#### We affirm Resolved: the US should substantially increase investment in domestic nuclear energy.

#### Energy demand is growing but fossil fuels are filling the gap, Renews 24 finds that recently

**Renews 24** [Renews, "‘Renewables failing to keep pace with energy demand’", 04/01/2024, reNEWS - Renewable Energy News, https://renews.biz/92255/renewables-failing-to-keep-pace-with-energy-demand/, Accessed 04/04/2025] //IA

Growing leadership and appetite for renewables in developing countries is clear, but finance remains a major obstacle, it found. Renewables are increasing in the overall energy mix, but they are not replacing coal, oil and gas at the required pace for various reasons: the overall demand for energy is rising fast, renewable energy projects are significantly more expensive in developing countries and[facing issues with] large bottlenecks persist in permitting, infrastructure and connecting renewables to grids. This is the main message of the GSR 2024 report released today. As the first module in a series to be unveiled during the year, the Global Overview provides the big picture status of renewables in the wider energy system and in the context of global challenges such as climate change, economic development and the geopolitical landscape. “The world is burning more fossil fuels than ever before, global energy-related emissions are increasing, and ever-growing energy demand is not being fully met by renewables,” said REN21 executive director Rana Adib (pictured). “This is aggravating the climate crisis and derailing the energy transition. We are missing the opportunity to build resilient and inclusive societies by fully deploying the economic opportunities that renewables provide. “We must also make rapid gains in energy efficiency to make best use of the energy we consume.” Renewable energy use surged 58% between 2012 and 2022, but overall energy demand also grew 16% during this period, said the report. The increase in demand has been met mostly by coal, oil, and fossil gas, which together accounted for around 65% of energy consumption growth between 2012 and 2022.

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#### And renewables are failing to meet promises, Renews continues

Renews 24 [Renews, "‘Renewables failing to keep pace with energy demand’", 04/01/2024, reNEWS - Renewable Energy News, https://renews.biz/92255/renewables-failing-to-keep-pace-with-energy-demand/, Accessed 04/04/2025] //IA

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#### All the while, nuclear energy is struggling to compete with fossil fuels

**WNA 24** (WNA, 8-27-2024, Nuclear Power in the USA, No Publication, https://world-nuclear.org/information-library/country-profiles/countries-t-z/usa-nuclear-power, Accessed 4-1-2025, wayway)

**The USA is the world's largest producer of nuclear power, accounting for about 30% of worldwide generation of nuclear electricity.** The country's nuclear reactors produced 772 TWh in 2022, 18% of total electrical output. Vogtle 3 was connected to the grid in April 2023, followed by unit 4 in March 2024. The Inflation Reduction Act was signed into law in August 2022. The Act provides support for existing and new nuclear development through investment and tax incentives for both large existing nuclear plants and newer advanced reactors, as well as high-assay low enriched uranium (HALEU) and hydrogen production. **Some states have liberalized wholesale electricity markets, which makes the financing of capital-intensive power projects difficult, and coupled with lower gas prices since 2009, have put the economic viability of some existing reactors and proposed projects in doubt.** 94 Operable Reactors 96,952 MWe 0 Reactors Under Construction 0 MWe 41 Reactors Shutdown 20,017 MWe Operable nuclear power capacity Electricity sector Total generation (in 2022): 4502 TWh Generation mix: natural gas 1742 TWh (39%); coal 909 TWh (20%); nuclear 804 TWh (18%); wind 440 TWh (10%); hydro 286 TWh (6%); solar 189 TWh (4%); biofuels & waste 66.8 TWh; oil 41.5 TWh; geothermal 19.6 TWh. Import/export balance: 41.2 TWh net import (56.9 TWh imports; 15.7 TWh exports) Total consumption: 4071 TWh Per capita consumption: c. 12,000 kWh in 2022 Source: International Energy Agency and The World Bank. Data for year 2022. In its Annual Energy Outlook 2022, the US Energy Information Administration's (EIA's) reference case shows electricity demand growth averaging 1% per year through to 2050. Nuclear power plays a major role in electricity provision across the country. The US fleet is operated by 30 different power companies across 30 different states. Since 2001 these plants have achieved an average capacity factor of over 90%. The average capacity factor has risen from 50% in the early 1970s, to 70% in 1991, and it passed 90% in 2002, remaining at around this level since. In 2019 it was a record 94%, compared with wind (32%) and solar PV (22%) (EIA data). The industry invests about $7.5 billion per year in maintenance and upgrades of the plants. Given that nuclear plants generate nearly 20% of the nation’s electricity overall and about 55% of its carbon‐free electricity, even a modest increase in electricity demand would require significant new nuclear capacity in order to maintain this share. If today’s nuclear plants retire after 60 years of operation, 22 GWe of new nuclear capacity would be needed by 2030, and 55 GWe by 2035 to maintain a 20% nuclear share. **Since about 2010 the prospect of sustained low natural gas prices has dampened plans for new nuclear capacity (see section on New nuclear capacity below).** A table of operable plants in the USA is available as an appendix to this page. **Almost all the US nuclear generating capacity comes from reactors built [before 1990] between 1967 and 1990. Until 2013 there had been no new construction starts since 1977, largely because for a number of years gas generation was considered more economically attractive** and because construction schedules during the 1970s and 1980s had frequently been extended by opposition, and compounded by heightened safety fears following the Three Mile Island accident in 1979. A further PWR – Watts Bar 2 – started up in 2016 following Tennessee Valley Authority's (TVA's) decision in 2007 to complete the construction of the unit. Despite a near halt in new construction for more than 30 years, US reliance on nuclear power has grown. In 1980, nuclear plants produced 251 TWh, accounting for 11% of the country's electricity generation. In 2019, that output had risen to 809 TWh and nearly 20% of electricity, providing more than 30% of the electricity generated from nuclear power worldwide. Much of the increase came from the 47 reactors, all approved for construction before 1977, that came online in the late 1970s and 1980s, more than doubling US nuclear generation capacity. The US nuclear industry has also achieved remarkable gains in power plant utilisation through improved refuelling, maintenance and safety systems at existing plants. Average nuclear generation costs have come down from $51.22/MWh in 2012 to $30.92/MWh in 2022. This 40% reduction in nuclear generating costs since 2012 has been driven by: a 41% decrease in fuel costs; a 51% decrease in capital expenditures; and a 33% decrease in operating costs.9

#### Critically, nuclear energy is only expensive now because the US has mishandled it.

**Brad Plumer from Vox explains**, 2-29-2016 // // Why America abandoned nuclear power (and what we can learn from South Korea) // https://www.vox.com/2016/2/29/11132930/nuclear-power-costs-us-france-korea // accessed 4-4-2025 // ashe

But there’s also an optimistic story for nuclear — and one that I think is worth hearing out. A recent paper in the journal Energy Policy by Jessica Lovering, Arthur Yip, and Ted Nordhaus of the Breakthrough Institute looked at construction costs for hundreds of reactors built in the US, France, Canada, Japan, German, India, and South Korea between 1960 and 2010. Their data tells a more nuanced story. **Nuclear** construction **costs in the US did spiral out of control**, especially **after the Three Mile Island meltdown in 1979**. **But** this wasn’t universal. **Countries like France, Japan, and Canada kept costs** fairly **stable** during this period. **And South Korea** actually **drove nuclear costs down**, at a rate similar to what you see for solar. Studying these countries can offer lessons for how to make nuclear cheaper — so that it can become a useful clean energy resource around the world. “The biggest thing we found is that **there’s nothing intrinsic to nuclear that leads to cost escalations**,” Lovering told me. “**It depends on** what **policies** are in place, on the market dynamics. You get very different cases in different countries.”

#### Which is why the Energy Information Administration finds in 2023, that because of low US government investment,

**US EIA 23** (Energy Information Administration, 8-1-2023, U.S. nuclear industry, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, Accessed 4-4-2025, wayway)

**There are 54 nuclear power plants operating in the United States** Electricity generation from commercial nuclear power plants in the United States began in 1958. As of August 1, 2023, the United States had 93 operating commercial nuclear reactors at 54 nuclear power plants in 28 states. The average age of these nuclear reactors is about 42 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 commercial service is Unit 3 at the Alvin W. Vogtle Electric Generating Plant in Georgia, which began commercial operation on July 31, 2023, and is the first reactor to come online since Watts Bar 2 was commissioned in 2016. The number of operating U.S. nuclear reactors peaked at 112, and their combined net summer electricity generation capacity was 99,624 megawatts. The number of operating reactors declined to 104 in 1998 and remained there through 2013. The number declined to 92 operating reactors in 2022. Total U.S. nuclear net summer electricity generation capacity peaked in 2012 at about 102,000 MW and declined to 94,765 MW in 2022. Although though the number of reactors has declined since 2012, power plant uprates—modifications to increase capacity—at individual nuclear power plants have made it possible for the entire operating nuclear reactor fleet to maintain high capacity-utilization rates (or capacity factors). These relatively high capacity factors helped nuclear power to provide 19%–20% of total annual U.S. electricity generation from 1990 through 2021. Some reactors also increased annual electricity generation by shortening the length of time reactors are offline for refueling. **Nuclear reactors are decommissioned after they are retired from commercial service. According to the U.S. Nuclear Regulatory Commission, 22 commercial nuclear power reactors at 18 sites are in various stages of decommissioning.**

#### To prevent this, we affirm the resolution: the US should substantially increase its investment in domestic nuclear energy.

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#### Affirming solves through upgrades. Tariq 24

**Tariq**, Ehtesham. “Costs and Benefits of Extending Aging Nuclear Power Plants | Certrec.” Certrec | Regulatory & Technology Solutions for the Energy Industry, December 2, **2024**. https://www.certrec.com/blog/costs-and-benefits-of-extending-aging-nuclear-power-plants/. [Certrec is a leading provider of regulatory compliance and digital integration solutions for the energy industry, with the mission of helping ensure a stable, reliable, bulk electric supply. Since 1988, Certrec’s innovation combined with industry expertise has helped hundreds of power-generating facilities manage their regulatory compliance with both the Nuclear Regulatory Commission (NRC) and North American Electric Reliability Corporation (NERC) and reduce their risks.] //MH

For several decades, nuclear power plants worked as a cornerstone of global energy strategies, providing reliable and carbon-free electricity to millions in the U.S. However, as many nuclear reactors approach the end of their initial design lives, questions arise about whether to decommission them or extend their operational lifespan. Aging nuclear power plants, though still a vital asset in many energy grids, face mounting challenges that require careful consideration. Extending the life of aging nuclear power plants involves a complex evaluation of costs, safety considerations, technological advancements, and socio-economic benefits. This decision-making process carries immense implications for energy security, climate goals, and financial investments. The Economic Rationale for Life Extension Projects The economics of extending the operational life of aging nuclear reactors is one of the primary drivers behind life extension projects. **Constructing new nuclear plants is a capital-intensive endeavor, often requiring billions of dollars and spanning a decade or more. In contrast, extending the life of an existing plant through life management programs, such as refurbishment and equipment upgrades, generally costs [little] significantly less.** According to the International Atomic Energy Agency (IAEA), life extension projects can cost 25–50% of the expenses of building a new plant, making them a cost-effective solution for maintaining energy supply. Operational costs are another favorable factor. Aging nuclear plants often operate at lower marginal costs than alternative energy sources, especially fossil fuels. **With upgrades in key systems, such as steam generators, turbines, and safety measures, older plants can achieve higher efficiencies, further driving down costs.** However, these financial **benefits come with** upfront investments in safety assessments, regulatory compliance, and **infrastructure modernization to meet evolving industry standards**. Safety Upgrades and Regulatory Challenges Safety is paramount in any discussion about extending the lifespan of nuclear power plants. **Aging infrastructure poses increased risks, necessitating comprehensive safety evaluations and enhancements. Life extension projects typically involve extensive inspections, including assessments of reactor pressure vessels, containment systems, and cooling mechanisms to identify potential vulnerabilities.** Advanced nondestructive testing methods are often employed to detect micro-cracks, corrosion, and material degradation that might compromise safety during extended operations. Meeting regulatory requirements from the Nuclear Regulatory Commission (NRC) presents additional challenges. Governments and nuclear safety agencies like the NRC require rigorous assessments to ensure that extended operations do not compromise public health or the environment. This involves implementing post-Fukushima safety measures, such as improved flood protection, enhanced seismic resilience, and backup power systems. These safety upgrades, while necessary, can significantly increase the costs and time required for life extension projects. Social and Energy Security Implications The socio-economic and energy security implications of extending the life of nuclear plants are profound. **These plants provide thousands of high-paying jobs, from engineers and technicians to plant operators and support staff.** Life extension projects, which require extensive maintenance and upgrades, often create additional employment opportunities in the local community. On the energy security front, extending nuclear plant operations reduces dependence on imported fossil fuels and mitigates price volatility in energy markets. Countries with aging nuclear fleets, such as the United States, France, and Canada, view life extension as a strategic move to maintain energy independence and secure supply chains. Conclusion The decision to extend the life of aging nuclear power plants is a multifaceted challenge involving economic, technical, environmental, and social considerations. While life extension offers significant benefits, including cost savings, enhanced energy security, and climate mitigation, it also demands substantial investments in safety upgrades, regulatory compliance, and public trust. By balancing these factors and leveraging advancements in nuclear technology, nations can ensure the safe and sustainable operation of nuclear power plants, paving the way for a cleaner and more secure energy future.

#### This produces two benefits

#### First, upgrades prevents accidents

#### the risk of meltdowns is going up now Maness 25

**Maness 25** [Coleman Maness, Director of sales and marketing at ARES Security Corporation, 2-24-2025, "Enhancing Nuclear Security in an Era of Rising Threats", ARES Security, https://aressecuritycorp.com/2025/02/24/enhancing-nuclear-security-in-an-era-of-rising-threats/, accessed 4-4-2025.] //aayush

**As global tensions and cybersecurity threats escalate**, **nuclear security remains a top priority for governments** and energy providers. This blog explores recent updates in nuclear security regulations, advancements in security technology, and **best practices for protecting nuclear facilities against physical and cyber threats**. Current Threat Landscape in Nuclear Security **With evolving geopolitical threats, nuclear facilities face increasing risks from cyberattacks, insider threats, and unauthorized drone surveillance**. **Recent attempts to breach nuclear plants have emphasized the need for robust perimeter security and advanced monitoring** systems. The **increasing threat of state-sponsored cyberattacks targeting nuclear reactors** highlights the necessity of multi-layered cybersecurity protocols. **The NRC’s latest assessments emphasize the need for real-time monitoring, automated threat detection, and rapid response capabilities** to prevent security breaches. Regulatory Developments and Compliance Requirements The Nuclear Regulatory Commission (**NRC**) **has introduced new cybersecurity frameworks for nuclear facilities, emphasizing compliance with regulations** such as 10 CFR Part 73. **Facilities must implement multi-layered security systems and continuous risk assessment protocols**. The Department of Energy (**DOE**) has **also increased funding for cybersecurity enhancements in nuclear energy facilities**, further reinforcing national security priorities. **Strengthening Nuclear Security Through Innovation** and Vigilance **Ensuring nuclear security requires continuous innovation and adherence to regulatory requirements**. **By integrating advanced security solutions and staying ahead of emerging threats, nuclear facilities can maintain operational resilience and public safety**. As the nuclear industry expands, **proactive security frameworks will remain essential** in mitigating evolving threats and ensuring long-term sustainability.

**And regulations are going down**

**Macfarlane 25** [Allison Macfarlane, Professor and director of the School of Public Policy and Global Affairs at the University of British Columbia, 2-21-2025, Trump just assaulted the independence of the nuclear regulator. What could go wrong?, Bulletin of the Atomic Scientists, https://thebulletin.org/2025/02/trump-just-assaulted-the-independence-of-the-nuclear-regulator-what-could-go-wrong/, GZR]

**President Trump, through** his recent Executive Order, has **attacked independent regulatory agencies in the US government**. This order gives the Office of Management and Budget power over the regulatory process of until-now independent agencies. **These regulatory agencies include the Federal Elections Commission, the Federal Trade Commission, the Securities and Exchange Commission, the Federal Energy Regulatory Commission**—and my former agency, the Nuclear Regulatory Commission, which I chaired between July 2012 and December 2014.

**An independent regulator is free from industry and political influence**. **Trump’s executive order flies in the face of this basic principle by requiring the Office of Management and Budget to** “**review**” **these independent regulatory agencies’ obligations** “for consistency with the President’s policies and priorities.” **This essentially means subordinating regulators to the president**.

In the past, the president and Congress, which has oversight capacity on the regulators, stayed at arm’s length from the regulators’ decisions. This was meant to keep them isolated, ensuring their necessary independence from any outside interference. Trump’s executive order implies there are no longer independent regulators in the United States.

Independent regulators should not only be free from government and industry meddling; they also need to be adequately staffed with competent experts and have the budget to operate efficiently. They also need to be able to shut down facilities such as nuclear power plants that are not operating safely, according to regulations. To do this, they need government to support their independent decisions and rulemaking.

**Independence matters**. When I was chairman, I traveled the world talking about the importance of an independent regulator to countries where nuclear regulators exhibited a lack of independence and were subject to excessive industry and political influence. It is ironic that the US Nuclear Regulatory Commission—often called the “Gold Standard” in nuclear regulation—has now been captured by the Trump administration and lost its independence. So much for the Gold Standard; the Canadian, the French, or the Finnish nuclear regulator will have to take on that mantle now.

**To understand what is at stake, one needs to look no further than the Fukushima accident** in March 2011, **which showed the world how a country’s economic security is vulnerable to a captured regulator**. After a magnitude 9.0 earthquake followed by a massive tsunami, the Fukushima Daiichi nuclear power plant, with its six reactors on Japan’s east coast, lost offsite power. The tsunami flooded their backup diesel generators, and the plant fell into the station blackout, leading to the complete loss of all power on site.

With no power to operate pumps to get cooling water into the reactors’ cores or into spent fuel storage pools, three reactor cores melted down—the first within hours of loss of power—with a concomitant release of large amounts of radionuclides due to containment breaches from hydrogen explosions.

Firefighters desperately tried to get water into the spent fuel pool of Unit 4 to ensure that pool water did not boil off since the pumps were no longer working. Should the spent fuel rods have become uncovered and no longer cooled, the fuel’s temperature would rapidly increase, and the fuel rods would melt, causing the release of even larger amounts of radiation material into the atmosphere threatening the Tokyo metropolitan area. Fortunately, the emergency workers got water to the pool within a few days of the fuel being uncovered.

Nonetheless, 160,000 people evacuated from the area near the reactors and along the corridor of radiation contamination to the northwest of the Fukushima Daiichi plant. Overnight, the agricultural and fishing industries near Fukushima were devastated. **Within a year after the accident, all 54 reactors in Japan were shut down**—**a loss of about a third of the country’s electricity supply**. More expensive diesel plants had to be set up to compensate for some of the missing power. The direct economic costs of the accident were estimated to be on the order of $200 billion—and even that number excluded the costs of replacing the lost power and multiple reactor shutdowns due to the reassessment of seismic hazards. **Nearly 14 years later, only 13 nuclear reactors have been turned back on, and 21 have been permanently shut down**. (The other 20 reactors are waiting for regulatory and prefecture approval.)

An independent investigation by the Diet (Japan’s house of parliament) into the cause of the Fukushima accident concluded unequivocally that: “**The TEPCO Fukushima Nuclear Power Plant accident was the result of collusion between the government, the regulators and TEPCO, and the lack of governance by said parties**. They effectively betrayed the nation’s right to be safe from nuclear accidents.” Japan’s government and nuclear industry continue to struggle with the clean-up of the Fukushima site, and it purposely began in 2023 to release still-contaminated water into the Pacific Ocean. Nearby countries responded by banning fishing products from the region.

As the industry often says, **a nuclear accident anywhere is a nuclear accident everywhere**. After the Fukushima accident, the US nuclear industry spent over $47 billion in safety upgrades to respond to lessons learned from the Fukushima accident. **These included the realization that not only more than one reactor could fail at a single power plant**, but also that backup generators needed to be in safe locations, not subject to flooding and other forms of failure; that generic fittings for pumps and equipment were needed so that any nearby equipment could be connected during an accident; that containments should be able to be vented remotely; that natural events such as earthquakes and flooding could be underestimated in the original reactor designs; and that spent fuel pools needed to provide real-time data in accident conditions. The upgrades that resulted from these lessons have greatly increased the safety of reactors in the United States and elsewhere. They were required because each of these upgrades was deemed necessary to address the lessons learned by the independent regulator. On its own, the industry might not have undertaken any of these measures.

What could go wrong? **Several possible outcomes could occur because of Trump’s new executive order assaulting the independence of the Nuclear Regulatory Commission** (NRC).

**Proponents of small modular reactors**, for instance, **have pressured Congress and the executive branch to reduce regulation** and hurry the NRC’s approval of their novel—and unproven—reactor designs. **They wish their reactors could be exempted from the requirements that all other designs before them have had to meet**: **detailed evidence that the reactors will operate safely** under accident conditions. Instead, **these proponents**—some **with no experience in operating reactors**—**want the NRC to trust their simplistic computer models** of reactor performance **and essentially give them a free pass to deploy their untested technology** across the country.

An accident with a new small modular reactor (SMR) would perhaps not make such a big mess: After all, the source term of radiation would be smaller than with large reactors, like those currently operating in the United States. But the accident in Japan demonstrated that countries should expect that more than one reactor at a given site can fail at the same time, and these multiple failures can create even more dire circumstances, impeding the authorities’ ability to respond to such a complex radiological emergency. At Fukushima, the first explosion at Unit 1 generated radioactive debris that prevented emergency responders from getting close to other damaged reactors nearby. Since designers plan to deploy multiple SMR units to individual sites, such an accidental scenario appears feasible with SMRs.

Since its creation in 1975, the Nuclear Regulatory Commission has had an excellent and essential mission: to ensure the safety and security of nuclear facilities and nuclear materials so that humans and the environment are not harmed. **Trump’s incursion means the agency will no longer be able to fully follow through with this mission independently**—and Americans will be more at risk as a result. **If any US reactor suffers a major accident, the entire industry will be impacted**—and perhaps **its 94 reactors in operation will even be temporarily shut down**. Can the industry and the American people afford the cost of losing the independence of the nuclear regulator?

#### Upgrades improve safety. Tariq 24

**Tariq**, Ehtesham. “Costs and Benefits of Extending Aging Nuclear Power Plants | Certrec.” Certrec | Regulatory & Technology Solutions for the Energy Industry, December 2, **2024**. https://www.certrec.com/blog/costs-and-benefits-of-extending-aging-nuclear-power-plants/. [Certrec is a leading provider of regulatory compliance and digital integration solutions for the energy industry, with the mission of helping ensure a stable, reliable, bulk electric supply. Since 1988, Certrec’s innovation combined with industry expertise has helped hundreds of power-generating facilities manage their regulatory compliance with both the Nuclear Regulatory Commission (NRC) and North American Electric Reliability Corporation (NERC) and reduce their risks.] //MH

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#### Accidents affect millions

Richard **Gray 19** (Richard Gray, 7-25-2019, The true toll of the Chernobyl disaster, No Publication, <https://www.bbc.com/future/article/20190725-will-we-ever-know-chernobyls-true-death-toll>, Accessed 4-4-2025, wayway)

According to the official, internationally recognised death toll, just 31 people died as an immediate result of Chernobyl while the UN estimates that only 50 deaths can be directly attributed to the disaster. In 2005, it predicted a further 4,000 might eventually die as a result of the radiation exposure. **Brown's research, however, suggests Chernobyl has cast a far longer shadow.** “When I visited the wool factory in Chernihiv, I met some of the women who were working at the time,” she says. “There were just 10 of these women still there. They told me that they were picking up bales of wool and sorting them on tables. In May 1986, the factory was getting wool that had radiation readings of up to 30Sv/hr. The bales of wool the women were carrying were like hugging an X-ray machine while it was turned on over and over again.” Getty Images The Ukrainian government pays benefits to more than 36,000 widows of men who have died as a result of the Chernobyl disaster (Credit: Getty Images)Getty Images The Ukrainian government pays benefits to more than 36,000 widows of men who have died as a result of the Chernobyl disaster (Credit: Getty Images) **Thousands of animals were slaughtered in the area around Chernobyl as it was being evacuated.** Brown believes fleeces from some of these animals appear to have found their way to the factory in Chernihiv along with other contaminated wool from farms enveloped in the clouds of radioactive material that spread out across northern Ukraine. When Brown spoke to the 10 “liquidators” at the wool factory, their stories gave a grim picture of what appears to have happened all across the region as ordinary people who had nothing to do with the clean-up of the disaster were exposed to radioactive material. “They pointed to different parts of their bodies that had aged more than the rest and where they had health problems,” says Brown. “They knew all about which radioactive isotopes had lodged in their organs.” The other 288 women, they told her, had either died or had taken pensions for ill health. **In the weeks and months that followed the Chernobyl disaster, hundreds of thousands of firefighters, engineers, military troops, police, miners, cleaners and medical personnel were sent into the area immediately around the destroyed power plant in an effort to control the fire and core meltdown, and prevent radioactive material from spreading further into the environment. These people – who became known as “liquidators” due to the official Soviet definition of “participant in liquidation of the Chernobyl nuclear power plant accident consequences” – were given a special status that meant they would receive benefits such as extra healthcare and payments. Official registries indicate that 600,000 people were granted liquidator status.** Getty Images Thirty one engineers, firemen and emergency clean-up workers are officially recognised as dying in the first three months after the explosion (Credit: Getty Images)Getty Images Thirty one engineers, firemen and emergency clean-up workers are officially recognised as dying in the first three months after the explosion (Credit: Getty Images) **But a contentious report published by members of the Russian Academy of Sciences indicates that there could have been as many as 830,000 people in the Chernobyl clean-up teams. They estimated that between 112,000 and 125,000 of these – around 15% – had died by 2005. Many of the figures in the report, however, were disputed by scientists in the West, who questioned their scientific validity.** The Ukrainian authorities, however, kept a registry of their own citizens affected by the Chernobyl accident. In 2015 there were 318,988 Ukrainian clean-up workers on the database, although according to a recent report by the National Research Centre for Radiation Medicine in Ukraine, 651,453 clean-up workers were examined for radiation exposure between 2003 and 2007. A similar register in Belarus recorded 99,693 clean-up workers, while another registry including included 157,086 Russian liquidators. **In Ukraine, death rates among these brave individuals has soared, rising from 3.5 to 17.5 deaths per 1,000 people between 1988 and 2012. Disability among the liquidators has also soared. In 1988 68% of them were regarded healthy, while 26 years later just 5.5% were still healthy. Most – 63% – were reported to be suffering from cardiovascular and circulatory diseases while 13% had problems with their nervous systems. In Belarus, 40,049 liquidators were registered to have cancers by 2008 along with a further 2,833 from Russia.** The International Atomic Energy Agency, however, says that health studies on liquidators have “failed to show any direct correlation between their radiation exposure” and cancer or other disease. Some of those living closest to the power plant received internal radiation doses in their thyroid glands that were up to 37,000 times the dose of a chest x-ray Another group who bore the brunt of the radiation exposures in the hours and days after the explosion were those living in the nearby town of Pripyat and the surrounding area. It took a day and a half before the evacuation began and led to 49,614 people being evacuated. Later a further 41,986 people were evacuated from another 80 settlements in a 30km (18.7 mile) zone around the power plant, but ultimately some 200,000 people are thought to have been relocated as a result of the accident. Some of those living closest to the power plant received internal radiation doses in their thyroid glands of up to 3.9Gy – roughly 37,000 times the dose of a chest x-ray – after breathing radioactive material and eating contaminated food. Doctors who have been studying the evacuees report that mortality among the evacuees has gradually increased, reaching a peak in 2008-2012 with 18 deaths per 1,000 people. But this still represents a small proportion of the people affected by Chernobyl. Getty Images Almost 100,000 people were evacuated from the area around Chernobyl in the months after the disaster but today the abandoned towns attract tourists (Credit: Getty Images)Getty Images Almost 100,000 people were evacuated from the area around Chernobyl in the months after the disaster but today the abandoned towns attract tourists (Credit: Getty Images) Brown has found evidence hidden in hospital records from around the time of the accident that show just how widespread problems were. **“In hospitals throughout the region and as far away as Moscow, people were flooding in with acute symptoms,” she says. “The accounts I have indicate at least 40,000 people were hospitalised in the summer after the accident, many of them women and children.”** Political pressure is widely thought to have led to the true picture of the problem to be suppressed by the Soviet authorities, who were keen not to lose face on the international stage. But following the collapse of the USSR and as people living in the areas that were exposed to radiation begin to present with a wide range of health problems, a far clearer picture of the toll taken by the disaster is emerging. The Chernobyl disaster is the largest anthropogenic disaster in the history of humankind Viktor Sushko, deputy director general of the National Research Centre for Radiation Medicine (NRCRM) based in Kiev, Ukraine, describes the Chernobyl disaster as the “largest anthropogenic disaster in the history of humankind”. The NRCRM estimate around five million citizens of the former USSR, including three million in Ukraine, have suffered as a result of Chernobyl, while in Belarus around 800,000 people were registered as being affected by radiation following the disaster. Even now the Ukrainian government is paying benefits to 36,525 women who are considered to be widows of men who suffered as a result of the Chernobyl accident. **As of January 2018, 1.8 million people in Ukraine, including 377,589 children, had the status of victims of the disaster, according to Sushko and his colleagues. There has been a rapid increase in the number of people with disabilities among this population, rising from 40,106 in 1995 to 107,115 in 2018.**

#### The 2nd impact is climate change

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#### Nuclear energy is efficient, and has a proven track record on a global level

**Grossi ’24** [Rafael Mariano Grossi; Director General at the International Atomic Energy Agency; 1-17-2024; World Economic Forum; "5 reasons nuclear energy is key to the climate transition"; https://www.weforum.org/agenda/2024/01/nuclear-energy-transistion-climate-change/]

**Globally, nuclear energy is [already]** also **playing a key role in** the transition to **net zero**. Fears about nuclear are slowly giving way to fact-based understanding. This year, for the first time, the document agreed at COP backed nuclear energy investment among low-emissions technologies. One of nuclear’s key attributes is its energy intensity. A thimble-sized pellet of uranium produces as much energy as almost 3 barrels of oil, more than 350 cubic metres of natural gas and about half a tonne of coal. 5 reasons we cannot ignore nuclear energy Nuclear power, which has 20,000 reactor years of experience across the world, has five distinct advantages. 1. From cradle to grave, nuclear energy has the lowest carbon footprint and needs fewer materials and less land than other electricity source. For example, to produce one unit of energy, solar needs more than 17 times as much material and 46 times as much land. 2. Uranium in the earth's crust and oceans is more abundant than gold, platinum and other rare metals. It is going to take us about 100 to 150 years to get through the uranium resources we deem economically recoverable today. 3. Nuclear power doesn’t rely on the weather. Well-run nuclear power plants, including for example those in the US, operate at least two to three times as reliably for two to three times as many years as intermittent low-carbon sources. As a flexible baseload for wind and solar that provides more energy when it is needed and less when it is not, nuclear power plants displace coal and enable renewables. 4. Each year, nuclear power plants produce a quarter of the world’s low-carbon electricity, saving many lives that would otherwise be cut short by the lethal pollution fossil fuels pump into the air. Nuclear energy is about as safe as solar. **It is far safer** than coal, gas and oil, and safer than almost **every** **other alternative** energy source. 5. It is true that **[waste]** spent fuel is highly radioactive and emits heat. But it is also **relatively** **compact**, and extremely **carefully managed** and regulated. Nuclear energy generation is so efficient that the amount of all spent fuel ever produced would — in theory — fit into 42 Olympic-sized swimming pools. Today, it is carefully stored in pools and dry storage systems or recycled. Countries like Finland and Sweden are close to putting into place deep geological repositories to dispose of spent fuel. France is also progressing in the implementation of a deep geological repository for high-level waste from spent fuel recycling. Nuclear is one of the safest, cleanest, least environmentally burdensome and — ultimately, over the lifetime of a nuclear power plant — one of the cheapest sources of energy available. But for all of nuclear energy’s positive attributes, there are hurdles to overcome. The accidents at Chernobyl and at the Fukushima Daiichi Nuclear Power Station left long shadows of mistrust and underinvestment. The upfront cost of building a nuclear power plant is considerable and budget overruns and long delays have made it more difficult to gain support for new construction. Three levers to catalyze investment in nuclear energy Three main levers will need to be pulled if we are to triple today’s investment levels and build the nuclear capacity that will help get us to net zero. Lever 1: Nuclear must be acknowledged for what it is: a reliable, scalable, safe and highly affordable low-carbon source of energy. It must be treated that way when it comes to investment incentives. Today’s energy markets are not the same as those of the 1970s and 1980s. Nuclear needs private investment, even in markets where governments still take on much of the financing. **Governments need to** shoulder the risk of the high capital costs at the start. But that alone is not enough. They need to attract private financing through assured revenues and an **enabl**ing **investment** environment over the longer term. That means levelling the playing field nationally and internationally, including by **changing** the **policies** preventing investment in nuclear energy by many keyinternational financial institutions and development banks. Lever 2: Governments and the public are again turning towards nuclear. The nuclear industry needs to respond to the challenge and opportunity of this unique moment by delivering on time and on budget, while achieving a greater level of industrial standardization and better incorporating safety, security and safeguards at the design stage. Lever 3: Regulators need to meet the moment by enabling the necessary tripling of capacity while maintaining high levels of safety. This includes building their own internal capacity, including to license the next generation of innovative reactors for which regulators do not yet have experience.

**Improving nuclear energy reduces emissions. Kharecha and Hansen 13**

Pushker Kharecha and James Hansen 13 observe, 4-22-2013, "Coal and gas are far more harmful than

nuclear power – Climate Change: Vital Signs of the Planet," Climate Change: Vital Signs of the Planet, https://climate.nasa.gov/news/903/coal-and-gas-arefar-more-harmful-than-nuclear-power/

Likewise, we calculated that nuclear power prevented an average of 64 gigatonnes of CO2-equivalent (GtCO2-eq) net GHG emissions globally between 1971-2009 (see Fig. 3). This is about 15 times more emissions than it caused. It is equivalent to the past 35 years of CO2 emissions from coal burning in the U.S. or 17 years in China (ref. 3) — i.e., **historical nuclear energy production has prevented the building of hundreds of large coal-fired power plants.** To compute potential future effects, we started with the projected nuclear energy supply for 2010-2050 from an assessment made by the UN International Atomic Energy Agency that takes into account the effects of the Fukushima accident (ref. 4). We assume that the projected nuclear energy is canceled and replaced entirely by energy from either coal or natural gas. We calculate that this nuclear phaseout scenario leads to an average of 420,000-7 million deaths and 80-240 GtCO2-eq emissions globally (the high-end values reflect the all coal case; see Figs. 1 and 3). This emissions range corresponds to 16-48% of the "allowable" cumulative CO2 emissions between 2012-2050 if the world chooses to aim for a target atmospheric CO2 concentration of 350 ppm by around the end of this century (ref. 5). In other words, **projected nuclear power could reduce the CO2 mitigation burden for meeting this target by as much as 48%.**

**Reducing climate change is key, every degree matters.**

**Cassella 23** [Carly Cassella, 8-30-2023, "Scientists Warn 1 Billion People on Track to Die From Climate Change," ScienceAlert,

https://www.sciencealert.com/scientists-warn-1-billion-people-on-track-to-die-from-climate-change] //clairec

The fossil fuels that humanity burns today will be a death sentence for many lives tomorrow. A recent review of 180 articles on the human death rate of climate change has settled on a deeply distressing number. Over the next century or so, conservative estimates suggest a**billion people could die from climate**catastrophes, possibly more. As with most predictions for the future, this one is based on several assumptions. One is a rough rule of thumb called the '1000-ton rule'. Under this framework,**every thousand tons of carbon that humanity burns is said to indirectly condemn a future person to death.** If the world reaches temperatures 2°C above the average global preindustrial temperature, which is **what we are on track for in the coming decades, then that's a lot of lives lost. For every 0.1 °C degree of warming from now on, the world could suffer roughly 100 million deaths**. "If you take the scientific consensus of the 1,000-ton rule seriously, and run the numbers, anthropogenic global warming equates to a**billion premature dead bodies over the next century**," explains energy specialist Joshua Pierce from the University of Western Ontario in Canada. "Obviously, we have to act. And we have to act fast." The human death rate from climate change is extremely tricky to calculate, even in the present day. The United Nations reports that every year, environmental factors take the lives of about 13 million people, and yet it's not clear how many of these deaths are directly or indirectly due to climate change. Some experts argue abnormal temperatures on their own may already claim as many as five million lives a year. Other estimates are much lower. Part of the problem is that the global effects of climate change are manifold. Crop failures, droughts, flooding, extreme weather, wildfires, and rising seas can all impact human lives in subtle and complex ways. Predicting the future death toll of these climate catastrophes is inherently imperfect work, but Pierce and his coauthor, Richard Parncutt from the University of Graz in Austria, think it's worth pursuing. They argue measuring emissions in terms of human lives makes the numbers easier for the public to digest, while also underlining how unacceptable our current inaction is.

#### Thus, negate.

# 2ac

the government is cutting funding

**Mcdermott 24** [Jennifer Mcdermott, "Trump administration cancels clean energy grants as it prioritizes fossil fuels", 03/08/2024, AP News, https://apnews.com/article/trump-energy-department-clean-energy-wind-solar-batteries-hydrogen-fossil-fuels-cf1dff9ee771c566765e9ca3e3599d91]

President Donald Trump’s administration **[the government] is terminating grants for** two **clean energy projects** and **roughly 300 others funded by the Department of Energy are in jeopardy** as the president prioritizes fossil fuels. The DOE is canceling two awards to a nonprofit clean energy think tank, RMI in Colorado, according to a document from the agency confirming the cancellations that was reviewed by The Associated Press on Friday. One was for nearly $5.3 million to retrofit low-income multifamily buildings in Massachusetts and California to demonstrate ways to reduce the use of energy and lower planet-warming greenhouse gas emissions. The other was for $1.5 million to assess business models for electric vehicle carsharing in U.S. cities. The department wrote that it had determined the awards do not meet the administration’s objectives. Both awards are on a list of about 300 clean energy projects under review. President Donald Trump declared an energy emergency early in his term and is working to speed up fossil fuel development, which he sums up as “drill, baby, drill.”

**Renewables are unviable for the foreseeable future**

**Osaka 25** [Shannon Osaka, "Renewable energy sources falling short of goals amid regulatory roadb…", 01/22/2025, archive.is, https://archive.is/0E0gw#selection-417.0-1241.256]

For years, renewable energy proponents have hoped to build a U.S. electric grid powered by wind, solar, geothermal and — to a lesser extent — nuclear power, with carbon-free energy surging into homes and businesses across the country. When President Joe Biden signed the Inflation Reduction Act in 2022, which slashed the cost of building renewables, that dream seemed likely to become a reality. But now, renewable developers say that the new technologies are stymied by complicated local and federal regulations, a long wait to connect to the electricity grid, and community opposition. Experts once hoped that by the end of the decade the United States could generate up to 80 percent of its power with clean power, and Biden set it as a national goal. Now, some wonder if the country will be able to reach even 60 percent. That means that even as renewables continue to break records, the Biden administration departs with the nation offtrack from its climate target of cutting emissions 50 to 52 percent by 2030. And as President Donald Trump takes the reins, threatening tariffs and halting new permitting for wind, the country is drifting further away from an all-renewable future. Trump’s **new executive order mandates a halt to all** offshore **wind leasing in federal waters**, pauses federal permitting for both onshore and offshore wind projects and launches a “comprehensive assessment and review” of wind leasing and permitting. 🌱 Follow Climate & environment Follow “The U.S. offshore wind business is at a very nascent stage versus Europe or China,” Rob Barnett, a senior analyst at Bloomberg Intelligence, said in an email. “With the new permitting pause, **it’s doubtful much progress** for this emerging industry **will be made** under the second Trump administration.” The order compounds struggles that the renewable energy industry was already facing. In theory, a better-designed grid could lead to renewable penetration of 60 to 70 percent, said Jason Grumet, CEO of the American Clean Power Association. But that’s only with substantial changes to where wind and solar can be built and how it gets connected to the grid. “Without progress, probably some places tap out at half that,” he said. After the Inflation Reduction Act passed, Rhodium Group — an independent clean energy research firm — estimated that between 2023 and 2025, on average, the country would add between 36 and 46 gigawatts of clean electricity to the grid every year. Late last year, however, the group found that the country only installed around 27 gigawatts in 2023. The U.S.’s renewable growth is now expected to fall on the low end of that range — or miss it entirely. “It actually is really hard to build a lot of this stuff fast,” said Trevor Houser, partner in climate and energy at Rhodium Group. **Renewables are falling short of expectations** Average clean electricity added to the grid between 2023 and 2025, in gigawatts per year. This dot chart shows that after the IRA, initial estimates showed that the US would build 36 to 46 GW of clean electricity every year. Now the country is only estimated to build 32 to 36 GW. 30 35 40 45 50 Previous estimate Current estimate The Clean Investment Monitor is a joint project of Rhodium Group and MIT’s Center for Energy and Environmental Policy Research. Previous estimate in August of 2022; current estimate from November 2024. Source: Clean Investment Monitor As a result, Rhodium found, the country only cut carbon emissions by 0.2 percent in 2024. To reach Biden’s climate goal, the country needs more than 7.6 percent every year from now until 2030. (The only example of such a steep drop in recent history was during covid-19, when emissions dropped about 10 percent in 2020.) A significant amount of this lag has come from wind power, where **problems with supply chains and getting permits and approval to build has put a damper on development**. But solar construction is also on the low end of what experts were expecting. “Immediately after the passage of the Inflation Reduction Act, there was a whole lot of enthusiasm,” said Brendan Pierpont, director of electricity modeling at Energy Innovation, a nonpartisan clean energy think tank. Models mostly use economics to make predictions — analyzing what the most cost-efficient actions will be and calculating the results accordingly. But the challenges that energy developers face today are not economic. “The premise of these congressional clean energy tax credits was to stimulate remarkable acceleration,” said Grumet. “The technology is ready, and the financial services are ready — but the question nobody really put enough thought into was, could the government keep up? And at the moment, the answer is no.” **Renewables** have many great benefits — they don’t produce deadly air pollution or contribute to global warming. But the electricity grid was in large part built for fossil fuels, which can be placed close to the communities they serve. Wind and solar, on the other hand, sometimes **need to be built hundreds or even thousands of miles away — which then requires large, long-distance transmission lines to move power. Renewables also take up more space**, although in some places wind and solar can coexist with agriculture and animal grazing. “**The grid that we have was never designed to handle this kind of load,**” said Sandhya Ganapathy, CEO of EDP Renewables North America. Developers point to lags in the interconnection queue — a system that gives new solar, wind or fossil fuel projects permission to connect to the larger electricity grid. According to a report from Lawrence Berkeley National Laboratory, **it can now take nearly 3 years for a project to get through the queue**. The grid operator that covers the Mid-Atlantic and parts of the Midwest, PJM, had over 3,300 projects in its queue at the end of 2023. The vast majority of these applications are for renewables — more than the entire number of active wind farms in the nation. Not all areas of the United States are equal. According to data from the Energy Information Administration and analyzed by Energy Innovation, Texas installed more solar, wind and storage than any other grid area between 2022 and 2024. A worker walks past solar panels at ENGIE's Sun Valley Solar project in Hill County, Texas. (Mark Felix/AFP/Getty Images) Ganapathy said that while a state like Texas can approve projects faster, most of the rising energy demand from AI and data centers is coming from the Mid-Atlantic and Midwest. “A project takes anywhere between six to eight years,” Ganapathy said. “All of the AI needs are coming — are they going to wait six to eight years until we have more power in the system? We need to streamline this.” Then there are the high-voltage transmission lines that move that power across the country. According to one study by the National Renewable Energy Laboratory, **the country could require up to 10,000 new miles of transmission to switch to clean electricity** by 2035. Last year, the country built just 255 miles of new transmission line, according to the American Clean Power Association. Some projects have gotten stalled for years; one such line in the Southwest, the SunZia line, just started construction after 18 years of development. “If you have a weak transmission system, we will always be hesitant to build a project,” said Ganapathy. “Why are we taking a big risk of a massive investment if I will not be able to sell the electrons?” Developers say that getting community support can also get more difficult as more and more wind and solar are added to the grid. “The low-hanging fruit has been developed,” said John Woody, senior vice president of development at Clearway Energy Group. Anti-wind and anti-solar groups have also begun using more sophisticated methods and have more funding, he added. Some states and cities have even tried to ban development of renewables, often citing misleading information about environmental or health hazards. There are possible solutions. Some developers hope to reuse old fossil fuel sites, like coal plants, that are already connected to the grid — bypassing the long queue entirely. The Federal Energy Regulatory Commission has instated new rules to make it easier to build transmission lines. But those changes need to happen quickly. **The United States is currently building 20** to 40 **gigawatts of renewables every year — but that number will need to increase to** 70 or **80** gigawatts **to meet** U.S. **climate goals**. “We’re building record amounts of wind and solar every year, but it seems like we’re kind of hitting a ceiling,” said Houser. Developers also worry about the threat of Trump’s proposed **tariffs**, which **could further destabilize an industry that relies on predicting prices and supply chains months or even years in advance**. Without advance knowledge or planning of the tariffs, they warned, **projects could grind to a halt**. Still the economics of clean energy are strong. Wind and solar, in many jurisdictions, are cheaper than fossil fuel plants. The challenge is building those wind and solar farms at a fast pace that will push aside existing coal and natural gas plants — before temperatures rise much higher. “If you had told me 20 years ago when I started working on climate, that we would be having discussions about not the direction of change, but the pace — I would be dancing in the streets,” said Houser. “The challenge is just, can we build it fast enough?”

**Nuclear better than renewables**

**RBC 24** [RBC, "Nuclear energy sector getting the push it needs", 05/08/2024, Canada Asia Centre-Vancouver, https://ca.rbcwealthmanagement.com/international.vancouver/blog/4188242-Nuclear-energy-sector-getting-the-push-it-needs]

The need to decarbonize Nuclear energy—like solar, wind, geothermal and hydro—generates low direct carbon emissions. With the urgent need to achieve global net zero targets, policymakers are embracing nuclear as a complement to renewables and abated natural gas-fired power plants. The International Energy Agency (IEA) suggests that nuclear power output would need to double by 2050 to achieve net zero goals.1 **Renewables alone may not get us there in a timely and cost-efficient manner**, despite their lofty growth expectations over the coming decades. From a lifecycle emissions perspective, i.e., taking into account indirect emissions associated with plant construction and disposal, nuclear compares well with other sources. This is because **nuclear requires less construction material, has a longer operational lifespan (lasting 40–100 years while solar panels and wind farms are replaced every 20–30 years), and occupies less land (solar plants and wind farms require 75x and 360x more land to produce the same amount of electricity, respectively)**.2 Delivering to net zero goals will be harder and more expensive without nuclear. The IEA notes that **without nuclear, there will be a need for $500B more investment and customer electricity bills will rise by $20B/year** to 2050.3 Clearly, a balanced mix of low-emission energies that includes nuclear power will be needed to achieve climate targets. Nuclear among lowest emissions energy available Low-cost alternative Nuclear’s reliability as a baseload power makes it a useful energy source. **Nuclear plants generate power 93% of the time, whereas** intermittent **renewable resources like wind and solar generate power 35% and 25% of the time**, respectively.4 Not only is extra capacity needed for renewables, **they also need a backup source or batteries to store energy. This raises the cost and emissions profiles of these sources.** While industry research suggests nuclear can be cost-competitive when considering total system costs, this differs from practice in many cases. Nuclear power projects have frequently experienced substantial cost overruns and delays during construction, causing actual costs of nuclear electricity to greatly exceed initial estimates. However, there are arguments that nuclear projects may be better positioned for success moving forward. New plant designs using modular construction techniques have the potential to lower complexity and risks, while technological know-how and experience will bring efficiencies. Additionally, governments can help reduce costs by providing long-term commitments, financing and regulatory clarity in the licensing and construction processes. **One of the most straightforward and inexpensive ways to increase nuclear capacity is through the extension of existing nuclear plants. The IEA noted that reactors designed for 40-year lifespans can be extended by 20–40 years.** This offers countries the opportunity to retain the economic benefits of carbon-free baseload power at low marginal costs and with lower construction costs/risks.5 This also makes nuclear energy extensions competitive with solar and wind in many regions.

**Renewables, on the other hand, hurt the environment**

**Hickel 19**, PhD, Fellow of the Royal Society of Arts, Senior Lecturer at Goldsmiths, University of London. (Jason, 5-6-2019, "The Limits of Clean Energy", Foreign Policy, https://foreignpolicy.com/2019/09/06/the-path-to-clean-energy-will-be-very-dirty-climate-change-renewables/)

#### We need a rapid transition to renewables, yes—but scientists warn that we can’t keep growing energy use at existing rates. No energy is innocent. The only truly clean energy is less energy. In 2017, the World Bank released a little-noticed report that offered the first comprehensive look at this question. It models the increase in material extraction that would be required to build enough solar and wind utilities to produce an annual output of about 7 terawatts of electricity by 2050. That’s enough to power roughly half of the global economy. By doubling the World Bank figures, we can estimate what it will take to get all the way to zero emissions—and the results are staggering: 34 million metric tons of copper, 40 million tons of lead, 50 million tons of zinc, 162 million tons of aluminum, and no less than 4.8 billion tons of iron. In some cases, the transition to renewables will require a massive increase over existing levels of extraction. For neodymium—an essential element in wind turbines—extraction will need to rise by nearly 35 percent over current levels. Higher-end estimates reported by the World Bank suggest it could double. The same is true of silver, which is critical to solar panels. Silver extraction will go up 38 percent and perhaps as much as 105 percent. Demand for indium, also essential to solar technology, will more than triple and could end up skyrocketing by 920 percent. And then there are all the batteries we’re going to need for power storage. To keep energy flowing when the sun isn’t shining and the wind isn’t blowing will require enormous batteries at the grid level. This means 40 million tons of lithium—an eye-watering 2,700 percent increase over current levels of extraction. That’s just for electricity. We also need to think about vehicles. This year, a group of leading British scientists submitted a letter to the U.K. Committee on Climate Change outlining their concerns about the ecological impact of electric cars. They agree, of course, that we need to end the sale and use of combustion engines. But they pointed out that unless consumption habits change, replacing the world’s projected fleet of 2 billion vehicles is going to require an explosive increase in mining: Global annual extraction of neodymium and dysprosium will go up by another 70 percent, annual extraction of copper will need to more than double, and cobalt will need to increase by a factor of almost four—all for the entire period from now to 2050. The problem here is not that we’re going to run out of key minerals—although that may indeed become a concern. The real issue is that this will exacerbate an already existing crisis of overextraction. Mining has become one of the biggest single drivers of deforestation, ecosystem collapse, and biodiversity loss around the world. Ecologists estimate that even at present rates of global material use, we are overshooting sustainable levels by 82 percent. Take silver, for instance. Mexico is home to the Peñasquito mine, one of the biggest silver mines in the world. Covering nearly 40 square miles, the operation is staggering in its scale: a sprawling open-pit complex ripped into the mountains, flanked by two waste dumps each a mile long, and a tailings dam full of toxic sludge held back by a wall that’s 7 miles around and as high as a 50-story skyscraper. This mine will produce 11,000 tons of silver in 10 years before its reserves, the biggest in the world, are gone.

**Water**

**Current designs and new innovations solve for the water cost**

Matthew L. **Wald 23** (Matthew L. Wald, 10-17-2023, Nuclear Reactors Don’t Need to Be So Thirsty, Breakthrough Institute, https://thebreakthrough.org/blog/nuclear-reactors-dont-need-to-be-so-thirsty, Accessed 3-29-2025, wayway)

As to how much water all these processes “cost,” a United Nations Economic Commission for Europe study from 2019 takes a stab at some answers. The study put nuclear energy from at an average of about 2.4 liters per kilowatt-hour, counting all types of cooling systems. (A kilowatt-hour is enough to run an efficient kitchen refrigerator for a day.) An ordinary coal plant was about the same, but a coal plant that captured its carbon dioxide was far higher. And natural gas in a combined cycle system was a little lower. A further study by the U.S. Department of Energy’s National Renewable Energy Laboratory concurred that **plants with cooling towers consume far more water than once-through cooling systems, which “withdraw” about 10 times more water per megawatt-hour produced but release the water back to its source.** In the jigsaw puzzle of picking a site for a power plant, considerations include grid access, proximity to rail or barge transport for coal, or availability of pipelines for natural gas. Water is sometimes not a concern. In other locations, it’s a critical consideration. Hence the idea for a reactor that will be cooled by air, at **a project in Idaho** that will be built for a coalition of public power entities, the Utah Associated Municipal Power Systems (UAMPS), with a cluster of NuScale reactors. The decision about what kind of plant to build is unlikely to be based on water usage; more important are the needs of the electricity system. If nuclear is a good fit, others can go the route that was taken in Idaho. Future Nuclear UAMPS’ Idaho project may be a harbinger of the future, at least in dry locations. It **will use an air-cooled condenser**. The steam leaving the turbine runs inside metal tubes, and fans blow air on the outside of the tubes. This cools the water somewhat the way a car radiator does. Using an air-cooled condenser makes it much easier to pick a spot to build a reactor; no river or lake is needed. But there’s a downside; the fans need electricity. The penalty is in the range of 5% to 7% of electricity production, depending on climate. NuScale is betting that in Idaho, and in some other locations in the future, **the electricity** to cool the condenser **will be less valuable than the water** for a water-cooled condenser would be. One of the drawbacks, though, is that the amount of electricity needed for cooling goes up when the air is hot. In the summer, when the grid most needs the power, production available for the grid is reduced. An air-cooled condenser is unusual, but **some coal plants** do **use** them. Some of those plants are on rivers that have very low flows in summer, so they use **air cooling** during hot-weather months, and water the rest of the time. The Russians built some small reactors with air cooling in the arctic, where liquid water wasn’t always available. And some nuclear designs don’t use water to move heat within the reactor at all. In fact, they may use inert gas, liquid metal, or liquid salt. An advanced reactor that used molten salt or molten metal to move heat from the core to make steam would likewise need water to condense the steam back to water for reheating. But these might need less water per kilowatt-hour than the current generation of reactors because they operate at higher temperatures, and higher temperature steam can make more kilowatt-hours per BTU of heat. Gas-graphite reactors, which use an inert gas like helium to move energy from the fuel to the turbine, can re-heat the inert gas without condensing it at all. Some plants will use less water to cool the condenser because they will make beneficial use of the heat that is captured by cooling the steam back to water. That heat, today thought of as waste, could be used for water desalination, hydrogen production, district heating, or industrial heat.

**Nuclear energy can draw water from unsuitable sources while helping in water production**

Matthew L. **Wald 23** (Matthew L. Wald, 10-17-2023, Nuclear Reactors Don’t Need to Be So Thirsty, Breakthrough Institute, https://thebreakthrough.org/blog/nuclear-reactors-dont-need-to-be-so-thirsty, Accessed 3-29-2025, wayway)

Reactors can also run on water that is unsuitable for other purposes. **Palo Verde, in Arizona, which is the largest nuclear plant in the United States (and will continue to be so until Vogtle 4 is finished in Georgia) uses water recycled from a sewage plant.** Water will be a concern going forward because rainfall is becoming more variable than the early nuclear planners had foreseen. Likewise, the temperature of surface water, which is needed for the condenser, is now higher sometimes than the planners expected. **But nuclear technology is capable of operation with very low water consumption, and advanced nuclear technologies will make saving water easier.** And nuclear will likely have another connection to water: making it. **Desalination is now most commonly done with electricity, and sometimes from direct use of natural gas, using the waste heat of a gas-fired power plant. Reactors are a very good way to make heat and electricity, and do so without adding to the carbon burden of the atmosphere, which is what is causing water problems to begin with.**

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