**Contention 1 is China.**

**America is setting itself back globally. Shepherd 4-4**

**Shepherd 4-4** [Christian Shepherd, China correspondent for The Washington Post. He previously covered the country for the Financial Times and Reuters from Beijing , 4-4-2025, "After Trump tariffs, China offers ‘trauma bonding’ with U.S. partners", Washington Post, https://www.washingtonpost.com/world/2025/04/04/trump-tariffs-china-global-trade/, accessed 4-4-2025.] //aayush

**In the upheaval of President Donald Trump’s blanket tariffs**, **China is seeking common cause with jilted partners of the United States as it tries to extend its influence and take center stage in a new trade order** — rebuilt without Washington. **China had already been working to exploit cracks in international leadership created by Trump’s “America First” foreign policy**. As the **United States has slashed development aid, abandoned climate talks and temporarily suspended military assistance to Ukraine, Beijing has ramped up its own alternative vision on each issue**. Trump’s emerging **global trade war gives Chinese leader Xi Jinping an additional lever to build influence**. “Beijing is **stepping up efforts to court U.S. allies and partners who remain stunned and disappointed by the new U.S. tariff hikes aimed at them**,” said Wendy Cutler, vice president at the Asia Society Policy Institute and a former U.S. trade negotiator. Trump this week imposed “**reciprocal**” **tariffs of between 10 and 49 percent on almost all other trading partners**. But **China**, which ran a trade surplus with the U.S. approaching $1 trillion last year, **was hit particularly hard**: From April 9, its exports to the United States will be hit with a minimum tariff rate of **54 percent**. China, the world’s second-largest economy, **announced 34 percent tariffs Friday on all U.S. goods, along with restrictions on exports of rare earth metals used to make high-tech products, along with a slew of other measures targeting American companies**. Even before Trump’s announcement, Beijing had been making overtures to other countries in a charm offensive fueled by his return to the White House. **In calls and meetings with officials from the European Union, South Korea and Japan in recent weeks, high-ranking Chinese officials have offered to join forces to resist Trump’s protectionism and “bring certainty to global trade.”** China and **the E.U.** should “jointly resist unilateralism and protectionism to protect the multilateral trading system,” Vice Premier He Lifeng last month told Maros Sefcovic, the European commissioner for trade, according to an official Chinese readout. Xi, the most powerful Chinese leader in decades, has sometimes led the outreach himself. Xi on Tuesday called for a “**Dragon-Elephant tango**” to **improve frayed diplomatic ties with India**, a day after the Chinese ambassador to New Delhi promised that China would buy more Indian products and a mere six months since they reached a deal to end four years of a sometimes violent border dispute. Now, **as the world reels from the tariffs, Beijing has an opportunity to build, or mend, ties with American partners over a sudden shared grievance with the United States**. “**Everyone feels attacked** by the U.S. and the victims can empathize with each other **through trauma bonding**,” said Xing Yue, director of the Center for Chinese Foreign Policy at Tsinghua University in Beijing. “**Previously, these allies followed the U.S. to isolate and attack China, but now they have become victims themselves**.” **Xi will reportedly visit Vietnam, Cambodia and Malaysia in the coming weeks**, countries which Trump hit with duties of 46, 49 and 24 percent respectively. There, **analysts expect Xi will present China as a defender of the existing international trade system**. **He may find** some **sympathetic ears**. Malaysia is still hoping to negotiate with the Trump administration on tariffs in the short term. “But in the medium to longer term, **Malaysia will slowly pivot to other regions and be less dependent on the U.S. for trade and investment flows**,” said Ong Kian Ming, board director of the Malaysian Investment Development Authority in Kuala Lumpur. Beijing has been quick to cast itself as a reliable partner and one among many injured parties that must come together to weather the tariff storm. “While countries around the world expand ‘circles of friends’ for trade,” **America’s imposition of tariffs means it is “self-isolating” from a network of global trade agreements**, said a blog post by state broadcaster China Central Television (CCTV). The **tariffs are “not only aimed at China, but the world,”** said He Weiwen, a senior fellow at the Center for China and Globalization, a think tank based in Beijing. “**The goal of ‘Liberation Day’ is to change the U.S. trade relationship with the world**.”

**Nuclear energy is key to countering China -- we’re neck and neck now. Sandstrom 25**

**Sandstrom**, Andrew, and Grayson Massey. “Opinion: Utah Is Right to Lead with Nuclear.” Deseret News, March 11, **2025**. https://www.deseret.com/opinion/2025/03/11/utah-leads-nuclear-energy-ai-data-centers/. [Andrew writes on energy and environmental issues and is the host of the Public Lands Policy Podcast. Grayson is the Western region director for the Young Republican National Federation.] //arrguy

Utah is booming. We had the third-fastest growing economy of any state over the last five years, and the population continues to increase. **But a booming economy means greater demand for energy and the very real threat of higher prices.** Utah needs a lot more energy — and we need it quickly. **The best way to meet this rising demand is to invest in nuclear energy.** That is why we need more leaders in our state to step up and join the movement to do just that. When it comes to leading-edge technology, this is the place. Artificial intelligence data centers are bringing jobs and opportunity to Utah, enabling Utahns to play a leading role in strengthening America’s national security. As Senate President Stuart Adams puts it: “The country that controls AI will control the world.” America must win the AI race, which means Utah must continue to make advances in AI. **But the energy cost of AI is staggering. Each data center requires several gigawatts of energy — enough to power millions of homes.** The entire state of Utah currently runs on just four gigawatts. The good news is that Utah’s elected officials recognize this need and are taking action. Gov. Spencer Cox launched Operation Gigawatt to double Utah’s energy production in a decade. Adams wants to triple it by 2050. Such a dramatic increase in energy production is an enormously difficult task. **But a growing number of leaders recognize that Utah can meet this challenge if we invest in nuclear energy. Cox and Republican leadership in the state Legislature have proposed the innovative solution of using small modular reactors (SMRs) to power our data centers — something that has never been done in America. SMRs have about one-third the capacity of a modern nuclear plant, but they take up far less space and are much cheaper and easier to build.** SMR opponents have raised concerns over the safety of nuclear energy. High-profile disasters from nearly a half-century ago still linger on the minds of those who grew up in an era of anti-nuclear activism. But nuclear technology has made incredible strides over the last four decades. **Thanks to advanced reactor designs, passive safety systems and other innovations, today’s nuclear power is the safest form of energy we have. Nuclear is also the most reliable energy known to man by far. A nuclear-powered grid would mean no rolling blackouts, no dirty smokestacks polluting our air and our kids’ lungs, and, of course, lower energy prices, even as Utah’s economy and tech sector continue to grow.** As our new United States Sen. John Curtis has put it, “Nuclear power is a critical component of our clean energy future. Its ability to generate large amounts of electricity with minimal greenhouse gas emissions makes it an invaluable part of our energy grid.” **There is no time to waste: China is neck and neck with us on AI technology and beating us on nuclear energy.** China made the world’s first commercial SMR and plans to build 150 new nuclear reactors in the next decade. View Comments Because of the economic and national security implications of falling behind in this energy race, President Donald Trump, Secretary of Energy Chris Wright and others in Washington are moving aggressively to reform federal energy permitting policies so that we can catch up. **This gives Utah a historic opportunity to take a leading role in nuclear energy — just as we play a leading role in AI.** Utah has always been a state of early adopters, and as with most technologies, there are substantial benefits to being the first to market. Because of its location and existing energy infrastructure, Utah is uniquely poised to lead on next-generation nuclear, and the sooner we adopt this new technology, the more of a boost it will be to Utah’s economy and quality of life for Utahns. The state Legislature realizes this, which is why they have moved quickly this year to advance major legislation to create a Nuclear Energy Consortium and a Utah Energy Council to designate specific zones for SMRs. **By embracing nuclear energy, Utah can secure its place as a leader in both technological innovation and energy independence.** With swift action, we can ensure affordable, reliable and clean energy for generations to come — powering our homes, businesses and critical industries while strengthening America’s national security. Thank you to our state Legislature, Gov. Cox and Sen. Curtis for their ongoing efforts to make this vision a reality.

**Investment drives innovation. Holtzman 23**

‌Benjamin **Holtzman**, Nuclear Energy Institute. “Opportunities for Industries,” **2023**. https://www.nei.org/advanced-nuclear-energy/opportunities-for-industries. [Ben is the Director of New Nuclear at the Nuclear Energy Institute. He is an accomplished and results-driven nuclear professional with over 15 years of experience in a variety of regulatory, technical, and business arenas. He currently is focused on developing a more efficient risk-informed regulatory framework, accelerating industry deployment readiness, and engaging with investors and new end-users to understand new nuclear opportunities. Ben has a B.S. in nuclear engineering, a M.S. in nuclear, plasma, & radiological engineering, and an executive M.B.A.] //MH

Industries across the economy are recognizing nuclear’s ability to reduce—or erase—their carbon footprints. **Existing nuclear, small modular reactors, and other advanced nuclear technologies also offer significant opportunities for industry innovation and growth beyond electricity.** Explore Nuclear & Your Industry Aerospace - Nuclear has successfully powered space... ...exploration for decades. Now, the industry is developing new nuclear energy technologies to power the next phase of space travel: early unmanned missions, earth satellites, permanent lunar bases and missions to Mars. Companies such as Zeno Power, X-energy and Ultra Safe Nuclear Corporation are creating next-generation radioisotope power systems to send spacecraft and probes even farther into space. NASA is exploring nuclear thermal propulsion to reduce flight time, enabling human missions to Mars and beyond. As part of the historic Artemis space program, NASA also awarded contracts for a small nuclear power system that could run a permanent base for surface power on the Moon for upwards of 10 years. **Agriculture - Nuclear technologies can reduce the carbon... ...footprint of this industry’s energy intensive processes.** Nuclear can make hydrogen for zero-carbon ammonia production and can also directly provide the process heat required to produce synthetic fertilizers. **Nuclear technology can be used to improve crop yield and develop plant varieties that need less water and are more resistant to the impacts of climate change.** Nuclear’s desalination capabilities can enable irrigation in arid regions and combat water disputes between agricultural, commercial, and residential interests. Nuclear can also help fight against pests, avoiding the need to use harmful pesticides. Irradiating food also kills E. coli, listeria and salmonella, so fresh foods can last longer. **Data Centers and Information Technology - Google and other companies... ...like Microsoft are turning to nuclear energy for a dependable, carbon-free source of power to power their data centers continuously. In the future, data centers may have dedicated, standalone, small modular reactors (SMRs) or microreactors to power their operations “behind the meter.”** SMRs can provide backup power for data centers on the grid and also operate independently of a grid. Some designs for new nuclear facilities also allow for data centers to be co-located on the same site, creating even more efficiencies. Finance, Blockchain, and Cryptocurrency - To address the substantial energy consumption... ...linked to cryptocurrency mining and transactions, businesses are looking towards eco-friendly energy alternatives. Nuclear energy can deliver consistent carbon-free power for continuous mining and transaction processing. Oklo entered a 20-year agreement with Compass Mining to offer 100 percent carbon-free electricity for crypto mining. Energy Harbor signed an agreement with Standard Power to deliver nuclear-generated, carbon-free, electricity to its bitcoin blockchain mining center in Ohio. Additionally, Talen Energy intends to establish a nuclear-powered cryptocurrency mining and data facility adjacent to the Susquehanna nuclear power plant. **Manufacturing - Advanced reactors can provide heat for... ...industrial processes such as chemical production and metal refining, enabling these industries to reduce their carbon footprint. Dow Chemical partnered with X-energy to develop SMR technology, while Nucor has invested in NuScale Power Corporation to support the development of small modular reactor nuclear plants which can meet their needs for reliable carbon-free electricity to power steel production.** Nucor was also the first major industrial company to join the United Nations 24/7 Carbon-Free Energy Global Compact, which is aimed at accelerating the decarbonization of the world's electricity systems to mitigate climate change and ensure access to clean and affordable energy. **Medicine and Health - Nuclear power plants play a crucial role in public health... ...by producing a life-saving resource, Cobalt-60.** This isotope sterilized billions of pieces of medical equipment in hospitals during the height of the COVID -19 pandemic. **Radioisotopes, which are naturally formed during the process of producing reliable, carbon-free electricity, have significant lifesaving applications such as diagnosis and treatments for cancers.** Bruce Power and Ontario Power Generation (OPG) are among the companies that collect these medical isotopes and process them for worldwide distribution. Demand for radioisotopes is continuously increasing. Nuclear radiation is also used to treat food, kill bacteria, and eradicate insects and parasites that cause illness. Lastly, microreactors offer the potential to provide hospitals with clean energy 24/7/365, either independently or as part of a microgrid, without relying on a larger power grid. These compact reactors can be transported by land, air, or sea to remote areas, allowing hospitals in communities with inadequate access to health care or that have been affected by disasters to be powered with reliable energy. Textiles - The textile industry can remove chemicals and... ...pollutants, such as dyes, starches, acids, salts and detergents, from its water by using nuclear electron beam technology. Electron beams can break apart the chemical bonds of clothing dyes and remove pollutants, allowing textile manufacturers to recycle wastewater for reuse. One textile factory in Southern China uses the technique to save up to 4.5 million cubic meters of fresh water annually, which is equivalent to the water consumed by about 100,000 people. The fashion industry, which accounts for nearly 10 percent of global emissions, is also turning to nuclear energy to decarbonize. Transportation - Some of today’s nuclear reactors are demonstrating... ...the capability for carbon-free production of large quantities of hydrogen, which can be used as fuel to power various forms of transportation, including aviation, shipping, heavy transport, fuel-cell trains, and vehicles. Advanced nuclear reactors can produce hydrogen. Nuclear energy is also a highly feasible option for providing steady and reliable carbon-free electricity to EV charging stations 24/7/365.

**Nuclear’s uniquely key — Trump’s gutting other R&D. Wong 25**

**Wong-Leung 25** [Jenny Wong-Leung, Data scientist with ASPI’s Cyber, Technology and Security program, 2-27-2025, US cuts to science and technology could fast-track China’s tech dominance, Strategist, https://www.aspistrategist.org.au/us-cuts-to-science-and-technology-could-fast-track-chinas-tech-dominance/, accessed 3-16-2025.] //aayush

Is **the United States now trying to lose the technology race with China**? It certainly seems to be. **The race is tight, and now the Trump administration is slashing funding for the three national institutions that have underpinned science and technology** (S&T) **and what advantage the US still has**. **China is outpacing the US in** the volume of **high-impact research in 57 of the 64 critical technologies in ASPI’s Critical Technology Tracker. The US’s main remaining advantage is downstream in implementing technology**, and **even that’s at risk as China’s significant S&T investments pay off**. Now **the US’s lead may disappear even faster following cuts to the National Institutes of Health** (**NIH**), National Aeronautics and Space Agency (**NASA**) **and** National Science Foundation (**NSF**). **The NIH is the biggest public funder of biomedical research worldwide** and impacts global health in ways often taken for granted. For example, **it supported the foundational work that led to the Haemophilus influenzae type b vaccine which, by some estimates, prevented 1.2 million infant deaths between 2000 and 2015**. **NASA is a stalwart of space research and inadvertently has contributed to medical innovations as it has attended to the health of its astronauts, such as the ear thermometer**. The **NSF funds all non-medical scientific research** (**biology, quantum computing, artificial intelligence, space and advanced materials**) in the US and manages major research facilities. **The NIH stands to lose $4 billion out of the $32 billion already allocated to US research grants in 2024**. This $4 billion cut is not just 11.4 percent of the NIH’s research grants; **it will also limit its ability to cover indirect costs associated with equipment, maintenance, safety and personnel—everything that keeps world-class research facilities ticking**. According to The New York Times, **indirect costs make up 29 percent of grant funds on average**. With only 85 out of 613 institutions having indirect costs below 15 percent, **a decision to cap indirect costs at 15 percent will at least halve the funds for maintaining labs for most NIH grant recipients**. If you are a grand-slam-winning tennis champion, **these indirect costs are akin to the payments for your team of coaches, strategists, medical entourage, all your equipment and access to training facilities**. Without these, **you won’t stay at number one**. It’s the same in the critical technology race. Typically, **labs and other research facilities have state-of-the-art equipment**, which have indirect costs commensurate with their level of sophistication. This means that **high-level labs**—**where breakthroughs often happen**—**have more to lose when funding is cut for indirect costs**. The biggest losers in these cuts will be **top US universities**, **medical schools and hospitals**, many of which **are among the top 10 institutions in the Tech Tracker for biotechnologies**, including MD Anderson Cancer Center, Memorial Sloan Kettering and many teaching hospitals within the Harvard Medical School. **The NIH not only provides research funding in the biomedical fields; it also has 27 biomedical research institutions**. The NIH combined is currently ranked second for vaccines and medical countermeasures and eighth for genetic engineering in the Critical Technology Tracker, highlighting its global importance and competitiveness. NIH-funded research has contributed to early detection and prevention of cancers, chemotherapy and immunotherapy. The NIH also helped develop vaccines for flu and RSV (Respiratory Syncytial Virus), as well as the mRNA Covid-19 vaccine. **These are the very institutions that the US government will rely on to develop the future vaccines needed to protect Americans from the next global pandemic**. In addition, in early February, biomedical research was again in the firing line with termination letters sent to hundreds of employees at the Centers for Disease Control and Prevention, the Food and Drug Administration, and the NIH. More job cuts are expected to follow, further weakening the sector. Around the same time, the NSF froze all grant review processes to comply with new directives to end all diversity, equity, and inclusion (DEI) programs. According to the Washington Post, NSF staff were tasked with scrutinising active research grants—preciously approved by peer review—with a list of keywords including ‘women’, ‘diverse’ and ‘institutional’ to reverse any grants remotely related to DEI initiatives. On 18 February, the haemorrhage of US S&T talent continued with a 10 percent cut to the NSF workforce. Given the NSF’s annual budget of $9 billion, the effect of this cut will be felt across all technologies. The Computer Research Association, for example, predicts devastating consequences for scientific innovation and talent in AI technologies and high performance computing, as **the NSF funds 80 percent of fundamental computing research at US institutions**. The **association credits foundational US technologies behind AI, cybersecurity and quantum technologies to NSF funding**. The Critical Technology Tracker ranks the US first in quantum computing, with seven of the top 10 institutions based in the US. However, **quantum technologies are priority areas for China, which unveiled its most advanced quantum computer**, a 504-Qubit Superconductor, **in December** 2024. In 2022, the NSF’s Directorate for Technology, Innovation and Partnerships was set up to accelerate the implementation of NSF-funded discoveries from research to new industries, especially in technologies where the US faced the greatest competition. According to Reuters, the directorate lost 20 percent of its staff last week. Similarly, **NASA**, currently ranked first in space launch systems research in the Tech Tracker, **may face a 10 percent cut to its specialised workforce**. These massive cuts have been put on hold, but if they resume, the loss of talent would be a blow to an important component of the technological race, especially with a worldwide shortage of tech specialists. Historically, **US space and satellite companies have benefited from NASA’s decades-long public investments in research and development**. The Economist reported that the scrutiny of DEI programs extended to keywords related to climate change. The National Oceanic and Atmospheric Administration (NOAA) and NASA are therefore expecting major job cuts for their work in climate science and extreme weather patterns. The NOAA plays an important role in weather prediction. Its research on space and sensors is visible in the Tech Tracker across the areas of small satellites, gravitational sensors, and sonar and acoustic sensors. **While the US is cutting its funding, China continues its systematic, long-term investment in critical technologies**. **Synthetic biology is a sector in which China has the largest lead in the Tech Tracker**. Over the past 5 years, **China has published 57.7 percent of high-impact research in the field, while the US has produced just 13.1 percent**. Synthetic biology is the design and building of new biological systems. It has applications in many areas, such as agriculture and medicine, which directly affect food security and health. **Like quantum computing, synthetic biology is an emerging technology where scientific innovation and intellectual property ownership can determine future industry dominance**. Since 2006, China has prioritised synthetic biology and built a tech ecosystem around this emerging technology, comprising research institutes and industry. As Drew Endy, a synthetic biologist from Stanford University, pointed out, the research infrastructure that China has built to support its all-of-nation approach to emerging biotechnology is now the envy of the world. The contrast between China’s investment strategy and the cuts imposed on the NIH could not be starker. **If the US doesn’t want to lose the S&T race with China, it must review its funding cuts. Reducing the funding envelope to grants organisations that oversee scientific grants, such as the NIH and NSF, will stifle the scientific innovations and breakthroughs that have been central to the rise of the US as a technology superpower**. Countries that have long relied on US technological research may need to step up spending on scientific research, or they, too, will risk being left behind.

**Technology will determine who wins the race. Sankowski 25**

Piotr **Sankowski**. “China Boosts Tech Budget to Rival US in Global Race.” **2025**. https://www.msn.com/en-us/money/other/china-boosts-tech-budget-to-rival-us-in-global-race/ar-AA1Akd3d. [Piotr Sankowski is a professor at the Institute of Informatics, University of Warsaw, where he received his habilitation in 2009 and where he received a doctorate in computer science in 2005. His research interest focuses on practical application of algorithms, ranging from economic applications, through learning data structures, to parallel algorithms for data science. In 2009, Piotr Sankowski received also a doctorate in physics in the field of solid state theory at the Polish Academy of Sciences. In 2010 he received ERC Starting Independent Researcher Grant, in 2015 ERC Proof of Concept Grant, and in 2017 ERC Consolidator Grant. He is a president of IDEAS NCBR – a research and development centre operating in the field of artificial intelligence and digital economy. Piotr Sankowski is also a co-founder of the spin-off company MIM Solutions.] //arrguy

**China is taking a new position in the race for technological dominance, competing with the USA.** It is set to spend enormous amounts of money on the development of AI, robotics, and 6G networks, increasing its science budget by 10% year over year to reach 398 billion yuan. **The South China Morning Post writes that this strategy could change the global balance of power. The South China Morning Post (SCMP) reports that Beijing has intensified the "technological arms race," increasing science funding by 10% for the second consecutive year.** By 2025, 398 billion yuan (54 billion USD) will be allocated. These figures are outlined in the Chinese Ministry of Finance's budget proposal, presented on Wednesday. **Under the category of "science," the funding is directed toward advancements in artificial intelligence, humanoid robots, and 6G networks.** SCMP reports that the integration of these technologies has the potential to reshape the global balance of power. China heavily invests in science **The English-language newspaper based in Hong Kong emphasizes that this is a clear signal that Beijing aims to dominate future technologies. This is part of a strategy to help China win the competition with the United States and transform the global technological power balance.** Renogy 2000W Pure Sine Wave Inverter Charger 12V To 120V AC Surge 6000W Off-Grid Solar Inverter Charger For RV Boat Home W/LCD Display, Auto This strategy includes attracting global talent and systematically investing in future technologies. China's increase in science expenditures is the largest among all categories of government spending, surpassing diplomacy, public safety, education, and defense. The US and China participate in a new "arms race" At the end of January, the Bank of China presented an "Action Plan to Support the Development of the Artificial Intelligence Industry Chain." Over the next five years, at least 1 trillion yuan (about 130 billion USD) will be allocated to provide financial support to AI-related entities. This will benefit technology sector leaders, including Huawei, Tencent, Baidu, and iFlytek, as well as key governmental and research institutions.

**Decline causes transition wars and lashout. Kim 19**

**Kim 19** [Min-Hyung Kim, Department of Political Science and International Relations, Kyung Hee University, Seoul, South Korea, 2-4-2019, A real driver of US–China trade conflict: The Sino–US competition for global hegemony and its implications for the future, No Publication, https://www.emerald.com/insight/content/doi/10.1108/itpd-02-2019-003/full/html, accessed 2-11-2025.] //aayush

Since the end of the Second World War, **the USA has undoubtedly been a global hegemon**. With its preponderant military and economic strength, it has created a liberal international economic order and maintained it by promoting global free trade. **USA sudden turn to protectionism under the banner of “America First” in the Trump administration illustrates “US fear” that its hegemony or Pax Americana is declining vis-à-vis China’s growing power**. It also demonstrates that **the USA now seeks to deter China from overtaking its hegemony so as to keep US hegemony as long as possible**. Currently, the USA and China are waging a trade war. What is important to note here is that **the driving force of the trade war between the world’s two largest economies is more political than economic**. That is to say, **as China’s economic and political influence in the world vis-à-vis that of the USA increases, US fear about China’s power also grows. Under these circumstances, Washington makes every effort to assert its global dominance by deterring China’s challenge to its hegemony**[13]. **It is this** sort of “US **fear**” **about hegemonic power transition from Washington to Beijing that brought about US policies against the BRI, the AIIB, and Made in China 2015**. The fear of hegemonic power transition is indeed a **driving force for the US-launched trade war**. Understood this way, **the trade war between the USA and China may be a harbinger of a much larger-scale conflict between the two parties**, since as PTT predicts, **war is more likely to occur when the power gap between a declining hegemon and a rising challenger is getting closed**. **As China’s economic**, technological, military **and political rise continues down the road, the USA will try to contain it in order to maintain its global hegemony**. The obvious consequence of this seesaw game is the **intensification of the Sino–US competition over global hegemony**. The USA and China, the two most powerful states in the world, **appear as if they were on a collision course.** What this means is that **so long as US fear about China’s overtaking US hegemony persists, a similar type of conflict between the two hegemonic powers is likely to occur in the future** even if the current trade war is over.

**Goes nuclear. Beres 21**

**Beres 21** [Louis Rene Beres is a Emeritus Professor of Political Science and International Law at Purdue. Beres has worked on matters with Department of Defense agencies, The Defense Nuclear Agency, the JFK Special Warfare Center; with Arms Control and Disarmament Agency; Defense Advanced Research Projects Agency; and with Nuclear Control Institute Beres has written twelve books and several hundred scholarly articles and monographs. He also lectures widely on matters of terrorism, strategy and international law - – “Controlling Nuclear Risks: A Basic Obligation of U.S, Law and Policy” – Jurist – March 10th - #E&F - https://www.jurist.org/commentary/2021/03/louis-rene-us-nuclear-policy-biden/]

**“Cold War II”** represents a comprehensive systemic structure within which virtually all contemporary world politics and world law could be meaningfully categorized and assessed. Current “Great Power” dispositions to war, however they might most usefully be ascertained, offer auspicious analytic background for still-wider **nuclear interactions**. What next? Planning ahead, what explanatory theories and scenarios could best guide the Biden administration in its multiple and foreseeable interactions with North Korea, Iran, China and Russia? Before answering this many-sided question with conceptual clarity and adequate specificity, a “correct” answer – any correct answer – will depend upon a more considered awareness of intersections and overlaps. Accordingly, some of these intersections and overlaps will be synergistic. By definition therefore, the consequential “whole” of any one particular interaction will be greater than the simple sum of its constituent “parts.” Going forward, the new American president’s advisors will have to consider one overarching assumption. This is the inherently problematic expectation of adversarial rationality. Depending upon the outcome of such consideration, the judgments they make about this will be decidedly different and more-or-less urgent. It now follows further that a primary “order of business” for American strategic analysts and planners will be reaching informed judgments about each specified adversary’s determinable ordering of preferences. Unequivocally, only those adversaries who would value national survival more highly than any other preference or combination of preferences would be acting rationally. But what about the others? For scholars and policy-makers, further basic questions must now be considered. First, what are the operational meanings of relevant terminologies and/or vocabularies? In the formal study of international relations and military strategy, decisional irrationality never means quite the same as madness. Nonetheless, certain residual warnings about madness should still warrant serious US policy consideration. This is because both “ordinary” irrationality and full-scale madness could exert more-or-less comparable effects upon any examined country’s national security decision-making processes. There is nothing here for the intellectually faint-hearted. This is not about “attitude” (the term Trump used to describe what he had regarded as most important to any negotiation ), but about fully science-based “preparation”. Sometimes, for the United States, understanding and anticipating these ascertainable effects could display existential importance. In all such prospective considerations, words could matter a great deal. In normal strategic parlance, “irrationality” identifies a decisional foundation wherein national self-preservation is not summa, not the very highest and ultimate preference. This preference ordering would have decidedly significant policy implications. An irrational decision-maker in Pyongyang, Tehran or elsewhere need not be determinably “mad” to become troubling for policy analysts in Washington. Such an adversary would need “only” to be more conspicuously concerned about certain discernible preferences or values than about its own collective self-preservation. An example would be those preferences expressed for feasible outcomes other than national survival. Normally, any such national behavior would be unexpected and counter-intuitive, but it would still not be unprecedented or inconceivable. Identifying the specific criteria or correlates of any such considered survival imperatives could prove irremediably subjective and/or simply indecipherable. Whether a particular American adversary were sometime deemed irrational or “mad,” US military planners would still have to input a generally similar calculation. Here, an analytic premise would be that the particular adversary “in play” might not be suitably deterred from launching a military attack by any American threats of retaliatory destruction, even where such threats would be fully credible and presumptively massive. Moreover, any such failure of US military deterrence could include both conventional and nuclear retaliatory threats. In fashioning America’s nuclear strategy vis-à-vis nuclear and not-yet-nuclear adversaries, US military planners must include a mechanism to determine whether a designated adversary (e.g., North Korea or Iran) will more likely be rational or irrational. Operationally, this means ascertaining whether the identifiably relevant foe will value its collective survival (whether as sovereign state or organized terror group) more highly than any other preference or combination of preferences. Always, this early judgment must be based upon defensibly sound analytic or intellectual principles. In principle, at least, it should never be affected in any tangible way by what particular analysts might themselves simply “want to believe”. A further analytic distinction is needed here between inadvertent nuclear war and accidental nuclear war. By definition, an accidental nuclear war would be inadvertent, but reciprocally, an inadvertent nuclear war need not always be accidental. False warnings, for example, which could be spawned by mechanical, electrical or computer malfunction (or by hacking) would not signify the origins of inadvertent nuclear war. Conceptually, they would fit under the more clarifying narratives of accidental nuclear war. **Most worrisome**, in such concerns, would be avoiding nuclear war caused by miscalculation. In striving for “escalation dominance,” competitive nuclear powers caught up with multiple bewildering complexities in extremis atomicum could sometime find themselves embroiled in an **inadvertent nuclear exchange**. Ominously, any such **unendurable outcome** could arise suddenly **and irremediably**, though neither side had actually wanted such a war.

**Extinction. Sargoytchev 8**

**Sargoytchev 8**. (Dr. Stoyan Sargoytchev, Engineering Diploma, PhD in Physics in the Field of Space Research, Worked with European Space Agency, Worked with the Program Intercosmos Coordinated by the Former Soviet Union, Visiting Scientist @ Cornell Univ, Worked in Arecibo Observatory, Currently Works with the Canadian Space Agency, and York University, Editor in Chief. “MANIFESTO: Prevent Nuclear Disaster – Doomsday” Paper Prepared by International Group of Scientists and Engineers, https://drive.google.com/file/d/1OMZpbkEkwxqq5jO2Wg0cj1bjr40mugUS/view?usp=sharing] SARG = Stimulated Anomalous Reaction to Gravity

One new physical phenomenon that resulted from antigravity research was reported at the 27 th Annual Meeting of the Society for Scientific Exploration, 25-28 June, 2008, in Boulder, CO, USA [2]. The unique gravito-inertial phenomenon achieved in the laboratory was called Stimulated Anomalous Reaction to Gravity (SARG). It was a result of years of research following successful theoretical predictions, and was supported by international private organizations. The theoretical and experimental research leading to the discovery of this effect were published at a number conferences and international meetings, and is the subject of a patent application [3,4,5]. In parallel with the laboratory experiments, extensive analysis was done on the effects of nuclear tests in the atmosphere using the physics behind the observed SARG effect. **A** **large quantity of** unclassified **nuclear test data** **from** both **the USA and** the former **Soviet Union** was used. Pictures and technical specs, as well as video material, are available via the Internet. The videos are **useful for observing** the **dynamics in the** **first few seconds of** **the nuclear explosion** when unusual phenomena take place. **It was observed that an** **extremely large** **scale** **SARG effect takes place** in the first few seconds or tens of seconds. The effect is stronger when the nuclear explosion takes place in the atmosphere between 200 m to 2 km above the ground. It is less strong at higher altitudes due to the rarefied atmosphere. Even for the non-scientist, **the** **effect of antigravity is apparent** in several videos such as the unclassified documentary movie entitled “Declassified U.S. Nuclear Test Film #70” [6]. The atmospheric nuclear test near the beginning of the documentary occurs at an altitude of 610 m from the ground. **As the plasma from the nuclear explosion** **expands, a thick column of dust and condensed air begins** **to rise from the ground**. It reaches the expanding plasma **in** about 20 sec. **Small**-diameter **tornado-like columns** **also arise simultaneously, and this** phenomenon **is** **very common** **during** atmospheric **nuclear explosions.** Note that the rising main column not only reaches the bulk of expanded plasma but also punches through it. **The SARG effect explains the rising column and surrounding tornados.** The nuclear explosion causes the formation of a vast quantity of expanding plasma. **This plasma affects the physical vacuum in such a way that an antigravity effect is created below the nuclear explosion.** The dust and condensed gases rise because of the antigravity effect. **They obtain a vertical pulse momentum during the existence of the plasma resulting from the explosion**, which may last for a few seconds to tens of seconds. The explosion also creates another detectable effect – a strong EM pulse. (In the laboratory experiment demonstrating the SARG effect, such a pulse is quite weak and is invoked by other means). The rising column and the expanding plasma create the well-known shape of the nuclear mushroom cloud. The same antigravity phenomenon with multiple tornados is also visible in the videos [7,8] of other atmospheric nuclear tests. From 1945 to 1963 the USA conducted an extensive campaign of atmospheric nuclear tests, grouped into roughly 20 test series [9]. USSR also conducted extensive atmospheric nuclear tests in the period from 1949 to 1962. They are summarized in a Catalog of Worldwide Nuclear Testing edited by V. N. Michailov [10]. After the Limited Test Ban Treaty was signed in 1963, testing by the U.S., Soviet Union, and Great Britain moved underground. France continued atmospheric testing until 1974 and China did so until 1980. In all the available information, there is no indication that simultaneous atmospheric nuclear tests separated by a finite distance have ever been performed. This has been our good fortune, as we will see. **In a single** atmospheric **test, the antigravity effect is** usually **directed** vertically **upward. But what might** **happen if simultaneous tests within a finite time and distance** **were done? The** **disturbance** **of the physical vacuum** **would lead to an antigravity effect that is not vertical.** Additionally, the two disturbances would interact and the columns from the rising dust and gases will be twisted. The new **physics of this phenomenon predicts** **that** **the antigravity effect from** **the** **two explosions will be much stronger. This may cause** **a part of the** **atmosphere to be thrown into space.** Further, it is possible that **a self-supported tornado-like effect** **may extend the life of the phenomenon, so a** **significant fraction of** **the earth’s** **atmosphere** **may be sucked into space.** **This is more than just speculation since** **exactly such an** **effect was observed on the Sun** **by some solar orbit satellites** [11,12]. The video clip on the National Geographic website [13] clearly shows the dynamics of the solar tornado extended into space. Now scientists claim that such a tornado is responsible for throwing large quantities of solar gaseous mass into space [14]. The phenomenon observed at the Sun could happen on the Earth during simultaneous nuclear atmospheric explosions that create similar conditions. To understand the gravity effects, one must have a correct model of the physical vacuum. The model adopted about 100 years ago is now not supported by laboratory experiments. We may think that the space outside the earth’s atmosphere is empty but it still has the properties of the physical vacuum, and many experiments show that it is not void. This new understanding is completely unknown to military advisors and politicians. They don’t have a clear idea what could happen during multiple nuclear explosions in the atmosphere because, fortunately, such experiments have never been done. We must not think that the atmosphere is something permanent and cannot be destroyed. The planet Mars is a good example of an atmosphere’s vulnerability. Once Mars had an atmosphere. This is evident from apparent surface erosion from rivers. Now the atmospheric pressure on Mars is about 0.1% of Earth’s atmospheric pressure. Mars lost its atmosphere probably because of some natural event such as a huge volcanic eruption. If the policy of preemptive nuclear strike is applied during a military conflict, there will likely be multiple cases of simultaneous nuclear explosions within a limited range and time. The probability is high that conditions will be created which can result in the loss of a fraction of the Earth atmosphere. Let us describe the consequences of this worst-case scenario that might develop during the initial phase of the nuclear strikes. If an atmospheric sucking-tornado effect occurs somewhere, the first effect will be a huge windstorm that equalizes the atmospheric pressure. This, of course, will not stop the nuclear strikes. The worst case is that the **global** **atmospheric pressure will drop** **below some critical level. It is well known that** **human** **beings** **are** **quite** **sensitive to changes** **in atmospheric pressure.** (Even a trained mountain climber could not climb a peak higher than 5 km without an oxygen mask). At some low level of atmospheric pressure, **a person** **loses consciousness.** **Since the effect of a** **pressure drop will be permanent, there is no chance of returning** **to consciousness.** Protective measures exist to counter all known effects of a nuclear explosion: i.e., direct radiation, shock waves, and radioactivity. **Protection from reduced** **atmospheric** **pressure,** **however,** **is impossible.** In the worst-case scenario, **there will be no survivors. It does not matter** that **you are** rich or poor, **living in a highly developed or a poor country,** **in an urban or low populated** **area. Everyone** **on Earth will die.** **This may happen** **in a time interval of 1-3 days.** The dead people will lay unburied together with animals. Microbes and fungi will survive while the **biomass of Earth’s human and animal population slowly disintegrates.** This will be a very tragic end to Earth’s civilization; a civilization that reached its apogee in order to destroy itself. **There will be no one left** **to document the end of humankind.**

**Contention 2 is Meltdown.**

**Meltdown is inevitable — it’s only a matter of time. Fox 24**

**Fox**, Audrey. “Is Nuclear Power Bad for the Environment?” Friends of the Earth, August 19, **2024**. https://foe.org/blog/is-nuclear-power-bad-for-the-environment/. [Audrey Fox is the digital communications manager at Friends of the Earth. She manages the organization’s websites, produces social content for the organization, tracks and analyzes metrics, and coordinates between the communications and campaign teams. She additionally assists with the production of multimedia content. Previously, she served as the organization’s communications intern, assisting the team with media outreach, social media, copy editing, and rapid response. Audrey holds a B.A. in Political Science and Communications with a specialization in Environmental Science from the University of California, San Diego. Outside of work, she enjoys skiing, hiking, biking, and watching Giants baseball.] //MH

**Nuclear Hazards – Safety and Health Nuclear disasters serve as prescient reminders of the unimaginable dangers of nuclear power. They may be caused by human error, mechanical failures, and/or natural disasters.** The Chernobyl disaster in Ukraine in 1986 remains the worst nuclear accident in history. It will take at least 3,000 years for the area surrounding the nuclear power plant to be habitable. The second worst nuclear accident occurred in 2011 after an earthquake and tsunami struck the Fukushima Daiichi Nuclear Power Station in Japan, causing all three operating reactors to melt down. The Three Mile Island Generating Station in Pennsylvania experienced a partial meltdown in 1979, leading to increases in cancer and other diseases. The worst radiation disaster in U.S. history is the Church Rock uranium spill, which occurred on the Navajo Nation a few months after Three Mile Island. Nuclear accidents pose extreme threats to life and have forced abandonment of wide swaths of land. Health impacts include increased risk of different types of cancer, immune deficiencies, infant mortality and birth defects, acute radiation syndrome (radiation poisoning), and harms to mental health. Those who mine and mill uranium and who work at nuclear power plants also face higher risk of diseases such as cancer. **The U.S. nuclear fleet is old, with an average age of 42 years. Aging infrastructure is more prone to cracks, corrosion, and other compromises in safety.** Nuclear power stations are also vulnerable to military strikes and threats of terrorism. Further, the technologies required to make nuclear energy are also the technologies required to make nuclear weapons, raising the risk of nuclear proliferation.

**The risk is peaking now. Dinneen 24**

James **Dinneen**. “Can Aging U.S. Nuclear Power Plants Withstand More Extreme Weather?” Yale E360, **2024**. https://e360.yale.edu/digest/u.s.-nuclear-power-climate-change. [Yale Environment 360 is an online magazine offering opinion, analysis, reporting, and debate on global environmental issues. We feature original articles by scientists, journalists, environmentalists, academics, policymakers, and business people, as well as multimedia and a daily digest of major environmental news.] //MH

To reach its climate goals, the Biden administration aims to extend the lives of U.S. nuclear reactors. But a new report finds regulators have not studied whether increasingly extreme weather could threaten the safety or viability of power plants largely built in the 1970s and 1980s. On August 10, 2020 a powerful derecho windstorm blasted the Duane Arnold nuclear power plant in Iowa. Up to 130 mile-per-hour winds caused a power outage and knocked over the 50-year-old plant’s wooden cooling towers, which triggered an automatic shutdown of the reactor and a switch to backup generators to power its cooling system. The U.S. Nuclear Regulatory Commission (NRC) concluded the plant’s multiple layers of defense had avoided any risk of releasing radioactive material, but the reactor was never restarted. The plant had been slated to close, and its owner decided not to repair the damage. “A weather-related event prematurely and permanently shut down the Duane Arnold,” says Jeff Mitman, a nuclear risk consultant and a former NRC engineer now involved in a campaign to highlight safety risks at aging nuclear plants. He points to Duane Arnold as an example of how such plants can be vulnerable to extreme natural hazards that may be exacerbated by climate change. The country’s 54 nuclear power plants still in operation were designed to be resilient to numerous outside threats, including the most extreme weather-related events deemed feasible based on the historical record, and even beyond. **But most plants were built more than 40 years ago, and a new investigation finds these plants may yet be vulnerable to unprecedented hazards fueled by climate change, at a time when many experts say nuclear power is needed to keep emissions from fossil fuels in check. According to the report released earlier this month by the U.S. Government Accountability Office (GAO), the investigative arm of Congress, every nuclear plant in the country is located in an area where climate change is set to worsen flooding, heat, storms, wildfires, extreme cold, or some combination. However, it found that the NRC — which is responsible for U.S. nuclear safety — has not conducted the analyses necessary to know whether nuclear power plants are prepared for those changing conditions.** The report did not demonstrate that any plants are necessarily vulnerable to these hazards, which would require a plant-by-plant analysis. But it found the NRC has not adequately addressed whether more extreme weather could force plants to shut down or lower power output more frequently, or pose a safety risk.

**Affirming solves through upgrades. Tariq 24**

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

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

**Replacements too. Fristch 24**

David Fritsch, Office of Nuclear Energy. “8 Things to Know about Converting Coal Plants to Nuclear Power,” 2024. https://www.energy.gov/ne/articles/8-things-know-about-converting-coal-plants-nuclear-power. [The Office of Nuclear Energy works to advance nuclear energy science and technology to meet the nation's energy, environmental, and economic needs.] //MH

Nearly 30% of the nation’s coal-fired power plants are projected to retire by 2035 as states continue to prioritize a shift toward cleaner energy sources. But with power demands expected to rise due to the electrification of more cars, appliances, and processes, something must help fill the void. The U.S. Department of Energy (DOE) projects we’ll need an additional 200 gigawatts (GW) of nuclear capacity to reach net-zero emissions by 2050 and some of that could take place at or near retiring coal plants — creating new job and economic opportunities for these energy communities. Here are 8 things you should know about transitioning coal stations to nuclear power plants. **1. The Majority of U.S. Coal Plants Could Be Converted A 2022 DOE report found that more than 300 existing and retired coal power plant sites are suitable to host advanced nuclear power plants. Each plant could match the size of the site being converted and help increase nuclear capacity by more than 250 GW—nearly tripling its current capacity of 95 GW.** 2. Coal to Nuclear Transitions Could Preserve and Create New Jobs According to the same study, employment in the region associated with an incoming nuclear plant could increase by more than 650 permanent jobs spread across the plant, supply chain, and surrounding community. Occupations seeing the largest gains include nuclear engineers, security guards, and nuclear technicians. The plants could also leverage the existing coal plant workforce in the community to help transition their current skills and knowledge to work in nuclear energy with wages that are typically 50% higher than those of other energy sources. **3. Converting Coal Plants to Nuclear Could Drive Economic Growth The study also indicates that long-term job impacts of a converted coal to nuclear power plant could lead to additional annual economic activity of $275 million. This includes a 92% increase in tax revenue from the new nuclear plant for the local county when compared to prior tax revenue from a coal plant.** These tax payments would also increase the amount of money available to improve local schools, infrastructure projects, and public services. **Additional benefits would also be distributed throughout the community as the wages from good-paying nuclear energy jobs lead to increased household spending. Local businesses may also benefit as suppliers of goods and services in support of plant operations, while others may benefit from increased household spending in the community.** 4. Coal to Nuclear Transitions Could Bring Environmental Benefits According to the U.S. Energy Information Administration, coal plants account for 20% of the nation’s total energy-related carbon dioxide emissions. Replacing unabated coal combustion with fission, a physical process that doesn’t emit carbon, would dramatically reduce green gas emissions in the energy sector. It would also directly improve the air quality in the region by avoiding other harmful byproducts produced by fossil fuel plants that are linked to asthma, lung cancer, and heart diseases — helping to improve the over health of the community. 5. Converting Coal Plants to Nuclear Could Save on New Construction Costs The DOE report also found that new nuclear power plants could save up to 35% on construction costs depending on how much of the existing site assets could be repurposed from retired coal power plants. These assets include the existing land, the coal plant’s electrical equipment (transmission connection, switchyard, etc.) and civil infrastructure, such as roads and buildings.

**It’s key to security. Maness 25**

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

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

**This is the most probable implementation.**

1. **It’s cheaper — that aligns with Trump’s agenda of limiting government involvement in the economy.**
2. **No need for new land — that avoids a lengthy permitting process and eminent domain lawsuits.**
3. **It’s a smaller adjustment — that takes less political capital and public support.**
4. **It’s politically expedient — Republicans wants to reap tangible benefits before the next election cycle so will prioritize a quicker project.**

**It trades off with renewables. Dascalu 24**

**Dascalu 24** [C. Dascalu, Associated Professor, UMF Grigore T. Popa Iasi, 3-18-2024, POSITION PAPER: The nuclear hurdle to a renewable future and fossil fuel phase-out, CAN Europe, https://caneurope.org/position-paper-nuclear-energy/, accessed 3-18-2025.] //aayush

More than three-quarters of the EU’s greenhouse gas emissions stem from our energy consumption, therefore it is vital to stop burning fossil fuels to limit temperature rise to 1.5°C, the Paris Agreement target. Together with members, and external experts, we developed our Paris Agreement compatible (PAC) energy scenario, which provides a robust, science-based pathway for Europe’s energy landscape. On the basis of this work, CAN Europe advocates for a phase-out of coal by 2030, gas by 2035, and a 100% renewables-based energy system by 2040, which requires the phase-out of nuclear power by then. The disruption of nuclear power can be observed in many countries, not only in Europe. In Dubai, at COP28, CAN was strongly opposed to and called out countries, supporting and signing the pledge led by the USA, UK, France and 18 other countries to globally triple nuclear power in the next 25 years. This goal is much higher than the high bracket of International Energy Agency (IEA) scenarios, already based on improbable hypotheses and risks to distract from the tripling of Renewable Energy capacities that was agreed by a much larger group of countries at COP28. In 2023, there was an **alarming push and a surge in support for nuclear power** within the EU political space. This development is **creating significant tension with proponents of energy sufficiency and a fully renewable energy system and marks a regressive step in** efforts towards a sustainable and just **energy transition**. While nuclear champions claim that nuclear energy can work hand-in-hand with renewables, **it is becoming increasingly clear that nuclear power acts as a significant hurdle to energy efficiency investments, the roll-out of renewables and fossil fuel phase-out in three spheres**: the EU political debate, energy system planning, and decentralisation. Climate Action Network International, the global umbrella under which CAN Europe participates, with a community of almost 2000 members from civil society, in more than 130 countries, stands united in opposing new and existing nuclear power stations. In 2020, we reviewed and agreed the CAN Charta, the ‘highest’ document for all CAN members, the international secretariat and the regional nodes, and we listed under strategies “Promoting a nuclear-free future”. **A hurdle in the policy debate** The starting gun for a renewed attempt at a nuclear renaissance was the inclusion of nuclear in the EU Taxonomy in 2022, and can be seen as the **nuclear lobby’s blueprint for its future ambitions** – **creating a large political debate using arguments of “technology neutrality” and a “level playing field” and forming alliances with fossil fuel advocates** (in this case, fossil **gas**) in order to reduce ambition to sustainable solutions. Since then, a **French-led campaign**, manifested through the 14 Member State “Nuclear Alliance”, coupled **alongside the lobbying activities of the nuclear industry, has run roughshod through EU energy and climate policy over the last two years**. Continuing the narrative of “technology neutrality” and a “level playing field”, this mission has aimed at **promoting nuclear energy at the direct expense of a transition to a 100% renewable-based energy system**, in legislation such as the Renewable Energy Directive, Electricity Market Design and Net Zero Industry Act. Attempting to lower renewable ambition In the context of the Renewable Energy Directive (RED III) revision, France tested the waters in 2023 by calling for a low-carbon ‘weighting’ in EU renewables target in order to support a higher EU 2030 renewable energy target of 45%, where so-called ‘low carbon’ energy sources are taken into account when establishing national renewable energy targets. Though this did not see the light, a concession was won on renewable hydrogen and gained provisions to facilitate nuclear-produced hydrogen – risking further watering down a renewables-based technology pathway. The EU Commission launched its proposal for the Net Zero Industry Act (NZIA) in March 2023 as a response to the Inflation Reduction Act (IRA) of the United States. While nuclear was included as a list of technologies that were seen as making a contribution to decarbonisation, the EU Commission President, Ursula von der Leyen, refused to include it in the list of “strategic technologies”, which could receive additional support. The list was limited, as to be better targeted, at technologies such as solar, wind, energy storage, heat pumps and grid technologies. The final political agreement has led to the inclusion of “nuclear fission energy technologies” as strategic, while this debate allowed the list to become so extensive it practically loses any strategic element. **Delaying fossil phase out via dirty trade-offs** During the Electricity Market Design reform, **nuclear and fossil fuel promoters in the Parliament attempted to derail a deal supporting renewables and flexibility**. In the Council, **due to the focus of the Nuclear Alliance on the Contracts for Difference (supported by some coal dependent countries) the negotiations were delayed by several months and conversations redirected away from renewables, leading to a deal supporting subsidies for existing and new nuclear reactors and a prolongation of subsidies to coal power plants** via capacity mechanisms. **Wasting time and diverting attention As the nuclear debate aggressively dominates political negotiations**, media, and public discourse, **it blatantly diverts critical attention from advancing the existing, affordable, sustainable solutions to the energy transition**. This overwhelming focus on nuclear power not only **overshadows** but also poses a risk of derailing the European **energy transition**, **hindering progress towards aligning with the ambitious yet achievable goal of a 100% renewable energy system** by 2040. A hurdle to a fully renewables based power system CAN Europe’s assessment of the draft National Energy and Climate Plans highlights that not a single Member State plan is aligned to a 1.5ºC compatible trajectory, nor minimum EU climate and energy requirements for 2030. Increased ambition is required on energy efficiency, energy savings, renewables and fossil fuels phase-out, while Member States are betting on false solutions to the challenge at hand, such as nuclear energy. As highlighted in our NECP analysis, **the EU has inadequate renewables expansion, grossly insufficient investment in energy efficiency, late coal phase-out deadlines and gas dependence, while countries such as Bulgaria, Czechia, Estonia, France, Hungary, the Netherlands, Poland, Romania and Slovenia, are considering new nuclear that might never materialise**. In 2023, Sweden has revised its 2040 target for 100% renewable electricity to 100% decarbonised electricity, to allow for continued and new nuclear power, and it is now clear that it can only happen with direct state aid. **Italy**, which voted against nuclear power in a referendum, is now **investigating future nuclear power, while delaying quitting coal by 4 years**. The largest nuclear power plant in Europe, the **Zaporizhzhia Nuclear Power Plant in Ukraine**, is currently occupied by the Russian military and Rosatom in an active warzone, but **has not prevented Ukraine from including new nuclear power in its reconstruction**. The Paris Agreement Compatible (PAC) scenario, on the other hand, emphasises renewables-based electrification, calling for determined and heightened attention to enable a 100% renewable-based EU energy system by 2040, and foresees no need for nuclear power in Europe. Nuclear power is too expensive When compared to renewables, the latest analysis from World Nuclear Industry Status Report, using the data from Lazard, determines that the levelized cost of energy (LCOE) for new nuclear plants makes it the most expensive generator, estimated to be nearly four times more expensive than onshore wind, while unsubsidized solar and wind combined with energy storage (to ensure grid balancing) is always cheaper than new nuclear. When compared against energy savings, analysis by Hungarian NGO Clean Air Action Group highlights that it is more economically efficient to invest in the renovation of households to save energy than in the construction, operation, and decommissioning of a new nuclear reactor. These findings were confirmed by a separate study by Greenpeace France, that showed that by investing 52 billion euros in a mix of onshore wind infrastructure/photovoltaic panels on large roofs, it would be possible to avoid four times more CO2 emissions than by investing the same amount in the construction of six EPR2 nuclear reactors by 2050, while electricity production triples. By investing 85 billion euros of government subsidies in energy savings by 2033, it would be possible to avoid six times more cumulative CO2 emissions by 2050 than with the construction program of six EPR 2 reactors. This would also make it possible to lift almost 12 million people out of energy poverty in a decade. Recent European projects in Slovakia, the UK, France, and Finland demonstrate the dramatic rising costs. EDF admitted that the costs for the British nuclear facility Hinkley Point C will skyrocket to 53.8 billion euros for the scheduled 3.2 GW power plant, more than twice as much as scheduled in 2015 when the plant was approved. The French project in Flamanville was originally projected to cost 3.3 billion euros when it began construction in 2007, but has since risen to 13.2 billion euros (16.87 billion euros in today’s money). The Finnish Olkiluoto-3 project 1.6GW reactor cost 3 times more than the original forecast price, reaching 11 billion euros. Slovakia’s second generation reactors Mochovce 3 and 4 ballooned costs to 6.4 billion euros from an initially estimated 2.8 billion. Slovenia’s president announced that a new 1.6GW reactor would cost 11 billion euros, following the Finnish example, demonstrating that these high prices are here to stay. In order to finance new and ongoing projects, the EU has approved State Aid for nuclear, in the case of Hungary, Belgium, and the United Kingdom, while national **governments seek support schemes**. Despite making **references to technology-neutrality**, this **creates an unlevel playing field slanted against renewable energy**. Given the significant investment gap to achieve 2030 climate targets, and the **limited fiscal space of many** Member **States**, **investments in nuclear risk diverting precious public resources into projects of poor value-for-money compared to alternatives in a renewables-based system**, while reducing the availability of public resources for all other components of the energy transition. Such a choice would equally fail to reduce prices for consumers in the context of the current fossil fuel energy crisis. Finally, the costs would be even larger if accounting for “unpaid externalities” borne by taxpayers and the public at large, from nuclear accident risks that are impossible to insure against by private actors. The costs of decommissioning of a nuclear power plant, which can cost 1-1.5 billion euros per 1000 MW, are often borne by the public as these costs are poorly taken into account when planning a new nuclear installation. The cost associated with storing radioactive waste for hundreds of thousands of years is also often undervalued, alongside costs associated with radioactive leaks from plants or storage facilities, as demonstrated by the radioactive leaks in the UK Sellafield site, causing tension with Ireland and Norway. To lower costs, attempted lowering of safety and environmental standards can be expected, posing risks to communities, nature, and society at large, also as a burden to future generations. New nuclear construction is too slow A rapid transition requires the use of existing technologies and solutions which can most quickly be rolled-out such as renewables, primarily solar and wind, energy efficiency, and system flexibility. For years, new nuclear energy projects in Europe have been plagued with delays and, coupled with an untrained workforce, are unable to support the speed of decarbonisation necessary. New nuclear plants typically take 15-20 years for construction, hence failing to address immediate decarbonisation needs to 2030. Indicatively, France’s six new reactors are estimated by its network operator to enter into use in 2040-2049, much too late to have any meaningful impact on emissions reduction needed already now, with a view to pathways to 2050, and beyond, for a sustainable future. The decision to build the UK’s Hinkley Point C nuclear reactor was announced in 2007 with an operational start date of 2017, however it has been delayed several times over, and is now estimated to start in 2031. In France, the Flamanville project is 16 years into construction and hitting new delays, while Finland’s Olkiluoto took a full 18 years to come online. Nuclear does not support energy autonomy Nuclear power units equally fail to pass an “energy security” test, and run counter to the RepowerEU target of enhancing Europe’s autonomy, given that more than 40% of the EU’s Uranium is imported from Russia and no EU country is currently mining uranium within its own borders . Though Kazakhstan is seen as an alternative, its uranium industry is directly tied to Rosatom. While import bans have been placed on Russian coal and liquified natural gas, and Russian oil and natural gas have been targeted, this has not been the case for uranium. A hurdle to a decentralised future **The declaration to triple nuclear power by 2050 signed by only 22 countries**, 5 of which do not have nuclear reactors, **on the sidelines of COP28 describes nuclear power as “source of clean dispatchable baseload power”, a common message of the nuclear industry used to argue against a 100% renewable system and nuclear’s use as a substitute for traditional fossil fuel generation**. **This claim**, however, **is misleading and outdated**. Europe is moving beyond a highly centralised energy system, towards one which is decentralised, digitalised, and able to flexibly adjust to changing patterns of generation and consumption. In a 100% renewable energy system, the need for traditional “baseload” power is obsolete and with distributed energy production, in a far more interconnected European Union, security of supply is better managed. Nuclear power production is not reliable Nuclear power units across Europe have been proven as unreliable in providing power when needed. Future climatic conditions, such as heatwaves, droughts, flooding and rising sea-levels only increase the likelihood of future nuclear power plant disconnections and pose further security risks. In 2022, on average French nuclear reactors had 152 days with zero-production. Over half of the French nuclear reactor fleet was not available during at least one-third of the year, one-third was not available for more than half of the year, and 98% of the year 10 reactors or more did not provide any power for at least part of the day. The myth of the need for nuclear baseload has been debunked for years. The energy system can be reliably and safely managed with 100% renewables and system flexibility. **Blocking renewables integration into the electricity grid** The **inflexibility of nuclear**, caused by technical limitations, safety requirements and economic factors, **prevents the feed-in of renewable electricity into the grid, causing grid congestion and curtailment**. **Nuclear’s dominance over grid capacity can block the connection of new renewable energy projects, where even announced and then abandoned plans for a new nuclear unit can delay renewable projects connection, allowing for continued fossil fuel usage. Grid structures designed for large-scale, centralised nuclear power, make it more challenging, time-consuming and costly to introduce small-scale distributed renewable power**. An example can be found **in Romania** where **Cernavodă 3 and 4 reactors have reserved grid capacity for years, blocking new renewable energy projects** in the Dobrogea region, the most wind-intensive region in the country. **Delayed grid investments, due to uncertainty of new nuclear units, have also meant that capacity bottlenecks exist today for renewables online. In the Netherlands, the only current nuclear power station, Borssele is competing for landing space for off-shore electricity. Post-Fukushima, renewables were blocked from connecting to the grid in Japan as the government considered restarting the reactors, despite public opposition to nuclear restarts and support for renewables**. Rather than taking the opportunity to invest in grids and integrate renewables twenty years ago, **Japan still heavily relies on fossil fuels today**. Prolonging the inevitable with nuclear extensions While European governments may be tempted to prolong existing nuclear reactors beyond their original foreseen lifespans, in the context of phasing out Russian gas, costly **upgrades to the ageing nuclear fleet, just like investing in new ones, risks diverting investment away from** more cost-effective solutions such as **renewables**, energy efficiency, and system flexibility, in addition to risking lowered safety standards and security of supply as ageing increases unplanned outages. Any prolongation of existing nuclear power plant units risks the continued crowding out of renewable energy sources from the electricity grid, preventing their price-dampening effects on the market.

**America needs to be the leader in nuclear energy. Sallee 21**

Kyle **Sallee**, American University. “Regaining American Competitiveness in the Global Nuclear Power Market,” **2021**. https://www.american.edu/sis/centers/security-technology/regaining-american-competitiveness-in-the-global-nuclear-power-market.cfm. [Currently, I study US foreign policy and national security at the American University School of International Service as a Master's Degree student. My focus includes US nuclear policy and security strategies within the post-Soviet space.] //MH

‌The US Department of Energy’s “Strategy to Assure U.S. National Security” is abundantly clear; America has relinquished its competitive global position as the world leader in nuclear energy to Russian and Chinese state-owned enterprises (SOE). The United States is missing out on a multi-billion-dollar export market, has nearly lost its domestic uranium mining capabilities, relies heavily on an aging domestic reactor fleet, and faces a crippling exodus of retiring nuclear policy experts and engineers. Estimates from the US Department of Commerce project that the United States is absent from a global nuclear reactor market valued at $500-740 billion over the next decade. Meanwhile, Russian SOE, Rosatom, is advancing its nuclear influence globally with $133 billion in foreign orders for reactors, planning to underwrite the construction of over 50 reactors in 19 countries. The China National Nuclear Corporation (CNNC), a strategic competitor, is constructing four reactors abroad, with prospects for 16 more. **The absence of the US from the global nuclear reactor market is economically significant, but the foreign policy implications of the American withdrawal are even more alarming. The absence of a robust US nuclear energy exports market erodes American credibility as the arbiter of global nuclear norms – the guidelines that ensure safe nuclear energy generation and exports.** Beginning with President Dwight Eisenhower’s “atoms for peace” framework (1953), the US leveraged its dominance of the global nuclear exports market to shape international nuclear governance through the Cold War. The International Atomic Energy Agency (IAEA), which develops international nuclear safety standards, and the Nuclear Suppliers Group (NSG), which coordinates members’ export control policies, both resulted from critical US leadership. The waning US nuclear exports market leaves American officials orchestrating nuclear regulatory policy without a tangible stake in the market and forfeiting valuable foreign policy opportunities. The vacuum left by the US withdrawal from the global nuclear energy market presents new foreign policy openings for its rivals. Rosatom is piloting its “Build-Own-Operate,” or BOO model in Turkey, which offers Russian state-backed financing for the construction of a nuclear reactor in exchange for control of its energy dispersal. In China, CNNC has expressed interest in similar quid-pro-quo structures. Beyond financing, reactor exports allow countries to form 100-year strategic relationships that can span construction, operation, and decommissioning of nuclear reactors and then influence a client’s nuclear regulations. These relationships are already being cultivated by Rosatom and CNNC across Asia, Eastern Europe, and South America. **Exporting nuclear technology is an opportunity to lead in the global marketplace, ensure US authority in international nuclear governance, and form new strategic partnerships.** The incoming Biden Administration has inherited a US nuclear industry in disarray that faces substantial international competition from Russia and China. **To regain its lead in the global nuclear exports market, the US must act quickly and deliberately.** The following identifies the advantages of US competitors and proposes immediate actions to bolster the American nuclear industry.

**Investment means improvement — solves the neg and outweighs on scope. Rehm 23**

**Rehm 23** [Thomas E Rehm, American Institute of Chemical Engineers, 3-xx-2023, Advanced nuclear energy: the safest and most renewable clean energy, No Publication, https://www.sciencedirect.com/science/article/abs/pii/S2211339822000880, accessed 3-10-2025.] //aayush

**Although legacy nuclear energy has been the safest form of electricity generation, it has been demonized** as unsafe since the 1960s. The three well-known **nuclear accidents**, Three Mile Island, Chernobyl, and Fukushima, **were legacy nuclear designs**. **Even with the best safety record of all types of electricity generation, it is time to move away from legacy nuclear to reap the benefits of a truly renewable source of safe clean energy, advanced nuclear**. Solar and wind cannot hold a renewable candle to the vast renewable potential of advanced nuclear energy. **The transition to carbon-neutral energy can best be made with advanced nuclear, in safety, waste minimization, true renewability for thousands of years, process heat for manufacturing, and a viable means of replacing our chemical manufacturing dependence on fossil fuels**. Some of my colleagues tell me, “There are few opportunities for chemical engineers in nuclear”. I disagree. **Opportunities include design and operation of high-temperature (550–750 °C) plants involving molten salts, liquid metal, and helium; application of this high-temperature capability for industrial process heating; recycling legacy nuclear ‘waste’ to provide fuel for advanced reactors; integration of the hydrogen economy into nuclear plant design and operation; improvement in moving pebble-bed advanced reactor technology; mining improvements for uranium and thorium, including mining uranium from seawater; molten salt storage systems for improving load following functionality and to provide process heat functionality; resolving corrosion challenges in molten salt reactors; and retrofitting existing oil-and-gas-based refineries to operate as nuclear biorefineries**.

**Otherwise, meltdown causes extinction. Hodges 19**

**Hodges 19** [Dave Hodges—Editor and Host of The Common Sense Show, internally citing Judy Haar, a recognized expert in nuclear plant failure analyses AND a source at the Palo Verde Nuclear power plant, 12/3/2019, “How the Coming Cascadia Subduction Zone Event Will Produce An Extinction Level Event (Part One)”, The Common Sense Show, https://thecommonsenseshow.com/activism-agenda-21-conspiracy/how-coming-cascadia-subduction-zone-event-will-produce-extinction-level-event-part-one]

A more detailed analysis reveals that the spent fuel pools carry depleted fuel for the reactor. Normally, this spent fuel has had time to considerably decay and therefore, reducing radioactivity and heat. However, the newer discharged fuel still produces heat and needs cooling. Housed in high density storage racks, contained in buildings that vent directly into the atmosphere, radiation containment is not accounted for with regard to the spent fuel racks. In other words, there is no capture mechanism. In this scenario, accompanied by a lengthy electrical outage, and with the emergency power waning due to either generator failure or a lack of diesel needed to power the generators, the **plant could lose the ability to provide cooling. The water will subsequently heat up, boil away and uncover the spent fuel rods** which required being covered in at least 25 feet of water to remain benign from any deleterious effects. Ultimately, **this would lead to fires as well and the release of radioactivity into the atmosphere. This would be the beginning of another Fukushima event** right here on American soil. Both my source and Haar shared exactly the same scenario about how a meltdown would occur. Subsequently, I spoke with Roger Landry who worked for Raytheon in various Department of Defense projects for 28 years, many of them in this arena and Roger also confirmed this information and that the above information is well known in the industry. Now that the danger is exposed, let's ask the earthquake question. When the Canadian Subduction Zone goes critical, this will cause a loss of power. Will the power be restored in 7-30 days, which is the time that all nuclear power plants are designed to be offline and still meet the cooling of the fuel rods question? The answer is frightening. If power is not restored, and that is assuming the structure of the plant is still intact following the earthquake, the authorities would have 1-4 weeks to restore power, at most. In conclusion, we must face the possibility that when we mix in nuclear power plants with the Cascadian Subduction Zone event, **we are facing an extinction level event**.

**Contention 3 is Space.**

**Colonization is structurally impossible now. Skove 25**

Sam **Skove**. “The Great Astronaut-Survival Problem.” POLITICO, February 26, **2025**. https://www.politico.com/newsletters/digital-future-daily/2025/02/26/astronaut-survival-mars-nasa-00206267. [Sam Skove is a space and emerging tech reporter at POLITICO, with a focus on how space policy is made across Congress, the White House, and federal agencies. He was previously an Army reporter at Defense One and before that a freelance war reporter in Ukraine. He has a master's degree in security studies from Georgetown and a bachelor's degree from Oberlin College. He speaks Russian fluently.] //arrguy

**A manned mission to Mars is being discussed more seriously than ever before, thanks to the interest of President Donald Trump — who used his inaugural address to promise an American flag on the Red Planet — and the immense influence of longtime Mars enthusiast Elon Musk.** Musk himself said in September that his company SpaceX will send manned missions to Mars as early as 2028. NASA’s current timeline is sometime in the 2030s, after a manned mission to the moon that the agency hopes to pull off in mid-2027. Musk’s priorities, though, could become NASA’s priorities. The confidante of Trump plays an outsize role in government, and Trump’s pick for NASA administrator Jared Isaacman has close ties to SpaceX. In a January tweet, Musk called the moon a “distraction,” and wrote “we’re going straight to Mars.” In a separate February tweet, Musk appeared to link cancelling the International Space Station with focusing on a Mars mission. Just one problem: Humans still have to survive the trip, survive the landing, and get back. And the faster NASA tries to plow through planning, the less likely it is that anyone will be alive once they open the hatch and take their first steps on Mars. “You can send people to Mars with a whole bunch of unknowns, and that’s all risk to the mission being successful, the crew surviving,” Nujoud Merancy, an agency expert in exploration architectures at NASA Headquarters, told DFD in a January interview. As millennia of explorers can attest, it’s sometimes easier to build a vessel than to manage the safety of the human cargo inside. **Humans going to Mars face a set of risks considerably larger than the ones they took going to the moon, a trip that took three days and never got further than a few hundred thousand miles from earth’s surface.** Mars has never been closer than about 34.8 million miles from Earth in recorded history — which means astronauts will be signing onto a round trip journey of around three years, according to NASA. Figuring out what could happen to them, and how to protect them along the way, is a puzzle that space experts are just starting to sort out. **Among the hardest problems for NASA is predicting the exact impact of deep space radiation on astronauts, which has the potential to kill or sicken them both in transit and on Mars’s surface.** On the journey, astronauts will face two types of radiation — solar radiation, which is easier to shield from, and galactic cosmic rays, which are harder to protect astronauts from. **NASA has worked on ways to shield from cosmic rays, but the particles, moving at near the speed of light, can pass easily through normal spacecraft.** To try to model the problem, NASA runs experiments using a galactic cosmic ray simulator at Brookhaven National Labs, which can replicate deep space radiation. It also can rely on a host of Earth-bound analogs related to historical instances of humans being exposed to radiation. One study is looking at the impact of radiation treatment on patients by looking at the effect of radiation on non-cancerous cells as an analog for the sorts of indirect radiation exposure astronauts might face, said Steven H. Platts, the chief scientist for NASA’s Human Research Program. Another looks at the effect of radiation on U.S. Navy submariners, based on their long-term proximity to their submarine’s reactor. Data collected on the survivors of the Hiroshima and other nuclear bombings is yet another large source of information. And Mars itself is its own wild card. “We won’t really know about the radiation environment on Mars until we’re on Mars,” said Platts. **Pack a lunch: Astronauts will also need to eat — but rockets have limited capacity to carry the two thousands pounds of food a human typically eats in a year.** Astronauts will also need variety, both for nutrition and for their mental health. Growing crops in space could solve some supply needs, but NASA experiments to date have only had astronauts growing a maximum of five percent of their food in space, said Platts. **Crew members will also need to handle medical emergencies on their own.** NASA is exploring the use of artificial intelligence to help astronauts solve medical problems, as well as providing compact ultrasound machines that can be used to diagnose issues, Platts said. **Some technology will need to be invented, though — astronauts won’t be able lug around the large machines used on Earth to run medical tests.** Gravity, or the lack thereof, is another major issue. Thanks to research from the International Space Station, NASA knows that astronauts have trouble regulating their blood pressure when exposed to microgravity for extended periods of time. It now issues astronauts with special suits that help them adjust to Earth’s gravity on their return. Other problems are still unsolved. Some astronauts experience vision problems in microgravity, a condition called Spaceflight Associated Neuro-Ocular Syndrome (SANS). NASA does not yet have a way to correct the problem. It also doesn’t know if the problem gets worse over time or if it plateaus — most astronauts stay on the ISS for six months, meaning that NASA only has high quality data for space stays of that much time. Platts said he’s confident that NASA will have solutions or at the very least a better understanding of the risks such that astronauts have “true informed consent” as to the risks they’re taking by NASA’s 2030s timeline. Speeding up the mission — as Musk appears to want — would mean astronauts won’t know exactly what they’re getting into, especially if NASA’s pursues Musk’s ambitious target of 2028. Musk may still be willing to send private astronauts on that journey. Trump, though, might not. While Trump relishes the idea of going to Mars, he also appears to be cognizant of the risk. In a 2019 National Space Council meeting with then NASA Administrator Jim Bridenstine, Trump repeatedly pressed the administrator as to why NASA couldn’t go to Mars. Bridenstine explained the problems — including that NASA needs to time its launches to moments when Mars and Earth are closest in their orbit around the sun. Trump dwelled on the consequences if astronauts missed that window, and replied twice: “You don’t want to be on that ship.”

**Swift action is key — political will is sufficient now but volatile in the future. McGrath 24**

**McGrath**, Jenny. “Why the US Hasn’t Sent Humans to Mars Yet.” Business Insider, May 27, **2024**. https://www.businessinsider.com/why-havent-we-been-to-mars-yet-2024-5. [Jenny McGrath is a senior science reporter, covering archaeology, paleontology, and more.] //arrguy

Humans have long imagined life on Mars, though our understanding of the planet has changed a lot. Some of the US's earliest plans assumed humans could reach the Red Planet by the 1980s. **Over the decades, technology and funding challenges have hampered the nation's hopes of crewed flights. Earlier this month, NASA announced it was funding a revolutionary high-thrust rocket — called a Pulsed Plasma Rocket — that could make crewed missions to Mars in just two months.** That's seven months faster than it'd take with current technology and would drastically reduce the risk and cost of a crewed Mars mission, according to Howe Industries, which is developing the concept. It "holds the potential to revolutionize space exploration," NASA said in a statement. The PPR is just one of the latest developments in the US's decades-long discussion to send humans to Mars. In the early '60s, for example, nuclear-bomb-powered spaceships were proposed for the trip. Since well before NASA landed the first humans on the moon, the US has poured money and time into proposals for a crewed Mars mission, only to see its attempts never leave the ground. But technology isn't the only thing standing in the way. Politics also plays a big role. "That's kind of like a joke within the space community or the Mars community," Matthew Shindell, a curator with the National Air and Space Museum, told Business Insider. "Putting humans on Mars is always 20 years away." **It's short enough to seem tangible, he said, but long enough that the political situation will change before it can be realized.** To fully understand why the US hasn't sent humans to Mars, despite sending more robots there than any other country, it just takes a trip down memory lane. Here's a history of the US's most promising crewed Martian missions that never were.

**Investment is needed — technology exists but can’t be scaled up. Uppal 25**

**Uppal**, Rajesh. “Nuclear Fusion-Powered Propulsion: A New Frontier in Space Exploration - International Defense Security & Technology.” International Defense Security & Technology, **2025**. https://idstch.com/space/nuclear-fusion-powered-propulsion-a-new-frontier-in-space-exploration/. [IDST follows a unique model that monitors and analyses complete Defense and Security ecosystem, and all its interrelationships in near real time starting from world geopolitics and its military and technology implications, global natural and manmade threats and mitigating technologies, future warfare scenarios and warfare domains, International military capabilities in all domains including doctrines and strategies, their technical challenges, requirements and solutions, Homeland security and technology requirements, Horizon scan of emerging technologies, and their military impact, manufacturing technologies and Industry trends. The model monitors the present and future threat environment, performs threat assessment, identify the required technologies to mitigate that threat through system] //arrguy

**Cost and Development Time Nuclear fusion technology is costly, and the timeline for achieving a space-compatible fusion reactor remains uncertain. Developing fusion propulsion requires considerable financial and institutional investment, as well as time for iterative testing and innovation. Currently, government and private sector collaborations are essential to funding research, but scaling up support could accelerate progress.** The high initial costs and long lead times mean that fusion propulsion may not be viable for near-term missions, although it has great potential for future interplanetary and interstellar travel. In short, while nuclear fusion-powered propulsion holds remarkable promise, sustained progress in research, funding, and material science will be necessary to overcome these challenges and make this vision a reality for space exploration.

**Affirming solves.**

**1 — Radiation. Lockheed 22**

**Lockheed** Martin. “Nuclear Thermal Propulsion,” **2022**. https://www.lockheedmartin.com/en-us/news/features/2022/how-nuclear-technology-will-get-us-to-mars-faster-than-ever.html. [We specialize in defense tech, solving complex challenges, advancing scientific discovery and delivering innovative solutions that help our customers keep people safe.] //arrguy

**Why Nuclear Thermal Propulsion? In short: speed, efficiency and reusability. NTP will enable faster space travel than ever before. Increased speed from NTP means benefits like longer launch windows, less crew exposure to cosmic radiation in space and satellites and robotic spacecraft getting to their destinations quicker or with much higher mass. The speed of NTP comes from its high-efficiency thrust—upwards of two times more efficient than conventional propulsion systems.** “It could take a hundred launches to get humans to Mars on a chemical propulsion system, but we can get it down to five with a nuclear thermal propulsion system,” said Chambers. NTP’s efficiency can also enable more abort options during missions. Other benefits include maximum reusability and extensibility to other missions. NTP allows the use of fewer refuelers than other systems – making it an environmentally cleaner, more efficient way to fuel. “If we want to get serious about deep space exploration, a reusable nuclear system is a cleaner, more efficient way to achieve our goals,” said Bendle. “NTP will enable us to extend our exploration beyond the Moon more quickly than other alternatives might.”

**2 — Supplies. Mulder 20**

Dr. Eben **Mulder**, Space: “X-Energy.” X-energy, **2020**. https://x-energy.com/why/nuclear-and-space/nuclear-thermal-propulsion. [As X-energy’s Chief Scientist, Eben Mulder, leads the development of X-energy’s technology drive in expanding its high-temperature gas reactor (HTGR) technology applicability. In this executive leadership role, he serves as overall lead for considering expansion into both electrical and non-electrical deployment. His role is to charter an innovative R&D roadmap in terms of advanced fuel-cycle designs, minimizing of the Xe-100 waste profile, cyber security and proliferation resistance profile and help in providing a long-term HALEU supply strategy.] //arrguy

**Going somewhere? Chemical rockets top the list of the fastest objects ever made. But if we want to open up the solar system for human exploration, they’re not nearly fast enough.** Today, a one-way trip to Mars takes a minimum of six months. That’s a long time for an astronaut to spend in a spacecraft about the size of a one-bedroom apartment. It also creates significant operational challenges for the mission. **The longer an astronaut is in transit, the more they’re exposed to high doses of dangerous cosmic radiation and the more supplies they need to carry with them for the mission.** Over the past half-century, engineers have squeezed every last drop of efficiency from conventional chemical rocket engines. If we actually want to make regular trips to Mars, we’re going to need a step change in rocket engine efficiency.

**Overall, colonization solves extinction. Bryner 23**

**Bryner 23** [Jeanna Bryner, Interim editor in chief of Scientific American. Previously she was editor in chief of Live Science and, prior to that, an editor at Scholastic's Science World magazine. Bryner has an English degree from Salisbury University, a master's degree in biogeochemistry and environmental sciences from the University of Maryland and a graduate science journalism degree from New York University, 3-21-2023, Will Humans Ever Go Extinct?, Scientific American, https://www.scientificamerican.com/article/will-humans-ever-go-extinct/, accessed 3-3-2025.] //aayush

**It’s** probably **a matter of when and how, not if, we humans will meet our doom** The species Homo sapiens evolved some 300,000 years ago and has come t**o** domi**n**ate **Earth** unlike any species that came before. But how long can humans last? **Eventually humans will go extinct**. **According to the most wildly optimistic estimate, our species will last perhaps another billion years but end when the expanding envelope of the sun swells outward and heats the planet to a Venus-like state**. But a billion years is a long time. One billion years ago life on Earth consisted of microbes. Multicellular life didn't make its debut until about 600 million years ago, when sponges proliferated. **What life will look like in another billion years is anyone's guess, but one modeling study published in 2021 in Nature Geoscience suggests that Earth's atmosphere will contain very little oxygen** by then, meaning that **anaerobic microbes, rather than humans, will probably be the last living Earthlings**. If surviving to see the sun fry Earth is a long shot, when is humanity likely to meet its doom? Paleontologically, **mammalian species usually persist for about a million years**, says Henry Gee, a paleontologist and senior editor at the journal Nature, whose forthcoming book is on the extinction of humans. That would put the human species in its youth. But Gee doesn't think these rules necessarily apply for H. sapiens. "Humans are rather an exceptional species," he says. "**We could last for millions of years, or we could all drop down next week**." **Opportunities for doomsday abound**. **Humans could be wiped out by a catastrophic asteroid strike, commit self-destruction with worldwide nuclear war or succumb to the ravages caused by the climate emergency**. But humans are a hardy bunch, so **the most likely scenario involves a combination of catastrophes that could eradicate us completely**. PICK YOUR POISON Some species killers are out of our control. In a 2021 paper in the journal Icarus, for example, researchers describe how **asteroids comparable to the one spanning 10 to 15 kilometers in diameter that killed off the nonavian dinosaurs hit Earth approximately every 250 million to 500 million years**. In a preprint paper posted on the server arXiv.org, physicists Philip Lubin and Alexander N. Cohen calculate that humanity would have the ability to save itself from a dino-killer-size asteroid, given six months' warning and an arsenal of nuclear penetrators to blow the space rock into a cloud of harmless pebbles. With less warning or a larger asteroid, Lubin and Cohen suggest, humanity should give up and "party" or "move to Mars or the Moon to party." Currently the biggest asteroid that scientists know of with the potential to strike Earth is called (29075) 1950 DA. It is a mere 1,300 meters across and has a one-in-50,000 chance of hitting our world in March 2880, according to a 2022 risk analysis by the European Space Agency. Incoming space rocks aside, **many threats to humanity are of our own making: nuclear war, the climate emergency, ecological collapse**. **We might be done in by our own tech in the form of sentient artificial intelligence that decides to snuff out its creators**, as some AI critics have suggested. An all-out nuclear war could easily destroy humanity, says François Diaz-Maurin, associate editor for nuclear affairs at the Bulletin of the Atomic Scientists. The last time humans dropped nuclear bombs on one another, only one country, the U.S., had nuclear warheads, so there was no risk of nuclear retaliation. That's not the case today—and now the bombs are a lot bigger. Those older bombs, which struck the Japanese cities of Hiroshima and Nagasaki in 1945, packed the equivalent of 15 and 21 kilotons of TNT, respectively. Together they killed an estimated 110,000 to 210,000 people. **A single modern-day, 300-kiloton nuclear weapon dropped on New York City, for example, would kill a million people in 24 hours**, Diaz-Maurin says. **A regional nuclear war, such as one between India and Pakistan, could kill 27 million people in the short term, whereas a full-scale nuclear war between the U.S. and Russia could cause an estimated 360 million direct deaths**, he adds. The threat to humanity's very existence would come after the war, when **soot from massive fires ignited by the bombings would rapidly alter the climate in a scenario known as nuclear winter**. Fears of nuclear winter may have receded since the end of the cold war, Diaz-Maurin says, but research shows that the **environmental consequences would be severe**. Even a **regional nuclear war would damage the ozone layer, block out sunlight and reduce precipitation worldwide. The result would be a global famine that might kill more than five billion people in just two years**, depending on the size and number of detonations. "That possibility of destroying humanity is still here and real," Diaz-Maurin says. **Death by ecological contamination or the climate emergency would be slower but still within the realm of possibility**. Already **humans are facing health stressors from chronic pollution** that have been **exacerbated by the additional heat brought on by climate change**, says Maureen Lichtveld, dean of the School of Public Health at the University of Pittsburgh. Hotter temperatures force people to breathe more rapidly to dispel warmth, which draws more pollution into their lungs. The climate emergency also **deepens existing problems around food security—for instance, persistent drought can devastate cropland—and infectious disease. "The interconnectedness of climate change and health inequities and inequities in general is what is impacting our global population**," Lichtveld says. THE PERFECT STORM Will these inequities eventually lead to a species-wide downfall? It's not easy to calculate the likelihood that, say, the climate emergency will kill us all, says Luke Kemp, a research affiliate at the Center for the Study of Existential Risk at the University of Cambridge. But it's probably not realistic to consider risks individually anyway, he says. "**When we look at the history of things like mass extinctions and societal collapses, it's never just one thing that happens**," Kemp says. "If you're trying to rely on a single silver bullet to kill everyone in a single event, you have to write sci-fi." **The end of humanity is far more likely to be brought about by multiple factors, Kemp says—a pileup of disasters.** Although apocalyptic movies often turn to viruses, bacteria and fungi to wipe out huge swathes of the population, **a pandemic alone probably won't drive humanity to extinction** simply because the immune system is a broad and effective defense, says Amesh Adalja, an infectious disease physician and senior scholar at the Johns Hopkins Center for Health Security. **A pandemic could be devastating and lead to severe upheaval—the Black Death killed 30 to 50 percent of Europe's population**—but **it's unlikely that a pathogen would kill all of humanity**, Adalja says. "Yes, an infectious disease could kill a lot of people," he says, "but **then you're going to have a group [of people] that are resilient to it and survive**." Humans also have tools to fight back against a pathogen, from medical treatments to vaccines to the social-distancing measures that became familiar worldwide during the COVID pandemic, Adalja says. There is one example of a mammalian species that may have been entirely eliminated by an infectious disease, he says: the Christmas Island rat (Rattus macleari), also called Maclear's rat, an endemic island species that may have gone extinct because of the introduction of a parasite. "We are not helpless like the Christmas Island rat, which couldn't get away from that island," Adalja says. "We have the ability to change our fate." If infectious disease contributes to the downfall of humanity, it will probably be as just one piece of a larger puzzle. Imagine a planet pushed to upheaval by sea-level rise and disruption to agriculture from climate change. **The humans of this climate-ravaged world attempt a geoengineering solution that goes wrong. The situation worsens. Resources are scarce, and a bunch of countries have nuclear weapons.** Oh, by the way, the **mosquitoes that carry yellow fever range as far north as Canada in this scenario**. It's **not hard to see how the human population could decline and disappear in the face of an arsenal of challenges**, according to Kemp. **Worst-case scenarios are understudied**, Kemp says. In climate science, for example, there is a lot of research into what the world might look like at two or three degrees Celsius warmer than the preindustrial average but **very little looking at what an increase of five or six degrees C might look like**. This is partly because scientists have a hard time predicting the effects of that much warming and partly because climate scientists feel pressure from politicians not to appear alarmist, Kemp says. **Models of future worst-case scenarios also tend to do an inadequate job of predicting the cascading effects of a disaster**. "The general field of existential risk is relatively new, nascent and just understudied," Kemp says. There are questions as to how much humans should worry about something as big picture as extinction. While some see the question as pressing—controversial tech billionaires such as Elon Musk and Peter Thiel have funded organizations dedicated to studying the risks of transformative technologies—others argue that today's problems are urgent enough. Already humans are heating the globe, overexploiting and destroying nature, using land and water unsustainably, and creating chemicals that are harmful to all life, often in service to the globally well-off, says Sarah Cornell, who studies global sustainability at the Stockholm Resilience Center at Stockholm University. "Today's reality is **that some human beings are undermining or even destroying living conditions of many, many other people**," Cornell says. "From a human-scale perspective, **this is an existential crisis already**, not a risk somewhere up ahead."

**Rebuttal.**

**Stade 23** (Kirsten Stade, conservation biologist and communications manager @ the NGO Population Balance "Technology Won't Save Us From Global Warming, but This Just Might", Newsweek, 10/18/23, https://www.newsweek.com/technology-wont-save-us-global-warming-this-just-might-opinion-1835495, ghs-eo)

**After the** **hottest** **Northern Hemisphere** **summer on record**, with record high temperatures around the world, **Pope Francis** recently **exhorted the developed world to** **act faster** **on climate change**. **An overhaul of wealthy lifestyles is in order**, he said, **and** **technological** **fixes** **are** **not the answer.** As **evidence of climate change** itself **becomes** **impossible to deny**, **governments** and industry **are responding with a new form of** **denial**: **the** **illusion** **that** **switching to "clean"** **energy** (solar, wind, geothermal), **"decarbonizing" the energy sector**, **and reaching net-zero emissions by 2050** **can "solve" the** **climate crisis**. **But** **warming** **of 2° C or more** by 2050 **is** **baked in** from the carbon **already in the atmosphere**, **and that doesn't** **account for** what current and **future** **emissions** will add. In fact, **the** **push for clean energy** **will** **drive** **temperatures up**, at least in the short term. **Building renewables requires** **massive** **amounts of** **fossil fuels** **and** **environmentally** **harmful** **trace** **metal mining**. **New** **transmission** **infrastructure** **destroys** **more** **habitat**. And as renewables come online and fossil fuels phase out, "aerosol dimming," which has been masking or offsetting warming, will cease. Sulfate aerosols from burning fossil fuels have a temporary cooling effect. **When fossil fuel use stops, so will the** **cooling effect**. **The** **Earth** **will** then **warm faster than lowered** **CO2** **emissions** **can** **cool** **it**, **causing a net** **temperature rise**. What **all this adds up to** is **that our chances for avoiding catastrophic warming depend upon our ability to** **remove CO2** **already in the atmosphere, in addition to** **stopping the emission** **of more**. **The solution proposed by our** political **leaders** and amplified in the media **is** **more technology.** Following intensive lobbying by the fossil fuel industry, the Biden Administration authorized billions of dollars in new subsidies for the industry to adopt carbon capture and storage (CCS) technologies. **Pope Francis rightly noted that such** **subsidies are** **a** **poor investment**. A new study compares technologies for mechanical carbon capture and storage to natural carbon dioxide removal (CDR) strategies like reforestation, improved forest management, and encouraging kelp growth in oceans. It found **mechanical methods fall short** **by** **every measure**, and that restoring forests, grasslands, and wetlands and shifting to regenerative forms of agriculture remove more carbon than CCS and use less energy and land. Through protecting and enhancing natural carbon sinks, natural CDR strategies are not only cost-effective but have co-benefits like conserving biodiversity and improving water quality. **CCS is** **expensive, energy-intensive, and** **risky, and yet** **companies** **that adopt these technologies** can **claim** **"green" credentials** **even** **though** **their** **operations** may **destroy** some of the **natural** **processes** **that** **sequester** **carbon** **effectively**. And to add a final insult to this litany of injuries, so far **the most common use for carbon captured through mechanical means is** **to pump it** **underground**—**where it** **facilitates** **the** **extraction of** **more fossil fuels**. And yet **even the IPCC has bought into this** **scam**.

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

We need a rapid transition to renewables, yes—but scientists warn that **we** **can’t** **keep growing energy use at existing rates**. No energy is innocent. **The only truly** **clean** **energy is** **less energy.** In 2017, the World Bank released a little-noticed report that offered the first comprehensive look at this question. It models the increase in material extraction that would be required to build enough solar and wind utilities to produce an annual output of about 7 terawatts of electricity by 2050. That’s enough to power roughly half of the global economy. By doubling the World Bank figures, we can estimate what it will take to get all the way to zero emissions—and the results are staggering: 34 million metric tons of copper, 40 million tons of lead, 50 million tons of zinc, 162 million tons of aluminum, and no less than 4.8 billion tons of iron. In some cases, **the transition to** **renewables will require a** **massive increase** **over** **existing levels** **of extraction**. For **neodymium**—an essential element in wind turbines—**extraction will need to** rise by nearly 35 percent over current levels. Higher-end estimates reported by the World Bank suggest it could **double**. The same is true of silver, which is critical to solar panels. Silver extraction will go up 38 percent and perhaps as much as 105 percent. Demand for **indium**, also essential to solar technology, **will** **more than** **triple** **and could** **end up skyrocketing by** **920 percent**. And then there are all the batteries we’re going to need for power storage. **To keep energy flowing when the sun isn’t shining and the wind isn’t blowing will require** **enormous batteries** at the grid level. **This means** **40 million tons of** **lithium**—**a**n eye-watering **2,700 percent** **increase** **over** **current levels** **of extraction. That’s just for electricity. We also need to think about** **vehicles**. This year, a group of leading British scientists submitted a letter to the U.K. Committee on Climate Change outlining their concerns about the ecological impact of electric cars. They agree, of course, that we need to end the sale and use of combustion engines. But they pointed out that unless consumption habits change, **replacing** **the world’s projected fleet of** **2 billion vehicles** **is going to** **require an** **explosive increase in mining**: Global annual extraction of neodymium and dysprosium will go up by another 70 percent, annual extraction of copper will need to more than double, and cobalt will need to increase by a factor of almost four—all for the entire period from now to 2050. The problem here is not that we’re going to run out of key minerals—although that may indeed become a concern. The real issue is that **this will** **exacerbate** **an** **already existing crisis of overextraction**. **Mining** has become one of the biggest single **drive**r**s of** **deforestation,** **ecosystem collapse, and** **biodiversity loss** around the world. Ecologists estimate that **even at** **present** **rates of global material use, we are** **overshooting sustainable levels** **by** **82 percent.** Take silver, for instance. Mexico is home to the Peñasquito mine, one of the biggest silver mines in the world. Covering nearly 40 square miles, the operation is staggering in its scale: a sprawling open-pit complex ripped into the mountains, flanked by two waste dumps each a mile long, and a tailings dam full of toxic sludge held back by a wall that’s 7 miles around and as high as a 50-story skyscraper. This mine will produce 11,000 tons of silver in 10 years before its reserves, the biggest in the world, are gone. **To transition the global economy to renewables, we need to commission up to** **130 more mines** **on the scale of** **Peñasquito**. **Just for silver**. **Lithium is another** **ecological disaster**. **It takes** **500,000 gallons of water** **to produce a** **single ton of lithium**. Even at present levels of extraction **this is causing** problems. In the Andes, where most of the world’s lithium is located, **mining companies** **are** **burning** **through** **the** **water** **tables** **and leaving farmers with** **nothing** **to irrigate their crops**. Many have had no choice but to abandon their land altogether. Meanwhile, **chemical leaks** **from lithium mines** **have** **poisoned rivers** from Chile to Argentina, Nevada to Tibet, **killing off** **whole** **freshwater** **ecosystems**. **The lithium boom has** **barely even started, and it’s** **already a crisis**. And **all of this is just to power the** **existing** **global economy**. **Things become** **even more** **extreme** **when we** start **account**ing **for** **growth. As energy demand continues to rise, material extraction for renewables will become** **all the more aggressive**—and **the** **higher the growth rate, the** **worse** **it will get.** It’s important to keep in mind that most of the key materials for the energy transition are located in the global south. Parts of **Latin America, Africa, and Asia will** **likely** **become the target of** **a** **new scramble for resources**, **and** **some countries may** **become** **victims of** **new forms of colonization**. **It happened in the 17th and 18th centuries with the hunt for** **gold** **and** **silver** from South America. In the 19th century, it was land for cotton and sugar plantations in the Caribbean. In the 20th century, it was diamonds from South Africa, cobalt from Congo, and oil from the Middle East. **It’s** **not difficult** **to imagine that the scramble for renewables might become** **similarly violent.** If we don’t take precautions, **clean energy** **firms** **could become** **as destructive as fossil fuel** **companies**—**buying off** **politicians,** **trashing** **ecosystems,** **lobbying against** **environmental** **regulations**, **even** **assassinating community leaders** who stand in their way.

Barry W. **Brook et al.**, Agustin Alonso, Daniel A. Meneley, Jozef Misak, Tom Blees, Jan B. van Erp, 12/20**14**, "Why nuclear energy is sustainable and has to be part of the energy mix," Faculty of Science, Engineering & Technology, University of Tasmania, Australia, Sustainable Materials and Technologies vol 1-2, https://www.sciencedirect.com/science/article/pii/S2214993714000050 // MH

**Humanity must face the reality that it cannot depend indefinitely on combustion of coal, gas and oil** for most of its energy needs. In the unavoidable process of gradually replacing fossil fuels, many energy technologies may be considered and most will be deployed in specific applications. However, **in the long term, we argue that nuclear fission** technology **is the only** developed **energy source that is capable** of delivering the enormous quantities of energy that will be needed to run modern industrial societies safely, economically, reliably and in a sustainable way, **both environmentally and as regards the available resource base**. Consequently, nuclear fission has to play a major role in this necessary transformation of the 21st century energy-supply system. In a first phase of this necessary global energy transformation, the emphasis should be on converting the major part of the world's electrical energy generation capacity from fossil fuels to nuclear fission. This can realistically be achieved within a few decades, as has already been done in France during the 1970s and 1980s. Such an energy transformation would reduce the global emissions of carbon dioxide profoundly, as well as cutting other significant greenhouse gases like methane. Industrial nations should take the lead in this transition. Because methane is a potent greenhouse gas, replacing coal-fired generating stations with gas-fired stations will not necessarily result in a reduction of the rate of greenhouse-gas emission even for relatively low leakage rates of the natural gas into the atmosphere. The energy sources popularly known as **‘renewables’** (such as wind and solar), will be hard pressed to supply the needed quantities of energy sustainably, economically and reliably. They are **inherently** intermittent, **depend**ing **on backup power or** on energy **storage** if they are to be used for delivery of base-load electrical energy to the grid. This **backup power** has to be flexible and **is derived** in most cases **from** combustion of **fossil fuels** (mainly natural gas). If used in this way, intermittent energy sources do not meet the requirements of sustainability, nor are they economically viable because they require redundant, under-utilized investment in capacity both for generation and for transmission. **Intermittent energy** installations, in conjunction with gas-fired backup power installations, **will in many cases** be found to **have a combined rate of greenhouse-gas emission** that is **higher** **than** that of **stand-alone coal**-fired generating stations **of equal** generating **capacity**. A grid connection fee, to be imposed on countries with a large intermittent generating capacity, should be considered for the purpose of compensating adjacent countries for the use of their interconnected electric grids as back-up power. **Also**, intermittent energy sources tend to **negatively affect grid stability**, especially as their market penetration rises. The alternative — dedicated energy **storage** for grid-connected intermittent energy sources (instead of backup power) — **is** in many cases **not** yet **economically viable**. However, intermittent sources plus **storage may be** economically **competitive for local** electricity **supply in** geographically **isolated regions without access to a** large electric **grid**. **Yet nuclear** fission energy **will, even then, be required for the majority displacement of fossil fuels this century**.

**Allegri 23** [Zongyuan Zoe Liu, 3-23-2023, Going Green Pits Renewables Against Farmland. Nuclear Energy Can Help, Council on Foreign Relations, https://www.cfr.org/blog/going-green-pits-renewables-against-farmland-nuclear-energy-can-help, accessed 3-24-2025.] //aayush

**Decarbonizing the global energy system is no mean task**. According to a 2022 McKinsey report [PDF], **achieving net-zero emissions by 2050 would cost an additional $3.5 trillion in annual capital expenditure on physical assets for energy and land-use systems**. That figure is equivalent to **half of all global corporate profits**, one-quarter of total tax revenue, or 7 percent of household spending in 2020. However, the clean energy transition is not just about the money. As the United States progresses toward net-zero carbon emissions, **it inevitably runs into competing demands for land, driven primarily by land-intensive renewable sources for power generation such as wind and solar. Not all renewable energy sources are equally land efficient**. **Maximizing land-use efficiency is critical** to ensure that a **cleaner energy** future does not come **at the expense of the unity of American communities and the foundation of the United States’ farmland and food security**. Expanding the domestic infrastructure for **nuclear energy**, one of the cleanest and least land-intensive sources of energy available, **could be the most viable strategy. The United States boasts one of the world’s largest areas of arable land and is a leading global food producer**. That abundance **has made its citizens complacent: the United States is losing its farmland at an alarming rate without being fully aware of the consequences**. Data from the U.S. Department of Agriculture shows that **between 2000 and 2022 U.S. farmland declined by 5.5 percent, with the total acreage shrinking from 954,080,000 to 893,400,000** [PDF]. That staggering loss translates to an area roughly the size of New Jersey and is much larger than the forty million [PDF] acres of U.S. agricultural land held by foreign entities. U.S. Senators Jon Tester (D-MT) and Mike Rounds (R-SD) recently introduced a bill to bar foreign adversaries—namely, China, Iran, North Korea, and Russia—from buying American farmland. The act was triggered by concerns over Chinese investment in U.S. farmland, although China currently owns less than 1 percent of U.S. foreign-held farmland (Canadian investors hold the largest share -nearly one third - of U.S. foreign-held farmland). Preventing adversaries from investing in U.S. farmland is a necessary but insufficient action. As the United States progresses with its net-zero transition, the **public and private sectors should maximize land efficiency for renewable energy sources. If not appropriately managed, electricity production from renewables to meet decarbonization goals could drive up land use and land-cover change, threatening biodiversity and food security and challenging other environmental and social priorities**. According to Bloomberg, the United States currently uses eighty-one million acres to power its economy, about the size of Iowa and Missouri combined and covering roughly 4 percent of the contiguous United States. **If the U.S. government and energy industry fail to maximize land efficiency in the energy transition process, replacing less land-intensive fossil fuels with more land intensive clean energy sources will dramatically drive up demand for land. Intensified competition for land use risks exacerbating farmland loss**. For example, according to a 2020 Brookings report, **electricity generation by wind and solar is at least ten times more land-intensive than coal- or natural gas-fired power plants**. A different study, using data from 1,400 real-world observations covering nine electricity sources across 73 countries and 45 U.S. states, also showed that **wind and solar are far more land intensive than fossil fuels, and biomass is the least land-efficient source of electricity**. To achieve President Joe Biden’s pledge to create a carbon-free economy by 2050, **the United States would need the equivalent of four additional South Dakotas to generate sufficient clean power to meet its electricity demand**, according to Princeton University estimates and Bloomberg analysis. The Biden administration has demonstrated a firm commitment to promoting clean energy development in the United States through landmark legislation, such as the infrastructure bill and the Inflation Reduction Act. **Policy measures such as subsidies and tax credits make it more lucrative for owners of farms and ranches to lease their land for solar and wind farms in exchange for annual royalty payments**. In parts of the country, such as Colorado, solar and wind farms have become the new cash crop, driving a frenzied land rush for renewable energy that has irrevocably altered the landscape. **Converting prime agricultural land into clean energy farms has also raised significant concerns and encountered local resistance in rural communities in states such as Texas. The United States needs a more land-efficient approach. That will require restoring American leadership in nuclear power research, development, and deployment**. Researchers have found that **nuclear power is by far the most land efficient for electricity generation compared to other energy sources**: to generate the same amount of electricity, it needs twenty-seven times less land than coal, eighteen times less than hydropower plants, and thirty-four times less than solar. However, developing nuclear energy has not been a priority in the U.S. energy agenda for decades. Between 2013 and 2021, at least twelve [PDF] U.S. nuclear reactors were shut down (representing 9,436 megawatts of electricity generation capacity) due to rising security costs, competition from wind and solar, and power generated by cheap natural gas, leaving just 92 nuclear reactors operating nationwide. Not until the recent disruption in global energy markets triggered by Russia’s invasion of Ukraine did the U.S. government step up support for its nuclear energy sector. The Biden administration has correctly recognized that maintaining and expanding nuclear power as a source of carbon-free electricity is crucial for reaching its climate commitment. To that end, the Biden administration recently offered $1.2 billion in aid to extend the life of distressed nuclear power plants. The funding is also available for recently closed plants, marking the first time such support has become available. The challenges of the energy transition to a clean and sustainable future extend beyond monetary costs. The transition requires careful consideration of land use intensity between competing interests and demands. **The U.S. government needs to revitalize the domestic nuclear power industry to drive the decarbonized American economy while protecting farmland and food security**.

**Klare** **’21** (Michael Klare, professor of peace and world security studies at Hampshire College. “Will there be resource wars in our renewable energy future?” Salon, May 31, 2021, , JB)

Thanks to its very name — renewable energy — we can picture a time in the not-too-distant future when our need for non-renewable fuels like oil, natural gas, and coal will vanish. Indeed, the Biden administration has announced a breakthrough target of 2035 for fully eliminating U.S. reliance on those non-renewable fuels for the generation of electricity. That would be accomplished by "deploying carbon-pollution-free electricity-generating resources," primarily the everlasting power of the wind and sun. With other nations moving in a similar direction**,** **it's tempting to conclude** **that the days when competition over finite supplies of energy was a recurring source of** **conflict** **will** **soon** **draw to a close**. Unfortunately, **think again**: **while the sun and wind are indeed infinitely renewable**, the **materials needed** **to convert those resources into electricity** — minerals **like** **cobalt, copper,** **lithium, nickel,** **and** **the** **rare-earth** **elements**, or REEs — **are anything but**. **Some** of them, in fact, **are** far **scarcer** **than petroleum**, suggesting that **global** **strife** over vital resources **may** **not**, in fact, **disappear** in the Age of Renewables. To appreciate this unexpected paradox, it's necessary to explore how wind and solar power are converted into usable forms of electricity and propulsion. Solar power is largely collected by photovoltaic cells, often deployed in vast arrays, while the wind is harvested by giant turbines, typically deployed in extensive wind farms. **To use electricity in transportation, cars and trucks must be equipped with advanced batteries** capable of holding a charge over long distances. Each one of these devices usessubstantial amounts of copper for electrical transmission, as well as a variety of other non-renewable minerals. Those **wind turbines**, for instance, **require manganese, molybdenum, nickel, zinc, and rare-earth elements for their electrical generators**, while **electric vehicles** (EVs) **need cobalt, graphite, lithium, manganese, and rare earths for their engines and batteries**. At present, with wind and solar power accounting for only about 7% of global electricity generation and electric vehicles making up less than 1% of the cars on the road, the production of those minerals is roughly adequate to meet global demand. **If**, however, **the U.S. and other countries** really do **move toward a green-energy future** of the kind envisioned by President Biden, the **demand** for them **will** **skyrocket** **and global** **output** **will fall** **far** **short** **of anticipated needs**. According to a recent study by the International Energy Agency (IEA), "The Role of Critical Minerals in Clean Energy Transitions," the demand for lithium in 2040 could be 50 times greater than today and for cobalt and graphite 30 times greater if the world moves swiftly to replace oil-driven vehicles with EVs. Such **rising demand will**, of course, **incentivize industry** **to develop** **new supplies** **of such** **minerals, but potential** **sources** **of them** **are limited** **and the process of bringing them online will be costly and complicated**. In other words, **the world could face** **significant shortages** **of critical** **materials**. ("As clean energy transitions accelerate globally," the IEA report noted ominously, "and solar panels, wind turbines, and electric cars are deployed on a growing scale, these **rapidly growing markets for key minerals could be subject to price** **volatility, geopolitical influence, and even disruptions to supply**.") And here's a further complication: **for a number of the most critical materials**, including lithium, cobalt, and those rare-earth elements, **production is** **highly concentrated** **in** **just a few countries**, a reality **that** **could lead to** **the sort of** **geopolitical struggles** **that accompanied the world's** **dependence** **on a few major sources of oil.** According to the IEA, **just** one country, **the Democratic Republic of the Congo (DRC), currently supplies more than 80% of the world's cobalt**, and another — China — 70% of its rare-earth elements. Similarly, **lithium** production **is** largely **in** two countries, **Argentina and Chile, which jointly account for nearly 80% of world supply,** while four countries — Argentina, Chile, the DRC, and Peru — provide most of our copper. In other words, such **future supplies are far more concentrated in far fewer lands than petroleum and** **natural gas**, leading IEA analysts to worry about future struggles over the world's access to them. From Oil to Lithium: the Geopolitical Implications of the Electric-Car Revolution The role of petroleum in shaping global geopolitics is well understood. Ever since oil became essential to world transportation — and so to the effective functioning of the world's economy — it has been viewed for obvious reasons as a "strategic" resource. Because the largest concentrations of petroleum were located in the Middle East, an area historically far removed from the principal centers of industrial activity in Europe and North America and regularly subject to political convulsions, the major importing nations long sought to exercise some control over that region's oil production and export. This, of course, led to resource imperialism of a high order, beginning after World War I when Britain and the other European powers contended for colonial control of the oil-producing parts of the Persian Gulf region. It continued after World War II, when the United States entered that competition in a big way. For the United States, ensuring access to Middle Eastern oil became a strategic priority after the "oil shocks" of 1973 and 1979 — the first caused by an Arab oil embargo that was a reprisal for Washington's support of Israel in that year's October War; the second by a disruption of supplies caused by the Islamic Revolution in Iran. In response to endless lines at American gas stations and the subsequent recessions, successive presidents pledged to protect oil imports by "any means necessary," including the use of armed force. And that very stance led President George H.W. Bush to wage the first Gulf War against Saddam Hussein's Iraq in 1991 and his son to invade that same country in 2003. In 2021, the United States is no longer as dependent on Middle Eastern oil, given how extensively domestic deposits of petroleum-laden shale and other sedimentary rocks are being exploited by fracking technology. Still, the connection between oil use and geopolitical conflict has hardly disappeared. Most analysts believe that **petroleum** **will** **continue to** **supply** **a** **major share** **of** **global energy** **for decades to come**, and **that's certain to generate** **political** **and** **military struggles** **over the remaining supplies**. Already, for instance, conflict has broken out over disputed offshore supplies in the South and East China Seas, and some **analysts predict a** **struggle** **for the control of untapped oil and mineral deposits in the** **Arctic region** as well. Here, then, is the question of the hour: Will an explosion in electric-car ownership change all this? EV market share is already growing rapidly and projected to reach 15% of worldwide sales by 2030. The major automakers are investing heavily in such vehicles, anticipating a surge in demand. There were around 370 EV models available for sale worldwide in 2020 — a 40% increase from 2019 — and major automakers have revealed plans to make an additional 450 models available by 2022. In addition, General Motors has announced its intention to completely phase out conventional gasoline and diesel vehicles by 2035, while Volvo's CEO has indicated that the company would only sell EVs by 2030. It's reasonable to assume that this shift will only gain momentum, with profound consequences for the global trade in resources. According to the IEA, a typical electric car requires six times the mineral inputs of a conventional oil-powered vehicle. These include the copper for electrical wiring plus the cobalt, graphite, lithium, and nickel needed to ensure battery performance, longevity, and energy density (the energy output per unit of weight). In addition, rare-earth elements will be essential for the permanent magnets installed in EV motors. Lithium, a primary component of lithium-ion batteries used in most EVs, is the lightest known metal. Although present both in clay deposits and ore composites, it's rarely found in easily mineable concentrations, though it can also be extracted from brine in areas like Bolivia's Salar de Uyuni, the world's largest salt flat. At present, approximately 58% of the world's lithium comes from Australia, another 20% from Chile, 11% from China, 6% from Argentina, and smaller percentages from elsewhere. A U.S. firm, Lithium Americas, is about to undertake the extraction of significant amounts of lithium from a clay deposit in northern Nevada, but is meeting resistance from local ranchers and Native Americans, who fear the contamination of their water supplies. Advertisement: Cobalt is another key component of lithium-ion batteries. It's rarely found in unique deposits and most often acquired as a byproduct of copper and nickel mining. Today, it's almost entirely produced thanks to copper mining in the violent, chaotic Democratic Republic of the Congo, mostly in what's known as the copper belt of Katanga Province, a region which once sought to break away from the rest of the country and still harbors secessionist impulses. Rare-earth elements encompass a group of 17 metallic substances scattered across the Earth's surface but rarely found in mineable concentrations. Among them, several are essential for future green-energy solutions, including dysprosium, lanthanum, neodymium, and terbium. When used as alloys with other minerals, they help perpetuate the magnetization of electrical motors under high-temperature conditions, a key requirement for electric vehicles and wind turbines. At present, approximately 70% of REEs come from China, perhaps 12% from Australia, and 8% from the U.S. A mere glance at the location of such concentrations suggests that **the green-energy transition envisioned by** **President Biden** **and other world leaders may** **encounter severe** **geopolitical problems, not unlike those** **generated** **in the past** **by** **reliance** **on oil.** As a start, **the most militarily powerful nation on the planet, the United States, can supply itself with only tiny percentages of REEs**, as well as other critical minerals like nickel and zinc needed for advanced green technologies. **While Australia, a close ally, will** **undoubtedly** **be an** **important supplier** **of some of them, China, already increasingly** **viewed** **as an adversary, is crucial when it comes to** **REEs, and the Congo, one of the most conflict-plagued nations on the planet, is the leading producer of cobalt**. So **don't** for a second **imagine that the** **transition** **to a renewable-energy future will either be** **easy** **or** **conflict-free**. The Crunch to Come Faced with the prospect of inadequate or hard-to-access supplies of such critical materials, energy strategists are already calling for major efforts to develop new sources in as many locations as possible. "Today's supply and investment plans for many critical minerals fall well short of what is needed to support an accelerated deployment of solar panels, wind turbines and electric vehicles," said Fatih Birol, executive director of the International Energy Agency. "These hazards are real, but they are surmountable. The response from policymakers and companies will determine whether critical minerals remain a vital enabler for clean energy transitions or become a bottleneck in the process." As Birol and his associates at the IEA have made all too clear, however, surmounting the obstacles to increased mineral production will be anything but easy. To begin with, **launching new mining ventures can be** **extraordinarily expensive** **and entail** **numerous risks. Mining** firms may be willing to invest billions of dollars in a country like Australia, where the legal framework is welcoming and where they can expect protection against future expropriation or war, but many promising ore sources lie in countries like the DRC, Myanmar, Peru, and Russia where such conditions hardly apply. For example, the current **turmoil in Myanmar, a major producer of certain rare-earth elements, has already led to worries about their future availability and sparked a rise in prices**. Advertisement: Declining ore quality is also a concern. When it comes to mineral sites, this planet has been thoroughly scavenged for them, sometimes since the early Bronze Age, and many of the best deposits have long since been discovered and exploited. "In recent years, ore quality has continued to fall across a range of commodities," the IEA noted in its report on critical minerals and green technology. "For example, the average copper ore grade in Chile declined by 30% over the past 15 years. Extracting metal content from lower-grade ores requires more energy, exerting upward pressure on production costs, greenhouse gas emissions, and waste volumes." In addition, **extracting minerals from underground rock formations often entails the use of acids and other toxic substances and typically requires vast amounts of water, which are contaminated after use**. This has become ever more of a problem since the enactment of environmental-protection legislation and the mobilization of local communities. In many parts of the world, as in Nevada when it comes to lithium, new mining and ore-processing efforts are going to encounter increasingly fierce local opposition. When, for example, the Lynas Corporation, an Australian firm, sought to evade Australia's environmental laws by shipping ores from its Mount Weld rare-earths mine to Malaysia for processing, local activists there mounted a protracted campaign to prevent it from doing so. For Washington, perhaps **no problem is more challenging, when it comes to the availability of** **critical materials** **for a green revolution,** **than** **this country's** **deteriorating** **relationship with** **Beijing.** After all, **China** currently **provides 70% of** **the world's** **rare-earth** **supplies and harbors significant deposits of other key minerals** as well. No less significant, that country is responsible for the refining and processing of many key materials mined elsewhere. In fact, when it comes to mineral processing, the figures are astonishing. China may not produce significant amounts of cobalt or nickel, but it does account for approximately 65% of the world's processed cobalt and 35% of its processed nickel. And while China produces 11% of the world's lithium, it's responsible for nearly 60% of processed lithium. When it comes to rare-earth elements, however, China is dominant in a staggering way. Not only does it provide 60% of the world's raw materials, but nearly 90% of processed REEs. To put the matter simply, **there is no way the United States or other countries can undertake a massive transition from fossil fuels to a renewables-based economy without engaging economically with China.** Undoubtedly, efforts will be made to reduce the degree of that reliance, but **there's no** **realistic** **prospect of eliminating dependence on China** **for rare earths**, lithium, and other key materials in the foreseeable future. If, in other words, **the U.S.** **were to** **move** **from a** **modestly** **Cold-War-like** **stance** **toward Beijing** **to** **an even** **more** **hostile** **one**, and if it were to engage in further Trumpian-style attempts to "decouple" its economy from that of the People's Republic, as advocated by many "China hawks" in Congress, there's no question about it: the Biden administration would have to abandon its plans for a green-energy future. Advertisement: **It's possible, of course, to** **imagine** **a future in which** **nations begin** **fighting** **over** **the world's** **supplies of critical minerals, just as they** **once** **fought over oil**. At the same time, it's perfectly possible to conceive of a world in which countries like ours simply abandoned their plans for a green-energy future for lack of adequate raw materials and reverted to the oil wars of the past. On an already overheating planet, however, **that would** **lead to a** **civilizational** **fate worse than death**.

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**Nuclear energy has advantages over renewables in terms of reliability, GHG emissions, land use and waste**. Nuclear **is far more reliable** (dispatchable) **than renewables like wind and solar**. **Nuclear plants keep churning out energy even when the wind is not blowing, and the sun is not shining**. Nuclear is also one of the **cleanest sources of energy.** Recent research published in the Journal of Cleaner Production found that the **emission of GHGs and natural resource use associated with nuclear power generation was similar to that of renewable energy**. An analysis by the European Commission indicates that in terms of full-cycle production, the emissions from nuclear are around the same as wind. Other studies have concluded that **nuclear may be even cleaner than solar. Orano claims that nuclear power generates four times fewer GHGs than solar**. a comparison of small modular reactors and photovoltaic solar panels **Nuclear also requires substantially less land than wind and solar**. According to some assessments, nuclear requires 1/2,000th as much land as wind and 1/400th as much land as solar. US **government data indicates that a 1,000-megawatt wind farm requires 360 times more land than a similar-capacity nuclear facility, while a solar plant requires 75 times more** area. While there are valid concerns about nuclear waste, **there are also legitimate issues with renewable waste. Wind and solar generate a litany of chemical wastes including toxic heavy metals like cadmium, arsenic, chromium, and lead. While nuclear waste can remain radioactive for thousands of years, waste metals associated with renewables remain dangerous forever**. Perhaps most importantly, the **volume of nuclear waste is a tiny fraction of renewable waste. Nuclear waste is 1/10,000th of the waste generated by solar and 1/500th of the waste generated by wind**.