# **Goat Neg**

#### **This is not a debate about whether nuclear energy is good or bad. This is a debate about whether or not the world would be better off if we kept our current approach with nuclear energy or if the Trump administration suddenly took the reins. The thesis of our case is that most things, including nuclear energy, are better off not being rushed by a narcissistic felon. Regardless, nuclear energy is booming right now. Obando 24**

**Obando 24** [Sebastian Obando, 11-24-2024, “Data center boom fuels demand for nuclear projects”, Utility Dive, https://www.utilitydive.com/news/data-center-boom-fuels-nuclear-construction-projects/733603/] //bid daddy yerg

**Tech giants are increasingly turning to nuclear power to meet the growing energy demands of the data center boom.**  For example, recent projects include **Amazon’s funding of four small modular reactors in Washington state, Google’s agreement with Kairos Power to develop small modular reactors by 2030 and Microsoft’s power purchase agreement to restart Three Mile Island Unit 1, a nuclear power reactor near Harrisburg, Pennsylvania**, that was shut down in 2019. That connection between data centers and nuclear power plants should continue to strengthen, said Gordon Dolven, director of data center research at CBRE, a Dallas-based commercial real estate services firm. “**This role is expected to grow, especially with advancements like small modular reactors**,” said Dolven. “**[These] offer scalable and flexible solutions to support future energy needs.” Integration of nuclear energy into tech companies’ operations offers new opportunities for contractors with specialized experience**, said Fluor CEO David Constable during the firm’s third quarter earnings call. Constable recently identified small modular reactors as a key growth area, saying “**there’s a strong appetite for nuclear energy to meet incredible demand for power globally.**” He noted that “**interest has never been greater.**” SMRs offer significant advantages for contractors during the construction phase. Their modular design simplifies construction, reduces timelines and requires less land compared to traditional reactors, according to an Amazon news release. **This makes SMRs particularly well-suited for powering data center operations, which demand reliable, around-the-clock energy to support artificial intelligenc**e, said Dolven. “There is growing interest in placing data centers near nuclear facilities. This is driven by the need for a reliable, 24/7 power source to support the growing demand for data centers, especially with the rise of AI workloads,” said Dolven. “**Nuclear power offers consistent energy with zero carbon emissions, aligning with both operational and sustainability goals.” Although expensive to build, nuclear power plants also offer relatively low operating costs for data center operators, according to the U.S. Energy Information Administration.** That makes them an attractive option for tech companies aiming to power energy-intensive data centers while meeting emission reduction targets. Upcoming projects Amazon agreed in October to fund four SMR construction projects in Washington state in partnership with Energy Northwest. The plant will generate 320 MW in its first phase. “It’s an important area of investment for Amazon,” said Matt Garman, CEO of Amazon Web Services, in a news release. “Our agreements will encourage the construction of new nuclear technologies that will generate energy for decades to come.” Similarly, Kairos Power, a nuclear technology, engineering and manufacturing company, will develop, construct and operate a series of advanced reactor plants as part of its agreement with Google. **The first SMR is set to be deployed by 2030, with plants strategically located near Google’s data centers, according to Kairos. In Pennsylvania, Microsoft also entered into a 20-year agreement with Constellation Energy to purchase power generated by the Crane Clean Energy Center, formerly known as Three Mile Island Unit 1. T**he deal will supply Microsoft’s data centers in the region, and includes significant investments to restore the plant, such as the turbine, generator, main power transformer and cooling and control systems.

#### **The days of fossil fuel dominance are coming to an end. Bremmer 25**

**Bremmer 25** [Ian Bremmer, Founder and President of Eurasia Group and GZERO Media, is a member of the Executive Committee of the UN High-level Advisory Body on Artificial Intelligence, 2-11-2025, Trump Will Not Kill the Global Energy Transition, Project Syndicate, https://www.project-syndicate.org/commentary/trump-will-not-kill-global-energy-transition-by-ian-bremmer-2025-02, accessed 3-29-2025.] //aayush

NEW YORK – Donald **Trump’s return to the White House has raised fears that the global energy transition will be thrown into reverse**. The US president has vowed to “drill, baby, drill,” roll back environmental regulations, and end the “green new scam.” **As Earth continues to warm – last month was the hottest January on record, and 2024 was the first year with global average temperatures exceeding 1.5° Celsius above pre-industrial levels – many worry that we are about to witness a worldwide slowdown in the shift away from fossil fuels**. But **Trump couldn’t kill the green transition during his first term, and he can’t kill it this time, either**. The reason is simple: **Technological breakthroughs, steep learning curves, and plummeting costs have made clean energy cheaper than fossil fuels in most places**. Moreover, the revolution was just getting started in 2017, whereas now **it has reached escape velocity. Its momentum is being driven not by politics or government intervention, but by markets**. The fact that **deep-red** (Republican-leaning) **Texas leads the United States in renewables deployment is a case in point. Politics will no longer hold back the American energy transition.** This is not to say that politics won’t slow the US transition. The Trump administration is already taking steps to loosen environmental and climate regulations, promote domestic oil and gas production, support gas-fired power plants, and end incentives to adopt clean energy and electric vehicles (EVs). The president’s day-one executive orders expanded the federal lands available for oil and gas exploration, reversed former President Joe Biden’s suspension of approvals for new liquefied natural gas terminals, and paused new wind projects on federal land and coastal waters. Aided by Republican majorities in Congress, Trump will seek to repeal roughly half of the Inflation Reduction Act’s outlays, including its provisions supporting EVs and offshore wind, as well as the IRA’s investment and production tax credits. Yet **that will not be enough to halt the forward movement of the US energy transition. Despite Trump’s claims of a “national energy emergency,” the US has been a net energy exporter since 2019 and already produces more oil than any country in history. Yet with prices low and US oil and gas output already at record levels, fossil-fuel production will struggle to rise much higher in the near term**, regardless of what Trump does. **The deployment of clean energy will therefore continue, driven by increasing power demand and declining costs – especially for solar**. American electric utilities will still invest aggressively in renewables to keep pace with rising energy use and ensure grid adequacy, even as new gas-fired power plants expand, too. US **automakers will not abandon their long-term EV plans just because the Trump administration has eliminated subsidies** and canceled funding for charging infrastructure. Besides, **Democratic-controlled states will continue pursuing ambitious standard-setting decarbonization policies, as they did during Trump’s first term**. Perhaps more importantly, **meaningful parts of the IRA will remain in place because of their political support with Republican constituencies**, which have benefited disproportionately from the new investments and job creation. Next-generation clean-energy technologies – **nuclear, geothermal, and carbon capture and storage – will continue receiving support**. As for the energy transition abroad, the implications of America’s retreat from global climate leadership will be significant, but not fatal. **Trump’s decision to withdraw the US from the Paris** climate agreement (again) **and withhold funding from the United Nations Framework Convention on Climate Change will reduce climate-finance flows for emerging economies**, dampening their enthusiasm for accelerated climate action and encouraging some (like Argentina and Indonesia) to follow Trump’s lead. **But just as the US transition is unstoppable, so, too, is the global transition**. Other industrialized countries will remain broadly committed to the Paris climate agreement and subject to the same market forces that are driving developments in the US. **Europe views the energy transition as a way to reduce its import reliance and improve its energy security. India, the world’s fastest-growing emitter, sees decarbonization as an economic opportunity and a necessary step to reduce some of the world’s worst air pollution**. And most other emerging markets are eager to accelerate their renewables deployment for purely economic reasons. Most critically, **China** – the largest source of global emissions – **is set to reach peak emissions five years ahead of its previously stated 2030 target**. Chinese manufacturers of solar panels, EVs, and batteries already dominate global supply chains and will not abandon their ambitions to expand simply because of changes in US demand or market access. If anything, they see the Trump administration’s policies as an opportunity to gain global market share, speeding adoption of these technologies and driving further price declines. While the US falls further behind China in clean energy, the continuing decline in renewable power costs will encourage more emerging markets to choose domestic solar and wind over volatile imported fossil fuels. **The economic and technological forces driving the clean-energy revolution have simply become too powerful for any single country or political leader to stop. The global energy transition will power forward, even if the road ahead includes a few more bumps**.

#### **Thus, market share is expected to grow significantly in the long term. Maguire 25**

**Maguire 25** [Daniel Maguire (Research Analyst, Autonomous Technology & Robotics), 3-18-2025, "Can The US Triple Its Nuclear Capacity By 2050?", Ark Invest, https://www.ark-invest.com/articles/analyst-research/can-the-us-triple-its-nuclear-capacity-by-2050] //bid daddy yerg

**Hyperscalers like Microsoft, Google, and Amazon are catching the nuclear energy wave in an attempt to meet the rising power demands associated with Artificial Intelligence** (AI).2 Commitments to net-zero carbon emissions have spurred new and renewed interest in nuclear energy, as shown below. ARK’s research suggests that the US must deploy microreactors, Small Modular Reactors (SMRs), and large-scale reactors to triple nuclear capacity by 2050. **For fifty years, excessive regulation has hampered the development of nuclear energy, leading to cost overruns and delays. Our research shows that regulatory hurdles instituted during the 1970s3 derailed the decline in US nuclear construction costs projected by Wright’s Law.4 That regulatory derailment has deprived the US of its share of global nuclear construction projects—with none currently underway—while countries like China are expanding their nuclear capacity aggressively, as shown below. Today, the US nuclear industry is beginning to revive and could be on the threshold of a renaissance**. In July 2024, the ADVANCE Act directed the Nuclear Regulatory Commission (NRC) to streamline licensing,6 and now the Department of Energy (DoE) is investing billions in nuclear energy. Meanwhile, as AI boosts demand for power, hyperscalers like Meta Platforms, Alphabet, Amazon, and Microsoft seem willing to pay higher rates for power purchase agreements (PPAs)7 to fund first-of-a-kind (FOAK) designs. As risk capital encourages new designs and regulators lower hurdles to innovation, Wright’s Law suggests that the cost competitiveness of nuclear power will be restored, ultimately lowering electricity prices and reigniting the powerful trends aborted by regulation in 1974.8 **To triple capacity by 2050, the US must add ~200 gigawatts (GW) of nuclear power. By 2035, the US plans to deploy 35GW and then add 15GW per year by 2040.9 Some older reactors may restart,10 but advanced reactors are likely to be the primary path to expansion, as shown below.** Moreover, the US must invest heavily in the nuclear supply chain to reduce reliance on Russian imports.11

#### **Unfortunately, almost every instance of government involvement has backfired, and nuclear energy stands to be another chapter. De Rugy 15**

**De Rugy 15** [Veronique De Rugy, George Gibbs Chair in Political Economy and Senior Research Fellow at the Mercatus Center at George Mason University and a nationally syndicated columnist. Her primary research interests include the US economy, the federal budget, taxation, tax competition, and cronyism. Her popular weekly columns address economic issues ranging from lessons on creating sustainable economic growth to the implications of government tax and fiscal policies. She has testified numerous times in front of Congress on the effects of fiscal stimulus, debt and deficits, and regulation on the economy, 3-24-2015, Subsidies Are the Problem, Not the Solution, for Innovation in Energy, Mercatus Center, https://www.mercatus.org/research/federal-testimonies/subsidies-are-problem-not-solution-innovation-energy, accessed 3-18-2025.] //aayush

The **Obama** administration’s FY 2016 budget **asks for a 42 percent increase in funding for the Department of Energy’s Office of Energy Efficiency and Renewable Energy** (EERE) and its portfolio of programs. Yet **more than 40 years after President Richard Nixon announced “Project Independence”—to wishfully wean the American economy off oil and decades of federal involvement in efforts to develop “alternative” energies—we are once again discussing how many more taxpayer dollars should be thrown at the alternative energy wall in the hopes that something will finally stick**. Far from suggesting that alternative energies aren’t welcome or desirable, I believe that it’s time for policymakers to recognize that **allowing the marketplace to determine winners and losers is preferable to a politicized, top-down approach that has produced more black eyes than benefits**. These black eyes belong to both parties and extend well beyond Solyndra and the ill-fated 1705 energy loan program, which has become a symbol of the problems with federal involvement in energy markets. Indeed, a **short list of the federal missteps over the years would include so-called clean coal, the Synthetic Fuels Corporation, the Clinch River Breeder Reactor, National Ignition Facility, Superconducting Super Collider, FutureGen, Partnership for a New Generation of Vehicles, FreedomCAR, and the Yucca Mountain nuclear waste repository mess**. I would argue that the most important consideration today should not be whether the Obama administration wishes to spend too much on EERE programs. (It does.) Nor should it be to figure out which special-interest squeaky wheels should get the most grease. What I believe **we should be discussing** is **whether these subsidy programs should exist at all**. I would argue that **EERE programs should be abolished, along with all other energy subsidies**—including those that benefit fossil-fuel production—because 1) **government lacks the incentives to manage funds that private investors have**; 2) **giving subsidies to some businesses puts other businesses that do not receive such subsidies at a disadvantage, distorting investment and other economic activity**; and 3) **the existence of government subsidies increases the incentive to lobby and the power of special interests**. GOVERNMENT LACKS THE PROPER INCENTIVES Even with the best of intentions, **elected officials and bureaucrats simply do not possess the proper incentives to manage taxpayers’ money prudently**. They are not rewarded when they maximize consumer value; nor are they punished when they take unnecessary risks or fail to minimize costs. **Government actors operate with limited knowledge**. While individuals acting in markets are able to use price signals to guide their decisions. **When a private company fails, the owners and its investors lose**. **Government decision makers have no such guide**. They have no way of accounting for the value or costs of their decisions. And **when the government fails, taxpayers lose. Subsidies are justified as being necessary to encourage the development of alternative energies** because the private sector is unwilling to undertake the risk necessary for their development. The truth is that **private investors should avoid throwing scarce dollars at endeavors that do not make economic sense**. Instances where the private sector will not invest signal that it would also be a bad idea for taxpayers to “invest.” Policymakers who believe that entrepreneurs and venture capitalists are investing insufficiently in new technologies should focus their efforts on reducing the federal tax burden on businesses and investment rather than attempting to subsidize specific firms, industries, or technologies. **Lowering the tax burden is more likely to result in higher economic growth, innovation, and job creation**—**the same canned justification that policymakers often fall back on to justify subsidy programs**. It is amazing that many of the policymakers who believe that the private sector needs the government to fill this mythical investment gap are the same ones who want to further tax the rewards of investment, and support sending the money to agencies like EERE that fund the research and development of commercial products. Advanced research and development subsidies are a form of corporate welfare because the **rewards end up going to private interests while the costs are borne by taxpayers**. This cycle of “tax and subsidize” is **just another example of the government robbing Peter to pay Paul**. Policymakers like to tout Paul’s “success stories” when defending energy subsidies, but somehow Peter escapes acknowledgement. **SUBSIDIES DISTORT ECONOMIC ACTIVITY** Policymakers justify energy subsidies by arguing that they are needed to fix alleged imperfections in the marketplace. The **imperfections**, however, **are typically short-term issues** (e.g., oil price spikes) **that the marketplace will address—if allowed**. **Policymakers often rush to address short-term concerns with government interventions, including subsidies, which end up distorting economic activity and generating failures of their own**. The problem is compounded by the reality that policymakers usually have political and parochial interests in mind when creating and sustaining subsidy programs. When government intervenes, 1) **subsidized firms get an unfair competitive advantage over firms that do not receive a government subsidy**, and 2) **policymakers**, instead of the market, **pick winners and losers**. Unseen Losses of Unsubsidized Competitors By aiding particular businesses and industries, **subsidies put other businesses and industries at a disadvantage.** This market distortion **generates losses to the economy that are not easily seen and thus generally aren’t considered by policymakers**. For example, **energy companies that don’t receive a government subsidy are disadvantaged when they compete against companies that do receive government backing**. A company or entrepreneur with a superior product or technology might never reach the market because they didn’t have access to government handouts. **The result is a diversion of resources from businesses preferred by the market to those preferred by policymakers, which leads to losses for the overall economy**. The Cost of Policymakers Picking Winners and Losers **When the government starts choosing industries and technologies to subsidize, it often makes bad decisions at taxpayer expense, because policymakers possess no special knowledge that allows them to allocate capital more efficiently than markets**. Businesses and venture capital firms make many mistakes as well, but they bear the consequences of those mistakes. **When the government picks losers, the costs are involuntarily borne by taxpayers**. Even the **supposed “success stories” that government officials and the direct beneficiaries of subsidies like to tout at congressional hearings do not come without cost**. In addition to the taxpayer money that’s spent when policymakers try to steer the market in certain directions, **government intervention can also delay the development of superior alternatives by companies and entrepreneurs who didn’t receive government backing**. Worse, **young companies and entrepreneurs can have a harder time acquiring capital because private investors usually prefer to provide capital to projects that are subsidized over ones that are not**. In a 2009 article in Wired magazine, Darryl Siry, a former executive with Tesla Motors, which has benefitted from government handouts, wrote that startup companies applying for energy subsidies “have admitted that private fundraising is complicated by investor expectations of government support.” He noted that the government trying to pick winners distorts the market for private capital, which “will have a stifling effect on innovation, as private capital chases fewer deals and companies that do not have government backing have a harder time attracting private capital.” **CORRUPTING INFLUENCE OF SPECIAL INTERESTS** Numerous economists have demonstrated that **government officials benefit by acting on behalf of special interests under the guise of working on behalf of the public good**. Policymakers aren’t driven by the profit motive as is the case in the marketplace; rather, **concerns about reelection and other self-rewarding benefits drive the decision-making process**. Thus, **interest groups who gain**, or stand to gain, **from government subsidies are willing and able to exploit the natural self-interest of policymakers**. When “free” government money is up for grabs, **interests that stand to benefit have a strong incentive to organize and lobby for a slice of the pie**. **Policymakers face little or no cost for conferring benefits** on particular interests who return the favor by delivering votes and campaign funds. Adding in the **lack of incentive for policymakers to be good stewards of taxpayers’ money results in government programs that exist to pick winners and losers in the marketplace—the “winner” being a politically predetermined outcome**. Unfortunately, when the government tries to pick winners and losers, **it often picks the wrong horse at the expense of taxpayers and the broader economy**. Government subsidies create an unhealthy—and sometimes corrupt—relationship between commercial interests and the government. **The more the government has intervened in energy markets, the more lobbying activity has been generated. The more subsidies that it hands out to businesses, the more pressure policymakers face to keep the federal spigot flowing. As the number of lobbyists grow, more economic decisions are made on the basis of politics, and more resources are misallocated. And the door opens to cronyism** and corruption. Solyndra has become emblematic of these issues, even as policies expanding subsidies for alternative energy companies have been pursued enthusiastically over the past several years. According to the New York Times, Solyndra “spent nearly $1.8 million on Washington lobbyists, employing six firms with ties to members of Congress and officials of the Obama White House” during the period of time that its subsidized loan request was under review by the Department of Energy. Beyond Solyndra, the Washington Post found that “$3.9 billion in federal grants and financing [from the Department of Energy] went to 21 companies backed by firms with connections to five Obama administration officials.” **THE DEPARTMENT OF ENERGY’S 1705 LOAN PROGRAM** The Department of Energy’s 1705 loan program **is a good example of the gap between what subsidy proponents claim they will achieve and what actually happens**. The program was a key part of the Obama administration’s **2009 stimulus program** and was **justified on the grounds that viable renewable energy companies lack sufficient access to capital**. The alleged imperfections of capital markets is a common—and mistaken—claim often used by policymakers to justify government intervention in various areas of the economy. In reality, **nearly 90 percent of the 1705 loan guarantees went to subsidize projects backed by large, politically connected companies including NRG Energy Inc. and Goldman Sachs**. Thus, it’s hard to believe that taxpayer-backed loans were necessary to make up for a supposed lack of capital available to economically viable commercial concerns. The **1705 program is also a good example of the government favoring multiple interest groups at the expense of taxpayers**: (1) lenders who are reimbursed by taxpayers in the event of a default and (2) the companies that borrow at beneficial rates and conditions. But while banks and companies that receive the guarantees get the upside of the program, **taxpayers bear the risk and shoulder the burden when companies like Solyndra go under and default on their loans**. While the results of the 1705 loan program speak for itself, the true problem is deeper than the numbers. Like most government interventions, **this program**—and government interventions in general—**create serious and systemic distortions in the market. These distortions create the conditions for businesses to maximize profits by pleasing government officials rather than customers**. This is called **cronyism**, and it **entails enormous**—and, most often, unseen—**economic costs**. CONCLUSION When the government subsidizes businesses, it weakens profit-and-loss signals in the economy and undermines market-based entrepreneurship. **Most of America’s technological and industrial advances have come from innovative private businesses in competitive markets**. Indeed, it is likely that most of our long-term economic growth has come not from existing large corporations or governments but from entrepreneurs creating new businesses and pioneering new industries. Such entrepreneurs have often had to overcome barriers put in place by governments and dominant businesses receiving special treatment. **Policymakers who are interested in supporting the entrepreneurs and companies that will deliver the next generation of energy supplies and products should focus their attention on correcting the federal government’s hostile tax climate and dispense with the futile hopes of outsmarting the marketplace**.

#### **To make matters worse, the investment itself would be tiny. ONE 24**

**ONE 24** [Office of Nuclear Energy, The Office of Nuclear Energy works to advance nuclear energy science and technology to meet the nation's energy, environmental, and economic needs, 3-14-2024, FY2024 Spending Bill Fuels Historic Push for U.S. Advanced Reactors, https://www.energy.gov/ne/articles/fy2024-spending-bill-fuels-historic-push-us-advanced-reactors, accessed 3-29-2025.] //aayush

President **Biden** recently signed off on the **FY2024 spending bill**, which **included more than $50 billion dollars for the U.S. Department of Energy (DOE).** The funding will lead to the creation of thousands of good-paying jobs across the country as we work to develop clean, affordable, and secure sources of American energy that will help address the climate crisis. A key piece to that puzzle will be our ability to build and deploy new reactor technologies, and this historic spending bill will literally fuel those efforts as we work to triple the nation’s nuclear capacity by 2050. Securing a domestic fuel supply **The FY2024 spending bill includes more than $1.68 billion for the Office of Nuclear Energy’s research and development activities**. Pivotally, **$2.72 billion was also provided to build out our advanced nuclear fuel supply chain. This historic funding** will increase our domestic enrichment capacity to meet the needs of our operating fleet, that of our allies, and future reactor designs.

#### **For comparison, Ghazi 24**

**Ghazi 24** [Dan Martin, Lead Economist, Economic Impact, 10-14-2024, The economic contribution of the US nuclear power industry, Oxford Economics, https://www.oxfordeconomics.com/resource/the-economic-contribution-of-the-us-nuclear-power-industry/, accessed 3-29-2025.] //aayush

**The US nuclear power generation industry provided approximately 19% of the electricity output of the electric power sector in 2022**. To generate this electricity, the nuclear power industry directly employed 73,832 workers, including 48,252 employees working at nuclear power plants themselves. But **the full economic contribution of the nuclear power industry extends further**. **Altogether, the total** (direct, indirect, and induced) **economic contribution of the US nuclear power industry in 2022 totaled 256,849 workers and $63.8 billion of GDP**. This activity generated $15.9 billion in federal, state, and local taxes. **The states with the largest economic contribution from nuclear power were Illinois** ($5.9 billion in GDP), **Pennsylvania** ($4.8 billion), **South Carolina** ($3.9 billion), **and California** ($3.6 billion). On average, each of the 52 US counties which house the nation’s 54 nuclear power plants had 1,758 workers whose job was supported by nuclear power, and an average GDP contribution from nuclear power of $770 million. **Nuclear power has a number of positive sustainability characteristics**. Unlike electricity generated by burning fossil fuels like gas or coal, **nuclear power generates no significant emissions of air pollution**. Nuclear power’s land use **footprint is the smallest of any electricity generating technology**, less than one-fiftieth that of ground-installed solar, and one three-hundredth that of on-shore wind, per unit of electricity produced. **Working at a nuclear power plant is one of the safest jobs in America, with zero fatal accidents since 2017, and a rate of non-fatal accidents one-seventh that of the electric power industry as a whole.**

#### **Thus, if we let Trump rush into a “massive” expansion of nuclear energy as a pet project for his big tech buddies, there will be 2 major harms.**

## **First is investment disruption.**

#### **The market’s sustainable now. P&S 25**

**P&S 25** [P&S Intelligence, P&S Intelligence is a leading market research and consulting services provider to clients across the globe, xx-xx-2025, U.S. Nuclear Power Market Size, Share & Trends Analysis, 2032, P&S Intelligence, https://www.psmarketresearch.com/market-analysis/us-nuclear-power-market, accessed 3-21-2025.] //aayush

**U.S. Nuclear Power Market Overview The U.S. nuclear power market valued USD 13.3 billion in 2024**, and **this number is expected to increase to USD 19.6 billion by 2032, advancing at a CAGR of 5.1% during 2025–2032**. The **market is driven by the growing demand for electricity due to a burgeoning population, rampant urbanization and industrialization, and booming construction sector**. Amidst all this, the rising emissions of GHGs and the country’s efforts to limit them drives the demand for green energy. The **existing nuclear reactors sustain the nation's electricity supply to a considerable degree, but must deal with higher operational expenses and several regulatory constraints.** Therefore, plant life is being expanded through modern techniques and advanced nuclear reactors, including small modular reactors, are being deployed. U.S. Nuclear Power Market Dynamics **Small Modular Reactors Are Biggest Trends** Small modular reactors (**SMRs**) **are attracting increasing interest because of their reduced costs and adaptive nature**. SMR development is **led by major power companies, such as NuScale, GE Hitachi, Toshiba, and Rolls-Royce. In January 2024, NuScale Power's VOYGR received the U.S. Nuclear Regulatory Commission certification**. Several small modular reactor installations at existing nuclear power facilities are currently in planning or execution. **In October 2024, Amazon.com Inc. announced three agreements in the area of SMRs**. The agreement with Energy Northwest in Washington state will entail the development of four advanced SMRs with a capacity of 320 Megawatts in the first phase and ultimate capacity of 960 MW. **The reactors will be developed by X-energy, which Amazon announced a significant investment to enable 5 GW of capacity. Amazon also signed an agreement** with utility company Dominion Energy **to develop SMRs** near the latter’s nuclear power station in North Anna. **The project will produce around 300 MW of nuclear power for the residents of Virgina**. Just like the conventional high-capacity reactors, SMRs are ideal for power generation, heat production, desalination, desalination, and many other purposes. The DoE is currently engaged in the development of SMRs cooled by light water, which would further bring down the cost of the technology. Moreover, they are being designed to be simpler in design yet highly safe. **Rising Demand for Clean Energy Propels Market** Nuclear power plays a crucial role in meeting the expanding electrical requirements due to **population increase, demand for transport electrification, and industrial growth**. **Nuclear power generates about 18% of the national electricity and almost 50% of the nation's emission-free electricity**. In 2023, 775 billion kilowatt-hours of nuclear power was produced in the country, as per the EIA. In 2024, utility-scale nuclear power plants in the U.S. had a cumulative capacity of 96,402.8 MW. The high operating efficiency of nuclear power plants enhances economic performance, which enables a stable and continuous power supply. As per the DoE, **nuclear power plants boast a capacity factor** (duration for which they operate at full power) of over 92%. This is on contrast to 56% for natural gas, 41% for hydropower, 40% of coal-based, 35% of wind, and 25% of solar power plants. **The price competition for nuclear power stands strong when compared to different forms of electrical power generation specifically in areas with limited easy access to cheap fossil fuel sources**. The **market is seeing increasing investment because the government at the federal and state levels supports nuclear power through tax credits, research and development funding, and loan guarantees**. The biggest reason behind this is the high GHG emissions of the U.S., which are only behind those of China. As per the EPA, the country emitted 6,343 million tCO2e of emissions in 2022, which is why it is aiming for a zero-emission grid by 2030.

#### **Thus, sudden government investment would be devastating. Karasa 25**

**Karasa 25** [Ignas Mikalauskas and Darius Karaša, Kaunas Faculty, Vilnius University, Muitines Street 8, 44280 Kaunas, Lithuania; Lithuanian Energy Institute, Breslaujos Street 3, 44403 Kaunas, Lithuania, 3-12-2025, The Risk of Financial Bubbles in Renewable Energy Markets, No Publication, https://www.mdpi.com/1996-1073/18/6/1400/pdf?version=1741778052, accessed 3-18-2025.] //aayush

**Particularly in high-growth industries such as solar** photovoltaics (PV) **and battery** storage, the **results of this study show that markets for renewable energy are prone to financial saturation and speculative bubbles**. The results underline the need for spotting bifurcation points (~70% saturation) and overheating phases (~90% saturation) to reduce **investment risk**. This part compares results with previous studies, places them in the larger framework of financial and energy policies and presents policy and investment ideas meant to stop financial instability.

5.1. Comparison with Existing Literature

**Bubbles in RE have not been deconstructed to identify their embedded pattern** and have not been evaluated through a **new perspective of capital flows, investments, and possible financial saturation in the market**. So far, **there has been no assessment of the impact on the invested capital and how it could affect the markets**. Although the **authors analyze the bubble** (e.g., Green Bubbles), **the analyses do not include financial saturation and the impact of capital/investment on bubble formation**. The existing body of research in this field, especially from a theoretical standpoint, is insufficiently developed and applied [ 35].

The following timeline summarizes the key saturation thresholds for the battery- storage market, illustrating its heightened risk of speculative overheating compared to solar and wind:

Particularly in technologically advanced sectors, the **results coincide with earlier research on financial market saturation and bubble dynamics**. Previous studies on financial Energies 2025, 18, 1400 16 of 20 bubbles imply that **when market expectations differ from basic values, speculative behavior gets more intense, which causes asset overvaluation and consequent corrections** [1 ,2 ]. **Driven by governmental** and environmental **aims, the renewable energy sector follows similar investment trends, whereby fast development can cause possible overheating** [3].

• **Battery storage is the most speculative sector**. The findings reflect earlier studies showing that **newer technologies with fast growth rates**—such as battery storage—**are more prone to financial speculation** [4 ,5]. **Early bifurcation of battery storage** (2031 in the medium term, 2042 in the long term) **and expected overheating** (~2048) **point to this industry being most vulnerable financially**.

• High investment volatility of **solar energy**. **Policy-driven incentives, including feed-in tariffs** (FiTs), **have helped overcome price rises and crashes** (e.g., Spain’s solar market collapse) **according to historical studies** of solar-energy investment cycles [ 6 ,9]. This work supports these results by determining 2030 (medium term) and 2039 (long term) as the crucial solar PV bifurcation point.

• Unlike solar and battery storage, **wind energy shows reduced saturation risks**, which corresponds with past research stressing **longer investment cycles and infrastructural restrictions as natural stabilizing forces** [10].

These comparisons show that **distinct investment and policy measures are needed for renewable energy financial risks since they are technologically specific**.

5.2. Policy and Investment Implications

5.2.1. Managing Speculative Risks in Renewable Energy Markets

**The existence of speculative investment cycles implies the necessity of government actions to stop market overheating**. Renewable energy markets may suffer asset price collapses without appropriate protections, much like prior financial bubbles in other sectors [11].

**Key policy recommendations include:**

**1. Gradual Phase-Out of Incentives**: • Governments should avoid abrupt subsidy removals, as seen in past crises (e.g., Spain’s FiT reduction in 2013) [6].

• Instead, **gradual reductions in incentives can help maintain investment stability while preventing speculative surges**.

**2. Stronger Financial Oversight:**

• **Regulatory bodies should** monitor financial saturation levels (~70% and ~90% thresholds) to **intervene if speculative risks increase**.

• **Financial stress tests** for high-growth renewable energy sectors **could prevent overleveraging and mitigate market crashes**.

**3. Diversification of Investment Models:**

• Encouraging **long-term infrastructure investments** (e.g., Power Purchase Agree- ments) **over short-term speculative capital flows would reduce financial instability**.

• Governments could support public–private partnerships that focus on sustainable financing.

5.2.2. Implications for Investors

The findings underline for investors the importance of risk-adjusted portfolio manage- ment in the markets for renewable energy:

• Battery-Storage Investment Risks: **Investors should carefully evaluate market val- ues and refrain from too strong short-term speculation** given the great chance of overheating in the battery sector by 2031 and 2038 in different periods.

• The **volatility of the solar business calls for hedging techniques like diversified portfolios balancing solar investments with more reliable energy sources**.

• Wind energy as a reduced-risk option: Because of its slower saturation trajectory and reduced speculative risks, investors looking for consistent, long-term returns might give wind energy top priority.

5.3. Long-Term Sustainability of Renewable Energy Markets

Beyond only financial concerns, the **possibility of speculative bubbles in markets for renewable energy has wider consequences for energy security and climate targets. A financial crisis in renewable energy could cause**:

**• Slowness in investments, postponing the energy changeover**.

**• Loss of public trust, so lowering political and financial backing for next initiatives**.

**• Market corrections, therefore raising the capital cost for sustainable energy.**

**• Energy markets should concentrate on sustainable, policy-driven investment strategies instead of speculative development patterns** if we are to guarantee long-term stability.

#### **This applies to fossil fuels too. Bove 21**

**Bove 21** [Bove, Tristan. “Could the next Financial Crisis Involve a Carbon Bubble?” Earth.org, September 20, 2021. https://earth.org/could-the-next-financial-crisis-involve-a-carbon-bubble/. Tristan is an International Studies and Chinese graduate of DePaul University. He has experience researching the impacts of humanity's relationship with the environment, and how states can successfully implement strategies for sustainable development. As Policy and Economics Editor, his current interests revolve around the developmental policies that can reconcile equitable economic growth with pathways to a net-zero future.] //arrguy

Renewables benefit from learning curves because they are new technologies with a high ceiling for improvement. The price of electricity generated from fossil fuels, meanwhile, does not. Due to learning curves, many project that the price difference between expensive fossil fuels and cheap renewable energy will only become larger as time goes on. **So from an economics standpoint, markets are telling us that a transition towards renewables is inevitable, and from a common sense standpoint, we know that we should be investing more of our resources into renewable energy to preserve our future.** Good news, right? Yes, but what happens to all the leftover fossil fuels? What will happen to the infrastructure and fossil fuel reserves that have benefited from decades’ worth of capital investment, but have suddenly become stranded assets, unable to turn a profit? **A carbon bubble is what happens, and it might be much larger than we think – potentially equal to the housing bubble that caused the 2008 financial crisis.** The Carbon Bubble The notion of a carbon bubble is based on our knowledge that 2°C is the absolute maximum amount of temperature rise we can cope with. Any more than 2°C, and the future frankly becomes too nightmarish for a carbon bubble to even register as a cause for concern. To stay under that benchmark, ideally far under it, we would only be able to burn a certain amount of fossil fuels which release carbon into the atmosphere. Any more than that, and we are basically over-budget. If we were to extract and burn all the remaining fossil fuel reserves in the world, global temperature averages would warm well past 2°C. This has been called ‘exceeding our carbon budget,’ the finite amount of carbon we can release into the atmosphere. The 2°C ceiling, which has now been largely amended to target a temperature rise of less than 1.5°C, is what we have to play with during our energy transition, but if we were to burn through all the fossil fuels that we could conceivably extract, we would be vastly over-budget. A 2021 study published in Nature proved that, to have a 50% chance of staying within a 1.5°C temperature rise scenario, 60% of remaining oil and fossil methane gas reserves and 90% of coal reserves must remain un-extracted by 2050. All these remaining reserves, the so-called ‘unburnable carbon,’ create a fossil fuel overhang of remaining reserves that we cannot touch. **The carbon bubble problem arises when we consider that all those reserves – every drop of oil and eventual particle of atmospheric carbon – are currently included in the valuation of the companies that own them.** Basically, unless we want to exceed our carbon budget, these companies are massively overvalued. **Every major oil and gas corporation, which are all listed on the stock exchange and in which countless people are invested, are valued on the basis that we are going to burn through all of our existing reserves, because that is the economical thing to do.** If you own an asset, even if it is unburnable carbon, responsibility to shareholders means that, in theory, the company that owns it has to profit from it. This leads **to** two potential outcomes. On the one hand, fossil fuel companies burn through all their existing reserves, blow past our carbon budget and cook the planet beyond recognition. **Alternatively, governments step in with regulations and stop companies from extracting unburnable carbon, which would make these massive fossil fuel corporations extremely overvalued, basically overnight.** The fossil fuel company you are invested in becomes the house you spent your savings on, and all of a sudden, that house has no value anymore. Who is complicit in creating this bubble and potential financial crisis? Well, it isn’t only the fossil fuel companies, but also the large and respected monitoring agencies that provide updated measurements of different energy sources’ LCOEs. The think tank RethinkX published a recent report that highlights how the International Energy Agency, the US Energy Information Administration, Wall Street analysts and others have routinely been overvaluing the LCOE and associated costs of conventional coal, natural gas and hydro power plants for years. Investors, regulators and policymakers rely on these agencies’ assessments to make decisions, but have been misled to think that fossil fuels and older forms of renewable energy plants produce much more electricity than they actually can, and are therefore far less expensive than they actually are, making those power plants appear as good investments when they really aren’t. The RethinkX report points out that since 2010, $2 trillion dollars have been invested in fossil fuels and nuclear power based on misleading assumptions on the value of these industries. These risky investments have only been exacerbated by even more uncertain speculation in the effectiveness of unproven technologies like carbon capture and storage. **The report estimates that the LCOE of coal, gas and hydro has been overvalued by as much as 400%, and that the resulting carbon bubble could swell to be worth over $1 trillion in stranded assets by 2030.** Shrinking the Carbon Bubble But wait, how could a carbon bubble impact me if I’ve never invested any money in fossil fuel companies? **Even if you have not personally invested any money in fossil fuel companies (and hopefully you haven’t), it is very likely that your pension fund has. A 2020 study found that pension funds in OECD countries could collectively manage anywhere between €238–828 billion in fossil fuel assets (up to USD$978 billion). In the UK alone, despite promises to divest from fossil fuels, £10 billion are still invested in fossil fuels from local government pension funds.** Even if very few of us are shareholders in fossil fuel companies, we are all, directly or indirectly, stakeholders in their fortunes and misfortunes. The carbon bubble has investors concerned. In 2013, unreasonably prescient British investor Jeremy Grantham, who manages over USD$106 billion in assets, pulled out of all coal and unconventional fossil fuel investments, such as tar sands. “The probability of [fossil fuel companies] running into trouble is too high for me to take that risk as an investor,” Grantham said, adding that: “If we mean to burn all the coal and any appreciable percentage of the tar sands, or other unconventional oil and gas then we’re cooked. [There are] terrible consequences that we will lay at the door of our grandchildren.” Much like with the housing bubble and subsequent financial crisis, there are no easy answers here. We need to eliminate fossil fuels from our energy grids, and to do this, some of the biggest and wealthiest companies in history cannot touch the vast majority of their assets. The best-case scenario for a way out is a managed decline to shrink the bubble as much as possible before fossil fuels, and also nuclear and hydro power, become financially unviable, completely outcompeted and disrupted by modern renewables. This has to come from governments, who should ensure that the public become gradually divested from these archaic forms of energy generation. At the same time, governments need to support the expansion of renewable energy sources that will replace them. **It is uncomfortable to think of, but most people are indeed financially invested in fossil fuels, either through pension funds or even regular unassuming asset managers.** In 2021, half of the world’s 29 largest asset managers did not have a policy in place to exclude coal as an asset. And while many asset managers have pledged to be leaving coal behind, the world’s three largest asset management groups, BlackRock, Vanguard and State Street, still managed over $300 billion worth of fossil fuel investments as recently as 2019.

#### **Bubbles cause collapse — China empirically proves. Wang 20**

**Wang 20** [Wang, Kai-Hua, Chi-Wei Su, Oana-Ramona Lobonţ, and Nicoleta-Claudia Moldovan. “Chinese Renewable Energy Industries’ Boom and Recession: Evidence from Bubble Detection Procedure.” Energy Policy 138 (March 2020): 111200. https://doi.org/10.1016/j.enpol.2019.111200. Kai-Hua Wang is an associate professor in the School of Economics at Qingdao University, China. He has two years of research experience in an academic institution, and his research interests focus on energy economics, international finance and corporate finance. He presides over one Qingdao City Social Science Foundation Project and publishes more than ten papers in professional academic journals.] //arrguy

Introduction China has been the largest energy consumer and importer, which consumes 23.2% of world energy in 2017, and its primary energy demand would achieve 4800 million tons of coal equivalent by 2020. Meanwhile, its energy structure heavily depends on fossil fuels, especially coal, and has become the largest carbon dioxide (CO2) emitter in 2011 (Xu and Lin, 2018a). Hence, China does not just confront with energy pressure, but it also face environmental pollution problems (Liang et al., 2019). To optimize energy consumption structure, China begins to accelerate development and utilization of solar, wind and hydro industries. It has been the global leader and the expansion of renewable energy market brings obvious economic benefits (Zhang et al., 2017; Lin and Xu, 2018; Zeng et al., 2018; Zheng et al., 2018). The solar, wind and hydro industrial rapid development have gained growing attention from investors. In terms of China National Bureau of Statistic (CNBS), the investment for solar, wind and hydropower generation reaches 843.54 billion RMB in 2015, an increase of 33% compared to 2014. When experiencing double-digit growth since 2012, new investment growth rates sharply fall to 5% and 2% in 2016 and 2017, respectively. We further find there exist huge different investment trends among renewable energy industries. Solar industry confronts unprecedented development opportunities and its investment reaches 491.32 billion RMB in 2017, which is ten times than that in 2012. However, hydro industry presents a downward trend, its investment reduces to 165.37 billion RMB in 2017 from the highest point of 214.51 billion RMB. Wind industry does not have obvious upward or downward trend, which reflects investment frequent fluctuations. The different industrial trends provide motivation for investigating bubbles in solar, wind and hydro industries, respectively. Meanwhile, the stock indices of renewable energy industries are often influenced by industrial policies, financial crisis, and other incidents. The volatility would increase risks and further impact the confidence of investors such as banks, which make firms hard to obtain financial support and face bankruptcy situation. In particular, Suntech Power Holdings Co., Ltd, the leader of the Chinese solar industry and the world's major manufacturer of solar panels, bankrupts in 2013, which marks the arrivals of industrial depression. The process of booming and recession in the energy industry may turn into bubbles, and bring negative influences on the process of optimizing energy structure, mitigating energy crisis and improving environmental quality (Xu and Lin, 2018b). Therefore, it is practical to recognize bubbles for these industries and take measures to alleviate undesirable impacts on itself and the Chinese economy. (see Fig. 3, Fig. 4) The performance in renewable energy depends on the rapid development of Chinese corresponding industries, which can be shown as followings. First, supportive policies have been implemented (Kuik et al., 2019). The “The 13th Five Year Plan for Energy Policy” is implemented by the National Energy Administration, which clearly encourages renewable energy industries development (Zhang et al., 2017). Second, China has carried out a wide investment in renewable energy industries (Zhu et al., 2019). In 2015, the amount of the investment is 102.9 billion U.S. dollars that accounts for more than 30% of global renewable energy investment. Third, the number of renewable energy firms has increased five times since 2008 and exceeds ten thousand in 2014 (Sun et al., 2019). Even though renewable energy industry has made tremendous progress, but it plunges as fast as rising and present hump-shaped performance pattern. Taking the solar industry as an example, the boom phase starts from 2004 that accompanied with a new wave of startups, including Jinko Solar, Yingli and other firms (Quitzow, 2015). This trend suddenly stops in 2008 because the global financial crisis results in a slowdown in the overseas subsidized solar market (Binz and Anadon, 2018). After 2008, China starts to adjust its market deployment policies, hence the tumbling solar companies obtain large loans in time to overcome difficulties (Dong et al., 2015; Zhao and Luo, 2017). Suffering this boom-collapse period, some major firms become vertically integrated leaders in global solar industry chain. However, due to the weak economic environment, high corporate debt levels and U.S. and the European Union's anti-dumping investigation, a lot of firms file for bankruptcy. Similarly, wind and hydro industries also suffer bubble process in their development (Dai et al., 2018; Hayashi et al., 2018; Li et al., 2018; Chu et al., 2019). In terms of close link exists between economic growth and renewable energy industries, hence the industrial bubble behaviours would bring negative impacts on economic activities such as firm bankrupt and investment volatility (Narayan and Doytch, 2017). In short-term, it makes firms bankruptcy, raises unemployment rate and reduces local fiscal revenue (Zeng et al., 2018). In the long-term, the bubble process in renewable energy industries would affect energy structure optimization strategy, reduce economic growth speed and quality and further influence China's sustainable development (Xu and Lin, 2019). That provides motivation for recognizing bubble periods from origination to termination, analyzing the influencing factors, constructing early warning mechanism and keeping renewable energy industries' sustainable development. Previous studies pay attention to the volatility in the renewable energy industry. Sadorsky (2012a) indicates that after double-digit growth rate from 2002 to 2007, the investment in the renewable energy industry presents an obvious drop in the period 2008–2009. Sadorsky (2012b) argues that renewable energy firms tend to go public to finance and expand their scale, which provides motivation for investigating their stock price fluctuations. Ferstl et al. (2012) utilize event study of Fukushima nuclear disaster and discover renewable energy firms present a positive abnormal performance in the event window. Bohl et al. (2013) clearly carry out bubble detection in German renewable energy stocks through Markov regime-switching ADF (MS-ADF) method, finding that it performs well from 2008 to 2011. Inchauspe et al. (2015) reveal that the renewable energy industry's expansion is not only occurring in developed markets such as U.S. and Germany but also in emerging markets including China and Brazil. Gatzert and Vogl (2019) indicate that regulatory and policy risks have been regarded as major role for investors when evaluating investments in renewable energy industries. Dutta (2017) realizes that renewable energy stock returns show more volatile when facing the global financial crisis. Dodd et al. (2018) argue that renewable energy industry outlooks are associated with industry's progress evidence from the U.S., Australia, and Germany. Dutta et al. (2018) discover that it is essential for investors and policymakers to recognize fluctuations of renewable energy stocks and potential links to other associated financial markets. Sung (2019) finds that government subsidy, available organizational slack and market competition would influence Korean renewable energy industry innovation and its further development. Israel and Jehling (2019) demonstrate that despite successive policies have led to profound transformative dynamics in Peru's renewable energy industries, but there still exist practices disconnection from national policies. Harjanne and Korhonen (2019) show that renewable energy production heavily depends on local natural conditions such as illuminated time, which offers great challenge for industrial development. Nicolli and Vona (2019) find energy liberalization increases public support for cultivating renewable energy industry. Gurtler et al. (2019) demonstrate that renewable energy market expansion is a policy-driven phenomenon. Dhakouani et al. (2019) indicate that the successful industrial framework consists of integration of renewable energies and their efficiency improvement in developing countries. Gungah et al. (2019) identify that enacting well-conceived renewable energy laws and building relevant institutions are crucial for achieving sustainable industrial development in Nigeria. Fobissie, (2019) find that environmental values and political ideology would produce influence on public support on renewable energy industry. Some studies also provide investigation for Chinese renewable energy industries. Liu et al. (2011) put forward bottom-up models to analyze renewable energy supply processes deeply, which are related to conversion technologies and energy demand modes. Zhang et al. (2013) argue that China has taken equipment manufacturing as a priority in developing renewable energy industries. Li et al. (2015) indicate China has obtained achievements in renewable energy exploitation and utilization, but there are still obstacles in this industry that influences sustainable industrial development. Reboredo and Wen (2015) discover that Chinese energy legislation policies dampen stock price fluctuations in all renewable energy industries. Xu and Lin (2018a) also prove the hump-shaped performance pattern and find these industries have achieved rapid growth under tightened environmental regulations and active industrial policies. Zeng et al. (2018) demonstrate that renewable energy firms in the Western region of China such as Sichuan have the highest investment fluctuation, while their peers in the Central region have the lowest volatility. Liu et al. (2018) argue that the mismatch between excessive production and declining market demand provides challenge for Chinese renewable energy industries. Crowley et al. (2019) indicate the export-oriented Chinese solar firms suffer difficult time when European announces trade restriction for solar-related products. Yang et al. (2019) discover that state subsidies would produce threshold effect on Chinese renewable energy investment, which means more policy support may not bring equal rewards. Chang et al. (2019) show that renewable energy investment is influenced by financing environment and firms’ own features. Zhang and Farnoosh (2019) find that electricity futures should perform as tools to gain more profit for the plants and stabilize the risk renewable energy industry. Ji and Zhang (2019) show that financial development plays a key role in extension of renewable energy industry and market. Yu et al. (2019) construct an analyzing system, including economic conditions, environmental protection and technological progress, to evaluate development of renewable energy industry. The existing studies carry out detailed investigation to renewable energy industry from concept, volatility, industrial policy and influencing factors, which provide robust basement for our empirical analysis (Bohl et al., 2013; Chang et al., 2019; Ji and Zhang, 2019; Sung, 2019; Yu et al., 2019). However, there are shortcomings that need to improve. First, China owns the largest wind and hydropower capacity in the world, and construct a complete solar industrial chain successfully. But the studies about Chinese renewable energy industry is scant, particularly for the potential industrial bubble behaviour. Secondly, most of the studies just describe the trajectory of fluctuation in renewable energy industries, which do not provide robust evidence for defining bubbles and recognizing explosive periods. The bubble behaviours would lead to over- or under-investment for these industries, influence investors’ confidence, and exacerbate renewable energy stock price volatility. It is worse than no one or some reasons can interpret explosive behaviours, hence the powerful method is needed. Third, the existing test of MS-ADF that employed in Bohl et al. (2013) has low powerful in detecting multiple bubbles (Phillips et al., 2011). Hence, this paper employs powerful SADF and GSADF tests to investigate bubble behaviours in Chinese renewable energy industry. Meanwhile, depending on new date-stamping strategy, this paper recognizes originating and finishing points of each bubble, which is expected to construct an early warning mechanism. The major contributions of our study to prior literature are shown as follows. **First, China confronts a serious dilemma that the unreasonable energy supply structure cannot support the booming energy demand.** In order to solve this problem, China puts considerable resources such as capital and technology to develop renewable energy industry. **Boom and recession are accompanied by industrial development process, which supplies a unique and typical example to analyze renewable energy industries.** Especially, being different from existing studies used the overall sample data, we identify and analyze different characters among solar, wind and hydro industries, which can provide more accurate conclusion. Second, effective warning mechanism for detecting bubbles ought to be provided for all kinds of market practitioners. Hence, the Supremum Augmented Dickey–Fuller (SADF) and the Generalized Supremum Augmented Dickey–Fuller (GSADF) tests are employed to investigate bubble behaviours in renewable energy industries. Both methods perform better than other bubble detecting approaches since they allow testing nonstationary process period by period, which is against mildly explosive alternatives (Phillips et al., 2013). **The GSADF test employs flexible window process to extend sample sequence, which further increases detecting accuracy, especially when confronting multiple bubbles (Su et al., 2017a).** Third, compared to previous methods, this study depends on recursive procedures and cross-time occurrence to recognize starting and ending time points in each bubble behaviours. That clearly offers dating algorithm anticipation and could construct early warning diagnostic system to assist supervisors in monitoring market actions. **We conclude that multiple bubble behaviours exist in renewable energy industries, which are influenced by stock market collapse, macroeconomic condition, government policy changes and high operation costs.** Meanwhile, industrial policies, technology, infrastructure may result in special bubbles in wind, solar and hydro industries. The paper provides an explanation based on the bubble model and pays attention to the formation of the bubble part. Combing with bubble evolution, we should adopt policies to promote renewable energy industry development. These are evidenced in followings: government should keep persistent implement of renewable energy policies, perfect electric infrastructure and guide reasonable investment for these industries. Firms should accelerate technique innovation, industrial development stage, concern macroeconomic condition changes, and foreign competition. This paper is shown as follows: Section 2 illustrates Methodology. Sections 3 presents Data. Sections 4 shows empirical results. Section 5 draws conclusions and infer policy implications.

#### **A US recession spills over. Ryssdal 20**

**Ryssdal 20** [Ryssdal, Kai. Host and senior editor of “Marketplace,” the most widely heard program on business and the economy — radio or television, commercial or public broadcasting — in the country. Kai speaks regularly with CEOs of Fortune 500 companies, startup entrepreneurs, small-business owners and everyday participants in the American and global economies. Before his career in broadcasting, Kai served in the United States Navy and United States Foreign Service. He’s a graduate of Emory University and Georgetown University. Kai lives in Los Angeles with his wife and four children. “If the U.S. Economy Gets Sick, Other Countries Could Catch ‘Pneumonia’ - Marketplace.” Marketplace, July 23, 2020. https://www.marketplace.org/2020/07/23/if-the-u-s-economy-gets-sick-other-countries-could-catch-pneumonia/.] //aayush + //arrguy

**The U.S. economy contributes more than half of the world’s stock market capitalization, accounts for over 15% of global GDP and is a pretty crucial import market to boot. It’s no wonder, then, that economic crises in the U.S. spill over into the global economy.** Marketplace host Kai Ryssdal spoke with University of Michigan provost and international economist Susan M. Collins about how the health crisis in the U.S. could translate into a global economic crisis. The following is an edited transcript of their conversation.

#### **That’s devastating. Bradford 13**

**Bradford 13** [Bradford, Harry. Former Associate Business Editor, The Huffington Post, “Economic Shock Could Throw 900 Million People into Poverty, IMF Study Warns.” HuffPost. HuffPost, April 5, 2013. https://www.huffpost.com/entry/global-poverty-900-million-economic-shock\_n\_3022420.] //arrguy

Hundreds of millions of people worldwide are on the brink of poverty. **A recent study by the International Monetary Fund warns that as many as 900 million people could fall back into poverty in the event of an economic shock like the Great Recession.** That figure is three times the size of the U.S. population. According to the World Bank, 1.2 billion people are currently living on less than $1.25 a day.‌ According to the World Bank, 1.2 billion people are currently living on less than $1.25 a day. While the report acknowledges that progress has been to made to reduce global poverty and strengthen the world economy following the financial crisis, the world is still in a vulnerable situation. Global unemployment, for example, is the highest it's been in two decades with 40 percent of the world's population out of work, according to the report. And things could get much worse in the event of a macroeconomic shock, of which the Europe and U.S. are dangerously close. The recent bailout of Cyprus threw the eurozone into chaos, igniting fears that the situation could lead to the next financial crisis. Here in the U.S., a series of automatic spending cuts know as the sequester could cost the economy hundreds of thousands of jobs. The cuts have already threatened the stability of safety nets designed to aid the nation's poorest. The U.S. continues to fail to sustain a robust job market, adding only 88,000 jobs in March.

## **Second is lobbying dynamics.**

#### **Big oil is stable now. Dareen 25**

**Dareen 25** [Seher Dareen, oversees and writes market reports with the commodities and energy team in Bangalore round-the-clock and monitors newsworthy events in the resources space, 1-27-2025, Big Oil in no rush to 'drill baby drill' this year despite Trump agenda, Reuters, https://www.reuters.com/business/energy/big-oil-no-rush-drill-baby-drill-this-year-despite-trump-agenda-2025-01-27/, accessed 3-24-2025.] //aayush

HOUSTON, Jan 27 - **Wall Street expects U.S. oil and gas companies to keep a lid on spending in 2025 and keep their focus on generating shareholder returns, despite calls** by President Donald Trump **to "drill, baby, drill."** Big Oil begins reporting fourth-quarter results this week, and outlooks for the coming year should reflect the **dissonance between Trump's oil and gas-maximizing agenda and investor expectations**. The **industry has pushed in recent years to drive down costs and increase production by using more efficient technology** rather than drilling many new wells. **Producers also must contend with lower global oil prices as the post-pandemic demand rebound runs its course and as China's economy struggles**. Benchmark Brent **crude oil prices are projected to average $74 per barrel in 2025, down from $81 in 2024**, according to the U.S. Energy Information Administration. **Overall, for the U.S. exploration and production sector, analysts at Scotiabank expect companies to target up to 5% production growth this year, and flat to slightly lower year-over-year capital expenditures. The exception is Exxon Mobil, which plans a large increase in production**. The largest U.S. oil company intends to more than triple its production in the Permian, the top U.S. shale field, and pump 1.3 million barrels per day from its lucrative operations in Guyana by 2030. "**We expect most oil and gas producers to remain disciplined with capital expenditures**," said Rob Thummel, senior portfolio manager at Tortoise Capital. "**However, less regulation will make it easier to increase drilling activity if commodity prices reach levels that are too high**." Chevron (CVX.N), which reports results on Friday, is expected to grow production by about 3% this year and in the mid-single digit percentage in 2026, said Barclays analysts in a research note. The company has followed a **conservative strategy**, **moving out of a phase of heavy investment in new projects, and is now generating cash**, said analysts from RBC Capital Markets in a note. **Chevron could also announce a dividend increase of at least 5% over the previous year**, Thummel added, as dividend **increases have been between 6% to 8% previously**. Chevron is expected to report $3.87 billion in profit, according to data compiled by LSEG, which would be a decline from $6.45 billion in the year-ago quarter. Exxon Mobil, meanwhile, is expected to report $6.85 billion in profit, down from $9.96 billion in the same quarter last year. The company signaled last month that **lower oil refining profits and weakness across its business would reduce earnings by about $1.75 billion compared to the third quarter**. An arbitration panel will decide in May on Exxon's challenge to Chevron's acquisition of Hess - a purchase that would give Chevron a rival stake in Guyana's rich offshore reserves. Exxon has claimed a contractual right to buy Hess' stake in the field. Producer ConocoPhillips (COP.N) could also grow oil and gas production in the low single-digit percentage this year to focus on returning cash to shareholders, Barclays said. The company in December completed its $22.5 billion buyout of smaller peer Marathon Oil, which had been under a Federal Trade Commission review. This could, according to Scotiabank analysts, swing its performance up. Occidental (OXY.N), meanwhile, is expected to report $730.9 million in adjusted profit for the fourth quarter, up from $710 million in the same quarter last year. The oil producer closed its acquisition of CrownRock in August and its capex this year is expected to total $7.44 billion, up from $6.9 billion last year, Barclays said. For Diamondback Energy (FANG.O), Raymond James analysts expect the company to choose free cash flow over growth after its acquisition of Endeavor. Profit is expected to come in at $977 million, up from $854 million in the same quarter last year. Production growth is expected to be flat with lesser spending in 2025, they added.

#### **However, oil lobbying is OP. Pearson 24**

**Pearson 24** [Daisy Pearson, Movement building officer (and unofficial in-house graphic designer) at Global Justice Now. She supports local group activism across the country, helping to organise events and designing campaigning materials and resources, 8-6-2024, To End Fossil Fuels, We Need To Take On Monopoly Power, Global Justice Now, https://www.globaljustice.org.uk/blog/2024/08/energy-monopolies-and-the-case-for-a-fossil-fuel-treaty/, accessed 3-11-2025.] //aayush

**Driving the divide** One of the first places **we should start is dismantling monopoly power**. In our recent report, Taken, Not Earned, produced with Balanced Economy Project, SOMO and LobbyControl, we **looked at how monopolists are driving the world’s power and wealth divide. Our economy is dominated by monopolies, with just a handful of companies dominating in most sectors**, from tech to pharma, agriculture and energy. **These vast monopoly corporations are wealth extraction machines: squeezing suppliers, overcharging consumers, evading tax, exploiting workers, destroying the environment and funnelling the money into the pockets (or tax havens) of billionaires**. Monopoly wealth is both exploitative and unjust, and it is destroying society and the planet along the way. **The energy sector is dominated by massive corporations. Oil giants are particularly well known: think Shell, BP, Exxon, Chevron and Total. These five conglomerates alone made $281 billion in the two years following Russia’s invasion of Ukraine, at precisely the time so many people were hit by vastly inflated energy bills**. They paid out over $200 billion of this directly to enrich their already wealthy shareholders, rather than investing it into any form of energy transition. In fact, **what funds they did invest were overwhelmingly in further fossil fuel production**, not in renewables. Despite many PR and advertising campaigns suggesting otherwise, **major energy companies’ investment in renewables is actually decreasing, as corporations like Shell and BP roll back on their plans to curb fossil fuel extraction**. In 2019, more than two-thirds of all energy was produced by the largest six companies. In 2021 dozens of smaller energy companies failed, further concentrating energy giants’ hold on the market. While geopolitical conditions at the time put a strain on all energy companies, high market concentration makes it near impossible for small businesses to emerge and survive. Dominant corporations squeeze out smaller competitors, enabled by public policies that favour big firms. **Such extreme market concentration gives these few corporations (and their billionaire owners) unprecedented power and influence over our political institutions, eroding democracy, and enabling them to circumvent labour and environmental regulations with little accountability**.

#### **They’re vehemently opposed to nuclear energy. Silverstein 16**

**Silverstein 16** [Ken Silverstein, 7-13-2016, Since the late 1990s, Ken Silverstein has covered energy, beginning with the rise and fall of Enron — first as a magazine writer before becoming a columnist and editor. He has been a columnist for Forbes for 13-plus years, focusing on the ‘green energy economy.’ Several publications and broadcasts have cited his Forbes’ stories. He also covers the Global South, traveling to various parts of the world. His independent work now appears in dozens of metropolitan dailies, and he has written for the Christian Science Monitor. His features and columns have won several national awards, Are Fossil Fuel Interests Bankrolling The Anti-Nuclear Energy Movement?, Forbes, https://www.forbes.com/sites/kensilverstein/2016/07/13/are-fossil-fuel-interests-bankrolling-the-anti-nuclear-energy-movement/, accessed 3-24-2025.] //aayush

It’s ironic and begs the question of **why the traditional environmental movement is so vehemently opposed to nuclear energy**, especially since it is the only fuel that can burn around the clock without releasing any carbon emissions. While this writer has had good relations among all those along the environmental continuum for 16 years, **critics will maintain that it is the fossil fuel interests that have bankrolled some of the legacy groups**. **In 1970, a leader of the petroleum industry and the head of the Atlantic Richfield Co. named Robert O. Anderson contributed $200,000 to fund Friends of the Earth, an organization that is strident in its opposition to nuclear energy, citing both safety and cost issues**. The topic is part of a book by F. William Engdahl titled Century of War: Anglo-American Oil Politics and the New World Orders, says Rod Adams, author of the blog Atomic Insights. “The discovery moved Anderson up to exhibit number one in my long-running effort to prove that **the illogically tight linkage between ‘environmental groups’ and ‘antinuclear groups’ can be traced directly to the need for the oil and gas industry to discourage the use of nuclear energy**,” writes Adams. He goes on to say that **oil and gas marketers are savvy and realize that transparent donations would be viewed with a jaundiced eye by journalists and others**. By surreptitiously giving money, Adams says that **those in the fossil fuel sector could establish proxies to do their fighting for them**. Why? **The oil industry had long-been concerned that “atomic fission” could replace oil, or at a minimum, significantly undercut its price**. Fission occurs when an atom is split into two parts and it results in the generation of electricity from a nuclear power plant. **Skeptics have long expressed concern over the use of such technology for warfare**. Adams says that **the fossil fuel industry has also glommed on to this argument as a matter of convenience**. “**Oil would be worth a lot less if more of the world’s energy needs were provided by atomic fission**,” Adams writes. “If oil was worth less, it would make no economic sense to press it out of shale rocks in North Dakota, drill for it deep under the Gulf of Mexico, or try to extract it from the challenging environment of the Arctic Ocean.” How does all this bear on today’s nuclear energy market? As for the United States, it gets about 19 percent of its electric generation from nuclear energy, which represents about 62 percent of its carbon-free power. In Canada, nuclear power is second only to hydropower as the biggest fuel used to generate electricity while in Mexico, it represents 18 percent of its electricity. Importantly, clean energy supplies as a total of the global electricity generation portfolio have been on the decline for two decades, according to Environmental Progress, which also says that a primary reason for this is because of the threats to nuclear generation: Germany has plans to nix its whole nuclear portfolio, as does Sweden, and **in the United States, smaller nuclear units that compete on the open market can’t go head-to-head with cheap natural gas**. True, wind and solar are growing, the think tank says, but not enough to make up for lost nuclear. And that’s just the tip: **In the United States, Environmental Progress says that 13 nuclear plants are at risk of closure over the next two years. Moreover, half of all such plants here could be shut down over the next 15 years**. “If that happens, the resulting higher carbon emissions will wipe out 43 percent of the EPA’s planned Clean Power Plan reductions,” says Michael Shellenberger, president of the Berkeley, Calif.-based think tank. Already, Entergy Corp., **Exelon Corp. and Dominion Resources have retired smaller nuclear units that are unable to compete with natural gas on the open market**. Exelon has said it might close two more in New York State unless the state approves subsidies. And late last month, Pacific Gas & Electric said it would retire a bigger base-load plant while Edison International’s San Onofre facility closed in 2013 after a persistent radiation leak.

#### **Significant government legislation causes concessions — lobbying influence causes acquiescence. Lefebvre 22**

**Lefebvre 22** [Ben Lefebvre, Lefebvre has covered energy industry and policy issues for nearly a decade. Prior to starting at Politico, he worked in Tokyo for three years covering the East Asia nuclear, coal industries for trade publication ICIS. He also wrote about Japanese business and culture for Quartz during that time.Before that he worked in Houston covering the energy boom for Dow Jones and the Wall Street Journal. He got his start in journalism at The Metro Times covering Detroit city hall shenanigans. He graduated with a degree in English from the University of Michigan, 7-28-2022, 'Easter eggs' in climate bill delight oil and gas industry, POLITICO, https://www.politico.com/news/2022/07/28/manchin-oil-gas-biden-schumer-climate-bill-00048514, accessed 3-24-2025.] //aayush

**The oil and gas industry doesn’t hate the climate bill**. The industry as a whole isn’t yet embracing the $700 billion-plus **reconciliation deal**, which would **penalize some forms of fossil fuel pollution** while making one of the largest investments in clean energy in U.S. history. **But the legislation also contains what some called “Easter eggs” that would benefit oil and gas companies, including access to new swaths of federal waters in Alaska and the Gulf of Mexico**. “There are **some things in there that are helpful to our business**,” **Rich Walsh, senior vice president and general counsel at Valero, one of the country’s largest fuel refiners, said** during an earnings call Thursday with investors. Frank Maisano, a partner at the at law firm Bracewell, said **the compromise deal offers wins for both the fossil fuel and green energy industries**. “**There are a lot of pieces in there that are going to be valuable to different sectors**,” said Maisano, whose firm works with companies in both fields. Maisano added that Sen. **Joe Manchin** (D-W.Va.), who **reached the deal with** Senate Majority Leader **Chuck Schumer**, “has been **clear on where he stands — to have some mix of benefits and not lean too heavily on renewables only**. That’s what he’s gotten here.” The bill, H.R. 5376 (117th), would spend an estimated $370 billion in an attempt to slash carbon emissions across the U.S. economy by the end of the decade, by an estimated 40 percent from 2005 levels. But **it includes proposals to ease federal rules that the West Virginia senator has said are constricting fossil fuel production and slowing needed upgrades to the power grid**. The compromise has infuriated some progressive environmental activists. One such group, the climate organization 350.org, called the bill “a sham” because of the fossil fuel provisions and accused the Biden administration of “engaging in a bait and switch tactic on climate legislation.” Still, other environmental groups have said they can live with the trade-offs. **And the oil and gas industry has identified provisions that may make the climate medicine go down a little easier**. Walsh, at Valero, pointed to a portion of the bill that would allocate $500 million to expand biofuel infrastructure such as storage tanks and blending facilities. The bill would also require the Interior Department to offer at least 2 million acres a year for onshore oil and gas lease sales. Unless it holds those lease sales, the bill says, the department could not offer rights of way for solar and wind power projects. Those **leasing provisions alone would offer a win for oil and gas companies that are feuding with the Biden administration over Interior’s slow pace of fossil fuel lease sales**, one lobbyist for the industry said. **Meanwhile, the bill’s proposal to charge a fee of up to $1,500 a ton for the petroleum industry’s emissions of methane, a potent greenhouse gas, would be less of an issue for large oil companies already working on reducing them**, industry analysts said. **“If you look at the pros and cons, the pros generally outweigh the cons,” the lobbyist said, speaking on condition of anonymity because he wasn’t authorized to speak to the news media.** “The Easter eggs that Manchin forced into the bill on leasing, **they’re a big deal. If you squint hard enough, you can see this being a bipartisan compromise.” The bill would also make it easier for businesses to use a tax credit for deploying technology that captures and stores planet-warming carbon emissions**, which has become big business for companies like Exxon Mobil and Chevron. The technology, which Manchin has championed as a way to stave off climate change but environmental groups and other critics say is not ready for prime time, aims to strip the carbon emissions from industrial smokestacks and bury them. “If enacted ... this package would provide the most transformative and far-reaching policy support in the world for the economy-wide deployment of carbon management technologies,” Madelyn Morrison, spokesperson for the advocacy group Carbon Capture Coalition, said in a prepared statement. Oil company BP said the deal offers a lot to like for oil companies that are extending their reach into renewables, carbon capture and other forms of alternative energy. “We applaud Senate lawmakers for making progress toward a historic climate deal,” BP spokesperson Josh Hicks said in an email. “BP has actively advocated for Congress to pass strong climate legislation, including the full suite of clean-energy and low-carbon tax credits the U.S. House passed in 2021. We will continue engaging constructively with policymakers to advance these measures as we aim to become a net zero company by 2050 or sooner.” Still, **not everyone in the industry was willing to call the bill a win**. The American Petroleum Institute, the **trade group representing the largest oil producers in the country, was more measured in its initial take. “While there are some improved provisions in the spending package released last night, we oppose policies that increase taxes and discourage investment in America’s oil and natural gas,” said Amanda Eversole, API’s executive vice president and chief advocacy officer, in a statement**.

#### **Independently, this fractures the environmental movement. Elpchick ND**

**Elphick ND** [Sam Elphick, Completed his History B.A. at Keele University in 2022, before going on to study Medieval History as his M.A. at the University of York: which he completed in 2023. He has immediately continued his studies with a PhD in Medieval Studies at the University of York in 2023, which is supervised by Professor Dawn Hadley. His research interests include: Anglo-Scandinavians, otherness, cultural history, diasporic studies, migration studies, coinage, and hagiography, xx-xx-xxxx, Environmentalism and Nuclear Power, Keele University, https://www.keele.ac.uk/extinction/campaign/environmentalismandnuclearpower/, accessed 3-18-2025.] //aayush

But, the **surging interest in pro-nuclear environmentalism** should not be considered a ‘birth’ of a new school of thought, but rather **a ‘re-kindling’ of previously stunted arguments for the environmental positives of nuclear power**. As I shall demonstrate, these **anchors to growth go back to the 1970s, and two primary groups**. **First is a group of ‘blue jeans and plaid shirts’**: **Nuclear Scientists who frequently produced arguments that showcased the ‘glory’ and endless benefits of their field** – and secondarily producing perhaps the **greatest conflict of interest in environmentalism ever. The second group includes early environmental scientists who struggled to conceive of nuclear weapons and nuclear energy as separate environmental issues** and **fought against ideas of pro-nuclear scientists** such as James Lovelock - inventor of the first device used to detect CFCs in the atmosphere, and of the GAIA hypothesis. It is in the way that **these two groups developed their ideas that has stunted the growth of pro-nuclear environmentalism** **and prevented an actual serious movement from ever forming**, despite any occasions of majority public support. One the 8th December, 1953, President **Dwight D. Eisenhower** gave a speech to the UN General Assembly. In it, Eisenhower **delivered these lines**: “I therefore make the following proposal. The **governments principally involved… should begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency…** The more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind.”[5] This speech is popularly remembered as the **‘Atoms for Peace’ speech**. Following the speech was the creation of the International Atomic Energy Agency (IAEA) in July 1957; and a re-focusing of the U.S.A.s Atomic Energy Commission (AEC) towards nuclear power, with an experimental nuclear power plant beginning construction in 1954.[6] From this speech to around the **1960s**, **American nuclear energy** (under the AEC headed by David Lilienthal) **enjoyed generous federal funding**, particularly as it was seen as the best -and most rapid - method to ‘ease the sense of national guilt’ over Hiroshima and promote nuclear technology as a peaceful development.[7] However, the nuclear industry was **criticised frequently for being un-economic and producing the environmental hazard of nuclear waste**.[8] By the early 1970s **these had become the main criticisms of nuclear energy** (especially during the 1973 Oil Crisis), and **with very little positives, the nuclear energy industry found itself as ‘a solution in search of a problem’**.[9] This problem appeared in the late 1970s-early 1980s. **The increasing scientific acceptance that CO2 emissions were causing a global warming provided an excellent jumping-off points for nuclear energy scientists worried about the survival of their field**. Thus, the first **environmental nuclear scientists began furiously presenting arguments that took the existing knowledge of nuclear power’s lack of air pollution and demonstrated nuclear energy’s ‘wonderous solutions’ to the end of the world.** However, **these scientists were often removed from public discourse**: they’d almost exclusively attend ‘formal sessions over dining tables, wearing blue jeans and plaid shirts, and carrying graphs and slides for their points’.[10] **These private and complicated discussions prevented the ‘blue jeans and plaid shirts’ group from having connection to the public about the environmental positives of nuclear energy**. On top of this, the **scientists did no favours for themselves in the earning of public trust**, especially when considering the ways in which previous nuclear effects were demonstrated. In 1956 a calculation was made assessing the effects of nuclear testing: ‘testing produced 2 additional birth defects per every 1,000 live births. In a population of 150 million, that amounted to 300,000 birth defects in one generation.’[11] However, the calculation was presented by nuclear scientists as this: ‘background radiation from natural sources, such as cosmic rays, produce 20 birth defects per every 1,000 live births. Nuclear testing brings this up to 22 per 1,000.’[12] While both are true, the second statement seen by the public is clearly dishonest, and as such through **repeated statements such as these the late 20th century public learnt to distrust nuclear scientists**; **something not helped by the obvious conflict of interest of the scientists using global warming as a crutch to provide a future for their field**. Furthermore, despite using environmentalist terms to create support for nuclear energy, **nuclear scientists continued to blame and vilify environmentalist critics**. Alvin Weinberg – a member of the Manhattan project – said **at the 1989 conference on nuclear energy** that **‘nuclear power will not return, unless the sceptical elite of environmentalists persuaded the public**.’[13] Clearly, **late-twentieth century nuclear scientists stunted the growth of pro-nuclear environmentalism through vilification of environmentalists and repeated betrayals of public trust. The other group to have stunted the growth of a pro-nuclear environmentalism were the early environmentalists**. **Immediately following the Hiroshima bombing**, there emerged a split in the British public opinion of the atomic technology. **Most viewed it as a destructive force** used by the anarchy of superpower competition. **Others viewed it in a more optimistic light** (too optimistic from today’s point of view), with atomic energy promising free electricity and atomic cars, to the ability to alter Britain’s climate.[14] **Most environmentalists seemingly missed the optimistic boat**. Former **Greenpeace member** Patrick Moore **was firmly against nuclear energy up until 2000** – when he apparently had an epiphany after talking to James Lovelock (who apparently had always aligned more with the second option expressed by the British public).[15] **According to Moore, Environmentalists had behaved emotionally rather than logically towards nuclear power during the 1950s-1980s**.[16] In fairness, this is a rather understandable reaction to nuclear technology. The 1961 Berlin and 1962 Cuban Crises terrified millions, shattering previously built ideas of a peaceful atom. Furthermore, civil defence drills, shelter campaigns, and famous school films such as Bert the Turtle heightened public anxiety.[17] Thus it is understandable that **Environmentalists thought that there was going to be a certain post-nuclear future**: one where either there had been a nuclear holocaust or one where nuclear technology had been declared dead and buried. This drive was immensely important in inspiring dis-armament campaigns, but it is the same **emotional drive that caused Environmentalists to overlook the green benefits of nuclear power, thus stunting the growth of a pro-nuclear environmentalist movement**.

#### **The threat of alternative energy causes massive production increases. Norman 24**

**Norman 24** [Maya A. Norman, Columbia University, Wolfram Schlenker, Research Associate @ Harvard, 5-xx-2024, Empirical Tests of the Green Paradox for Climate Legislation, National Bureau of Economic Research, https://www.nber.org/system/files/working\_papers/w32405/w32405.pdf, accessed 4-3-2025.] //bid daddy yerg + aayush

Climate legislation often establishes goals for the future to give companies and consumers time to adapt and plan for a transition away from fossil fuels. For example, the European Union enacted the goal to be climate neutral (net zero emissions) by 2050, while China established the same goal for 2060. Fossil fuels are exhaustible resources, and their finite availability dictates their use and price path (Hotelling 1931). This scarcity leads to a price that exceeds the marginal extraction cost, resulting in resource rents that ensure less is consumed today and fossil fuels are saved for the future.1 The literature on the “Green Paradox” highlights that **climate legislation**, which limit future fossil fuel use, **give** resource **owners an incentive to extract more in the present** and medium term **before** the **regulation** binds, **leading to lower prices**, accelerated resource depletion, **and higher consumption** today. This theoretical literature is based on Hotelling’s seminal model (Hoel 2010a, Sinn 2008a, Sinn 2008b, Van der Ploeg and Withagen 2012, Van der Ploeg and Withagen 2015). By the same logic, a global carbon tax on fossil fuels with scarcity rents will not be passed on to consumers. If producers did so, then demand for fossil fuels would fall, cumulative consumption would decrease and not all fossil fuels would be used, incentivizing resource owners to lower fossil fuel prices to sell all units. In the end, much of a carbon tax would be absorbed by producer rents with limited effects on fossil fuel use or consumers (Dasgupta, Heal and Stiglitz 1980, Heal and Schlenker 2019). What is common to both a carbon tax and future carbon quantity regulation is the concern that such legislation might not lead to the desired reductions in cumulative fossil fuel use and may even accelerate consumption today through lower prices, limiting the regulation’s effectiveness. On the other hand, the limited pass-through alleviates widely held apprehensions that such policy would have distributional consequences and high personal costs. If the dynamics of Hotelling’s rule shield consumers from a global carbon tax, it would significantly improve public opinion of such a policy (Dechezleprˆetre, Fabre, Kruse, Planterose, Sanchez Chico and Stantcheva 2022). The “Green Paradox” hence has important implications for both the effectiveness of climate legislation in limiting fossil fuel use as well as the pass-through of carbon taxes, yet most of the literature to date has been theoretical. Our paper adds to the emerging empirical literature on the “Green Paradox.” Specifically, we test the predictions of the “Green Paradox” **using several** data **sources on different timescales**. We **consistently find evidence** of the mechanism underlying the “Green Paradox:” additional restrictions on oil use, or an increased likelihood of future restrictions, reduce both the oil spot price and oil futures prices in the years for which futures data are traded, i.e., the following two years. This occurs as supply is reallocated from the future to the present. This pattern holds true when analyzing monthly returns in conjunction with decades-long data on policy stringency, when using high-frequency daily data on oil prices coupled with daily changes in prediction market prices, as well as when estimating the oil price return after unexpected news regarding court cases that limited future fossil fuel use. Empirically testing the “Green Paradox” is difficult because the analysis requires information about firms’ expectations of climate policy stringency for which there is very little data. We side step this challenge through the use of prediction market prices, a measure that captures the market’s expectations, a news based index proxying for information shocks related to climate policy, and unexpected news regarding court cases that mandated changing climate policy. We begin by documenting that oil price shocks, i.e., changes in the daily oil price, have become stickier over the last three decades, implying that shocks have become more permanent rather than transitory. Under the “Green Paradox,” uncertainty from climate legislation deliberations leads to persistent (sticky) price changes, as changes in expectations around future climate **legislation reset the entire future** oil price **path** and hence impact all maturities equally. Consistent with this prediction, we find the **persistence of** spot price **shocks** among maturities ranging from 1 to 24 months greatly increased during periods when climate bills were under consideration (the 2000s and 2010s). Daily changes in the oil spot price translate into roughly the same change in oil futures prices with a maturity one month into the future throughout the sample period. However, the story differs for longer-term maturities: in the 1990s, spot price shocks phased out for oil futures with longer maturities. Specifically, only about a third of the spot price change was reflected in the oil futures with a 24-month maturity. Around 2010, the fraction doubled to two thirds, i.e., daily shocks phased out slower with longer-term maturity futures. This finding only reverses in the 2020s, when COVID-related temporary supply disruptions lead to a decoupling of future and spot price movements. The time profile of how shocks phase out provides an important baseline for subsequent analysis. In a second step, we pair monthly oil price data with monthly estimates of U.S. renewable policy and international climate negotiation salience. We measure policy salience using Noailly, Nowzohour and Van Den Heuvel (2021)’s news-based indices generated by text-mining articles from ten leading US newspapers published between 1981 and 2019. The indices reflect the monthly number of articles covering US renewable policy and international climate negotiations, respectively, relative to the total number of articles published. While the “Green Paradox” makes no direct predictions of the effect of climate policy salience on oil prices, the measure of climate policy salience used in this paper generally tracks events that strengthened future climate policy, i.e., the renewable policy index peaks after the passage of renewable policy. Hence, pairing oil prices with the news based indices can provide a suggestive yet compelling test of the paradox’s prevalence over the last four decades. The “Green Paradox” predicts that the indices should be negatively correlated with oil prices. For example, increases in the international negotiations index indicate international cooperation around climate likely strengthened, elevating the expected stringency of future climate policy, causing oil producers to supply more today, and consequently reducing prices. Consistent with the paradox’s predictions, we find increases in the salience of international climate negotiations significantly reduce oil prices. On the other hand, we find increases in the salience of renewable energy policy significantly increase oil prices. Renewable energy programs have two countervailing effects: strengthening renewable energy policy could reduce the backstop price causing oil producers to increase supply today, reducing oil prices. Alternatively, strengthening of renewable policy has often occurred in place of climate policy, thereby easing the concern that there might be future restriction on fossil fuel use, resulting in higher oil prices as future supply is no longer threatened. Our finding suggests that the latter dominates, i.e., oil **producers do not view current** renewable **policy as a threat** to future oil demand and supply in the future, but instead as a distraction from climate policy, reducing the probability of stricter climate policy in the future. We present tests to rule out reverse causality, i.e., the possibility that higher oil prices correlated with positive oil future returns increased the likelihood that renewable policy passed and renewable policy salience. Specifically, our findings are robust to controlling for the oil spot price. In a third step, we present a direct test of the “Green Paradox” in our preferred specification by pairing daily oil price data with daily estimates of the market’s expectations that Waxman-Markey would pass. Waxman-Markey was a climate bill that intended to limit economy wide greenhouse gas emissions in the U.S. through cap and trade. We retrieve the market’s expectations using prediction market contract prices in 2009 and **2010**. Theory predicts that increases in the probability of a cap and trade bill passing should reduce contemporaneous oil prices and vice versa. Consistent with this prediction, we find a significant negative coefficient; prices of oil futures decline whenever the expected likelihood that the bill will pass increases. This effect is persistent across all futures contracts, even increasing for longer-term maturities, suggesting that the relationship reflects long-term adjustments in the expected oil price path rather than temporary shocks. Through our analysis we find (i) the passage of the **Waxman-Markey bill would** ha**ve increased** global oil **consumption** 2-**4%** and (ii) Waxman-Markey deliberations increased oil consumption by 8-27 million metric tons equivalent to 1-3 days of global oil consumption. We present two pieces of evidence to rule out the possibility that reverse causality could explain our finding, i.e., that lower oil prices associated with negative returns increased the likelihood that a climate bill would pass, or stated differently, opposition to the bill was higher when oil prices were higher. We find that the effect is even larger and more significant when we limit the sample to days with major changes in prediction market prices – these major changes were driven by political negotiations at committee meetings that were scheduled in advance and should not have been influenced by day-to-day oil price movements, ruling out reverse causality. Moreover, there is no qualitative difference in the relationship when we control for the oil spot price. In a falsification check, we find no significant effect if we use a one-period lead in prediction market price changes,2 confirming that prediction market movements on a particular day and the implied news on that day lead to changes in oil future prices. In a fourth step, we construct the abnormal oil price returns on the days two historic climate court cases were made public. Specifically, we study the effect of the surprise Urgenda v. Netherlands rendering, when a Dutch court sided with an environmental group and ordered the Dutch government to have stricter limits on future fossil fuel emissions. When the ruling was announced, people predicted it would set a precedent for all countries subject to the European Convention. Additionally, we study the effect on the day news coverage suggested that Justice Kennedy, the swing vote in the Massachusetts v. EPA Supreme Court case, would support the states suing the EPA to regulate automobile carbon dioxide emissions. At the time that the case was deliberated, numerous additional climate court cases awaited the Supreme Court’s verdict, including a case challenging the EPA’s refusal to regulate power plant carbon dioxide emissions. In both instances, we find significant negative coefficients, i.e., oil futures prices declined when new information increased the expected likelihood of limitations on future fossil fuel use. Taken together, these findings show that the oil market is sensitive to climate laws and that expected restrictions on future fossil fuel use will lead to increased consumption today. The economics of exhaustible resources predicts that discoveries of an exhaustible resource influence the scarcity of a resource and its price (Ekeland, Schlenker, Tankov and Wright 2022). If total availability of an exhaustible resource goes up through a new discovery, the expected future price path resets and is lowered. The effect of climate legislation is analogous: by limiting resource use in the long-term, available resources are shifted towards the short and medium-term. By the same token, scarcity rents will absorb carbon taxes, shielding consumers. Our paper contributes to the emerging empirical literature on the “Green Paradox,” by documenting how environmental laws can increase present-day oil demand through lowering prices. Grafton, Kompas, Long and To (2014) show that increases in biofuel production, a substitute to fossil fuels, increase oil production. Di Maria, Lange and van der Werf (2014) show that the passage of the acid rain program decreased the price of high-sulphur coal. Merrill (2018) finds the out-of-committee introduction of climate related bills in congress accelerate oil and gas firm wellhead investments. Lemoine (2017) observes an abnormal return in coal futures on the day Graham abandoned the Waxman-Markey bill on Monday, April 26, 2010. Barnett (2023) observe abnormal returns in the oil spot price in response to climate transition events – major events in the energy industry, election results, and other major shifts in climate policy. A challenge of previous papers is to determine when the market updated its beliefs about the likelihood of a policy change. The “Green Paradox” is derived from expectations of future prices, and markets might see and react to an impending regulation before it is officially implemented and ratified (Dube, Kaplan and Naidu 2011, McDermott, Meng, McDonald and Costello 2019, Langer and Lemoine 2020). Lemoine (2017), Merrill (2018), and Di Maria et al. (2014) test the paradox’s predictions using policy or information shocks occurring at a specific moment, relying on comparisons between the period before and after a single shock. Grafton et al. (2014) uses annual variation in biofuel production as a proxy for annual variation in biofuel subsidies to test the paradox. Barnett (2023) interacts climate transition events with a portfolio tracking the response of firms highly exposed to climate transition risk to account for and recover dynamics in the magnitude and timing of transition events. We see the novelty of our paper as follows: our approach’s reliance on monthly and daily information shocks allow us to both capture how the policy making process – announcements, deliberation, redrafting, and upheavals – impacts oil prices and employ more convincing variation in the market’s beliefs regarding the stringency of future climate policy. Additionally, the referenced empirical “Green Paradox” literature might be susceptible to reverse causality. For political economy reasons, a bill might be more easily passed when a resource was declining in economic importance and the price was falling. Or, a subsidy might be more easily implemented when there is generally more demand for fuel. In both cases, estimates of the “Green Paradox” could instead reflect reverse causality. A key innovation of our paper is that our approach is more defensible against the concerns of reverse causality as we employ a panel data set encompassing numerous daily changes in expectations that occurred in response to previously scheduled committee meetings. These meetings, scheduled weeks or months in advance, are unlikely to coincide with daily oil spot price shocks Our paper builds most closely on Lemoine (2017) and reinforces its findings. We make several additional contributions: first, our analysis is less likely to be confounded by other events as our analysis relies on various time scales including high-frequency daily data.

#### **Allowing big oil to expand is devastating. Miller 21**

**Miller 21** [Anna Miller, leads the media and external communication strategy at Harvard Chan C-CHANGE, translating the Center’s research into messages that are actionable, accessible, and personal. She works with the media, policymakers, health care providers, and researchers to turn science into climate action that improves health. Miller received her Master’s in Public Health from Harvard T.H. Chan School of Public Health in 2019, 2-9-2021, Fossil fuel air pollution responsible for 1 in 5 deaths worldwide, Harvard T.H. Chan School of Public Health, https://hsph.harvard.edu/climate-health-c-change/news/fossil-fuel-air-pollution-responsible-for-1-in-5-deaths-worldwide/, accessed 3-29-2025.] //aayush

**New research from Harvard University**, in collaboration with the University of Birmingham, the University of Leicester and University College London, **found that more than 8 million people died in 2018 from fossil fuel pollution**, **significantly higher than previous research suggested**—**meaning that air pollution from burning fossil fuels like coal and diesel was responsible for about 1 in 5 deaths worldwide**. The study, “Global Mortality From Outdoor Fine Particle Pollution Generated by Fossil Fuel Combustion,” published in Environmental Research, is based on a groundbreaking analysis that enabled the researchers to **directly attribute premature deaths from fine particulate pollution (PM 2.5) to fossil fuel combustion**. “Often, **when we discuss the dangers of fossil fuel combustion, it’s in the context of CO2 and climate change and overlook the potential health impact of the pollutants co-emitted with greenhouse gases**,” said Dr. Joel Schwartz, Professor at Harvard Chan School and co-author of the study. “We hope that **by quantifying the health consequences of fossil fuel combustion, we can send a clear message to policymakers and stakeholders of the benefits of a transition to alternative energy sources**.” The findings underscore the **detrimental impact of fossil fuels on global health**. “The health gains we can achieve from getting off fossil fuels is twice what we thought it was yesterday,” said Dr. Aaron Bernstein, Director of the Center for Climate, Health, and the Global Environment at Harvard Chan School. “The Global Burden of Disease study estimated deaths from fossil fuels numbered 4.2 million in 2015, but thanks to more rigorous science, we can now see that **fossil fuels cause far more harm than previously understood. Now more than ever we can see the healthier, more just and sustainable world that climate actions can deliver**.”

#### **Don’t sacrifice lives for Trump’s big tech empire. Negate.**

Rebuttal ev

**Gardner 24** [Timothy Gardner, 4-24-2024, "US as many as 15 years behind China on nuclear power, report says", Reuters, <https://www.reuters.com/business/energy/us-many-15-years-behind-china-nuclear-power-report-says-2024-06-17/>] //bid daddy yerg

WASHINGTON, June 17 (Reuters) - **The U.S. is as many as 15 years behind China on developing high-tech nuclear power as Beijing's state-backed technology approach and extensive financing give it the edge**, a report said on Monday. **China has 27 nuclear reactors under construction with average construction timelines of about seven years, far faster than other countries**, said the study by Information Technology & Innovation Foundation, a Washington-based nonpartisan research institute. "China’s rapid deployment of ever-more modern nuclear power plants over time produces significant scale economies and learning-by-doing effects, and this suggests that Chinese enterprises will gain an advantage at incremental innovation in this sector going forward," the report said. The U.S. has the world's largest fleet of nuclear power plants and President Joe Biden's administration considers the virtually emissions-free electricity source to be critical in curbing climate change. But after two large plants in Georgia came online in 2023 and 2024 billions of dollars over budget and delayed by years, no U.S. nuclear reactors are being built. A high-tech plant that had been planned to be built at a U.S. lab was canceled last year.

**Sobalvarro 25** [Wilson Center, April, Sarah Sobalvarro is an intern at the Wahba Institute for Strategic Competition at the Wilson Center, and is currently pursuing a Master's degree in Security Studies at the Walsh School of Foreign Service at Georgetown University. She holds a BA in International Relations from the War Studies Department at King's College London. Her undergraduate dissertation focused on the security risks stemming from state-led commercial nuclear export programs to non-nuclear countries, a topic which she presented on at the Royal United Services Institute’s UK Project on Nuclear Issues Annual Conference this past September., "US Inaction Is Ceding the Global Nuclear Market to China and Russia", <https://www.wilsoncenter.org/article/us-inaction-ceding-global-nuclear-market-china-and-russia>] //bid daddy yerg

The closest that the US may have come in recent years to a nuclear export plan was Project Phoenix, a plan under the Biden administration to offer technical assistance and support feasibility studies to countries seeking small modular reactors. Although it involved nuclear cooperation between the US and Global South, Project Phoenix was not an export plan and did not involve nuclear investment or construction. One of the main impediments to a US export plan is a lack of government financing. Previous legislation, such as the Bipartisan Infrastructure Law of 2021, **the Inflation Reduction Act of 2022, and the Nuclear Fuel Security Act have helped to generate funding for nuclear energy, but primarily support domestic nuclear advancement. A government-regulated nuclear export plan would require significant financial resources.**

**Scoles**, Sarah. “Why We’ll Never Live in Space.” Scientific American, October **2023**. <https://www.scientificamerican.com/article/why-well-never-live-in-space/>. [Sarah Scoles is a Colorado-based science journalist, a contributing editor at Scientific American and a senior contributor at Undark. Her newest book is Countdown: The Blinding Future of Nuclear Weapons (Bold Type Books, 2024).] //arrguy

**Human bodies** really **can't handle space.** Spaceflight damages DNA, changes the microbiome, disrupts circadian rhythms, impairs vision, increases the risk of cancer, causes muscle and bone loss, inhibits the immune system, weakens the heart, and shifts fluids toward the head, which may be pathological for the brain over the long term—among other things. At the University of California, San Francisco, medical researcher Sonja Schrepfer has dug into two of the conditions that afflict space explorers. Her research, using mice floating within the International Space Station, has revealed that blood vessels leading to the brain get stiffer in microgravity. It's part of why today's astronauts can't simply walk out of their capsules once they return to Earth, and it would play out the same way on Mars—where there's no one to wheel them to their new habitat on arrival. Schrepfer and her colleagues did, however, uncover a molecular pathway that might prevent those cardiovascular changes. “But now the question I try to understand is, Do we want that?” she says. Maybe the vessels' stiffening is a protective mechanism, Schrepfer suggests, and limbering them up might cause other problems. **She also wants to figure out how to help astronauts' faltering immune systems, which look older and have a harder time repairing tissue damage than they should after spending time in space.** “The immune system is aging quite fast in microgravity,” Schrepfer says. She sends biological samples from young, healthy people on Earth up to orbit on tissue chips and tracks how they degrade. Vision and bone problems are also among the more serious side effects. **When astronauts spend a month or more in space, their eyeballs flatten, one aspect of a condition called spaceflight-associated neuro-ocular syndrome, which can cause long-lasting damage to eyesight.** Bones and muscles are built for life on Earth, which involves the ever present pull of gravity. The work the body does against gravity to stay upright and move around keeps muscles from atrophying and stimulates bone growth. **In space, without a force to push against, astronauts can experience bone loss that outpaces bone growth, and their muscles shrink.** That's why they must do hours of exercise every day, using specialized equipment that helps to simulate some of the forces their anatomy would feel on the ground—and even this training doesn't fully alleviate the loss. **Perhaps the most significant concern about bodies in space, though, is radiation, something that is manageable for today's astronauts flying in low-Earth orbit but would be a bigger deal for people traveling farther and for longer. Some of it comes from the sun, which spews naked protons that can damage DNA, particularly during solar storms. “[That] could make you very, very sick and give you acute radiation syndrome,” says Dorit Donoviel, a professor at the Baylor College of Medicine and director of the Translational Research Institute for Space Health (TRISH).** Future astronauts could use water—perhaps pumped into the walls of a shelter—to shield themselves from these protons. But scientists don't always know when the sun will be spitting out lots of particles. “So if, for example, astronauts are exploring the surface of the moon, and there is a solar particle event coming, we probably have the capability of predicting it within about 20 to 30 minutes max,” Donoviel says. That means we need better prediction and detection—and we'd need astronauts to stay close to their H2O shield.

**Crimmins**, Tricia. “How the US Climate Alliance Is Responding to Trump’s Second Term.” Tech Brew. Morning Brew, February 13, **2025**. [**https://www.emergingtechbrew.com/stories/2025/02/13/us-climate-alliance-trump-second-term-casey-katims**](https://www.emergingtechbrew.com/stories/2025/02/13/us-climate-alliance-trump-second-term-casey-katims). [Tricia Crimmins is a Senior Reporter on the politics and tech team covering discrimination, identity, and the 2024 election. She is part of the adjunct faculty at Columbia University Graduate School of Journalism and has interned and freelanced for Moment Magazine. She was an entertainment editorial fellow at Mashable and interned at Mic and the U.S. House of Representatives. Crimmins has a bachelor’s degree from Bates College in Maine and a master’s degree from Columbia University Graduate School of Journalism.] //arrguy

**On June 1, 2017, shortly after President Donald Trump withdrew the US from the Paris Climate Agreement, the governors of New York, Washington, and California announced that they were forming the US Climate Alliance and committed to reducing their states’ greenhouse gas emissions by 26% to 28%.** During Trump’s first term, the alliance made good on its promise to reduce state emissions, widened access to clean energy, and created clean energy jobs. **The group’s work didn’t stop while President Joe Biden was in office, but now that Trump has withdrawn the US from the Paris Climate Agreement again, the alliance is ready to leverage its collective power against climate rollbacks.** Tech Brew talked with Casey Katims, USCA’s executive director, about Trump’s second term, climate-focused executive orders, and what’s next for the group. What are the US Climate Alliance’s plans for the second Trump administration? How is this going to be different from his first term? Governors understand that the climate crisis demands action, and that the crisis doesn’t pause just because there’s a change in federal administration. So, governors across the US Climate Alliance are committed to advancing climate solutions and continuing to press forward toward our climate goals and climate targets because it is a scientific imperative, regardless of what happens at the federal level. Our coalition got its start seven and a half years ago when President Trump yanked the US out of the Paris agreement the last time. So we were quite literally built for this moment. And the good news is that states continue to have broad authority under the US Constitution to advance solutions to the climate crisis…The commitment and resolve that the alliance has for tackling this crisis isn’t going to change. It [now] means that we don’t necessarily have a partner in the federal government in our work. That’s not a new challenge to our governors. During the first Trump administration, US Climate Alliance governors learned really effective strategies for how to tap their authority and their experience at the state level, and how to leverage their collective market share. **The alliance represents, collectively, 60% of the US economy, 55% of the US population.** There’s a capability for [us] acting together to transform markets and to adopt substantially similar solutions that make a meaningful impact, that reduce greenhouse gas emissions, that increase resilience to the climate crisis, and put us on a path to a safer, cleaner future. Any reactions to Trump’s climate-focused executive orders? And what sort of strategies will the alliance be using to get around those? There’s a lot of things that the executive orders don’t change. The executive orders don’t change the fact that the climate crisis is here…And they don’t change the economic benefits that are delivered to consumers, households, and businesses from taking action on climate. These technologies of the future are, in many cases, lower-cost, more efficient, more effective, and better technology. The executive order can’t stop the deployment of cleaner technologies like heat pumps. It’s not going to stop the EV transition. In many cases, the Trump administration may act more like a speed bump than a roadblock on our way to the net-zero future, and some of those technological and scientific shifts that our society is going through are not impacted by the executive order as much as the president may wish that they were.

**Randers et al. 20,** Jorgen Randers [BI Norwegian Business School, Oslo, Norway] and Ulrich Goluke [BI Norwegian Business School, Oslo, Norway] “An earth system model shows self-sustained thawing of permafrost even if all man-made GHG emissions stop in 2020” Scientific Reports volume 10, Article number: 18456 (2020), 2020, <<https://www.nature.com/articles/s41598-020-75481-z#Abs1>> // angel

**The risk of points-of-no-return, which, once surpassed lock the world into new dynamics,** have been discussed for decades. Recently, there have been **warnings that some of these tipping points are coming closer and are too dangerous to be disregarded. In this paper we report that in the ESCIMO climate model the world is already past a point-of-no-return for global warming.** In **ESCIMO we observe self-sustained thawing of the permafrost for hundreds of years, even if global society stops all emissions of man-made GHGs immediately.** We encourage other model builders to explore our discovery in their (bigger) models, and report on their findings. **The thawing (in ESCIMO) is the result of a continuing self-sustained rise in the global temperature.** This warming is the **combined effect of three physical processes: (1) declining surface albedo (driven by melting of the Arctic ice cover), (2) increasing amounts of water vapour in the atmosphere (driven by higher temperatures), and (3) changes in the concentrations of the GHG in the atmosphere** (driven by the absorption of CO2 in biomass and oceans, and emission of carbon (CH4 and CO2) from thawing permafrost). This **self-sustained, in the sense of no further GHG emissions, thawing process (in ESCIMO) is a causally determined, physical process that evolves over time.** It starts with the man-made warming up to the 1950s, leading to a rise in the amount of water vapour in the atmosphere—**further lifting the temperature, causing increasing release of carbon from thawing permafrost, and simultaneously a decline in the surface albedo as the ice and snow covers melts. To stop the self-sustained warming in ESCIMO, enormous amounts of CO2 have to be extracted from the atmosphere.**