# Fairmont Prep PJ -- NDCAs -- Neg vs. Campbell

1NC--- renewables, accidents

1AC--- space, climate

2NC--- accidents

2AC--- climate

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## 1NC

### 1NC -- Tradeoff

#### Renewables are solving the climate crisis now

**Bremmer 25** [Ian Bremmer, PhD in political science from Stanford University & Executive Committee Member of a UN High-level Advisory Body, 2-11-2025, Trump Will Not Kill the Global Energy Transition, Project Syndicate, https://www.project-syndicate.org/commentary/trump-will-not-kill-global-energy-transition-by-ian-bremmer-2025-02, Willie T.]

Despite Donald Trump's promise to boost fossil-fuel production, the **economic and technological forces** driving the clean-energy revolution cannot be stopped. The global transition will power forward, even if America has abandoned climate leadership, and even if the road ahead includes a few more bumps.

But Trump couldn’t kill the green transition during his **first term**, and he can’t kill it this time, either. The reason is simple: **Technological breakthroughs**, steep **learning curves**, and **plummeting costs** have made clean energy **cheaper than fossil fuels** in most places. Moreover, the revolution was just getting started in 2017, whereas now it has reached escape velocity. Its momentum is being driven not by politics or government intervention, but by **markets**. The fact that **deep-red (Republican-leaning) Texas** leads the United States in renewables deployment is a case in point. Politics will no longer hold back the American energy transition.

This is not to say that politics won’t slow the US transition. The Trump administration is already taking steps to loosen environmental and climate regulations, promote domestic oil and gas production, support gas-fired power plants, and end incentives to adopt clean energy and electric vehicles (EVs). The president’s day-one executive orders expanded the federal lands available for oil and gas exploration, reversed former President Joe Biden’s suspension of approvals for new liquefied natural gas terminals, and paused new wind projects on federal land and coastal waters. Aided by Republican majorities in Congress, Trump will seek to repeal roughly half of the Inflation Reduction Act’s outlays, including its provisions supporting EVs and offshore wind, as well as the IRA’s investment and production tax credits.

Yet that will not be enough to halt the forward movement of the US energy transition. Despite Trump’s claims of a “national energy emergency,” the US has been a net energy exporter since 2019 and already produces more oil than any country in history. Yet with prices low and US oil and gas output already at record levels, fossil-fuel production will struggle to rise much higher in the near term, regardless of what Trump does.

NEW YORK – Donald Trump’s return to the White House has raised fears that the global energy transition will be thrown into reverse. The US president has vowed to “drill, baby, drill,” roll back environmental regulations, and end the “green new scam.” As Earth continues to warm – last month was the hottest January on record, and 2024 was the first year with global average temperatures exceeding 1.5° Celsius above pre-industrial levels – many worry that we are about to witness a worldwide slowdown in the shift away from fossil fuels.

The deployment of clean energy will therefore **continue**, driven by increasing power demand and declining costs – **especially for solar**. American electric **utilities** will still invest aggressively in renewables to keep pace with **rising energy use** and ensure **grid adequacy**, even as new gas-fired power plants expand, too. US **automakers** will not abandon their long-term EV plans just because the Trump administration has eliminated subsidies and canceled funding for charging infrastructure. Besides, **Democratic-controlled states** will continue pursuing ambitious standard-setting decarbonization policies, as they did during Trump’s first term. Perhaps more importantly, meaningful parts of the **IRA will remain in place** because of their political support with **Republican constituencies**, which have benefited disproportionately from the new investments and job creation. Next-generation clean-energy technologies – nuclear, geothermal, and carbon capture and storage – will continue receiving support.

**Renewables are crucial to meeting 2030 goals. Lockhart 24**

Chelsea Bruce-Lockhart, 2-9-2024, "Why wind and solar are key solutions to combat climate change", Ember, <https://ember-energy.org/latest-insights/why-wind-and-solar-are-key-solutions-to-combat-climate-change/> // Lunde

Once installed, virtually no greenhouse gases are emitted as a result of wind and solar power generation, and they pay off the energy related to their manufacturing and construction within a matter of months. Their existence prevents the continuous burning of fossil fuels for decades. Over the course of a typical 3 megawatt wind turbine’s 25 year lifespan, 154,484 tonnes of coal would need to be burned to produce the equivalent amount of power. This would emit around 400,000 tonnes of CO2 into the atmosphere – roughly the same as driving an average petrol car around the equator 50,000 times. Global power sector emissions would have been 20% higher in 2022 if all the electricity from wind and solar had instead come from fossil generation. Building a global net zero power sector by 2045 – compatible with the goal of keeping global warming below 1.5 degrees – will, as modelled by the IEA, require the expansion of many types of clean power. But the necessary near-term solutions for cutting power sector emissions already exist. It is possible that technologies currently in development could change the landscape of what’s most efficient for scaling up clean power beyond 2030. But with the speed of transition required, wind and solar are crucial for keeping the world on track for 1.5C this decade.

**Unfortunately, aff investment into nuclear energy trades off with renewables**

1. **Investor incentive**

**Schlissel 24** [David Schlissel, engineering degrees from MIT and Stanford University, May 2024, Small Modular Reactors Still Too Expensive, Too Slow, and Too Risky, Institute for Energy Economics & Financial Analysis, https://ieefa.org/sites/default/files/2024-05/SMRs%20Still%20Too%20Expensive%20Too%20Slow%20Too%20Risky\_May%202024.pdf, Willie T.]

NuScale has based its reactor cost estimates on the assumption that its SMR will operate with a capacity factor of 95%. If built, that is possible, although probably optimistic, since the average for the operating reactors in the U.S. has never been that high. Duke Energy, for example, one of the largest nuclear plant operators in the U.S., says its fleet average has hit 95% during a couple of years, but not consistently. 34 Still, the key point is that if NuScale did consistently post a 95% capacity factor it would be **impossible** by definition for it also to be a flexible, load-following resource. Both things cannot be true. The reality is that developers bringing **multibillion**-dollar SMRs onto the electric grid would have **every incentive** to run them as much as possible to recover their costs through **electricity sales**. Instead of working with renewables, they would effectively be **blocking renewables** from the grid. The graphic below illustrates the problem for SMR developers. The less they run, the more their per megawatt-hour costs rise and the **harder it will be for them to compete** in the market. Having invested billions, it is unlikely developers will willingly cycle their plants to accommodate renewables.

**Tradeoffs are devastating - renewables are comparatively better than nuclear for the climate. Lovins 21**

[Amory B. Lovins is an adjunct professor of civil and environmental engineering at Stanford University who has advised major firms and governments in over 70 countries for 49 years, Dec 17, 2021, “Why Nuclear Power Is Bad for Your Wallet and the Climate,” // Arham S

<https://news.bloomberglaw.com/environment-and-energy/why-nuclear-power-is-bad-for-your-wallet-and-the-climate>]

Does climate protection need more nuclear power? No—just the opposite. Saving the most carbon per dollar and per year requires not just generators that burn no fossil fuel, but also those deployable with the least cost and time. Those aren’t nuclear. Making 10% of world and 20% of U.S. commercial electricity, nuclear power is historically significant but now stagnant. In 2020, its global capacity additions minus retirements totaled only 0.4 GW (billion watts). **Renewables** in contrast added 278.3 GW—782x more capacity—able to **produce** about **232x more** annual **electricity** (based on U.S. 2020 performance by technology). **Renewables** swelled supply and **displaced carbon as much every 38 hours as nuclear did all year**. As of early December, 2021’s score looks like nuclear –3 GW, renewables +290 GW. Game over. The world already invests annually $0.3 trillion each, mostly voluntary private capital, in energy efficiency and renewables, but about $0.015–0.03 trillion, or 20–40x less, in nuclear—mostly conscripted, because investors got burned. Of 259 US power reactors ordered (1955–2016), only 112 got built and 93 remain operable; by mid-2017, just 28 stayed competitive and suffered no year-plus outage. In the oil business, that’s called an 89% dry-hole risk. Renewables provided all global electricity growth in 2020. Nuclear power struggles to sustain its miniscule marginal share as its vendors, culture, and prospects shrivel. World reactors average 31 years old, in the U.S., 41. Within a few years, old and uneconomic reactors’ retirements will consistently eclipse additions, tipping output intopermanent decline. World nuclear capacity already fell in five of the past 12 years for a 2% net drop. Performance has become erratic: the average French reactor in 2020 produced nothing one-third of the time. China accounts for most current and projected nuclear growth. Yet China’s 2020 renewable investments about matched its cumulative 2008–20 nuclear investments. Together, in 2020 in China, sun and wind generated twice nuclear’s output, adding 60x more capacity and 6x more output at 2–3 times lower forward cost per kWh. Sun and wind are now the cheapest bulk power source for over 91% of world electricity. Nuclear Power Has No Business Case Nuclear power has bleak prospects because it has no business case. New plants cost 3–8x or 5–13x more per kWh than unsubsidized new solar or windpower, so new **nuclear power** produces 3–13x fewer kWh per dollar and therefore **displaces** 3–**13x less carbon** per dollar **than** new **renewables. Thus buying nuclear makes climate** change **worse**. End-use efficiency is even cheaper than renewables, hence even more climate-effective. Arithmetic is not an opinion. Unsubsidized efficiency or renewables even beat most existing reactors’ operating cost, so a dozen have closed over the past decade. Congress is trying to rescue the others with a $6 billion lifeline and durable, generous new operating subsidies to replace or augment state largesse—adding to existing federal subsidies that rival or exceed nuclear construction costs. But no business case means no climate case. Propping up obsolete assets so they don’t exit the market blocks more climate-effective replacements—efficiency and renewables that save even more carbon per dollar. Supporters of new subsidies for the sake of the climate just got played. Fashionably rebranded “Small Modular” or “Advanced” reactors can’t change the outcome. Their smaller units cost less but output falls even more, so SMRs save money only in the sense in which a smaller helping of foie gras helps you lose weight. They’ll initially at least double existing reactors’ cost per kWh; that cost is ~3–13x renewables’ (let alone efficiency’s); and renewables’ costs will halve again before SMRs can scale. Do the math: 2 x (3 to 13) x 2 = 12–52-fold. Mass production can’t bridge that huge cost gap—nor could SMRs scale before renewables have decarbonized the US grid. Even free reactors couldn’t compete: their non-nuclear parts cost too much. Small Modular Renewables are decades ahead in exploiting mass-production economies; nuclear can never catch up. It’s not just too little, too late: **nuclear hogs market space, jams grid capacity, and diverts investments** that more-climate-effective carbon-free competitors then can’t contest. Meanwhile, SMRs’ novel safety and proliferation issues threaten threadbare schedules and budgets, so promoters are attacking bedrock safety regulations. NRC’s proposed Part 53 would perfect long-evolving regulatory capture—shifting its expert staff’s end-to-end process from specific prescriptive standards, rigorous quality control, and verified technical performance to unsupported claims, proprietary data, and political appointees’ subjective risk estimates. But that final abdication can’t rescue nuclear power, which stumbles even in countries with impotent regulators and suppressed public participation. In the end, physics and human fallibility win. History teaches that lax regulation ultimately causes confidence-shattering mishaps, so gutting safety rules is simply a deferred-assisted-suicide pact. Modern renewable generation keeps rising faster than nuclear output ever did in its 1980s heyday. During 2010–20, renewables reduced global power-sector carbon emissions 6x more than coal-to-gas switching (ignoring methane escape), and 5x more than nuclear growth.

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#### AND the aff slows transition from fossil fuels.

**Schroeder 25** [Patrick Schröder, senior research fellow @ the Chatham House Environment and Society Centre & PhD in Environmental Studies from Victoria University of Wellington, 3-4-2025, Nuclear Power Is the Cuckoo in the Climate Policy Nest, Foreign Policy, https://foreignpolicy.com/2025/03/04/nuclear-power-australia-britain-reactors/, Willie T.]

It is fair to say that nuclear has become a cuckoo in the climate policy nest: a potentially **disruptive** presence during the energy transition. Nuclear power has entered climate policy discussions in **various** **countries** in a way that threatens to **dominate, divert, or disrupt** the focus on other short-term solutions, such as **fast deployment** renewable energy technologies.

A 2024 study by the Institute for Energy Economics and Financial Analysis found not only that SMRs are still “**too expensive**” and “too slow” to build, but also that investments in SMRs risk **taking resources away** from the carbon-free and lower-cost renewable technologies that are available today. The researchers concluded that this could delay the transition from fossil fuels forward **significantly** in the coming 10 years.

Recent data released by the International Energy Agency’s World Energy Outlook confirmed that renewable energy sources are going to remain the main drivers of the green transition despite the prognosed surge in nuclear energy production; the EU’s nuclear power production dropped from 2010 to 2023, leading the technology’s share in electricity production to fall from 29 percent to 23 percent.

The long construction times of **10-15 years**, substantial public financing required, and **frequent delays** further underscore that this technology cannot serve as a timely climate solution, especially when the U.N. Intergovernmental Panel on Climate Change emphasizes that global decarbonization must accelerate **steeply within the five years** (carbon dioxide emissions should decline by about 45 percent from 2010 levels by 2030) and continue over the next decades to reach net zero by 2050.

**Delaying the transition kills millions**

**Pearce 23** [Joshua M. Pearce, "Quantifying Global Greenhouse Gas Emissions in Human Deaths to Guide Energy Policy", August 19, 2023, MDPI, https://www.mdpi.com/1996-1073/16/16/6074] roy

2.4. Marginal Carbon Emissions-Related Deaths The estimates made in Section 2.1, Section 2.2 and Section 2.3 are very rough but provide a useful rule of thumb for gaging a first approximation. The 1000-ton rule makes it clear that there is a marginal human death cost to every amount of warming, no matter how small. Thus, **every 0.1 °C degree of warming** can be expected to **cause 100 million deaths**. Similarly, every 0.001 °C of warming will cause a million deaths. If humanity misses the 2 °C target or any of the more granular goals to stop ‘dangerous climate change’ [75], which appears likely according to AI models [76], rather than relax and accept it, **all efforts to reduce carbon emissions can be viewed as lifesaving.**

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### 1NC -- Accidents

Meltdowns

#### Trump is decking NRC independence allowing companies to skip steps causing Fukushima 2.0

**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?

#### AND Energy Secretary Chris Wright has a history of neglecting safety.

**Accountable 25** [Accountable US (Accountable.US (A.US) is a nonpartisan, 501(c)3 organization that shines a light on special interests that too often wield unchecked power and influence in Washington and beyond.) February 4, 2025, Watchdog: Senate Confirms Oil Man & Serial Workplace Safety Violator Chris Wright as Trump’s Energy Secretary", https://accountable.us/watchdog-senate-confirms-oil-man-serial-workplace-safety-violator-chris-wright-as-trumps-energy-secretary/, GZR]

WASHINGTON, D.C. – Following the Republican-led Senate’s vote to confirm Chris Wright as **U.S. Energy Secretary**, Accountable.US Executive Director Tony Carrk released the following statement: “The choice of Chris Wright to run the powerful Energy Department was based on what’s best for the bottom line of Donald Trump’s big oil megadonors, not everyday consumers and workers. With his Project 2025 ties and financial stakes in the big oil and nuclear industry, Wright is just the wealthy insider Trump needs to carry out his plans for padding profits of energy special interests – even if it means higher prices at the pump. And with Wright’s company’s history of violating workplace safety standards and anti-discrimination laws, he’s now in the driver’s seat to sweep such problems under the rug for his industry friends.” BACKGROUND: Conflicts Of Interest With Energy Companies **Chris Wright is a member of the board of Oklo nuclear company and has business before the Department of Energy. Oklo’s application before the Nuclear Regulatory Commission was previously denied due to a lack of information about accidents and safety. Chris Wright claims he will step down from the board, but questions remain about whether he will fairly regulate and ensure accountability from energy industries** when he has spent so much of his career working for and serving on the boards of oil and gas and nuclear energy companies. Project 2025 Wright has been on the board of the Western Energy Alliance, an oil industry trade group that authored many of Project 2025’s oil and gas provisions. Chris Wright has been a member of the board of Western Energy Alliance (WEA) WEA is an oil industry trade group. WEA’s president authored the oil and gas provisions of Project 2025. Project 2025 would eliminate “key offices at the DOE, including the Office of Energy Efficiency and Renewable Energy, the Office of Clean Energy Demonstrations, the Office of State and Community Energy Programs, the Office of Grid Deployment, and the Loan Programs Office.” Workplace Safety and Racial Harassment **Questions remain whether Wright will look the other way when energy companies violate safety standards** and anti-discrimination laws, considering his company, Liberty Energy, was frequently fined over workplace safety standards and paid $265,000 to settle lawsuits from black and Hispanic employees who faced hostile work environment and were called slurs. **Under Chris Wright’s leadership, Liberty Energy has faced at least three separate penalties for workplace and safety violations** since 2023. Liberty Energy, in 2024, paid $265,000 to settle an EEOC discrimination lawsuit after black and Hispanic field mechanics faced racial harassment.

#### Affirming gives Wright the keys.

**Lynch 25** [James Lynch, news writer for National Review & B.A. in Political Science from Notre Dame, 2-7-2025, Chris Wright Makes Unleashing Nuclear Power Priority for American Energy Abundance, National Review, https://www.nationalreview.com/news/chris-wright-makes-unleashing-nuclear-power-priority-for-american-energy-abundance/, Willie T.]

In a letter to sent Thursday, American Nuclear Society CEO Craig Piercy suggested that Wright focus securing congressional appropriations to fulfill his promises about advancing the nuclear power industry and supporting innovative reactors.

“Many in the industry think additional government support will be needed to reach nth-of-a-kind nuclear plant construction **costs**, while others believe rising electricity demand alone will take care of that in time,” the letter reads.

“Either way, as secretary of energy, you will **need appropriations** to engineer any kind of nuclear ‘win.’ You will spend more time than you think **preparing budgets**, arguing with the Office of Management and Budget over what’s included, and then defending said budgets on Capitol Hill. Don’t let the bean counters steal from you!”

**Accidents cause BioD Loss.**

**Olsson 11** [Henrik von Wehrden, Joern Fischer, Patric Brandt, Viktoria Wagner, Klaus Kümmerer, Tobias Kuemmerle, Anne Nagel, Oliver Olsson, Patrick Hostert, 12-28-2011, Chair of Material Resources, Institute of Environmental Chemistry, Leuphana University Lüneburg, Scharnhorststr, 1, 21335 Lüneburg, Germany "Consequences of nuclear accidents for biodiversity and ecosystem services," Society for Conservation Biology, https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/j.1755-263X.2011.00217.x, DOA: 3/30/2025] JZ

To characterize and quantify the potential **consequences of nuclear accidents for biodiversity and ecosystem services, we reviewed 521 published studies investigating the impacts of the Chernobyl disaster**, which, until now, has been the only available baseline event to empirically judge the consequences of catastrophic nuclear accidents (see online Supplementary Material for Methods). Specifically, our study aimed to (1) provide a summary of the spatial and temporal patterns of the documented effects of the Chernobyl disaster on a wide range of organisms, and (2) discuss the implications of nuclear accidents for the provision of ecosystem services, again, drawing on documented evidence in the aftermath of the Chernobyl accident. We conclude with four tangible take-home messages, intended to be **directly relevant to debates about the future of nuclear energy.**

Consequences or impacts to species

 Spatially, the documented effects of the Chernobyl disaster broadly follow known fallout patterns (Figure 1). However, variance in radiation levels is extremely high, not only between but also within sites. At a given study location, radiation levels have been shown to vary from 44,300 to 181,100 Becquerel per kilogram (Bq/kg) for mushrooms in southern Sweden (Mascanzoni 2009), from 3,000 to 50,000 Bq/kg for bats in Chernobyl (Gashchak et al. 2010), and from 176 to 587,000 Bq/kg for higher plants in southwestern Russia (Fogh & Andersson 2001); the latter equals almost a hundred times the threshold (600 Bq/kg) set by the European Union for Food that is deemed safe for consumption. High variance in radiation levels means that fallout maps based on extrapolations, models, and climate forecasts are not sufficient to evaluate radiation levels on a fine scale—field data are critically important for this purpose. Furthermore, radiation levels measured in the field and predicted fallout patterns based on meteorological data sometimes do not match (McAulay & Moran 1989), because additional factors, such as dry deposition, are not accounted for by climatic predictors (Arvelle et al. 1990). In addition, **some regions and types of ecosystems are systematically underrepresented in studies to date. For example, existing data is sparse for marine and aquatic ecosystems** (Figure 1).

Although many measurements were undertaken in the aftermath of the Chernobyl accident worldwide, existing **studies are greatly** **biased toward few taxonomic groups** (Figures 2 and 3). Most studies have focused on topsoil measurements and accumulation in the plant layer, which is where radiation can be most easily measured. **Despite this bias, it is clear that for most well-studied groups, greatly elevated radiation levels can occur up to thousands of kilometers away from the disaster site.** For example, recorded radiation levels in mushrooms were up to 13,000 Bq/kg in Denmark in 1991 (Strandberg 2003) and up to 25690 Bq/kg in Norway in 1994 (Amundsen et al. 1996).

**The consequences of elevated radiation levels in many parts of a given ecosystem remain poorly understood, but are likely substantial.** For example, rats showed changes in sleep behavior after drinking water poisoned with “only” 400 Bq/l (Lestaevel et al. 2006), and onions have shown a significantly elevated rate of chromosomal aberrations at levels as low as 575 Bq/kg (Kovalchuk et al. 1998).

Although numerous studies have investigated physiological and morphological alterations in the vicinity of the Chernobyl accident site, hardly any studies have quantified the possibility of such alterations at larger distances. This could be a major shortcoming, because **radiation levels are known to be greatly increased in some organisms even at large distances from the accident site** (see earlier)—physiological or morphological alterations, therefore, are plausible, at least in isolated instances. Where such alterations occur, their long-term consequences on the ecosystem as a whole can be potentially profound (Kummerer & Hofmeister 2009).

The legacies of the environmental consequences of the Chernobyl accident are still prevalent today, 25 years after the event. Although many studies have shown a peak in radiation immediately after the catastrophe and then a continuous decline, **radiation levels measured throughout the ecosystem are still highly elevated.** For example, radiation levels in mosses (Marovic et al. 2008), soil (Copplestone et al. 2000), and glaciers (Tieber et al. 2009) have remained greatly elevated in several locations around Europe. The long-lasting legacy of the Chernobyl accident was also illustrated by intense wildfires in the Chernobyl region in 2010, which caused a renewed relocation of radioactive material to adjacent regions (Yoschenko et al. 2006). The persistence of high radiation levels can be attributed partly to the half-life rates of the chemical elements involved (e.g., 31 years for Caesium-137; 29 years for Strontium-90; and 8 days for Iodine-131).

In addition to elevated radiation levels, **morphological and physiological changes are by definition long-term in nature, and can even be permanent** if **genetic alterations occur**. For example, a range of bird species now have developed significantly smaller brains inside the core zone around the Chernobyl reactor site compared to individuals of the same species outside this zone (Møller et al. 2011). The consequences of such changes on long-term evolutionary trajectories remain largely unknown.

**Lethal mutations following exposure to nuclear fallout have been observed in various plant** (Abramov et al. 1992; Kovalchuk et al. 2003) and animal species (Shevchenko, et al. 1992; Zainullin et al. 1992), yet research has mainly been conducted within the Chernobyl region. Morphological changes have also been observed in a wide array of species, including plants (Tulik & Rusin 2005), damselflies (Muzlanov 2002), diptera (Williams et al. 2001), and mice (Oleksyk et al. 2004). In addition, some studies have documented.

**Physiological effects, such as changes in the leukocyte level (Camplani et al. 1999) and reduced** **reproduction rates** (Møller et al. 2008). **Changes in genetic structure** have been recorded in various organisms, including fish (Sugg et al. 1996) and frogs (Vinogradov & Chubinishvili 1999). More broadly, elevated radiation can **negatively affect the abundance of entire species groups**, such as insects and spiders (Møller & Mousseau 2009a), raptors (Møller & Mousseau 2009b), or small mammals (Ryabokon & Goncharova 2006).

How low levels of radiation affect different species is poorly understood; studies have suggested that low levels of radiation can have a **persistent influence on mutation rates** in Drosophila (Zainullin et al. 1992), and can weaken **immune (Malyzhev 1993) and reproductive systems (Serkiz 2003) of small mammals;** but again, most studies have been restricted to the Chernobyl accident area. A more obvious measure of permanent change is widespread death of organisms living in the direct vicinity of the disaster site (Figures 1 and 2).

Food web and ecosystem impacts

In addition to effects on individual species, **biological** **accumulation through the food web can negatively** **affect some species**—particularly those at higher trophic levels and those depending on strongly affected food items. Bioaccumulation poses a risk to affected species because it **exacerbates exposure to elevated radiation levels, and hence, leads to increased chances of physiological or morphological alterations.** For example, can radiation levels in top predators remain elevated for a long time even when species at lower trophic levels show negligible radiation levels, as demonstrated for the Trench (Tinca tinca) in the Kiev Reservoir (Koulikov 1996).

#### BioD loss increases the chances of a pandemic.

**W**orld **H**ealth **O**rganization [agency created by the UN aimed at increasing health], "Biodiversity," February 18, 20**25**; accessed 4/9/25

https://www.who.int/news-room/fact-sheets/detail/biodiversity // Oliver J

Biodiversity plays a crucial role in disease regulation by maintaining balanced ecosystems where no single species dominates. This balance helps **limit** the spread of [zoonotic diseases](https://www.who.int/news-room/fact-sheets/detail/zoonoses) (infectious diseases that jump from animals to humans). Recent studies estimate that **over 75%** of emerging infectious diseases, such as Ebola or Nipah virus, are zoonotic and often arise in areas where ecosystems and habitats have been disrupted by deforestation or land-use change. By maintaining biodiversity, ecosystems can buffer humans from risks of exposure to disease reservoirs.

#### \*\*\*A zoonotic pandemic kills x amount of people. (ask willie)

**Extinction!**

**Torres 16** [Phil Torres, biologist, science communicator, 2-10-2016, "Biodiversity Loss and the Doomsday Clock: An Invisible Disaster Almost No One is Talking About," Common Dreams, https://www.commondreams.org/views/2016/02/10/biodiversity-loss-and-doomsday-clock-invisible-disaster-almost-no-one-talking-about, DOA: 3/30/2025] JZ

But there's another global catastrophe that the Bulletin neglected to consider -- **a catastrophe that will almost certainly have conflict** multiplying **effects no less than climate change. I'm referring here to biodiversity loss** -- i.e., the reduction in the total number of species, or in their population sizes, over time. The fact is that in the past few centuries, the loss of biological diversity around the world has accelerated at an incredible pace. Consider the findings of a 2015 paper published in Science Advances. According to this study, we've only recently entered the **early stages of the sixth mass extinction event in life's entire 3.5 billion year history.** The previous mass extinctions are known as the "Big Five," and the last one wiped out the dinosaurs some 65 million years ago. Unlike these past tragedies, though, the current mass extinction -- called the "Holocene extinction event" -- is almost entirely the result of a one species in particular, namely Homo sapiens (which ironically means the "wise man").

"If the environment implodes under the weight of civilization, then civilization itself is doomed."

But **biodiversity loss isn't limited to species** extinctions. As the founder of the Long Now Institute, Stewart Brand, suggests in an article for Aeon, one could argue that a more pressing issue is the reduction in population sizes around the globe. For example, the 3rd Global Biodiversity Report (GBO-3), published in 2010, found that the total abundance of vertebrates -- a category that includes mammals, birds, reptiles, sharks, rays, and amphibians -- living in the tropics declined by a whopping 59% between 1970 and 2006. In other words, the population size of creatures with a spine more than halved in only 36 years. The study also found that farmland birds in Europe have declined by 50% since 1980, birds in North America have declined by 40% between 1968 and 2003, and nearly 25% of all plant species are currently "threatened with extinction." The latter statistic is especially worth noting because many people suffer from what's called "plant blindness," according to which we fail "to recognize the importance of plants in the biosphere and in human affairs." Indeed, plants form the very bottom of the food chains upon which human life ultimately depends.

Even more disturbing is the claim that amphibians "face the greatest risk" of extinction, with "42% of all amphibian species ... declining in population," as the GBO-3 reports. Consistent with this, a more recent study from 2013 that focused on North America found that "frogs, toads and salamanders in the United States are disappearing from their habitats ... at an alarming and rapid rate," and are projected to "disappear from half of the habitats they currently occupy in about 20 years." The decline of amphibian populations is ominous because amphibians are "ecological indicators" that are more sensitive to environmental changes than other organisms. As such they are the "canaries in the coal mine" that reflect the overall health of the ecosystems in which they reside. **When they start to disappear,** biggerproblems are sure to follow.

Yet another comprehensive survey of the biosphere comes from the Living Planet Report -- and its results are no less dismal than those of the GBO-3. For example, it finds that the global population of vertebrates between 1970 and 2010 dropped by an unbelievable 52%. Although the authors refrain from making any predictions based on their data, the reader is welcome to extrapolate this trend into the near future, noting that as **ecosystems** weaken**, the likelihood of** further population losses increases. This study thus concludes that humanity would "need 1.5 Earths to meet the demands we currently make on nature," meaning that we either need to reduce our collective consumption and adopt less myopic economic policies or hurry up and start colonizing the solar system.

Other studies have found that 20% of all reptile species, 48% of all the world's primates, 50% of all freshwater turtles, and68% of plant species are currently threatened with extinction. There's also talk about the Cavendish banana going extinct as a result of a fungus, and research has confirmed that honey bees, which remain "the most important insect that transfers pollen between flowers and between plants," are dying out around the world at an alarming rate due to what's called "colony collapse disorder" -- perhaps a good metaphor for our technologically advanced civilization and its self-destructive tendencies.

Turning to the world's oceans, one finds few reasons for optimism here as well. Consider the fact that atmospheric carbon dioxide -- the byproduct of burning fossil fuels -- is not only warming up the oceans, but it's making them far more acidic. The resulting changes in ocean chemistry are inducing a process known as "coral bleaching," whereby coral loses the algae (called "zooxanthellae") that it needs to survive. Today, roughly 60% of coral reefs are in danger of becoming underwater ghost towns, and some 10% are already dead. This has **direct** **consequences for humanity because coral reefs "provide us with food, construction materials (limestone) and** **new** **medicines,"** and in fact "more than half of new cancer drug research is focused on marine organisms." Similarly, yet another study found that ocean acidification is becoming so pronounced that the shells of "tiny marine snails that live along North America's western coast" are literally dissolving in the water, resulting in "pitted textures" that give the shells a "cauliflower" or "sandpaper" appearance.

Furthermore, human-created pollution that makes its way into the oceans is carving out vast regions in which the amount of dissolved oxygen is too low for marine life to survive. These regions are called "dead zones," and the most recent count by Robert Diaz and his colleagues found more than 500 around the world. The biggest dead zone discovered so far is located in the Baltic Sea, and it's been estimated to be about 27,000 square miles, or a little less than the size of New Hampshire, Vermont, and Maryland combined. Scientists have even discovered an "island" of trash in the middle of the Pacific called the "Great Pacific Garbage Patch" that could be up to "twice the size of the continental United States." Similar "patches" of floating plastic debris can be found in the Atlantic and Indian oceans as well, although these are not quite as impressive. The point is that "Earth's final frontier" -- the oceans -- are becoming vast watery graveyards for a huge diversity of marine lifeforms, and in fact a 2006 paper in Science predicts that there could be virtually no more wild-caught seafood by 2048.

Everywhere one looks, the biosphere is wilting -- and a single bipedal species with large brains and opposable thumbs is almost entirely responsible for this worsening plight. If humanity continues to prune back the Tree of Life with reckless abandon, we could be forced to confront a global disaster of truly unprecedented proportions. Along these lines, a 2012 article published in Nature and authored by over twenty scientists claims that humanity could be **teetering on the brink of a catastrophic, irreversible collapse of the global ecosystem**. According to the paper, there could be **"tipping points" -- also called "critical thresholds" -- lurking in the environment that, once crossed, could initiate radical and sudden changes in the biosphere**. Thus, an event of this sort could be preceded by little or no warning: everything might look more or less okay, until the ecosystem is suddenly in ruins.

We must, moving forward, never forget that just as we're minds embodied, so too are we bodies environed, meaning that **if the environment implodes under the weight of civilization, then civilization itself is doomed.** While the threat of nuclear weapons deserves serious attention from political leaders and academics, as the Bulletin correctly observes, it's even more imperative that we focus on the broader "contextual problems" that **could inflate the overall probability of wars and terrorism in the future.** Climate change and biodiversity loss are both conflict multipliers of precisely this sort, and each is a contributing factor that's exacerbating the other. If we fail to make these threats a top priority in 2016, the **likelihood of nuclear weapons -- or some other form of emerging technology, including biotechnology and artificial intelligence -- being used in the future will only increase.**

Perhaps there's still time to avert the sixth mass extinction or a sudden collapse of the global ecosystem. But time is running out -- the doomsday clock is ticking.

#### Independently, accidents turn *GLOBAL* sentiment against nuclear which kills aff solvency --- Fukushima proves.

**Paillere 20** [Dr. Henri PAILLERE has over 26 years of experience in the nuclear energy sector and is currently working as Head of the Planning and Economic Studies Section at the International Atomic Energy Agency, 11-27-2020, Nuclear Power 10 Years After Fukushima: The Long Road Back, IAEA, https://www.iaea.org/newscenter/news/nuclear-power-10-years-after-fukushima-the-long-road-back, Willie T.]

At the beginning of the new millennium, amid growing awareness of the link between energy-related greenhouse gas emissions and climate change, the notion of a ‘nuclear renaissance’ became popular. Scientists and policy makers identified low carbon nuclear power as a potential protagonist in the transition to clean energy.

However, the accident at the Fukushima Daiichi Nuclear Power Plant, operated by the Tokyo Electric Power Company (TEPCO), on 11 March 2011 dealt a blow to plans for swiftly scaling up nuclear power to address not only climate change, but also energy poverty and economic development. As the global community turned its attention to strengthening nuclear safety, several countries opted to phase out nuclear power.

Following efforts to strengthen nuclear safety and with global warming becoming ever more apparent, nuclear power is regaining a place in global debates as a climate-friendly energy option. That is due to its vital attributes: zero emissions during operation, 24/7 availability, a small land footprint and the versatility to decarbonize ‘hard-to-abate’ sectors in industry and transportation. But even as technology-neutral organizations such as the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) recognize nuclear power’s ability to address major global challenges, the extent to which this clean, reliable and sustainable source of energy will achieve its full potential remains uncertain.

The Fukushima Daiichi accident and public acceptance in some countries continue to *cast a shadow* over nuclear power’s prospects. Furthermore, in some major markets, nuclear power lacks a favourable policy and financing framework that recognize its contributions to climate change mitigation and sustainable development. Without such a framework, nuclear power will struggle to deliver on its full potential, even as the world remains as dependent on fossil fuels as it was three decades ago.

Impact on electricity generation

The biggest immediate blow to nuclear electricity generation came in Japan. With public confidence in nuclear power at record low levels following the accident, authorities suspended operations at 46 of the country’s 50 operational power reactors. Nuclear energy, a strategic priority since the 1960s, supplying almost a third of Japan’s electricity, was suddenly shelved. In 2019, nuclear power provided only 7.5% of Japan’s electricity. Just nine nuclear power reactors have resumed operation.

Meanwhile, public and government opinion turned against nuclear power in some other countries as well. Germany, less than three months after the accident, decided to phase out nuclear power entirely by 2022. All but six of the country’s 17 power reahttps://thecommonsenseshow.com/activism-agenda-21-conspiracy/how-coming-cascadia-subduction-zone-event-will-produce-extinction-level-event-part-onectors have since been permanently shut down. Nuclear power produced about 12% of the country’s electricity in 2019 compared with around 25% before the accident at Fukushima Daiichi, while coal-fired plants remained the largest source of electricity, according to the IEA. Elsewhere, Belgium confirmed plans to exit nuclear power by 2025. In Italy, a government-backed plan to bring back nuclear power, shuttered since 1990, fizzled. And countries such as Spain and Switzerland decided not to build new nuclear plants. Between 2011 and 2020, some 48 GWe of nuclear capacity was lost globally as a total of 65 reactors were either shut down or did not have their operational lifetimes extended.

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### AT: Space

2. Their own evidence, Risch 25, which they cite, specifically says

**Current funding is insufficient. Disregard doubt on fusion. Any risk that we prove federal investment is enough to make fusion possible AND faster means it’s try or die. Risch 25 FAIRMONT READS BLUE**

James Risch, Maria Cantwell, Ylli Bajraktari, Risch is an American lawyer and politician who has served as the junior United States senator from Idaho since 2009, Cantwell is an American politician who has been the junior United States senator from Washington since 2001, Bajraktari is the President and CEO of the Special Competitive Studies Project February 24 2025, "Fusion Power Enabling 21st Century American Dominance" No Publication,

https://www.scsp.ai/wp-content/uploads/2025/02/Final-Fusion-Power\_-Enabling-21st-Century-American-D ominance.pdf //rchen

Thanks to decades of federal investment in basic research, American **scientists have** now **proven** that **fusion is possible**. Growing power demands,**recent tech**nological **breakthroughs**, and the shifting market dynamics of energy create a unique opportunity for fusion to finally see its time in the Sun. A big bet on fusion could **secure America’s position** as a technological superpower for decades to come. The Global Fusion Race The U.S. Fusion Landscape America has led the world in fusion energy sciences since the days of the Manhattan Project.12 U.S. universities have consistently attracted the world’s best talent, many of whom created today’s leading fusion companies. Our National Labs beat the world in demonstrating fusion’s scientific feasibility. **Yet** despite this legacy of scientific excellence, the **U**nited **S**tates finds itself **underprepared** for fusion’s transition from experimental science to commercial reality.**Achieving fusion** energy on a competition-relevant timeline will **require** more than just tackling key scientific hurdles. It calls for an entirely different posture than the current U.S. approach, one that prioritizes commercialization and optimizes **U.S. spending on fusion.** Though progress has been made in strategy, infrastructure, and **investment**in recent years, it is not sufficient to compete and harness fusion energy’s full potential. An assessment of the U.S. fusion landscape reveals: Strategy: Stemming from the 2022 Bold Decadal Vision,recent U.S. strategic initiatives have laudably sought to push fusion toward commercialization, but have **fallen short**in translating ambitious goals into urgent, concrete, actionable policies **and** programs.13 The Department of Energy’s (DOE) 2024 Fusion Energy Strategy focuses on three pillars: bridging technological gaps for a pilot plant, enabling sustainable deployment, and forging external partnerships.14 The Milestone-Based Fusion Development Program, modeled after NASA’s Commercial Orbital Transportation Services (COTS) program, seeks to reduce investment risk by setting discrete technical milestones that unlock government funds. Other programs include the Fusion Innovation Research Engine (FIRE) Collaboratives, which provide testing infrastructure that private firms can**not** develop on their own,15 the Innovation Network for Fusion Energy (INFUSE), which provides access to technical and financial support,16 and most recently the Private Facilities Research (PFR) program, which will enable public research at private fusion facilities.17However, appropriations for these programs have been less than **Congressionally authorized** levels.18 The **failure to implement** many critical **recommendations** made by strategic documents, such as DOE’s Fusion Long-Range Plan, has **left** an **incomplete ecosystem** that China is racing to complete itself.19 Scientific Breakthroughs: In December 2022, after a decade of diligent work, scientists at the U.S. National Ignition Facility (NIF) achieved the long-sought milestone of producing more energy in a fusion reaction than the laser energy used to create it (Q > 1).20 Indeed, the fusion process itself became the primary source of heat for the fusion fuel, signifying true ignition. NIF scientists have reproduced ignition multiple times since, while no other machine has yet to replicate it.21 The NIF’s breakthrough marked the starting gun for the commercial fusion race, but there are a number of scientific and engineering challenges on the road ahead.22 The scientific community has identified a suite of R&D infrastructure that—with **an upfront investment**—would help **solve** these **challenges and unlock fusion**’s economic potential.23 The key hurdles involve sustaining and stabilizing a burning plasma, increased energy gain, developing components that can handle radiation and extreme heat, and breeding and recycling tritium to fuel the reaction.24 In addition to hardware and infrastructure, significant progress has been made, largely in the United States, in the computer simulation of plasmas.25 Simulation has driven the invention of new concepts, such as the Spherical Tokamak NSTX-U at the Princeton Plasma Physics Laboratory (PPPL).26 The United States is also applying AI across multiple fusion fronts, including PPPL’s AI platforms predicting and preventing plasma instabilities in real time.27 The combination of advanced simulations and

AI is poised to further accelerate the development of optimized fusion designs, **significantly expediting the path to** practical**fusion energy**.

#### 3. [NL] Fusion is a myth -- takes into account breakthroughs that the aff cites.

Philip **Ball** [graduate @Oxford; author of the acclaimed *Critical Mass: How One Thing Leads to Another]*, "What Is the Future of Fusion Energy?," June 1, 20**23**

<https://www.scientificamerican.com/article/what-is-the-future-of-fusion-energy/> // Oliver J \*\*images omitted\*\*

Nuclear fusion won’t arrive in time to fix climate change, but it could be essential for our future energy needs

Last December physicists working on fusion **claimed a breakthrough**. A team at the National Ignition Facility (NIF) in California announced it had [extracted more energy from a controlled nuclear fusion reaction than had been used to trigger it](https://www.scientificamerican.com/article/nuclear-fusion-lab-achieves-ignition-what-does-it-mean/). It was a global first and a significant step for physics—but **very far** from enabling practical exploitation of fusion as an energy source. The high-profile announcement elicited a familiar pattern of responses to fusion research: acclaim from boosters of the technology and dismissals from skeptics, who complain that scientists continually promise that fusion is **just 20 years away** (or 30 or 50, take your pick).

These fervent reactions reflect the [high stakes for fusion](https://www.scientificamerican.com/article/the-road-to-fusion/). The world is increasingly desperate for an abundant source of clean energy that can **mitigate the climate crisis** created by burning fossil fuels. Nuclear fusion—the merging of light atomic nuclei—has the potential to produce energy with near-zero carbon emissions, without creating the dangerous radioactive waste associated with today's nuclear fission reactors, which split the very heavy nuclei of radioactive elements. Physicists have been studying fusion power **since the 1950s**, but turning it into a practical energy source has remained frustratingly elusive. Will it ever be [a significant source of power for our energy-hungry planet](https://www.scientificamerican.com/article/its-time-for-congress-to-support-fusion-energy/)—and if so, will it arrive in time to save Earth from meltdown?

The latter question is one of the few in this field to which there is a clear answer. Most experts agree that we're unlikely to be able to generate large-scale energy from nuclear fusion before around **2050** (the cautious might add on another decade). Given that the global temperature rise over the current century may be largely determined by what we do—or fail to do—about carbon emissions before then, fusion can **be no savior.** (Observatory columnist Naomi Oreskes also makes this point [here](https://www.scientificamerican.com/article/why-nuclear-fusion-wont-solve-the-climate-crisis/).) “I do think fusion looks a lot more plausible now than it did 10 years ago as a future energy source,” says Omar Hurricane, a program leader at Lawrence Livermore National Laboratory, where the NIF is housed. “But it's not going to be viable in the next 10 to 20 years, so we **need other solutions**.”

Decarbonizing by mid-century will therefore **depend on other technologies**: renewables such as solar and wind; nuclear fission; and perhaps carbon-capture techniques. As we look further out, though, there are good reasons to think fusion will be a key part of the energy economy in the second half of the century, when more developing countries will start requiring Western-size energy budgets. And solving the problem of climate change is not a one-time affair. If we can navigate the bottleneck of the next few decades without transforming the climate too radically, the road beyond may be smoother.

Everything else was analytical

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### AT: Climate

#### T - Uranium and released vapors increase emissions.

**Jacobson 24** [Mark Z. Jacobson, Professor of Civil and Environmental Engineering @ Stanford, 10-10-2024, 7 reasons why nuclear energy is not the answer to solve climate change, One Earth, https://www.oneearth.org/the-7-reasons-why-nuclear-energy-is-not-the-answer-to-solve-climate-change/, Willie T.]

6. Carbon-Equivalent Emissions and Air Pollution

There is **no such thing** as a zero- or close-to-zero emission nuclear power plant. Even existing plants emit due to the **continuous mining and refining of uranium** needed for the plant. Emissions from new nuclear are 78 to 178 g-CO2/kWh, **not close to 0.** Of this, 64 to 102 g-CO2/kWh over 100 years are emissions from the background grid while consumers wait 10 to 19 years for nuclear to come online or be refurbished, relative to 2 to 5 years for wind or solar. In addition, all nuclear plants emit 4.4 g-CO2e/kWh from the **water vapor and heat they release**. This **contrasts** with solar panels and wind turbines, **which reduce** heat or water vapor fluxes to the air by about 2.2 g-CO2e/kWh for a **net difference** from this factor alone of **6.6 g-CO2e/kWh.**

In fact, China’s investment in nuclear plants that **take so long** between planning and operation instead of wind or solar resulted in China’s CO2 emissions **increasing 1.3 percent** from 2016 to 2017 **rather than declining** by an estimated average of 3 percent. The resulting difference in air pollution emissions may have caused **69,000 additional air pollution deaths** in China in 2016 alone, with additional deaths in years prior and since.

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