The nation's demand for electricity has decreased, and the power distribution grid is rapidly becoming decentralized. Nuclear power is having trouble competing in current deregulated energy markets dominated by low-cost natural gas and renewable energy sources. The industry hasn't been able to build new power plants within budget and in a timely manner, as recent efforts in South Carolina and Georgia illustrate. There are concerns about safety, waste management, and nuclear proliferation. And **efforts to develop advanced reactors that might meet these challenges have lagged. The industry can't afford major research and development, and efforts by the Department of Energy, once a prime mover in reactor development, have been moribund as a result of inadequate funding and leadership.**

Upgrading nuclear facilities

xForbes- a single upgrade will provide the energy increase of 1,200 wind turbines

James Conca, 8-22-2017, "There's More Than One Way To Get Nuclear Power," Forbes, https://www.forbes.com/sites/jamesconca/2017/08/22/theres-more-than-one-way-to-get-nuclear-power/#12fd488418b6

While some companies seem to be having trouble building new nuclear power capacity, the Tennessee Valley Authority (TVA) seems to have it down pat. **To increase nuclear power in this country,** you can build a new reactor. Or you can upgrade and complete reactors that were never finished**. Or you can increase the power output of existing reactors**. TVA is on track for all three. TVA submitted the first-ever permit application to the NRC for a new design small modular nuclear reactor (SMR). Their Watts Bar 2 Nuclear Generating Station, an upgraded and completed partially-constructed plant from the 1980s, became the first new nuclear power plant this century in the United States. The third method, increasing the power output of existing reactors, called uprating, is what TVA is starting at their Browns Ferry Nuclear Plant. TVA just received approval from the Nuclear Regulatory Commission to significantly increase the generating capacity of the three nuclear reactors at Browns Ferry, located in Athens, Alabama. Significant indeed – **this uprate will add almost 500 MW of nuclear capacity. This will generate an additional 4 billion kWhs each year of exceptionally low-carbon electricity. This is more low-carbon power than 1,200 new MW wind turbines and twice as much as the biggest solar array in the world. And for only $0.5 billion, a fraction of the price for the wind or solar path. 1,200 new MW wind turbines would cost about $2.5 billion. A 1,500 MW solar array would cost over $10 billion. 'The real advantage of the Browns Ferry investment is that we are maximizing the capability of an existing generation asset that already produces our lowest-cost, most reliable form of carbon-free baseload power,'** TVA spokesman Jim Hopson said. 'It's a true win-win.' The NRC staff determined that TVA could safely increase the reactors' output at Browns Ferry primarily by upgrading certain plant systems and components. NRC staff also reviewed TVA's evaluations showing the plant's design can handle the increased power level. Utilities have used power uprates for a long time as a way to generate more electricity from their nuclear plants. So far**, NRC has approved over 8,000 MW of uprates, equivalent to building eight new nuclear power plants**. To increase the power output of a reactor, a utility will refuel with either slightly more enriched uranium fuel or use a higher percentage of new fuel in the core. These produce more thermal energy and more steam, driving turbines to generate more electricity. Components such as pipes, valves, pumps, heat exchangers, electrical transformers and generators must be able to accommodate the higher power level with its increased flows and heat. For an extended power uprate like Browns Ferry, the NRC staff issued a draft environmental assessment for a 30-day public comment period, and considered and addressed all comments before finalizing the environmental assessment. The NRC's safety evaluation of the proposed uprate for Browns Ferry focused on areas such as the nuclear steam supply systems, instrumentation and control systems, and accident evaluations. NRC itself conducted independent confirmatory calculations and audits. **Claims by anti-nuclear groups that the higher core temperatures would make the plant less safe, and increase the chance for a meltdown or radiation leak, proved baseless**. This power uprate for Browns Ferry authorizes an increase of maximum power level by about 155 MW for each unit. The uprates for the three reactors will occur during their planned refueling outages over the next two years. The uprate is just the latest move by TVA to increase its energy diversity and reliability while cutting carbon emissions. Besides the Watts Bar start-up last year, TVA started their large solar power program and have ramped up efficiency dramatically. It's why TVA has cut carbon emissions by 30% since 2005, a reduction that should rise to 60% by 2020. The new Watts Bar 2, like the power uprate at Browns Ferry, is quite important to grid reliability needs as well. 'With the drought conditions we experienced in the

first half of the year, which limited power production from our dams, Watts Bar Nuclear Unit 2 played an important role in keeping costs low,' says TVA President Bill Johnson. 'TVA's generation fleet continues to become more diversified and this is helping us provide low-cost energy in a reliable and efficient manner.' Although not planned, more of its nuclear fleet could be uprated in the future if additional power demands are higher than expected. Last year, TVA generated 155 billion kWhs of electricity that sold for $10.5 billion. To produce this energy, 10,000 employees operated a mix of sources that included 37% nuclear, 24% coal, 20% natural gas, 9% hydro, 3% wind & solar and 7% energy efficiency. It's nice to see that being 84 years old hasn't slowed TVA down.

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Inderscience Publishers, 3-5-2008, "Nuclear Power Not Efficient Enough To Replace Fossil Fuels, Study Finds", Science Daily
https://www.sciencedaily.com/releases/2008/03/080304100413.htm

Nuclear energy production must increase by more than 10 percent each year from 2010 to 2050 to meet all future energy demands and replace fossil fuels, but this is an unsustainable prospect. According to a report published in Inderscience's International Journal of Nuclear Governance, Economy and Ecology such a large growth rate will require a major improvement in nuclear power efficiency otherwise each new power plant will simply cannibalize the energy produced by earlier nuclear power plants. Physicist Joshua Pearce of Clarion University of Pennsylvania has attempted to balance the nuclear books and finds the bottom line simply does not add up. **There are several problems that he says cannot be overcome if the nuclear power option is taken in preference to renewable energy sources. For example, the energy input required from mining and processing uranium ore to its use in a power plant that costs huge amounts of energy to build and operate cannot be offset by power production in a high growth scenario. There are also growth limits set by the grade of uranium ore. "The limit of uranium ore grade to offset greenhouse gas emissions is significantly higher than the purely thermodynamic limit set by the energy payback time**," he explains.

Brad Plumer@Bradplumerbrad@Vox, 4-13-2014, "How to slow global warming, in six steps," Vox,
https://www.vox.com/2014/4/13/5610356/un-panel-heres-how-we-cut-emissions-and-avoid-a-climate-disaster

The IPCC calculates that **annual greenhouse-gas emissions would have to start dropping each year — until they were 41 percent to 72 percent below 2010 levels by mid-century**. Then emissions would have to keep falling until humans were hardly putting any extra greenhouse gases by the end of the century. We'd also likely have to pull some carbon-dioxide out of the atmosphere. That all sounds difficult — and it is. But the IPCC notes that it becomes even more difficult the longer we put off cutting emissions — because carbon-dioxide and other greenhouse gases will keep piling up in the atmosphere in the meantime, and the cuts needed to stay below the limit become more severe. In fact, **if annual emissions in 2030 are still above today's levels, the report notes, it becomes nearly impossible to stay below that 2°C limit.**

https://www.isa.org.usyd.edu.au/publications/documents/ISA_Nuclear_Report.pdf

Too expensive to build nuclear plants

WaPo - $9 billion expenditure on projects wasted

Gregory **Jaczko**, Chairman of the Nuclear Regulatory Commission, Washington Post, 5-17-2019, "I oversaw the U.S. nuclear power industry. Now I think it should be banned."
https://www.washingtonpost.com/outlook/i-oversaw-the-us-nuclear-power-industry-now-i-think-it-should-be-banned/2019/05/16/a3b8be52-71db-11e9-9eb4-0828f5389013_story.html

Within a year of the accident at Fukushima — and over my objections — the NRC implemented just a few of the modest safety reforms that the agency's employees had proposed, and then approved the first four new reactor licenses in decades, in Georgia and in South Carolina. But there was a problem. After Fukushima, people all over the world demanded a different approach to nuclear safety. Germany closed several older plants and required the rest to shut down by 2022. Japan closed most of its plants. Last year, even France, which gets about 80 percent of its electricity from nuclear power, proposed reducing that figure to 50 percent by 2035, because safety could not be guaranteed. Trying to make accidents unlikely wasn't enough. And here in the United States, those four new reactors — the vanguard of the "nuclear renaissance" — still haven't opened. **The South Carolina companies building two of the reactors canceled the project in 2017, after spending $9 billion of their customers' money without producing a single electron of power.** The construction company behind the utilities, Westinghouse, went bankrupt, almost destroying its parent company, the global conglomerate Toshiba. **The other two reactors licensed** while I chaired the NRC **are still under construction** in Georgia **and years behind schedule**. Their **cost has ballooned from $14 billion to $28 billion and continues to grow.** History shows that the expense involved in nuclear power will never change. Past construction in the United States exhibited similar cost increases throughout the design, engineering and construction process. The technology and the safety needs are just too complex and demanding to translate into a facility that is simple to design and build. No matter your views on nuclear power in principle, no one can afford to pay this much for two electricity plants. New nuclear is simply off the table in the United States.

UCS - Nuclear power cost more than value they generate

Union of Concerned Scientists, 12-17-20**15**, "The Cost of Nuclear Power"
https://www.ucsusa.org/resources/nuclear-power-cost

A half century later, we have learned that nuclear power is, instead, too expensive to finance. **The first generation of nuclear power plants proved so costly to build that half of them were abandoned during construction. Those that were completed saw huge cost overruns, which were passed on to utility customers in the form of rate increases**. **By 1985, Forbes had labeled U.S. nuclear power "the largest managerial disaster in business history.**" The industry has failed to prove that things will be different this time around: soaring, uncertain costs continue to plague nuclear power in the 21st century. Between 2002 and 2008, for example**, cost estimates for new nuclear**

plant construction rose from between $2 billion and $4 billion per unit to $9 billion per unit, according to a 2009 UCS report, while experience with new construction in Europe has seen costs continue to soar.

With this track record, it's not surprising that **nuclear power has failed to attract private-sector financing—so the industry has looked to government for subsidies**, including loan guarantees, tax credits, and other forms of public support. And these subsidies have not been small: according to a 2011 UCS report, by some estimates **they have cost taxpayers more than the market value of the power they helped generate**. When nuclear energy was an emerging technology, public support made some sense. But more than 50 years (and two public bailouts) after the opening of the first U.S. commercial nuclear plant, nuclear power is a mature industry that should be expected to stand on its own. Instead, the industry has responded to escalating costs with escalating demands for government support. **A 2009 UCS report estimated that taxpayers could be on the hook for anywhere from $360 billion to $1.6 trillion if then-current proposals for nuclear expansion were realized.**

UCS - Florida and Georgia costs ballooned 1200%

Union of Concerned Scientists, 8-25-20**11**, "Florida and Georgia Nuclear Power Projects Too Risky, Costly"
https://www.ucsusa.org/resources/florida-and-georgia-nuclear-power-projects-too-risky-costly
Both projects intend to use the Westinghouse AP1000 reactor, a new design approved by the NRC in December 2011, which has not been completed and brought on line anywhere in the world to date. Nuclear power construction has always been subject to major cost increases and regulatory delays; adding a new reactor technology to the process is unlikely to make it go more smoothly or cheaply. **Cost projections for the Levy plant have risen from $3.5 billion to $22.5 billion just in the five years since the initial estimate;** Synapse's analysis finds that the cost will probably be between $22.5 billion and $29.3 billion. In the case of the Vogtle expansion, the utility, Georgia Power, has not included cost and schedule data in the information it has made public—an omission that ought to make ratepayers nervous, given that **the first two reactors built at the site exceeded their original cost projection by a whopping 1,200 percent.**

Takes too long to build nuclear plants

Stanford - nuclear plants take 10-19 years to plan and start operating

Mark Z. Jacobson, Stanford University, "The 7 reasons why nuclear energy is not the answer to solve climate change," Leonardo DiCaprio Foundation,
https://www.leonardodicaprio.org/the-7-reasons-why-nuclear-energy-is-not-the-answer-to-solve-climate-change/
The time lag between planning and operation of a nuclear reactor includes the times to identify a site, obtain a site permit, purchase or lease the land, obtain a construction permit, obtain financing and insurance for construction, install transmission, negotiate a power purchase agreement, obtain permits, build the plant, connect it to transmission, and obtain a final operating license. **The planning-to-operation (PTO) times of all nuclear plants ever built have been 10-19 years or more.** For example, the Olkiluoto 3 reactor in Finland was proposed to the Finnish cabinet in December 2000 to be added to an existing nuclear power plant. Its latest estimated completion date is 2020, giving it a PTO time of 20 years. The Hinkley Point nuclear plant was planned to start in 2008. It has an estimated completion year of 2025 to 2027, giving it a PTO time of 17 to 19 years. The Vogtle 3 and 4 reactors in Georgia were first proposed in August 2006 to be added to an existing site. The anticipated completion dates are November 2021 and November 2022, respectively, given them PTO times of 15 and 16 years, respectively. The Haiyang 1 and 2 reactors in China were planned to start in 2005. Haiyang 1 began commercial operation on October 22, 2018. Haiyang 2 began operation on January 9, 2019, giving them PTO times of 13 and 14 years, respectively. The Taishan 1

and 2 reactors in China were bid in 2006. Taishan 1 began commercial operation on December 13, 2018. Taishan 2 is not expected to be connected until 2019, giving them PTO times of 12 and 13 years, respectively. Planning and procurement for four reactors in Ringhals, Sweden started in 1965. One took 10 years, the second took 11 years, the third took 16 years, and the fourth took 18 years to complete. Many claim that France's 1974 Messmer plan resulted in the building of its 58 reactors in 15 years. This is not true. The planning for several of these nuclear reactors began long before. For example, the Fessenheim reactor obtained its construction permit in 1967 and was planned starting years before. In addition, 10 of the reactors were completed between 1991-2000. As such, the whole planning-to-operation time for these reactors was at least 32 years, not 15. That of any individual reactor was 10 to 19 years

New plants lose out on money

Bloomberg - ½ of all all nuclear reactors are losing money

Jim Polson, 6-14-2017, "More Than Half of America's Nuclear Reactors Are Losing Money," Bloomberg
https://www.bloomberg.com/news/articles/2017-06-14/half-of-america-s-nuclear-power-plants-seen-as-money-losers

More than half of America's nuclear reactors are bleeding cash, racking up losses totaling about $2.9 billion a year, based on a Bloomberg New Energy Finance analysis. Nuclear power plants are getting paid $20 to $30 a megawatt-hour for their electricity, Nicholas Steckler, an analyst at Bloomberg New Energy Finance, said in a report Wednesday. Meanwhile, it costs them an average of $35 a megawatt-hour to run. **That puts 34 of the nation's 61 plants out of the money, with almost all of the merchant reactors** owned by Exelon Corp., Entergy Corp. and FirstEnergy Corp. **appearing to be below break-even**, he said.

Nuclear energy production decreasing

Vox - Nuclear energy production decreasing since 2006 (from 17.6% to 10.8%)

Brad Plumer, 8-1-2014, "The rise and fall of nuclear power, in 6 charts," Vox,
https://www.vox.com/2014/8/1/5958943/nuclear-power-rise-fall-six-charts

Nuclear energy production has been falling since 2006. Nuclear electricity generation kept rising during the 1990s until it hit a peak of 2,660 terawatt-hours in 2006. But then it started falling — and generated just 2,359 Twh of electricity in 2013. What's more, nuclear power has been eclipsed by other energy sources — particularly coal and natural gas. **Back in 1996, nuclear power provided 17.6 percent of the world's electricity. Today, that's down to around 10.8 percent.**

Nuclear energy trades off with other sources (Crowd out)

Washington Post - nuclear is more expensive than other energy sources, yet its presence crowds other sources

Gregory Jaczko, Chairman of the Nuclear Regulatory Commission, Washington Post, 5-17-2019, "I oversaw the U.S. nuclear power industry. Now I think it should be banned."
https://www.washingtonpost.com/outlook/i-oversaw-the-us-nuclear-power-industry-now-i-think-it-should-be-banned/2019/05/16/a3b8be52-71db-11e9-9eb4-0828f5389013_story.html

Would shutting down plants all over the world lead to similar results? Eight years after Fukushima, that question has been answered. Fewer than 10 of Japan's 50 reactors have resumed operations, yet the country's carbon emissions have dropped below their levels before the accident. How? Japan has made significant gains in energy efficiency and solar power. It turns out that **relying on nuclear energy is actually a bad strategy for combating climate change: One accident wiped out Japan's carbon gains. Only a turn to renewables and conservation brought the country back on target.** What about the United States? Nuclear accounts for about 19 percent of U.S. electricity production and most of our carbon-free electricity. Could **reactors be phased out here without increasing carbon emissions**? If it were completely up to the free market, the answer would be yes, **because nuclear is more expensive than almost any other source of electricity** today**. Renewables such as solar, wind and hydroelectric power generate electricity for less than the nuclear plants under construction in Georgia, and in most places, they produce cheaper electricity than existing nuclear plants that have paid off all their construction costs.**

Cooper- tax subsidies for uneconomic industries crowd out wind, solar, efficiency

Mark Cooper, Institute for Energy and the Environment, 10-2019, "THE ENDGAME FOR NUCLEAR POWER: A DESPERATE PUSH FOR SUBSIDIES IN THE 2019 TAX EXTENDERS"
http://foe.org/wp-content/uploads/2019/10/2019-10-22_Final-FOE-ITC-Study.pdf
A new proposal to provide a 30% investment tax credit (ITC) for existing nuclear reactors would be harmful to taxpayers, ratepayers, and the climate. Even assuming that the new tax credit would phase down slowly as currently proposed, the expenditure over the coming decade comes to almost $23 billion, even using optimistic assumptions for capital expenditures, fuel, and qualifying reactors. Using more realistic assumptions about the cost of aging reactors, the 10-year cost to taxpayers is likely to be over $26 billion. **As wind, solar, storage, and efficiency are "crowded out" by keeping uneconomical reactors online with tax subsidies, the cost to regular ratepayers over the coming 20 years is $33 billion.** A recent report from the Rhodium Group analyzes a potential investment tax credit for existing nuclear reactors, but it vastly overstates the number of reactors likely to retire soon, significantly understates the declining cost of renewables, and never analyzes the tax losses from subsidies or the ratepayer impact of reliance on high-cost nuclear reactors. If carbon reduction is

the ultimate concern, neither new nor existing nuclear reactors can compete with wind and solar, factoring in the cost of carbon abatement. Nuclear power is historically one of the largest beneficiaries of federal subsidies, a largesse that has not fundamentally changed its economics or made it competitive with renewables. Today, it is still the beneficiary of numerous advantages built into the tax code, as well as favorable rules adopted by transmission organizations and utility com

Smith- crowding out slows transition to cheaper renewable energy like wind and solar

Grant Smith, Senior Energy Policy Adviser,7-12-2019, "States Stick Ratepayers With $15 Billion To Rescue Nukes ," Environmental Working Group
https://www.ewg.org/energy/22743/states-stick-ratepayers-15-billion-rescue-nukes

Not only are existing nuclear power plants obscenely expensive to maintain but their continued operation also crowds out renewables, which slows the transition to renewable energy. The proposed legislation in Ohio weakens the state's renewable energy mandate for utility companies, all but ensuring that existing nuclear power plants will continue to crowd out cheaper wind and solar investments. Mark Jacobson, director of the Atmosphere and Energy Program at Stanford University, asserts that New York, despite its aggressive renewable energy targets, will now spend more than twice as much on nuclear bailouts than on clean energy. Connecticut's bailout locked in nuclear plants as a dominant source of power in the state for years. State contracts with Millstone and an out-of-state nuclear plant will represent nearly 45 percent of the state's energy mix, according to Utility Dive.

Smith- NY spends twice as much on nuclear bailouts as renewables

Grant Smith, Senior Energy Policy Adviser,7-12-2019, "States Stick Ratepayers With $15 Billion To Rescue Nukes ," Environmental Working Group
https://www.ewg.org/energy/22743/states-stick-ratepayers-15-billion-rescue-nukes

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Energy News Network- nuclear energy tries to undermine wind and solar, fighting against subsidies, development and tax incentives

Why the nuclear industry targets renewables instead of gas, Energy News Network, Kari Lydersen
February 6, 2015,
https://energynews.us/2015/02/06/midwest/why-the-nuclear-industry-targets-renewables-instead-of-gas/

Cheap natural gas has upended the nation's energy landscape and made aging nuclear power plants increasingly uncompetitive. Yet **the nuclear industry,** which generates almost a fifth of the nation's energy, **has declared war not on gas but on**

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

wind and solar, which represent about 4 and 0.2 percent of our energy mix, respectively. **Nuclear generators have successfully fought against renewable and energy efficiency standards on the state level, and lobbied against tax incentives for wind and solar on the federal level. They're in the process of securing changes in regional capacity markets that would benefit nuclear and harm solar and wind. And as states develop their Clean Power Plans to fulfill the federal mandate to reduce carbon emissions, nuclear is often pitted against renewables.** In deregulated states like Illinois, Ohio, Michigan and Pennsylvania, nuclear generators have found it increasingly difficult to sell their power at a profit on open markets, because of competition primarily from gas but also from wind. Meanwhile, energy efficiency and distributed solar generation have reduced demand for electricity and are part of a fundamental shift which could significantly shrink the role of large, centralized power plants. Proponents describe nuclear energy as the ultimate clean fuel, with zero carbon or other harmful emissions and steady reliability. "Nuclear energy produces more clean-air energy than any other source and is the only one that can produce large amounts of electricity 24/7," says a fact sheet from the Nuclear Energy Institute trade association. But nuclear critics point out the safety and environmental risks and long-term costs of nuclear power. And they fear that the nuclear industry's tactics could hamper renewable energy development at a crucial time. Illinois: Ground zero Nuclear energy provides almost half of Illinois' electricity; wind and solar provide almost five percent and less than a tenth of a percent, respectively. Chicago-based Exelon, the country's largest nuclear generator, has said that three of its six Illinois plants could close if state lawmakers don't provide "market-based solutions" to help them become more profitable. A diverse group of business and clean energy interests are campaigning against an Exelon "bailout," as critics call it, pegged at $580 million, saying citizens have already subsidized the company more than enough. Exelon's fortunes have plummeted in recent years, though a report recently released by Illinois state agencies indicated the company is exaggerating the crisis facing its Illinois plants. As part of the report, required by a 2014 law pushed by Exelon, Illinois officials considered the possibility of a low-carbon energy standard similar to the state's renewable standard. If nuclear energy were allowed to fulfill state clean energy goals, advocates fear the nuclear plants would overwhelm the program and leave little or no incentive for new renewable energy. **Exelon also pressured state legislators last spring to halt a planned "fix" of the state's renewable energy standard, which would have facilitated the development of more wind and solar power. New wind development in Illinois has stalled because of the problems with the standard. Legislation to fix it will likely be introduced again this spring, with Exelon again weighing in and trying to tie any changes to support for its nuclear plants.** Ohio: Trouble in Toledo In Ohio, FirstEnergy successfully lobbied to suspend the state's renewable energy and energy efficiency standards. Now FirstEnergy is asking that ratepayers be forced to pay a guaranteed rate for energy from the troubled Davis-Besse nuclear plant near Toledo, under a proposal pending before the Public Utilities Commission of Ohio. "Clearly FirstEnergy was seeing both energy efficiency and renewable energy as direct competitors," said Allison Fisher, energy program outreach director of the watchdog group Public Citizen. "The arguments they were using were that these mandatory standards are distorting the market and are costly to ratepayers. But as soon as the standards were frozen, they turned around and proposed a plan that is looking to distort the market and going to cost $3 billion." If the plan is approved, the Ohio Consumers' Counsel estimates it could cost ratepayers an extra $3.2 billion. "It's both their actions and the hypocrisy of their arguments that makes what they are doing so incredibly brazen," Fisher continued. FirstEnergy spokespeople Doug Colafella and Jennifer Young said in written answers that the Economic Stability Program, as the proposal regarding Davis-Besse is called, is "designed to provide an additional opportunity for our customers to benefit from the competitive market." They said that studies by FirstEnergy and other entities project energy prices will rise, which could mean customers will actually benefit from buying the Davis-Besse power at a fixed price. In fact FirstEnergy estimates that rather than losing $3.2 billion, customers will save $2 billion through the plan. FirstEnergy's generation mix is 57 percent coal, 23 percent nuclear, 8 percent natural gas and 11 percent renewables. FirstEnergy and the Nuclear Energy Institute say that the Davis-Besse plant pumps $1.1 billion into the state economy each year and is crucial to the region's electricity supply. Regarding FirstEnergy's lobbying against the efficiency and renewable standards, the spokespeople said: "It was clear that the mandates imposed a significant cost to customers that had to be thoughtfully looked at. Ohio can continue to promote the wise use of our natural resources while lifting an undue cost burden on our customers, especially our job creators in Ohio." Renewable energy advocates say it is ironic that companies with nuclear plants are asking for government assistance because their plants are facing challenges on the open market – given that the same companies pushed for deregulation in years past, when nuclear plants stood to benefit from market conditions. "They are operating in a deregulated market, but they're trying to re-regulate again," said Fisher. "It's important to remember that they're failing in the marketplace and they're not making changes to their business model, instead they're going into the political and regulatory arenas. Their strategy is killing their competition by eliminating energy efficiency and renewable energy as incentivized [sources], then going to regulators asking to bail them out." Nuclear engineer Arjun Makhijani, president of the Institute for Energy and Environmental Research, called the nuclear generators' requests for subsidies "outrageous." "These free-marketeers are going to the government with hat in hand whenever they have trouble raising revenues," he said. "But when they make a lot of money they don't offer to give the excess back to ratepayers." Why attack renewables? The advent of horizontal hydraulic fracturing (fracking) about a decade ago provided an abundant fuel for natural gas plants which can quickly ratchet up and down to match demand. Cheap natural gas has driven the closing of scores of coal plants nationwide, and has had a major impact on the nuclear industry. So why isn't the nuclear industry trying to curb the influence of natural gas? Energy experts point to straightforward political and business reasons and the complicated structure of the auctions where energy is sold. **"The fact of the matter is natural gas and wind power both compete with Exelon's nuclear generation," said Environmental Law & Policy Center director Howard Learner. "Exelon can't do anything about the market price for natural gas, so Exelon is training its fire on trying to stop and hold off wind power and solar energy development."** Some companies that own nuclear generation are also heavily invested in natural gas. Nuclear makes up 81 percent of Exelon's generation and 54 percent of its capacity, while natural gas makes up 10 percent of its generation and 22 percent of its capacity. Wind and solar make up 1.9 and 0.3 percent of Exelon's generation, respectively. "One thing to understand about the nuclear industry is that nuclear is also the coal and natural gas industry," said Tim Judson, executive director of the Nuclear Information and Resource Service, which published the September 2014 report "Killing the Competition" about nuclear attacks on renewables. "Wind and efficiency are just boutique elements of their portfolios." Nuclear Energy Institute spokesman Thomas Kauffman said that the institute does not take a position on renewable energy subsidies and that it, "supports the Obama administration's all-of-the-above energy strategy." He declined to answer further questions and said that groups weighing in about recent developments have "a history of opposing nuclear power." Colafella and Young of FirstEnergy said "we believe that a diverse mix of generating assets, including renewables, is needed to keep power flowing reliably and affordably." "Low market prices – which are largely driven by low-cost natural gas, not renewables – are putting pressure on baseload generating plants that reliably deliver power to our customers around the clock," they added. But, they reiterated they expect prices to rise, reviving the nuclear plants' profits. Auction action Nuclear energy and wind power are both known as "price-takers" in the regional auctions where generators sell their energy. In these auctions, all sellers get the same price for energy sold at a given time. They are all paid the price of the most expensive bid that is accepted into the auction to meet demand. Nuclear plants and wind turbines both generate energy very cheaply, even though the overall costs of maintaining and running a nuclear plant are high. Before the fracking revolution, natural gas-fired power was typically much more expensive than other sources, so nuclear and coal generators would enjoy getting paid at the same rate as natural gas. These days natural gas-fired power is cheap, but wind is even cheaper. So a lot of wind on the market not only edges out other energy sources in the auction, it also can lower the price that all players are paid for their energy. The nuclear industry is striking back at wind in a specific type of market known as capacity, where energy providers are essentially paid for promising to be ready to provide energy at peak times. The PJM regional market has adopted changes that greatly increase the capacity payments that Exelon's nuclear plants will receive, while making it extremely difficult for wind and solar to benefit from these payments. Exelon lobbied hard for the changes, which must still be approved by federal regulators. Paradigm shift Nuclear companies also appear to oppose the proliferation of

distributed solar and other renewable generation for the same reasons that apparently motivate utility companies like We Energies in Wisconsin. Even if renewables make up only a small amount of generation, they represent a shift to a more decentralized energy system, less reliant on big baseload coal or nuclear power plants. While Exelon's unregulated generation arm runs the nuclear plants in Illinois, Exelon is also a regulated utility in the process of acquiring Washington D.C.-area Pepco Holdings, which would make it the country's largest utility. "It goes back to the concept of maintaining the old model of utilities as long as possible because you have control, as opposed to something out of their control like solar panels on rooftops," said Dave Kraft, director of the Nuclear Energy Information Service. Ongoing improvements to the grid, including new transmission and increased grid storage, also pose a challenge to centralized power. When it gets easier to move electricity around or to store it on the grid, energy generated by the sun and wind can be better used when and where it is needed. Scared by solar? Exelon runs a 10 MW solar farm on Chicago's South Side. But critics say this does not make the company a friend of solar. In different jurisdictions Exelon has argued that people with solar panels should not be paid the retail rate for energy they send back to the grid. This same position has been taken by utilities around the country looking to curb distributed solar generation; in most cases it has met with strong opposition from both the public and regulators. Exelon's stance on solar has stoked resistance to the company's proposed merger with Pepco. Exelon spokesman Paul Adams said, "As technology continues to evolve, it is important that we maintain a reliable, secure and universally available electric grid and ensure that energy policies do not permit shifting the costs of maintaining the grid from some customers to others, creating energy 'haves' and 'have nots.'" This is the same argument that We Energies has made in its highly controversial rate case in Wisconsin. Makhijani called Exelon's point disingenuous, especially since the changes Exelon pushed in the capacity market will likely increase Illinois customers' rates 11 percent or more. "It's crocodile tears, the crocodile feeling very sorry for this deer it just caught," Makhijani said. "Suddenly there's this huge concern for the poor." Louisiana-based Entergy has also promoted policies that pay low rates to customers with solar panels for the energy they send back to the grid. Entergy has nuclear plants that sell their power on the open market as well as regulated nuclear plants where the company is guaranteed to recoup its costs from ratepayers. Fighting over subsidies **Nuclear proponents have long depicted tax breaks for wind and other renewables as unfair and a threat to reliability. In 2012 Exelon was expelled from the American Wind Energy Association (AWEA) and its board, because of Exelon's aggressive lobbying to end the federal Production Tax Credit which provided tax breaks crucial for wind development.** "It was simply a fact that they no longer supported the aims" of promoting wind power, said AWEA spokesman Peter Kelley. "They were marshaling allies, teaming up with anti-wind organizations that have always been against wind energy." Kelley said that cheap natural gas prices have had a much more profound impact than wind on the viability of nuclear plants. "You have to ignore the real reasons and exaggerate a few outlier moments when wind had any impact on their business at all," to be convinced by Exelon's arguments, Kelley said. "They're ignoring the real reasons and blaming wind because they may think it's [politically] expedient." Adams said the Exelon "believes the transition to clean energy should be left to the free market, rather than through the government picking technology winners and losers through tax subsidies. We believe that the wind PTC has served its purpose and oppose its reinstatement." Exelon had argued that the Production Tax Credit was causing a phenomenon known as "negative pricing" when power from its nuclear plants could not be delivered where it was wanted. In March 2014 AWEA released a study criticizing Exelon for what it called exaggerations and distortions on that issue. AWEA said negative pricing was rare, was caused more by congestion on power lines and other factors than by wind, and had nothing to do directly with the tax credit. Critics point out that the nuclear industry was built on government subsidies and continues to be heavily subsidized. A 2011 report by the Union of Concerned Scientists describes a host of past and ongoing nuclear subsidies related to construction, operation, insurance, waste management and uranium mining. "It's the throwing stones from glass houses problem," said Makhijani. "They have more glass in their house than any other industry." Clean power plans Nuclear plants could benefit substantially from the clean power plans that states are developing in keeping with the Environmental Protection Agency (EPA)'s rules on reducing carbon emissions from power plants. Much depends on how the final EPA rules play out and how states decide to achieve their required reductions. The Nuclear Energy Institute wrote a letter in December to EPA Administrator Gina McCarthy asking the EPA to treat avoided carbon emissions from existing nuclear plants the same way that reduced emissions are treated. And it noted that the EPA's calculations show that per ton of carbon avoided, nuclear plants are cheaper than creating new sources of renewable energy. "Renewable energy, nuclear energy and hydro receive vastly different treatment under the proposed [EPA] rule, but nuclear energy does not receive appropriate credit," says the letter. Environmentalists say that rewarding existing nuclear plants for their zero-carbon power is not in the spirit of the EPA rules. "Exelon has talked about redefining clean energy to include nuclear plants that produce large amounts of highly radioactive waste," said Learner. "That too-clever definition is simply not credible with the public. To redefine clean energy to include nuclear power really doesn't pass the straight-face test."

Renewable Energy Better

Jacobson - nuclear power costs 5x more, takes 17 years longer to build, and produces 23x the emissions than wind power

Mark Z. Jacobson, Stanford University, "The 7 reasons why nuclear energy is not the answer to solve climate change," Leonardo DiCaprio Foundation, https://www.leonardodicaprio.org/the-7-reasons-why-nuclear-energy-is-not-the-answer-to-solve-climate-change/

To recap, **new nuclear power costs about 5 times more than onshore wind power** per kWh (between 2.3 to 7.4 times depending upon location and integration issues). Nuclear **takes 5 to 17 years longer between planning and operation and produces on average 23 times the emissions per unit electricity generated** (between 9 to 37 times depending upon plant size and construction schedule). In addition, it creates risk and cost associated with weapons proliferation, meltdown, mining lung cancer, and waste risks. Clean, renewables avoid all such risks. Nuclear advocates claim nuclear is still needed because renewables are intermittent and need natural gas for backup. However, nuclear itself never matches power demand so it needs backup. Even in France with one of the most advanced nuclear energy programs, **the maximum ramp rate**[2] **is 1 to 5 %**

[2] power generation to express how quickly a power plant's power output is changing

per minute, which means they need natural gas, hydropower, or batteries, which ramp up 5 to 100 times faster, to meet peaks in demand. Today, in fact, batteries are beating natural gas for wind and solar backup needs throughout the world. A dozen independent scientific groups have further found that it is possible to match intermittent power demand with clean, renewable energy supply and storage, without nuclear, at low cost. Finally, many existing nuclear plants are so costly that their owners are demanding subsidies to stay open. For example, in 2016, three existing upstate New York nuclear plants requested and received subsidies to stay open using the argument that the plants were needed to keep emissions low. However, subsidizing such plants may increase carbon emissions and costs relative to replacing the plants with wind or solar as soon as possible. Thus, **subsidizing nuclear would result in higher emissions and costs over the long term than replacing nuclear with renewables.**

Cooper- 95% of low carbon electricity has come from alternatives like wind and solar

Mark Cooper, Institute for Energy and the Environment, 10-2019, "THE ENDGAME FOR NUCLEAR POWER: A DESPERATE PUSH FOR SUBSIDIES IN THE 2019 TAX EXTENDERS"
http://foe.org/wp-content/uploads/2019/10/2019-10-22_Final-FOE-ITC-Study.pdf
Nuclear advocates frequently argue that existing nuclear reactors account for 60% of current, U.S. low-carbon electricity resources. However, economic analysis should focus on forward-looking costs, not sunk costs. In fact, **over the last 20 years, 95% of low-carbon electricity resources have come from alternatives, like wind and solar.** In the past 20 years, no nuclear reactors have been brought online in the U.S. The only reactor that might be completed in the next decade has a price tag that is over three times the cost of alternatives.

Smith- invested $600B in nuclear, far less in wind and solar with better outcomes

Federal Energy Subsidies: What Are We Getting for Our Money?, Grant Smith, Senior Energy Policy Advisor and Bill Walker, Vice President and Editor in Chief, WEDNESDAY, JULY 17, 2019,
https://www.ewg.org/energy/22777/federal-energy-subsidies-what-are-we-getting-our-money

Federal subsidies for fossil fuel production in 2015 and 2016 were nearly $15 billion a year, according to a study by Oil Change International. The American Wind Energy Association, or **AWEA, estimates that since World War II, fossil fuel subsidies total more than $600 billion**. **Taxpayers' return on investment: the worsening climate crisis, dirty air that threatens public health, oil spills and toxic waste.**
Since the beginning of the nuclear age, federal funding just for research and development of nuclear power have topped $100 billion, says the Congressional Research Service. AWEA's estimate for all federal subsidies to the nuclear industry during that period is nearly twice that much. ROI: Huge cost overruns passed on to utility customers; aging and crumbling reactors riskily kept running longer than they were built for; tens of thousands of tons of radioactive waste that will remain dangerous for many millennia.
Federal subsidies for wind and solar projects and technology development totaled about $75 billion over the past decade, according to EWG's analysis of data from the Treasury Department, Congress' Joint Committee on Taxation and the Congressional Research Service. That's less than 2 percent of the entire federal budget for last year. ROI: cleaner and healthier air, cheaper electricity, billions in economic activity and hundreds of thousands of jobs.

US energy information administration- US gives 4x as much to nuclear as to solar

https://www.eia.gov/analysis/requests/subsidy/

Indicators	FY 2010	FY 2013	FY2016
Total Energy Subsidies and Support **(million 2016 dollars)**	**37,992**	**29,335**	**14,983**
U.S. Energy Consumption	**96,850**	**98,655**	**96,788**
U.S. Energy Production	**73,695**	**81,151**	**84,833**
U.S. Natural Gas (dry and liquids)	24,105	28,220	32,652
U.S. Crude Oil	11,512	15,370	18,797
U.S. Coal	21,657	20,223	14,807
U.S. Nuclear	8,318	8,099	8,352
U.S. Biomass	4,358	4,680	4,963
U.S. Hydroelectric	2,588	2,582	2,482
U.S. Wind	863	1,557	2,038
U.S. Solar	88	205	533
U.S. Geothermal	207	215	209

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Smith- solar and wind costs fell 70% and 90%, respectively

Federal Energy Subsidies: What Are We Getting for Our Money?, Grant Smith, Senior Energy Policy Advisor and Bill Walker, Vice President and Editor in Chief, WEDNESDAY, JULY 17, 2019, https://www.ewg.org/energy/22777/federal-energy-subsidies-what-are-we-getting-our-money

The Solar Energy Industries Association attributes the investment tax credit in the past 10 years to growing the industry by more than 10,000 percent and leveraging $140 billion in economic activity. The solar industry now employs more than 240,000 people. The tax credits for wind and solar have contributed to a remarkable drop in the cost of renewables projects. In the past decade, **wind costs have declined nearly 70 percent and utility-scale solar costs also fell by almost 90 percent. New solar and wind power are now cheaper than new coal, nuclear and natural gas technology.**

Walker- more money goes to nuclear than renewables ($4B), $500M to store radioactive waste (burden on government, not companies)

Federal Energy Subsidies: What Are We Getting for Our Money?, Grant Smith, Senior Energy Policy Advisor and Bill Walker, Vice President and Editor in Chief, WEDNESDAY, JULY 17, 2019, https://www.ewg.org/energy/22777/federal-energy-subsidies-what-are-we-getting-our-money

The research service says that **since 2010, nuclear power has received in excess of $4 billion more in taxpayer support for technology development than renewables have.** Taxpayers for Common Sense reports that the new units at Georgia Power's Vogtle nuclear plant, under construction since 2013, have received more than $12 billion in loan guarantees but now are projected to cost twice as much as initially estimated.In addition, a study by Stanford University estimates **federal taxpayers are paying about $500 million a year to utility companies for storing radioactive waste onsite at nuclear plants**. The Department of Energy has responsibility for storing the waste – not the companies whose reactors generated it – but concerns about safety have repeatedly stymied efforts to site a national dump for waste that will remain dangerous for more than 10,000 years. The Government Accountability Office says the waste stored at reactor sites has reached 90,000 metric tons and would fill the area the size of a football field 66 feet deep. Estimates of subsidies vary according to who's doing the counting: For example, as Oil Change International notes, should the cost to taxpayers for cleaning up fossil fuel pollution be counted as a subsidy? Still, it's pretty simple: **The more taxpayers invest in renewables, the greater the benefits. The more taxpayers prop up fossil fuels and nuclear power, the greater the burdens.** It is past time for the nation to shift tax resources to accelerating the urgently needed transition to clean, renewable power, instead of accelerating the climate crisis and harming public health to boost the profits of the fossil fuel and nuclear industries

Funkhouser- falling prices of wing energy helped decrease emissions in 2017 to lowest levels since 1991

David Funkhouser, 3-16-2018, "How Much Do Renewables Actually Depend on Tax Breaks?," State of the Planet, https://blogs.ei.columbia.edu/2018/03/16/how-much-do-renewables-actually-depend-on-tax-breaks/

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

The U.S. produces more megawatt hours of wind energy than any other nation. Wind and solar energy production are growing faster in the United States than any other source of electricity, and falling prices are making them more competitive with fossil fuel-driven electricity. Meanwhile, natural gas has surpassed coal as the prime fuel for power plants. **Those trends helped drive down U.S. greenhouse gas emissions in 2017 to their lowest level since 1991**, according to a report for the Business Council on Sustainable Energy. That's good news for anyone concerned about climate change. The shift to renewable energy is a key part of the global effort to reduce emissions of carbon dioxide and other earth-warming gases and slow down climate change by reducing our dependence on fossil fuels. But critics argue that this growth wouldn't be possible without financial support from the government. How much do renewables actually need tax breaks and other subsides?

Funkhouser- solar and wind is cheaper to produce than coal, nuclear, and natural gas

David Funkhouser, 3-16-2018, "How Much Do Renewables Actually Depend on Tax Breaks?," State of the Planet, https://blogs.ei.columbia.edu/2018/03/16/how-much-do-renewables-actually-depend-on-tax-breaks/

From the perspective of cheap energy, the U.S. is doing well. **Americans in 2017 devoted less than 4 percent of their spending on energy, a near-record low.** The boom in natural gas and shrinking cost of solar and wind from more efficient technology and scaled-up manufacturing have helped keep prices relatively low. Taking out subsidies, **solar and wind power are now cheaper than electricity generated by coal, nuclear power and even natural gas** over the lifetime of a power facility, according to a 2016 analysis by Lazard Ltd., a financial advisory and asset management firm. Between 2009 and 2016, Lazard said, the cost of solar power in the United States dropped 85 percent, and wind power dropped by 66 percent. Levelized cost of energy from different sources by 2020, taking into account subsidies. The range of costs reflects different scenarios. Source: U.S. Energy Information Administration; for another view of energy costs, see a report by Lazard here.

Berkely- increased use of solar and wind could have averted 7,000 deaths

University Of Houston Energy Fellows, 3-23-2018, "Renewable Energy Subsidies," Forbes, https://www.forbes.com/sites/uhenergy/2018/03/23/renewable-energy-subsidies-yes-or-no/#9464ac56e232

Millstein, the Berkeley National Lab researcher, has tried to quantify the impact of pollution from carbon sources of energy. Basically, he has reported, more pollution equals more deaths –his research found **that 7,000 deaths could have been avoided over a 10-year period through the increased use of wind and solar.**

Renewable energy could replace nuclear

Smith - renewable energy can replace nuclear plants in NY and save $8 billion

Grant Smith, Senior Energy Policy Adviser, 7-12-2019, "States Stick Ratepayers With $15 Billion To Rescue Nukes ," Environmental Working Group
https://www.ewg.org/energy/22743/states-stick-ratepayers-15-billion-rescue-nukes
A Stanford University and German Aerospace Center study in November 2016 found that **a combination of wind, solar and energy efficiency could replace**, in the near term, **the same three nuclear plants in New York that are getting a bailout. This would produce a savings of $800 million to nearly $8 billion**. In California, Pacific Gas & Electric agreed with a study that concluded replacing the Diablo Canyon nuclear units with renewable energy would save $5 billion over the expense of keeping it running.

Smith - CA met climate goals by redirecting nuclear investments in other renewables

Grant Smith, 1-9-2019, Nuclear Power Is Economically Obsolete, Eco Watch
https://www.ecowatch.com/nuclear-power-cost-renewables-2625524662.html
Nuclear advocates' claims that nuclear power is required to fight climate change falls short. **California met its climate goal of reducing greenhouse gas emissions to 1990 levels by 2020 four years early by turning off its nuclear plants and setting policies that prioritize renewables, energy efficiency and energy storage investments over natural gas plant additions.** An argument advanced in the Energy Department report is that, to ensure that power can be delivered 24/7, large coal and nuclear power plants designed to run day and night—also known as baseload plants—need to be replaced by small nuclear units that run day and night. However, mounting, real-world evidence refutes this assertion. **Recent studies from New York and California show that it is cheaper to invest in renewables, energy efficiency and energy storage in order to replace aging nuclear plants than it is to keep the existing plants running.** Savings range from hundreds of millions to billions of dollars—achieved without any impact on electric system reliability. Nuclear power belongs in a museum. We shouldn't continue to squander public dollars on a technology that will never make economic sense. We should divert resources into improving and deploying wind, solar, energy efficiency and energy storage technology that we know will keep the lights on, effectively reduce carbon emissions and cost what we can afford to pay.

Smith- renewables can economically replace nuclear energy plants currently in operation

Grant Smith, Senior Energy Policy Advisor, April 23, 2018, Renewables, Not Natural Gas, Should Replace Shuttered Nuclear Plants, Enviormental Working Group
Across the nation, utilities continue to announce the planned shutdown of nuclear power plants.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Early retirement of these crumbling, outrageously expensive and dangerous plants is long overdue. But will they be replaced by polluting natural gas plants, or can clean, renewable energy be brought on line quickly enough to fill the gap?
As New York Times columnist Brad Plumer recently noted, the fear is that replacing suddenly retired nuclear plants, which don't emit carbon, with natural gas would increase the greenhouse gas emissions that drive climate change.
Timing is the critical variable here. At what pace can nuclear plants be replaced and does natural gas have to play a role in that transition? Three recent studies show how **we can bypass natural gas when replacing nuclear power plants:**

- **A Stanford University and German Aerospace Center study in November 2016 found that a combination of wind, solar and energy efficiency in various scenarios could replace three nuclear plants in New York in the near term. This would produce a savings of $800 million to nearly $8 billion, and reduce carbon emissions by 32.5 million tons, compared to keeping the plants running.**
- **A study by the Center for Energy Efficiency and Renewable Energy Technologies estimated that a combination of renewable and energy efficiency investments would be up to $5 billion cheaper than extending operation of Diablo Canyon, the last remaining nuclear plant in California. This cost convinced Pacific Gas & Electric to commit to closing Diablo's twin reactors in 2024 and 2025.**
- **A 2017 report by Strategen Consulting said a combination of wind and solar power, storage of the electricity, and increased energy efficiency could replace the Indian Point nuclear plant near New York City more cheaply than natural gas, saving $315 million over five years.**

Besides the cost of the energy itself, there are other reasons to quickly move away from nuclear power. For years, analysts have warned the Nuclear Regulatory Commission, or NRC, about the danger of nuclear fuel pools, where high-level nuclear waste is stored. Because the fuel rods are packed too closely, the pools are vulnerable to catastrophic fires or terrorist attacks.
A recent paper by Princeton University and Union of Concerned Scientists found that moving older fuel rods from the pools to safer dry cast storage "could reduce radioactive releases from pool fires (in the event of an emergency) by 99 percent." This would cost the industry $50 million for each pool. But NRC has ignored the warning.
"The agency has been pressured by the nuclear industry, directly and through Congress, to lowball the potential consequences of a fire because of concerns that increased costs could result in shutting down more nuclear power plants," Frank Von Hippel, a research physicist at Princeton and the paper's co-author, told Science Daily.
The true costs of natural gas and nuclear safety must be included in any assessment of our future energy mix. Ease of deployment, declining costs, and minimal impacts on health and climate make renewables, efficiency and storage technologies the clear choice for replacing nuclear power plants.

Fossil fuels obsolete

Forbes- half of all new electricity in 2017 was wind and solar

University Of Houston Energy Fellows, 3-23-2018, "Renewable Energy Subsidies," Forbes, https://www.forbes.com/sites/uhenergy/2018/03/23/renewable-energy-subsidies-yes-or-no/#9464ac56e232
Today 80% of the energy we use globally is sourced from hydrocarbons (oil, natural gas and coal), and 20% comes from renewables and nuclear. There are many hypotheses about the future energy mix. One possibility is that in 2040, 60% of the world's energy will come from hydrocarbons, with natural gas making up the largest percentage of that, while 40% will come from renewables and nuclear, with most of that in the form of wind and solar energy.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

In 2017 in the United States, wind and solar represented almost half of new electricity generation capacity. Meanwhile, total energy usage is predicted to rise between 25% and 35% by 2040 due to increasing population and higher global GDP. So the projections are that in the future, we will use more energy, and a larger share of that energy will be from renewable sources. We are already seeing an increase in the usage of renewables, especially to generate electricity.

Nuclear waste

Nicholas Kusnetz, 1-7-2020, "U.S. Emissions Dropped in 2019: Here's Why in 6 Charts," InsideClimate News, https://insideclimatenews.org/news/07012020/infographic-united-states-emissions-2019-climate-change-greenhouse-gas-coal-transportation

Overall, **U.S. greenhouse gas emissions fell about 2 percent in 2019,** according to preliminary estimates by Rhodium Group, an economic analysis firm. The previous year, strong economic growth and other factors had pushed emissions up roughly 3 percent**. The 2019 drop was driven by a nearly 10 percent fall in emissions from the power sector, the biggest decline in decade**s, according to Rhodium. And the story there is all about coal. Coal generation in the U.S. fell by 18 percent last year, the largest annual decline on record, according to Rhodium. Another study, published in December, found a smaller but still dramatic drop for coal generation last year. **Renewable power sources such as wind and solar have seen sharp increases in recent years as their costs of generation have fallen below that of coal.** But natural gas has replaced far more coal generation capacity than renewables.

Indigenous People

General Native American Cards

Public Citizen, 1991, "Radioactive Racism: The History of Targeting Native American Communities with High-Level Atomic Waste Dumps"
https://www.nirs.org/wp-content/uploads/radwaste/scullvalley/historynativecommunitiesnuclearwaste06142005.pdf

Low-income and minority communities are disproportionately targeted with facilities and wastes that have significant and adverse human health and environmental effects.1 This places the burdens of society on those who are most vulnerable. These communities are at a tremendous economic and political disadvantage over the decision-making process that is dominated by large, wealthy corporations and/or government agencies. Ironically, **low income and People of Color communities targeted with hazardous facilities often benefit the least from whatever societal "good" is purported to justify the generation of the hazardous substances in the first place**.2 According to the 1990 U.S. Census (the very time period when

the U.S. nuclear establishment intensified and accelerated its targeting of Native American communities with high-level radioactive waste dumps, as shown below), over 31% of Native Americans living on reservations had incomes below the federal poverty line.3 After centuries of oppression and domination, stripped of their lands, resources, and traditional governments, these communities lack political power, and desperately need economic development. **The "tribal sovereignty" of Native Americans, which makes their lands exempt from state law and many environmental regulations, only increases their attractiveness as targets for facilities unwanted elsewhere.** Native Americans have already disproportionately borne the brunt of the impacts from the nuclear fuel chain over the past 60 years.4 In the case of radioactive waste storage and disposal, the nuclear power establishment in industry and government is simply taking advantage of these vulnerable communities, attempting to hide from environmental regulation and widespread public opposition behind the shield of tribal sovereignty.

Kline - 80% US uranium located on tribal land

Curtis Kline, Intercontinental Cry, 7-2-2013, "URANIUM MINING AND NATIVE RESISTANCE: THE URANIUM EXPLORATION AND MINING ACCOUNTABILITY ACT"
https://intercontinentalcry.org/uranium-mining-and-native-resistance-the-uranium-exploration-and-mining-accountability-act/

Native Americans in the northern great plains have the highest cancer rates in the United States, particularly lung cancer. It's a problem that the United States government has woefully ignored, much the horror of the men and women who must carry the painful, life-threatening burden. **The cancer rates started increasing drastically a few decades after uranium mining began on their territory.** According to a report by Earthworks, "**Mining not only exposes uranium to the atmosphere, where it becomes reactive, but releases other radioactive elements** such as thorium and radium and toxic heavy metals including arsenic, selenium, mercury and cadmium. **Exposure to these radioactive elements can cause lung cancer, skin cancer, bone cancer, leukemia, kidney damage and birth defects**." Today, in the northern great plains states of Wyoming, Montana and the Dakotas, the memory of that uranium mining exists in the form of 2,885 abandoned open pit uranium mines. **All of the abandoned mines can be found on land that is supposed to be for the absolute use of the Great Sioux Nation** under the 1868 Fort Laramie Treaty with the United States. The Area Agreed Upon in the Fort Laramie Treaty of 1868 (photo republicoflakotah.com) There are also 1,200 abandoned uranium mines in the Navajo Nation, where cancer rates are also significantly disproportionate. **In fact, it is estimated that 60 to 80 percent of all uranium in the United States is located on tribal land, and three fourths of uranium mining worldwide is on Indigenous land.** Defenders of the Black Hills, a group whose mission is to preserve, protect, restore, and respect the area of the 1851 and 1868 Fort Laramie Treaties, is calling the health situation in their own territory America's Chernobyl. It's not far from the truth. A nuclear physics professor from the University of Michigan, Dr. K. Kearfott, Ph. D., who studied the situation in northwestern South Dakota as well as the situation in Japan has said, **The contamination from the mines escapes into the air. It poisons grain that is fed to cattle that provide milk and beef for the rest of the nation**. The abandoned uranium mines of the Cave Hills in northwestern South Dakota empty into the Grand River which flows through the Standing Rock Indian Reservation. **Three villages are located on the Grand River and their residents have used the water for drinking and other domestic purposes for generations. The water runoff from the Slim Buttes abandoned uranium mines empty into the Moreau River which flows through the Cheyenne River Indian Reservation.** Both of these rivers empty into the Missouri River which empties into the Mississippi.

Bruce E. Johnson, Professor of Communications at University of Nebraska, 6-1997, "The High Cost of Uranium in Navajoland"
https://ratical.org/radiation/UraniumInNavLand.html

When Native Americans in the Western United States were assigned reservations in the late nineteenth century, many were sent to land thought nearly worthless for mining or agriculture. The year 1871, when treaty-making stopped, was a time before sophisticated irrigation, and before dryland farming techniques had been developed. Industrialization was only beginning to transform the cities of the Eastern Seaboard and the demand for oil, gas and even coal was trivial by present-day standards. And, in 1871 Madame Curie had not yet isolated radium. Before

1900, there was little interest in locating or mining uranium, which later became the driving energy force of the nuclear age. In a century and a quarter, the circumstances of industrialization and technical change have made many of these treaty-guaranteed lands very valuable, not least because under their often barren surface lies a significant share of North America's remaining fossil fuel and uranium resources. Nationwide, the Indians' greatest mineral wealth is probably in uranium. According to a Federal Trade Commission Report of October 1975, **an estimated 16 percent of the United States' uranium reserves** that were recoverable at market prices **were on reservation lands; this was about two-thirds of the uranium on land under the legal jurisdiction of the United States Government. There were** almost 400 uranium leases on these lands, according to the F.T.C., and **between 1 million and 2 million tons of uranium ore a year, about 20 percent of the national total, was being mined on reservation land.** Moreover, if the uranium reserves on reservation land are added to those estimated on land guaranteed to Indian nations by treaty, **the Indians' share of uranium reserves within the United States rises** to nearly 60 percent; the Council of Energy Resource Tribes places the figure at 75 percent **to 80 percent**. About two-thirds of the 150 million acres guaranteed to Indians by treaty has been alienated from them -- by allotment, other means of sale, or by seizure without compensation. Some of these areas, notably the Black Hills of South Dakota, underwent a uranium mining boom during the 1970s, even though legal title to the land is still clouded. Sioux leaders have refused to settle with the United States for the land, despite a price tag that had grown to $351 million principal and interest by 1993.

Alvarez - 3 billion tons nuclear waste, Navajos live near ⅓ of all abandoned uranium mines

Robert Alvarez, Bulletin of the Atomic Scientists, 3-30-2017, "Native American uranium miners and the Trump budget"
https://thebulletin.org/2017/03/native-american-uranium-miners-and-the-trump-budget/

Native American uranium miners were essential to the United States' efforts to create a nuclear arsenal. From the late 1940s to the early 1970s, **Indian people dug up approximately four million tons of uranium ore**—nearly a quarter of the total national underground production in the United States used in nuclear weapons. As they did so, they were sent into harm's way without sufficient warning, becoming the workers most severely exposed to ionizing radiation in the US nuclear weapons complex. After more than a century, the legacy of US uranium mining lingers. **More than three billion metric tons of mining and milling wastes were generated in the United States. Today, Navajos still live near about one third (approximately 1,200 out of 4,000) of all abandoned uranium mines in the United States.** Only after concerted efforts by Navajo activists to spur congressional investigations in 1993 and 2006 did the US government promise to remediate abandoned mines and ascertain their health impacts. But more than a century after the government issued the first uranium mining leases on Navajo land, the Trump administration has proposed deep cuts in the Environmental Protection Agency's budget—upward of 30 percent overall—putting that cleanup effort in peril. America's Indian miners were never warned of the hazards of radioactivity in the mines, where they inhaled, ingested, and drank uranium dust. The water in the mines was especially dangerous; it contained high quantities of radon—a radioactive gas emanating from the ore. Radon decays into heavy, more radiotoxic isotopes, called "radon daughters," which include isotopes of polonium, bismuth, and lead. The alpha particle emissions of radon daughters are considered to be about 20 times more carcinogenic than x-rays. If they lodge in the respiratory system, especially the deep lung, radon daughters emit energetic ionizing radiation that can damage cells of sensitive internal tissues. And of course, the miners brought the uranium dust home, along with their contaminated clothing. A known danger, hidden. The hazards of uranium mining have been known for centuries. As early as 1556, dust in the Ore Mountain (Erzgebirge) mines bordering Germany and what is now the Czech Republic was reported to have "corrosive qualities... it eats away the lungs and implants consumption in the body..." **By 1879, researchers found that 75 percent of the miners in the Ore Mountains had died from lung cancer.** By 1932, the Ore Mountain miners were receiving compensation for their cancers from the German government. Uranium mining was convincingly linked to lung cancer by dozens of epidemiological and animal studies by the late 1930s. In 1942, Wilhelm C. Hueper, the founding director of the environmental cancer section of the National Cancer Institute, brought the European studies to light in the United States—concluding that radon gas was responsible for half of the deaths of European miners after 10 to 20 years of exposure. By this time,

uranium had become a key element for the making of the first atomic weapons. Hueper's superiors blocked him from further publication and discussion in this area; they told him that dissemination of such information was "not in the public interest."

Harms

Alvarez - 75% of miners died from lung cancer

Robert Alvarez, Bulletin of the Atomic Scientists, 3-30-2017, "Native American uranium miners and the Trump budget"
https://thebulletin.org/2017/03/native-american-uranium-miners-and-the-trump-budget/
it eats away the lungs and implants consumption in the body..." **By 1879, researchers found that 75 percent of the miners in the Ore Mountains had died from lung cancer.** By 1932, the Ore Mountain miners were receiving compensation for their cancers from the German government. Uranium mining was convincingly linked to lung cancer by dozens of epidemiological and animal studies by the late 1930s. In 1942, Wilhelm C. Hueper, the founding director of the environmental cancer section of the National Cancer Institute, brought the European studies to light in the United States—concluding that radon gas was responsible for half of the deaths of European miners after 10 to 20 years of exposure. By this time, uranium had become a key element for the making of the first atomic weapons. Hueper's superiors blocked him from further publication and discussion in this area; they told him that dissemination of such information was "not in the public interest."

Hudetz - 26% of Navajo women and newborns had concentrations of uranium that exceeded highest 5% of US populations

Mary Hudetz, Associated Press, 10-8-2019, "US Official: Research finds uranium in Navajo women, babies"
https://kutv.com/news/local/us-official-research-finds-uranium-in-navajo-women-babies
About a quarter of Navajo women and some infants who were part of a federally funded study on uranium exposure had high levels of the radioactive metal in their systems, decades after mining for Cold War weaponry ended on their reservation, a U.S. health official Monday. The early findings from the University of New Mexico study were shared during a congressional field hearing in Albuquerque. Dr. Loretta Christensen — the chief medical officer on the Navajo Nation for Indian Health Service, a partner in the research — said 781 women were screened during an initial phase of the study that ended last year. Among them, **26% had concentrations of uranium that exceeded levels found in the highest 5% of the U.S. population**, and **newborns with equally high concentrations continued to be exposed to uranium during their first year**, she said. The research is continuing as authorities work to clear uranium mining sites across the Navajo Nation.

Moore-Nall - Gov/companies failed to inform Navajo miners of health risks, 133/150 miers died from cancer, most still live near toxic waste

Anita Moore-Nall, Montana State University, *Geosciences*, 2-3-2015, "The Legacy of Uranium Development on or Near Indian Reservations and Health Implications Rekindling Public Awareness"
https://www.mdpi.com/2076-3263/5/1/15/htm
The Navajo Nation was one of the Indian nations heavily affected by this activity with more than a thousand mines and four uranium mills on the reservation lands [5,6,8]. When mining came to the reservation the Navajo men were ready to gain employment and the close work seemed ideal. What they didn't realize was that they were being exposed to radiation when they worked and brought it home with them in their clothing to their families [6]. Energy material may contain harmful chemical substances that, if mobilized into air, water, or soil, can adversely impact human health and environmental quality [18]. As a result of the mining activity much of the population of the Navajo Nation residing near the areas of mining or milling has had their health compromised. Many of the miners developed cancers; some were lung cancer from inhalation of

radioactive particles, i.e., exposure to radon [6]. **Of the 150 Navajo uranium miners who worked at the uranium mine in Shiprock, New Mexico until 1970, 133 died of lung cancer or various forms of fibrosis by 1980** [19]. Other potential health effects include bone cancer and impaired kidney function from exposure to radionuclides in drinking water [12]. **The government and the mining companies failed to inform the people of the Navajo Nation that working with uranium might be hazardous to one's health** [2,3,4,5,6,7,8]. **The Public health Service even conducted a study to document the development of illnesses as the mining progressed without consent or presenting the data to the miners involved** [5,8]. **Most of the 1000** unsealed tunnels, unsealed pits and **radioactive waste piles still remain on the Navajo reservation today, with Navajo families living within a hundred feet of the mine sites** [9,20]. **Some of the homes were built with tailings material and much of the water is contaminated on the reservation**

Johnson - People living near tailing 2x as likely to get lung cancer

Bruce E. Johnson, Professor of Communications at University of Nebraska, 6-1997, "The High Cost of Uranium in Navajoland"
https://ratical.org/radiation/UraniumInNavLand.html
In early 1978, however, **the Department of Energy released a Nuclear Waste Management Task Force report** which said **that persons living near the tailings piles have twice the expected rate of lung cancer.** By 1978, the Navajos were beginning to trace the roots of a lung cancer epidemic which had perplexed many of them, since the disease was very rare among Navajos before World War II. In addition to exposure from the tailings piles, many of the miners who started America's nuclear stockpile had died of lung cancer. Although health and safety measures have improved in the mines since the 1950s, due to governmental and popular pressure, present practices still expose workers to unhealthy amounts of radon. As for Kerr-McGee, in whose mines many of the Navajos worked, a company statement maintained as late as mid-1979 that uranium-related deaths among miners were mere allegations. **Lung cancer results from inhalation of radon gas, a by-product of uranium's decay into radium.** Tom Barry, in an investigative series for the Navajo Times, found documentation that miners who worked for Kerr-McGee during the 1940s were exposed to between 100 and 1,000 times the dosage of radon now considered safe by the federal government. Harris Charley, who worked in the mines for 15 years, told a United States Senate hearing in 1979, "We were treated like dogs. There was no ventilation in the mines." Pearl Nakai, daughter of a deceased miner, told the same hearing that "No one ever told us about the dangers of uranium." The Senate hearings were convened by Sen. Pete Domenici, New Mexico Republican, who is seeking compensation for disabled uranium miners, and for the families of the deceased. "The miners who extracted uranium from the Colorado Plateau are paying the price today for the inadequate health and safety standards that were then in force," Domenici told the hearing, held at a Holiday Inn near the uranium boom town of Grants, N.M.

Hoover - PCB 25,000 times standard for human health

Elizabeth Hoover, Environmental Health Perspectives, 12-1-2012, "Indigenous People of North America: Environmental Exposures and Reproductive Justice"
https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.1205422

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

In addition to deposition of petrochemical and military waste, mining tends to heavily impact native communities. Uranium mining and mine tailings are major problems in both South Dakota and New Mexico. There was extensive uranium mining in the Southwest in the past, often on Indian land, and the mounds of mine tailings leached uranium into drinking and groundwater (Landa and Gray 1995). **Uranium is both radioactive and has direct metal toxicity, which results in increased risk of cancer, birth defects, and kidney disease** (Craft et al. 2004). In addition to mining effluents, the Tewa community in northern New Mexico is also exposed to toxic and radioactive wastes coming from releases from the Los Alamos National Laboratory, spread by air and surface and groundwater. Although a systematic health study has not been conducted in these populations, some **environmental testing** has been commissioned by local nonprofit organizations, which **found PCB levels 25,000 times the standard for human health and 1,000 times over the standard for wildlife habitat in Los Alamos Canyon** (Amigos Bravos and Concerned Citizens for Nuclear Safety 2006). Amigos Bravos won a settlement in May 2011 against the U.S. EPA and Los Alamos over discharge permits that will require clean up of a number of sites, increase monitoring, and install pollution control measures (van Buren 2011)

Government neglect Native Americans / lack of advocacy

Risen - Federal government ignore Native Americans, Native Americans developed distrust

Tom Risen, US News, 6-16-2016, "For some Native AMerican communities facing water problems, hope circles the drain"
https://www.usnews.com/news/articles/2016-06-16/some-native-americans-lack-access-to-safe-clean-water
So why, in 2016, are people still living without access to safe drinking water? John Echohawk, an attorney and founder of the Native American Rights Fund, a nonprofit that provides legal assistance to tribes, says many people in the U.S. are simply unaware of the problems faced by Native Americans. "A lot of people say we are kind of invisible in the national consciousness, so we are always doing what we can to educate everybody," Echohawk says. **"As late as the 1960s, the mentality of the federal government was to ignore the Indian treaties, force assimilation and basically do away with the tribes. We were the vanishing Americans and we are still living with the vestiges of that, even though we have made a tremendous comeback**." Advocacy groups since the 1970s have helped improve conditions for tribes thanks to a "legal revolution" that Echohawk says has made legal representation more available to low-income tribal members. Native Americans also are becoming better at pressuring elected officials by making more political contributions, he says, and by pressing for more access to polling places to make voting easier for tribal members in rural areas.

The EPA's emergency response aid to the Navajo has included $1.1 million in funds to provide hay and water to affected Navajo farmers, and the agency reportedly is making $2 million available for use by the Navajo and Ute tribes – as well as by the states of Utah, New Mexico and Colorado – for long-term monitoring related to the mine pollution. The EPA additionally committed to reimbursing expenses related to the spill, including $116,000 to the Southern Ute tribe in Colorado and $157,000 to the Navajo Nation in New Mexico, and had been reviewing additional possibilities for reimbursement. But Begaye says **the Navajo have a "legacy of distrust" with federal agencies, in part because of improper efforts by companies to seal uranium mines on tribal land**. The majority of America's uranium mines opened during the early 20th century were dug on tribal land in the Southwest, and the resulting water and soil contamination from those mines is so pervasive it's believed to have contributed to the rise of a unique radiation-related disease among nearby residents called Navajo neuropathy. The disease causes symptoms such as muscle weakness, liver problems and birth defects. It can also be fatal.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Alvarez - Trump Budget Cuts to EPA endangers cleanup efforts

Robert Alvarez, Bulletin of the Atomic Scientists, 3-30-2017, "Native American uranium miners and the Trump budget"
https://thebulletin.org/2017/03/native-american-uranium-miners-and-the-trump-budget/

But more than a century after the government issued the first uranium mining leases on Navajo land, **the Trump administration has proposed deep cuts in the Environmental Protection Agency's budget—upward of 30 percent overall—putting that cleanup effort in peril.** America's Indian miners were never warned of the hazards of radioactivity in the mines, where they inhaled, ingested, and drank uranium dust. The water in the mines was especially dangerous; it contained high quantities of radon—a radioactive gas emanating from the ore. Radon decays into heavy, more radiotoxic isotopes, called "radon daughters," which include isotopes of polonium, bismuth, and lead. The alpha particle emissions of radon daughters are considered to be about 20 times more carcinogenic than x-rays. If they lodge in the respiratory system, especially the deep lung, radon daughters emit energetic ionizing radiation that can damage cells of sensitive internal tissues. And of course, the miners brought the uranium dust home, along with their contaminated clothing. A known danger, hidden. The hazards of uranium mining have been known for centuries. As early as 1556, dust in the Ore Mountain (Erzgebirge) mines bordering Germany and what is now the Czech Republic was reported to have "corrosive qualities

Risen - Accidents receive little attention and resources, throwing more money won't help

Tom Risen, US News, 6-16-2016, "For some Native AMerican communities facing water problems, hope circles the drain"
https://www.usnews.com/news/articles/2016-06-16/some-native-americans-lack-access-to-safe-clean-water

Navajo Nation President Russell Begaye says **the national attention and resources given to the 100,000 Flint residents marks a "day-and-night difference" compared with the response to mining pollution that** in August **contaminated water in the San Juan River used by his tribe**. "**It indicates to us that we are not a priority,**" Begaye says. "Maybe it is because we don't have the voting influence that Michigan has. Whatever the factor is, we definitely have been ignored." Begaye says crops and livestock the Navajo depend on were endangered by acid mine runoff that turned the Animas River bright yellow and flowed into the San Juan River, and his tribe has threatened legal action against the Environmental Protection Agency for its role in contaminating the water.

"Cleaning up these mines will be a massive undertaking," Daguillard says, though "we also have a better understanding of the scope of the remaining problem." Although the mine pollution has brought more attention to the plight of Native Americans, **it is** still difficult **for reservations in rural areas to compete for limited government funds to develop even basic modern amenities like clean, running water and toilets in their homes**, says James Grijalva, a law professor at the University of North Dakota. And **more money wouldn't necessarily be the silver bullet.**

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Church Rock Spill

Stanford - Church Rock Spill water 7000x standard amount radiation

Nathaniel Morris, 3-9-2017, Stanford University, "Church Rock Spill"
http://large.stanford.edu/courses/2017/ph241/morris-n1/

Because of the large area the radiation spill contacted, the environmental and health effects have been wide reaching. **Elevated radiation has been monitored as far as 50 miles away from the initial spill and the radiation in the Puerco River showed 7,000 times the standard amount for drinking water.** [4] This radiation contaminated not only the water but the food chain as well as seen through cattle in the area showing higher levels of radiation. Because roughly half of the Navajo population in the area get their water from unregulated sources, which became contaminated, they suffered from exposure to high levels of poisonous uranium mill tailings in the water supply. **This resulted in elevated rates of kidney disease as well as at the affected Navajo population being 1.83 times more likely to have 1 of 33 selected defects**

The United Nuclear Corporation along with the government of New Mexico did embark on a cleanup effort as shown in Fig. 1. **However this attempt to fix their mistake is criticized as being vastly inadequate** for the severity of damages caused by the Church Rock Spill. **Scholars argue that their response was an insufficient response to the drastic situation considering the impoverished Navajo people were not able to advocate for themselves. Additionally many of the Navajo people were not able to speak English and authorities did not communicate properly in order to warn the residents in the area to protect themselves from the radiation and poisonous water.** Half of recoverable uranium is in New Mexico and half of that is located on Navajo land. Because of this the Navajo people have been subjected, since 1940 when uranium mining began in New Mexico, to the negative health effects of the radioactive metal. One in six Navajo uranium miners have been afflicted with lung cancer. While the Church Rock spill was the largest destructive incident other instances of uranium poisoning in Navajo lands have been a continuous problem and this one spill was not an isolated incident.

Moore-Hall - Church Rock Spill more radiation than Three-Mile Island, received little public attention

Anita Moore-Nall, Montana State University, *Geosciences*, 2-3-2015, "The Legacy of Uranium Development on or Near Indian Reservations and Health Implications Rekindling Public Awareness"
https://www.mdpi.com/2076-3263/5/1/15/htm

Over ninety percent of all milling done in the U.S. occurred on or just outside the boundaries of American Indian reservations [33]. Mills logically would be located near the production or mine sites for infrastructure, thus many mills were on or near the reservations where uranium mining was operating. A disaster of huge consequence for the Navajo Nation occurred at the Church Rock uranium mill spill on 16 July 1979, in New Mexico when United Nuclear Corporation's Church Rock uranium mill tailings disposal pond breached its dam [34]. **Over 1000 tons of solid radioactive mill waste and 93 million gallons of acidic, radioactive tailings solution flowed into the Puerco River, and contaminants traveled 130 km downstream onto the Navajo Nation** [35]. The mill was located on privately owned land approximately 27 km north of Gallup, New Mexico, and bordered to the north and southwest by Navajo Nation Tribal Trust lands [35]. Local residents, who were mostly Navajos, used the Puerco River for irrigation and livestock and were not immediately

aware of the toxic danger [34]. The Navajo Nation asked the governor of New Mexico to request disaster assistance from the U.S. government and have the site declared a disaster area, but he refused, limiting disaster relief assistance to the Navajo Nation [34]. **In terms of the amount of radiation released, the accident was larger in magnitude than the Three Mile Island accident of the same year** [34] **but received little public attention**. This was likely due to the remoteness and sparsely populated area of the Navajo Nation which was impacted by the spill. The area was inhabited by mainly Navajo people, many who only spoke their native tongue [34]. This is in contrast to the highly populated area of Middletown, Pennsylvania located three miles from the Three Mile Island Nuclear Generating Station where the TMI accident occurred. Possibly the greater significance of a nuclear power plant versus a tailings dam may also have influenced media coverage.

Jennings - Spill contaminated water but people do not have alternatives

Trip Jennings, New Mexico in Depth, 7-7-2014, "Remembering the largest radioactive spill in U.S. history"
http://nmindepth.com/2014/07/07/remembering-the-largest-radioactive-spill-in-u-s-history/

The U.S. Department of Energy has estimated that "millions of gallons of water contaminated by mill tailings were released into the groundwater over the life of the sites through the unlined ponds," according to the GAO report. But the 1979 dam collapse represented something altogether different than the leaching of contaminated materials into the groundwater, which occurs over time. The onrush of contaminated water was a fast-moving public health disaster, with almost immediate effects. Pasternak, who dug into archival collections, books and government documents and who interviewed hundreds of people for Yellow Dirt, described the consequences of having contaminated water come into contact with humans and animals on July 16 and the days afterward: The water, filled with acids from the milling process, twisted a metal culvert in the Puerco and burned the feet of a little boy who went wading. Sheep keeled over and died, and crops curdled along the banks. The surge of radiation was detected as far away as Sanders, Arizona, fifty miles downstream. **The IHS (Indian Health Service) and the state urged Navajos not to drink the water nor enter it, nor let their animals do so, anywhere downstream from the spill. But the people by the Puerco didn't have many alternatives**. The dam collapse was one of the more public catastrophes due to decades of uranium mining on the Navajo Nation. But there were others that were less visible, ones that were associated with the mines themselves. The Navajo Nation raised those concerns during a congressional hearing in 1993, citing the physical hazards (shafts, pits, and debris piles) and the potential exposure to uranium ore (contaminated materials, and heavy metals), according to the Navajo Nation Environmental Protection Agency's website.

Water

NPR - 2 million Americans don't have access to clean water

Laurel Morales, NPR, 11-18-2019, "Many Native Americans Can't Get Clean Water, Report Finds"
https://www.npr.org/2019/11/18/779821510/many-native-americans-cant-get-clean-water-report-finds

For many people, turning on the tap or flushing the toilet is something we take for granted. But a report released Monday, called "Closing the Water Access Gap in the United States," shows that **more than 2 million Americans live without these conveniences and that Native Americans are more likely to have trouble accessing water than any other group.** The nearest water station for Darlene Yazzie is 9 miles away at the Dennehotso Chapter House — a community center — in the Four Corners region of the Navajo Nation. On Tuesday, she counted her dimes and nickels to pay for water. It costs $1.10 plus gas money to fill up two 50-gallon barrels, and she has just been told the price is going up next month.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

NPR - Navajo water sources uranium levels 5x than safe drinking water standards

Laurel Morales, NPR, 11-14-2017, "For Some Native Americans, Uranium Contamination Feels Like Discrimination"
https://www.npr.org/sections/health-shots/2017/11/14/562856213/for-some-native-americans-uranium-contamination-feels-like-discrimination

When she was pregnant, Nez and her children drank from **a spring, located on Navajo Nation in northeastern Arizona, with uranium levels at least five times greater than safe drinking water standards**, according to a study published in the journal Environmental Science & Technology in 2015. Four of her children died as toddlers. Three died in early adulthood. Their stomachs became bloated, and their eyes turned a cloudy gray. The three remaining children, now adults, have health problems. "It is worrisome and troublesome, and you hope that something will be done," Nez said. In a new poll by NPR, the Robert Wood Johnson Foundation and the Harvard T.H. Chan School of Public Health, more than 1 in 4 Native Americans say the quality of their drinking water is worse than in other places. From 1944 to 1986, mining companies blasted 30 million tons of uranium out of Navajo land. When the U.S. Energy Department had stockpiled enough for the Cold War, the companies left, abandoning 521 mines. Since then, many Navajo have died of conditions linked to contamination.

Other countries

Urwin - Uranium mines in Australia leads to spilled contaminated material

Jessica Urwin, Australian National University, 5-5-2019, "Uranium mines harm Indigenous people – so why have we approved a new one?", The Conversation
http://theconversation.com/uranium-mines-harm-indigenous-people-so-why-have-we-approved-a-new-one-116262

Last week the federal government approved the Yeelirrie uranium mine in Western Australia in the face of vigorous protest from traditional owners. This Canadian-owned uranium mine is the newest instalment in Australia's long tradition of ignoring the dignity and welfare of Aboriginal communities in the pursuit of nuclear fuel. For decades, Australia's desert regions have experienced uranium prospecting, mining, waste dumping and nuclear weapons testing. Settler-colonial perceptions that these lands were "uninhabited" led to widespread environmental degradation at the hands of the nuclear industry. As early as 1906, South Australia's Radium Hill was mined for radium. Amateur prospectors mined haphazardly, damaging Ngadjuri and Wilyakali lands. And **an estimated 100,000 tonnes of toxic mine residue (tailings) remain at Radium Hill with the potential to leach radioactive material into the environment.** Uranium mines across Australia have similar legacies, with decades of activism from the Mirarr people against the Ranger and Jabiluka mine sites in Kakadu National Park. In the 36 years since it began operating, **the Ranger mine has produced over 125,000 tonnes of uranium and experienced more than 200 accidents. In 2013, a reported one million litres of contaminated material leaked from a Ranger tank (the spill was contained to the site).**

https://www.eia.gov/energyexplained/nuclear/where-our-uranium-comes-from.php

https://www.liberationnews.org/resource-extraction-of-the-american-indigenous-population-uranium/
Indigenous peoples and the ethics of remediation: redressing the legacy of radioactive contamination for native peoples and native lands
Indigenous peoples of North America: environmental exposures and reproductive justice
The legacy of uranium development on or near Indian reservations and health implications rekindling public awareness
Environmental impact assessment of uranium exploration and development on indigenous land in Labrador (Canada): a community-driven initiative
Native America: The Economics of Radioactive Colonization
Uranium Mining Banned on Navajo Lands
https://time.com/5784266/trump-uranium-mining-stockpile/
https://navajotimes.com/news/2009/0709/072309uranium.php

Nuclear disaster

MIT- 50:50 chance that a major nuclear disaster will occur before 2050

Emerging Technology Correspondent. MIT Technology Review. 2015.
https://www.technologyreview.com/s/536886/the-chances-of-another-chernobyl-before-2050-50-say-safety-specialists/

Today, we get an answer thanks to the work of **Spencer Wheatley and Didier Sornette at ETH Zurich in Switzerland and Benjamin Sovacool at Aarhus University in Denmark**. These guys have compiled the most comprehensive list of nuclear accidents ever created and used it to calculate the likelihood of other accidents in future. Their worrying **conclusion is that the chances are 50:50 that a major nuclear disaster will occur somewhere in the world before 2050.** "**There is a 50 per cent chance that a Chernobyl event (or larger) occurs in the next 27 years**," they conclude. The nuclear industry has long been criticised for its over-confident attitude to risk.

Small nuclear reactors do not solve

WaPo -nuclear's tech and safety needs make it inherently expensive, new tech will never solve (history shows)

Gregory **Jaczko**, Chairman of the Nuclear Regulatory Commission, Washington Post, 5-17-2019, "I oversaw the U.S. nuclear power industry. Now I think it should be banned."
https://www.washingtonpost.com/outlook/i-oversaw-the-us-nuclear-power-industry-now-i-think-it-should-be-banned/2019/05/16/a3b8be52-71db-11e9-9eb4-0828f5389013_story.html

Within a year of the accident at Fukushima — and over my objections — the NRC implemented just a few of the modest safety reforms that the agency's employees had proposed, and then approved the first four new reactor licenses in decades, in Georgia and in South Carolina. But there was a problem. After Fukushima, people all over the world demanded a different approach to nuclear safety. Germany closed several older plants and required the rest to shut down by 2022. Japan closed most of its plants. Last year, even France, which gets about 80 percent of its electricity from nuclear power, proposed reducing that figure to 50 percent by 2035, because safety could not be guaranteed. Trying to make accidents unlikely wasn't enough. And here in the United States, those four new reactors — the vanguard of the "nuclear renaissance" — still haven't opened. The South Carolina companies building two of the reactors canceled the project in 2017, after spending $9 billion of their customers' money without producing a single electron of power. The construction company behind the utilities, Westinghouse, went bankrupt, almost destroying its parent company, the global conglomerate Toshiba. The other two reactors licensed while I chaired the NRC are still under construction in Georgia and years behind schedule. Their cost has ballooned from $14 billion to $28 billion and continues to grow. **History shows that the expense involved in nuclear power will never change.** Past construction in the United States exhibited similar cost increases throughout the design, engineering and construction process. **The technology and the safety needs are just too complex and demanding to translate into a facility that is simple to design and build. No matter your views on nuclear power in principle, no one can afford to pay this much for two electricity plants. New nuclear is simply off the table in the United States.**

Union of Concerned Scientists: Studies find that energy from small reactors will be more expensive and will have no buyers. Logic: producing more drives down costs

Union of Concerned Scientists, Small Modular Reactors: Safety, Security and Cost Concerns
Published Sep 23, 2013, https://www.ucsusa.org/resources/small-modular-reactors

SMR-based power plants can be built with a smaller capital investment than plants based on larger reactors. Proponents suggest that this will remove financial barriers that have slowed the growth of nuclear power in recent years. However, there's a catch: "affordable" doesn't necessarily mean "cost-effective." **Economies of scale dictate that, all other things being equal, larger reactors will generate cheaper power**. SMR proponents suggest that mass production of modular reactors could offset economies of scale, but **a 2011 study concluded that SMRs would still be more expensive than current reactors.** Even if SMRs could eventually be more cost-effective than larger reactors due to mass production, this advantage will only come into play when many SMRs are in operation. But **utilities are unlikely to invest in SMRs until they can produce competitively priced electric power.** This Catch-22 has led some observers to conclude that the technology will require significant government financial help to get off the ground.

Carnegie Mellon- industry would need several hundred billion dollars of subsidies over the next several decade to be viable

Noel Wauchope, 17 August 2019, Seven reasons why small modular nuclear reactors are a bad idea for Australia, Independent Australia, https://independentaustralia.net/environment/environment-display/seven-reasons-why-small-modular-nuclear-reactors-are-a-bad-idea-for-australia,13010

Researchers from Carnegie Mellon University's Department of Engineering and Public Policy concluded that the SMR industry would not be viable unless the industry received 'several hundred billion dollars of direct and indirect subsidies' over the next several decades. For a company to invest in a factory to manufacture reactors, they'd need to be sure of a real market for them — Australia would have to commit to a strong investment up front. To have any hope of being economically viable, SMRs would have to be mass-produced and deployed and here is a catch-22 problem — **the economics of mass production of SMRs cannot be proven until hundreds of units are in operation. But that can't happen unless there are hundreds of orders and there will be few takers unless the price can be brought down. Huge government subsidy is therefore required.**

Wauchope- Small reactors are more expensive, and will cost $140/MWh for energy (more than current reactors)

Noel Wauchope, 17 August 2019, Seven reasons why small modular nuclear reactors are a bad idea for Australia, Independent Australia, https://independentaustralia.net/environment/environment-display/seven-reasons-why-small-modular-nuclear-reactors-are-a-bad-idea-for-australia,13010

The diseconomics of scale make SMRs more expensive than large reactors. A 250 MW SMR will generate 25 per cent as much power as a 1,000 MW reactor, but it will require more than 25 per cent of the material inputs and staffing and a number of other costs including waste management and decommissioning will be proportionally higher.

A study by WSP/Parsons Brinckerhoff, commissioned by the 2015/16 South Australian Nuclear Fuel Cycle Royal Commission, estimated costs of A$180–184/MWh (US$127–130) for large pressurised water reactors and boiling water reactors, compared to A$198–225 (**US$140–159) [MWh] for SMRs.**

Union of Concerned Scientists: larger risks than traditional: they do not have backup systems in place, increase risk of hydrogen explosions

Union of Concerned Scientists, Small Modular Reactors: Safety, Security and Cost Concerns

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Published Sep 23, 2013, https://www.ucsusa.org/resources/small-modular-reactors
One of the chief selling points for SMRs is that they are supposed to be safer than current reactor designs. However, their safety advantages are not as straightforward as some proponents suggest.

- SMRs use passive cooling systems that do not depend on the availability of electric power. This would be a genuine advantage under many accident scenarios, but not all. Passive systems are not infallible, and **credible designs should include reliable active backup cooling systems.** But this would add to cost.
- **SMRs feature smaller, less robust containment systems than current reactors. This can have negative safety consequences, including a greater probability of damage from hydrogen explosions**. SMR designs include measures to prevent hydrogen from reaching explosive concentrations, but they are not as reliable as a more robust containment—which, again, would add to cost.

Union of Concerned Scientists: putting reactors underground increase risk of flood damage and decrease chances of emergency intervention

Union of Concerned Scientists, Small Modular Reactors: Safety, Security and Cost Concerns
Published Sep 23, 2013, https://www.ucsusa.org/resources/small-modular-reactors

- Some proponents have suggested siting SMRs underground as a safety measure. However, underground siting is a double-edged sword—it reduces risk in some situations (such as earthquake) and **increases it in others (such as flooding). It can also make emergency intervention more difficult.** And it too increases cost.
- Proponents also point out that smaller reactors are inherently less dangerous than larger ones. While this is true, it is misleading, because small reactors generate less power than large ones, and therefore more of them are required to meet the same energy needs. **Multiple SMRs may actually present a higher risk than a single large reactor**, especially if plant owners try to cut costs by reducing support staff or safety equipment per reactor.

Independent Australia- Russia, South Korea, and China have all given up on the program, no customers to buy or company to assemble reactors

Noel Wauchope, 17 August 2019, Seven reasons why small modular nuclear reactors are a bad idea for Australia, Independent Australia,
https://independentaustralia.net/environment/environment-display/seven-reasons-why-small-modular-nuclear-reactors-are-a-bad-idea-for-australia,13010
For Australia, this has to be the most salient point of all. Economist John Quiggin has pointed out that Australia's nuclear fans are enthusing about small modular nuclear reactors, but with no clarity on which, of the many types now designed, would be right for Australia. NuScale's model, funded by the U.S. Government, is the only one at present with commercial prospects, so Quiggin has examined its history of delays. But Quiggin found that **NuScale is not actually going to build the factory, it is going to assemble the reactor parts which have been made by another firm — which firm is not clear.** Quiggin concludes: 'Australia's proposed nuclear strategy rests on a non-existent plant to be manufactured by a company that apparently knows nothing about it.'

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

As there's no market for small nuclear reactors, companies have not invested much money to commercialise them. Westinghouse Electric Company tried for years to get government funding for its SMR plan, then gave up and switched to other projects. Danny Roderick, then president and CEO of Westinghouse, announced: "The problem I have with SMRs is not the technology, it's not the deployment — it's that there's no customers. The worst thing to do is get ahead of the market." **Russia's programme has been delayed by more than a decade and the estimated costs have ballooned. South Korea decided on SMRs, but then pulled out, presumably for economic reasons. China is building one demonstration SMR, but has dropped plans to build 18 more due to diseconomics of the scheme.** There's a lot of chatter in the international media about all the countries that are interested, or even have signed memoranda of understanding about buying SMRs, but still with no plans for actual purchase or construction. Is Australia going to be the guinea pig for NuScale's small and medium reactor scheme? If so, when? The hurdles to overcome would be mind-boggling. The start would have to be the repeal of Australia's laws: the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Section 140A and the Australian Radiation Protection and Nuclear Safety Act 1998. Then comes the overcoming of State laws, much political argy-bargy, working out regulatory frameworks, import and transport of nuclear materials, finding locations for siting reactors, Aboriginal issues, community consent and waste locations. And what would it all cost? In the meantime, energy efficiency developments, renewable energy progress and storage systems will keep happening, getting cheaper and making nuclear power obsolete.

Deign- small nuke cost target is $65/MWh, but onshore is at $50/MWh, and storage is plummeting in costs so intermittency doesn't matter

JASON DEIGN, MAY 14, 2018, Small Modular Nuclear Reactors Will Soon Face a Moment of Reckoning, https://www.greentechmedia.com/articles/read/small-modular-nuclear-reactors-moment-of-reckoning

And, critically, it will have to be competitive with other generation sources being built eight years from now. Nabizad said that t**he estimated overnight cost for the UAMPS project was $2.9 billion, and its target levelized cost of energy was $65 per megawatt-hour.** For comparison, the International Renewable Energy Agency predicts that by 2020, more than half a decade ahead of the UAMPS project going live, **onshore wind will be hitting an LCOE of $50 per megawatt-hour and solar will be at $60 per megawatt-hour.** Naturally, NuScale should be able to point to the fact that SMRs do not suffer from intermittency as a reason for paying a premium for nuclear energy. The NuScale design, unlike traditional reactors, is also supposed to be capable of a certain amount of load-following, which could help it compete with gas plants. The problem is that neither of these arguments is much of a deal-clincher at the moment, and it is unclear if they will be in eight years' time. Gas is beating nuclear not because of its load-following abilities, but because markets, particularly in the U.S., are not set up to fully reward the high-volume carbon emission reductions that reactors can deliver. **And with wind- or solar-tied storage plummeting in cost, it is unclear to what extent intermittency will be an issue for intermittent renewables eight years from now.** All these factors could fuel concerns that SMRs may never be a viable technology.

Global News- will take up to 15 years to become viable economically

Emerald Bensadoun, Jan 27, 2020, Are small nuclear reactors really better? Here are the pros and cons, Global News CA, https://globalnews.ca/news/6243567/small-nuclear-reactors-environment/

Con: They won't be commercially viable for years

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

The provincial leaders said it could be an opportunity for economic growth, estimating the Canadian market for this energy at $10 billion and the global market at $150 billion — **but it currently isn't viable.** Donev said it could **take anywhere between five and 15 years to become a commercially viable product.**

With climate change moving rapidly towards the point of no return, time is of the essence. And while developing SMR technology would take time, Donev argued: "we don't have time not to."

"There is not the ability to deploy that much wind and that much solar and not much hydro," said Donev. "We need to bring all of the solutions to the table."

Dept of Energy- will take 10-15 years

"Advanced Small Modular Reactors (SMRs)," Energy.gov, https://www.energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors

Advanced Small Modular Reactors (SMRs) are a key part of the Department's goal to develop safe, clean, and affordable nuclear power options. The advanced SMRs currently under development in the U.S. represent a variety of sizes, technology options, and deployment scenarios. These advanced reactors, envisioned to vary in size from a couple megawatts up to hundreds of megawatts, can be used for power generation, process heat, desalination, or other industrial uses. SMRs can employ light water as a coolant or other non-light water coolants such as a gas, liquid metal, or molten salt. Advanced SMRs offer many advantages, such as relatively small size, reduced capital investment, ability to be sited in locations not possible for larger nuclear plants, and provisions for incremental power additions. SMRs also offer distinct safeguards, security and nonproliferation advantages. The Department has long recognized the transformational value that advanced SMRs can provide to the Nation's economic, energy security, and environmental outlook. Accordingly, the Department has provided substantial support to the development of light water-cooled SMRs, which **are under licensing review by the Nuclear Regulatory Commission (NRC) and will likely be deployed in the next 10-15 years.** The Department is also interested in the development of SMRs that use non-traditional coolants such as liquid metals, salts, and helium because of the safety, operational, and economic benefits they offer.

Intermittency not a problem

Output will not fluctuate when the renewable plants are geographically distributed

Real-World Experience, xx-xx-xxxx, "Can renewables provide baseload power?," No Publication, https://skepticalscience.com/print.php?r=374

Wind power is currently the cheapest source of renewable energy, but presents the challenge of dealing with the intermittency of windspeed. Nevertheless, as of 2011, wind already supplies 24% of Denmark's electricity generation, and over 14% of Spain and Portugal's. **Although the output of a single wind farm will fluctuate greatly, the fluctuations in the total output from a number of wind farms geographically distributed in different wind regimes will be much smaller and partially predictable.** Modeling has also shown that it's relatively inexpensive to increase the reliability of the total wind output to a level equivalent to a coal-fired power station by adding a few low-cost peak-load gas turbines that are opearated infrequently, to fill in the gaps when the wind farm production is low (Diesendorf 2010). Additionally, in many regions, peak wind (see Figure 4 below) and solar production match up well with peak electricity demand.

Solar storage

Schroeder- cost of lithium-ion batteries dropped 80% past five years, making a completely renewable future possible

Dennis Schroeder,, 1-2-2020, "Declining Renewable Costs Drive Focus on Energy Storage," No Publication, https://www.nrel.gov/news/features/2020/declining-renewable-costs-drive-focus-on-energy-storage.html

An oft-repeated refrain—the sun doesn't always shine, and the wind doesn't always blow—is sometimes seen as an impediment to renewable energy. But it's also an impetus toward discovering the best ways to store that energy until it's needed.

Declining costs in available technologies have propelled interest in energy storage forward like never **before. The price of lithium-ion batteries has fallen by about 80% over the past five years, enabling the integration of storage into solar power systems**. Today, nearly 18% of all electricity produced in the United States comes from renewable energy sources, such as hydropower and wind—a figure that is forecast to climb. And as communities and entire states push toward higher percentages of power from renewables, there's no doubt storage will play an important role.

Compared with the same period a year earlier, the United States saw a 93% increase in the amount of storage deployed in the third quarter of 2019. By 2024, that number is expected to top 5.4 gigawatts, according to a forecast by market research firm Wood Mackenzie Power & Renewables. The market value is **forecast to** increase from $720 million today to $5.1 billion in 2024. Driving such growth is an increased focus on adding renewable energy sources to the nation's grid.

Only in the past decade has th**e widespread adoption of renewable energy sources become an economic possibility,** said Paul Denholm, a principal energy analyst at the National Renewable Energy Laboratory (NREL). He joined NREL 15 years ago and, at the time, he and other analysts were busy plotting a path to 20% of the nation's energy supply coming from renewable sources. Now, they're aiming much higher.

"The declining cost of wind and solar and now batteries makes it conceivable to consider 100% renewables," he said. NREL's Renewable Electricity Futures Study estimated that 120 gigawatts of storage would be needed across the continental United States by 2050, when the scenario imagined a future where 80% of electricity will come from renewable resources. The country currently has 22 gigawatts of storage from pumped hydropower, and another gigawatt in batteries.

Deign- intermittency will not be an issue in 8 years because of solar storage

JASON DEIGN, MAY 14, 2018, Small Modular Nuclear Reactors Will Soon Face a Moment of Reckoning, https://www.greentechmedia.com/articles/read/small-modular-nuclear-reactors-moment-of-reckoning

And, critically, it will have to be competitive with other generation sources being built eight years from now. Nabizad said that t**he estimated overnight cost for the UAMPS project was $2.9 billion, and its target levelized cost of energy was $65 per megawatt-hour.** For comparison, the International Renewable Energy Agency predicts that by 2020, more than half a decade ahead of the UAMPS project going live, **onshore wind will be hitting an LCOE of $50 per megawatt-hour and solar will be at $60 per megawatt-hour.** Naturally, NuScale should be able to point to the fact that SMRs do not suffer from intermittency as a reason for paying a premium for nuclear energy. The NuScale design, unlike traditional

reactors, is also supposed to be capable of a certain amount of load-following, which could help it compete with gas plants. The problem is that neither of these arguments is much of a deal-clincher at the moment, and it is unclear if they will be in eight years' time. Gas is beating nuclear not because of its load-following abilities, but because markets, particularly in the U.S., are not set up to fully reward the high-volume carbon emission reductions that reactors can deliver. **And with wind- or solar-tied storage plummeting in cost, it is unclear to what extent intermittency will be an issue for intermittent renewables eight years from now.** All these factors could fuel concerns that SMRs may never be a viable technology.

Bloomberg- most houses are connected to the grid

2023, Becoming, 5-10-2019, "How is Solar Energy Stored in 2019?,"Solar Sage, https://www.energysage.com/solar/solar-energy-storage/how-do-solar-batteries-work/
To appreciate why you might choose to install a solar-plus-storage system for your home, you first need to understand how a standard home solar PV system functions. The typical solar energy system includes solar panels, an inverter, equipment to mount the panels on your roof, and a performance monitoring system that tracks electricity production. The solar panels collect energy from the sun and turn it into electricity, which is passed through the inverter and converted into a form that you can use to power your home. **The vast majority of residential solar energy systems are connected to the electricity grid (or "grid-tied")**. When your panels are producing more electricity than your home needs, the excess is fed back into the power grid. Conversely, when your home needs more electricity than your solar panels are producing, you can draw power from the electric grid. In most cases, you receive a credit on your utility bill for the electricity you send back to the grid. Later, when you are using more electricity than your solar panels have generated, you can use those credits instead of having to pay more to your utility. This process is known as net metering.

Nuke cannot solve CC

French Climate Forum- Even if we could build one reactor a week, would only achieve 10% of what is needed to avert climate change

Source : "Nuclear power : a false solution to climate change". August 2015. Réseau Action Climat - France (RAC-F), Amis de la Terre, France Nature Environnement, Greenpeace, Fondation Heinrich Böll Bureau UE, Réseau "Sortir du nucléaire"
The fight against climate change is a race against time. Emissions worldwide should reach their peak within the next 5 years before declining drastically. According to an International Energy Agency (IEA) study from 2010, even if one nuclear reactor per week got online over the next 15 years, this could only contribute to 9% of the global effort to stabilise CO_2 concentration to 450 ppm (and since 1,5°C scenarios require an higher effort, the effective contribution would be even smaller) ! The industrial and financial capacities necessary for such nuclear growth are plainly lacking, rendering it impossible.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Zyga - need 15,000 nuclear reactors to supply energy

Lisa Zyga, 5-11-2011, "Why nuclear power will never supply the world's energy needs," No Publication, https://phys.org/news/2011-05-nuclear-power-world-energy.html

As Abbott notes in his study, global power consumption today is about 15 terawatts (TW). Currently, the global nuclear power supply capacity is only 375 gigawatts (GW). In order to examine the large-scale limits of nuclear power, **Abbott estimates that to supply 15 TW with nuclear only, we would need about 15,000 nuclear reactors.** In his analysis, Abbott explores the consequences of building, operating, and decommissioning 15,000 reactors on the Earth, looking at factors such as the amount of land required, radioactive waste, accident rate, risk of proliferation into weapons, uranium abundance and extraction, and the exotic metals used to build the reactors themselves.

US Subsidies keep renewable energy prices low - no price spikes

https://cleantechnica.com/2019/07/22/nextera-energy-predicts-50-renewable-energy-in-us-by-2030/
https://www.forbes.com/sites/brianmurray1/2019/06/17/the-paradox-of-declining-renewable-costs-and-rising-electricity-prices/#4b2b365261d5

These dramatic renewable generation cost declines have been attributed to policies such as tax credits, preferential feed-in tariffs, and renewable portfolio standards (RPS), which directly target the use of renewables, expand demand and create cost-reducing economies of scale to meet that demand. Renewables that were once inarguably much more expensive and required large subsidies and mandates to incentivize adoption have slid into grid parity territory, now able to compete directly with conventional sources in many places.

US can transition to renewable energy

Hanley- US can hit 50% renewable energy by 2030

https://cleantechnica.com/2019/07/22/nextera-energy-predicts-50-renewable-energy-in-us-by-2030/

In May, the company presented a slide based on data supplied by IHS Markit for calendar year 2017. It showed the United States would get 25% of its electricity from renewable energy resources by 2030. That slide was deleted from the June presentation and replaced with one based on data supplied by the National Renewable Energy Laboratory for calendar year 2018. The new slide projects t**he country will reach 50% renewables by 2030.** The difference is startling and proof of how quickly things are changing in the utility industry. NextEra Energy is no featherweight. It has the largest market capitalization of any utility holding company. It is the parent company of Florida Power & Light, Gulf Power, and NextEra Energy Resources, among other entities. It employs 14,000 people, generates 45,900 megawatts of electricity annually, and has yearly revenue of $17 billion. Not too shabby. If it says renewables will account for half of all electricity a decade from now, other companies should sit up and take notice. Government leaders, too.

Land requirements

Zyga- nuke takes up 20 square kilometers. Even if solar takes up more, it can be located in unused desert areas

Lisa Zyga, 5-11-2011, "Why nuclear power will never supply the world's energy needs," No Publication, https://phys.org/news/2011-05-nuclear-power-world-energy.html

Land and location: One nuclear reactor plant requires about 20.5 km2 (7.9 mi2) of land to accommodate the nuclear power station itself, its exclusion zone, its enrichment plant, ore processing, and supporting infrastructure. **Secondly, nuclear reactors need to be located near a massive body of coolant water, but away from dense population zones and natural disaster zones.** Simply **finding 15,000 locations on Earth that fulfill these requirements is extremely challenging.**

Solar thermal devices harness the Sun's energy to produce heat that creates steam that turns a turbine to generate electricity. **Solar thermal technology avoids many of the scalability problems facing nuclear technology. For instance, although a solar thermal farm requires a little more land area than the equivalent nuclear power infrastructure, it can be located in unused desert areas. I**t also uses safer, more abundant materials. Most importantly, solar thermal can be scaled to produce not just 15 TW, but hundreds of TW if it would ever be required.

AT: Climate Change

1. Expensive and too long term to fix

General

https://www.energy.gov/sites/prod/files/2019/01/f58/Ultimate%20Fast%20Facts%20Guide-ebook_1.pdf

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Definitions

Increase- must be a net increase

- Increase is not relative to 5 or 10 years in the future
- Increase is relative to the very moment preceding implementation
- Must be a net increase from where nuclear is today

Uranium

How nuclear reactors work

Martin Klaproth, 2-2020, "What is Uranium? How Does it Work," World Nuclear
https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/what-is-uranium-how-does-it-work.aspx

Nuclear power stations and fossil-fuelled power stations of similar capacity have many features in common. Both require heat to produce steam to drive turbines and generators. In a nuclear power station, however, the fissioning of uranium atoms replaces the burning of coal or gas. In a nuclear reactor the uranium fuel is assembled in such a way that a controlled fission chain reaction can be achieved**. The heat created by splitting the U-235 atoms is then used to make steam which spins a turbine to drive a generator, producing electricity.** The chain reaction that takes place in the core of a nuclear reactor is controlled by rods which absorb neutrons and which can be inserted or withdrawn to set the reactor at the required power level. The fuel elements are surrounded by a substance called a moderator to slow the speed of the emitted neutrons and thus enable the chain reaction to continue. Water, graphite and heavy water are used as moderators in different types of reactor. **Because of the kind of fuel used** (i.e. the concentration of U-235, see below), **if there is a major uncorrected malfunction in a reactor the fuel may overheat and melt, but it cannot explode like a bomb. A typical 1000 megawatt (MWe) reactor can provide enough electricity for a modern city of up to one million people.**

On a scale arranged according to the increasing mass of their nuclei, uranium is one of the heaviest of all the naturally-occurring elements (hydrogen is the lightest). Uranium is 18.7 times as dense as water. Like other elements, uranium occurs in several slightly differing forms known as 'isotopes'. These isotopes differ from each other in the number of uncharged particles (neutrons) in the nucleus. Natural uranium as found in the Earth's crust is a mixture largely of two isotopes: uranium-238 (U-238), accounting for 99.3% and uranium-235 (U-235) about 0.7%. The isotope U-235 is important because under certain conditions it can readily be split, yielding a lot of energy. It is therefore said to be 'fissile' and we use the expression 'nuclear fission'. Meanwhile, like all radioactive isotopes, they decay. **U-238 decays very slowly, its half-life being about the same as the age of the Earth** (4500 million years). **This means that it is barely radioactive, less so than many other isotopes in rocks and sand.** Nevertheless it generates 0.1 watts/tonne as decay heat and this is enough to warm the Earth's core. U-235 decays slightly faster.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Uranium Fuel Cycle

Hugh Hewitt, Washington Post, 9-2-2019, "Trump's crucial decision on nuclear power"
https://www.washingtonpost.com/opinions/2019/09/02/trumps-crucial-decision-nuclear-power/

The uranium cycle is, basically, (1) uranium mining and milling, (2) conversion into uranium hexafluoride gas and (3) enrichment. Natural uranium has about a 0.7 percent concentration of the fissile uranium-235 isotope. Enrichment increases that share; just under 4 percent gets you nuclear fuel for electricity while 90 percent can get you a bomb (or fuel for a naval reactor).

Source of Uranium

Hugh Hewitt, Washington Post, 9-2-2019, "Trump's crucial decision on nuclear power"
https://www.washingtonpost.com/opinions/2019/09/02/trumps-crucial-decision-nuclear-power/

About 90 percent of the uranium used by U.S. utilities is imported, **thus the first step in the "uranium cycle" is dangerously dependent on foreign sources.** Not only do you need domestic production of uranium, you need domestic enrichment. The United States, however, saw its last plant for highly enriched uranium in Paducah, Ky., shuttered earlier this decade after the 2011 Fukushima disaster sent shudders through the nuclear power industry. **The United States must now dilute its pre existing stockpiles of highly enriched uranium — the end product of an expensive and difficult process — into lower-state products.** Like pulling up your floorboards to burn in the furnace, this solution is neither efficient nor sustainable in the long term. Though our current stockpiles could in theory be made to last until around 2040, facing increasing threats from Russia and China, we can't predict what new demands will be placed on this finite stockpile in the next few years. Thirteen countries (including North Korea and Iran) are now ahead of the United States in terms of indigenous enrichment capacity — and all of those countries' foreign enrichment plants are state-owned. It would be foolish to count on foreign governments to allow us to use their enrichment plants to fuel our warships or maintain our nuclear weapons. Outsourcing one of our core national security requirements is never a good idea.

Status Quo

Electricity generation from commercial nuclear power plants in the United States began in 1958. **As of the end of December 2018, the United States had 98 operating commercial nuclear reactors at 60 nuclear power plants** in 30 states. The average age of these nuclear reactors is about 38 years old. The oldest operating reactor, Nine Mile Point Unit 1 in New York, began commercial operation in December 1969. The newest reactor to enter service, Watts Bar Unit 2, came online in 2016—the first reactor to come online since 1996 when the Watts Bar Unit 1 came online. Nineteen shut down commercial power reactors at 17 sites are in various stages of decommissioning. **Although seven nuclear reactors have been shut down since 2013, total nuclear electricity generation capacity at the end of 2018 was about the same as total capacity in 2003**, when the United States had 104 operating reactors. Power plant uprates—modifications to increase

capacity—at nuclear power plants have made it possible for the entire operating nuclear reactor fleet to maintain a relatively consistent total electricity generation capacity. These uprates, combined with high capacity utilization rates (or capacity factors), have helped nuclear power plants maintain a consistent share of about 20% of total annual U.S. electricity generation since 1990. Some reactors have also increased annual electricity generation by shortening the length of time reactors are offline for refueling.

https://www.sciencedirect.com/science/article/abs/pii/S0301421512003527

Climate Change

EU - CO2 responsible for 64% of global warming

EU, "Causes of Climate Change"
https://ec.europa.eu/clima/change/causes_en
CO2 is the greenhouse gas most commonly produced by human activities and it **is responsible for 64% of man-made global warming.** Its concentration in the atmosphere is currently 40% higher than it was when industrialisation began. Other greenhouse gases are emitted in smaller quantities, but they trap heat far more effectively than CO2, and in some cases are thousands of times stronger. Methane is responsible for 17% of man-made global warming, nitrous oxide for 6%.

Nuclear Waste Disposal

Cards:

Nuclear energy does not constitute renewable energy

National Geographic
https://www.nationalgeographic.org/encyclopedia/non-renewable-energy/
Nuclear energy is usually considered another non-renewable energy source. Although nuclear energy itself is a renewable energy source, the material used in nuclear power plants is not.

Resolved: The United States should increase its use of nuclear energy for commercial energy production.

Nuclear energy harvests the powerful energy in the nucleus, or core, of an atom. Nuclear energy is released through nuclear fission, the process where the nucleus of an atom splits. Nuclear power plants are complex machines that can control nuclear fission to produce electricity. The material most often used in nuclear power plants is the element uranium. Although uranium is found in rocks all over the world, nuclear power plants usually use a very rare type of uranium, U-235. **Uranium is a non-renewable resource.** Nuclear energy is a popular way of generating electricity around the world. **Nuclear power plants do not pollute the air or emit greenhouse gases.** They can be built in rural or urban areas, and do not destroy the environment around them. However, nuclear energy is difficult to harvest. Nuclear power plants are very complicated to build and run. **Many communities do not have the scientists and engineers to develop a safe and reliable nuclear energy program.**

Studies (didn't read full yet)

Renewable energy consumption in squo not enough to reduce emissions

K Menyah, Y Wolde-Rufael - Energy Policy, 6-2010, "CO2 emissions, nuclear energy, renewable energy and economic growth in the US"
https://www.sciencedirect.com/science/article/abs/pii/S0301421510000303
This study explores the causal relationship between carbon dioxide (CO2) emissions, renewable and nuclear energy consumption and real GDP for the US for the period 1960–2007. Using a modified version of the Granger causality test, we found **a unidirectional causality running from nuclear energy consumption to CO2 emissions** without feedback but **no causality running from renewable energy to CO2 emissions**. The econometric evidence seems to suggest that **nuclear energy consumption can help to mitigate CO2 emissions**, **but so far, renewable energy consumption has not reached a level where it can make a significant contribution to emissions reduction.**

Nuclear energy do not directly cause emissions, but construction of power plants do

BK Sovacool - Energy Policy, 4-2008, "Valuing the greenhouse gas emissions from nuclear power: A critical survey"
https://www.sciencedirect.com/science/article/abs/pii/S0301421508001997
This article screens 103 lifecycle studies of greenhouse gas-equivalent emissions for nuclear power plants to identify a subset of the most current, original, and transparent studies. It begins by briefly detailing the separate components of the nuclear fuel cycle before explaining the methodology of the survey and exploring the variance of lifecycle estimates. It calculates that while the range of emissions for nuclear energy over the lifetime of a plant, reported from qualified studies examined, is from 1.4 g of carbon dioxide equivalent per kWh (g CO2e/kWh) to 288 g CO2e/kWh, the mean value is 66 g CO2e/kWh. The article then explains some of the factors responsible for the disparity in lifecycle estimates,

in particular identifying errors in both the lowest estimates (not comprehensive) and the highest estimates (failure to consider co-products). It should be noted that **nuclear power is not directly emitting greenhouse gas emissions, but rather that lifecycle emissions occur through plant construction, operation, uranium mining and milling, and plant decommissioning.**

While nuclear technologies did not fulfill these dreams, nuclear power has still emerged to become a significant source of electricity. In 2005, **435 nuclear plants supplied 16% of the world's power**, constituting 368 GW of installed capacity generating 2768 TWh of electricity (International Energy Agency, 2007). **In the US alone**, which has 29.2% of the world's r**eactors, nuclear facilities accounted for 19% of national electricity generation**. In France, 79% of electricity comes from nuclear sources, and nuclear energy contributes to more than 20% of national power production in Germany, Japan, South Korea, Sweden, Ukraine, and the United Kingdom. Advocates of nuclear power have recently framed it as an important part of any solution aimed at fighting climate change and reducing greenhouse gas emissions. The Nuclear Energy Institute (2007) tells us, ''it is important to build emission-free sources of energy like nuclear'' and that nuclear power is a ''carbon-free electricity source'' (1998). Patrick Moore, co-founder of Greenpeace, has publicly stated that ''nuclear energy is the only non-greenhouse gas emitting energy source that can effectively replace fossil fuels and satisfy global demand'' (Environmental News Service, 2005). The nuclear power company Areva (2007) claims that ''one coal power station of 1 GWe emits about 6 million tons of CO2 per year while nuclear is quite CO2 free''

Nuclear energy decreases emissions

J Baek, D Pride - Energy Economics, 1-2014, "On the income–nuclear energy–CO2 emissions nexus revisited"
https://www.sciencedirect.com/science/article/pii/S014098831400019X
This paper seeks to contribute to the debate over the income–nuclear energy–CO2 emissions nexus by taking specific account of the possible endogeneity of income, which has been largely ignored by early studies. A multivariate cointegrated vector autoregression (CVAR) is applied to the top six nuclear generating countries. We find that nuclear energy tends to reduce CO2 emission for all countries. It is also found that income has a beneficial effect on the environment only in some countries. Finally, we find that CO2 emissions and income are indeed determined simultaneously, while nuclear energy acts exogenously, indicating that nuclear energy is the driving variable, which significantly influences the long-run movements of CO2 emissions and income, but is not affected by CO2 emissions and income in the model

R York - Society and Natural Resources, 10-9-2010, "Three Lessons From Trends in CO2 Emissions and Energy Use in the United States"
https://www.tandfonline.com/doi/abs/10.1080/08941920903421133
I derive three lessons about the potential to reduce CO2 emissions in the United States by analyzing data on CO2 emissions and energy use from 1960 to 2003. First, improvements in the energy efficiency of the economy and reductions in the CO2 intensity of the energy supply did not lead to a decline in CO2 emissions but rather were

associated with rising CO2 emissions. Second, the decline in the CO2 intensity of the energy supply was primarily due to the expansion of nuclear power, which is not environmentally benign. There is no free lunch with regard to non- and low-carbon energy sources, since all energy sources generate some environmental impacts. Furthermore, expanding the use of non-fossil-fuel energy sources does not necessarily suppress the use of fossil-fuel energy sources. Third, population growth has been a key factor driving the expansion of national CO2 emissions and energy use, particularly since per capita levels stabilized after the 1970s.

JE Payne, JP Taylor - Energy Sources, Part B: Economics, Planning, and Policy, 7-2010, "Nuclear Energy Consumption and Economic Growth in the U.S.: An Empirical Note"
https://www.tandfonline.com/doi/abs/10.1080/15567240802533955
This empirical note examines the relationship between nuclear energy consumption growth and real gross domestic product (GDP) growth within a neoclassical production function framework for the US using annual data from 1957 to 2006. The Toda-Yamamoto (1995) test for long-run Granger-causality reveals the absence of Granger-causality between nuclear energy consumption growth and real GDP growth which supports the neutrality hypothesis within the energy consumption-economic growth literature.

K Vaillancourt, M Labriet, R Loulou, JP Waaub - Energy Policy, 2008, "The role of nuclear energy in long-term climate scenarios: An analysis with the World-TIMES model"
https://www.sciencedirect.com/science/article/abs/pii/S0301421508000153
There is a revival in the nuclear debate observed in the literature. Several analyses have shown that nuclear technologies may represent very attractive options for greenhouse gas (GHG) emission reductions, especially in countries with high growth projections for energy demand. Our objective is to analyze the role of nuclear energy in long-term climate scenarios using the World-TIMES (The Integrated MARKAL-EFOM System) bottom-up model. World-TIMES is a global model that optimizes the energy system of 15 regions over a 100-year horizon (2000–2100).
We present energy and emission results for climate scenarios for two levels of CO2 concentration (450 and 550 ppmv by 2100). We analyze the penetration level of nuclear energy under various sets of assumptions on technology parameters and exogenous constraints on nuclear development to reflect social perceptions. Nuclear energy technologies satisfy a large portion of electricity production in many regions. Most regions experience an energy transition based on advanced oil and gas technologies and hydropower. Other renewable technologies might play a more important role but need further cost reductions or new regulations to penetrate the market in substantial proportions. Carbon sequestration and endogenous demand reductions for energy services are also significantly contributing to reach environmental target.

Idk what tf this is tryna say

24K Saidi, MB Mbarek - Progress in Nuclear Energy, 1-2016, "Nuclear energy, renewable energy, CO2 emissions, and economic growth for nine developed countries: Evidence from panel Granger causality tests"
https://www.sciencedirect.com/science/article/pii/S014919701630018X
The aim of this paper is to investigate the causal relationship between nuclear energy consumption, CO2 emissions, renewable energy and real GDP per capita using dynamic panel for nine developed countries over the period 1990–2013. Capital and labor are included as additional variables. Results shown that there is a

unidirectional causality running from renewable energy consumption to real GDP per capita for the whole panel at short run; this implies that policies for reducing energy consumption may not retard economic growth and income. However, there is no links between nuclear energy consumption and real GDP per capita, but a unidirectional causality from nuclear energy consumption to labor. Moreover, a bidirectional causality between labor and capital, and between CO2 emissions and capital are found. In addition, there is a unidirectional causal relationship from labor to CO2 emissions, while among other variables no causal relationship is found. In the long run, there exists also a bidirectional causality between renewable energy consumption and real GDP per capita, which complain that renewable energy is a crucial component for economic growth. In addition, results revealed a unidirectional causality from GDP to CO2 emissions.