Contention 1 is Court Clog

Courts are working efficiently now

Reuters '23 [Thomson Reuters; February 3; News and information services company, citing the second annual State of the Courts report, which included a survey of over 200 judges; Thomson Reuters, "Court efficiency: Using legal technology to alleviate delays," https://legal.thomsonreuters.com/blog/using-legal-technology-to-alleviate-delays/] recut //cy

Courts are investing in **tech**nology: Almost **two-fifths** reported an introduction of new/**improved methods**/processes or **service innovations** in the past **12 months**. The top improvements are **E-filing**, Zoom/Web-Ex/Teams, etc., and **virtual/remote hearings**. Although these are critical **tech**nology **investments** for a court's **digital infrastructure**, more can be done to ensure the judge has access to all relevant information and legal analysis to make **faster decisions** with confidence. **Virtual** courts are here to stay: Naturally, the pandemic also seems to have spawned a broader adoption of virtual hearings to help with these delays. That trend has continued, as the majority of respondents said they regularly attend virtual hearings, and 40% of those asked said they actually outnumber traditional ones now. Further, video conferencing has been adopted by 90% of respondents.Opportunity to **reduce delays** by addressing **root causes**: One of the major factors that slows a case down is hearing delays. The TR survey showed that the average Judge has 58 hearings per week. And, on average 10 of those hearings (18%) were delayed. Moreover, a hearing delay has a domino effect on other cases. 77% of the judges surveyed said that the impact of a single delay impacts other cases on the docket. Implementing solutions to reduce the number of hearing delays is key to any modernization strategy. The survey further asked courts to identify the top causes for delays. The number one cause for delays was failure to appear, the number two cause was for evidentiary delays, the number three cause was clerical error, and the number four cause was legal issue. Strategies to reduce delaysOffer **remote** participation **options** – In Arizona, judges and other court officials reported a notable boost in participation rates in 2020, largely due to remote access. There was an 8% year-over-year drop in automatic judgments in June of 2020 and the failure-to-appear rate for eviction proceedings in Arizona's largest county, Maricopa, dropped from close to 40% in 2019 to just around 13% in February of 2021.**Organize evidence** and legal **analysis** – A judge's time is the court's most valuable resource. It is **critical** that any **modernization** strategy includes **solutions** that shorten the **time** it takes for the judge to gain all the **requisite information** needed to confidently make a decision.

The aff opens the floodgates and overburden the courts

MacNeil '13 [Robert; September 10; Senior Lecturer at the University of Sydney; Climate Policy, "Alternative Climate Policy Pathways in the US," vol. 13] https://ideas.repec.org/a/taf/tcpoxx/v13y2013i2p259-276.html recut //cy

Title: Alternative Climate **Policy** Pathways**i**n the US The implementation of these schemes, however, should not lead one to underestimate the immense political will that will be required to undertake such a task. Indeed, **any** administration that **attempt**ed to implement such a programme would be required to spend vast quantities of political capital on the endeavour, and would **undoubtedly** face **considerable** political and legal challenges. From the Right,the programme would be **attacked** not only for the supposed **regulatory** and **cost burdens** placed on **businesses** and **households**, but also for the nature of the strategy itself and the potentially **antidemocratic** optics of '**legislating** through the **backdoor**'. Moreover,the EPA would have to contend seriously with the **very real possibility** that Congress will attempt to **strip** the **agency** of its **authority** to regulate GHG emissions. This has occurred in the **past** in the form of **bills** and **riders** proposed by Republicans and Democrats **alike**. For example, in 2009, the Republican Senator of Alaska, Lisa Murkowski, put forth a rider on the EPA's appropriations bill for that year that would have achieved this end, and in 2010, the Democratic Senator of West Virginia, Jay Rockefeller, proposed a bill that would have suspended GHG emissions regulation for all stationary sources (Monast et al., 2010). Indeed, a **series** of **legal challenges** regarding the agency's initial **endangerment finding** and **tailoring rule** would be all but **inevitable**. Although most of these problems could be dealt

with through presidential vetoes – as indeed President Obama has done by signalling his intention to veto any attempts to remove the EPA's capacity to regulate GHGs30 – the continuity of such a rule is at risk given that the Executive Branch will eventually change hands. Still, short of a future Republican administration completely abolishing the CAA – a near-impossibility given that congressional gridlock on the environment cuts both ways, with the Democratic Party scuttling most major roll-backs proposed by the Republicans since the 1980s – such an incoming administration would find itself in a difficult position if it attempted to get rid of the programme. Indeed, if a GOP administration attempted to shirk the obligations that stem from Massachusetts v. EPA,the **f**ederal **g**overnment should expect an **endless stream** of **lawsuits** from **states** and **interest groups**. At best, it could attempt to change the EPA's endangerment finding and assert that GHGs do not, in fact, contribute to climate change. However, it would once again be sued for this and would risk a great deal of international embarrassment and derision, as it would have to cite extremely marginal 'scientific' evidence to support such a claim.

Empirics prove

Nuclear News, 01-13-2025, [Website Dedicated to updates on nuclear industry], "Last Energy, Texas, Utah allege NRC overstepping in SMR regulation," ANS, https://www.ans.org/news/2025-01-13/article-6680/last-energy-texas-utah-allege-nrc-overstepping-in-s mr-regulation/, accessed 3-30-2025 //cy

Advanced nuclear reactor company Last Energy joined with two Republican state attorneys general in a **lawsuit** against the Nuclear Regulatory Commission, arguing that some microreactors should not require the commission's approval. **Utah and Texas** are the states involved in the lawsuit, which was filed December 30 in federal court in Texas. The parties' goal is to **accelerate the pace** of micro- and small modular reactor deployment in the United States by exempting some new technologies from the traditional licensing process. According to a Last Energy spokesperson, "This case will determine the threshold at which a nuclear reactor is so safe that it is below concern for federal licensing. There's no doubt that robust shielding can eliminate exposure to, and the hazards from, nuclear radiation. Congress and former NRC executive director Victor Stello Jr. have both argued for a de minimus standard, and our intent is for the courts to enforce that recommendation." An NRC spokesperson said the agency will respond through its filings with the district court. Background: The nuclear power industry is experiencing a surge of support as Americans are using more energy through the electrification of the economy. The biggest customers in the playing field are large tech companies trying to build additional data centers and support artificial intelligence growth, both power-hungry endeavors. Recent federal legislation like the ADVANCE Act won bipartisan approval in 2024 and aims to make sweeping changes in the approval process for new nuclear technology. Unlike Last Energy's lawsuit, the new policy isn't trying to cut the NRC out of the licensing process—it's trying to streamline the commission's workflow and make the review process more efficient. But some say the NRC review **should not be necessary** in all cases, pointing to an example of microreactors too small to power evan an LED lightbulb that under current rules still require complicated and costly NRC licensing, the lawsuit states. Last Energy's microreactor is designed to produce 20 MW, which is about as large as a unit can be while still categorized as "micro." The units can be scaled to meet customer demand, and Last Energy promises deployment in under 24 months. The company has issued news releases about deployment progress globally—with agreements for more than 80 units across Europe—but has yet been able to secure licensing to deploy units domestically. The states argue: "SMRs are not being constructed or operated in Texas because of prohibitive NRC regulations. . . . The NRC's unlawful and overburdensome regulations have effectively precluded Last Energy from placing SMRs in Texas and continue to stymie Last Energy's efforts," the lawsuit spells out. Utah is involved "for many of the same reasons Texas is harmed," according to the lawsuit, with the state seeing rapid population growth, increasing energy demand, and retiring baseload power sources. In October, Gov. Cox launched Operation Gigawatt, with the goal of doubling Utah's power production over the next 10 years and specifically calling out nuclear as a source to help meet the state's clean, reliable energy needs.

Mere risk of litigation decimates innovation.

Lee '21 [Jongsub; February 24; Associate Professor of Finance at Seoul National University, PhD, Finance, NYU Stern; Texas A&M University Department of Finance, "Inter-firm Patent Litigation and Innovation Competition," https://mays.tamu.edu/department-of-finance/wp-content/uploads/sites/2/2021/03/Oh.pdf]

The importance of intellectual property to firms has increased over time, and conse- quently, patent litigation has become an important means of actively protecting valuable patent intellectual properties. As these intellectual properties are essential for defining firms' product market boundaries, it is important to elucidate the potential broader impact of patent litigation on various corporate policies. For example, costly patent litigation could hurt firms' financial health, which, in turn, may deter their investment activity through financial frictions (Zingales (2002)). More indirect evidence could also include changes in firms' innovation landscape, such as expanding or narrowing the current technological scope given rising intellectual property rights disputes. In growing technological sectors, patents have become an essential input for producing goods that are competitively sold in end- product markets. Therefore, patent litigation could have a significant impact on product market dynamics through its effect on both the level and scope of subsequent innovation activities. Using novel hand-collected inter-firm patent litigation data, we examine the effects of patent litigation on firms' innovation strategies in product markets. Rather than focusing on non-practicing entity (NPE)-driven patent litigation known as "patent trolls" (e.g., Cohen, Gurun, and Kominers (2019)), we examine inter-firm patent litigation in which both the plaintiffs and defendants are practicing entities (PEs) that compete in similar (or different) product markets. In many respects, the motives of NPE patent litigation differ from those of inter-firm patent litigation. For example, NPE litigation is less likely to result in back-to-back litigation,1 while inter-firm litigation is frequently followed by subsequent lawsuits, such as the recent Samsung vs. Apple cases. Unlike patents in NPE litigation that have increasingly become unrelated to firms' core technology and products (Government Accountability Office (2013)),2 patents in inter-firm litigation tend to embed firms' key technology and amplify litigation consequences through loss of sales, disruption of product lines and subsequent product market strategy, and even corporate bankruptcy. A case in point is a series of patent disputes between Johnson & Johnson and Boston Scientific around a key technology in coronary artery stents. After a series of disputes, Boston Scientific eventually settled the cases by paying Johnson & Johnson of $1.7 billion. This was the largest sum ever paid to resolve patent litigation over a medical device and subsequently halved Boston Scientific's cash holding, curtailed the acquisition opportunities, and led to a layoff of about 1,300 em- ployees worldwide.3 Such strategic interactions between practicing entities would eventually impact industrial-organizational dynamics, which is the main focus of our paper. Using inter-firm patent litigation data between 2005 and 2011, we uncover a significant interplay between intellectual property rights' boundaries and product market dynamics. We demonstrate how innovation competition interacts with product market competition in the presence of significant litigation risk, which we instrument using China's passage of National Intellectual Property Strategy (NIPS) reform in 2008. By its nature, our study significantly differs from the studies that focus on other types of corporate litigations such as security lawsuits (Bhagat, Brickley, and Coles (1994), Bhagat, Bizjak, and Coles (1998)) that focus on the debate between a firm and its investors regarding corporate governance, managerial misconduct, and disclosure-related issues. Our sample period also differs from that of the studies in that we focus on the post-2000 time period when corporate innovation serves as a central driver of entrepreneurial growth and product market dynamics in the U.S. private sector. This differentiates our study from the literature that primarily focuses on the early period like 80's (e.g., Bhagat et al. (1994)). Building upon the theoretical notions introduced by Lanjouw and Lerner (1997), we identify legal expenses, damages awards, and the probability of winning a case as important determinants of patent litigation. Using this framework, we derive several testable impli- cations for the economics of inter-firm patent litigation. We first hypothesize that patent litigation reduces patenting activity of defendant firms as the expected cost incurred by lit- igation increases a firm's hurdle rate for innovation investments. We further predict that defendant firms are more likely to narrow down the scope of their innovation activities after litigation (i.e., more exploitative innovations rather than exploratory innovations) to reduce future litigation risk. Lastly, we expect the decrease in innovation activities and the pursuit of exploitative innovations to be more pronounced among firms with greater product market overlap due to the larger expected damages awards upon litigation. A key challenge in estimating the patent litigation effect on firms' innovation activity is that patent litigation is likely endogenous to a number of observable and unobservable factors. For example, financially weaker firms may be targeted more easily in patent lit- igation and these firms could also reduce innovation activity. To alleviate these potential endogeneity concerns, we use an instrumental variable approach. We use China's passage of NIPS in 2008 as a quasi-natural experiment that exogenously increases the U.S. firms' patent litigation risk. The strengthening intellectual property (IP) rights in China around NIPS increases sales, royalties, and licensing fees received by the U.S. firms that have already established strong operational exposure in China. The incentives to protect their IP-related profits from China imply that these firms could preemptively stop potential domestic rivals who could prey on new business opportunities that arise in China post-NIPS reform. The U.S. firms with strong presence in the Chinese product market would attempt to secure their IP boundaries against new entrants through active IP-related litigation strategies, which is the main channel through which we identify arguably more exogenously increasing litigation risk among the U.S. firms. Using this instrumental variable approach, we find that firms in the industries with Chinese market exposure prior to NIPS are more likely to be defendants in inter-firm patent litigation. We further find that such increasing patent litigation risk significantly reduces defendant firms' innovation activity by 7.5% based on the number of new patent applications by these firms. The effect is statistically significant at the 1% to 5% levels, and is consistent with our theoretical prediction that patent litigation increases the cost of innovation and discourages corporate innovation activities. These defendant firms also seem to attempt to offset the adverse litigation shock by shifting innovation strategy toward more narrow-scoped ones in order to keep the future litigation risk lower. We empirically gauge at firms' innovation strategy using exploitative and exploratory measures developed by Gao, Hsu, and Li (2018). We find that defendant firms' innovation becomes more exploitative and less exploratory to avoid inter-firm IP disputes. Firms increasingly depend on the existing patents and technologies, while they explore less on new

knowledge outside the firm's existing **IP** boundary. Firms' innovation activities become **significantly narrower** in scope when they face rising innovation competition. Next, we go one step further and examine whether the patent litigation effect inter- acts with product market dynamics. We decompose our litigation cases into intra- versus inter-industry cases. Based on the firms' product markets in place, we define a case as an intra-industry case if the IP dispute occurs between plaintiffs and defendants in the same three-digit standard industrial classification (SIC) code. Other cases are defined as inter-industry cases accordingly. Consistent with our theoretical prediction, we find that the negative litigation effects on corporate innovation activities strengthens in the intra-industry cases, in which greater product market overlap amplifies the damages award of inter-firm lit- igation. The litigation effects in intra-industry cases are almost four times larger than those in the inter-industry cases. We further show the robustness of our findings to the use of an alternative product market classification measure, product market fluidity, developed by Hoberg, Phillips, and Prabhala (2014). This alternative measure defines the product market rivals based on the product description overlap as reported in the firms' annual reports. Finally, we analyze broader product market implications of inter-firm patent litigation. Patents are inherently linked to product market competition as they provide monopoly rights to use, make, and sell the pertinent invention. Patent policies and patent litigation courts often consider the extended impact on market competition. Hence, we first investigate how patent litigation affects industry competition between market rivals. We use Hoberg and Phillips (2010) text-based network industry classification (TNIC) data and obtain TNIC score that measures the competitiveness of rivals based on the similarity of product descrip- tions. We find that patent litigation intensifies the competition among rivals of a defendant because patent litigation shrinks the sphere of product market competition as innovation becomes more exploitative. While rivals become more similar and competitive, the overall firm distribution in industries becomes more dispersed in size and patenting activities. In summary, we find that patent litigation appears to locally intensify the product market com- petition among "close" rivals, yet it makes firms in the industry more dispersed in innovation outcomes. Given that patent litigation reduces the overall level of innovation activity, our results suggest that increasing patent risk among practicing firms could lead to an industry structure in which Schumpeterian effect of competition could prevail (Aghion, Bloom, Blun- dell, Griffith, and Howitt, 2005). We make several important contributions to the literature on corporate innovation and product market dynamics. We expand the Non-PE patent litigation literature (Cohen et al. (2019), Mezzanotti (2019), Appel, Farre-Mensa, and Simintzi (2018)) by showing important PE dynamics within product markets as well as their change in innovation strategies. We show that inter-firm patent litigation could have motivations beyond the cash-driven incen- tives that are primarily identified for NPE trolls. In contrast to NPE trolls, PEs strategically alter their innovation strategies rather than simply reducing R&D expenditure post-litigation to stay competitive in the technological race. Our paper also extends the broader corporate litigation literature. Existing corporate litigation literature focuses on corporate fraud (e.g., Karpoff and Lott Jr. (1993), Dyck, Morse, and Zingales (2010)), shareholder litigation (e.g., Lin, Liu, and Manso (2020), Field, Lowry, and Shu (2005)), environment-related litigation (Karpoff, Lott, and Rankine (1999)), antitrust litigation (Bizjak and Coles (1995)) and general inter-firm litigation (Bhagat et al. (1994)). In contrast to corporate fraud and shareholder litigation that stems from a manage- rial agency problem, inter-firm patent litigation highlights the operating risk of firms with substantial intellectual properties. Our findings are **consistent** with those reported in Bha- gat et al. (1994) who document the **negative stock** market reaction to defendant firms after general inter-firm **litigations**. By focusing on patent litigation, we add substantial details of how firms change their innovation strategy under the fierce technological competition.4 We also show that product market overlap is key to understanding how patent litigation, especially those between practicing entities, affects their product market strategies through post-litigationinnovationstrategyshift.5 **All** these findings are **novel** additions to the general corporate litigation **literature**.

Innovation solves existential risks. Haygerdee '17

HÉigeartaigh '17 – [Hay-ger-dee] Professor @ Cambridge, PhD in Genomics from Trinity College Dublin (Sean, "Technological Wild Cards: Existential Risk and a Changing Humanity", https://www.bbvaopenmind.com/en/articles/technological-wild-cards-existential-risk-and-a-changing-h umanity/, Accessed 3-7-2019)

Technological progress now offers us a vision of a remarkable future. The advances that have brought us onto an unsustainable pathway have also raised the quality of life dramatically for many, and have unlocked scientific directions that can lead us to a safer, cleaner, more sustainable world. With the right developments and applications of technology, in concert with advances in social, democratic, and distributional processes globally, progress can be made on all of the challenges discussed here. Advances in **renewable energy** and **related tech**nologies, and more **efficient energy use**—advances that are likely to be accelerated by progress in technologies such as **a**rtificial **i**ntelligence—can bring us to a point of **zero-carbon emissions**. New **manufacturing capabilities** provided by synthetic biology may provide cleaner ways of producing products and degrading waste. A greater scientific understanding of our natural world and the ecosystem services on which we rely will aid us in plotting a trajectory whereby **critical environmental systems are maintained** while allowing human flourishing. Even advances in education and women's rights globally, which will play a role in achieving a stable global population, can be aided specifically by the information, coordination, and education tools that technology provides, and more generally by growing prosperity in the relevant parts of the world. There are **catastrophic** and **existential** risks that we will simply **not be able to overcome without advances in science and technology**. These include possible **pandemic outbreaks**, whether natural or engineered. The early **identification of incoming asteroids**, and approaches to shift their path, is a topic of active research at NASA and elsewhere. While currently there are no known techniques to prevent or mitigate a **supervolcanic** eruption, this may not be the case with the tools at our disposal a century from now. And in the longer run, a civilization that has **spread permanently beyond the earth**, enabled by advances in **spaceflight**, manufacturing, robotics, and terraforming, is one that is **much more likely to endure**. However, the

breathtaking power of the tools we are developing is **not to be taken lightly**. We have been very lucky to muddle through the advent of nuclear weapons without a global catastrophe. And within this century, it is realistic to expect that we will be able to rewrite much of biology to our purposes, intervene deliberately and in a large-scale way in the workings of our global climate, and even develop agents with intelligence that is fundamentally alien to ours, and may vastly surpass our own in some or even most domains—a development that would have uniquely unpredictable consequences.

Contention 2 is BioDiversity

Affirming Overstretched the NRC risking accidents

Gilbert 21 [Alex Gilbert, 5-15-2021, A complex systems researcher with expertise in nuclear innovation, space mining, energy markets, and climate policy. "Unlocking Advanced Nuclear Innovation: The Role of Fee Reform and Public Investment," Nuclear Innovation Alliance, https://www.nuclearinnovationalliance.org/unlocking-advanced-nuclear-innovation-role-fee-reform-and-public-investment, DOA: 3/30/2025] JZ + shaan

Due to the limited resources and flexibility, NRC was unable to proactively develop rules and perform technical activities for advanced reactors. Many of these are now being done on an adhoc basis for individual applications. The current fee model creates uncertainty for developers, customers, and investors as NRC reviews of advanced reactors can be lengthy and thus involve unexpected and open-pended licensing review costs. While the NRC regulations require fees to recover "full cost" of NRC's review, there is no way to predict what that "full cost" will be and therefore what the fees will be. In some cases, at the time that NRC accepts an application for review, it has provided an estimate of how much the fees will be. But that estimate is only an estimate. The applicant is still responsible for the full cost, regardless of the estimate.

Congress addressed some of these concerns when it passed NEIMA (See Section 2.c.). Off-fee funding in NEIMA and subsequent legislation are providing initial resources for NRC activities to build advanced reactor regulatory infrastructure. While NIA applauds these activities, expanded and more durable public resources are needed to ensure NRC remains a global leader in nuclear regulation. In addition, a more holistic review and revision to NRC's fee structure can address the underlying issues that NEIMA attempted to address.

Fees are an important consideration for commercializing advanced reactors, and nearterm licensing activities make reconsideration of licensing fees an urgent imperative. In the case of fees collected for NuScale's recent design certification, estimated upfront licensing fees were equivalent to at least 10-15 years of annual fees for operating facilities. 12 These costs could be even more significant for combined or operating license applicants who must recoup fees through revenues from a specific and limited customer base. As licensing fees occur at the beginning of the project, they require equity or debt servicing until operation commences, and can have large impacts on a project's net present value. Therefore, even though fees are only a small part of a project's lifecycle cost, they can have disproportionate impacts on early-stage projects and even discourage consideration of nuclear energy in the first place.

Today, NRC's regulatory framework for licensing reviews is largely predicated on review of large light-water reactors. To apply this framework to advanced reactors requires extensive company and staff work to identify non-applicability of regulations, exemptions, and other adaptations. This can cause initial advanced reactor reviews to take longer and cost more than historical reviews. This conflicts with the general principle of risk-informed, performancebased regulation. Advanced reactors are expected to be significantly safer than past designs, and the fees incurred should be reflective of the enhanced safety, rather than a result of inefficient requirements. Until regulations are modernized, fees pose additional undue burdens on innovators and may be costlier compared to licensing with performance-based regulatory frameworks in other countries.

That shreds oversight.

CBS 19 [CBS News, 7-17-2019, CBS News is the news division of the American television and radio broadcaster CBS. It is headquartered in New York City. "Nuclear Regulatory Commission mulls cutting back on inspections at nuclear reactors,"CBS News, https://www.cbsnews.com/news/nuclear-regulatory-commission-mulls-cutting-back-on-inspections-at-nuclear-reactors/, DOA: 3/30/2025] JZ

Washington – The staff of the Nuclear Regulatory Commission is recommending that the agency cut back on inspections at the country's nuclear reactors, a cost-cutting move promoted by the nuclear power industry but denounced by opponents as a threat to public safety.

The recommendations, made public Tuesday, include reducing the time and scope of some annual inspections at the nation's 90-plus nuclear power plants. Some other inspections would be cut from every two years to every three years.

Some of the staff's recommendations would require a vote by the commission, which has a majority of members appointed or reappointed by President Trump, who has urged agencies to reduce regulatory requirements for industries.

The nuclear power industry has prodded regulators to cut inspections, saying the nuclear facilities are operating well and that the inspections are a financial burden for power providers. Nuclear power, like coal-fired power, has been struggling in market completion against cheaper natural gas and rising renewable energy.

While Tuesday's report made clear that there was considerable disagreement among the nuclear agency's staff on the cuts, it contended the inspection reduction "improves efficiency while still helping to ensure reasonable assurance of adequate protection to the public."

Commission member Jeff Baran criticized the proposed changes Tuesday, saying reducing oversight of the nuclear power industry "would take us in the wrong direction."

"NRC shouldn't perform fewer inspections or weaken its safety oversight to save money," Baran said.
The release comes a day after Democratic lawmakers faulted the NRC's deliberations, saying they had failed to adequately inform the public of the changes under consideration.

"Cutting corners on such critical safety measures may eventually lead to a disaster that could be detrimental to the future of the domestic nuclear industry," Rep. Frank Pallone, D-N.J., chair of the House Energy and Commerce Committee, and other House Democrats said in a letter Monday to NRC Chairwoman Kristine Svinicki.

Asked for comment Tuesday, NRC spokespeople pointed to the staff arguments for the changes in the report. Trimming overall inspections "will improve effectiveness because inspectors again will be focused on issues of greater safety significance," staffers told commission members in the recommendations.

Edwin Lyman, a nuclear-power expert at the nonprofit Union of Concerned Scientists, faulted the reasoning of commission staff that the good performance of much of the nuclear power industry warranted cutting back on agency inspections for problems and potential problems.

"That completely ignores the cause-and-effect relationship between inspections and good performances," Lyman said.

Independently, mining causes loss Good 23

Quentin Good (Frontier Group researcher; conducts independent, nonpartisan analysis on environmental policy), 8-8-2023, "Renewed interest in uranium mining threatens waterways andwildlife,"FrontierGroup, https://frontiergroup.org/articles/renewed-interest-in-uranium-mining-threatens-waterways-and-wildlife/, accessed 3-27-2025 //MA

Mining for and processing uranium ore both present serious risks to our waterways and wildlife. In addition, transporting highly radioactive uranium ore from mines to mills on public roads – many of which cut through native reservations that have long been plagued by the long-term health impacts of uranium mining – is a toxic spill waiting to happen. **Uranium mines produce radioactive water polluted with arsenic, uranium and other toxic substances. This water is typically stored in open air wastewater tanks called impoundments where it is meant to slowly evaporate. But such impoundments are often only protected by a fence. Animals, especially small animals and birds, can easily drink from these highly toxic ponds, exposing them to dangerous levels of radiation. Uranium mines have also discarded waste rock outside of impoundments. Wind can pick up radioactive dust from these rocks, spreading it far and wide into lakes and streams, animal habitats and human settlements. Once uranium is mined, uranium mills use chemicals to dissolve and separate uranium from crushed ore. This process leaves behind toxic compounds called tailings that are poured into massive ponds on site.** Transporting uranium from mine to mill poses serious health risks to communities located en route to the destination. The 300-mile route from Pinyon Plain mine to the White Mesa Mill includes segments of highway where fatal traffic accidents are 240%-700% higher than average, and four out of five of the most dangerous stretches of road are in the Navajo Nation. Past uranium mining and the resulting exposure to radiation has left a “legacy of harm” for the Navajo people – from cancer to respiratory illnesses. Further risks of

contamination are simply unacceptable. Nuclear advocates argue that these problems are a thing of the past because uranium mines and mills are now highly regulated. However, the case of the White Mesa Mill demonstrates that uranium production continues to have long-lasting environmental and health impacts today. The Denver Post reports that since 1999, the mill has been cited at least 40 times for violations by Utah regulators, including for discharging pollutants into waterways. Testing **wells** near the site have regularly found levels of uranium, nitrates, cadmium and nickel above Utah state limits; one well **had concentrations of uranium more than six times the federal limit for drinking water.** Some residents of the nearby town of White Mesa, sensibly, prefer bottled water. **The harms of uranium mining are clear: contamination of the air, water and soil, as well as damage to wildlife and communities. The push for new nuclear power cannot mean expanding the toxic footprint of uranium mining across even more of the West.**

Moreover improper disposal decks diversity. FJ 23

FJ, (independent brand specializing in reusable, eco-friendly hydration products), 9-18-2023, "How does nuclear energy contribute to water pollution?," FJBottle Official Website, https://www.fjbottle.com/blogs/news/how-does-nuclear-energy-contribute-to-water-pollution, accessed 3-26-2025 //MA

Radioactive waste disposal and its impact on water systems Types and characteristics of radioactive waste **Radioactive waste produced by nuclear power plants is a major concern when it comes to water pollution. This waste includes spent fuel rods and other byproducts that contain radioactive materials. These materials can remain hazardous for thousands of years and require careful handling and disposal.** Challenges in radioactive waste disposal **Disposing of radioactive waste safely is a complex and challenging task.** The current methods involve storing the waste in specially designed facilities deep underground. However, **concerns arise due to the potential for leaks or failures in containment structures, which could lead to the release of radioactive materials into surrounding soil and water systems.** Potential risks and contamination of water sources In the event of a leak or failure in radioactive waste storage facilities, there is a risk of contamination of water sources. **This contamination can have severe consequences for human health and the environment, as radioactive materials can spread through groundwater, rivers, and other water bodies, affecting drinking water supplies and aquatic life.**

Knox ‘19

Miranda Knox, 5-25-2019, "Chernobyl disaster was seconds from killing millions more and wiping out

half of Europe had it not been for three heroic volunteers", Sun, https://www.thesun.co.uk/news/9145299/chernobyl-disaster-series-three-hero-volunteers//?EEda03/13/25

Following the accident at Chernobyl's Unit 4, all fires were extinguished within six hours - but a more dangerous problem soon emerged. Days after the explosion, Soviet authorities made the horrifying discovery that the core of the reactor that had exploded was still melting down. Valeri Bezpalov and Alexi Ananeko were part of the 'Suicide Squad' with Boris Baranov 6 Valeri Bezpalov and Alexi Ananeko were part of the 'Suicide Squad' with Boris Baranov Underneath this was a huge pool of water, which acted as a coolant for the power plant. **The melting core was nearing the water - which, had they mixed, would have caused a second steam explosion.** Andrew Leatherbarrow, author of 2016 book Chernobyl 01:23:40, explains: "This would have done unimaginable damage and destroyed the entire power station, **including the three other reactors." Estimates suggest that had this been allowed to happen, half of Europe would have been wiped out**, many millions would have perished, and the entire **area would have been uninhabitable for over 500,000 years.** Soviet physicist Vassili Nesterenko said: "Minsk, which is 320 kilometres from Chernobyl, would have been razed and Europe rendered uninhabitable."

Accidents deck biodiversity.

Olsson et al. 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).

Any biodiversity loss would cause cataclysmic extinction. Exeter ‘18 University of Exeter 18 (The University of Exeter is a public research university in Exeter, Devon, South West England, United Kingdom, Febuary 29th 2018, “Biodiversity loss raises risk of 'extinction cascades” Science Daily, https://www.sciencedaily.com/releases/2018/02/180219155019.htm#:~:text=New%20research%20shows%20that%20the,domino%20effect%20of%20further%20extinctions.&text=%22And%20because%20species%20are%20interconnected,can%20affect%20others%20as%20well. Febuary 9th 2021) /MA

The researchers, from the University of Exeter, showed there is a higher risk of extinction cascades when other species are not present to fill the "gap" created by the loss of a species. **Even if the loss of one species does not directly cause knock-on extinctions, the study shows that this leads to simpler ecological communities that are at greater risk of "run-away extinction cascades" with the potential loss of many species. With extinction rates at**

their highest

levels ever and numerous species under threat due to human activity, the findings are a further warning about the consequences of eroding biodiversity. "Interactions between species are important for ecosystem (a community of interacting species) stability," said Dr Dirk Sanders, of the Centre for Ecology and Conservation at the University of Exeter's Penryn Campus in Cornwall. "And because **species are interconnected through multiple interactions, an impact on one species can affect others as well. "It has been predicted that more complex food webs will be less vulnerable to extinction cascades because there is a greater chance that other species can step in and buffer against the effects of species loss**. "In our experiment, we used communities of plants and insects to test this prediction." The researchers removed one species of wasp and found that it led to secondary extinctions of other, indirectly linked, species at the same level of the food web. This effect was much stronger in simple communities than for the same species within a more complex food web. Dr Sanders added: "**Our results demonstrate that biodiversity loss can increase the vulnerability of ecosystems to secondary extinctions which, when they occur, can then lead to further simplification causing run-away extinction cascades**." The study, supported by France's Sorbonne Université, is published in the journal Proceedings of the National Academy of Sciences. The paper is entitled: "Trophic redundancy reduces vulnerability to extinction cascades." How extinction cascades work The loss of a predator can initiate a cascade, such as in the case of wolves, where their extinction on one mountain can cause a large rise in the number of deer. This larger number of deer then eats more plant material than they would have before. This reduction in vegetation can cause extinctions in any species that also relies on the plants, but are potentially less competitive, such as rabbits or insects.

Biodiversity loss empirically causes war. LS 09

Live Science 09 (Live Science Staff research group), Febuary 20, 2009, “Most Wars Occur in Biodiversity Hotspots, https://www.livescience.com/5315-wars-occur-biodiversity-hotspots.html

More than 80 percent of the world's major armed conflicts from 1950-2000 occurred in regions identified as the most biologically diverse and threatened places on Earth. Scientists compared major conflict zones with the Earth's 34 biodiversity hotspots identified by Conservation International (CI). The hotspots are considered top conservation priorities because they contain the entire populations of more than half of all plant species and at least 42 percent of all vertebrates, and are highly threatened. "This astounding conclusion — that the richest storehouses of life on Earth are also the regions of the most human conflict — tells us that these areas are essential for both biodiversity conservation and human well-being," said Russell A. Mittermeier, president of Conservation International (CI) and an author of the study. "Millions of the world's poorest people live in hotspots and depend on healthy ecosystems for their survival, so there is a moral obligation — as well as political and social responsibility — to protect these places and all the resources and services they provide," Mittermeier said. The finding, announced today, is published in the journal Conservation Biology. **The study found that more than 90 percent of major armed conflicts — those resulting in more than 1,000 deaths — occurred in countries that contain one of the 34 biodiversity hotspots, while 81 percent took place within specific hotspots.** A total of 23 hotspots experienced warfare over the half-century studied. Examples of the nature-conflict connection include the Vietnam War, when poisonous Agent Orange destroyed forest cover and coastal mangroves, and timber harvesting that funded war chests in Liberia, Cambodia and Democratic Republic of Congo (DRC), according to a statement released by Conservation International. In those and countless other cases, the collateral damage of war harmed both the biological wealth of the region and the ability of people to live off of it. In addition, war refugees must hunt, gather firewood or build encampments to survive, increasing the pressure on local resources, the researchers explained. More weapons means increased hunting for bush meat and widespread poaching that can decimate wildlife populations — such as 95 percent of the hippopotamus slaughtered in DRC's Virunga National Park

Contention 3 is Haleu

Nuclear facilities are safe for now.

Earnhardt et al 21 (Rebecca L Earnhardt, Research Associate with the Nuclear Security program at the Stimson Center. Her research focuses on emerging technology threats to nuclear facilities, adaptation of nuclear security plans in times of crisis, and international nuclear security governance, Brendan Hyatt, nuclear security intern at the Stimson Center, Nickolas Roth, senior director of Nuclear Materials Security at the Nuclear Threat Initiative and senior research associate at the Project on Managing the Atom at the Harvard Kennedy School's Belfer Center for Science and International Affairs, 14 January 2021, "A threat to confront: far-right extremists and nuclear terrorism", Bulletin of the Atomic Scientists, https://thebulletin.org/2021/01/a-threat-to-confront-far-right-extremists-and-nuclear-terrorism/, DOA 3/28/2025) ESR

Could they really pull it off? While some violent far-right extremists are clearly motivated to carry out catastrophic terrorist attacks, a question remains: Do they possess the means and opportunity to conduct an act of nuclear terrorism? There is no public evidence violent far-right extremist groups have obtained the resources or exhibited the requisite operational sophistication to carry out an act of nuclear terrorism. Many of the plots involving far-right extremists and nuclear terrorism have been poorly conceived and were unlikely to succeed. These incidents, however, likely do not provide a complete picture of the threat, because publicly accessible information on the capability of these groups is limited, creating ambiguity about their general capabilities.

New reactors will be built with HALEU.

Robinson 24 [Julia (MA in science communication and science correspondent @ Chemistry World, former leader of clinical and science content at The Pharmaceutical Journal), "Proliferation warnings over enriched nuclear fuel for advanced reactors," Chemistry World, Jun. 12, 2024, https://www.chemistryworld.com/news/proliferation-warnings-over-enriched-nuclear-fuel-for-advanced-reactors/4019621.article, DOA 03-23-2025] anika + abhi

Governments and others promoting the use of high-assay low-enriched uranium (HALEU) for nuclear power have not considered the potential terrorism risk that widespread adoption of this fuel creates, nuclear scientists have warned. HALEU is a **nuclear reactor fuel** enriched with uranium-235 to between 5 and 20%. At 20% uranium-235 and above, the mixture is called highly-enriched uranium (HEU) and it is internationally recognised that it can be **employed in nuclear weapons**. Related stories War of words ensues over proliferation warnings on enriched nuclear fuel 'It's an efficient machine to destroy nuclear waste': nuclear future powered by thorium beckons Imperial College nuclear reactor becomes first UK site to be completely decommissioned **Historically, HALEU use has been limited to research reactors,** where it is used in **small quantities**, while commercial reactors typically use fuels with low enrichments, in the range of 3 to 5% uranium-235, which cannot sustain an explosive chain reaction. However, new advanced reactors are being **designed to run on HALEU** – most favouring 19.75% uranium-235 HALEU – in the hope that these reactors will be smaller, more flexible and less expensive. In the US, the Department of Energy (**DOE**) and US Department of Defense are providing funds for **more than 10 reactor concepts,** while the UK's Civil Nuclear Roadmap, announced on 11 January, promised up to £300 million of investment specifically to develop HALEU fuel production. However, in a policy forum in Science, experts in nuclear science and global security highlight that in many of the designs, the amount of HALEU needed is **'hundreds to thousands of kilograms'**, which may mean that **a single reactor contains enough HALEU to make a nuclear weapon.** The authors said that estimates indicate that quantities ranging from several hundred kilograms to about a tonne of 19.75% HALEU could produce **explosive yields similar to** or **greater than** that of the **Little Boy bomb dropped** on **Hiroshima**. If this is the case, they said, commercialising HALEU fuels **without ensuring** that the material is 'appropriately protected against **diversion** by **national governments** or **theft** by **terrorists** would **pose** a **serious threat** to **security'**. 'The time has come to review policies governing the use of this material,' the authors write. 'We recommend that the US Congress direct the DOE's National Nuclear Security Administration to commission a fresh review of HALEU proliferation and security risks by US weapons laboratory experts.' They also suggested that, according to the information available, a reasonable balance of the risks and benefits could be struck if enrichment of uranium-235 was restricted to 12% or less.

But a lack of DOE funding is preventing its implementation.

Geiger 25 [Julianne (veteran editor, writer and researcher @ Oilprice.com, member of the Creative Professionals Networking Group), "Trump Freezes Department of Energy's $50 Billion Budget," OilPrice.com, Jan. 24, 2025, https://oilprice.com/Latest-Energy-News/World-News/Trump-Freezes-Department-of-Energys-50-Billion-Budget.html, DOA 03-23-2025] anika + abhi

In a sweeping move that halts billions in spending, President Trump's administration **has frozen the Department of Energy's (DOE) activities** pending a comprehensive review of its alignment with his priorities. According to a memo from acting Energy Secretary Ingrid Kolb, the freeze affects **grants, loans, procurement, studies, and even personnel decisions**, effectively bringing the agency's **$50 billion budget to a standstill.** Beyond bureaucratic tinkering, the halt is a direct shot at dismantling Biden-era climate policies. The DOE's Loan Programs Office, **holding $41.2 billion** in conditional commitments to energy technology companies, now finds its **purse strings tightly cinched**. Other **critical missions**, like nuclear waste cleanup and maintenance of emergency crude reserves, are similarly **on pause**. The order mirrors an earlier Trump directive freezing funds tied to Biden's Inflation Reduction Act and a bipartisan infrastructure law, both of which allocated billions for clean energy initiatives. Trump, who has championed fossil fuels as a cornerstone of his energy policy, has made it clear that climate-focused spending is no longer a federal priority. The Interior Department issued a similar freeze on wind and solar project leases on federal lands and waters. While the Trump administration's goal is to "unleash" American energy by

cutting red tape, critics argue that freezing investments in innovative technologies jeopardizes long-term energy security. For now, the **DOE** and the clean energy sector are **left in limbo** pending the results of a review that could redefine the nation's energy landscape

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Aff funding allows HALEU reactors.

Ekinci et al. 24 [Fatih Ekinci is a researcher at the Department of Medical Physics at the Institute of Nuclear Sciences of Ankara University, Mehmet Serdar Guzel is a researcher at the Department of Computer Engineering at Ankara University, Koray Acici is a researcher at the Department of Artificial Intelligence and Data Engineering at Ankara University, Tunc Asuroglu is a faculty member of the Medicine and Health Technology department at Tampere University, 7-31-2024, "The Future of Microreactors: Technological Advantages, Economic Challenges, and Innovative Licensing Solutions with Blockchain," Applied Sciences, Volume 14, Issue 15, https://www.mdpi.com/2076-3417/14/15/6673, accessed 3-15-2025] zayd 🍃

The successful deployment of microreactors **heavily depends** on the current state and future of nuclear fuels. In this context, various strategies must be developed for the **production** and **supply chain management** of HALEU fuel. Firstly, it is **essential** to **increase** the existing HALEU production capacity. Modernizing current production facilities plays a **critical** role in this process. Updating these facilities with new **technologies** will **enhance** production **efficiency** and allow for **higher quantities** of HALEU production. **Additionally**, establishing **new** facilities for the production of highly enriched uranium is **crucial.** These new facilities should be planned to meet increasing demand and operated in compliance with international standards. Various research and development projects should be conducted to develop HALEU production techniques and improve existing methods. The United States, in particular, is undertaking several R&D projects aimed at increasing HALEU production capacity. These projects should focus on developing new production techniques and improving current ones. Moreover, these projects should be supported through international collaborations and increased knowledge sharing. Effective supply chain management **must** be established to ensure the **secure** and **efficient** supply of HALEU fuel. Strict security protocols and logistical planning should be implemented at all stages from production to consumption. Innovative solutions like blockchain technology should be utilized in this context. Blockchain can enhance the transparency and reliability of the supply chain by recording and tracking all movements of the fuel from production to final use. To balance the **high costs** of HALEU fuel and make microreactors economically attractive, **economic incentives** and support **programs should** be developed. Such incentives will facilitate the long-term economic benefits of microreactors.

That invites runaway terror and prolif.

Nurnberger 24 [Lisa Nurnberger, bachelor's from Penn State and oversees the Media Team, and received a first place award from the Society of Professional Journalists, 6-6-2024, "Analysis Published in Science Finds High Assay Low-Enriched Uranium Fuel to be Produced for Small Nuclear Power Reactors Poses a Greater Proliferation Threat than Previously Acknowledged" Union of Concerned Scientists, https://www.ucs.org/about/news/analysis-published-science-finds-high-assay-low-enriched-uranium-fuel-be-produced-small?, accessed: 4-3-2025] anika + OA

An analysis published today in the journal Science found that, contrary to a widely held assumption, the high assay low-enriched uranium (**HALEU**) now being produced with federal subsidies to fuel the next generation of small nuclear power reactors can be **used directly** to make **nuclear weapons**, and thus presents **greater terrorism** and **nuclear proliferation** threats than **publicly acknowledged** by the federal government and industry. "Were **HALEU** to become a **standard reactor fuel** without appropriate restrictions determined by an interagency security review, other countries would be able to **obtain**, **produce**, and **process weapons-usable HALEU** with impunity, eliminating the **sharp distinction** between **peaceful** and **nonpeaceful nuclear programs**," according to the analysis conducted by five of the world's leading academic and independent proliferation experts. "Such countries would be only **days away** from a **bomb**, giving the international community **no warning** of forthcoming **nuclear proliferation** and virtually **no opportunity** to prevent it." The paper calls for additional measures to mitigate this risk as the United States and other countries pursue international deployment of HALEU-fueled reactors. "Given the stakes, we recommend that the US Congress direct the DOE's National Nuclear Security Administration to commission a fresh review of HALEU proliferation and security risks by US weapons laboratory experts." Fuels for today's commercial reactors **do not rely** on HALEU, which is enriched to between 10% and 20% uranium-235, and instead typically use uranium enriched to below 5%. At those levels, the fuel cannot sustain an **explosive chain reaction**, which has prevented **nations** or **terrorists** from **repurposing** commercial reactor fuel for weapons. However, for technical reasons, **many** of the **nuclear reactor** designs that engineers **want to build today** would use HALEU. Since HALEU is below the 20% enrichment lower bound that defines highly-enriched uranium (HEU), which is understood to be directly usable in nuclear weapons, development of these reactors has not raised significant proliferation concerns. But by reviewing information in the open literature to analyze the quantities and enrichment levels of HALEU that the new reactors would use, the authors of the Science paper concluded that HALEU above about 12% uranium-235 could be used to make **practical weapons** with yields comparable to the bombs that destroyed **Hiroshima** and **Nagasaki**. Many proposed reactors could contain enough HALEU to make a nuclear weapon and thus pose serious security risks, according to the article. These risks are increasing because, although the quantity of HALEU in commercial use today is relatively small, the federal government is actively encouraging HALEU use and funding its production.

Safeguards fail and reactors get exported.

UCS 21 (*Union of Concerned Scientists, nonprofit science advocacy organization, No date listed, 3-14-2021 from Internet Archive, "'Advanced' Isn't Always Better: Assessing the Safety, Security, and Environmental Impacts of Non-Light Water Nuclear Reactors," https://www.ucsusa.org/sites/default/files/2021-05/ucs-es-AR-3.21-web_May%20rev.pdf)

Nuclear **prolif**eration and **nuc**lear **terror**ism risk is the danger that nations or terrorist groups could **illicitly obtain** nuclear-weapon-usable materials from **reactors** or **fuel cycle facilities. LWRs** operating on a once-through fuel cycle present relatively **low** proliferation and terrorism **risks**. However, any nuclear fuel cycle that utilizes **reprocessing** and **recycling** of spent fuel poses **significantly greater** nuclear **prolif**eration and **terror**ism **risks** than do **LWRs without reprocessing**, because it provides **far greater opportunities** for **diversion or theft** of plutonium and other nuclear-weaponusable materials. International **safeguards** and **security** measures for reactors and fuel cycles with reprocessing are **costly and cumbersome**, and they cannot fully compensate for the **increased vulnerability** resulting from **separating** weapon-usable **materials.** Also **using HALEU** instead of less-enriched forms of LEU **would increase prolif**eration **and terror**ism **risks**, although to a far lesser extent than using plutonium or uranium-233. Nuclear proliferation is **not a risk** in the United States simply because it already possesses nuclear weapons and is designated as a nuclear-weapon state under the Nuclear Non-Proliferation Treaty. As such, it is not obligated to submit its nuclear facilities and materials for **verification** by the International Atomic Energy Agency (IAEA), although it can do so voluntarily. However, US reactor development does have implications for proliferation, both because **US vendors** seek to **export new reactors** to other countries and because **other countries are likely to emulate the US** program. The United States has the responsibility to set a **good** international **example** by ensuring its own nuclear enterprise meets the **highest** nonproliferation **standards.**4

Indeed

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.

Unqiuely likely now

Earnhardt et al 21 (Rebecca L Earnhardt, Research Associate with the Nuclear Security program at the Stimson Center. Her research focuses on emerging technology threats to nuclear facilities, adaptation of nuclear security plans in times of

crisis, and international nuclear security governance, Brendan Hyatt, nuclear security intern at the Stimson Center, Nickolas Roth, senior director of Nuclear Materials Security at the Nuclear Threat Initiative and senior research associate at the Project on Managing the Atom at the Harvard Kennedy School's Belfer Center for Science and International Affairs, 14 January 2021, "A threat to confront: far-right extremists and nuclear terrorism", Bulletin of the Atomic Scientists, https://thebulletin.org/2021/01/a-threat-to-confront-far-right-extremists-and-nuclear-terrorism/, DOA 3/28/2025) ESR

Far-right narratives of nuclear terror. **The intersection between violent far-right extremist ideology and catastrophic terrorism goes back decades. In** The Turner Diaries**, a 1978 novel labeled the "bible of the racist right," the protagonists use acts of nuclear terror in service of the creation of a "white world**." Protagonists bomb nuclear installations, seize nuclear weapons, target missiles at New York City and Tel Aviv, and ultimately destroy the Pentagon in a suicidal nuclear attack.[3] **The International Centre for Counterterrorism ties the Diaries to "at least 200 murders and at least 40 terrorist attacks/hate crimes" in the last 40 years**.[4] This includes Timothy **McVeigh's 1995 bombing** of the Alfred P. Murrah Federal Building in Oklahoma City, resulting in the deaths of 168 people.[5] McVeigh, however, is not the only far-right terrorist to be inspired by the Diaries. **In 2011, violent far-right extremist Anders Breivik's terror attacks killed 77 people in Norway. Dozens of pages in his 1,500-page "manifesto" discuss the execution of different acts of nuclear terrorism**.[6] **An increasingly active generation of violent far-right extremist groups and actors have adopted an especially dangerous ideology that is compatible with an act of nuclear terror: accelerationism**.[7] **Violent far-right extremists** who adopt accelerationism **view societal collapse as inevitable and seek to hasten that collapse in service of "total revolution"—the complete destruction of the existing system of governance.**[8] **Violent far-right extremists who adopt accelerationism hope to set off a series of violent chain events, with violence begetting more violence, destabilizing society**.[9] **Indiscriminate, highly destructive acts of terror—like a nuclear attack—are therefore perfect tools to sow chaos and accelerate this societal collapse. In Siege, one of the defining theoretical works of violent far-right accelerationism, author and accelerationist leader James Mason writes that, "[White supremacists] will be the single survivor in a war against the System**, a TOTAL WAR against the System."[10] In a recent act of violent far-right extremist terrorism, Brenton Tarrant, the Australian perpetrator of the 2019 terrorist attack on Christchurch masjidain in New Zealand, wrote about accelerationism in his manifesto.[11] Groups with nuclear interests**. Inspired by the ideas of accelerationism, the modern breed of violent far-right extremism is becoming more destructive, and nuclear weapons certainly fit into this profile of catastrophic violence.** The intention to bring about a cataclysmic clash of civilizations bears resemblance to better known terrorist organizations like Al Qaeda and Aum Shinrikyo, both of which have pursued nuclear weapons. As director of intelligence and counterintelligence at the US Department of Energy, Rolf Mowatt-Larssen, once observed, "Osama bin Ladin has signaled a specific purpose for using WMD in al Qaeda's quest to destroy the global status quo, and to create conditions more conducive to the overthrow of apostate regimes throughout the Islamic world."[12] Like Al-Qaeda, **violent far-right extremists support the creation of a new society that is in line with their own ideology. One of the most notable and violent far-right extremist groups that have adopted accelerationism and operate in the United States is the Atomwaffen Division** (**AWD**).[13] The organization's name translates from German to "**the nuclear weapons division**," indicating that **its members have an explicit interest in nuclear terrorism**. Brandon Russel, a former Florida National Guard member and an AWD co-founder, is one case of an aspiring nuclear terrorist. **A heavily armed Russel and a fellow AWD member were recently arrested while in route to the Turkey Point nuclear power plant**. During the investigation officials found that Russel lived in an apartment with two AWD co-conspirators; in the apartment was a prominently placed copy of the Turner Diaries and a framed photo of Oklahoma City Bomber Timothy McVeigh. The trio stockpiled weapons and explosives with the intent to blow up, among other targets, a nuclear power plant. In their apartment, police found pipe bomb components, traces of the explosive hexamethylene triperoxide diamine, and detonators. Police also detected two radioactive materials—thorium and americium—in his bedroom.[14] **AWD was not the first far-right ext remist in America to consider using radioactive or nuclear materials in a terrorist attack. Several previously documented attempts by violent far-right extremists to commit acts of radiological terror indicate a longstanding interest among far-right actors in highly destructive, non-conventional acts of terror**.[15] In 2004, National Socialist Movement member Demetrius **Van Crocker attempted to build a dirty bomb to blow up a courthouse**.[16] In 2008, James **Cummings, a white supremacist, obtained four 1-gallon containers of a mix of depleted uranium and thorium-232. He planned to use these materials to assemble a dirty bomb**.[17] In 2013, a member of the Ku Klux Klan who worked at General Electric carried out research on radiation dispersal devices, learning what level of emission was required to kill humans.[18]

Even one attack escalates

Buis 18 [Irma Arguello and Emiliano J. Buis, * founder and chair of the NPSGlobal Foundation, and head of the secretariat of the Latin American and Caribbean Leadership Network. She holds a degree in physics, a Master's in business administration, and completed graduate studies in defense and security, ** lawyer specializing in international law. He holds a PhD from the University of Buenos Aires (UBA), a Master's in Human and Social Sciences from the University of Paris/Panthéon-Sorbonne, and a postgraduate diploma in national defense from the National Defense School, "The global impacts of a terrorist nuclear attack: What would happen? What should we do?," 2018, *Bulletin of the Atomic Scientists*, Vol. 74, Issue 2, pp. 114-119, https://doi.org/10.1080/00963402.2018.1436812, Recut EA]

The consequences of a terrorist nuclear attack A small and primitive 1-kiloton fission bomb (with a yield of about one-fifteenth of the one dropped on Hiroshima, and certainly much less sophisticated; cf. Figure 1), detonated in any large capital city of the developed world, would cause an **unprecedented catastrophic scenario.** [FIGURE 1 OMITTED] An estimate of direct effects in the attack's location includes a death toll of 7,300-to-23,000 people and 12,600-to-57,000 people injured, depending on the target's geography and population density. Total physical destruction of the city's infrastructure, due to the blast (shock wave) and thermal radiation, would cover a radius of about 500 meters from the point of detonation (also known as ground zero), while ionizing radiation greater than 5 Sieverts – compatible with the deadly acute radiation syndrome – would expand within an 850-meter radius. From the environmental point of view, such an area would be **unusable** for years. In addition, radioactive fallout would expand in an area of about 300 square kilometers, depending on meteorological conditions (cf. Figure 2). [FIGURE 2 OMITTED] But the consequences would go far beyond the effects in the target country, however, and **promptly propagate worldwide. Global** and national **security, economy and finance, international governance** and its framework, **national political systems**, and the **behavior of governments** and individuals would all be put under **severe trial.** The severity of the effects at a national level, however, would depend on the countries' level of development, geopolitical location, and resilience. Global security and regional/national defense schemes would be strongly affected. An increase in **global distrust** would **spark rising tensions** among countries and blocs, that could even lead to the brink of **nuclear weapons use** by states (if, for instance, a sponsor country is identified). The consequences of such a shocking scenario would include a **decrease in** states' **self-control**, an **escalation of present conflicts** and the emergence of **new ones**, accompanied by an increase in military unilateralism and military expenditures. Regarding the economic and financial impacts, a severe global economic depression would rise from the attack, likely lasting for years. Its duration would be strongly dependent on the course of the crisis. The main results of such a crisis would include a 2 percent fall of growth in global Gross Domestic Product, and a 4 percent **decline** of **international trade** in the two years following the attack (cf. Figure 3). In the case of developing and less-developed countries, the economic impacts would also include a shortage of high-technology products such as **medicines**, as well as a fall in foreign direct investment and a severe decline of international humanitarian aid toward low-income countries. We expect an increase of unemployment and poverty in all countries. Global poverty would raise about 4 percent after the attack, which implies that at least 30 million more people would be living in extreme poverty, in addition to the current estimated 767 million. [FIGURE 3 OMITTED] In the area of international relations, we would expect a breakdown of **key doctrines** involving politics, security, and relations among states. These international tensions could lead to a **collapse of the nuclear order** as we know it today, with a consequent setback of **nuclear disarmament** and **nonproliferation** commitments. In other words, the whole system based on the Nuclear Non- Proliferation Treaty would be put under severe trial. After the attack, there would be a reassessment of existing security doctrines, and a deep review of concepts such as nuclear deterrence, no-first-use, proportionality, and negative security assurances. Finally, the **behavior** of governments and individuals would also change radically. **Internal chaos** fueled by the **media** and **social networks** would **threaten governance** at **all levels**, with greater impact on those countries with weak institutional frameworks. Social turbulence would emerge in most countries, with consequent attempts by governments to **impose restrictions on personal freedoms** to preserve order – possibly by declaring a state of siege or state of emergency – and legislation would surely become tougher on **human rights.** There would also be a significant increase in social fragmentation – with a deepening of antagonistic views, mistrust, and intolerance, both within countries and towards others – and a resurgence of large-scale social movements fostered by ideological interests and easily mobilized through social media. Prevention, preparedness, response Given the severity of the impacts, no country in possession of nuclear weapons or weapons-usable materials can guarantee its full protection against nuclear terrorism or nuclear smuggling for proliferation purposes. Nor is it realistic to conceive of full compensation to others in the international community, if a catastrophic event happens because of any country's acts or omissions. Therefore, we consider that **prevention** is the **only** acceptable **way** forward to **preserve global stability.**

Independently, prolif ensures extinction.

Pax '17 finds

Paxchristiusa, 6/11/15, "Prayer-Study-Action on Banning Nuclear Weapons by the Pax Christi Anti-Racism Team," Pax Christi USA, https://paxchristiusa.org/2017/06/01/prayer-study-action-on-banning-nuclear-weapons-by-the-pax-christi-anti-racism-team///EEdoa12/17/23

The increase of nuclear arsenals also included extensive nuclear "testing" in the Pacific islands, where the majority are people of color, including the Bikini Atoll of the Marshall Islands. They were called "tests," but the Pacific islanders experienced radiation poisoning, injuries, and the loss of their ancestral homes. Like the "Kibakusha" – the people of Japan

who survived the hellfire of the atomic bomb – the Pacific Islanders have been tireless prophets in the movement to end nuclear weapons. **Nuclear weapons are the most volatile weapons of mass destruction that have ever existed, and their use cannot be limited to combatants. They kill massively, destroying everything in their expansive range, and leave irreversible injuries to the humans, creatures, and creation that survive.** Yet ironically, while other, less-destructive (though still horrific) weapons, including chemical and biological weapons, are illegal**, there is no such legal prohibition against nuclear weapons.** The Non-Proliferation Treaty Has Not Achieved Nuclear Disarmament In 1968, concerns about the proliferation of nuclear weapons resulted in the adoption of the "Treaty on the Non-Proliferation of Nuclear Weapons" (NPT,) ratified in 1970. Under the NPT, the nations with nuclear weapons agreed to disarm if nations without nuclear arsenals agreed to never acquire them. However, there was no timetable for disarmament set, and nearly 50 years later there are 14,900 nuclear weapons in existence. The US has 6800 and Russia has 7000, and nuclear nations continue to substantially invest in "modernizing" their arsenals, which really means enhancing the mobility, deliverability, accuracy, and lethal character of their weapons. Often, **deterrence is suggested as a logical reason for amassing nuclear weapons; that is, the threat of mutually-assured destruction keeps any country from ever pushing the nuclear button. This is nonsense. Deterrence is a myth, and the risk of power-hungry and vengeful heads of state being in charge of nuclear arsenals, accidental nuclear war due to faulty intelligence, nuclear malfunctions, or the risk of theft by non-state actors of nuclear capability are too deadly to chance.**

Rebuttal

A2 Mars General

1. **Extinction at home isn't inevitable even with new proliferating threats, Dvorsky '23.**

George Dvorsky, 3/6/20, "How Humanity Could Last Forever,"Gizmodo, https://gizmodo.com/how-humanity-could-last-forever-1841892619//EEdoa10/8/23. **Of course, by "we" I'm referring to future offshoots of humans, as our species is likely to change dramatically over the coming eons, should we successfully stave off extinction**. Moreover, **if we** are able to avoid an apocalypse and **get our shit together**, it's fair to say that the **indefinite prolongation of life is an inalienable good**, assuming we enter into a benign mode of existence. We should want to do this, as the alternative—**oblivion—isn't much of a choice.** Consequently, it's something we should be seriously considering. **The first step will be to avert the climate emergency we're embroiled in. Technological, social, and economic progress will be very difficult if all our energy and resources are used to mitigate the threats posed by a deteriorating environment. We must also find ways to sustain a growing global population, alleviate stresses caused by the uneven distribution of wealth, and live sustainably on a planet with finite resources**. As urgently, we need to confront a grim reality: **Our civilization will soon have to juggle an increasing array of existential and catastrophic risks**, in which each added doomsday scenario will boost the odds of our self-destruction by orders of magnitude. That **we devise sensible, practical solutions is paramount**, if our civilization—and our species itself—is to last forever. **Somew zzz here**

between a second and a millennium from now, you will die. Your body and all of its parts… Distributed Humanity Creating powerful safeguards, accountable governments and institutions, and effective, enforceable global-scale policies are all important if our civilization is to survive into the 22nd century and beyond, but there's a sad fact we have to consider: Our current state of technology is forcing us to keep all our eggs in one basket. Accordingly, we need to become an interplanetary species. Once we develop the capacity to live off-planet, however, it might be best for us to break off into separate groups and head in different directions—even if it means forever losing contact with each other. It's an idea I call Distributed Humanity.

2. Aff locks in extinction. Singer 1 (Clifford E., professor of nuclear engineering and director of the Program in Arms Control, Disarmament, and International Security at the University of Illinois at Urbana—Champaign, Spring 2001, Swords and Ploughshares,
http://www.acdis.uiuc.edu/homepage_docs/pubs_docs/S&P_docs/S&P_XIII/Singer.htm
However the technology to build isolated extraterrestrial settlements naturally brings along with it another potentially powerful technology–the ability to move sizeable asteroids. Back in 1979 it was shown that this is not as difficult as one might at first think. The requisite technique is to land a spacecraft on one asteroid, dig up material and throw it the path of another asteroid that will approach nearby, and perturb the orbit of that asteroid until it passes nearby another large object. Once an asteroid or comet makes a controlled approach near any planet but Mercury or Pluto, then it can easily be directed near or at the earth at enormous velocity. Fortunately for our hypothetical descendants here destroying all human life on earth by asteroid impact would likely require moving objects with a diameter in excess of ten kilometers. While there are many of these, the required orbit perturbation would require a lot of lead-time and work and could be very difficult to motivate and conceal. Nevertheless with contributions from this technology a dispute between the earth and a handful of its fragile far-flung offspring in space that is carried to the extreme could conceivably lead to human extinction. Only when settlements in space are sufficiently numerous or far flung would such a possibility effectively be ruled out, primarily by physical considerations.

A2 Continuous Power

1. Alt sources are continuous and can solve, Parrish finds

Jeremy Parrish, "Did You Know? … Geothermal could lead to life on Mars", Utah FORGE, https://utahforge.com/did-you-know-geothermal-could-lead-to-life-on-mars///EEdoa04/12/25 **Earth's heat is a fundamental building block of our planet. Radioactive decay formed the core and layers** of the Earth, and the excess heat is what geothermal energy is produced from. **Mars was formed in a very similar way to Earth** with a core, mantle, and crust. For decades, countries around the world have been looking there for the first extraterrestrial colonization. One of the many obstacles for hopeful settlers is the need for power and heat on these barren landscapes. Some geologists and other scientists theorize that **geothermal energy may be the answer. They suggest that utilizing heat extraction technologies is the key to humans living on Mars!** The Red Planet's surface is riddled with remnants of tectonic and geothermal activity. Home to volcanoes over 17 miles in height, ancient geothermal manifestations prove that it was geothermally

active long ago. Mars is significantly less active than Earth in the modern era; however, there are several indications that geothermal energy might still be accessible under the regolith. There are a few main reasons why scientists believe in Martian geothermal viability. **First, the Red Planet has a broad range of terrestrial heat flow. While there have been no concrete experiments, the heat flow is theorized to vary depending on the geographic region. This is due to tectonism, found in faulting, folding, and uplifting of tectonic plates, and "young" volcanism, volcanic activity believed to have occurred within the last 100 million years.** These events and the diversity in temperature might prove a good environment for geothermal energy on the planet. Scientists have determined that Martian heat flow fluctuates between high and low temperatures, and with enough discovery, we will find areas that are hot enough for utilization. **Scientists have recorded several "Marsquakes" (**Martian earthquakes) in areas that are theorized to contain consistent seismic activity. These geologic events imply that there is h**eat generated under the surface by friction and pressure.** In order to test Mars for geothermal activity, some scientists have proposed shallow drilling tests across the surface of the planet to locate regions of "young" volcanism. Mars's surface is unlivable due to the thin atmosphere; deeper than that, temperatures in the crust of the planet are not hot enough to utilize for geothermal heating or electricity generation. However, a phenomenon known as magmatic intrusion, where pressurized magma from the planet's mantle bursts outward, has previously allowed planetary heat to escape through the crust. **Geologists believe that scientists can recreate magmatic intrusions by piercing the mantle of Mars to extract geothermal energy from the crust. Low average surface temperatures (-63° C) can be survived using geothermal fluids (30-50° C) if scientists can figure out how to access Martian geothermal energy. Conventional heating is the best and most probable way to utilize the planet's heat; any other uses for geothermal energy, like electricity production, are purely theoretical due to a lack of testing. If humanity wants to sustainably live on Mars, the potential for geothermal energy is truly out of this world! So, why is geothermal important for Mars? First, there are very few options that will be effective in that planet's environment; there is very little wind on Mars, solar power generation would be ineffective due dust storms and cold temperatures harming solar panel infrastructure, and nuclear energy requires a substantial amount of time to build the infrastructure to operate. And while nuclear is one of the most optimistic possibilities to generate electricity, scientists believe that geothermal energy is a pivotal step towards the planet's colonization.** Not only can it provide heating, but it is renewable and actually more efficient than it is on Earth; **since low gravity and atmospheric pressure means that the rocks are less dense and more permeable! If humanity wants to sustainably live on Mars, the potential for geothermal energy is truly out of this world!**

A2 Lateral Innovation

1. Lateral innovation is non-unique:

a. Private Sector. Tyron '24

Leon Tyron (Entrepreneur, researcher & systems thinker pioneering predictive engineering, AI-driven cybersecurity & scalable digital infrastructures) , 10-19-2024, "Why the Private Space Sector Will Lead the Next Era of Space Exploration: A New Frontier Beyond…," Medium, https://medium.com/@leontyron/why-the-private-space-sector-will-lead-the-next-era-of-space-exploration-a-new frontier-beyond-61a19cda3df4, accessed 4-12-2025 //RP

In the past, space exploration was dominated by government agencies like NASA, Roscosmos, and ESA. These organizations spearheaded missions that landed humans on the Moon, sent probes to distant planets, and launched satellites to study our universe. **However, the landscape of space exploration has dramatically shifted. Today, private companies are at the**

forefront, pushing the boundaries of what's possible in space travel and exploration. This shift is not just a trend but a crucial evolution that will drive humanity's future in space. 1. **The Rise of Private Space Companies The early 2000s marked a turning point for the space industry. Entrepreneurs like Elon Musk, Jeff Bezos, and Richard Branson entered the scene with ambitious visions that aimed to make space more accessible**. Companies like SpaceX, Blue Origin, and Virgin Galactic have transformed the industry from a government-dominated field to a dynamic ecosystem of private players. **One of the key factors in this shift is the reduction of costs. SpaceX, for example, has drastically lowered the cost of launching payloads to orbit by developing reusable rockets.** This breakthrough has opened the door for a variety of missions, from satellite launches to interplanetary exploration. The private sector has demonstrated that it can innovate quickly, take risks, and find more cost-effective ways to achieve ambitious goals. **2. Innovation Through Competition Competition among private companies has fueled rapid innovation in the space sector.** SpaceX's Falcon Heavy, capable of carrying heavy payloads to orbit, was a response to the increasing demand for more robust and affordable launch systems. Meanwhile, Blue Origin is developing its own reusable rockets and aiming to build a lunar lander that can carry cargo and crew to the Moon's surface. This competition is driving progress at a pace that was previously unimaginable. Beyond rockets, companies like Rocket Lab, Planet Labs, and OneWeb are working on smaller, specialized missions. These **companies are launching constellations of small satellites, providing new data and communication capabilities that will be critical for the future of space infrastructure.** The diversity of private players means that **no single organization holds a monopoly over the future of space.** This c**ompetition is creating a rich environment for technological advancements**. 3. Partnerships with Governments: The New Normal Government agencies have recognized the value of partnering with private companies. NASA's Artemis program, which aims to return humans to the Moon by the mid-2020s, is a prime example. NASA has contracted private companies, including SpaceX and Blue Origin, to develop the technology needed for these missions. This approach leverages the speed and cost-effectiveness of private enterprises while still maintaining oversight and strategic direction. These public-private partnerships are becoming the norm. For instance, NASA's Commercial Crew Program has relied on companies like SpaceX to transport astronauts to the International Space Station (ISS). This shift not only reduces the burden on government budgets but also allows agencies to focus on broader, long-term missions such as sending humans to Mars and beyond. 4. Opening the Door to Commercialization **The commercialization of space is another significant factor that will drive future exploration. Private companies are not just launching rockets; they're developing a range of services that will support a sustainable space economy. From in-orbit manufacturing and satellite servicing to space tourism, the private sector is expanding the scope of what can be done in space. Companies like Axiom Space are even planning to build the world's first commercial space station, which will serve as a hub for research, manufacturing, and tourism. This vision of a commercialized space sector opens up endless possibilities, from asteroid mining to establishing bases on the Moon and Mars. By creating a profitable space economy, private companies are incentivizing further exploration and developmen**t. 5. The Role of Venture Capital and Investments Another driving force behind the private space sector is the influx of venture capital. Investors see the potential for massive returns in space-related technologies, from satellite networks providing global internet coverage to rockets that can transport goods across the world in minutes. In 2023 alone, **venture capital firms invested billions of dollars in space startups, betting on the future potential of the industry.** This financial **backing has enabled startups to take risks, innovate, and compete with established players**. The result is a thriving ecosystem of companies developing new technologies that range from advanced propulsion systems to space debris removal solutions.

A2 Transition

1. Transition now is fast enough

Atkinson and Gulli ’25 (Will Atkinson [S.M., Technology and Policy Program, Massachusetts Institute of Technology A.B., Geosciences, Princeton University.], Chiara Gulli [MSc, Energy, Katholieke Universiteit Leuven MSc, Energy Innovation, Electrical Engineering, Kungliga Tekniska Högskolan BSc, Energy Engineering, Politecnico di Milano.], “The Energy Transition in 2025: What to Watch For,” Rocky Mountain Institute, 1-08-2025, https://rmi.org/the-energy-transition-in-2025-what-to-watch-for/)//Shwillett As we enter a new year, the race between tipping points is clearer than ever. 2024 was likely the hottest year on record, raising the risk of earth system tipping points if we fail to speed up solutions. But despite warnings of a slowdown,**solutions** continue to **race** forward. As **cleantech** becomes **cheaper** than ever, **2024** saw **record uptake** in **renewable energy**, electric vehicles (**EVs**), and **more**. These **positive tipping points** are happening **worldwide** — with major progress in **China** and the **Global South**. Let’s review what that means for the year ahead. **Costs falling fast**. Solar module prices fell 35 percent to 9 cents per watt; EV batteries are now below $100/kWh and often at cost parity with their fossil-fueled competition. Cleantech growing **globally**. Solar additions grew to 600 GW, EV sales climbed 25 percent, and battery storage additions nearly doubled. Changing perception. IEA **forecasts** have **improved** for cleantech and **fallen** for fossil fuels several years in a row. New year, new progress? Energy efficiency and methane are the two fastest ways to cut warming, but also the two furthest off track. From ambition to action. With national climate plans due in February, it is time to include all sectors, pollutants, and solutions — and then hit the ground running. <<<FIGURE OMITTED>>> With falling costs, be ready for a cleantech **revolution** After 2024, clean energy is cheaper than ever. Global solar module prices fell 35 percent to less than 9 cents/kWh. EV batteries saw their **best price decline** in seven years, dropping **~30–50 percent** for cathodes and 20 percent for the full battery to below $100/kWh. EVs are now at cost-of-ownership parity in the United States and purchase price parity in China — with that milestone expected around now for Europe, in 2026 for the United States, and in 2027 for India’s two- and four-wheelers. Thankfully, lower cost does not mean lower quality. Take batteries: the average cell in 2024 used less than half as much nickel and cobalt as a decade ago, and **new technologies** could **double energy densities** in the next five years. As we see improving **safety**, **charge** time, and **longevity**, **uptake** will follow and drive **down cost** in a **virtuous cycle**. <<<FIGURE OMITTED>>> Adoption is going global Cleantech uptake is more widespread than ever. Renewable energy additions grew 17 percent with a record ~600 GW of solar, ~125 GW of wind, and near-doubling of grid storage installations to ~170 GWh in 2024. Renewables now **outpace** fossil electricity **investment** by **10 to 1**, with more investment in solar than all other power sources combined. As a result, renewables are poised to overtake coal as the leading power source in 2025. This progress is truly global. As a share of electricity,**solar** and **wind** is **scaling twice as fast** in the Global **South** as in the Global **North.** Countries like Pakistan and Namibia have used Chinese solar exports to nearly double their total electricity capacity in just two years. Meanwhile, **EV** growth rose **25 percent**(and faster for trucks), with more than 16 million vehicles sold in 2024 — driven by China, which has electrified more than half of its new cars since July. Last year started with unfounded fears of a major EV sales drop — but this is the cycle every year, as all car sales tend to be lower in Q1. Naysayers may point to a similar drop in Q1 2025, but the expected annual growth is larger than ever. <<<FIGURE OMITTED>>> Advancing policy from pledges to progress **New** national **pledges** can **accelerate** change. Led by the EU, countries on five continents **redoubled** their **commitments** to a 1.5oC-aligned emissions path, while the UK pledged an 81 percent reduction by 2035 and Mexico committed to net zero by 2050. All G20 nations now have net-zero goals that could help limit warming to well below 2oC, if realized. Governments are also taking direct action to transition away from fossil fuels. Indonesia has announced plans to switch fully to renewables in the next 15 years — retiring all coal, oil, and gas power plants despite coal’s current dominance. And Ethiopia became the first nation to ban imports of non-electric cars, citing efforts to clean the air and save billions of dollars in annual oil imports. Next year will be crucial. With national climate plans due in February, it is a key opportunity to include all sectors, pollutants, and solutions like energy efficiency. Then, the focus turns to implementation — including for nature, with the next UN climate conference in Brazil. Global outlooks get more **bullish** Are we doing enough to meet the 2030 targets? It depends — but, based on the latest trends, progress-as-usual would meet the 2023 goal to triple renewable energy capacity, as well as the 2024 goal for a six-fold increase in grid energy storage. And from vehicles to heat pumps to industry, annual **electrification** progress **doubled** in the past year — a **key step** for the energy **efficiency** pledge and its many benefits. Fossil fuel **emissions** appeared to rise 0.8 percent to 37.4 GtCO2 in 2024, but **multiple analyses** show that they may well **peak** and **decline** in **2025**. **Half the world** or more has **passed peak demand** for residential gas and gasoline, and **more than half** of countries are **5+ years past the peak** for fossil electricity. As a result, leading outlooks such as the International Energy Agency (IEA) have once again raised their forecasts for renewable energy and electrification, while lowering their forecasts for fossil fuels, emissions, and carbon capture. Time will tell if they do the same in 2025.

And only ev read about actual total emissions, Gaffney ‘25

Michael Gaffney, Ben King and John Larsen, 1-9-2025, "Preliminary US Greenhouse Gas Estimates for 2024", No Publication, https://rhg.com/research/preliminary-us-greenhouse-gas-estimates-for-2024///EEdoa04/13/25 Lower manufacturing output drove the overall decrease **in 2024** emissions, with industrial sector **emissions falling by 1.8%.** In the oil and gas sector, continued reductions in methane emissions intensity led to a 3.7% drop in emissions. Increased air and road travel partially offset these reductions, which drove up transportation sector emissions by 0.8%. Demand for electricity—led by the residential sector—also rose by 3% and was met by higher natural gas, wind, and solar generation, while coal generation saw just a slight decline. For the first time, combined solar and wind generation surpassed coal, although overall power sector emissions increased by a slight 0.2%. In the buildings sector, emissions crept up 0.4% due to slightly elevated fuel use. The modest 2024 decline underscores the urgency of accelerating decarbonization in all sectors. To meet its Paris Agreement target of a 50-52% reduction in emissions by 2030, the US must sustain an ambitious 7.6% annual drop in emissions from 2025 to 2030, a level the US has not seen outside of a recession in recent memory.

And Models are overestimated

Wade '21 [Robert H.; 2021; Professor of Global Political Economy at the London School of Economics, DPhil and MPhil in Social Anthropology from Sussex University, Master's in Economics from Victoria University, BA in Economics from Otago University; Global Policy Journal, "What is the Harm in Forecasting Catastrophe Due to Man-Made Global Warming?," https://www.globalpolicyjournal.com/blog/22/07/2021/what-harm-forecasting-catastrophe-due-man-made-global-warming

] Upward Bias in Temperature Forecasting Models

The prospect of a coming catastrophe for humanity and the biosphere rests **heavily** on outputs of climate forecasting **models**. But as David Legates and co-authors argue, these models "exhibit a **strong exaggeration** in their results even when narrowly adopting atmospheric carbon dioxide as the sole driver of climate responses…. [General circulation models, such as those of the IPCC, the Intergovernmental Panel on Climate Change] have **consistently overestimated** the climate sensitivity to rising atmospheric carbon dioxide."

Ross McKitrick (2020) begins his assessment, "Two new peer-reviewed papers from independent teams confirm that *climate models overstate atmospheric warming, and the problem [of overstatement] has gotten worse over time, not better*". One of the papers (by McKitrick and John Christy) examined 38 models, the other, 48 models, used by the Intergovernmental Panel on Climate Change (IPCC), the various US "National Assessments", the EPA's "Endangerment Finding", and more.

McKitrick continues, "Both papers looked at **'hindcasts'**, which are reconstructions of recent historical temperatures in response to observed greenhouse gas emissions and other changes (eg aerosols and solar forcing). Across the two papers it emerges that the models **overshoot** historical warming from the near-surface through the upper troposphere, in the tropics and globally." The study based on 48 models for 1998 to 2014 found that *they warm on average 4 to **5 times** faster than the observations*.

McKitrick concludes, "modelling the climate is incredibly difficult, and no one faults the scientific community for finding it a tough problem to solve. But we are all living with the consequences of climate modelers **stubbornly** using **generation after generation** of models that exhibit **too much surface** and **tropospheric** warming, in addition to running **grossly exaggerated forcing scenarios** (eg RCP8.5).

"[W]hen the models get the tropical **troposphere** wrong, it drives potential errors in many **other** features of the model atmosphere. Even if the original problem was confined to excess warming in the tropical mid-troposphere, it has now expanded into a more pervasive warm bias throughout the global troposphere.

"If the discrepancies in the troposphere were evenly split across models between excess warming and cooling we could chalk it up to noise and uncertainty. *But that is not the case: it's **all** excess **warming**…. That's **bias**, not uncertainty, and until the modelling community finds a way to fix it, the economics and policy making community are justified in assuming future warming projects are overstated, potentially by a great deal…."*

The **strong upward bias** in temperature forecasts relative to observations **compromise** the **models' forecasting impacts** on ecosystems, including agriculture, by **exaggerating** the probability of catastrophic effects.

The IPCC makes projections of future global temperatures to the end of century based on various models. They range from a low of 1.4 C to a high of 5.6 C over pre-industrial temperature (roughly 1900). The wide range makes them almost **meaningless**. The IPCC explains that the wide range results from uncertainty about the magnitude of the feedback between warming and increased rates of evaporation – and David Seckler adds, also about the effects of evaporation on clouds and precipitation. (5)

It is astonishing to learn that the climate models miss a critical component of the climate system -- the hydrological cycle, and specifically clouds, which the IPCC calls the "wild card" in the climate system.

The IPCC's **Worst Case** Scenario is commonly used as the **Business as Usual** without a Radical Policy Action' Scenario

The IPCC's Assessment Report 5 (AR5), published in 2014, presented a range of forecasts of global climate out to 2050 and 2100, based on different assumptions about radiative forcing (a measure of how much of the sun's energy the atmosphere traps). The most extreme – the worst case – was called Representative Concentration Pathway (RCP) 8.5. It assumes **ominous reversals** in several **basic, long-standing trends**, all heading in the extremely wrong direction to 2100:

- high population growth to reach more than 12 billion people
- slow **tech**nology development
- coal consumption increases by 500 % between 2005 and 2100 (no account taken of supply constraints)
- slow GDP growth
- fast rise in world poverty
- high energy use
- high GHG emissions.
- **temp**erature forecast: **5 C** rise between 2005 and 2100.

RCP 8.5's vision is **horrifying**, as worst-case scenarios should be.

A **whole wave** of **lit**erature, in peer-reviewed journals as well as in media, even by IPCC authors, has since presented this worst-case as either "the most **likely** case" or "the baseline case – business as usual without policy action". This **misleading** assumption provoked a recent paper in Nature subtitled: "Stop using the worst-case scenario for climate warming as the most likely outcome" (see also, Chrobak, 2020).

2. They cook timeframe litany of reasons : Mark Z. Jacobson, 10-10-2024, "7 reasons why nuclear energy is not the answer to solve climate change", One Earth, (Mark Z. Jacobson's career has focused on better understanding air pollution and global warming problems and developing large-scale clean, renewable energy solutions to them. Toward that end, he has developed and applied three-dimensional (3-D) atmosphere-biosphere-ocean computer models and solvers to simulate and understand air pollution, weather, climate, and renewable energy systems. He has also developed roadmaps to transition countries, states, cities, and towns to 100% clean, renewable energy for all purposes and computer models to examine grid stability in the presence of 100% renewable energy. Jacobson has been a professor at Stanford University since 1994)https://www.oneearth.org/the-7-reasons-why-nuclear-energy-is-not-the-answer-to-solve-c limate-change///EEdoa04/02/24

There is a small group of scientists that have proposed replacing 100% of the world's fossil fuel power plants with nuclear reactors as a way to solve climate change. Many others propose nuclear grow to satisfy up to 20 percent of all our energy (not just electricity) needs. They advocate that nuclear is a "clean" carbon-free source of power, but they don't look at the human impacts of these scenarios. Let's do the math... **One nuclear power plant takes on average about 14-1/2 years to build**, from the planning phase all the way to operation. According to the World Health Organization, about 7.1 million people die from air pollution each year, with more than 90 percent of these deaths from energy-related combustion. **So switching out our energy system to nuclear would result in about 93 million people dying, as we wait for all the new nuclear plants to be built in the all-nuclear scenario.** U**tility-scale wind and solar farms**, on the other hand**, take on average only two to five years,** from the planning phase to operation. Rooftop solar PV projects are down to only a 6-month timeline. So transitioning to 100% renewables as soon as possible would result in tens of millions fewer deaths. This illustrates a major problem with nuclear power and why renewable energy -- in particular Wind, Water, and Solar (WWS) -- avoids this problem. Nuclear, though, doesn't just have one problem. It has seven. Here are the seven major problems with nuclear energy:

The time lag between planning and operation of a nuclear reactor includes the times to identify a site, obtain a site permit, purchase or lease the land, obtain a construction permit, obtain financing and insurance for construction, install transmission, negotiate a power purchase agreement, obtain permits, build the plant, connect it to transmission, and obtain a final operating license. The planning-to-operation (PTO) times of all nuclear plants ever built have been 10-19 years or more. For example, the Olkiluoto 3 reactor in Finland was proposed to the Finnish cabinet in December 2000 to be added to an existing nuclear power plant. Its latest estimated completion date is 2020, giving it a PTO time of 20 years. The Hinkley Point nuclear plant was planned to start in 2008. It has an estimated the completion year of 2025 to 2027, giving it a PTO time of 17 to 19 years. The Vogtle 3 and 4 reactors in Georgia were first proposed in August 2006 to be added to an existing site. The anticipated completion dates are November 2021 and November 2022, respectively, given them PTO times of 15 and 16 years, respectively. The Haiyang 1 and 2 reactors in China were planned to start in 2005. Haiyang 1 began commercial operation on October 22, 2018. Haiyang 2 began operation on January 9, 2019, giving them PTO times of 13 and 14 years, respectively. The Taishan 1 and 2 reactors in China were bid in 2006. Taishan 1 began commercial operation on December 13, 2018. Taishan 2 is not expected to be connected until 2019, giving them PTO times of 12 and 13 years, respectively. Planning and procurement for four reactors in Ringhals, Sweden started in 1965. One took 10 years, the second took 11 years, the third took 16 years, and the fourth took 18 years to complete. **Many claim that France's 1974 Messmer plan resulted in the building of its 58 reactors in 15 years. This is not true. The planning for several of these nuclear reactors began long before. For example, the Fessenheim reactor obtained its construction permit in 1967 and was planned starting years before. In addition, 10 of the**

reactors were completed between 1991-2000. As such, the whole planning-to-operation time for these reactors was at least 32 years, not 15. That of any individual reactor was 10 to 19 years.

A2 Peak Oil

1. Peak oil's fake AND demand will peak before supply. Berman '25 Arthur Berman (associate editor of the AAPG Bulletin and was a managing editor and frequent contributor to theoildrum.com. I worked 20 years for Amoco (now BP) and 22 years as consulting geologist. I have an M.S. (Geology) from the Colorado School of Mines and a B.A. (History) from Amherst College) , 2025, 2-3-2025, "Peak Oil: Requiem for a Failed Paradigm," Art Berman, https://www.artberman.com/blog/peak-oil-requiem-for-a-failed-paradigm/, accessed 4-12-2025 //RP Peak Oil was supposed to be a warning. When world production peaked, shortages, soaring prices, and economic collapse would follow. Twenty years ago, Matt Simmons made that case in Twilight in the Desert, arguing that if Saudi oil peaked, a global crisis was coming. **The Peak Oil movement ran with it, predicting an imminent decline. That didn't happen. Peak Oil is a failed paradigm.** Why I'm Writing This In a recent post, I explained that many **widely held beliefs about Peak Oil are memes—ideas that sound credible and feel right but fall apart when tested with data**. The response was overwhelming—plenty of questions, some pushback, and even a few angry reactions. That told me a deeper dive was needed. My goal isn't to be dismissive or negative but to clarify my views. I was an active Peak Oil advocate 15 years ago and have spent a lot of time reflecting on where we were right—and where we were wrong. Any criticism here applies equally to me. One thing is clear: **we were wrong about Peak Oil. Not the concept itself, but certainly the timing.** I still believe Peak Oil will happen—but not the way we imagined. This isn't the first time I've been wrong, and it won't be the last. But as a scientist, I believe in revisiting past ideas and challenging my own assumptions. Honest reflection is more important than sticking to outdated narratives. That's why I'm writing this—not to offend, but to be realistic—to give a once-vital model its due respect while bidding it farewell. The analysis that follows isn't an endorsement of more oil consumption. A world constrained by Peak Oil would be better for the planet—but that's not the reality playing out. Where Peak Oil Came From Peak Oil started with credibility. M. King Hubbert predicted U.S. oil production would peak around 1970—and he was right. A geologist, he applied discovery, extraction, and depletion models from mineral resources to oil, showing that production follows a bell curve—rising with discoveries, peaking at the halfway point, then declining as what remains gets harder to extract. **After the oil shocks of the 1970s, a decade of low prices and oversupply almost buried Hubbert's warnings.** But in 1998, Colin Campbell and Jean Laherrère reignited the debate in The End of Cheap Oil , warning that global production was near its peak, with lasting economic and geopolitical consequences. Their argument: Oil discoveries peaked in the 1960s. The world's largest fields were depleting. Non-OPEC production (U.S. and North Sea) would peak by 2010, making OPEC dominant. Technology could slow decline but not stop it. Governments needed to prepare for shortages and price shocks. These ideas shaped the Peak Oil movement, a loose network of scientists, analysts, and activists pushing for alternative energy and policy shifts. Inside the Peak Oil Movement I was there. I served on the Board of Directors for the Association for the Study of Peak Oil (ASPO). I knew Matt Simmons and Colin Campbell and still talk with Jean Laherrère. I was a contributor and managing editor at The Oil Drum, the online hub for Peak Oil discussions. **At its core, Peak Oil was about depletion. But it lost focus. Instead of studying the economics of supply, it became a contest to predict the exact peak date, mostly driven by people with no industry experience.** They didn't understand reserve determination, oil-field mechanics, or how investment cycles extend supply. **Most critically, Peak Oil ignored economics—supply isn't just geology; it's shaped by price and availability of capital.** Peak Oil Never Saw Shale Coming **The early 2000s were a different oil world. Conventional crude dominated supply, and shale, deepwater, and oil sands played minor roles**. The U.S. was heavily dependent on Middle East crude, and energy independence seemed impossible. If global production peaked and exporters kept more for themselves, shortages would cripple economies. Peak Oil never saw shale coming—and worse, refused to admit its impact once it

did. **By 2010, fracking and horizontal drilling unlocked massive U.S. tight oil resources, reversing decades of decline**. U.S. **crude output more than doubled from 2008 to 2018**, making it the world's top producer. **Peak Oil models also ignored Canada's oil sands and Brazil's deepwater pre-salt, both of which became major supply sources. Enhanced recovery methods pushed even more oil out of old fields, delaying decline further.** Peak OII's Biggest Flaw: Geology vs Economics and Markets **The critical flaw was geological determinism—the assumption that supply was limited to known reserves plus some that probably existed, and their depletion. But oil isn't just about what's already known—it's about what can be found with different price assumptions, advancing technology, and capital investment. The 2005-2014 oil price boom proved that economics, not just geology, dictates supply, as higher prices drove a surge in investment and new production.** Markets Changed, Peak Oil Didn't Oil wasn't just about geology anymore: OPEC+ emerged as a dominant force, controlling output to balance prices. The U.S. lifted its 40-year crude export ban in 2015, reshaping global trade flows. Oil pricing was now financialized—futures trading, speculation, and hedging meant prices weren't just about physical supply and demand. The Debate Flipped: Peak Supply vs Peak Demand **Peak Oil collapsed as a useful framework. Instead of fearing a supply crunch, the question became whether demand will peak first**, driven by: Decreasing affordability of oil EVs and electrification Climate policy and decarbonization Shifts in global energy use **The world didn't run out of oil—it found new ways to produce it and is now changing how it uses it. "The dominance of road transport fuels is anticipated to decline, whilst demand growth is expected to be driven by petroleum products used in the production of plastics and fuel for residential activities and aviation."** Vitol Long Term Oil Demand Outlook (February 2025) **World oil demand is expected to reach a peak plateau in the 2030s, and then decrease back to current levels by 2040 (Figure 1). Road transport fuels are expected to decline from 45% to 40% of oil consumption by 2040. These losses will be offset by gains in aviation and petrochemical uses of oil.** Figure 1. Vitol oil demand change by sector of outlook. Source: Vitol and Labyrinth Consulting Services, Inc. Figure 1. Vitol oil demand change by sector of outlook. Source: Vitol and Labyrinth Consulting Services, Inc. The Evidence: Oil Supply Isn't Shrinking In "Lazy Thinking: How Memes Get Oil All Wrong," I laid out the numbers: **At current consumption, there's 60 years of proven oil at today's prices—plus another 70 years that may require higher prices. Even if you cut proven reserves in half, there's still plenty of oil left to get us to the cliff toward which civilization seems headed. The idea that oil is running out isn't true—global reserves are at record highs and still keeping up with demand.** I was sent a rebuttal—Figure 2—which separates conventional crude (green) from all liquids, including NGLs, other liquids, and refinery gains (blue), predicting Peak Oil between 2019 and 2025. Unconventional oil isn't acknowledged but apparently contributes to "liquids." Figure 2 . World oil production and forecast using ASPO (Association for the Study of Peak Oil) data. Source: Jean Laherrère. Figure 2. World oil production and forecast using ASPO (Association for the Study of Peak Oil) data. Source: Jean Laherrère. But Figure 3 tells the real story. As of October 2024 EIA data, neither crude plus condensate (including unconventional oil) nor total liquids match Figure 2's decline. October crude plus condensate production was 7 mmb/d above the 2004–2011 plateau—a trend that I once considered the strongest case for Peak Oil—and is expected to exceed 10 mmb/d more by 2026. Figure 3. October world crude + condensate production was 7 mmb/d more than 2004-11 plateau. It is expected to be more than 10 mmb/d more by the end of 2026. Source: EIA & Labyrinth Consulting Services, Inc. Why Peak Oil's View is Wrong The two figures might as well come from parallel universes. The real world aligns with Figure 3, making Figure 2's Peak Oil predictions questionable. **Unconventional oil is still oil. Refineries—crude's only buyers—don't care about Peak Oil's artificial categories. They pay for oil that meets their specifications, whether it's conventional or unconventional.** Dismissing unconventional oil is like saying, "Tomato production is up, but all the growth came from greenhouses, not traditional fields, so it doesn't count," as if the tomatoes aren't the same. Paradigm Shift: Peak Oil is Obsolete Thomas Kuhn said a paradigm must solve real, recognized problems. What problems does Peak Oil solve today? That we are in big trouble as long as we ignore unconventional oil? Unconventional oil is the world's largest new source of energy since natural gas (Figure 4). Its primary consumption is equal to wind + solar + nuclear + hydro combined. **Dismissing unconventional oil or downplaying its role isn't reality—it's just defending a narrative that can no longer be supported.** Figure 4. Unconventional oil is the world's largest new source of energy since natural gas. Its primary consumption is equal to wind + solar + nuclear + hydro combined. Source: EIA, BP, IEA, FRED, OWID, World Bank & Labyrinth Consulting Services, Inc. Yes, oil production will peak someday. But inevitability doesn't make a paradigm useful. We all know we'll die, but that fact alone doesn't shape reality. Kuhn warned that paradigms don't die easily. Copernicus had to fight Ptolemy's theories, Einstein had to push past Newton's world view, and it took plate tectonics 75 years to finally overturn the static Earth

model. Peak Oil got lost when shale rewrote the script. **Technology, capital, and price—not just geology—now dictate oil supply**. The 2005-2014 price boom unlocked more oil than anyone expected. Today, financial markets and geopolitics—not depletion—drive the oil game. **Shale changed everything, unleashing a massive new supply. Peak Oil still pretends it doesn't exist—won't even put it on a chart.** That's why it's a dying paradigm. It had its moment and reshaped my world view in important ways. May it rest in peace.