1NC:

C1: Terror

Uranium imports down.

Irina **Slav**, 4/1/20**25**, "U.S. Uranium Market Goes Radio Silent on Tariff Shock", OilPrice, https://oilprice.com/Alternative-Energy/Nuclear-Power/US-Uranium-Market-Goes-Radio-Silent-on-Tariff-Shock.html //Spok

Uranium purchases in the United States have slowed considerably as power utilities process the effect of President Donald Trump's tariff offensive in the market—and that offensive may yet transform that same market. Bloomberg reported this week that **uranium purchases by U.S. power utilities had dropped by 50% ahead of the 10% import tariff that Trump imposed on Canadian energy exports.** The publication noted that those power utilities source more than a quarter of their uranium from Canada, which makes the **potential impact of the tariffs rather palpable.**

Aff restarts the demand, and requires materials come from shipping routes

EPA 25,03-05-25, "Transportation of Radioactive Material," US EPA, https://www.epa.gov/radtown/transportation-radioactive-material, accessed 4-5-2025/SidRev

Most radioactive material is shipped on the highway. When transporting materials that are **highly radioactive, shipping routes are picked** very carefully and shipments are tracked. Sometimes, these shipments are escorted to provide extra security. Depending on the level of radioactivity, **shipments** may have to follow the most direct route while bypassing heavily populated areas.

Drivers who transport radioactive material are trained in basic radiation science and in radiation emergency safety. Safety and training practices make sure that the materials and packages are handled properly so that they cannot harm workers, the public, or the environment.

While **not all radioactive material is highly radioactive,** there are special requirements in place when transporting the most hazardous radioactive materials. Very high-level radioactive materials, such as spent nuclear fuel, must be shipped in specially designed containers called casks. These casks are designed to contain the high-level radioactive material even if there's an accident. Casks undergo a series of extreme tests before they are used, such as:

Reliance on foreign suppliers increases nuclear terror risks

Squassoni '24 [Sharon; Research Professor of International Affairs @ the George Washington University; April; George Washington University; "New Nuclear Energy: Assessing the National Security Risks," https://bpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/1053/files/2024/04/NewNuclearRisk_Report_2024_v4-1-0b59385f1c7d4153.pdf; DOA: 3-23-2025] //Spok + Lex RR—SR --- recut shassy

The proliferation of nuclear weapons is the key national security risk associated with nuclear energy. But nuclear power plants also pose risks for **nuclear terrorism** and have been targeted for sabotage, coercion, and military operations. A less acute but persistent national security challenge is **dependence on foreign suppliers.** To date, treaties, agreements, inspections, and monitoring together have managed these risks, but **the concentration of nuclear power worldwide has helped.** A different future is being charted that is likely to feature much less cooperation and potentially greater dispersal of nuclear capabilities across the globe. **Small modular reactor designs do little to reduce the existing national security risks of nuclear power and may in fact increase those risks under some circumstances.** Proliferation and nuclear **terrorism** risks. Misusing materials, equipment, technology, and skills acquired for peaceful purposes to support and build a nuclear weapons program is the most prominent national security risk associated with the spread of nuclear power. The larger and more sophisticated a nuclear energy program is, the easier it is to use facilities and equipment for malign purposes **without detection.** Over time, the risks of commercial reactors have been downplayed relative to the risks of fuel cycle facilities like uranium enrichment and spent fuel reprocessing. Government officials largely have convinced themselves that as long as states only buy reactors, and don't dabble in fuel-making processes, they can avoid the em

The NRC's is uniquely unprepared for an increase

GAO 24 (Government Accountability Office, independent, nonpartisan government agency within the legislative branch that provides auditing, evaluative, and investigative services for the United States Congress, September 2024, "PREVENTING A DIRTY BOMB Nuclear Regulatory Commission Has Not Taken Steps to Address Certain Radiological Security Risks", GAO, https://www.gao.gov/assets/gao-24-107014.pdf, DOA 3/28/2025) ESR --- recut shassy

NRC has not implemented the majority of the **actions** we have **recommended that would reduce the risk of a** radiological disaster resulting from a **dirty bomb**. Specifically, **NRC has not implemented 11 out of 18 actions** we have **recommended since 2012**. These unimplemented recommendations generally fall into two categories. First, NRC has not taken action to consider socioeconomic consequences in its decision-making criteria for determining security requirements for radioactive materials. Second, **NRC has not taken** the majority of the **actions** we have **recommended to strengthen the security of category 3 quantities of radioactive materials**. As stated previously, NRC has not incorporated consideration of the socioeconomic consequences of a dirty bomb into its decision-making when assessing risk for the development of security measures. So that NRC could be better assured its requirements reflect these significant and more likely consequences, in 2019 we recommended that NRC account for socioeconomic consequences in its decision-making regarding security measures for materials that could be used in a dirty bomb.41 NRC disagreed and, in its comments on our 2019 report, stated that the likelihood of a dirty bomb was low and its regulations were sufficient to provide for the safe and secure use of radioactive materials. Officials we interviewed for this report stated that this remains NRC's position today and confirmed that NRC does not plan to implement this recommendation.

Nuclear Shipments Via Oceans Are Terrorizable

Smith 06 [Dr Ron Smith, Director of International Relations and Security Studies at the University of Waikato, Hamilton, New Zealand. "Terrorism and the Shipment of Nuclear Material", published 2006. The study was carried out with the cooperation and support of the nuclear companies in Japan, France and the United Kingdom, who are responsible for most of the present transportation of nuclear material on dedicated ships. These are, respectively, the Overseas Reprocessing Company of Japan; Areva, France; and British Nuclear Fuels Limited (now the Nuclear Decommissioning Authority). Through them the author was able to meet with officials responsible for preparing cargoes and conducting the shipments as well as persons in the various security agencies in the countries concerned, who were responsible (in concert with the relevant company officials) for making security arrangements. The author was also able to see the facilities and technology for handling the various cargoes, including the ships and the technology associated with packaging them for transportation, as well as the training and equipment of the security personnel involved. https://www.pntl.co.uk/2006/09/terrorism-and-the-maritime-shipment-of-nuclear-material/]//dshah

After all this, what we are left with is fire and explosion. Assuming the ship to have been taken over, fires could be started in various places, with the normal fire-fighting mechanisms disabled. Like the immersion contingencies, this contingency has also been studied in the context of accidental fire[27] and the results of this study may be applied to the supposed terrorist-sabotage case. In general, the sort of package used for the transportation of nuclear materials is resistant to all but the hottest and most persistent of fires (which are unlikely to occur accidentally in the hold of the ship)[28]. To achieve any breach of the package seals would require the contrivance of high temperatures for a prolonged period. This, in turn, suggests that there would be a need for additional combustible material, which would have to be procured from somewhere and loaded, which would, in turn, suggest further substantial logistical problems. Even at the end of all this effort, the amount of radioactive material released to the environment might be trivially small. Taking control of an oil tanker (or, better still, an LNG tanker) and setting that on fire would seem to be a far better bet, in terms of public spectacle.[29]

There is a final possibility to be considered, and that is that **terrorists** who have taken over the ship **use explosive** (and, especially, 'shaped') **charges to breach the shipping casks and release** some quantity of the **nuclear material** within. The Greenpeace International consultants discussed this possibility at some length in the context of the French overland component of US plutonium shipments to France. In the course of this discussion, they claimed that **tests performed by** the French nuclear protection institute **(IRSN) show** that **the FS47 cask** (as used in the Eurofab case) **is vulnerable to breach by** advanced **modern** shaped-charge **munitions, and** that this **could result in the ejection of a significant quantity** of the plutonium oxide powder (although IRSN deny this). Given the consultants' further claim that such an outcome could be achieved through the deployment of a rocket-propelled grenade, it may be that there is some need for further scientific testing. The experts at IRSN are currently engaged in evaluating a whole range of scenarios involving different shipping containers and differing contents against possible modes of assault. Of course, it would not be in the interests of security to make the results of these tests public and, in any case, this can never be a static situation. As in other contexts, the security authorities need to continue to respond to innovation on the part of potential threat groups. On the other hand there is no need for them to assist the latter by telling them of the progress they have made.

Spread enables WMDs.

Squassoni '24 [Sharon; Research Professor of International Affairs @ the George Washington University; April; George Washington University; "New Nuclear Energy: Assessing the National Security Risks," https://bpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/1053/files/2024/04/NewNuclearRisk_Report_2024_v4-1-0b59385f1c7d4153.pdf; DOA: 3-23-2025] tristan

At the time of the 2008 ISAB report, small modular reactors were not being widely considered as potentially influencing the spread of nuclear power.64 Yet a successful "**SMR revolution**" could **lower** the **political**, **technical**, and **financial barriers** to entry into the **nuclear** field **significantly**. In some regions, political instability or **terrorist activity** could **increase** risks for nuclear energy. For those countries that do not already have nuclear research reactors, developing the scientific and engineering skills associated with nuclear power would enhance their proliferation potential, triggering concern in neighboring states about the possibility that these countries could develop weapons programs.

In addition to more states deploying nuclear energy, more **reactors** will **require** more **fuel services**. An "SMR revolution" limited to light water reactor designs may not increase proliferation risks if countries forego reprocessing. But it would still require **expanded enrichment** capacity. In particular, small modular reactors that require infrequent refueling operate less efficiently with that fuel, requiring **more uranium to be mined, processed and enriched**.65 **An increase in the number of enrichment plants around the world, particularly if they are located in new countries, would raise proliferation risks.**

Widespread use of reactors fueled by HEU or plutonium would certainly increase the risks of proliferation and terrorism since those materials are weapons-usable. But even the greater use of high-assay low-enriched (HALEU) fuel could heighten proliferation and terrorism risks compared to the status quo. HALEU would be impractical to use directly in a nuclear weapon, but it is not impossible. One calculation is that 300kg of 19.75% enriched HALEU would be needed in a nuclear weapon; a single Oklo microreactor would contain enough material for 10 bombs.66

Similarly, reactor designs that feature **lifetime cores** begin with a higher load of fissile material and continue to produce plutonium in the fuel. One estimate is that a 200 MWe lifetime core reactor could contain 1000kg of plutonium after seven years and 3000 kg of plutonium after 30 years.67 This is **hundreds** of **weapons'** worth of plutonium in a single core.

Lastly, SMR designs that incorporate continuous recycle of fuel may pose the highest proliferation risk. These can include designs that integrate pyroprocessing, a version of reprocessing

As in 2008, **nuclear energy** is still highly **concentrated** in a comparatively **small** number of **countries**. The top generators of nuclear electricity constitute about seventy percent of global capacity. Two-thirds of countries with commercial nuclear power have 5 or fewer reactors while fewer than ten countries have ten or more. The **promotion** of **SMRs** could **change** those **numbers** drastically, with two to three times as many countries operating nuclear power plants. Even if the risk of proliferation remains constant, a **growing number** of reactors provides **additional targets** for **sabotage**, coercion, blackmail or military operations. Reactors that are housed underground could mitigate some of the risks that might accrue from increased numbers of reactors, likely at an increased cost.

For many countries, the attacks on, coercion of and misinformation propagated about Ukraine's nuclear energy program since last year may be perceived as local, aberrant risks brought about by war. Indeed, before Russia's invasion of Ukraine, the shelling of nuclear power plants was unthinkable in the context of central Europe. However, national security risks can materialize in situations short of war if nuclear energy expands to countries with fragile governance structures and experience.

The 2008 ISAB study identified 30 countries that did not have nuclear power but were interested in moving ahead. The table below lists those countries according to how far their plans have developed and their supplier relationships as well as other countries that have a developed an interest in nuclear power since 2008.68 Most importantly, Table 2 includes all countries' ranking in the 2022 Fragile States Index. (The Fragile States Index ranks countries in terms of their sustainability, using three measures in four areas: cohesion, economics, political legitimacy and social/cross-cutting indicators.) Finally, the table highlights where countries have specifically noted an interest in SMRs and those that might have potential interest based on the existence of an electrical grid smaller than 20 GWe. Those countries highlighted in bold text already have nuclear power plants under construction, all by Russian vendors.

Many of the **countries** that have **expressed** an **interest** in nuclear power may never move forward. More than **half**, however, **appeared** in the **Fragile States Index** with a rating of "Warning" or higher and three– Syria, Sudan, and Myanmar – appeared in the "High Alert" category.

Perception of nuclear terror causes extinction.

Hayes '18 [Peter; PhD from Yale University, Director of the Nautilus Institute, Honorary Professor @ the Centre for International Security Studies @ the University of Sydney, Former Professor @ Northwestern University; January 18; Nautilus Institute; "NON-STATE TERRORISM AND INADVERTENT NUCLEAR WAR," https://nautilus.org/napsnet/napsnet-special-reports/non-state-terrorism-and-inadvertent-nuclear-war/; DOA: 3-19-2025] tristan **brackets & ellipses r og**

Early **warning systems** fail or are "**tripped**" in ways that lead to **launch**-on-**warning** Accidental nuclear detonation, including sub-critical explosions. **Strategic miscalculation** in crisis, **show** of **force**. **Decision-making failure** (such as irrational, **misperception**, bias, degraded, group, and **time-compressed** decision-making) Allied or enemy **choices** (to **seek revenge**, to exploit nuclear risk, to act out of **desperation**) Organizational cybernetics whereby a nuclear command-control-and communications (NC3) system generates error, including the interplay of national NC3 systems in what may be termed the meta-NC3 system. Exactly how, where, and when nuclear terrorism may "ambush" nuclear armed states already heading for or on such a path to inadvertent nuclear war depends on who is targeting whom at a given time, either immediately due to high tension, or generally due to a structural conflict between states. Nuclear armed states today form a complex set of global threat relationships that are not distributed uniformly across the face of Earth. Rather, based on sheer firepower and reach, the nine nuclear weapons states form a global hierarchy with at least four tiers, viz: Tier 1: United States, clear technological supremacy and qualitative edge. Tier 2: Russia, China, global nuclear powers and peers with the United States due to the unique destructive power of even relatively small nuclear arsenals, combined with global reach of missile and bomber delivery systems, thereby constituting a two-tiered global "nuclear triangle" with the United States. Tier 3: France, UK, NATO nuclear sharing and delivery NATO members (Belgium, Germany, Italy, the Netherlands and Turkey) and the NATO and Pacific nuclear umbrella states (Japan, South Korea, Australia) that depend on American nuclear extended deterrence and directly and indirectly support US and US-allied nuclear operations even though they do not host nor deliver nuclear weapons themselves. Tier 4: India, Pakistan, Israel, DPRK. The first two tiers constitute the global nuclear threat triangle that exists between the United States, Russia, and China, forming a global nuclear "truel." Each of these states targets the other s; each represents an existential threat to the other; and each has a long history of mutual nuclear threat that is now a core element of their strategic identity. Tier three consists of states with their own nuclear force but integrated with that of the United States (even France!) that expand the zone of mutual nuclear threat over much of the northern and even parts of the southern hemisphere; and states that host American nuclear command, control, communications, and intelligence systems that support US nuclear operations and to whom nuclear deterrence is "extended" (if, for example, Australia's claim to having an American nuclear umbrella is believed). The fourth tier is composed of smaller nuclear forces with a primarily regional reach and focus. Between most of these nuclear armed states and across the tiers, there are few shared "rules of the road." The more of these states that are engaged in a specific conflict and location, the more unpredictable and unstable this global nuclear threat system becomes, with the potential for cascading and concatenating effects. Indeed, as the number of nuclear states projecting nuclear threat against each other increases, the notion of strategic stability may lose all meaning. The emergence of a fifth tier—of non-state actors with the capacity to project nuclear threat against nuclear-armed and nuclear umbrella states (although not only these states)—is a critically important possible catalytic actor in the new conditions of nuclear threat complexity that already exist today. Such a layer represents an "edge of chaos" where the attempts by nuclear armed states to exert absolute "vertical" control over the use of nuclear weapons confront the potential of non-state entities and even individuals (insiders) to engage in "horizontal" nuclear terrorism, presenting radically different control imperatives to the standard paradigm of organizational procedures, technical measures, and safeguards of various kinds. This tier is like the waves and tides on a beach that quickly surrounds and then causes sand castles to collapse. In 2010, Robert Ayson reviewed the potential linkages between inter-state nuclear war and non-state terrorism. He concluded: "…[T]hese two nuclear worlds—a non-state actor nuclear attack and a catastrophic interstate nuclear exchange—are not necessarily separable. It is just possible that some sort of terrorist attack, and especially an act of nuclear terrorism, could precipitate a chain of events leading to a massive exchange of nuclear weapons between two or more of the states that possess them."[5] How this linkage might unfold is the subject of the next sections of this essay. Are non-state actors motivated and able to attempt nuclear terrorism? A diverse set of non-state actors have engaged in terrorist activities—for which there is no simple or consensual definition. In 2011, there were more than 6,900 known extremist, terrorist and other organizations associated with guerrilla warfare, political violence, protest, organized crime and cyber-crime. Of these, about 120 terrorist and extremist groups had been blacklisted by the United Nations, the European Union and six major countries.[6] Some have argued that the technical, organizational, and funding demanded for a successful nuclear attack, especially involving nuclear weapons, exceeds the capacity of most of the non-state actors with terrorist proclivities. Unfortunately, this assertion is not true, especially at lower levels of impact as shown in Figure 1; but even at the highest levels of obtaining authentic nuclear weapons capabilities, a small number of non-state actors already exhibit the motivation and possible capacity to become nuclear-armed. Ellingsen suggests a useful distinction that nuclear terrorists may be impelled by two divergent motivations, as shown in Figure 2, creating "opportunistic" and "patient" profiles.[7] The requirements for an opportunist non-state nuclear terrorist tend towards immediate use and the search for short-term payoffs with only tactical levels of commitment; whereas the patient non-state nuclear terrorist is able and willing to sustain a long-term acquisition effort to deal a strategic blow to an adversary in a manner that could be achieved only with nuclear weapons. In turn, many factors will drive how a potential nuclear terrorist non-state organization that obtains nuclear weapons or materials may seek to employ them, especially in its nuclear command-and-control orientations. Blair and Ackerman suggest that the goals, conditions, and capacity limitations that shape a possible nuclear terrorist's posture lead logically to three types of nuclear terrorist nuclear command-and-control postures, viz: pre-determined (in which the leadership sends a fire order to a nuclear-armed subordinate and no change is entertained and no capacity to effect change is established in the field, that is, the order is fire-and-forget); assertive (in which only the central command can issue a nuclear fire order, central control is maintained at all times, with resulting demanding communications systems to support such control); and delegative (in which lower level commanders control nuclear weapons and have pre-delegated authority to use them in defined circumstances, for example, evidence of nuclear explosions combined with loss-of-connectivity with their central command).[8] An example of such delegative control system was the November 26, 2008 attack on Mumbai that used social media reporting to enable the attacking terrorists to respond to distant controller direction and to adapt to counter-terrorist attacks—a connectivity tactic that the authorities were too slow to shut down before mayhem was achieved.[9] Logically, one might expect nuclear terrorists oriented toward short-term, tactical goals to employ pre-determined nuclear command-and-control strategies in the hope that the speed of attack and minimum field communications avoids discovery and interdiction before the attack is complete; whereas nuclear terrorists oriented toward long-term, strategic goals might employ more pre-delegative command-and-control systems that would support a bargaining use and therefore a field capacity to deploy nuclear weapons or materials that can calibrate actual attack based on communications with the central leadership with the risk of interdiction through surveillance and counter-attack. These differing strategic motivations, timelines, and strategies in many respects invert those of nuclear weapons states that rely on large organizations, procedures, and technical controls, to ensure that nuclear weapons are never used without legitimate authorization; and if they are used, to minimize needless civilian casualties (at least some nuclear armed states aspire to this outcome). The repertoire of state-based practices that presents other states with credible nuclear threat and reassures them that nuclear weapons are secure and controlled is likely to be completely mismatched with the strengths and strategies of non-state nuclear terrorists that may seek to maximize civilian terror, are not always concerned about their own survival or even that of their families and communities-of-origin, and may be willing to take extraordinary risk combined with creativity to exploit the opportunities for attack presented by nuclear weapons, umbrella, and non-nuclear states, or their private adversaries. For non-state actors to succeed at complex engineering project such as acquiring a nuclear weapons or nuclear threat capacity demands substantial effort. Gary Ackerman specifies that to have a chance of succeeding, non-state actors with nuclear weapons aspirations must be able to demonstrate that they control substantial resources, have a safe haven in which to conduct research and development, have their own or procured expertise, are able to learn from failing and have the stamina and strategic commitment to do so, and manifest long-term planning and ability to make rational choices on decadal timelines. He identified five such violent non-state actors who already conducted such engineering projects (see Figure 3), and also noted the important facilitating condition of a global network of expertize and hardware. Thus, although the skill, financial, and materiel requirements of a non-state nuclear weapons project present a high bar, they are certainly reachable. Along similar lines, James Forest examined the extent to which non-state actors can pose a threat of nuclear terrorism.[10] He notes that such entities face practical constraints, including expense, the obstacles to stealing many essential elements for nuclear weapons, the risk of discovery, and the difficulties of constructing and concealing such weapons. He also recognizes the strategic constraints that work against obtaining nuclear weapons, including a cost-benefit analysis, possible de-legitimation that might follow from perceived genocidal intent or use, and the primacy of political-ideological objectives over long-term projects that might lead to the group's elimination, the availability of cheaper and more effective alternatives that would be foregone by pursuit of nuclear weapons, and the risk of failure and/or discovery before successful acquisition and use occurs. In the past, almost all—but not all—non-state terrorist groups appeared to be restrained by a combination of high practical and strategic constraints, plus their own cost-benefit analysis of the opportunity costs of pursuing nuclear weapons. However, should some or all of these constraints diminish, a rapid non-state nuclear proliferation is possible. Although only a few non-state actors such as Al Qaeda and Islamic State have exhibited such underlying stamina and organizational capacities and actually attempted to obtain nuclear weapons-related skills, hardware, and materials, the past is not prologue. An incredibly diverse set of variously motivated terrorist groups exist already, including politico-ideological, apocalyptic-millenarian, politico-religious, nationalist-separatist, ecological, and political-insurgency entities, some of which converge with criminal-military and criminal-scientist (profit based) networks; but also pyscho-pathological mass killing cults, lone wolves, and ephemeral copy-cat non-state actors. The social, economic, and deculturating conditions that generate such entities are likely to persist and even expand. In particular, rapidly growing coastal mega-cities as part of rapid global urbanization offer such actors the ability to sustain themselves as "flow gatekeepers," possibly in alliance with global criminal networks, thereby supplanting the highland origins of many of today's non-state violent actors with global reach.[11] Other contributing factors contributing to the supply of possible non-state actors seeking nuclear weapons include new entries such as city states in search of new security strategies, megacities creating their own transnationally active security forces, non-states with partial or complete territorial control such as Taiwan and various micro-states, failing states, provinces in dissociating, failing states that fall victim to internal chaos and the displacement effects of untrammeled globalization, and altogether failed states resulting in ungoverned spaces. To this must be added domestic terrorist entities in the advanced industrial states as they hollow out their economies due to economic globalization and restructuring, adjust to cross-border migration, and adapt to cultural and political dislocation. In short, the prognosis is for the fifth tier of non-state actors to beset the other four tiers with intense turbulence just as waves on a beach swirl around sandcastles, washing away their foundations, causing grains of sand to cascade, and eventually collapsing the whole structure. Observed non-state nuclear threats and attacks In light of the constraints faced by non-state terrorist actors in past decades, it is not surprising that the constellation of actual nuclear terrorist attacks and threats has been relatively limited during and since the end of the Cold War. As Martha Crenshaw noted in a comment on the draft of this paper: We still don't know why terrorists (in the sense of non-state actors) have not moved into the CBRN [chemical,biological, radiological or nuclear] domain. (Many people think biosecurity is more critical, for that matter.) Such a move would be extremely risky for the terrorist actor, even if the group possessed both capability (resources, secure space, time, patience) and motivation (willingness to expend the effort, considering opportunity costs). So far it appears that "conventional" terrorism serves their purposes well enough. Most of what we have seen is rhetoric, with some scattered and not always energetic initiatives.[12] Nonetheless, those that have occurred demonstrate unambiguously that such threats and attacks are not merely hypothetical, in spite of the limiting conditions outlined above. One survey documented eighty actual, planned attacks on nuclear facilities containing nuclear materials between 1961-2016[13] as follows: 80 attacks in 3 waves (1970s armed assaults, 1990s thefts, post-2010, breaches) High threat attacks: 32/80 attacks posed substantial, verified threat of which 44 percent involved insiders. All types of targets were found in the data set—on reactors, other nuclear facilities, military bases leading Gary Ackerman and to conclude: "Overall, empirical evidence suggests that there are sufficient cases in each of the listed categories that no type of threat can be ignored."[14] No region was immune; no year was without such a threat or attack. Thus, there is a likely to be a coincidence of future non-state threats and attacks with inter-state nuclear-prone conflicts, as in the past, and possibly more so given the current trend in and the generative conditions for global terrorist activity that will likely pertain in the coming decades.Of these attacks, about a quarter each were ethno-nationalist, secular utopian, or unknown in motivation; and the remaining quarter were a motley mix of religious (11 percent), "other" (5 percent), personal-idiosyncratic (4 percent), single issue (2 percent) and state sponsored (1 percent) in motivation.

The conclusion is unavoidable that there a non-state nuclear terrorist attack in the Northeast Asia region is possible. The following sections outline the possible situations in which nuclear terrorist attacks might be implicated as a trigger to interstate conflict, and even nuclear war. Particular attention is paid to the how nuclear command, control and communications systems may play an independent and unanticipated role in leading to inadvertent nuclear war, separate to the contributors to inadvertency normally included such as degradation of decision-making due to time and other pressures; accident; "wetware" (human failures), software or hardware failures; and misinterpretation of intended or unintended signals from an adversary.

Regional pathways to interstate nuclear war

At least five distinct nuclear-prone axes of conflict are evident in Northeast Asia. These are:

- US-DPRK conflict (including with United States, US allies Japan, South Korea and Australia; and all other UNC command allies. Many permutations possible ranging from non-violent collapse to implosion and civil war, inter-Korean war, slow humanitarian crisis. Of these implosion-civil war in the DPRK may be the most dangerous, followed closely by an altercation at the Joint Security Area at Panmunjon where US, ROK, and DPRK soldiers interact constantly.
- China-Taiwan conflict, whereby China may use nuclear weapons to overcome US forces operating in the West Pacific, either at sea, or based on US (Guam, Alaska) or US allied territory in the ROK, Japan, the Philippines, or Australia); or US uses nuclear weapons in response to Chinese attack on Taiwan.
- China-Japan conflict escalates via attacks on early warning systems, for example, underwater hydrophone systems (Ayson-Ball, 2011).
- China-Russia conflict, possibly in context of loss-of-control of Chinese nuclear forces in a regional conflict involving Taiwan or North Korea.
- Russia-US conflict, involving horizontal escalation from a head-on collision with Russian nuclear forces in Europe or the Middle East; or somehow starts at sea (mostly likely seems ASW) or over North Korea (some have cited risk of US missile defenses against North Korean attack as risking Russian immediate response).

Combinations of or simultaneous eruption of the above conflicts that culminate in nuclear war are also possible. Other unanticipated nuclear-prone conflict axes (such as Russia-Japan) could also emerge with little warning.

Precursors of such nuclear-laden conflicts in this region also exist that could lead states to the brink of nuclear war and demonstrate that nuclear war is all too possible between states in this region. Examples include the August 1958 Quemoy-Matsu crisis, in which the United States deployed nuclear weapons to Taiwan, and the US Air Force has only a nuclear defense strategy in place to defend Taiwan should China have escalated its shelling campaign to an actual attack; the October 1962 Cuban Missile Crisis, when a US nuclear armed missile was nearly fired from Okinawa due to a false fire order; the March 1969 Chinese-Soviet military clash and resulting consideration of nuclear attacks by both sides; and the August 1976 poplar tree crisis at Panmunjon in Korea, when the United States moved nuclear weapons back to the DMZ and the White House issued pre-delegated orders to the US commander in Korea to attack North Korea if the tree cutting task force was attacked by North Korean forces.

Loss-of-control of Nuclear Weapons

As is well known, nuclear armed states must routinely—and in the midst of a crisis—ensure that their nuclear weapons are never used without legitimate authority, but also ensure at the same time that they are always available for immediate use with legitimate authority. This "always-never" paradox is managed in part by a set of negative and positive controls, reliant upon procedural and technical measures, to maintain legitimate state-based command-and-control (see Figure Four).

In this framework, Jerry Conley has produced a taxonomy of nuclear command-and-control structures that embody varying notional national "command-and-control" orientations (also referred to as stability points or biases). Each nuclear armed state exhibits a distinct preference for technical and procedural measures to achieve negative and positive control of nuclear weapons. The way that a state constructs its control system varies depending on its size, wealth, technology, leadership, and strategic orientation, lending each state a unique use propensity affected by the information processing and transmission functions of the nuclear command-and-control system, that in part determines the use or non-use decisions made by the leaders of nuclear armed states. The resulting ideal nuclear command-and-control state structures are shown in Table 1.

In Northeast Asia, a four-way nuclear threat system exists that has a three world-class nuclear armed states, the United States, Russia and China, interacting with a fourth tier, barely nuclear armed state, the DPRK. In this quadrilateral nuclear standoff, the DPRK's simple NC3 system likely is an amalgam of a poorly resourced, militarized, and personalized leadership—which may lead it to oscillate between procedural and technical measures as the basis of control, with a primary emphasis on positive use control, not negative control to avoid unauthorized use. China's large, centralized NC3 system co-mingles nuclear and conventional communications between national commanders and deployed nuclear forces and may emphasize negative more than positive use controls to ensure Party control. Russia's highly centralized, complex NC3 system relies on legacy technology and limited economic base for modernization. It too may be more oriented towards negative controls in peacetime, but have the capacity to spring almost instantly to primary reliance on positive controls in times of crisis or tension. The US NC3 system is large, complex and based on wealth and technological prowess. It is under civilian, not military control, at least in principle and in peacetime, and is redundant, diverse, and relatively resilient.

Non-state nuclear attack as trigger of inter-state nuclear war in Northeast Asia

The critical issue is how a **nuclear** terrorist **attack** may "**catalyze**" inter-state **nuclear war**, especially the **NC3 systems** that **inform** and partly determine how **leaders** respond to nuclear threat. Current conditions in Northeast Asia suggest that **multiple** precursory **conditions** for nuclear terrorism **already exist** or exist in nascent form. In Japan, for example, low-level, individual, **terroristic violence** with nuclear materials, against nuclear **facilities**, is **real**. In all countries of the region, the risk of diversion of nuclear material is real, although the risk is likely higher due to volume and laxity of security in some countries of the region than in others. In all countries, the risk of an insider "sleeper" threat is real in security and nuclear agencies, and such insiders already operated in actual terrorist organizations. Insider corruption is also observable in nuclear fuel cycle agencies in all countries of the region. The threat of extortion to induce insider cooperation is also real in all countries. The possibility of a cult attempting to build and buy nuclear weapons is real and has already occurred in the region.[15] Cyber-terrorism against nuclear reactors is real and such attacks have already taken place in South Korea (although it remains difficult to attribute the source of the attacks with certainty). The stand-off ballistic and drone threat to nuclear weapons and fuel cycle facilities is real in the region, including from non-state actors, some of whom have already adopted and used such technology almost instantly from when it becomes accessible (for example, drones).[16]

Two other broad risk factors are also present in the region. The **social** and **political conditions** for **extreme** ethnic and xenophobic **nationalism** are **emerging** in China, Korea, Japan, and Russia. Although there has been no risk of attack on or loss of control over nuclear weapons since their removal from Japan in 1972 and from South Korea in 1991, this risk continues to exist in North Korea, China, and Russia, and to the extent that they are deployed on aircraft and ships of these and other nuclear weapons states (including submarines) deployed in the region's high seas, also outside their territorial borders.

The most conducive circumstance for catalysis to occur due to a nuclear terrorist attack might involve the following nexi of timing and conditions:

Low-level, tactical, or random individual terrorist attacks for whatever reasons, even assassination of national leaders, up to and including dirty radiological bomb attacks, that overlap with inter-state crisis dynamics in ways that affect state decisions to threaten with or to use nuclear weapons. This might be undertaken by an opportunist nuclear terrorist entity in search of rapid and high political impact.

Attacks on major **national** or **international events** in each country to **maximize terror** and to de-legitimate national leaders and whole governments. In Japan, for example, more than ten heads of state and senior ministerial international meetings are held each year. For the strategic nuclear terrorist, patiently acquiring higher level nuclear threat capabilities for such attacks and then staging them to maximum effect could accrue strategic gains.

Attacks or threatened attacks, including deception and disguised attacks, will have maximum leverage when nuclear-armed states are near or on the brink of war or during a national crisis (such as Fukushima), when intelligence agencies, national leaders, facility operators, surveillance and policing agencies, and first responders are already maximally committed and over-extended.

At this point, we note an important caveat to the original concept of catalytic nuclear war as it might pertain to nuclear terrorist threats or attacks. Although an attack might be disguised so that it is attributed to a nuclear-armed state, or a ruse might be undertaken to threaten such attacks by deception, in reality a catalytic strike by a nuclear weapons state in conditions of mutual vulnerability to nuclear retaliation for such a strike from other nuclear armed states would be highly irrational.

Accordingly, the effect of nuclear terrorism involving a nuclear detonation or major radiological release may not of itself be catalytic of nuclear war—at least not intentionally–because it will not lead directly to the destruction of a targeted nuclear-armed state. Rather, it may be **catalytic** of non-**nuclear war** between **states**, especially if the **non-state actor** turns out to be **aligned** with or **sponsored** by a **state** (in many Japanese minds, the natural candidate for the perpetrator of such an attack is the pro-North Korean General Association of Korean Residents, often called Chosen Soren, which represents many of the otherwise stateless Koreans who were born and live in Japan) and a further sequence of coincident events is necessary to drive escalation to the point of nuclear first use by a state. Also, the catalyst—the non-state actor–is almost assured of discovery and destruction either during the attack itself (if it takes the form of a nuclear suicide attack then self-immolation is assured) or as a result of a search-and-destroy campaign from the targeted state (unless the targeted government is annihilated by the initial terrorist attack).

It follows that the **effects** of a non-state nuclear **attack** may be characterized better as a **trigger effect**, bringing about a **cascade** of **nuclear** use **decisions** within NC3 systems that shift each state increasingly away from nuclear non-use and increasingly towards nuclear use by releasing negative controls and enhancing positive controls in multiple action-reaction escalation spirals (depending on how many nuclear armed states are party to an inter-state conflict that is already underway at the time of the non-state nuclear attack); and/or by inducing concatenating nuclear attacks across geographically proximate nuclear weapons forces of states already caught in the crossfire of nuclear threat or attacks of their own making before a nuclear terrorist attack.[17]

An example of a cascading effect would be a **non-state attack** on a key node of linked **early warning systems** that is **unique** to and **critical** for **strategic** nuclear **forces** to be employable, or the effect of multiple, coincident and erroneous sensor alerts of incoming attacks (as occurred during the Cuban Missile Crisis with radar in Florida monitoring Soviet missiles in Cuba that mistakenly fused an erroneous reading of a missile trajectory with a real observation of a Soviet satellite that happened to be passing overhead).

An example of a concatenating effect would an attack that **leads a** nuclear **weapons state to target** two other **states forces** because it **cannot determine whose** forces **attacked** its **own**. This circumstance might arise if key anti-submarine forces or an aircraft carrier battle group were attacked and it was impossible to determine in a given waterway or area of ocean whose submarines were present or responsible for the attack, leading the attacked state to destroy all the submarines presenting on-going threat to its strategic forces.

As we noted above, a terrorist nuclear shock may take various forms and appear in different places. Ever since an extortion attempt in Boston in 1974 based on the threat of nuclear detonation, the threat of an improvised nuclear device has been credible. For such a threat to be credible, a non-state terrorist entity must release a plausible precursor such as nuclear material or warhead design information, or stage an actual demonstration attack that makes it plausible that the attacker controls a significant quantity of fissile material (most likely plutonium, or simply radioactive materials suitable for a radiological device that might be used to draw in first responders and then detonate a warhead to maximize damage and terror). Such an attack might be combined with a separate attack on critical infrastructure such as a cyberattack. The attacker might retain sufficient material for bargaining and insurance should the initial attack fail. Given the need to adapt to circumstances, such an attacker is likely to be patient and strategic, in the terms defined earlier, and to have extensive organizational and communication capacities; and to be able to operate at multiple targeted sites, possibly in multiple countries. Given its patience and stamina, such an attacker would select a highly symbolic target such as a high level meeting. Such a case would present the targeted state with an exquisite dilemma: bargaining and negotiation with the non-state actor threatening such an attack may be justified given the explicit and plausible nature of the threat, which may be politically impossible while making counter-terrorism operations very risky and only possible with extreme caution. And, such an **attacker** might well **issue a false statement** about **state-sponsorship** to **invoke** third **parties** in ways that vastly **complicate** the response to the **threat**.

If the attacker is less capable and driven for immediate political or other returns, then it may be satisfied with highly delegated delivery with no recall option, and no use of communications to minimize the risk of discovery or interdiction. Such an attacker is also less likely to wait for the circumstances in which inter-state nuclear war is more likely due to inter-state tension; and also less likely to seek third party effects beyond the damage to the immediate target and resulting terror. Should **surveillance indicate** that an **improvised** nuclear **device** is in motion, then an all-out **search** to interdict the attackers and to retrieve the device or materials would likely **ensue**.

In these two instances of credible threat of non-state nuclear attack, the insider versus outsider perpetrator factor will affect significantly how the attack affects possible inter-state conflicts. In Kobe's terms, if the **perpetrator** is confirmed to be an **outsider**, then a **country**-of-**origin suspicion matrix** may **cast suspicion** onto **another state** as possible sponsor. For an attack threatened in China, the linkage might be back to Russia, the United States, or North Korea. For an attack threatened in Russia, the linkage might be back to the United States, China, or North Korea. For an attack threatened in North Korea, the linkage might be back to the United States, China, or Russia. And for an attack threatened in one of the umbrella states in the region, South Korea and Japan, such an attack might be linked to each other, as well as to China, North Korea, or Russia. In each case, the **shadow** of **suspicion** and **possible accusations** could **tilt decision-making** processes in one or more of these states and ways that could worsen pre-existing views about the **nuclear use** propensity of an opposing nuclear armed state.

Should an **actual** nuclear **attack** occur, the situation is even more complex and problematic. Such an attack might be purely accidental, due to hardware, software, or human error while nuclear materials or weapons are in transit. In principle, this limits the site of such an event to the nuclear weapons states or their ships and aircraft as neither South Korea nor Japan host nuclear weapons today. If an insider is involved, then the perpetrator may be identified quickly, and whether there is a linkage with another state may become evident (depending on nuclear forensics as well as insight obtained from surviving attackers).

If an outsider is the perpetrator, then the **suspicion matrix** will come into **play** again, with possibly **severe effects** on inter-state **tension** due to **accusation**, **suspicion**, and **fear** of **follow**-on **attacks**. During the attack, especially if it is a hostage-taking type of attack, the **identity** of the **perpetrator** may be **unknown** or **ambiguous**, and maintaining this ambiguity or even opacity as to the attacker may be deliberate—as was the case with the 2008 Mumbai attack in which the controller tried to ensure that all the attackers were killed in the course of the twelve separate but coordinated attacks across the city over four days. Although much progress has been made in establishing local nuclear forensics capability in Japan,[18] China, and South Korea, there is no certainty that it is sufficiently developed to identify the perpetrator of an act of nuclear terrorism, especially if there is a state sponsor and deception involved.

Conclusion

We now move to our conclusion. Nuclear-armed states can place themselves on the edge of nuclear war by a combination of threatening force deployments and threat rhetoric. Statements by US and North Korea's leaders and supporting amplification by state and private media to present just such a lethal combination. Many observers have observed that the risk of war and nuclear war, in Korea and globally, have increased in the last few years—although no-one can say with authority by how much and exactly for what reasons.

However, states are restrained in their actual decisions to escalate to conflict and/or nuclear war by conventional deterrence, vital national interests, and other institutional and political restraints, both domestic and international. It is not easy, in the real world, or even in fiction, to start nuclear wars.[19] Rhetorical threats are standard fare in realist and constructivist accounts of inter-state nuclear deterrence, compellence, and reassurance, and are not cause for alarm per se. States will manage the risk in each of the threat relationships with other nuclear armed states to stay back from the brink, let alone go over it, as they have in the past.

This argument was powerful and to many, persuasive during the Cold War although it does not deny the hair-raising risks taken by nuclear armed states during this period. Today, the multi-polarity of nine nuclear weapons states interacting in a four-tiered nuclear threat system means that the practice of sustaining nuclear threat and preparing for nuclear war is no longer merely complicated, but is now enormously complex in ways that may exceed the capacity of some and perhaps all states to manage, even without the emergence of a fifth tier of non-state actors to add further unpredictability to how this system works in practice.

The possibility that non-state actors may attack without advance warning as to the time, place, and angle of attack presents another layer of uncertainty to this complexity as to how inter-state nuclear war may break out. That is, non-state actors with nuclear weapons or threat goals and capacities do not seek the same goals, will not use the same control systems, and will use radically different organizational procedures and systems to deliver on their threats compared with nuclear armed states. If used tactically for immediate terrorist effect, a non-state nuclear terrorist could violently attack nuclear facilities, exploiting any number of vulnerabilities in fuel cycle facility security, or use actual nuclear materials and even warheads against military or civilian targets. If a persistent, strategically oriented nuclear terrorist succeed in gaining credible nuclear threat capacities, it might take hostage one or more states or cities.

If such an event coincides with already high levels of tension and even military collisions between the non-nuclear forces of nuclear armed states, then a **non-state** nuclear **terrorist attack** could **impel** a **nuclear** armed **state** to **escalate** its threat or even military **actions** against **other** states, in the **belief** that this **targeted state** may have **sponsored** the non-state attack, or was simply the **source** of the **attack**, whatever the declared identity of the attacking non-state entity. This **outcome** could **trigger** these states to go onto one or more of the pathways to inadvertent **nuclear war**, especially if the terrorist attack was on a high value and high risk nuclear facility or involved the seizure and/or use of fissile material.

Nuclear strike causes extinction, Sarg 15

Dr. Stoyan Sarg 15, PhD Physics, Director of the Physics Research Department at the World Institute for Scientific Exploration, "The Unknown Danger of Nuclear Apocalypse," https://www.foreignpolicyjournal.com/2015/10/09/the-unknown-danger-of-nuclear-apocalypse/, cc. Recut //MVSG With the new NATO plan for installation of nuclear tactical weapons in Europe, nuclear missiles may reach Moscow in only 6 minutes, and the opposite case is also possible in the same time. The question is: how can we be sure that this will not be triggered by a human error or computer malfunction. An adequate reaction dictated by the dilemma "to be or not to be" and the concept of preventive **nuclear strike may lead to a nuclear consequence that is difficult to stop. At the present level of distributed controlled systems and military global navigations, this will lead to unstoppable global nuclear war.** However, there is something not predicted, of which the military strategists, politicians and powerful forces are not aware. Probably, it will not be a nuclear winter that they hope to survive in their underground facilities. **The most probable consequence will be** a partial loss of the Earth's atmosphere as a result of one or many powerful simultaneous tornadoes caused by the nuclear explosions. In a **tornado, a powerful antigravitational effect** takes place. The official science does not have an adequate explanation for this feature due to an incorrect concept about space. The antigravitational effect is not a result of the circling air. It is a specific physical effect in the aether space that is dismissed in physics as it is currently taught. Therefore, the effective height of this effect is not limited to the height of the atmosphere. Then in the case of many simultaneous powerful tornadoes, **an effect of suction of the earth atmosphere into space might take place**. Such events are observed on the Sun and the present physical science does not have an explanation for them. The antigravitational effect is accompanied by specific electric and magnetic fields with a twisted shape.

C2: Renewables

The renewable energy market is strong despite Trump.

Copley 25 [Michael (correspondent on NPR's Climate Desk; covers what corporations are and are not doing in response to climate change, and how they're being impacted by rising temperatures.), "America's clean-energy industry is growing despite Trump's attacks. At least for now," March 12, 2025, NPR, https://www.npr.org/2025/03/12/nx-s1-5319056/trump-clean-energy-electricity-climate-change] DOA 03-17-2025//abhi☺***Brackets in OG***

Despite the **Trump administration's wide-ranging attacks on renewables** like wind and solar power, the **clean-energy industry** is on pace for **record growth** this year, according to government analysts. The buildout of big solar and battery plants is expected to hit an all-time high in 2025, accounting for 81% of new power generation that companies will add to America's electric grids, the Energy Information Administration (EIA) said in a recent report. Including **wind** projects, the share of new **power capacity** that's expected to come **online this year** from **renewables and batteries jumps** to **93%**, the EIA said. The U.S. needs all the power it can get, because electricity **demand** is **surging** for the first time in decades, industry analysts and executives say. That means kickstarting development of nuclear power and geothermal projects, burning more natural gas and, in some cases, delaying retirement of old coal plants. But in the scramble for electricity, **renewable-energy** and battery plants are **crucial, analysts** and **executives** say, because **they're quick to build** and **provide electricity that's** relatively **cheap**. "There is no doubt that the increased demand for electricity over the next decade, coming from data centers and advanced manufacturing, will continue to require vast amounts of renewable energy and batteries," Andrés Gluski, chief executive of The AES Corporation, a power company that owns both clean-energy and fossil-fuel plants, told Wall Street analysts recently. Still, the renewables industry faces potential upheaval. The Trump administration tried to withhold federal funding Congress previously approved for climate and clean-energy projects. Trump also ordered the government to temporarily stop issuing or renewing leases for offshore wind projects in federal waters. The Department of the Interior limited who at the agency can issue permits for renewable energy projects on public lands, which could slow permitting. And conservatives are pushing Congress to wipe out tax incentives for clean energy. If the disruptions spread, companies could abandon plans to build new power plants. That could dampen economic growth and hamstring efforts to develop data centers for artificial intelligence, a priority of the Trump administration. In an interview that aired Sunday on Fox News, Trump declined to rule out the possibility of an economic recession this year. "At a time when we're all very concerned about energy abundance and this administration's broad goal of re-establishing energy dominance, just the idea that we'd be constraining the build of new energy [infrastructure] really feels like it's rowing in the wrong direction," says Rich Powell, chief executive of the Clean Energy Buyers Association, whose members range from Amazon to ExxonMobil to Walmart. Interior Secretary Doug Burgum chairs the Trump administration's National Energy Dominance Council. An Interior Department spokesperson, Elizabeth Peace, said in a statement that the agency supports renewable-energy development "where it makes sense while ensuring that all energy sources contribute to a reliable and affordable power grid." **Demand** for clean energy 'is certainly **not going away'** The clean-energy industry has exploded over the past decade. Solar, in particular, has accelerated. Meanwhile, growth in the wind industry has slowed because of problems ranging from inflation to pushback on siting projects. The industry overall has boomed thanks to falling technology costs, federal tax incentives and state renewable-energy mandates. The market got another big boost in 2022, when President Joe Biden signed the Inflation Reduction Act, which provided hundreds of billions of dollars in federal funding for clean-energy projects, among other climate investments. **Corporations** like **Amazon, Meta** and **Google** have also played a role, **signing contracts** to buy ever-larger amounts of **renewable energy**. "I expect that that will continue," says Powell of the Clean Energy Buyers Association. "The demand is certainly not going away." Some big investors seem to take a similar view. Led by Trump supporter Steve Schwarzman, the investment firm Blackstone said in February that it raised $5.6 billion for its "energy transition" business, which in the past has invested in companies that work in the renewable energy industry. Also last month, Brookfield Asset Management agreed to buy a U.S. renewable energy business for more than $1.7 billion. "Renewables will be the biggest beneficiary of growing electricity demand because they are **the cheapest option**, and [electricity buyers] will always absorb as much of the cheapest source of power before turning to more expensive forms of power," Brookfield's chief executive, Bruce Flatt, told Wall Street analysts in February. Congressional Republicans have backed Trump's pro-fossil fuel agenda. But a group of 21 GOP lawmakers recently called for Congress to preserve tax credits that support the renewable energy industry. "As energy demand continues to skyrocket, any modifications that inhibit our ability to deploy new energy production risk sparking an energy crisis in our country, resulting in drastically higher power bills for American families," the lawmakers wrote to the Republican chairman of the House Ways and Means Committee, Rep. Jason Smith of Missouri. Key conservatives call for backing natural gas instead Clean energy's draw could wear off as Trump's policies take effect, says Diana Furchtgott-Roth, director of the Center for Energy, Climate, and Environment at the Heritage Foundation, a conservative think tank. The Heritage Foundation produced a governing agenda called Project 2025 that aligns with many actions Trump has taken so far. Among its dozens of recommendations, the plan calls for Congress to repeal the Inflation Reduction Act, which could eliminate tax incentives that lower the price tag for clean-energy projects. "I think that what you're seeing [right now] is people operating with the old prices" in U.S. power markets, Furchtgott-Roth says. "But I think that that might change." Rather than renewables and batteries, Furchtgott-Roth says natural gas is "the wave of the future for the United States." After all, she says, the country has "an almost infinite supply." The U.S. has huge reserves of natural gas, but its main component, methane, is a big contributor to global warming. Natural gas fueled about 43% of America's electricity last year, according to a report from BloombergNEF and the Business Council for Sustainable Energy. The country will almost certainly burn more gas to meet growing power demand, industry analysts say. Gas plants can produce electricity when it's needed, which regulators say is becoming more important because large parts of the country are expected to face a growing risk of blackouts as coal plants retire. "We are unabashedly pursuing a policy of more American energy production and infrastructure, not less," Energy Secretary Chris Wright said Monday at an energy conference in Houston, where he touted the importance of natural gas, according to a copy of his prepared remarks. Wright downplayed the role of renewables and called climate change a "side effect of building the modern world." Executives say it will take years to build a lot of new gas plants A problem with gas plants, though, is that the cost to build them has risen, industry executives say. Gas turbines are also on backorder, and that means companies can't build plants fast enough to meet rising electricity demand in the next few years. "Renewables and storage are ready now to meet that demand and will help lower power prices. Gas-fired generation is moving forward but won't be available at scale until 2030," John Ketchum, chief executive of NextEra Energy, told Wall Street analysts days after Trump's inauguration. NextEra runs one of the world's top renewable energy developers and also has a big natural gas business. The EIA says solar will account for just over half of new power generation that will get built in the U.S. this year. So far, the Trump administration hasn't targeted solar like it has the wind industry, and developers are moving ahead with projects, says Paula Mints, chief analyst at SPV Market Research, which tracks the solar market. But she says companies are nervous. Sweeping tariffs from the Trump administration could increase costs across the U.S. energy industry, making it more expensive to build new power plants of all kinds, says John Hensley, senior vice president of markets and policy analysis at American Clean Power, a trade group. And if Congress gets rid of clean-energy tax credits in the Inflation Reduction Act, power prices for homeowners, renters and businesses would go up, and the country would build fewer clean energy projects, according to a study commissioned by the Clean Energy Buyers Association. The result is confusion in the market, leading some businesses to rethink U.S. investments. Days after Trump's inauguration, an Italian company called the Prysmian Group cancelled plans to build a factory in Massachusetts that would have supplied undersea cables for offshore wind projects. An Indian solar manufacturer, Premier Energies, recently told investors that it paused plans for a U.S. plant until it knows what will happen to federal tax incentives. And Aspen Aerogels, an American firm, stopped construction of a factory in Georgia where it planned to make components for electric vehicles, citing an "evolving environment." In a recent report, Climate Power, an advocacy group, says more than 42,000 announced clean-energy jobs have been "threatened or eliminated" since Trump took office. In the face of rising power demand, the last thing the country needs is to slow down clean-energy development, Ketchum told analysts in January. "We can't afford to take any options off the table," he said.

Tariffs Supercharge the UQ

Bearak Last Week [Bearak, Max, et al. “How Tariffs Could Upend the Transition to Cleaner Energy.” The New York Times, 3 Apr. 2025, www.nytimes.com/2025/04/03/climate/trump-tariff-clean-energy-transition.html.]

In **recent** years, many **solar, wind and battery manufacturers had sought to open new factories** in the United States, spurred by generous tax credits and incentives from the 2022 Inflation Reduction Act. The United States now has the capacity to make 50 gigawatts’ worth of solar modules, enough to satisfy U.S. demand, although it still imports many of the underlying components such as cells and wafers.

This year, wind, solar and batteries are projected to make up 93 percent of new electric capacity added to American grids. In many places, building new wind turbines or installing **solar panels are often the cheapest** ways to generate additional electrons.

In theory, **tariffs could spur more domestic clean energy manufacturing in the United States.**

Government investment shifts private investment to nuclear

Melanie **Windridge 23**; April 13; PhD plasma physicist and science communicator best known for her book Aurora: In Search of the Northern Lights and her educational work on fusion energy with the Institute of Physics and the Ogden Trust; Forbes, “Investors Hold The Key To Fusion And Our Clean Energy Future,” https://www.forbes.com/sites/melaniewindridge/2023/04/13/investors-hold-the-key-to-fusion-and-our-clean-energy-future/, Accessed 3-12-2025, ARC–recut Lex RR–SR

But **investors** also need **gov**ernment **support** and **certainty**. That’s one reason why the U.K. is currently in a strong position for fusion energy development, because they have outlined their plans for a regulatory framework for fusion while other countries are still in discussion.

It goes further than technology regulation, however. **Policy** and **incentives** will be **required** in the financial services industry **to drive** the effective **reallocation of capital**.

Michelle Scrimgeour, Chief Executive of Legal & General Investment Management, gave evidence to a 2022 U.K. parliamentary inquiry entitled ‘The financial sector and the U.K.’s net zero transition’.

Scrimgeour said: “A successful transition to a decarbonised economy, consistent with less than 1.5 degrees warming, will require a substantial change in capital allocation. Several trillion dollars a year of incremental capital will need to be invested into low carbon energy, energy infrastructure and energy efficiency. For this capital allocation to occur, a financial services industry that is aligned with net zero outcomes will be crucial. Equally, this requires global policy action at international governmental level, particularly on an effective regulatory structure to price carbon and other greenhouse gases."

So while investors hold the key to the success of fusion and our clean energy future, it's not just down to investors—**gov**ernment **policy** will be **crucial** in **enabling investors** to **drive** the **change**.

That kills renewables. It diverts attention, resources, and lacks grid compatibility, and it's significantly more expensive and takes time to build

CAN 24 Climate Action Network, 3-18-2024, "POSITION PAPER: The nuclear hurdle to a renewable future and fossil fuel phase-out," [Climate Action Network (CAN) Europe is Europe's leading NGO coalition fighting dangerous climate change. We are a unique network, in which environmental and development organisations work together to issue joint lobby campaigns and maximise their impact], https://caneurope.org/position-paper-nuclear-energy/, DOA 3-25-2025 //Wenzhuo recut //cy–recut lexmas–recut Lex RR–SR

More than three-quarters of the EU's greenhouse gas emissions stem from our energy consumption, therefore it is vital to stop burning fossil fuels to limit temperature rise to 1.5°C, the Paris Agreement target. Together with members, and external experts, we developed our Paris Agreement compatible (PAC) energy scenario, which provides a robust, science-based pathway for Europe's energy landscape. On the basis of this work, CAN Europe advocates for a phase-out of coal by 2030, gas by 2035, and a 100% renewables-based energy system by 2040, which requires the phase-out of nuclear power by then. The disruption of nuclear power can be observed in many countries, not only in Europe. In Dubai, at COP28, CAN was strongly opposed to and called out countries, supporting and signing the pledge led by the USA, UK, France and 18 other countries to globally triple nuclear power in the next 25 years. This goal is much higher than the high bracket of International Energy Agency (IEA) scenarios, already based on improbable hypotheses and risks to distract from the tripling of Renewable Energy capacities that was agreed by a much larger group of countries at COP28. In 2023, there was an **alarming push** and a surge in support **for nuclear power** within the EU political space. This development is creating significant tension with proponents of energy sufficiency and a fully renewable energy system and marks a regressive step in efforts towards a sustainable and just energy transition. While nuclear champions claim that nuclear energy can work hand-in-hand with renewables, it is becoming increasingly clear that nuclear power acts as a significant hurdle to energy efficiency investments, the roll-out of renewables and fossil fuel phase-out in three spheres: the EU political debate, energy system planning, and decentralisation. Climate Action Network International, the global umbrella under which CAN Europe participates, with a community of almost 2000 members from civil society, in more than 130 countries, stands united in opposing new and existing nuclear power stations. In 2020, we reviewed and agreed the CAN Charta, the 'highest' document for all CAN members, the international secretariat and the regional nodes, and we listed under strategies "Promoting a nuclear-free future". A hurdle in the policy debate The starting gun for a renewed attempt at a nuclear renaissance was the inclusion of nuclear in the EU Taxonomy in 2022, and can be seen as the nuclear lobby's blueprint for its future ambitions – creating a large political debate using arguments of "technology neutrality" and a "level playing field" and forming alliances with fossil fuel advocates (in this case, fossil gas) in order to reduce ambition to sustainable solutions. Since then, a French-led campaign, manifested through the 14 Member State "Nuclear Alliance", coupled alongside the lobbying activities of the nuclear industry, has run roughshod through EU energy and climate policy over the last two years. Continuing the narrative of "technology neutrality" and a "level playing field", this mission has aimed at promoting nuclear energy at the direct expense of a transition to a 100% renewable-based energy system, in legislation such as the Renewable Energy Directive, Electricity Market Design and Net Zero Industry Act. Attempting to lower renewable ambition In the context of the Renewable Energy Directive (RED III) revision, France tested the waters in 2023 by calling for a low-carbon 'weighting' in EU renewables target in order to support a higher EU 2030 renewable energy target of 45%, where so-called 'low carbon' energy sources are taken into account when establishing national renewable energy targets. Though this did not see the light, a concession was won on renewable hydrogen and gained provisions to facilitate nuclear-produced hydrogen – risking further watering down a renewables-based technology pathway. The EU Commission launched its proposal for the Net Zero Industry Act (NZIA) in March 2023 as a response to the Inflation Reduction Act (IRA) of the United States. While nuclear was included as a list of technologies that were seen as making a contribution to decarbonisation, the EU Commission President, Ursula von der Leyen, refused to include it in the list of "strategic technologies", which could receive additional support. The list was limited, as to be better targeted, at technologies such as solar, wind, energy storage, heat pumps and grid technologies. The final political agreement has led to the inclusion of "nuclear fission energy technologies" as strategic, while this debate allowed the list to become so extensive it practically loses any strategic element. Delaying fossil phase out via dirty trade-offs During the Electricity Market Design reform, nuclear and fossil fuel promoters in the Parliament attempted to **derail** a deal supporting renewables and flexibility. In the Council, due to the focus of the Nuclear Alliance on the Contracts for Difference (supported by some coal dependent countries) the negotiations were delayed by several months and conversations redirected away from renewables, leading to a deal supporting subsidies for existing and new nuclear reactors and a prolongation of subsidies to coal power plants via capacity mechanisms. Wasting time and diverting attention As the nuclear debate **aggressively** dominates political negotiations, media, and public discourse, it **blatantly diverts critical attention from** advancing the **existing,** affordable, sustainable solutions to the energy transition. This overwhelming focus on nuclear power not only overshadows but also poses a risk of **derailing** the European **energy transition,** hindering progress towards aligning with the ambitious yet achievable goal of a **100% renewable energy** system by 2040. A hurdle to a fully renewables based power system CAN Europe's assessment of the draft National Energy and Climate Plans highlights that not a single Member State plan is aligned to a 1.5ºC compatible trajectory, nor minimum EU climate and energy requirements for 2030. **Increased ambition is required** on energy efficiency, energy savings, renewables and fossil fuels phase-out, while Member States are **betting on false solutions** to the challenge at hand, such as nuclear energy. As highlighted in our NECP analysis, the EU has inadequate renewables expansion, grossly insufficient investment in energy efficiency, late coal phase-out deadlines and gas dependence, while countries such as Bulgaria, Czechia, Estonia, France, Hungary, the Netherlands, Poland, Romania and Slovenia, are considering new nuclear that might never materialise. In 2023, Sweden has revised its 2040 target for 100% renewable electricity to 100% decarbonised electricity, to allow for continued and new nuclear power, and it is now clear that it can only happen with direct state aid. Italy, which voted against nuclear power in a referendum, is now investigating future nuclear power, while delaying quitting coal by 4 years. The largest nuclear power plant in Europe, the Zaporizhzhia Nuclear Power Plant in Ukraine, is currently occupied by the Russian military and Rosatom in an active warzone, but has not prevented Ukraine from including new nuclear power in its reconstruction. The Paris Agreement Compatible (PAC) scenario, on the other hand, emphasises renewables-based electrification, calling for determined and heightened attention to enable a 100% renewable-based EU energy system by 2040, and foresees no need for nuclear power in Europe. Nuclear power is too expensive When compared to renewables, the latest analysis from World Nuclear Industry Status Report, using the data from Lazard, determines that the levelized cost of energy (LCOE) for new nuclear plants makes it the most expensive generator, estimated to be nearly **four times more expensive** than onshore wind, while unsubsidized solar and wind combined with energy storage (to ensure grid balancing) is always cheaper than new nuclear. When compared against energy savings, analysis by Hungarian NGO Clean Air Action Group highlights that it is more economically efficient to invest in the renovation of households to save energy than in the construction, operation, and decommissioning of a new nuclear reactor. These findings were confirmed by a separate study by Greenpeace France, that showed that by investing 52 billion euros in a mix of onshore wind infrastructure/photovoltaic panels on large roofs, it would be possible to avoid **four times** more CO_2 emissions than by investing the same amount in the construction of six EPR2 nuclear reactors by 2050, while electricity production triples. By investing 85 billion euros of government subsidies in energy savings by 2033, it would be possible to avoid six times more cumulative CO_2 emissions by 2050 than with the construction program of six EPR 2 reactors. This would also make it possible to lift almost 12 million people out of energy poverty in a decade. Recent European projects in Slovakia, the UK, France, and Finland demonstrate the dramatic rising costs. EDF admitted that the costs for the British nuclear facility Hinkley Point C will skyrocket to 53.8 billion euros for the scheduled 3.2 GW power plant, more than twice as much as scheduled in 2015 when the plant was approved. The French project in Flamanville was originally projected to cost 3.3 billion euros when it began construction in 2007, but has since risen to 13.2 billion euros (16.87 billion euros in today's money). The Finnish Olkiluoto-3 project 1.6GW reactor cost 3 times more than the original forecast price, reaching 11 billion euros. Slovakia's second generation reactors Mochovce 3 and 4 ballooned costs to 6.4 billion euros from an initially estimated 2.8 billion. Slovenia's president announced that a new 1.6GW reactor would cost 11 billion euros, following the Finnish example, demonstrating that these high prices are here to stay. In order to finance new and ongoing projects, the EU has approved State Aid for nuclear, in the case of Hungary, Belgium, and the United Kingdom, while national governments seek support schemes. Despite making references to technology-neutrality, this creates an unlevel playing field slanted against renewable energy. Given the significant investment gap to achieve 2030 climate targets, and the limited fiscal space of many Member States, investments in nuclear risk **diverting precious public resources** into projects of poor value-for-money compared to alternatives in a renewables-based system, while reducing the availability of public resources for all other components of the energy transition. Such a choice would equally fail to reduce prices for consumers in the context of the current fossil fuel energy crisis. Finally, the costs would be even larger if accounting for "unpaid externalities" borne by taxpayers and the public at large, from nuclear accident risks that are impossible to insure against by private actors. The costs of decommissioning of a nuclear power plant, which can cost 1-1.5 billion euros per 1000 MW, are often borne by the public as these costs are poorly taken into account when planning a new nuclear installation. The cost associated with storing radioactive waste for hundreds of thousands of years is also often undervalued, alongside costs associated with radioactive leaks from plants or storage facilities, as demonstrated by the radioactive leaks in the UK Sellafield site, causing tension with Ireland and Norway. To lower costs, attempted lowering of safety and environmental standards can be expected, posing risks to communities, nature, and society at large, also as a burden to future generations. New nuclear construction is too slow A rapid transition requires the use of existing technologies and solutions which can most quickly be rolled-out such as renewables, primarily solar and wind, energy efficiency, and system flexibility. For years, new nuclear energy projects in Europe have been plagued with delays and, coupled with an untrained workforce, are unable to support the speed of decarbonisation necessary. New nuclear plants typically take 15-20 years for construction, hence failing to address immediate decarbonisation needs to 2030. Indicatively, France's six new reactors are estimated by its network operator to enter into use in 2040-2049, much too late to have any meaningful impact on emissions reduction needed already now, with a view to pathways to 2050, and beyond, for a sustainable future. The decision to build the UK's Hinkley Point C nuclear reactor was announced in 2007 with an operational start date of 2017, however it has been delayed several times over, and is now estimated to start in 2031. In France, the Flamanville project is 16 years into construction and hitting new delays, while Finland's Olkiluoto took a full 18 years to come online. Nuclear does not support energy autonomy Nuclear power units equally fail to pass an "energy security" test, and run counter to the RepowerEU target of enhancing Europe's autonomy, given that more than 40% of the EU's Uranium is imported from Russia and no EU country is currently mining uranium within its own borders . Though Kazakhstan is seen as an alternative, its uranium industry is directly tied to Rosatom. While import bans have been placed on Russian coal and liquified natural gas, and Russian oil and natural gas have been targeted, this has not been the case for uranium. A hurdle to a decentralised future The declaration to triple nuclear power by 2050 signed by only 22 countries, 5 of which do not have nuclear reactors, on the sidelines of COP28 describes nuclear power as "source of clean dispatchable baseload power", a common message of the nuclear industry used to argue against a 100% renewable system and nuclear's use as a substitute for traditional fossil fuel generation. This claim, however, is misleading and outdated. Europe is moving beyond a highly centralised energy system, towards one which is decentralised, digitalised, and able to flexibly adjust to changing patterns of generation and consumption. In a 100% renewable energy system, the need for traditional "baseload" power is obsolete and with distributed energy production, in a far more interconnected European Union, security of supply is better managed. Nuclear power production is not reliable Nuclear power units across Europe have been proven as **unreliable** in providing power when needed. Future climatic conditions, such as **heatwaves, droughts, flooding** and rising sea-levels only increase the likelihood of future nuclear power plant disconnections and pose further security risks. In 2022, on average French nuclear reactors had 152 days with zero-production. Over half of the French nuclear reactor fleet was not available during at least one-third of the year, one-third was not available for more than half of the year, and 98% of the year 10 reactors or more did not provide any power for at least part of the day. The myth of the need for nuclear baseload has been debunked for years. The energy system can be reliably and safely managed with 100% renewables and system flexibility. Blocking renewables integration into the electricity grid. **The inflexibility of nuclear, caused by technical limitations, safety requirements and economic factors, prevents** the feed-in of **renewable electricity into the grid, causing** grid **congestion and** curtailment. Nuclear's dominance over grid capacity can **block** the connection of **new** renewable energy **projects**, where even announced and then abandoned plans for a new nuclear unit can delay renewable projects connection, allowing for continued fossil fuel usage. Grid structures designed for large-scale, centralised **nuclear** power, **make it more** challenging, time-consuming and **costly to** introduce small-scale **distribut**ed **renewable** power.

An **example** can be **found in Romania where** Cernavodă 3 and 4 **reactors have reserved grid capacity** for years, **blocking new renewable** energy **projects** in the Dobrogea region, the most wind-intensive region in the country. **Delayed** grid **investments**, **due to uncertainty of new nuclear units, have also meant that capacity bottlenecks exist today for renewables online.**

In the Netherlands, the only current nuclear power station, Borssele is competing for landing space for off-shore electricity.

Post-Fukushima, renewables were blocked from connecting to the grid in Japan as the government considered restarting the reactors, despite public opposition to nuclear restarts and support for renewables. Rather than taking the opportunity to invest in grids and integrate renewables twenty years ago, Japan still heavily relies on fossil fuels today.

Prolonging the inevitable with nuclear extensions

While European governments may be tempted to prolong existing nuclear reactors beyond their original foreseen lifespans, in the context of phasing out Russian gas, costly **upgrades to** the ageing **nuclear** fleet, **just like investing in new ones**, **risks diverting investment** away **from more cost-effective** solutions such as **renewables**, energy efficiency, and system flexibility, in addition to risking lowered safety standards **and** security of supply as ageing increases unplanned outages.

Any prolongation of existing nuclear power plant units risks the continued **crowding out of renewable** energy **sources from the** electricity **grid**, **preventing** their **price-dampening** effects on the market. So-called "Small Modular Reactors" European lawmakers are increasingly persuaded by the empty promises of Small Modular Reactors (SMRs). Argued to be more flexible, decentralised, smaller, and cheaper than existing nuclear designs, countries are wasting public resources in favour of a non-existent product, riddled with the same limitations as their predecessors, and presenting poor value-for-money compared to existing alternatives. The focus on SMRs risks delaying the development of renewable energy technologies already available at the moment, and thereby prolonging the usage of fossil fuels., , Burdened by the same high capital costs, SMRs would have to run near constantly to reduce losses, thereby further congesting the grid and making them useless in providing back-up power needed for peak hours against renewables and energy storage. Nuclear energy is too risky and unsafe Nuclear technology inherently carries the risk of severe nuclear accidents with the release of large amounts of radioactivity as shown by catastrophic accidents in Fukushima or Chornobyl. **Extreme** and more frequent **weather** events due to climate change create **unprecedented** risks through storms or flooding that are not captured in planning standards for nuclear plants based on historic frequencies and severeness. Extreme weather events may also indirectly affect nuclear plants, such as breaking dams above nuclear plants or longer disconnection from electricity grids after storms. **Cyber attacks, military aggression** e.g. Russia's occupation of the Zaporizhzhia Nuclear Power Plant, and terrorist attacks, e.g. via drone attacks, could also lead to severe accidents of nuclear plants. Nuclear waste remains a risk worldwide to the health of all living creatures, including humans, for thousands of years after its use in energy production. Management of any future storage facility would still be at risk of natural disasters and decisions of future generations, whereas currently without any long-term solutions risks are increasingly shifting to interim storage which were not planned for the current supply and length of storage. Beyond decarbonisation For heightened climate ambition, renewables, energy efficiency, storage, interconnection and flexibility are best suited to make up this gap in generation and support increased renewables-based electrification, while phasing out fossil fuels in parallel. Given the poor speed and high costs of future nuclear projects, the difficulty to build several units at the same time, and the realities of SMRs, it is unlikely nuclear will be able to cover any significant part of Europe's energy needs by 2040. The future energy system will be far more decentralised, and active consumer and flexibility oriented, which are not the ideal conditions for new nuclear plants. For these reasons stated above, it is in the nuclear industry's interest to delay Europe's progress and keep in place the current centralised, fossil-based energy system, jeopardising climate goals, in the hope that projects are able to materialise in the future, and to lower safety standards to reduce costs. Nuclear energy is also at odds with an energy system based on democratic ownership of energy production, as opposed to renewables. A true democratic debate on nuclear has not been underway, but rather a capture by geopolitical interests and corporations. Problems in three identified spheres, the political debate, energy system planning, and decentralisation have been mapped as current and possible future areas where nuclear advocates may be actively hostile towards renewables and fossil fuel phase out. Though we must look beyond energy and decarbonisation, and have a holistic vision of nuclear power, incorporating drawbacks such as safety, waste, weapon proliferation, uranium dependency, operation in warzones and biodiversity.

Perception, siting, spent fuel, AND staffing independently zero investment.

William **Fletcher &** Craig B. **Smith 23**. **Served as an officer and engineer in the Navy working on the design and operation of nuclear-powered ships, as well as an engineer involved with the design and construction of commercial nuclear power plants. Later, he focused on industrial development and automation. **Engineer and former faculty member at UCLA. "Can we overcome the hurdles for nuclear power revival?" 4/14/23. https://thehill.com/opinion/energy-environment/3950501-can-we-overcome-the-hurdles-for-nuclear-power-revival/

The **spent fuel problem** must be resolved before we embark on an expansion of nuclear power. All reactors, including SMRs will have depleted nuclear fuel that **has to be disposed**. In over 50 years, the U.S. government hasn't been able to reach a politically acceptable **solution**. Today, all the spent fuel is stored at each reactor site, even for those reactors that have been decommissioned. Several other countries already have acceptable means to dispose of spent fuel.

Siting can be an issue. Where will we put new nuclear power plants? Most people **don't want to live near a nuclear power plant** even if the experts tell us that new designs are much safer. It can take a **long time to select and get approval** of a site for a new reactor.

Funding could be a problem. New nuclear plants are funded by private capital. It **takes 30 years** or so to **recover the large up-front investment** required to build a nuclear power plant. Nuclear power plants are expensive to build, but they are estimated to be less expensive to operate. However, if the cost of their electricity is not competitive, they will not be able to recover the investment involved.

Staffing and training could **take time.** The large number of skilled people needed have to see a reasonably secure future for nuclear power before they will commit their careers to this industry.

Zero carbon energy production means renewables solve.

IRENA 17 [IRENA, 2017, "ISBN 978-92-9260-044-0", The International Renewable Energy Agency (IRENA) is a lead global intergovernmental agency for energy transformation that serves as the principal platform for international cooperation, supports countries in their energy transitions, and provides state of the art data and analyses on technology, innovation, policy, finance and investment. IRENA drives the widespread adoption and sustainable use of all forms of renewable

energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, and energy security, for economic and social resilience and prosperity and a climate-proof future.
IRENA's membership comprises 169 countries and the EU. Together, they decide on the Agency's strategic direction and programmatic activities, in line with the global energy discourse and priorities to accelerate the deployment of renewables-based energy transitions worldwide.
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/IRENA_A_key_climate_solution_2017.pdf?la=en&hash=A9561C1518629886361D12EFA11A051E004C5C98]/dshah

The year 2016 was the world's hottest on record, surpassing 2015 and marking the third consecutive year of record average temperatures. In fact, of the 17 hottest years on record, 16 have occurred in the 21st century (NOAA, 2016). As it stands, the world is on track to massively miss the goals set forth in the Paris Agreement,[1] with nearly 1°C of global average temperature rise already witnessed since the pre-industrial era (WMO, 2016). To stay within the agreed Paris Agreement boundaries, the world can only afford 0.6°C to 1.1°C of additional average warming (NOAA, 2016). Current country pledges, or nationally determined contributions (NDCs), could initiate an emission decline in the coming years, but they are not sufficient to reach climate goals. Efforts must be strengthened.

Around **two-thirds of GHG emissions stem from energy production** and use, which puts the **energy sector at the core of efforts to combat climate change.** The largest CO_2-emitting sectors are electricity generation and industry, together responsible for about 65% of all energy-related CO_2 emissions today. The remaining 35% comes from transport, buildings and district heating (IRENA, 2017c).

[1] To limit global temperature increase to well below 2 degrees Celsius (2°C) above preindustrial levels.

The energy **sector needs** a total overhaul, with a transformation from fossil-based to **zero-carbon energy production** by the second half of this century. Today, 84% of energy use comes from fossil fuels, with 16% derived from renewables (IRENA, 2017c). Analysis by the International Renewable Energy Agency (IRENA) shows how, through accelerated uptake, 65% of energy use could come from renewables by 2050. This would be enough for countries to meet the Paris Agreement climate goals. Renewable energy currently represents about 25% of global electricity generation, with the rest generated by fossil fuels, according to IRENA's global energy roadmap, known as "REmap". Around 80% of all electricity in 2050 could be generated by renewable energy (IRENA, 2017c).
The transformation to a sustainable energy system with high shares of renewables would meet climate goals and pay for itself. It would lead to USD trillions in economic growth between now and 2050, and the health, environmental and climate benefits would save up to six times more than the additional costs associated with reconfiguring the energy sector, all while creating millions of jobs in the process (IRENA, 2017c).
Figure 1: CO_2 emissions reduction potential from all sectors under current plans and policies vs. accelerated uptake of renewables in 2050
Notes: Gt = gigatonnes; yr = year. CO_2 emissions include energy-related emissions (fossil fuel, waste, gas flaring) and process emissions from industry. If only fossil fuel emissions were displayed in this figure, CO_2 emissions would start from 32 Gt in 2015 and would reach 40.5 Gt and 9.5 Gt per year in 2050 in the Reference Case and REmap, respectively. The Reference Case (also called the baseline or business-as-usual), is the most likely case based on current and planned policies and expected market developments. It reflects NDCs if they are already an integral part of a country's energy plan, which is the case for around 60% of total global primary energy supply. The 2050 REmap scenario is a low-carbon technology pathway that goes beyond the Reference Case for an energy transition in line with the aims of the Paris Agreement. [2]
Accelerated deployment of renewable energy and energy efficiency measures form the key elements of the energy transition. Recent analysis shows that the world can meet around 90% of the decarbonisation needed to stay within the Paris Agreement boundaries through accelerated deployment of renewable energy and energy efficiency, with the remaining 10% to be met by other low-carbon solutions (IRENA, 2017c).
[2] Technologies covered under REmap include: renewable energy technologies for energy and as feedstock for production of chemicals and polymers; energy efficiency measures and widespread electrification that also improves efficiency; carbon capture and storage for industry; material efficiency technologies such as recycling.
Energy-related CO_2 emissions from all sectors totalled 36 Gt in 2015. These need to fall to 13 Gt in 2050 to achieve the REmap scenario, a reduction of 70% compared to the Reference Case, under which emissions are estimated to reach 45 Gt in 2050. Renewable energy could provide 44% of these reductions (20 Gt per year in 2050), as illustrated in Figure 1. **To enable this** dramatic emissions reduction, the share of **renewable energy must rise** from around 16% of the primary energy supply in 2015 to around 65% in 2050.
Renewable technologies could generate more than 80% of all electricity by 2050, with the remaining 20% generated by natural gas and nuclear. By 2050, **emissions** from electricity generation **would plummet** by **85%** in the REmap scenario, despite the fact that electricity generation is expected to increase by nearly 80% (IRENA, 2017c).[3]
Coal-based power generation would cease altogether. Besides increasing shares of renewables, the decrease in power sector emissions is also due to energy efficiency measures taken in industry and buildings to reduce electricity use for heating and cooling. Emissions in the buildings sector would decrease by about 70% by 2050. Transport emissions would be halved, while industry would become the largest emitter of CO_2.
Two-thirds of global greenhouse gas (GHG) emissions stem from the production and use of energy. This puts the energy sector at the core of efforts to combat climate change
The current electricity system evolved over many decades with fossil fuels at the centre. New power generation technologies require a new electricity system that is flexible and allows the integration of variable sources, such as solar and wind energy. Electricity generation from these variable renewables fluctuates according to resource availability and may not coincide with demand. This can cause difficulties in matching supply and demand, requiring flexibility to deal with variability. A range of flexibility options exist and will be needed as the role of variable renewables grows.
Under REmap, the share of wind and solar in power generation would increase to 52% by 2050, requiring a range of flexibility options to ensure grid stability, including time of-use electricity pricing, adaptation of market designs and new business models. Additional interconnectors, flexible fossil fuel generation and demand-side response can also increase flexibility, thus enabling higher shares of variable renewable energy. An often-discussed flexibility option is storage, which comes in many forms. Today, around 4 700 gigawatt hours (GWh) of electricity storage exists, 96% of which comes from pumped hydro (IRENA, 2017b). Under REmap, 11 900-15 300 GWh of electricity storage is expected by 2030, with only 51% from pumped hydro.[4] With an average battery pack of 50 kilowatt hours (kWh) per vehicle, electric vehicles alone could provide about 8 000 GWh of battery storage by 2030.
[3] Electricity generation is anticipated to increase to 43 000 terawatt hours (TWh) per year by 2050, up from 24 100 TWh in 2015. [4] Reference Case estimates 6 600-7 800 GWh of storage by 2030.

This would help to accommodate higher shares of wind and solar through flexible charging, when there is surplus generation and electricity prices are low. To achieve the conditions needed for electric vehicles to provide significant benefits to electric power systems by 2030, IRENA estimates that 160 million electric vehicles will be needed worldwide by then (IRENA, 2017a).
While the power sector holds great potential for renewables, electricity accounts only for around 20% of final energy use today. As a result, IRENA analysis points to an essential role for renewable energy technology deployment in end-use sectors. Such a role is especially important because together they account for approximately 80% of all global energy demand today. In the end-use sectors, REmap shows that the renewable energy share can grow to 78% in buildings, 38% in industry and 53% in transport by 2050 (IRENA, 2017c).[5] In transport, the number of electric vehicles needs to grow and new solutions will need to be developed for freight and aviation. New buildings will have to meet the highest efficiency standards, while existing buildings must be rapidly renovated. Buildings and city designs should facilitate renewable energy integration.
The energy transition can fuel economic growth and create new employment opportunities. The renewable energy sector alone could support around 26 million jobs in 2050,[6] with new job creation in renewables and energy efficiency more than offsetting job losses in the conventional energy sector (IRENA, 2017d). In fact, net energy sector employment in the REmap scenario (including in energy efficiency) would be higher by 6 million additional workers in 2050 compared to the Reference Case (IRENA, 2017c). Furthermore, global GDP would be 0.8% higher in 2050 compared to the Reference Case, a cumulative gain of USD 19 trillion from 2015 to 2050.[7] This overall improvement in GDP would induce additional job creation in other economic sectors as well.
The energy transition is technically and economically feasible. Drastic cost reductions have been instrumental in the unprecedented scale-up of renewable energy we are currently witnessing. Among the most transformative developments of the current decade has been the dramatic and sustained improvement in the cost-competitiveness of renewable electricity generation technologies. Technology learning and the opening up of new markets in countries with high resource potential continue to make renewables increasingly attractive.

Nine-tenths of the necessary emissions reduction can be achieved through accelerated uptake of **renewables** and energy efficiency

Since the end of 2009, solar photovoltaic (PV) module prices have fallen by around 80% and the price of wind turbines by 30-40% (IRENA, 2016). Biomass for power, hydropower, geothermal and onshore wind technologies can all now provide electricity that is competitively priced compared to fossil fuel-fired electricity generation.

The levelised cost of electricity from solar PV fell by more than 68% between 2010 and 2016, meaning it is also increasingly competitive with conventional power generation technologies at utility scale. Onshore wind has witnessed an 18% decline in its levelised cost of electricity since 2010, while offshore wind has seen a 9% decline over the same period. IRENA analysis predicts further substantial cost reductions in the coming decade (IRENA, 2016).
Cost reductions have opened the door to an energy transition that makes economic sense. Early action, however, is essential to capitalise on the economic opportunities available while avoiding the future costs of stranded assets. Delayed policy action would result in significant asset stranding in comparison to an energy transition where accelerated renewable energy and energy efficiency deployment begins today.
Early action is critical to reduce the stranding of economically valuable assets.[8] Delaying decarbonisation of the energy sector would require higher levels of investment to achieve the same objectives and would double stranded assets. In the REmap scenario, cumulative stranded assets from 2015 to 2050 would total USD 10 trillion, coming largely from buildings that need to be replaced because of low energy efficiency, and upstream energy infrastructure and assets (gas, oil and coal that must stay in the ground). This would double to USD 20 trillion to reach the same emissions objective by 2050 if effective mitigation policy was delayed by only one decade (IRENA, 2017e). To put this into context, USD 20 trillion is approximately 4% of global wealth in 2015 terms.[9]

US policy spills over

IRENA 15 ["Renewable Energy Prospects: United States of America", January 2015, IRENA, https://www.irena.org/Publications/2015/Jan/Renewable-Energy-Prospects-United-States-of-America]

The **United States** has the potential to **lead the global transition to renewable energy**. It has some of the best wind, solar, geothermal, hydro and biomass resources in the world. It also has a vibrant culture of innovation, plentiful financing opportunities, and a highly skilled workforce, alongside an agile and entrepreneurial business sector. REmap 2030, a global roadmap prepared by the International Renewable Energy Agency (IRENA) – assesses how countries can work together to double the share of renewable energy in the global energy mix by 2030. Under current policies and investment patterns, the share of renewables in the US energy mix is projected to only reach 10% by 2030 compared to 7.5% in 2010. The REmap analysis, however, shows that the country could realistically scale up renewables to 27%. The required investment of USD 86 billion per year could potentially save the US as much as USD 140 billion annually by 2030, factoring in the benefits of improved health and lower CO_2 emissions. Renewable Energy Prospects: United States of America is the second in a series of country reports that IRENA has released to supplement the range of global and sector-specific reports released since early 2014 as part of REmap 2030.

Climate change.

Nogue 23 [Sandra; Lecturer in Paleoenvironmental Science @ the University of Southampton; 3-23-2023; OUP Academic; “Catastrophic climate change and the collapse of human societies,” https://academic.oup.com/nsr/article/10/6/nwad082/7085016; DOA: 3-24-2025] nikhil **brackets in original**

The scientific community has focused the agenda of studies of climate change on lower-end warming and simple risk analyses, because more realistic complex assessments of risk are more difficult, the benchmark of the international targets is the Paris Agreement goal of limiting warming to <2°C, and the culture of climate science is to try to avoid alarmism [1]. Current fires, prolonged droughts, floods and heat waves, together with the consequent **food insecurity**, **civil unrest** and **migrations**, however, are opening the eyes not only of most scientists but also of most people all over the world to the need for considering, at least, the potential catastrophic effects of the collapse of ecosystems and society due to the current **emergency** of climate change.

The projections for the climate of the coming decades are, as we all know, worrying. The worst-case scenarios in the 2022 Intergovernmental Panel on Climate Change (IPCC) report project temperatures by the next century that last occurred in the Early Eocene, reversing 50 million years of cooler climates within two centuries. The Pliocene and Eocene provide the best analogues for near-future climates [2]. Climates like those of the Pliocene are likely to prevail **as soon as 2030** and unmitigated scenarios of **emissions** of greenhouse gases (GHGs) will **produce climates like** those of the **Eocene** for the coming decades. This situation is particularly alarming because human societies are locally adapted to a specific climatic niche with a mean annual temperature of ~13°C [3]. We can thus logically expect that current and future warming may **easily overwhelm** societal adaptive capacity.

These climate projections could be even more detrimental if models would not neglect, as they currently do, **feedback in the carbon cycle** and potential **tipping points** that could generate higher GHG concentrations [4]. Examples include the apparent slowing of dampening feedbacks such as the natural carbon-sink capacity [5,6], the loss of carbon due to increasing frequencies and intensities of fire at northern latitudes [7], **droughts and fires** in the Amazon [8] or the thawing of Arctic permafrost that releases methane and CO_2 [9]. This feedback is also likely not proportional to warming, as is sometimes assumed. Instead, abrupt and/or irreversible changes may be triggered at a temperature threshold [7]. Particularly worrying is a 'tipping cascade' in which **multiple tipping elements** interact in such a way that tipping one threshold increases the likelihood of **tipping another** [4,10].

Climate change also interacts with **other anthropogenic stressors** such as changes in **land use**, loss of **biod**iversity, **nutrient imbalances**, **pollution** and an **overuse** of available resources that are crossing the planetary safety boundary limits and operating as a possible **catastrophic** mix. This mix may exacerbate society vulnerabilities and cause multiple indirect stresses such as economic damage, loss of land and water, and food insecurity that can merge into system-wide synchronous failures. These cascading effects are not only biophysical or biogeochemical, but they also affect human society, generating **conflicts**, **political instability**, systemic financial risks, the spread of **infectious diseases** and the **risk of spillover**. For example, there is evidence that the 2007–10 drought contributed to the conflict in Syria [11].

Anthropogenic climate change interacting with these other stressors could thus cause a global catastrophe, in a **worldwide societal collapse**. Kemp et al. [1] have reminded us that although we have reasons to suspect it, such potential collapsing futures are rarely studied and poorly understood. The closest research is the search for evidence of tipping dynamics and estimating thresholds, timescales and impacts of potential tipping points [4]. We advocate for considering them while using the available knowledge acquired from historical and prehistorical examples of local and regional collapses, transformations and resilience of human societies also driven by climate and unsustainable use of resources (Fig. 1).

C3: Cyber

Nuclear energy development is down right now

Dianne **Plummer 25**. "Power Play: The Economics Of Nuclear Vs. Renewables." *Forbes*. 02/12/2025. https://www.forbes.com/sites/dianneplummer/2025/02/12/power-play-the-economics-of-nuclear-vs-renewables// Accessed: 04/07/2025. Sachin

Government Subsidies and Investment Trends: Nuclear Vs. Renewables

Despite the **declining costs of renewables**, government **subsidies still play a crucial role** in energy economics. Nuclear research and **development has significantly decreased** in relative terms since the 1970s as investments have become more **diversified**. In 2015, the International Energy Agency reported that nuclear technologies received just 20% of the public R&D energy budget, a steep decline from nearly 73% in 1975. In contrast, funding for energy efficiency and renewable technologies has **grown substantially**, with both receiving shares of energy R&D comparable to nuclear in 2015. According to the "Energy Subsidies: Evolution in the Global Energy Transformation to 2050" report, global direct energy sector subsidies—spanning fossil fuels, renewables, and nuclear—totaled approximately USD 634 billion in 2017. Fossil fuel subsidies dominated, accounting for about 70% of the total (USD 447 billion), while renewable energy subsidies accounted for 20% (USD 128 billion), biofuels 6% (USD 38 billion), and nuclear received at least 3% (USD 21 billion). However, the actual total could be higher due to data gaps, particularly in sub-national subsidies. Their analysis of nuclear subsidies reflects a minimum estimate for existing nuclear power generation.

According to the report, total annual energy sector subsidies are expected to decline, with projections estimating a reduction to USD 466 billion per year by 2030, with a slight increase to USD 475 billion in 2050. This would represent a 25% decrease from 2017 levels and a 45% reduction (USD 390 billion) from the projected subsidy levels without the realistic acceleration of renewable energy deployment. In the U.S., the Inflation Reduction Act (2022) provides tax credits for wind and solar projects, contributing to a surge in renewable investments.

China leads the world in renewable energy investments, allocating $546 billion in 2022, according to Scientific American.

The Caribbean Context Renewables Vs. Nuclear

Caribbean governments have historically taken a project-by-project approach to renewable energy development. However, the region's small and isolated islands, combined with limited space for large-scale solar or onshore wind farms, have posed challenges to achieving economies of scale. Additionally, the lack of a local supply chain and the inability to procure at scale make renewable energy projects more expensive in the Caribbean. According to IRENA, Caribbean Community Member States have set a regional goal of generating 47% of their electricity from renewable sources by 2027. To meet this target, Caribbean islands need to add 4 GW of renewable energy capacity, requiring an estimated USD 9 billion in additional investments to fulfill their Nationally Determined Contributions. Through the Small Island Developing States Lighthouses Initiative, IRENA offers support to SIDS in their energy transition by providing policy, regulatory, and technical advisory services, as well as facilitating knowledge sharing, capacity building, and funding for early-stage projects. The 15 Caribbean islands participating in the LHI have a combined installed power capacity of approximately 1,936 MW, consisting of 743 MW of hydropower, 640 MW of bioenergy, 327 MW of solar photovoltaic, and 225 MW of wind energy. Additionally, SIDS are the countries that will feel the effect of climate change with the decimation of their coastlines.

On the other hand, nuclear energy remains absent from the region due to high capital costs, safety concerns, and lack of expertise. Jamaica is working to integrate nuclear power into its energy mix, having signed a memorandum of understanding with Canadian Nuclear Laboratories and Atomic Energy of Canada Limited. According to the Prime Minister, this initiative aims to leverage nuclear technology to produce clean electricity, while also promoting economic growth and enhancing energy security for the country. However, introducing nuclear power in Jamaica's energy mix is unlikely to significantly improve energy security due to the high costs, long lead times, and reliance on foreign expertise and resources for nuclear technology. Additionally, the raw materials required for nuclear power plants, such as uranium, would still need to be imported, further limiting the potential for true energy independence.

Nuclear and Renewables: Weighing the Future of Energy

As the global energy transition accelerates, the debate between nuclear power and renewables remains **complex**. While nuclear energy offers high-capacity, low-carbon baseload power, it is often hindered by **long construction timelines**, cost overruns, **waste issues** and **decommissioning** challenges. Conversely, renewables such as solar and wind continue to experience declining costs and rapid deployment, supported by government subsidies and technological advancements. However, integrating intermittent renewables into the grid requires significant investment in storage and infrastructure. In regions like the Caribbean, renewables face unique geographical and economic challenges, while nuclear remains largely absent due to financial, lack of expertise and logistical barriers. Although some nations, including Jamaica, explore nuclear options, the high costs and foreign dependency may limit its viability and will still leave them desiring energy security. Ultimately, **the choice between nuclear and renewables hinges on economic feasibility**, policy support, and **technological advancements**, and requires a balanced approach to ensure a sustainable and resilient energy future.

New nuclear energy is vulnerable

Chatham 24 [Chatham House, July 12, 2024, "Cybersecurity of the civil nuclear sector", Chatham House – International Affairs Think Tank, https://www.chathamhouse.org/2024/07/cybersecurity-civil-nuclear-sector/2-threats-and-risks-civil-nuclear-infrastructure]//dshah + spok + shassy + Lex RR–SR

A combination of factors – from energy security and decarbonization agendas to the emergence of small modular reactors (SMRs) that potentially make nuclear energy more accessible – are prompting many countries to consider adopting, or increasing their use of, nuclear energy. But the prospect of more nuclear power plants, many of them more digitally connected than in the past, coming into operation in more countries makes ensuring the cybersecurity of civil nuclear infrastructure more critical than ever. This paper considers the evolving cyberthreats that the civil nuclear sector faces both in peacetime and during conflict. It outlines key vulnerabilities in the sector, including the use of older or bespoke software, a **safety culture insufficiently attuned to digital and cyber risks,** and the emergence of novel risks around the use of SMRs and microreactors. The paper then outlines the existing international legal frameworks that already apply to the issue and can help protect the civil nuclear sector from cyberthreats, and proposes steps to improve cybersecurity. These steps include doing more to interpret and leverage international law in the relevant areas, and enhancing operational protections such as cyber incident-response planning.

This paper builds on previous Chatham House research into the cybersecurity of civil nuclear facilities. **The paper draws on an extensive review of existing work in the field,** as well as on interviews with a wide range of relevant stakeholders in the cybersecurity and nuclear industries.[6] Three themes emerged from our latest work in this area. Firstly, it is clear that **the nuclear industry was a** comparatively **late starter in considering cybersecurity,** at least relative to other industries associated with critical national infrastructure (CNI) or to commercial sectors such as finance. The nuclear industry's strong pre-existing physical security, and its use of bespoke or uncommon industrial control software, meant that there was a sense within the sector that all aspects of security were sufficiently covered. However, in recent years, as ever more systems in nuclear power plants have acquired digital elements, including commercial off-the-shelf software solutions, **more cyber vulnerabilities have been introduced.** This has increasingly left systems and facilities open to a potential attack vector that has been insufficiently addressed. In some respects, the civil nuclear industry is thus still playing catch-up. The UK's 2022 Civil Nuclear Cyber Security Strategy[7] exemplifies the problem by setting goals that, while sensible, should ideally have been reached several years earlier. Similar shortcomings in national cybersecurity frameworks have been pointed out repeatedly since the mid-2010s by a variety of actors, including the International Atomic Energy Agency (IAEA). Secondly, due to the specific regulatory environment involved, the nuclear industry is isolated from other industries when it comes to exchange of best practice. This makes learning from best practice on cybersecurity difficult, as pathways to knowledge exchange are ad hoc, often informal, and largely based on the personal drive and networks of individuals in cybersecurity roles. There is also a **lack of transparency about cybersecurity incidents, due to** concerns both about acknowledging and **advertising** vulnerabilities, **and** about **how vulnerabilities might be perceived by the public**. The nuclear industry's preoccupation with perceptions can get in the way of transparency, even though stronger disclosures would help to bolster confidence in the safety of working practices.

The nuclear industry's preoccupation with perceptions can get in the way of transparency, even though stronger disclosures would help to bolster confidence in the safety of working practices. Thirdly, governments often have limited ability to enforce cybersecurity standards. In part, this reflects the fact that nuclear energy installations are privately operated in many countries. Efforts to ensure private operators meet cybersecurity standards are often ineffective or inefficient, resulting in delays, slow progress and inconsistencies between operators. While government regulators, such as the Office for Nuclear Regulation (ONR) in the UK, typically conduct regular inspections and can recommend and mandate requirements, the nature of licensing systems for nuclear operators means that long periods of risky working practices are often tolerated, and that government often has limited power to intervene. Even where civil nuclear infrastructure is state-owned, moreover, facilities may operate at arm's length from government.

Some of the challenges in this area were highlighted by the investigation into cybersecurity at the Sellafield nuclear waste site in the UK. Sellafield was repeatedly flagged in ONR inspections for 'enhanced regulatory attention' on cybersecurity practices.[8] ONR then brought criminal charges against the operator Sellafield Limited for having gaps in its cybersecurity from 2019 to 2023, charges to which Sellafield Limited pleaded guilty in June 2024.[9] Concerns about regulators' ability to influence the cybersecurity practices of operators, and about the accessibility of best-practice recommendations, are not exclusive to the UK. A review by the George Washington University of cybersecurity practices across a range of nuclear operators in different countries found that 'none of the proposed guidelines have holistically provided detailed security procedures specific to the architecture and working of [nuclear power plants]'.[10] France's nuclear regulator, the Autorité de sûreté nucléaire (ASN), highlighted concerns about EDF's supply-chain management, especially for SMR projects, in a January 2024 press update.[11]

To address some of the challenges outlined above, the IAEA has done important work to standardize and improve cybersecurity guidance across the civil nuclear industry globally.[12] This can help address the fact that some national regulators provide only general cybersecurity guidance that fails to take into account challenges specific to the civil nuclear industry.

Cybersecurity challenges require a higher level of attention across all levels of the industry, to ensure gaps in risk mitigation can be closed swiftly. Some of the barriers to achieving this exist globally. They include: 1) **a lack of transparency across the industry**, with regulators often discussing cybersecurity gaps only with specific operators rather than sharing concerns more widely, and operators reluctant to disclose their own cybersecurity gaps for fear of the impact on trust in their services; 2) the gap between guidance and implementation; 3) differing levels of capacity and investment in cybersecurity from one country to another.[13]

Civil nuclear infrastructure is vulnerable to cyber operations due to its high value as a target, and due to features inherent in the information technology required to run and operate facilities.[14] The nuclear sector's designation as critical national infrastructure (CNI) in many countries could encourage cyber operations originating from a range of actors – including both states and non-state groups – and for a range of motives. Such actors could, for instance, include: anti-nuclear-energy hacktivists; cybercriminals looking to blackmail facilities, operators or governments, seeking ransom, or intending to steal confidential information; state actors wanting to target another state's CNI to jeopardize that state's energy security or gain military advantage; or terrorists looking to advance their own agenda.[15]

Cyber incidents can also occur accidentally as a result of existing vulnerabilities in commercial software. These vulnerabilities include: entry poin**ts such as inadequate IT infrastructure maintenance; missing patches and updates; and unsafe working practices such as connection to unprotected networks, the use of portable storage devices, the use of legacy systems, and inadequate data protection**. **Crucially, these vulnerabilities can also open a backdoor for targeted cyber operations, providing an attack vector f**or hostile actors. This range of potential threats makes it doubly essential to ensure fundamentally secure working practices, as it is very difficult to **identify and protect against every individual vulnerability.[16]**

The cyber vulnerabilities of civil nuclear facilities are summarized in Table 1:significant limiting factor when assessing past cases of cyber operations targeting nuclear power plants is the lack of publicly available information on such incidents. This can reflect concerns on the part of operators, regulators and governments about the release of sensitive data, and about the potential for revelations of cybersecurity failures to reduce public trust in nuclear energy. However, publicly known past examples of cyber operations against civil nuclear infrastructure cover a range of scenarios. One of the earliest-known incidents was in 2003, when the Slammer worm infiltrated the management and operational information and communication technology (ICT) systems of the Davis-Besse nuclear power plant in the US.[18] Slammer was able to access the power plant's system through an IT consultant's infected device. While this was an accident, it exemplifies how malicious actors could go about engineering an attack.

Two other well-researched examples are the 2010 Stuxnet worm attack in Iran, and the 2014 hack of a South Korean nuclear power operator, Korea Hydro and Nuclear Power Co., Ltd (KHNP). These two examples show the range of harms that cyber operations can cause, from the theft of sensitive data to physical damage. The Stuxnet example was extraordinary in the extent of the damage it caused, whereas the KHNP example is more typical of other cyber operations against nuclear power plants. What both have in common is that the attackers were alleged to be states: Israel and the US in the case of the Stuxnet attack on Iran's nuclear facilities; and North Korea in the case of KHNP.

Stuxnet remains one of the most famous intentional cyber operations targeting nuclear infrastructure. The operation sought to disrupt operations at Iran's Natanz nuclear enrichment facility. Stuxnet was a computer worm targeting supervisory control and data acquisition (SCADA) systems. Once inside the industrial control system, the worm caused the control software to accelerate rotation of the centrifuges to the point of physical damage.[19] This makes it one of the only examples of a cyber operation having caused physical damage.

KHNP, South Korea's state-run nuclear power operator, was targeted in December 2014. In this cyber operation, sensitive information was stolen, including blueprints for reactors, electrical flow charts and personal details of employees. One of the hackers' goals was to undermine public trust in the safety of the nuclear power plant.[20] But the South Korean government said that the hackers had not managed to access any control systems.[21]

As the Stuxnet episode shows, cyber operations have the potential to cause tangible damage to physical assets.[22] **The impact of a cyber operation targeting civil nuclear infrastructure can** be as wide-ranging as the theft of sensitive information, the loss of access to or control over monitoring and control software, operating difficulties, or – in the worst-case scenarios **– reactor shutdown or difficulties controlling nuclear** storage, for example through loss of access to external power sources for cooling.[23] There is only a small possibility that a cyber operation would cause loss of control over a nuclear reactor to the point of meltdown or a significant release of radiation. This is because nuclear power plants have other redundant safety features such as back-ups for cooling.[24] However, the potential impacts if a meltdown or major radiation release did occur could be very significant, including deaths or long-term health problems among nuclear power plant workers or members of the public exposed to radiation, as well as long-term environmental damage and contamination. **A cyber operation targeting a nuclear facility also has the potential to disrupt the electric grid. States that have nuclear power plants often rely on nuclear power to provide a reliable baseload of energy to their electric grid. This dependency is increasing as countries transition away from fossil fuels.** A stable baseload is required for a steady availability of energy throughout the day. However, not all types of energy generation offer a uniform power supply over the course of a day. Solar and wind power rely on certain environmental conditions for optimal performance. On a rainy or windless day, for example, other forms of energy generation must make up for the lack of solar- or wind-generated power. Nuclear energy, in contrast, can always generate power. If an electric grid became unreliable because nuclear power was unable for some reason to provide a reliable baseload – for example, as a result of a cyber operation – this could disrupt many aspects of daily life. Affected areas could include economic activity, the functioning of government, transport links, healthcare facilities and other critical public services. This in turn could cause elevated levels of distress in the population, and even excess deaths if healthcare functions were compromised.[25] Given that many countries are considering nuclear energy due to increasing energy demand and a desire to transition away from fossil fuels, it is now all the more critical to ensure that new nuclear power plants and new reactor types are designed with cybersecurity in mind. The following section explores two emerging technological developments and their impacts on the risk landscape for civil nuclear infrastructure. The first is the evolution of nuclear reactor technologies themselves, as well as their increased distribution through the advent of small modular reactors (SMRs) and microreactors. The second is the rise of artificial intelligence (AI), in terms of both its increasing capabilities and widening usage. AI could lower the barrier to malicious cyber operations by making tools for cyber intrusions more accessible and affordable for a wider range of actors, including potential hackers or cybercriminals.[26]

The development of SMRs and microreactors provides an opportunity to increase energy security in areas where a traditional, larger nuclear power plant might be too difficult or expensive to build. In comparison to traditional nuclear infrastructure, which tends to take decades to plan and build, SMRs or microreactors could be deployed more quickly in areas where there is a significant energy need. Some SMRs are designed to be transported or deployed offshore, making them potentially more versatile than traditional nuclear power plants. The IAEA is aware of over 80 different SMR designs and concepts that are at different stages of development and implementation. As of early 2024, five SMR designs were under construction or operating.[27] The operating and monitoring software used in SMRs and microreactors will be less bespoke than in some older models of nuclear power plant. Indeed, one of the selling points of the newer designs is that SMRs and microreactors are easier to run, given that staff are more likely to be familiar with the operating software. Likewise, one of the purported advantages of SMRs and microreactors is that it is possible to control several reactors remotely at the same time. In some cases, **SMRs and microreactors are intended to be operated fully remotely, without any staff on site**. This increases the requirements for software solutions that **are cloud-based or connected to the internet.**

Cybersecurity is typically a consideration in the design of newer reactors in a way that has not been the case with traditional nuclear power plants, as older plants were developed at a time when cybersecurity standards did not yet exist or were just emerging. The risk landscape around such designs is mixed. On the one hand, newer reactors are designed to be fundamentally safer and more secure from a cybersecurity point of view. Cybersecurity is typically a consideration in their design in a way that has not been the case with traditional nuclear power plants, as older plants were developed at a time when cybersecurity standards did not yet exist or were just emerging. In this way, some vulnerabilities might be removed at the design stage by drawing on cybersecurity best practice.

On the other hand, the fact that **SMR**s are less bespoke than many more traditional reactor designs, and in many cases **are connected to the internet, makes them more likely to have cyber vulnerabilities**. In turn, this makes newer reactors more of a target for opportunistic cybercriminals. Security solutions such as ‘air gapping’ (which means not connecting critical parts of the control system to the internet) are often not possible in such cases due to the requirement for remote access.

In addition, increased deployment of SMRs and microreactors could create novel risks. **First, if there are more reactors overall, the risk of any one reactor falling victim to a cyber operation increases**. Another risk stems from **the construction supply chain. Many companies** are likely to be involved in the production of parts for these reactors. It is **unclear whether such parts will consistently be designed with cybersecurity principles in mind. Therefore, the security of the supply chain could become very difficult to guarantee in its entirety.**[28] The IAEA is working with SMR designers to ensure that all new designs meet stringent safety standards for reactor and fissile-material safety. But ensuring the cybersecurity of the supply chain for SMRs and microreactors could present additional challenges, because a wide range of hardware manufacturers and software developers might all be suppliers for the same SMR or microreactor project. This highlights how important – and difficult – it will be for manufacturers to audit and monitor their supply chains for cybersecurity. In addition to these inherent risks, it is envisaged that many SMRs and microreactors will be deployed in countries that may have lower cybersecurity capacity to begin with.[29] Such countries might struggle to ensure the additional cybersecurity requirements of nuclear reactors. The IAEA provides guidance on how to ensure a high standard of cybersecurity for nuclear reactors. However, as implementation is down to national governments, standards can vary according to the awareness and capacity of each government or operator.

As mentioned, adding to the civil nuclear industry's risk of exposure to malicious cyber operations is the fact that **hacking is arguably getting easier.** Hacking tools are **more widely available**, and the emergence of **AI**-assisted programming tools may **lower the barrier to entry for cybercriminals**. Vulnerable sectors such as CNI could thus be targeted by a wider range of criminals who previously may not have been able to use cyber tools.[30]

Adversaries uniquely try to penetrate US critical infrastructure – Kushner 16

David Kushner. 2016. "The Geeks on the Front Lines." Rollingstone.com. 2016. https://www.rollingstone.com/interactive/feature-the-geeks-on-the-frontlines/. Spok

After decades of seeming like a sci-fi fantasy, the cyberwar is on. **China, Iran and other countries** reportedly **have armies of state-sponsored hackers infiltrating our critical infrastructure**. The **threat**s are the stuff of a Michael Bay blockbuster: downed power grids, **derailed trains, nuclear meltdowns.** Or, as then-Defense Secretary **Leon Panetta put it last year, a "cyber-Pearl Harbor... an attack that would cause physical destruction and the loss of life, paralyze and shock the nation and create a profound new sense of vulnerability."** In his 2013 State of the Union address, President Obama said that "**America must also face the rapidly growing threat from cyberattacks**. . . .We cannot look back years from now and wonder why we did nothing in the face of real threats **to our security and our economy**." The pixelated mushroom cloud first materialized in 2010 with the discovery of Stuxnet, a computer worm said to be designed by the Israeli and U.S. governments, which targeted uranium-enrichment facilities in Iran. Last fall, Iranian hackers reportedly erased 30,000 computers at a Middle Eastern oil company. In February, security researchers released a report that traced what was estimated to be hundreds of terabytes of stolen data from Fortune 500 companies and others by hackers in Shanghai. **A leaked report** from **the Department** of **Homeland Security** in May **found** "increasing **hostility**" aimed online **against "U.S. critical infrastructure** organizations" – power grids, water supplies, banks and so on. Dave Marcus, director of threat intelligence and advance research at McAfee Federal Advanced Programs Groups, part of McAfee Labs, a leading computer-security firm, says the effects would be devastating. "**If you shut off large portions of powe**r, you're not bringing people back to 1960, **you're bringing them back to 1860," he says**. "Shut off an interconnected society's power for three weeks in this country, **you will have chaos."**

Cyberattacks initiate meltdowns

Van Dine 16 [Alexandra Van Dine, Csis Poni, 5-17-2016, "The Cyber Threat to Nuclear Facilities", Nuclear Network, https://nuclearnetwork.csis.org/the-cyber-threat-to-nuclear-facilities/]//SPok + shassy

In April, a German company announced that it had suffered a cyber attack. This is not shocking. As retired Marine Gen. James Cartwright has said, there are two realities for companies today: "You've either been hacked and [are] not admitting it, or you're being hacked and don't know it." But this attack was on a nuclear power plant. **And the malware found inside the plant allo**wed hackers to access sensitive plant information from afar. Stuxnet illustrated the art of the possible in the cyber-nuclear space. **This malware defeated security systems, jumped airgaps (which disconnect networks from the internet) and, most importantly, caused physical consequences. Stuxnet's aim was limited—break centrifuges**. But what if hackers had more catastrophic ambitions? Well-resourced hackers can achieve physical consequences at nuclear facilities with cyber attacks, possibly resulting in theft of nuclear material or sabotage. For example, **surveillance systems** or **keycard readers could be disrupted**, allowing thieves to enter a **facility, steal nuclear material**, and depart uninterrupted. A sophisticated **cyber attack** could even **cut power to cooling systems**, **resulting in** a Fukushima-like **meltdown**. **Several factors exacerbate this**

threat. Increased reliance on digital controls and technological vulnerabilities across the **nuclear enterprise increase opportunities for attackers.**

Extinction via food, ecosystems, poison

Christopher Allen **Slocum 15**, VP @ AO&G, "A Theory for Human Extinction: Mass Coronal Ejection and Hemispherical Nuclear Meltdown," 07/21/15, The Hidden Costs of Alternative Energy Series, http://azoilgas.com/wp-content/uploads/2018/03/Theory-for-Human-Extinction-Slocum-20151003.pdf

With our intelligence we have littered the planet with massive spent nuclear fuel pools, emitting **lethal radiation** in over-crowded conditions, with circulation requirements of **electricity**, **water**-supply, and neutron **absorbent chemicals**. The failure of **any** of these conditions for any calculable or incalculable reason, will release all of a pool's **cesium** in**to** the **atmosphere**, causing 188 square miles to be contaminated, 28,000 cancer deaths and $59 billion in damage. As of 2003, 49,000 tons of SNF was stored at 131 sites with an additional 2,000-2,400 metric tons produced annually. The NRC has issued permits, and the nuclear industry has amassed unfathomable waste on the premise that a deep geological storage facility would be available to remediate the waste. The current chances for a deep geological storage facility look grim. The NAS has required geologic stability for 1,000,000 years. It is impossible to calculate any certainty 1,000,000 years into the future. Humanity could not even predict the mechanical failures at Three Mile Island or Chernobyl, nor could it predict the size of the tsunami that triggered three **criticality** events at Fukushima Daiichi. These irremediable crises span just over 70 years of human history.

How can the continued production and maintenance of SNF in pools be anything but a **precedent** to an **unprecedented human cataclysm**? The Department of Energy's outreach website explains nuclear fission for power production, providing a timeline of the industry. The timeline ends, as does most of the world's reactor construction projects in the 1990s, with the removal of the FCMs from Three Mile Island. One would think the timeline would press into the current decade, however the timeline terminates with the question, "How can we minimize the risk? What do we do with the waste?" (The History of Nuclear Energy 12). Nearly fifteen years into the future, these questions are no closer to an answer. The reactors at Fukushima Daiichi are still emitting radioisotopes into the atmosphere, and their condition is unstable. TEPCO has estimated it could take forty years to recover all of the fuel material, and there are doubts as to whether the decontamination effort can withstand that much time (Schneider 72). A detailed analysis of Chernobyl has demonstrated that nuclear fall-out, whether from thermonuclear explosions, spent fuel pool fires, or reactor core criticality events are deleterious to the **food**-**chain**. **Cesium** and strontium are taken into the **roots** of **plants** and **food** crops, causing direct **human** and **animal** contamination from ingestion, causing cancer, teratogenicity, mutagenesis and death. Vegetation suffers mutagenesis, reproductive loss, and death. Radioactive fields and **forest** floor**s** **decimate** **invertebrate** and **rodent variability** and number necessary to supply nature's **food-chain** and **life** **cycles**. The **flesh and bones** of freshwater and oceanic biota contribute significantly to the total radiation dose in the food-chain. Fresh **water** **lakes**, **rivers** and **streams** become radioactive. Potable **aquafers** directly underlying SNFs and FCMs are penetrated by downward migration of radioisotopes. **Humans must eat to live. Humans must have water. No human can survive** **5** **Sv** **of exposure** to ionizing radiation, many cannot survive exposure to 1 Sv.

Independently retracts the aff – public perception halts reactor development. Empirics!

Lambermont 20 [Paige Lambermont, 1-14-2020, Paige Lambermont is a Policy Associate at the Institute for Energy Research. In her role, she writes about the impacts of government policy on energy markets. She has a bachelor's degree in political science from American University, and is from Butler, Pennsylvania, "Three Mile Island and the Exaggerated Risk of Nuclear Power", Foundation for Economic Education, https://fee.org/articles/three-mile-island-and-the-exaggerated-risk-of-nuclear-power/]//shassy + Spok

The Psychological Impacts

The main impact of the Three Mile Island accident has been psychological rather than physical. Big events like this one shape public attitudes for decades. People don't remember the real impact of the event; they remember the feelings of uncertainty and fear that came with it. Those feelings now taint the public image of nuclear power in the United States.

The accident at Three Mile Island Unit 2 occurred at 4 a.m. on March 28, 1979. There was a malfunction in the reactor's secondary cooling circuit, and the temperature of the reactor's primary coolant rose, causing an automatic shutdown of the reactor. Control room instruments didn't alert operators that a relief valve failed to close. Because of this, the reactor did not cool as it should have, and the core was damaged. Later that day, a small amount of gas was released accidentally, but the released gas traveled through air filters, which removed all of the radionuclides save the relatively harmless and short half-lived noble gases.

The event caused no physical harm, but the public perception of the risks of nuclear energy was heightened dramatically.

The accident created **public fear** but posed no real threat to the public. According to the Nuclear Regulatory Commission (NRC), the two million people in the area around TMI-2 at the time of the accident received an estimated dose of only 1 millirem above the usual background dose of radiation, less exposure than they would receive from a chest x-ray and a tiny fraction of the 100-125 millirem normal yearly background dose in the area. This is a minuscule amount of radiation compared to what all of us encounter in the normal course of everyday life.

Because of cancer concerns following the accident, the Pennsylvania Department of Health maintained a registry of people living within five miles of Three Mile Island when the accident occurred. The 30,000 person list was kept up until mid-1997 when it was determined that there had been no unusual health trends or increased cancer cases in the area immediately surrounding the accident.

People were frightened by the event, but there was no physical harm. Only the **public perception of the risks** of nuclear energy was heightened dramatically. **The greatest effects were on the future permitting and construction of reactors and on NRC rules and procedures.**

Changes in Nuclear Regulation and Construction

Following this accident, it became far more **difficult to construct a reactor** in the United States, in part **because the politics and economics both shifted. Heightened fear makes approval more difficult** and causes **people to be less supportive of new construction, and changes on the** regulatory **side of things increase costs, shifting the economics of bringing new plants online.** A 1984 New York Times article on the abandonment of construction of the Marble Hill plant in Indiana cites more than **100 plant cancellations following** the Three Mile Island **Accident**.

Significant changes came to the NRC following Three Mile Island. It expanded its resident inspector program in which two NRC inspectors live near each of the plants and provide oversight of adherence to the agencies' regulations. Safety became a more essential element of the system, but regulatory costs also rose. It also expanded both safety and performance-oriented inspections and established an operations center staffed 24 hours a day to provide assistance in plant emergencies. The Institute of Nuclear Power Operations, which is now the Nuclear Energy Institute, was also established to be an internal policing mechanism for the industry, providing a single point of interaction with NRC and other agencies on many issues and allowing them to share a framework for approaching generic issues they all experience. Plants were also required to install additional equipment to monitor certain conditions in order to mitigate future accidents. These and other changes created a far more safety-oriented regulatory environment than previously existed. Safety became a more essential element of the system, but regulatory costs also rose. The Role of Precautionary Thinking and the Recallability Trap This is certainly a case where the downside of the precautionary principle has negative effects. Decisions that account more for the damage caused by rare accidents than by the constant benefits produced operate under an inaccurate cost-benefit analysis. This is even more true in this case, where there was widespread fear but no real off-site damage. The Mercatus Center's Adam Thierer made a similar point about the aftermath of Japan's Fukushima disaster in an October 31 piece titled "How Many Lives are Lost Due to the Precautionary Principle?" wherein he pointed out the hidden costs of overly precautionary thinking. Following Fukushima, Japan stopped using nuclear power, which had previously been 30 percent of its energy. Energy prices rose, and in the subsequent four years, there were 1,280 cold-related deaths. Precautionary thinking can lead to costly unforeseen outcomes. Reliable and affordable energy is essential—a fact no more apparent than when it becomes less affordable and less reliable. Although the Three Mile Island aftermath isn't quite so dramatic, it's a similar concept. Fears of worst-case scenarios prevent the development of important resources. Overprecaution fueled by outlier events means that less nuclear power is constructed, plants are shut down before they need to be, and the public is misinformed about the safety of this technology. The public is strongly influenced by accidents in this space, and public perception is quickly changed when they occur. When major events occur, we often fall into the recallability trap, wherein more dramatic events are remembered more sharply and seen as more likely to occur than less dramatic ones. We might be more afraid of a nuclear disaster or a lightning strike than we are of a car crash or heart attack even though we're far more likely to be done in by the latter than the former. Rare but dramatic events tend to feel far more likely than statistics indicate. We misestimate the chances of these things happening. The recallability trap is especially relevant to nuclear power. Although there have only been three major commercial nuclear accidents—Three Mile Island, Chernobyl, and Fukushima—and only one of those was in the United States, the general public views these events as far more likely.

According to a CBS News survey, in 1977, 69 percent of Americans favored building new nuclear power plants, but by 1979, after Three Mile Island, support fell to 46 percent. Following Chernobyl in 1986, support had fallen to just 34 percent. By 2008, it had risen to 57 percent, but in 2011, after Fukushima, it fell back down to 43 percent. **The public is strongly influenced by accidents** in this space, and **public perception is quickly changed when they occur.** Shifting Public Support. Following the Three Mile Island incident, attitudes toward nuclear power in the United States shifted.

The impetus to **license new plants was** all but **gone. Public fear was overwhelming** enough to **discourage new development.** From 1978 to 2012, the **NRC didn't approve the construction of any new commercial reactors**. As the chart below shows, new reactors were still constructed following the incident, but **new permitting did not occur,** although various projects were attempted throughout the period. Much of this gap can be attributed to the Three Mile Island accident. Indeed, in 2019, Exelon, the owner of the Three Mile Island plant, announced it would be closing down its final remaining reactor after years of losing money. Following an incident like this one, people become overcautious. Nonetheless, in the early 2000s, this finally started to change as the "nuclear renaissance" began. Following a few decades of no development, nuclear power was planning a big comeback. But because **of a combination of the fears created by Fukushima** and economic realities at home thanks to the financial crisis, **the renaissance never materialized. So, even though no one died** or was even harmed in the Three Mile Accident, its impact is still clearly seen today**. The accident seemed major and ominous, and because it was seen that way, p**ublic pressure made new construction far more difficult than it **otherwise would have been.**

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Tariffs Mean Nuclear Energy is Screwed, the aff literally can't solve

Pomper 25 [Miles A. Pomper, Yanliang Pan, 3-10-2025**,** Miles Pomper is a **Senior Fellow** in the Washington DC office of CNS. His work focuses on nuclear energy, nuclear nonproliferation, nuclear security, and nuclear arms control. He holds a master's degree in international affairs from Columbia University and a master's degree in journalism from Northwestern University. Before joining CNS he served as Editor-in-Chief of *Arms Control Today* from 2003-2009. Previously, he was the lead foreign policy reporter for *CQ Weekly* and *Legi-Slate News Service*, where he covered the full range of national security issues before Congress, and a Foreign Service Officer with the US Information Agency. "Trump's Tariffs on Canada Could Kill the U.S. Nuclear Energy Revival", World Politics Review, https://www.worldpoliticsreview.com/us-nuclear-energy-tariffs/]//dshah

Hopes for a U.S. nuclear energy revival may be **jeopardized by the tariffs that President Donald Trump continues to threaten to impose** on Canada, as well as his plans to similarly target the European Union moving forward.

That's because the **nuclear industry depends on a global supply chain** that can take uranium concentrate from Kazakhstani mines, for instance, convert it to uranium hexafluoride in Canada and enrich the product in France, before finally delivering it to a U.S. fuel fabricator. **Trump's tariffs will make that exceedingly complicated, costly and precarious, to the great detriment of the U.S. nuclear sector.**

Flexible global market mechanisms have allowed the U.S.—a country with negligible uranium mining activities and limited downstream conversion and enrichment capacity—to secure enough fuel to operate the largest fleet of nuclear reactors worldwide, producing some 20 percent of the country's electricity. All that will change if the Trump administration follows through on its threatened 10 percent tariff on uranium imports from Canada, among other products—which were imposed on March 4 but subsequently removed—amid threats of broadening the trade war to the EU. Trump left in place an additional 10 percent tariff he announced on March 4 on Chinese uranium imports, which were already under a 17.5 percent tariff as of Feb. 4.

As of 2023, more than **95 percent of** the **uranium purchased by U.S. utilities was of foreign origin.** Canada accounted for the largest share at just over 25 percent. Further downstream along the supply chain, only around one-third of the uranium conversion and enrichment capacity needed to keep U.S. reactors running are domestically located, with the rest sourced from the EU, Canada, Russia and China. For the U.S. nuclear industry, the tariffs would be all harm and no benefit, not least because U.S. nuclear fuel buyers will have to swallow much of the costs. Ever since the first Trump administration contemplated tariffs on uranium products in 2019, the Canadian uranium supplier Cameco has included provisions in its fuel contracts to ensure that any future U.S. tariffs would be passed on to the buyer. Nor will the impact on prices be confined to Canada and the EU, for **once tariffs kick in, all suppliers will have an incentive to raise their asking price**. And the **U.S. utilities will have** to pay given their inelastic demand and—in some cases—**limited inventories.**

To make matters worse, the same **uranium material may have to leave the U.S. for conversion,** enrichment and fuel fabrication before re-entering the country, thereby **triggering the tariff a second and even third time**, quickly compounding domestic fuel costs. Fuel prices have already spiked in recent years due to geopolitical turbulence as well as expectations that rising demand for low-carbon fuel sources and electricity—needed to power data centers and electric cars—will spark a nuclear renaissance. Recurring tariffs may further **erode utilities' thin operating margins,** further burdening an industry that is just beginning to recover from its post-Fukushima decline as well as competition with cheap natural gas from fracking.

Will U.S. domestic fuel producers benefit from these tariffs? The answer, for the most part, is no. Mining, conversion and enrichment are capital-intensive industries, and companies wait for long-term price signals when deciding whether to undertake the cumbersome and time-consuming process of restarting or expanding operations. For those companies previously on the verge of such a decision, skyrocketing uranium prices in recent years have already provided the necessary demand signal, and a tariff would make little difference. In conversion and enrichment, meanwhile, **domestic producers** would **lose** foreign **customers** reluctant to pay a tariff on any uranium feed material they ship to U.S. facilities for further processing. And if **reactors** do **shut down** due to higher fuel and operating costs, demand on uranium products and services will fall, thus threatening recent commitments to capacity expansion by U.S.-based fuel producers, which have given the domestic supply chain its first hopes of recovery in more than a decade.

In no small part due to the protests of U.S. utilities and foreign nuclear fuel suppliers alike, the first Trump administration in 2019 decided not to impose trade restrictions on uranium imports following a lengthy investigation into whether they threatened national security. Even the domestic uranium producers that petitioned for trade protection in the first place eventually applauded the "no action" decision as it ended 19 months of market uncertainty.

From a market perspective, the only thing worse than tariffs is arguably the uncertainty over future **tariffs.** Unfortunately, Trump's flip-flopping on the import duties threatened for Canada, combined with those expected for the EU, will likely represent only the **begin**ning of **an uncertain period.** There are still questions, for instance, over how long tariffs on various products that may be imposed will remain in place, given the administration's signals of sector-specific exemptions. Logistically, great uncertainty also remains over how tariffs would apply to book transfers and swaps that are common in the nuclear industry, as well as over how U.S.-origin material stored at foreign warehouses would count versus foreign-origin material at U.S. facilities.

The expectation of tariffs leading into the March 4 announcement had already led to a price premium on uranium held within the United States. Any further tariffs would now risk bifurcating the market between U.S.- and foreign-origin uranium products, with the potential to disrupt supply chains. Uranium traders have not tracked the physical origins of traded material for decades. For an industry accustomed to a globally interconnected open market, a return to the practice of tracking uranium origins all the way through the supply chain could impose unforeseen logistical burdens and supply disruptions, if it can even be done.

Still, the greatest open question is over the retaliatory export restrictions that major nuclear fuel suppliers might impose on the U.S. in response. **The Canadian government has been contemplating retaliatory controls** and taxes on major export commodities bound for the U.S., **including uranium.** If **Canada wants to retaliate in the civil nuclear sector**, it can. **Beyond uranium, the leading U.S.-based vendor of reactor technology, Westinghouse Electric Company, is now Canadian-owned. And U.S.-based companies marketing small modular reactors, from NuScale to GE-Hitachi, have received their first crucial orders from European and Canadian customers. Without these demonstration projects, their reactor designs will remain confined to paper. To complicate matters further, U.S. companies, lacking heavy nuclear manufacturing capacity of their own, must rely on foreign suppliers of large reactor components** for future construction. North America's largest manufacturing facility for commercial reactor equipment, for instance, is the BWXT factory in Ontario, where the pressure vessel for GE-Hitachi's BWRX-300 reactor is supposed to be fabricated—that is, if the BWRX project is not canceled due to Trump's tariffs and the ensuing retaliatory turmoil.

In 2020, during the first Trump administration, the Department of Energy published a strategy paper titled, "Restoring America's Competitive Nuclear Energy Advantage," highlighting the importance of the industry for national security. Energy assurance is arguably an even bigger priority for Trump during his second term, and judging from his Jan. 20 executive order urging the return of uranium to the critical minerals list, the current White House clearly recognizes the importance of uranium as a strategic resource.

Yet imposing **tariffs** on major uranium-supplying allies is a poor way of guaranteeing the United States' uranium access, as it **risks undermining** the open market and the United States' position within it. Nor is alienating critical reactor development and deployment partners like Canada a winning strategy for restoring the U.S. civil nuclear industry, which already lacks both committed demand and supply capacity, and has for decades struggled to compete with vertically integrated Russian and Chinese state-owned enterprises. Unless the administration begins paying attention to the dangerous effects of its trade policy on the **nuclear industry, the U.S. will keep losing** in that competition.

On Climate

On the uq

NU: Emissions down

Gaffney et al 25 (Michael Gaffney: research analyst with Rhodium Group's Energy and Climate practice, attended UC San Diego School of Global Policy and Strategy where he earned a Master of Public Policy specializing in energy and environmental policy. He holds a bachelor's degree in political economy from UC Berkely. Ben King: associate director with Rhodium Group's Energy and Climate practice, focusing on the effects of policy and economic changes to the US energy system. He previously worked for the US Department of Energy in the Office of Energy Efficiency and Renewable Energy. John Larsen: partner at Rhodium group where he leads the firm's US energy system and climate policy research, a non-resident Senior Associate at the Energy and National Security program at CSIS. He has lectured at Johns Hopkins and Amherst College. He holds a master's degree in Environmental Policy and Planning from Tufts University. January 9, 2025, "Preliminary US Greenhouse Gas Emissions Estimates for 2024", Rhodium Group, https://rhg.com/research/preliminary-us-greenhouse-gas-estimates-for-2024/ . DOA March 17, 2025) CLS

Since peaking in 2004, emissions have trended downward in a bumpy fashion. But after a significant decline in 2023, we estimate that 2024 emissions were down by just 0.2% year-on-year while the economy grew by 2.7%, continuing a decoupling of emissions and economic activity. Emissions are still below pre-pandemic levels and remain about 20% below 2005 levels, the benchmark for US commitments under the Paris Agreement. Lower manufacturing output drove the overall decrease in 2024 emissions, with industrial sector emissions falling by 1.8%. In the oil and gas sector, continued reductions in methane emissions intensity led to a 3.7% drop in emissions. Increased air and road travel partially offset these reductions, which drove up transportation sector emissions by 0.8%. Demand for electricity—led by the residential sector—also rose by 3% and was met by higher natural gas, wind, and solar generation, while coal generation saw just a slight decline. For the first time, combined solar and wind generation surpassed coal, although overall power sector emissions increased by a slight

0.2%. In the buildings sector, emissions crept up 0.4% due to slightly elevated fuel use. The modest 2024 decline underscores the urgency of accelerating decarbonization in all sectors. To meet its Paris Agreement target of a 50-52% reduction in emissions by 2030, the US must sustain an ambitious 7.6% annual drop in emissions from 2025 to 2030, a level the US has not seen outside of a recession in recent memory. Economic growth and slightly lower emissions in 2024 Economic growth is one of the major determinants of GHG emissions, and in 2024, the US gross domestic product (GDP) expanded at a projected annual rate of 2.7%. This growth was driven by strong consumer spending as well as public and private investment, despite persistent inflation, high interest rates, and elevated labor and materials costs. Clean technology played a significant role. Record-high investment in the manufacturing and deployment of clean technologies accounted for 5% of total private investment in structures, equipment, and durable consumer goods in Q3, according to the latest data from the Clean Investment Monitor, a joint effort between Rhodium Group and MIT's Center for Energy and Environmental Policy Research (CEEPR). While the economy grew, we estimate that US GHG emissions fell slightly in 2024. The US will get its final GHG report card for 2024 when the EPA finalizes its annual GHG inventory in spring 2026. However, using preliminary economic and energy activity data, we project that economy-wide emissions declined by just 0.2% in 2024 (Figure 1). This puts US emissions at about 20% below 2005 levels, and down by 8% from pre-pandemic levels.

Pref: we are only side analyzing emissions data

On the L

1. Time means we obv can't solve rn, we need ot do it by 2030, that's 1NC Nogue

LT. Nuclear is too slow and raises net emissions.

Ramana 24 [M.V. Ramana, Simons Chair in Disarmament, Global and Human Security and Professor of Public Policy and Global Affairs @ University of British Columbia, 7-29-2024, "Atomic Fallacy: Why Nuclear Power Won't Solve the Climate Crisis" Literary Hub, https://lithub.com/atomic-fallacy-why-nuclear-power-wont-solve-the-climate-crisis/, accessed: 4-1-2025] OA

Some might argue that these risks are the price we must pay to counter the threat of climate change. I disagree, but even if one were to adopt this position, my **research** shows that **nuclear energy** is just **not** a **feasible solution** to climate change. A nuclear power plant is a **really expensive** way to produce electricity. And nuclear energy simply cannot be scaled **fast enough** to match the rate at which the world needs to **lower carbon emissions** to stay under 1.5 degrees Celsius, or even 2 degrees. Cost and the slow rate of deployment largely explain why the share of global **electricity** produced by nuclear reactors has been **steadily declining**, from around 16.9 percent in 1997, when the Kyoto Protocol was signed, to 9.2 percent in 2022. In contrast, as the costs of **wind** and **solar** energy **declined dramatically**, and modern renewables (which do not include large dams) went from supplying 1.2 percent of the world's electricity in 1997 to **14.4 percent** in 2022. Another contrast is revealing. When pro-**nuclear advocates** talk about solving climate change with **nuclear energy**, they call for building **lots and lots** of **reactors**. The World Nuclear Association, for example, proposes building **thousands** of nuclear reactors, which would together be capable of generating a million megawatts of electricity, by **2050**. Such a goal is completely at odds with **historical rates** of building nuclear **reactors**. Some proponents of nuclear energy refuse to give up on the technology. They blame the decline in nuclear energy and the high costs and long construction periods on the characteristics of older reactor designs, arguing that alternative designs will rescue nuclear energy from its woes. In recent years, the alternatives most often advertised are small modular (nuclear) reactors—SMRs for short. These are designed to generate between 10 and 300 megawatts of power, much less than the 1,000–1,600 megawatts that reactors being built today are designed to produce. For over a decade now, many of my colleagues and I have consistently explained why these reactors would not be **commercially viable** and why they would never resolve the **undesirable consequences** of building **nuclear power plants.** I first started examining small modular reactors when I worked at Princeton University's Program on Science and Global Security. Our group largely comprised physicists, and we used a mixture of technical assessments, mathematical techniques, and social-science-based methods to study various problems associated with these technologies. My colleague Alex Glaser, for example, used neutronics models to calculate how much uranium would be required as fuel for SMRs, which we then used to estimate the increased risk of nuclear weapons proliferation from deploying such reactors. Zia Mian, originally from Pakistan, and I showed why the technical characteristics of SMRs would not allow for simultaneously solving the four key problems identified with **nuclear power**: its high **costs**, its **accident risks**, the difficulty of dealing with **radioactive waste**, and its linkage with the capacity to make **nuclear weapons**. My colleagues and I also undertook case studies on Jordan, Ghana, and Indonesia, three countries advertised by SMR vendors as potential customers, and showed that despite much talk, none of them were investing in SMRs, because of various country-specific reasons such as public opposition and institutional interests. We were not the only people coming up with reasons for not believing in the claim that new reactor designs would solve all these problems. Other scientists and analysts also highlighted the dangers and false promises of SMRs. Nuclear advocates are not deterred by such arguments. They **insist** that this time it will be **different**. Nuclear plants would be cheap, would be quick to build, would be safe, would never have to be shut down in unplanned ways, and would not be affected by climate-related extreme weather events. The evidence from the **real world**, which I elaborate on later, suggests **otherwise**. Nuclear reactors are unlikely to possess any of these characteristics, let alone all of them. Thus, what is actually being advocated might be termed faux nuclear plants, existing only in the imagination of some, not in the real world. My bottom line is that nuclear energy, whether with **old reactor designs** or **new faux alternatives**, will simply **not** resolve the **climate crisis**. The threat from **climate change** is **urgent**. The world has neither the **financial resources** nor the luxury of **time** to **expand nuclear** **power**. Meanwhile, even a limited expansion would aggravate a range of **environmental** and **ecological risks**. Further, nuclear energy is deeply imbricated in creating the conditions for nuclear annihilation. Expanding nuclear power would leave us in the **worst** of **both** **worlds**.

OWs on scope, climate change cant be solved wihtout the efforts of all countries, the NEG keeps the most effective and the accessible method to solve, and prob our ev does the actual comparison

On Salination

On the uq

1.

On the L

1. UQ> L: Obviously can't solve for salination if their are a bunch of droughts
2. LT: Us solving for climate change means increased crops
3. There's plants in other countries, they can js do the food shipping

On the IL

1. Tariffs mean people are s

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On the uq

NU/T - Rosatom is declining, but Western development allows them to compete.

Bellona 24 [Bellona; News Organization; March 13; "Rosatom's output **dropped** over the last year. We look at three reasons why," https://bellona.org/news/nuclear-issues/2024-03-rosatoms-output-dropped-over-the-last-year-we-look-at-three-reasons-why; DOA: 3-27-2025] tristan

A decrease in output from Russian nuclear power plants is an expected and natural stage in the development of the country's nuclear energy industry, which is experiencing a period of **aging** of a certain part of its nuclear fleet. In recent decades, Rosatom has taken a leading position in the construction of nuclear power plants abroad, but has delayed the construction phase of replacement capacities within the country. Over the next 5 years, there will be a gradual **reorientation** of Rosatom's activities from foreign nuclear power plant construction projects to domestic ones. At the same time, the quality of Russian turbine equipment still leads to periodic technical problems and is mainly used on domestic Russian projects. It is unlikely that the situation will change quickly in the coming years, therefore, in many cases of competitive selection of projects, the success of Rosatom's new export proposals for the construction of nuclear power plants will **depend** on effective cooperation with foreign, primarily Western, partners. And in the future, perhaps even Chinese.

not comparative

And, China's exports will slow.

Willis 24 [Matthew; News Reporter @ NSB; May 16; New Security Beat; "Don't Panic US: China's Nuclear Power Ascendancy Has Its Limits," https://www.newsecuritybeat.org/2024/05/dont-panic-us-chinas-nuclear-power-ascendancy-has-its-limits/; DOA: 3-27-2025] tristan

Nonetheless, nuclear projects have encountered hurdles in developing countries where substantial financial support, technical oversight, and design adaptations to local conditions are often required. Moreover, China has **rarely** mobilized its vast financial resources to support nuclear abroad.

Even ignoring prospective stagnation at home and the unlikeliness of that leading to major exports, China's nuclear sector will be preoccupied with **domestic** commitments for some time.

These constraints, paired with the Belt and Road Initiative's focus on **other** energy projects and the **failure of past** bilateral nuclear agreements, make it unlikely China will build 30 or more reactors overseas by 2030. Beijing will finance only so many projects abroad, especially with current high debt levels and other economic headwinds.

Competition with China Should Not Drive US Nuclear Power Policy

American policymakers should resist the drumbeat of some advocates pushing a boost of the US nuclear industry to "keep up" with China's nuclear construction. China's domestic nuclear constraints and lack of overseas expansion means increased US nuclear support for competitive reasons is not warranted.

On the L

1. China and Russia way to far ahead why does investment solve, it takes 30 years to build a nuclear reactor

On the !