# **1AC**

### **CT1 Air Pollution**

#### **Quarry Lane Affirms:**

#### **Contention One is Air Pollution**

#### **First, US Air Pollution is a problem**

***Greenstone 24 [Michael Greenstone, Tanushree Ganguly, Christa Hasenkopf, Nishka Sharma and Hrishikesh Gautam "*** ***United States Fact Sheet" AIR QUALITY LIFE INDEX® | August 2024] [thiele] [https://aqli.epic.uchicago.edu/wp-content/uploads/2024/08/US-FactSheet\_2024.pdf] [Greenstone = Director, Professor, Energy Policy Institute at the University of Chicago (EPIC), first to quantitatively link PM2.5 to mortality]***

Since the Clean Air Act was enacted in 1970, particulate pollution (PM2.5) has declined by 67.2 percent—extending the life expectancy of an average American by 1.5 years (Figure 1).1 Responding to the latest scientific evidence on the health impact of lower levels of air pollution , the United States recently revised their national annual standard for PM2.5 from 12 μg/m3 to 9 μg/m3. With this revision implemented, only 13 out of the 3,142 counties in the United States (home to approximately 5 percent of the county’s population) are not meeting this standard. If these counties were to meet the country’s new standard, the total life expectancy in the US would go up by 1.9 million years. 1 Our 1970 US estimates are based on only 237 US counties for which 1970 PM2.5 concentrations could be approximated. It should be noted that not all states include counties with data available from 1970. Here we are comparing 1970s imputed PM2.5 data for those 237 counties with 2022 PM2.5 data, which are available for all 3,136 US counties. For further information, see the Technical Appendix available at https://aqli.epic.uchicago.edu/policy-impacts/ united-states-clean-air-act/. 2 Greatest reduction within the 237 counties for which 1970 PM2.5 data was imputable. KEY TAKE-AWAYS • According to the latest satellite-derived data on particulate pollution, the annual-average PM2.5 concentration in the United States was 6.9 μg/m3 in 2022. Sustained exposure to this level of particulate pollution could shorten the average Americans’ life expectancy by 2.2 months or a total of 62.6 million life years relative to what it would be if the World Health Organization (WHO) guideline of 5 μg/m3 was met. • While only 5.1 percent of the country’s population lives in regions that don’t meet the country’s revised standard, 93.8 percent of the population lives in regions that don’t meet the WHO guideline. • Despite air pollution having a relatively smaller impact in the United States compared to some other countries, the health burden of particulate pollution is five times that of HIV/AIDS and four times that of nutritional deficiencies.

#### **Second, Trumps recent rollback of EPA regulations will only increase air pollution**

***Drugmand 25 [Dana Drugmand "Americans to face more disease and death due to Trump’s air quality rollbacks, health experts warn" The New Ledge March 14, 2025] [thiele] [https://www.thenewlede.org/2025/03/americans-to-face-more-disease-and-death-due-to-trumps-air-quality-rollbacks-health-experts-warn/] [Drugmand, Climate Journalist, Master's in Environmental Law & Policy (MELP) degree from Vermont Law School in 2017.2012 graduate of Mount Holyoke College with a major in Environmental Studies]***

American families will face increasing rates of environmental-related illnesses and premature deaths, including lung and cardiovascular diseases, due to the Trump administration’s sweeping rollbacks of air quality regulations, health professionals warn. The moves to slash roughly two dozen environmental and public health protections weaken rules dealing with a range of health threats, including mercury emissions from power plants and tailpipe pollution from vehicles. Environmental Protection Agency (EPA) Administrator Lee Zeldin announced March 12 what the agency is labeling the biggest and greatest deregulatory push in US history. “We are driving a dagger straight into the heart of the climate change religion to drive down cost of living for American families, unleash American energy, bring auto jobs back to the US and more,” Zeldin said in the announcement. Industry trade groups applauded the EPA actions. The American Petroleum Institute said the Trump administration is “answering the call” for more “affordable, reliable and secure American energy,” while the American Chemistry Council said EPA’s plan to revisit soot standards will help “foster continued industry growth.” “Sicker and poorer” Public health and environmental experts, however, said the Trump administration is ignoring the enormous health and economic benefits that clean air and climate protections provide. “If Zeldin’s deregulatory jihad succeeds, he will leave America a sicker and poorer place,” Joseph Goff, former assistant administrator for the EPA’s Office of Air and Radiation, said in a statement. A September 2024 report from the Environmental Protection Network – a group of former EPA staff – found that air pollution regulations issued during the Biden administration would avoid over 100 million asthma attacks and save over 200,000 lives through 2050 while delivering over $250 billion in health and environmental benefits annually. New rules from Biden’s EPA to reduce carbon emissions and other air pollutants from power plants were estimated to result in the avoidance of 1,200 premature deaths, 870 hospital and emergency room visits, 1,900 cases of asthma onset and 360,000 cases of asthma symptoms by 2035. “The Trump administration’s agenda seeks to roll back environmental regulations that are proven to have saved countless lives and prevented many illnesses, disabilities and hospitalizations,” said Ted Schettler, a physician and science director of the Science and Environmental Health Network. “The predictable increased costs of illness and added suffering will be borne by individuals, families, and communities across the country.” The list of rules and standards on EPA’s chopping block include air quality standards for fine particulate matter (soot) that can lodge deep in the lungs and cause respiratory ailments, multiple national emission standards for hazardous air pollutants, mercury and air toxic standards and wastewater regulations on coal-fired power plants, Clean Air Act regulations on the oil and gas industry, limits on greenhouse gas emissions from the power sector and from automobiles, a rule requiring highly hazardous industrial facilities to prevent and plan for chemical disasters, the social cost of carbon and the greenhouse gas reporting program, and more. “Killing kids” During Trump’s first term, the EPA pursed a similar agenda rolling back or attempting to reverse over 100 environmental regulations, said Phil Landrigan, a pediatrician and public health physician and director of the global public health program at Boston College. An analysis he and colleagues conducted of the public health impacts of those actions found that they resulted in about 20,000 additional deaths, Landrigan said. The most air pollution-related deaths during Trump’s first term occurred in “red” states that voted for Trump, as these states tend to have weaker state programs for public health and environmental protection. “The downstream consequences of these actions are more pollution, more disease, and more death,” he said. “It’s important to point out, for an administration that portrays itself as pro-life, a group within the population that will suffer most seriously from those impacts are pregnant women, their infants in the womb, and young kids. Something that is portrayed as freeing up industry actually ends up killing kids. That is the bottom line.” One action the first Trump administration did not undertake, but that the new administration is pursuing, is attempting to scrap EPA’s 2009 endangerment finding for greenhouse gases. This finding underpins EPA’s legal obligation to regulate climate pollution under the Clean Air Act. “I’ve been told the endangerment finding is considered the holy grail of the climate change religion,” Zeldin said in a video message accompanying his announcement. He said he intends to reconsider all rules that stem from that science-based finding, such as standards limiting tailpipe pollution from cars and trucks. Moves to roll back clean vehicle standards would expose American families to “significantly more toxic air pollution from vehicle exhaust, exacerbating the risks of asthma, lung disease, and heart attacks,” Alliance of Nurses for Healthy Environments Executive Director Katie Huffling said in a statement. The American Lung Association and the American Public Health Association (APHA) also issued statements criticizing Zeldin’s massive deregulatory announcements. American Lung Association called EPA’s plan a “tragedy for health” and APHA said the rollbacks will lead to increased pollution that will “continue to harm communities across the US.”

#### **Third, Increased federal investment will increase nuclear power to replace fossil fuel power.**

***Dubois-Pelerin March 4 [Emmanuel Dubois-Pelerin, Tony Lenoir, Sylvain Cognet-Dauphin, and Dan Thompson " A multidimensional nuclear resurgence: Differing drivers and challenges" S&P Global March 4, 2025] [thiele] [https://www.spglobal.com/en/research-insights/special-reports/look-forward/a-multidimensional-nuclear-resurgence-differing-drivers-and-challenges] [Dubois-Perin = Managing Director, S&P Global Ratings. HEC Paris Master in Management (Grande Ecole) School of Management, Jouy-en-Josas 1988 - 1991, Graphique Université Paris-Sorbonne Université Paris-Sorbonne Master's degree (DEA) History 1989 – 1996 Graphique EHESS - École des hautes études en sciences sociales, EHESS - École des hautes études en sciences sociales Master's degree (DEA) Microeconomics / Macroeconomics]***

Governments, utilities and large electricity users increasingly view nuclear energy as a sensible solution to decarbonize the energy sector while ensuring firm power — subject to favorable policy, notably financial incentives. The AI-fueled boom in energy-intensive server-housing facilities has magnified nuclear energy's renewed momentum in the US, with this dynamic expected to take hold in Europe, where the datacenter sector is expanding more slowly. Despite numerous nuclear new-build announcements in Europe and North America, actual project construction is limited. In contrast, nuclear growth in China is accelerating, with ongoing construction and a healthy project pipeline. As the world grapples with climate change and energy security challenges alongside steepening AI-related load forecasts, nuclear power is experiencing a global resurgence in interest. This was evinced by a goal set at the 2023 UN Climate Change Conference (COP28) to triple nuclear capacity by 2050. Nuclear energy can provide 24/7 carbon-free power while helping countries diversify their energy mix — a political imperative in parts of Europe following the energy crisis, heightened after Russia’s invasion of Ukraine. Technological maturity, construction costs and financing, however, must be addressed for a true nuclear renaissance. Nuclear new builds in Europe hinge on financial framework European countries, primarily those with existing reactors, are promoting nuclear energy as a key part of their decarbonization pathways. At the same time, this technology faces risky and rising investment costs of up to €15 million/MW. Interest in new nuclear comes amid increased energy security concerns, aging nuclear fleets and growing system needs for firm, low-carbon power. To mitigate these risks and attract capital, governments are seeking new frameworks to ease the burden. Interest in new nuclear comes amid increased energy security concerns, aging nuclear fleets and growing system needs for firm, low-carbon power. Tailwinds for new nuclear Europe’s 2021–23 gas and power crisis turned the spotlight on new nuclear as the only source of firm, low-carbon power that provides energy security and grid stability, is expandable at scale, curbs capital expenditure — unlike wind and solar — and has a limited physical footprint. After record French net exports in 2024, in February 2025, President Emmanuel Macron and state-owned Électricité de France (EDF), owner of the majority of Europe’s nuclear capacity, said 1-2 GW of existing nuclear capacity — and land around reactors — could feed the dynamic growth in datacenter demand, which contrasts with persistently weak domestic and European demand. Europe is expecting a partial nuclear comeback, except in countries such as Germany, Spain and Belgium, which have shut or intend to permanently close capacity. EDF’s new Flamanville 3 plant in France was connected to the grid in December 2024, though construction took 17 years. Currently, outside France, new nuclear construction totaling 6 GW of net capacity is focused on only three countries: the UK, Hungary and Slovakia. About 15 large reactors are planned for commissioning in the 2030s but have not reached final investment decisions in France — where preparatory works are progressing — the UK, the Czech Republic, Poland, Romania or Bulgaria. These new builds are crucial to rejuvenating aging fleets, and we expect the use of Western and South Korean technology. In Europe, small modular reactors (SMRs) are not yet an alternative to large-scale nuclear, despite boasting attractive features such as simplified reactor design, lower capital intensity and more flexibility to meet demand. While several SMR projects have been announced and the EU has initiated an SMR industrial alliance, these remain in the early stages of development compared with large reactor projects. Level and unpredictability of costs are major obstacles to renaissance Overnight costs, or the cost of immediate construction without factoring interest incurred, are likely to be about €10 million/MW for a new European pressurized reactor, or over €30 billion (in 2024 euros) for a pair. This is more than double the annual funds from operations of any European integrated utility other than EDF and over triple that of the largest renewable projects. The European pressurized reactor is the nuclear reactor design selected for most current large-scale new builds in West and North Europe, with reactors recently commissioned or under construction in Finland (Olkiluoto), France (Flamanville) and the UK (Hinkley Point). Its unit size is 1,600-1,700 MW. Factoring the project’s real weighted average cost of capital (WACC) raises costs by about 50%. Estimates of nuclear’s levelized cost of energy highlight its lack of cost competitiveness and high sensitivity to assumptions regarding asset life, WACC or load factors. While the levelized cost of energy does not capture nuclear’s full power system value, it is helpful to compare the economics of generating electricity across technologies. Government or customer support is vital Current funding mechanisms for new nuclear include strong taxpayer or consumer support, such as the Czech Republic’s combination of a subsidized state loan and 40-year contract for difference; the combination of state ownership and either regulated asset base support from the first day of the construction phase (e.g., Sizewell C in the UK) or state lending (e.g., Poland); or lending-only state support, as seen in Hungary. Affordability remains a constraint for regulated asset base models if new nuclear faces cost inflation and delay risks during construction, which contracts for difference do not protect against. Nuclear new-build exposures typically constrain credit quality, absent substantial burden-sharing Overall, exposure to new nuclear builds tends to constrain ratings from a business and financial perspective. New nuclear projects typically stretch corporate balance sheets for European utilities, absent considerable state or consumer support for construction, access to financing, long-term arrangements to support revenue stability and end-of-life-cycle liabilities. New nuclear projects typically stretch corporate balance sheets for European utilities, absent considerable state or consumer support for construction, access to financing, long-term arrangements to support revenue stability and end-of-life-cycle liabilities. Remedies include revenue support and WACC mitigation; the latter is much less visible from a media/society viewpoint, but can support creditworthiness until commissioning, when the new reactor starts generating strong and dependable free cash flow. New nuclear in the US: Will the tech sector take the driver’s seat? As in Europe, decarbonization challenges — such as renewable intermittency and the need for firm power — coupled with energy security concerns led to a reevaluation of US nuclear energy early this decade. Federal support to extend the life of existing US nuclear and develop additional capacity was established with the Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022, including tax incentives to bolster nuclear economics. Under the Inflation Reduction Act, production or investment tax credits are available for the construction of new nuclear. According to the act's energy community special rule, new US nuclear facilities sited in a qualifying geography are eligible for 10% tax credit step-ups, bringing overall tax breaks to 40%. These rise to 50% if domestic component thresholds are met. The fate of policies promoting carbon-free energy is uncertain under the new Trump administration. ChatGPT and related advances in generative AI followed in 2022 — the latest chapter of the Fourth Industrial Revolution — necessitating millions of square feet of power-hungry datacenter space and magnifying energy transition growing pains. A solution amid steepening load forecasts After decades of weak electricity demand growth, the boom in facilities housing the hardware and software supporting AI has taken the US energy sector by storm. S&P Global Market Intelligence 451 Research anticipates US datacenter power consumption to reach 795 TWh in 2029 — more than double 2024 levels and about 1.6 times what Texas consumes on an annual basis. While many datacenter owners have set net-zero emissions goals, rapidly growing power demand is leading hyperscalers to deprioritize clean energy requirements and seek any available power. S&P Global Market Intelligence 451 Research anticipates US datacenter power consumption to reach 795 TWh in 2029 — more than double 2024 levels. Energy developers and grid managers have markedly revised their demand expectations upward. In July 2024, the Electricity Reliability Council of Texas published a revised long-term load forecast anticipating a potential 148 GW peak load in 2030, a nearly 64% hike from its forecast of 90.3 GW in January 2024. Datacenter stakeholders have set their sights on nuclear as a result, announcing multiple high-profile deals and partnerships with energy providers and developers. Amazon kicked this off, announcing in March 2024 that it purchased a datacenter colocated with, and powered by, a portion of the 2.5-GW Susquehanna Steam Electric Station in Pennsylvania. In September 2024, Microsoft and Constellation Energy signed a 20-year nuclear power purchase agreement to restart the undamaged reactor at Three Mile Island Nuclear Generating Station, renamed the Crane Clean Energy Center, which was the site of a partial meltdown in 1979. The news led to Constellation's share price jumping 22.3% on Sept. 20, 2024. In December 2024, Meta announced a request for proposals to identify nuclear energy developers, targeting 1-4 GW of new nuclear generation capacity in the US. There are 17 announced nuclear projects in the US, including the restart of unit 1 at the Crane Clean Energy Center. In contrast with Europe, 11 of these projects involve developing SMRs, though with lead times well into the future. While the cost of electricity from such facilities is uncertain, current estimates in the US, including available tax credits, suggest SMRs could deliver power at a first-year power purchase agreement price of $79/MWh. This represents an estimated 26% premium over forecast wholesale PJM Interconnection market revenue and is competitive with recent datacenter procurement data points. US clean energy credits and carbon pricing in regions of the US and Europe also reduce the merchant revenue shortfall. Lead time gaps Nuclear's edge over other energy technologies — the ability to provide carbon-free power around the clock — complements the needs and environmental objectives of datacenters. Mismatches in development timelines, however, present challenges. For a new datacenter build in the US, the time from land acquisition to up-and-running facility generally ranges from 18 to 24 months. That compares to a midpoint estimate of six years for an SMR or light water reactor, according to the US Energy Information Administration. The latest additions to the US civilian nuclear fleet, units 3 and 4 of the Alvin W. Vogtle Electric Generating Plant in Georgia, entered commercial operation in 2023 and 2024, respectively — about 15 years after the utility received approval to expand the facility. It takes three years on average to build a combined cycle gas plant, according to the EIA, and two years to complete a hybrid solar-plus-storage project. Overall, power project development timelines are often compounded by lengthy permitting processes, including impact studies to assess grid connectivity. Once up, nuclear reactors perform well, with nuclear boasting the highest capacity factor across all energy sources. The US nuclear power fleet ran at 93.1% capacity in 2023, according to the EIA, versus 33.2% for wind and 23.5% for solar. The utilization rate for natural gas power plants has hovered around 55%. China: Steady, strong growth and a substantial pipeline China is a different story; rather than seeking a revival, it has been growing at a strong and steady clip. By the end of 2024, China's installed nuclear capacity was at 58 GW, with nuclear output representing 5% of total electricity generation. The acceleration of nuclear power development in China is being driven by consistent policy frameworks, robust supply chains and advancements in domestic technologies. Capacity additions are anticipated to exceed 40 GW during 2026–30, more than double the additions of 2021–25. This increase is primarily attributed to the approval of a substantial project pipeline totaling 38 GW over the past three years, which exceeds total global additions over the same time frame. China’s installed nuclear capacity is expected to more than triple by 2050 to reach over 260 GW. Consequently, the share of nuclear in the country’s overall generation mix is projected to double to 10% by 2050 from 5% in 2024. Nuclear energy will continue as a critical base load source in China, addressing the supply gap from the phaseout of coal. The capacity factor for nuclear power is anticipated to remain above 80% in China in the long term, enabling nuclear reactors to distribute substantial capital costs. China’s installed nuclear capacity is expected to more than triple by 2050 to reach over 260 GW. Looking forward Energy security and decarbonization have been key drivers of interest in nuclear, though current activity and plans for new builds vary by region. Whereas China has been adding new reactors, a “nuclear renaissance” in Europe and the US has yet to materialize. Unlike Europe, the US is combining more advanced SMR projects with considerable datacenter firm power needs. Interest in the US comes from the private sector responding to markets and is supported by different policy incentives. Europe’s prioritization of new, large-scale reactors creates challenges for securing stakeholders’ credit, leaving projects more dependent on public support, though it bolsters government commitments to a net-zero power sector and energy security.

#### **Fourth, Next few months are key**

***Toohill February 21 [Spencer Toohill, Adam Stein "Opportunities and Uncertainty in America's Nuclear Future" The Breakthrough Institute February 21, 2025] [thiele] [https://thebreakthrough.org/articles/opportunities-and-uncertainty-in-americas-nuclear-future] [Toohill = Nuclear Energy Innovation Analyst, MA in International Policy (2024) and her BA in International Affairs (2023) at the University of Georgia; Stein = Director of the Nuclear Energy Innovation program; Ph.D. and M.S. in Engineering and Public Policy from Carnegie Mellon University]***

On January 20th, Donald Trump returned to the White House as president, marking a new chapter for U.S. energy policy. With growing concerns over energy security, the future of decarbonization, and global competitiveness, nuclear energy sits at an important crossroads. While Trump has historically championed deregulation and energy independence, his positions on nuclear power have been inconsistent—at times supportive, yet often vague or contradictory. But there are some clear advocates for nuclear power in his inner circle. His pick to lead the Department of Energy, Chris Wright, is notably pro-nuclear. Wright, a longtime oil and gas executive, served on the board of directors of Oklo, a microreactor company, prior to his confirmation. Vice-President J.D. Vance publicly supports nuclear energy—framing it as a reliable and innovative energy solution. And Elon Musk, a long-time supporter of nuclear power but a relative newcomer to Trump’s entourage, has publicly advocated for nuclear power in an interview with Trump himself. Overall, there are solid signs for a pro-nuclear Trump administration. Trump’s campaign website includes a commitment to modernizing the Nuclear Regulatory Commission (NRC), keeping existing nuclear plants operational and investing in small modular reactors (SMRs). Subsequently, a commitment to shifting energy policy from Biden’s climate-centric priorities to a focus on energy security and competitiveness—as already seen in the pullout from the Paris climate agreement, the pause of IRA and IIJA funds, and the declaration of a “national energy emergency”—will likely privilege nuclear energy in the Trump administration. These signs are now solidified by one of Trump’s most recent executive orders to establish The National Energy Dominance Council, in which Trump has set his sights specifically on SMRs. But while Trump’s rhetoric about "rapid approvals" and nuclear modernization sounds promising, it is unclear how they will translate into action. The biggest challenge at this moment remains uncertainty. Signals from key political figures and campaign promises offer optimism for new nuclear development, but the lack of detailed policy commitments and clarity on execution leaves stakeholders grappling with questions. Will his administration support or even expand programs like the Advanced Reactor Demonstration Program (ARDP) and those building a domestic nuclear fuel supply chain? How will regulation change at the NRC? Will incentives from the Inflation Reduction Act (IRA) remain intact or be carved up under a Republican majority? Will policy and workforce changes undermine the implementation and execution of the “energy dominance” agenda? Can the nuclear industry actually make significant headway under this administration? The industry is optimistic but has already put the brakes on several projects due to uncertainty. A rapidly changing landscape doesn’t encourage investment in an 80-year asset. Until at least some of these questions are answered and policy stabilizes, announcements and PR may accelerate, but real progress will slow. Continued approval and execution of programs in DOE is critical. Alternatively, efforts to cut agency employment—a priority of the newly created Department of Government Efficiency—will slow down the federal support that the industry desperately needs. Federal funding and incentives aimed at new projects could aid deployment exponentially. However, budget priorities are non-specific and the administration is not likely to advocate for federal handouts. These contingencies—coupled with remaining indecision, implicit policies, and implied long-term goals for nuclear energy—could delay critical progress if not addressed swiftly. In short, the tone from key figures in the administration is promising for nuclear energy, but the lack of specificity and Trump’s track record of unpredictability leave much up in the air. Unpredictability is not what the nuclear sector needs to get moving and may negatively impact private investment in nuclear more than good policy can encourage it. The next few months will be critical in determining whether this moment becomes a turning point or a missed opportunity for nuclear energy in the United States.

#### **Fifth, nuclear power fills gaps renewables cannot**

***Bowen 20 [Matt Bowen "Why the United States Should Remain Engaged on Nuclear Power: Climate Change and Air Pollution" Center on Global Energy Policy at Colombia University/ June 11, 2020] [thiele] [https://www.energypolicy.columbia.edu/publications/why-united-states-should-remain-engaged-nuclear-power-climate-change-and-air-pollution/] [Senior Research Scholar at the Center on Global Energy Policy at Columbia University SIPA; Bachelor of Science degree in physics from Brown University and a Ph.D. in theoretical physics from the University of Washington, Seattle]***

Broadly accepted analysis has consistently found that total system costs for deeply decarbonized systems are lower if they include a diverse set of energy sources (e.g., nuclear power and fossil plants equipped with carbon capture and sequestration) rather than rely exclusively on renewable energy.[18] For example, in 2019, the state of Washington passed the Clean Energy Transformation Act, directing utilities toward carbon-free electricity by 2045. Studies in the Pacific Northwest had previously found that deep decarbonization was possible in the area but that dispatchable zero-carbon generation was required to meet reliability standards (i.e., avoid blackouts) and keep energy supply affordable.[19] As those studies—and others[20]—have pointed out, an underlying challenge with trying to build an electrical grid based solely on 100 percent renewable energy (an approach recommended by some papers[21]) is the variable nature of wind and solar energy. The challenge of overcoming periods of the year (days or weeks) with low to minimal solar and wind generation can be overcome in a technical sense, but doing so could lead to either an overbuild of renewable energy generation or a very large amount of storage capacity. These in turn could drive cost increases.[22] For example, one of the reports focusing on deep decarbonization in the Pacific Northwest assessed that “it would be extremely costly and impractical to replace all carbon-emitting firm generation capacity with solar, wind, and storage … Firm capacity is needed to meet the new paradigm of reliability planning under deep decarbonization, in which the electricity system must be designed to withstand prolonged periods of low renewable production once storage has depleted.”[23] A report published after the Washington state clean energy law passed concluded that small modular reactors (discussed below) could help to reduce the costs of achieving a 100 percent decarbonized electricity grid in the state of Washington by nearly $8 billion per year, in part by avoiding a large overbuild of renewables.[[24]](https://www.energypolicy.columbia.edu/publications/why-united-states-should-remain-engaged-nuclear-power-climate-change-and-air-pollution/#_edn24) In this way, new nuclear power plants could help the United States to achieve decarbonization of the power sector at lower cost compared with an approach premised solely on renewable energy. The associated concern with a large cost increase in energy prices as part of decarbonization efforts is the negative economic effect from those higher costs as well as the potential to reduce public support for strong measures to address climate change.

#### **Finally, US coal power plants kill 40,000 yearly from air pollution**

***Henneman 23 [Henneman, Lucas, et al. "Mortality risk from United States coal electricity generation." Science 382.6673 (2023): 941-946] [thiele] [https://pmc.ncbi.nlm.nih.gov/articles/PMC10870829/] [Department of Civil, Environmental, and Infrastructure Engineering, George Mason University Volgenau School of Engineering, Fairfax, VA, USA. 2Department of Biostatistics, Harvard T.H. Chan School of Public Health, Harvard Data Science Initiative, Harvard University, Boston, MA, USA]***

We conducted the longest-term national study to date estimating the excess number of deaths associated with exposure to SO2 emissions from US coal EGUs. A key innovation in this study is the combined use of coal EGU-specific exposure estimates and individual-level health data on the same population during the same time period to estimate the mortality burden. This approach has been hampered until now by the limited availability of large-scale health databases and source-specific exposure estimates. Our approach illustrates the utility of deriving air pollution exposure with a combination of dispersion-based and chemical transport models in epidemiological and risk assessment for well-characterized sources. We found that, over the past two decades in the US, coal PM2.5 was associated with 460,000 extra deaths, constituting >22% of total excess deaths attributable to PM2.5. We also found that the mortality burden of coal PM2.5 has been underestimated using traditional impact assessments that rely on CRFs for total PM2.5 mass (13, 16-18, 39-41). The elevated mortality RR associated with annual exposure to coal PM2.5 aligns with previous evidence of increased relative health risks associated with coal-related PM2.5 or sulfur or sulfate exposure per unit concentration (19-25), although other studies have found little evidence of increased risk related to secondary sulfate PM2.5 or PM2.5 associated with coal (26, 27). Large decreases in annual deaths across the study period high-light the success of emissions reductions brought about by regulations under the 1990 Clean Air Act Amendments. Although coal use in the US has remained low, global use is expected to increase and plateau by 2025 (8), suggesting the potential for high mortality costs from coal for years to come. We used SO2 emissions from coal to derive coal PM2.5; however, we cannot conclude that the portion of ambient PM2.5 associated with SO2 emissions emitted from coal power plants is more or less harmful than ambient PM2.5 from other species emitted from coal power plants. Disentangling the mortality risks of the various PM2.5 species emitted from coal EGU emissions is not possible within our modeling framework because of the high correlation between species emitted from coal EGUs such as NOx and primary PM2.5. Given how we estimate exposure to “coal PM2.5,” our finding of a higher mortality risk of exposure to coal PM2.5 relative to other PM2.5 suggests the potential for population health benefits of reducing SO2 emissions from coal power plants, for example, by installing emissions control devices or shutting coal facilities completely. Full separation of the health impacts of various emitted species from coal EGUs is of additional interest to policy-makers because of the varying technologies available to reduce EGU emissions of specific pollutants, and it should be considered in future studies. HyADS benefits from well-characterized source locations and emissions, along with the relatively slow atmospheric transformation of emitted SO2 to particulate sulfate. Expanded incorporation of information from observation and chemical transport model–based source apportionment techniques in reduced complexity models may enable linkages between emitted species beyond SO2, atmospheric processes, exposure, and health outcomes. Although source-specific PM2.5 cannot be directly measured, observation-based receptor methods for PM2.5 source apportionment (42) could provide an approximate ground truth (albeit with their own uncertainties) for evaluating modeled source-specific exposure. Advanced sensitivity approaches incorporated within chemical transport models, such as GEOS-Chem Adjoint used here, and sensitivity methods such as the direct decoupled method (DDM) (43) or the integrated source apportionment method (ISAM) (44) offer model-based approaches that more explicitly incorporate atmospheric chemistry and physics. Expanding computational capacity will make comparisons with these types of models in applications with many sources increasingly feasible. These results advance the growing body of evidence showing varying toxicity of PM2.5 originating from different sources. Although the US and other countries continue to regulate total ambient PM2.5 concentrations, entities such as the EPA Clean Air Scientific Advisory Committee have specifically cited a need for research to assess health effects associated with changes in PM2.5 composition and sources over time as an important consideration for future PM2.5 policy assessments (45). Our findings have implications for current air pollution risk assessments, which incorrectly assume equal toxicity for ambient PM2.5 from all sources and for all locations. The research platform that we used to quantify exposure associated with individual coal EGUs, which accounts for pollution transport and location relative to population centers, can support more efficient regulatory efforts by producing targeted evidence of how individual EGU sources contribute to the existing health burden.

### **CT2 Desalination**

#### **Contention Two is Desalination**

#### **First, Water scarcity is rampant and will only increase**

***Sudalaimuthu January 1 [Sudalaimuthu, Pitchaiah, Ravishankar Sathyamurthy, and Ammar Elshiekh. "Nuclear power plant waste heat opens a window of next-generation desalination hybridization: a SOAR-based review." Water Science & Technology 91.1 (2025): 1-11] [thiele] [https://iwaponline.com/wst/article-pdf/91/1/1/1520283/wst2024399.pdf] [Sudalaimuthu = enter for Advanced Energy Materials, SRM TRP Engineering College, Tiruchirapalli, Tamil Nadu 621105, India]***

Climate change, urbanization, and population growth majorly contribute to greenhouse gas (GHG) emissions and the rise in demand for low-carbon resource energy and clean water. Renewable energy resources are still struggling at the point of effective harvesting. Low-carbon emission, high-energy density, and sustainable nuclear resources are lightening nuclear power generation. Economic and safety concerns limit the usage of nuclear energy resources (Aunedi et al. 2023). Deploying nuclear energy is forced by an energy crisis. Currently, more than 10% of total electricity comes from nuclear power plants (NPPs), and in the coming days, this can increase due to new proposals (Black et al. 2023). As per the International Atomic Energy Agency (IAEA) report, up to May 2023, 410 reactors are active, 325 more reactors are proposed, and 59 reactors are under construction. Harnessing the plenteous energy is viable from NPP. 30–35% of thermal efficiency is attained during nuclear power generation (Elsaid et al. 2020). The remaining 60–70% of thermal energy is discharged from a plant by a coolant to a secondary loop. This was recirculated by cooling towers or directly discharged into the ocean, resulting in heavy thermal energy loss and damage to the ocean ecosystem by hot water. On the other hand, ocean water desalination looks at thermal drive resources for clean water production because of water scarcity. By 2030, almost 50% of the global population is estimated to reside in regions facing significant water scarcity, commonly known as water stress. Nearly 4 billion people face sanitation issues. Water scarcity and wastewater mismanagement create several threats against creatures and the environment (Barati et al. 2023). The ocean holds about 96.5% of the total earth’s water. Ocean water is potable if it removes the dissolved salt and minerals. The scientific community has put a continuous effort into this process to produce clean potables. Up to date, various desalination techniques have been implemented and commercialized, such as thermal-driven solar still (SS), multi-effect desalination (MED), multi-stage desalination (MFD), and membrane-driven reverse osmosis (RO), membrane distillation (MD), thermal vapor compression (TVC) and so on. However, the desalination process meets less than 2% of the water demand at the global level (Caldera & Breyer 2023). Rapid growth driven by water stress is predicted to reach 8% by 2025. Large-scale production and availability of energy resource crises are barriers to desalination. Several strategies are proposed to enlarge desalination plants. Among them, low GHG emissions and sustainability attract waste heat and renewable energy utilization. Therefore, hybridizing present desalination with these sources is built into next-generation desalination in a wider range. In this review, the analysis of various desalination techniques, hybridization, and NPP waste heat resource and renewable energy resource drive is based on the SOAR-based approach (Table 1). The SOAR desalination technique, as applied to the hybridization of NPP waste heat with desalination processes, involves four key parameters: Strengths (S): These refer to the advantages of internal energy efficiency and available resources, such as the waste heat from NPPs, which can be harnessed for desalination without additional significant energy inputs. Opportunities (O): This includes external factors such as combining nuclear waste heat with renewable energy sources (e.g., solar thermal energy), providing a continuous energy supply for desalination. The hybrid system addresses growing global water demand and facilitates clean water production with minimal environmental impact. Aspirations (A): These strategic initiatives aimed at improving desalination technologies, such as advancements in heat exchangers and membrane technology and the development of passive processes that reduce energy consumption and cost. Results (R): The expected outcomes include improved water recovery rates, lower operational costs, energy efficiency, and minimized environmental impact. The SOAR technique allows for continuous optimization through process monitoring and technology enhancement.

#### **Second, increased federal nuclear investment would fuel adoption of small modular reactors**

***Bowen February 25 [Matt Bowen How the Energy Secretary Can Achieve His Goal of Next-Generation Nuclear Energy Deployment Feb 25, 2025] [https://www.energypolicy.columbia.edu/publications/how-the-energy-secretary-can-achieve-his-goal-of-next-generation-nuclear-energy-deployment/] [Dr. Matt Bowen is a Senior Research Scholar at the Center on Global Energy Policy at Columbia University SIPA, focusing on nuclear energy, waste, and nonproliferation. He is also nonresident senior fellow with the Atlantic Council’s Global Energy Center. Bachelor of Science degree in physics from Brown University and a Ph.D. in theoretical physics from the University of Washington, Seattle. He has held positions at the National Academies with the Board on Physics and Astronomy, the Board on Energy and Environmental Studies, and the Division on Engineering and Physical Sciences]***

The new secretary of energy, Chris Wright, views nuclear energy as a promising option for addressing growing world energy needs while minimizing adverse environmental and public health impacts. Wright has mentioned nuclear’s high energy density, small land impact, large scaling ability, and ability to provide high temperature heat for industrial and other purposes.[i] He issued a secretarial order on February 5 that included an action item on enabling the rapid deployment of next-generation nuclear technology.[ii] Since the Department of Energy (DOE) has no regulatory role over commercial nuclear power, Secretary Wright will need to choose whether, where, and how his agency will make investments toward his goal of advancing nuclear energy. This commentary describes the underpinnings of interest in nuclear reactor designs the Nuclear Regulatory Commission (NRC) collectively calls “advanced reactors.”[iii] It then discusses two possible policy options if the secretary decides that a substantial investment in nuclear energy development is warranted: 1. negotiate an agreement with the Tennessee Valley Authority to move its Clinch River small modular reactor (SMR) project forward, and 2. partner with private high temperature reactor consortiums in the same way NASA partnered with SpaceX. Growing Interest in Advanced Reactors Nations are interested in nuclear energy for reasons that are similar to the United States (e.g., reliability, meeting load growth, low emissions) and different (e.g., energy security and reducing dependence on Russia).[iv] In Europe, for example, targets to reduce emissions are juxtaposed with energy security and cost concerns. In July 2024, a working group of entities from 11 European countries formed to focus on deployment of the GE Hitachi BWRX-300 SMR design.[v] Table 1 lists the six countries with companies in this working group that have the highest combined dependency on fossil fuels for electricity generation, as well as each country’s average price of electricity (which, in some cases, is substantially higher than it is in the United States). Small Modular Reactors But why SMRs over traditional, larger nuclear reactor designs? One advantage over gigawatt-scale light water reactors is their likely shorter construction cycles (which reduce financing costs) and smaller amount of capital required for one unit, which means utilities would not have the same level of risk in committing to construction. The possibility of financial ruin when large reactor construction projects go badly has historical precedent. South Carolina utilities spent $9 billion on two Westinghouse AP1000 reactors (1,100 megawatts [MW] each) with ultimately nothing to show for it before they were cancelled in 2017, with substantial harm to state ratepayers.[vi] Investigations into those projects would ultimately lead to four criminal convictions and sentences for the Westinghouse and South Carolina utility executives involved.[vii] Westinghouse itself went bankrupt because of the first round of AP1000 projects going over schedule and budget.[viii] AP1000s at the Vogtle site in Georgia were completed in 2023 and 2024 but at more than double the original cost and schedule; again, with harm to ratepayers in that state. Of course, it is possible first-of-a-kind SMR deployments could also go over schedule and budget, but the financial consequences would be smaller. A 2024 Idaho National Laboratory assessment found that levelized cost of electricity (LCOE) estimates for both new SMRs and new large reactors are uncertain: the differences in LCOE between the two may ultimately be very small or, in some circumstances (e.g., in environments with a higher weighted average cost of capital), may be lower for an SMR than for a large plant.[ix] Regardless, in some cases, a shorter construction cycle and smaller capital outlay for an SMR might outweigh even a higher projected LCOE given the greater financial strain and cost and schedule risks associated with a larger plant. In addition, an SMR might be a better fit to replace similarly-sized coal plants in the US and around the world compared with a large reactor—i.e., make use of the existing infrastructure at a given site—or may be better-sized for deployment to countries with smaller electrical grids. High Temperature Reactors Accelerating the availability of high temperature reactors (which are all cooled using materials other than water) could be valuable to US interests as well. These designs might have reduced capital costs compared with light water reactors, and, because of their higher operating temperatures, should be able to serve more process heat needs outside of power production. In the industrial sector, for example, the temperatures required for some processes greatly exceed what a light water-cooled reactor is capable of (e.g., 600o C or higher versus a light water reactor’s approximately 300o C).[x] Since heat is what nuclear fission produces rather than electricity as with solar PV or wind turbines, directly using that heat might be a promising business opportunity for reactor developers, especially if more industrial entities want to reduce their fossil fuel usage in that regard. Nuclear reactor and fuel company X-energy, for instance, has entered into a partnership with Dow Chemical to potentially deploy its first high temperature, gas-cooled SMR at a site in Texas (the gas that cools it being helium).[xi] X-energy’s Xe-100 reactor is designed to produce heat at around 600oC. The reactors would provide low-carbon process heat (replacing current fossil fuel use) as well as electricity. The specific facility in Texas produces material for food packaging and preservation, footwear, wire and cable insulation, solar cell membranes, and packaging for medical and pharmaceutical products.[xii] X-energy’s design uses a robust fuel form of graphite pebbles with coated fuel kernels inside that can contain fission products at temperatures exceeding 1,600o C for extended periods of time. Another high temperature reactor company, Kairos Power, is building a test-scale version of its fluoride-lithium-beryllium (FLiBe) salt-cooled reactor in Tennessee with plans to commence operations of that test reactor in 2027.[xiii] The company has also obtained construction permits from the NRC to build two reactors at the same site that will produce electricity for part of their operational lifetimes (which the first reactor will not). The Kairos Power reactor design uses the same type of robust fuel as high temperature gas reactor designs like X-energy’s, but is cooled with a FLiBe salt that does not boil until over 1,400o C and can be operated at near atmospheric pressure. It is possible that such a high-temperature, low-pressure system (utilizing a robust fuel form and high-boiling point coolant) could have lower capital costs than a light-water reactor.[xiv] AI Demand The secretary of energy has an additional reason to consider advanced nuclear energy development: the predicted surge in electricity demand coming from artificial intelligence (AI) and datacenter usage. Maintaining US leadership in AI almost certainly will require additional US power capacity, but many hyperscalers don’t want to contribute to climate change by keeping existing coal plants running longer than they otherwise would or by building new natural gas plants.[xv] Several announcements in 2024 illustrated this nexus. In October, Google and Kairos announced a partnership to deploy 500 MW of the FLiBE-cooled reactors to power Google datacenters with the first deployment by 2030.[xvi] Also in October, Amazon announced a $500 million investment in X-energy and a plan to partner with Energy Northwest in the state of Washington and Dominion Energy in Virginia to deploy a total of 320 MW (with the option to increase to 960 MW).[xvii] Finally, in December, Meta announced it would seek proposals for 1,000 to 4,000 MW of nuclear power to help it meet its AI innovation and sustainability objectives.[xviii] However, this desire to avoid emissions on the part of the hyperscalers is clearly not without limits, as Meta is also planning to power a new datacenter in Louisiana with natural gas[xix]—seemingly the alternative to nuclear for new AI demands. Given these developments align with his own stated ambition to advance nuclear power, the secretary of energy could consider how DOE might leverage these growing interests to make greater progress on nuclear energy development and enhance US leadership. DOE Policy Options While there have been positive developments in the US nuclear industry in recent years, there are no commercial reactors under construction and no firm orders from utilities for them yet either. The challenges associated with first-of-a-kind deployments of new nuclear energy technologies remain formidable, but if Secretary Wright is determined that “the long-awaited American nuclear renaissance must launch during President Trump’s administration” (per his secretarial order), those challenges have to be overcome. To support and accelerate the afore-identified developments in nuclear energy, this commentary suggests two potential policy options to the secretary that could help lower the barriers associated with first-of-a-kind reactor deployment and shorten timelines to commercial operations. The first option involves a federal utility that has been a longtime partner with DOE on SMR development and is the only utility that already holds an early site permit for SMR deployment. The second option would utilize a different public-private partnership structure than DOE has generally used in the past but one that has shown promise elsewhere in the federal government: payment-for-milestones, in this case with companies developing high temperature reactor designs. 1. Negotiate with TVA to move its Clinch River SMR project into construction The Tennessee Valley Authority (TVA) was an early awardee in DOE’s SMR licensing and technical support cost-share program and obtained an early site permit from the NRC in 2019 for SMR deployment at its Clinch River site in Tennessee.[xx] TVA has selected GE Hitachi’s BWRX-300 design for potential deployment at the site; the utility and entities from Canada and Poland have together invested a total of $400 million in the GE Hitachi reactor design.[xxi] In Canada, construction of a BWRX-300 at the Darlington site is expected to start this year.[xxii] TVA is working toward a construction permit application to submit to the NRC for the Clinch River project, and other US utilities (e.g., Duke Energy[xxiii]) have publicly stated their interest in building SMRs—but none has submitted an application to the NRC to build one yet, much less committed to construction. If Secretary Wright wants to help create another nuclear energy option for utilities to use in addressing US energy and environmental challenges, as well as a new option to be exported to other countries, he could negotiate an agreement with TVA to help move the Clinch River SMR project into the next phase. This could take the form of an agreement by DOE to purchase power from TVA’s Clinch River SMR at a higher price than it would pay for current grid electricity for DOE sites in the area (e.g., Oak Ridge National Laboratory or Y-12).[xxiv] If construction of the SMR happens in the United States after the same design is deployed in Canada, it would help to further reduce schedules and costs as well as related uncertainties and risks, thereby helping this project and any later deployments by private US utilities. Depending on the DOE-TVA negotiations and other factors, construction on the Clinch River project could begin in the next few years. The key question for the negotiations will be cost, and especially the additional costs and schedule risks associated with the first deployments, which are part of the argument for a government role. It bears mentioning that Congress has already directed DOE to support light water SMRs through the Consolidated Appropriations Act of 2024, which appropriated $900 million for this purpose.[xxv] DOE issued a request for proposals in October 2024 and applications to support SMR deployment were due by January 17, 2025. Presumably, DOE will complete this congressionally directed light water SMR cost-share award sometime in 2025. This is a separate action from what is suggested above. 2. Partner with private high temperature reactor consortiums à la NASA and SpaceX Nearly 20 years ago, with the space shuttle retirement looming, NASA initiated the Commercial Orbital Transportation Services program to partner with the private sector to develop new launch vehicles to access space and specifically the International Space Station.[xxvi] Rather than merely contract with the traditional aerospace giants for cost-plus contracts worth billions of public dollars, NASA took a chance on emerging private companies, creating a milestone-based funding program that rewarded objective achievements. Participating companies proposed a series of milestones and associated payments that NASA would pay them for achieving each milestone, and the agency selected the offers that it judged gave the public the best value for its dollars. The agency even brought in venture capital expertise to advise the program. If a company was selected but did not achieve its milestones (and one of the first companies selected by NASA did not), it did not get paid, thereby providing a measure of protection to the taxpayer. SpaceX was one of the first companies selected by NASA and ultimately emerged as the standout performer, meeting every milestone and ultimately transforming America’s position in the global launch market from one of dependence to one of dominance. Secretary Wright could pursue a similar program to accelerate advanced reactor deployment.[xxvii] The secretary could solicit proposals from industry consortiums—including hyperscalers and industrial entities—in the form of payment-for-milestones and evaluate which proposals (if any) are worth the associated public expenditures. A different tack the secretary could take would be to modify/renegotiate existing cost-share awards that were made by DOE to high temperature reactor companies in 2020 as part of the first Trump administration.[xxviii] The three largest awards for high temperature reactors were to TerraPower, X-energy, and Kairos Power (largest to smallest, respectively). The current status of these awards (how much money has been used by the private entities) does not appear to be in the public realm, but it is known that the TerraPower and X-energy agreements were not structured as payment-for-milestones. Kairos Power held out for three years while negotiating its agreement to use that structure. As mentioned, in 2024, two of those companies (X-energy and Kairos) reached agreements with hyperscalers, and TerraPower is talking with datacenter companies as well. The secretary could renegotiate these agreements to structure them all as payment-for-milestones and to add scope/milestones relevant to hyperscaler needs, for example. NASA (and the Department of Defense) also played an important role in SpaceX’s development by being some of the early customers for the company’s launch services. Similarly, DOE could assist advanced reactor developers by being an early customer (in addition to the hyperscalers and industrial entities). For example, Secretary Wright could consider offering commitments for DOE facilities to take power and heat from new advanced nuclear facilities, providing an additional incentive for new reactor construction projects. Conclusion If the new secretary of energy decides to make significant investments in nuclear energy development, he could pursue two initiatives this commentary discusses that focus on supporting and accelerating promising developments in nuclear energy. First, negotiations with TVA could advance its SMR project that has been in development but is not yet in construction, and in the process help create a new reactor option that could be deployed by US utilities and other nations. Second, Secretary Wright could partner with private high temperature reactor consortiums involving hyperscalers and industrial entities in a similar payment-for-milestones manner used by NASA with SpaceX. Both initiatives could help scale up new dispatchable nuclear energy options domestically and for export to meet growing energy demands for affordable, reliable energy while minimizing land use, air pollution, and greenhouse gas emissions.

#### **Third, SMR regulatory support will create the infrastructure to globally export SMRs**

***International Trade Commission 24 [Brian Daigle Samantha DeCarlo Nathan Lotze "Big Change Goes Small: Are Small Modular Reactors (SMRs) the Future of Nuclear Energy? U.S. International Trade Commission, Office of Industry and Competitiveness Analysis. March 2024] [thiele] [https://www.usitc.gov/publications/332/working\_papers/smrs\_fo\_ma.pdf]***

Small modular reactors (SMRs) currently represent a promising evolution in nuclear energy technology, offering a range of potential advantages compared to traditional larger-scale reactors. These compact nuclear reactors are characterized by their smaller size, which allows for easier scalability and greater flexibility in deployment due to SMRs modularity when compared to traditional reactors. SMRs, like traditional reactors decades ago, appears to hold promise across many sectors and could serve as a lynchpin in a number of areas tied to the push for green energy and combatting climate change. The adaptability of the SMRs is cited a key factor in the ability of SMRS to serve various purposes beyond just electricity generation (e.g., industrial processes, desalination plants, serve as baseload power for renewable energy sources), and the smaller scale makes SMRs potentially more manageable in terms of safety and security. There are challenges to adoption and implementation of SMR technology similar to what has been experienced over the years with the installation and maintenance of traditional reactors. Generally, for the installation of SMRs to occur many regulatory frameworks will need to be adapted to accommodate the technology unique to these newer technologies used while ensuring safety standards. SMRs require smaller upfront investment costs than conventional reactors, and adoption of SMRs into countries’ energy grids has the potential to expand the use of nuclear power and can potentially provide solutions for locations where domestic energy generation is known to be difficult or impossible. Moreover, establishing a sustained supply chain for manufacturing these reactors while simultaneously addressing public perception of nuclear power is critical for the possibility for widespread adoption. This paper begins with an introduction to SMRs, followed by an overview of some industrial markets (e.g., hydrogen generation, desalination) and locations (e.g., remote regions and islands) where SMRs could address existing gaps. There are brief country specific profiles on SMRs for United States, United Kingdom, Russia, and China, each of which have invested in research and development of SMRs. The paper ends with an exploration of the current challenges for SMR adoption, highlighting the regulatory gaps and policy uncertainty which can hinder adoption of this technology.

#### **Fourth, US SMRs are key to global desalination projects**

***Sudalaimuthu 25 [Sudalaimuthu, Pitchaiah, Ravishankar Sathyamurthy, and Ammar Elshiekh. "Nuclear power plant waste heat opens a window of next-generation desalination hybridization: a SOAR-based review." Water Science & Technology 91.1 (2025): 1-11] [thiele] [https://iwaponline.com/wst/article-pdf/91/1/1/1520283/wst2024399.pdf] [Sudalaimuthu = enter for Advanced Energy Materials, SRM TRP Engineering College, Tiruchirapalli, Tamil Nadu 621105, India]***

Desalination is the process of removing salt and minerals from sea or brackish water and making clean, potable water. It is mainly classified as thermal and membrane desalination. Both are energy-intensive due to the requirement for heat and elec- trical energy. Fossil fuel contribution elimination is essential to removing economic and environmental burdens. Due to this, alternatively, renewable and sustainable low-carbon energy sources for desalination are preferred. Compared to other low- carbon emission sources, NPP outperforms in terms of steady power supply. Need to care about the difficulty between a con- nection of the reactor, desalination, and radioactive substances. Jung et al. (2014) highlighted the advantages of small-sized reactors, thus eliminating heavy coolant and safety precautions and substantially improving inherent safety. Moreover, smal- ler residual heat, small inventory, and more practical benefits suppress the risks behind NPP. The small nuclear plants do not prioritize generating electricity, thus producing heat solely for thermal desalination. The IAEA has recognized nuclear power plants for clean water production in recent decades due to improved safety precautions and tremendous water and energy crises (Table 2). In nuclear and desalination co-generation cases, thermal energy is utilized to produce both electricity and water simultaneously, but in nuclear waste, heat utilization is not synchronized with water and electricity generation. Nuclear and desalination cogeneration practically face more complexity due to the synchronization of energy and heat distribution. Therefore, nuclear waste heat thermal desalination has a high potential for implementation. NPPs supply greater than 10% of world electricity consumption. In the current decade, safety precaution techniques development and low-carbon energy pro- duction enhance nuclear energy dependency. Typically, 60% of heat is discharged from a nuclear reactor. Utilization of waste heat to desalination minimizes the thermal discharge and environmental and economic burden. In this aspect, NPP energy is utilized to power the desalination; it is preferred for large and continuous desalination. Several studies exhibit the feasibility of coupling NPP waste heat to a desalination system. Multi-stage flash and multi-effect distillation are powered by thermal desalination. Currently, those plants are operated by fossil fuels. Requiring more energy results in increased costs and carbon emissions by these plants are high. Therefore, plants come under a weak business model and are more expensive. In this scenario, NPP will build the cogeneration system to support MED and MSF plants by the way to waste heat and elec- tricity provision. Typically, compared to membrane technologies, thermal desalination end-product quality is high. Waste heat utilization improves the MED exergy and system economics significantly. Waste heat from the powered 80–130 °C temp- erature range MED plant benefits from 34% cost savings than without waste heat utilization. Dardour et al. (2007) studies exhibit that gas-cooled reactors and pebble bed modular reactors are suitable to couple the MED clean water generation. Khalid et al. (2016) investigated a helium gas turbine-modular reactor hybridized with RO desalination. The results of the study show the amount of waste heat utilized increases exergy efficiency by 10%. Ahmed et al. (2014) ensured that gas- cooled reactors, pressurized water reactors, heavy water reactors, and boiling water reactors are feasible to couple with MED and RO desalination. Pressurized water reactors are mostly proposed for MED, MSF, and RO desalination. Therefore, the hybridization of NPP waste heat to desalination has a degree of freedom. RO desalination is powered by a high-pressure and semi-permeable membrane. Brackish salt water is passed through a semi-permeable membrane on one side due to high pressure and on the other side to obtain salt-free clean water. More electric energy is required to create pressure through pumps. Nuclear energy is used to produce steam, which is rotated by the turbine to generate electricity. In addition, NPP waste heat can be utilized for steam generation. Khamis & El-Emam (2016) investigated ultra-filtration RO–LTE nuclear-pow- ered pilot desalination. The inlet of the RO unit comes from the outlet of the LTE plant. Pre-treatment by waste heat significantly reduces RO energy consumption, improves membrane permeability and life, and increases clean water yield. RO–LTE is found to be the most competitive option. RO–LTE hybridization rectifies the RO output water quality issues and energy consumption. Compact design and technological development replaced MED and MSF desalination by RO. This technology adopted a wide range from seawater to brackish water for potable production. RO is almost considered green desalination; however, membrane, energy-intensive, and water quality concern researchers who are intensely interested in developing hybridization techniques and looking for carbon energy sources as an alternative to fossil fuel energy. This review highlights the nuclear waste heat desalination in a positive strategic manner by discussing the strengths, opportunities, aspirations, and results of RO–LTE. A hybrid desalination system is emerging in the 21st century. Nuclear waste heat with hybrid desalination technologies is getting more views. Next-level improvement and overcoming present process limitations have the potential to be satisfied through hybridization. Which is to reduce energy consumption and support meeting water demand further. Mass production and barriers to high energy consumption are key to hybridizing a desalination plant and incorporating renewable and waste heat resource drive. Typically, desalination is an energy-intensive process (Kim & No 2012). Thermal drive desalination resources are demanded. Harnessing the plenteous energy is viable from NPP. 30–35% of thermal efficiency is attained during nuclear power generation (International Atomic Energy Agency 2020; World Nuclear Association 2020; Lamarsh & Baratta 2017). The remaining 60–70% of thermal energy is allowed to discharge through the ocean. It heavily affects the ocean’s ecosystem. The temperature range of NPP waste heat is ideal for desalination (Younos & Tulou 2005; World Nuclear Association 2020; International Atomic Energy Agency 2020). Effective up-scaling and implementation of various hybrid systems are easily viable at low-carbon energy resources called nuclear waste heat. All NNPs have 60–70% unavailable waste heat; therefore, we pay close attention to coupling various options of waste heat recovery systems; among them, desa- lination is essential.

**Water scarcity causes wars and structural violence.**

Ian **James**, Dec. 28, 20**23**, LA Times, “Water increasingly at the center of conflicts from Ukraine to the Middle East” <https://www.latimes.com/environment/story/2023-12-28/water-related-conflicts-on-the-rise-worldwide>

Six months ago, an explosion ripped apart Kakhovka Dam in Ukraine, unleashing floods that killed 58 people, devastated the landscape along the Dnipro River and cut off water to productive farmland.

The destruction of the dam — which Ukrainian officials and the European Parliament blame on Russia, even though the structure was under Russian control — was one in a series of attacks on water infrastructure that have occurred during the Russia-Ukraine war.

Alongside those strikes, violence linked to water has erupted this year in other areas around the world.

In countries including India, Kenya and Yemen, disputes over water have triggered bloodshed.

And on the Iran-Afghanistan border, a conflict centering on water from the Helmand River boiled over in deadly clashes between the two countries’ forces.

These are some of the 344 instances of water-related conflicts worldwide during 2022 and the first half of 2023, according to data compiled by researchers at the Pacific Institute, a global water think tank. Their newly updated data, collected through an effort called the Water Conflict Chronology, shows a major upsurge in violent incidents, driven partly by the targeting of dams and water systems in Ukraine as well as an increase in water-related violence in the Middle East and other regions.

“It’s very disturbing that in particular attacks on civilian water infrastructure seem to be on the rise,” said Peter Gleick, the Pacific Institute’s co-founder and senior fellow. “We also see a worrying increase in violence associated with water scarcity worsened by drought, climate disruptions, growing populations, and competition for water.”

Gleick has been tracking cases of water-related conflict for more than three decades and cataloged the latest incidents with other researchers at the Oakland-based institute.

The database now lists more than 1,630 conflicts. Most of the cases have occurred since 2000, and there has been a rising trend over the last decade, with a spike the last few years.

The researchers collect data from news reports and other sources and accounts. They classify instances into three categories: where water or water systems have been a trigger of violence, used as a “weapon” or have been targeted and become a “casualty” of violence.

Not every case involves injuries or deaths, but many do.

In African countries including Nigeria, Somalia and South Sudan, fighting has erupted between farmers and herders over water sources and land.

“There have been a growing number of incidents where drought has led to violence associated with disputes over control and access to freshwater,” Gleick said.

In South Africa, protests over lack of access to clean water have turned volatile, with people burning tires and throwing rocks at police. During droughts in Iran and India, protests over water shortages have also sparked violence.

“We know that climate change is worsening severe droughts, and that makes me worry that these kinds of incidents will become more common,” Gleick said.

Parsing the mix of factors that lead to water conflicts is complicated and an area Gleick and his colleagues plan to study further — including the role climate change is playing in worsening scarcity and contributing to violence.

During the last two years, they have also seen a large increase in the number of “casualty” incidents, in which water infrastructure is targeted.

The latest additions to the database include 56 incidents from the Russia-Ukraine war, many of them involving attacks on water infrastructure.

In 2022, Russian troops bombed a water system in Kherson and a pumping plant in Chernihiv, and were blamed for deliberately cutting off the water supply to the city of Mykolaiv. Ukraine’s military also flooded lands north of Kyiv to block a Russian assault on the capital.

This year, Russian forces destroyed dams and other infrastructure, and disrupted water supplies for 35,000 people during an assault on Marhanets.

The destruction of Kakhovka Dam has eliminated irrigation for large areas of agricultural land in southern Ukraine, harming food production and the Ukrainian economy.

Many of these attacks appear to violate the Geneva Conventions and other international treaties that prohibit attacks on civilian water infrastructure during war, Gleick said.

The latest data show there have been 107 conflicts over water reported in the Middle East since the start of 2022, with about 60% of those involving incidents between Israelis and Palestinians.

In various cases in the West Bank, Israeli military forces have destroyed Palestinian-owned wells and water systems. Israeli settlers have demolished water tanks and pipes belonging to Palestinians, and seized control of wells and water sources.

And Palestinians have repeatedly clashed with Israeli troops in disputes over wells and springs, including a case in which violence erupted after troops prevented Palestinians from digging a well.

Because the researchers have yet to analyze reports of conflicts during the last six months, they don’t have detailed information about water-related violence in the ongoing Israel-Hamas war.

In the West Bank, incidents involving the destruction of orchards, irrigation systems and water tanks have been happening for years, “but it picked up a lot in the last two years,” said Morgan Shimabuku, a senior researcher at the Pacific Institute.

Elsewhere in the Middle East, there have been deadly fights over control of water sources in Yemen, bombings of water infrastructure in Syria, and clashes during protests over lack of water in Iraq.

Shimabuku said efforts to ease conflicts will require “protecting civilian water infrastructure and resources and developing water-governance structures that are just and equitable.”

Different patterns of violence have emerged in other regions. In Latin America, hundreds of environmental activists have been killed in recent years, including many Indigenous activists.

In one of the most infamous cases, Honduran Indigenous activist Berta Cáceres was shot and killed in 2016 after years of threats over her work to stop a dam project on the Gualcarque River.

There have been many more killings in the last few years. Those listed in the database include the assassinations of a Honduran activist who protested an open-pit mine in 2020, a Honduran activist who was fighting a new dam on the Ulua River in 2021, and an activist in Cuernavaca, Mexico, who had led protests over inadequate water service.

In various cases, Shimabuku said, Indigenous people have been involved in violent conflicts over water and land protection where “government-backed corporate entities are committing violence.”

“A lot of those are people protecting water, because they don’t want a dam built, they don’t want their forests to be destroyed, and their rivers to be destroyed,” Shimabuku said.

#### **Water conflicts wreck global stability and go nuclear**

Dahr **Jamail 19**, Truthout contributing writer, Board of Advisers member and former staff reporter, has won the Izzy Award and the Martha Gellhorn Award for Investigative Journalism, 2/11/19, “The World Is on the Brink of Widespread Water Wars,” https://truthout.org/articles/the-world-is-on-the-brink-of-widespread-water-wars/

The most recent United Nations Intergovernmental Panel on Climate Change report warned of increasingly intense droughts and mass water shortages around large swaths of the globe.

But even more conservative organizations have been sounding the alarm. “Water insecurity could **multiply** **the risk of** **conflict**,” warns one of the World Bank’s reports on the issue. “Food price spikes caused by droughts can inflame latent conflicts and drive migration. Where economic growth is impacted by rainfall, episodes of droughts and floods have generated waves of migration and spikes in violence within countries.”

Meanwhile, a study published in the journal Global Environmental Change, looked at how “**hydro-political issues**” — including tensions and potential conflicts — could play out in countries expected to experience water shortages coupled with high populations and pre-existing geopolitical tensions.

The study warned that these factors could combine to increase the likelihood of water-related tensions — potentially **escalating into armed conflict** in cross-boundary river basins in places around the world by 74.9 to **95 percent**. This means that in some places **conflict is** **practically** **guaranteed**.

These areas include regions situated around primary rivers in **Asia** and **North Africa**. Noted rivers include the Tigris and Euphrates, the Indus, the Nile, and the Ganges-Brahmaputra.

Consider the fact that 11 countries share the Nile River basin: Egypt, Burundi, Kenya, Eritrea, Ethiopia, Uganda, Rwanda, Sudan, South Sudan, Tanzania and the Democratic Republic of Congo. All told, more than 300 million people already live in these countries, — a number that is projected to double in the coming decades, while the amount of available water will continue to shrink due to climate change.

For those in the US thinking these potential conflicts will only occur in distant lands — think again. The study also warned of a very high chance of these “hydro-political interactions” in portions of the southwestern US and northern Mexico, around the Colorado River.

India and Pakistan

Potential tensions are particularly worrisome in **India and Pakistan**, which are already rivals when it comes to water resources. For now, these two countries have an agreement, albeit a strained one, over the Indus River and the sharing of its water, by way of the 1960 Indus Water Treaty.

However, water claims have been central to their ongoing, burning dispute over the Kashmir region, a flashpoint area there for more than 60 years and counting.

The aforementioned treaty is now more strained than ever, as Pakistan accuses India of limiting its water supply and violating the treaty by placing dams over various rivers that flow from Kashmir into Pakistan.

In fact, a 2018 report from the International Monetary Fund ranked Pakistan third among countries facing severe water shortages, This is largely due to the rapid melting of glaciers in the Himalaya that are the source of much of the water for the Indus.

To provide an idea of how quickly water resources are diminishing in both countries, statistics from Pakistan’s Islamabad Chamber of Commerce and Industry from 2018 show that water availability (per capita in cubic meters per year) shrank from 5,260 in 1951, to 940 in 2015, and are projected to shrink to 860 by just 2025.

In India, the crisis is hardly better. According to that country’s Ministry of Statistics (2016) and the Indian Ministry of Water Resources (2010), the per capita available water in cubic meters per year was 5,177 in 1951, and 1,474 in 2015, and is projected to shrink to 1,341 in 2025.

Both of these countries are nuclear powers. Given the dire projections of water availability as climate change progresses, nightmare scenarios of **water wars** **that** **could spark nuclear exchanges** are now becoming possible.

As if to underscore all of this, even the US military recently warned that climate change is a worldwide threat. The military’s Worldwide Threat Assessment report warned that climate change and other types of **environmental degradation threatened global stability** because they are “likely to fuel competition for resources, economic distress, and social discontent through 2019 and beyond.”

### **CT3 Politics**

#### **Tax cuts pass now.**

**Freking ‘4-11** [Kevin, Reporter for WDSU News, “Now That They’ve Passed a Budget Plan, the Hard Part Begins for Republicans.” WDSU, 11 Apr. 2025, [www.wdsu.com/article/republicans-budget-tax-cuts-challenges/64456119.]//neev](http://www.wdsu.com/article/republicans-budget-tax-cuts-challenges/64456119.%5d/neev)

“The American people are counting on us,” Johnson said. Rep. Tom Cole, R-Okla., said he's confident a final bill will pass with the House winning the most important tussles on the scope of taxes and spending cuts. “I will bet you they will fold rather than inflict the largest tax increase in American history on their voters,” Cole said of the Senate. “And two-thirds of them, with all due respect, aren’t on the ballot next time. ... Whereas everyone here is on the line. And our majority is much more on the line that their majority is."

#### **Nuclear energy investment drains PC.**

**Jerome** a Paris, August 22, 20**24**, “Why fans of nuclear are a problem today” <https://jeromeaparis.substack.com/p/why-fans-of-nuclear-are-a-problem>

Nuclear energy has been great. In many places, it has produced relatively cheap electricity and (although we did not care about that when it was built) it is largely carbon-free. It still works, but it is simply no longer competitive against available alternatives, and it is going to be increasingly difficult to integrate in a system that is inexorably dominated by solar energy during the day and other renewables. (see for instance this recent academic study). In any case, it is not financeable, and given the large amounts required for each plant, they will struggle to get built, even with large-scale state support.

If a few nuclear plants could easily be built on budget and on time in a given system, it would not be an issue, but the problem is that (i) a lot of the energy of its proponents is directed at maligning renewable energy, presenting it as unserious and insufficient (arguments of the “you can’t do vital surgery if there’s no wind” type which ignore how grids work), and (ii) more importantly, nuclear swallows an incredible volume of political capital that could better be used for other purposes, like energy efficiency, upgrading the grid or reducing fossil fuel use outside the electricity sector.

Politicians like these very large, multi-billion-euro projects that seem to solve an issue in one go, and can be forcefully and visibly decided by a handful of large-ego persons like themselves. They don’t understand (or hate) the very decentralized and uncontrollable nature of renewable energy systems, that require complex rules and don’t give them the same publicisable impact on things. Nuclear provides a concentrated nexus of jobs, TV opportunities, and VIP meetings with big stakes. So they are easily convinced by proponents that this is what is needed.

And thus we get endlessly repeating “decisions” to build new nuclear plants, to be executed over the next 20 or 40 years, and which increasingly resemble fusion energy - always 20 years away. This is because the underlying arithmetic unfortunately no longer works, and nobody is actually willing to sink the billions, or pay the inflated tariffs, that are required to get the plants of the ground - and that’s before delays and cost overruns hit (and obviously nobody sane will agree to be responsible for these in advance).

If nuclear made sense, Microsoft or Amazon or Rio Tinto would finance the construction of a few plants to feed their ever growing appetite for reliable carbon-free energy… In reality, despite all the high-powered attention, ridiculously few new nuclear plants are being built compared to new renewables, even in China. Nuclear is at best irrelevant and at worst a distraction…

This would be harmless if it did not occupy the limited time that senior politicians have to spend on the topic of energy, and get them to spend their political capital on these projects that end up going nowhere. It also means that they don’t understand what is actually happening in the energy sector in the meantime, and don’t work on the new policies that are needed to make sure that ongoing (unstoppable) transition to renewables is done more smartly and efficiently.

Nuclear proponents do understand the energy system a bit better, and they certainly see that renewables are eating their lunch (typified by the switch in discourse, beyond the “it’s ugly” and ‘what do you do when there’s no wind” arguments, from “it’s too small to matter” to “it cannot do 100% on its own”) and thus they need to attack and criticise renewables to make it appear that nuclear is still necessary or relevant.

In that - continuing to denigrate renewables, and capturing too much political attention, nuclear proponents achieve only one thing - slowing down the transition to renewables, and making it more expensive than it could be because regulatory changes are not made. They have effectively become the useful idiots of the fossil fuels industry which they still occasionally claim to fight.

And, to conclude, a fun fact that seems ignored by most: France has lost more annual kWh from nuclear than Germany since 2011, which closed its plants. Maybe the blame for weakening the nuclear case should go to France rather than Germany?

#### **Political capital necessary for tax cuts**

**Neiffer ‘3-24** [Paul, Journalist for AgWeb, How Your Income Taxes Will Change This Year. 24 Mar. 2025, https://www.agweb.com/news/business/taxes-and-finance/how-your-income-taxes-will-change-year]//neev+thiele

The Trump tax cuts, officially known as the Tax Cuts and Jobs Act (TCJA) of 2017, have been a topic of significant debate since their inception. It appears the Republicans might have enough political capital to both extend the TCJA and enact additional tax cuts that could help farmers.

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#### **Tax cuts ensure space col.**

Ross 18, American businessman who served as the 39th United States Secretary of Commerce from 2017 to 2021 (Wilbur, “Remarks by U.S. Commerce Secretary Wilbur L. Ross at the Aerospace Industries Association Board of Governors Meeting,” Department of Commerce, https://2017-2021.commerce.gov/news/speeches/2018/11/remarks-us-commerce-secretary-wilbur-l-ross-aerospace-industries-association.html)

Good morning, and thank you for the warm introduction. Today is an exciting time for *aerospace* industries in America. The economy is strong. *Tax cuts* and deregulation are maximizing business opportunities and creating jobs. And domestic manufacturing is growing at an unprecedented rate.

Over the last year, U.S. manufacturing added well over 300,000 jobs, the most since 1995. Under the Trump Administration, America is open for business once again. And at the Department of Commerce, we’re always working to support U.S. industry.

Our toolkit is quite broad. Our work to help American enterprise reaches from the depths of the oceans *to the vast frontiers of space*. When I was sworn in as Secretary almost two years ago, I knew the Department had a broad portfolio. From trade policy, to standards and technology, to the weather service and Census bureau — I knew we’d be pretty busy. But I must admit that even I was surprised by the amount of time dedicated to the FISH.

In my first few months in office, I spent countless hours dealing with regional fish councils, environmental groups, fishermen, and the large fish lobby. You wouldn’t believe how much congressmen care about fish — sometimes I wonder if the fish can vote!

But in all seriousness, our team at Commerce does important work — from the seas to the skies — to help the American people. The recent efforts of Commerce’s National Oceanic and Atmospheric Administration are a good example. This past summer, during Hurricane Florence, NOAA’s 5-day hurricane track predicted the storm’s landfall within 2 miles. It was a record unlike any before. Our hurricane hunters team utilized a combination of drone submarines, the new GOES-S weather satellite, and other modern technologies to more accurately collect and monitor weather data.

Thanks to technology advancements – many driven by commercial support – we are generating more accurate and early weather forecasts. This enables state governors to more quickly declare emergencies, order evacuations, and save lives. The GOES-S weather satellite scans the Earth five times faster, at four times the image resolution, with triple the number of channels than older GOES spacecraft.

Satellite technology is redefining the world as we know it. And as a result, business today looks far different than in generations past. That’s what I’d like to focus on this morning. For an Administration that boasts the world’s fastest growing major economy, space is truly the next frontier.

And you all are leading the way.

U.S. Aerospace companies continue to set the standard for human achievement and innovation — *push*ing the *bounds* of commercial success and supporting the United States’ position as the global leader in space.

Today there is a new space race — but this time, it is being run in the private sector. Companies are pushing one another to impressive new heights. The global space economy now totals almost $400 billion – already up from the $340 billion statistic I was using when I started this job. About 80% of that total is commercial. I believe we can reach $1 Trillion far sooner than most people realize. But it’s going to take the people in this room to get us there.

At the Department, we have an effective approach to aid in this effort. It involves 4 key principles: Advocacy; Regulatory Reform; Industry engagement; and Mission Support.

Commerce continues to promote and advocate for the U.S. space industry with foreign governments around the world. Our International Trade Administration’s Advocacy Center currently has 21 space sector cases valued at $2.83 Billion. Since 2010, we’ve recorded 24 project wins for space companies across the globe valued at more than $4.3 Billion.

In the broader aerospace/defense area, we’ve helped companies win 61 major contracts with foreign governments between October 2016 and September 2018. The wins value over $79 billion. We’re also continuing to host events that connect industry with capital investment, export opportunities, and new customers.

This past summer we debuted a space commerce segment at our SelectUSA Summit – thanks in part to the help of Virgin Galactic, Lockheed, and others. The summit welcomed some 3,000 business and government leaders to discuss foreign investment opportunities in America. My team and I have also been meeting with dozens of stakeholders to discuss the challenging issues facing their commercial space activities, not the least of which is burdensome regulation.

Commerce is conducting a regulatory reform that will unshackle the commercial space sector and unleash economic growth. As many of you know, last year we signed an interagency MOU that established concrete review deadlines and elevated decision-making when timely resolutions are not achieved. As a result, the Department’s commercial remote sensing office expedited its licensing timelines.

In 2016, the average time to obtain a license was over 140 days. Today that average has dropped to 62 days – and we are still improving. We are also working on new regulations that, if finalized, will revolutionize the way we regulate the use of cameras in space.

This past August, after soliciting feedback from stakeholders on the existing regulations, my team got to work. In just 2 months we drafted a new remote sensing rule and submitted it to OMB for final interagency review. We look forward to getting it out for public comment very soon. I can’t say too much before the rule is out for comment, but I can tell you this: we didn’t just make modest revisions.

We started from scratch. The existing regulations are decades old and needed to be rewritten. Regulation of space activities today should not be a “one size fits all” approach as space activities quickly transform in purpose, size, and capabilities. Rather, the new rule would establish categories for license applications that exempt certain pre-approved activities from the lengthy review process if they are determined to not reach a heightened security threat threshold.

In other words, the “Go-Pro-Like” cameras used by SpaceX and other companies — for marketing and showing customers successful stage separations — probably will not be treated the same as advanced sensing cameras that can see our shoelaces from space. This approach would allow the Federal government to focus its efforts on proposals that truly warrant national security attention.

The new framework would also be “living” regulations that require Executive Branch agencies to periodically revisit category criteria for the differing license review processes. We will better accommodate rapid technology advancements and regulate for the future, not the past. Proactive, not reactive. Rules that enable, not disable.

I’m also pleased to report that Commerce recently submitted to Capitol Hill a new legislative proposal from the Administration – the SPACE Act. As directed by the President’s Space Policy Directive 2, the proposal calls for creating a consolidated new Bureau of Space Commerce. The Bureau will report directly to my office and coordinate all of the Department’s space efforts.

The Bureau of Space Commerce will devote additional resources to supporting a wide range of new space activities – tourism, manufacturing, on-orbit servicing, prospecting, and space situational awareness, to name a few. To be clear, the proposal should not be mistaken as expanding government. Just the opposite. Working in concert with our Regulatory Reform Officer, the Bureau will better coordinate and consolidate functions across the Department.

We are going to make life easier on all of you. And the office will be comprised of a lean team of experts, bolstered by internal and external detailees. We look forward to working with Congress to see this much-needed storefront for industry become a reality.

As prioritized in the Department’s Strategic Plan, advancing commercial space is a whole-of-Department initiative. We have already begun laying the foundation for this “one stop shop.” Our new space team, representing all Commerce offices and bureaus, meets weekly and collaborates on ways to advance this growing economy.

Our Bureau of Industry and Security is actively engaged in White House-led interagency discussions on export control reform. And we continue working on holistic spectrum management policies that will advance the far-reaching commercial space missions envisioned by President Trump and Vice President Pence. Even our grant-making agencies are focused on space.

Last month, the Minority Business Development Administration awarded a small grant to the Space Foundation to assist minority businesses supporting the industry. Our Economic Development Agency has also supported several commercial space initiatives through its Office of Innovation and Entrepreneurship. And our Office of Space Commerce is reinvigorated. The Office will host an investment summit next month to unite large-scale lenders with key industry participants. If we are going to get to *$1T*, significant financing at all levels of capital structure will be essential.

Finally, as many of you know, the President and National Space Council in June directed Commerce to take on a new role in Space Traffic Management and Space Situational Awareness. We’ve been working very closely with the Department of Defense to take on this responsibility. Our senior space officials spent time at Vandenberg Air Force Base and in Colorado Springs to more deeply understand DoD’s existing operation and capabilities.

I’ll be heading up to Vandenberg later today. I’m very excited about it… though perhaps not the terrestrial traffic between here and there. If any of you have handy reading materials to lend me for the car ride, please let me know.

We’ve forged a strong alliance with DoD, the U.S. Air Force, and especially U.S. Strategic Command. As part of this partnership, we will soon assemble a cadre of Commerce employees to work at Vandenberg as we become the civil agency interface for industry on SSA-STM.

We are also meeting regularly with the companies poised to provide tracking, analysis, and safe coordination of objects in space. By tapping into industry expertise, we aim to provide basic STM/SSA services that more accurately track objects in space. Even the very small ones. Today the government can track and provide warnings for 10cm objects in space. We’d like to get that down to 2cm.

To improve basic SSA data, Commerce must act more like a business ———Nimble and adaptable.

We’re already investigating ways to incorporate cloud computing and other advanced technologies, into an “open architecture data repository.” This will showcase innovation beneficial to the entire U.S. SSA/STM enterprise. And we see opportunities to incorporate more automation, launch vector analysis, and crash probability algorithms into the operation. A safe and sustainable space environment is vital to business.

The topic of the $1T space economy isn’t a pure invention -- several assessments envision rapid growth between now and 2040. One estimate from Bank of America places the space economy near $3T by that timeframe. Next week I’m giving a talk at the Chamber of Commerce Space Summit titled “How do we get to $1 trillion dollars.” Maybe I’ll see some of you there.

For the rest of you — here’s the cliff notes version: The first element is continued disruption and innovation in “traditional” commercial models in areas like remote sensing, navigation, and even weather. Positive disruption in technology for mapping, agriculture, and insurance are rapidly expanding both the terrestrial and space economies. Commercial entities are collecting new phenomena and using novel platforms to gain unique information.

Location based services are expanding, and more precise weather predictions are helping farmers, shipping routes, and pilots. GPS has redefined the economy accounting for over $60 billion in indirect economic benefit. And that’s just what we are able to currently measure. Many of you have already used satellite technology today to get here in a car, communicate with a family member, or keep from getting lost on your morning run. It’s a wonder how we got around before smart phones.

Second, we are going to need a robust finance and insurance environment for space industry to get to $1 Trillion. There continues to be *strong* and growing financial support for the space industry. But one of the missing components of space finance are the bigger institutions — banks — whose participation will be necessary to achieve longer-term commercial plans.

To return to the Moon and get to Mars, large-scale financing at all levels of capital structure will be needed. To this end, the Department is hosting the Space Investment Summit on December 12 to bring the entire capital spectrum into the discussion.

#### **Asteroid deflection**

Daniel **Deudney** **20**, Political Science Professor at JHU, 12/29/20, “Superpower Restraints, Planetary Security, and Earth Identity,” in Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity, p. 250-1, DOI: 10.1093/oso/9780190903343.001.0001 [language modified]

The essence of the deflection dilemma is simple: species and civilizational survival inevitably will **eventually require** the development of the ability to **deflect asteroids** and comets away from Earth, but this technology also inherently creates the **possibility** that such objects could be **directed toward the Earth**. The **existential stakes** are clear: “the **destructive energy** latent in a large near-Earth asteroid ~~dwarfs~~  [outclasses] anything else the human species can get its hands on,” making them potentially “the **most powerful w**eapon of **m**ass **d**estruction ever devised”71 (see Table 7.4.A and B).72 Once the population of these bodies is fully mapped, and technologies to deflect them are developed, Sagan argues, the prospects for **collision** increase over the **natural rate** due to the possibility of **intentional bombardment**. Given these possibilities, **perhaps the reason the dinosaurs lasted for nearly two hundred million years is because they did not have a space program**.

In his major book on the human space future, Pale Blue Dot, Sagan lays out several scenarios for intentional collisions. His arguments are essentially the arguments of nuclear arms controllers. Madmen exist, and some “achieve the highest levels of political power in modern industrial nations.”73 Recalling the extreme destruction caused by Hitler and Stalin, Sagan posits the possibility that a “misanthropic psychopath” or a “**megalomaniac lusting** after ‘**greatness’** or **glory**, a **victim** of **ethnic violence** bent on revenge, someone in the grip of **severe testosterone poisoning**, some **religious fanatic** hastening the **Day of Judgment**, or just some technicians **incompetent** or **insufficiently vigilant**” will bring about a **catastrophic collision**.74 Earth-approaching asteroids amount to “**30,000 swords of Damocles** hanging over our heads,” for which “there is no acceptable national solution.”75 And, like Cole and Salkeld (not mentioned), Sagan points to the possibilities of clandestine use of this technology.

Sagan’s solution to the dilemma is to be found in the fact that “the timescales of the two dangers are different.”76 The natural threat is long term, while the **human-made** threat is potentially **short term**, and so **delay** in both mapping and deflection technology is **prudent**. Delay should occur until “the reliability of world political organizations” and the “confidence they inspire” have made “significant strides,” permitting them to be “trusted to deal with a problem of this seriousness.”77 But because deflection must eventually occur if humanity is to survive, the asteroid threat provides a “potent motivation to create effective transnational institutions and to unify the human species.”78

Sagan’s argument for **delay** and extreme caution hinges on political claims about the **limitations** of the **international system** and of states in **restraining the use of violence**, and about the **potential viability** of world institutions. Danger of use **arises** because **rival**rous state**s** are likely to **weaponize asteroids**, as they have done with so many other militarily significant capabilities, and because hierarchical and secretive states are prone to reckless and aggressive behaviors.