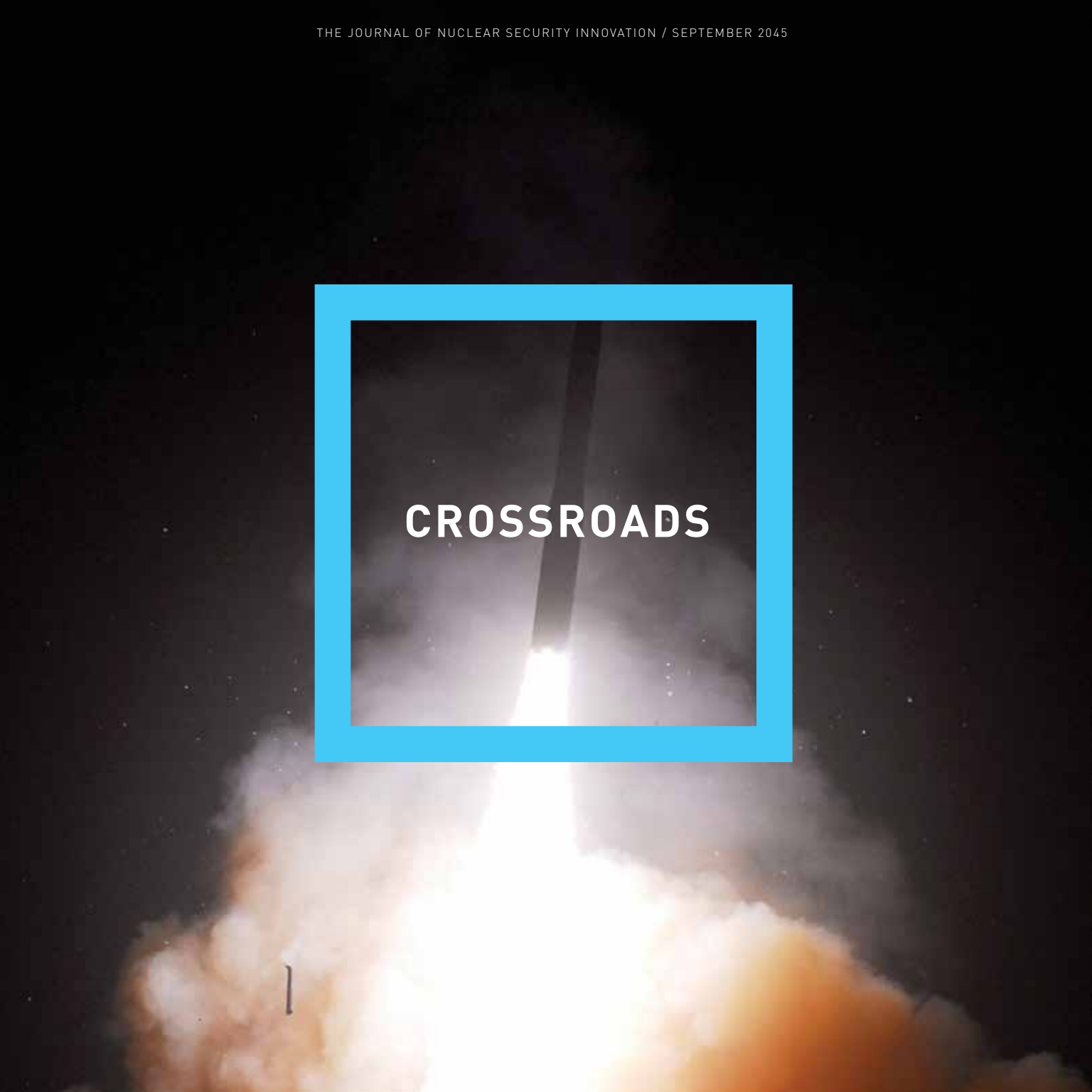

CROSSROADS

THE WORLD WAS NOT
MEANT TO BE A PRISON
IN WHICH HUMANKIND
AWAITS ITS EXECUTION

John Fitzgerald Kennedy, State of the Union Address, 1962

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Letter from the Editor

In March 2015, futurist Jamais Cascio and the N Square collaborative created five plausible scenarios, each set in the year 2045, for reaching the internationally-agreed upon goal of eliminating nuclear weapons. This is an extremely valuable thought experiment, one that supports common efforts to create a better future for our children and grandchildren. These scenarios, alternatively fascinating, terrifying and hopeful, highlight specific areas where innovation is urgently needed. These include not only new technical approaches to global security issues, but also innovation that reshapes belief systems and institutional norms while defining public education's role in ensuring that the leaders of tomorrow are knowledgeable about and engaged in this issue.

These five scenarios posit events that catalyze changing attitudes towards nuclear weapons. As in life, however, each scenario hints at a darker possibility; but for key decisions and actions, the world could slide into a multilateral nuclear arms race or, in the worst case, all-out nuclear war.

At the end of each scenario we identify those key decisions and actions. We highlight places where innovation in science, technology, and international diplomacy can increase the likelihood of a future free from the threat of nuclear weapons. You will find that these innovations—as is so often the case—also have a dark side that reminds us of the ethical and moral considerations we'll face as we work our way out of this thorny problem.

More importantly, you will read these scenarios through the filter of your own experience and will recognize opportunities for innovation we might never imagine. Our hope is that these scenarios will catalyze a network of people like you who bring their own resources, insights and expertise to bear on this, the wickedest man-made problem in human history.

ERIKA GREGORY
DIRECTOR, N SQUARE

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BY JAMAIS CASCIO



THE JAMMU DISASTER

How a Nuclear Accident Served as Catalyst to Eliminate the Weapons



The Jammu urban center was largely destroyed with the blast, which had immediate effects that could be felt in Sialkot, Pakistan, about 20 miles away. Close to 40,000 people died in the explosion.

To this day, people still argue if it was really an accident. More than a decade later, after the cleanup, after the resettlements, after the lawsuits and arrests and assassination attempts, it still isn't known with certainty whether the nuclear weapon that went off in Jammu-Kashmir was just a horrible accident or an even more horrible provocation.

Weighing in on the side of "accident" was the political context: the relationship between India and Pakistan in 2027 was calm, even if still very frosty. The cycle of saber-rattling and semi-mobilization over disputed regions was at its low point, and neither military was prepared for an attack (as demonstrated in the immediate aftermath of the warhead explosion: there was so much confusion in the early moments that neither Islamabad nor Delhi went on full military alert for nearly 30 minutes). The global press started screaming about "nuclear terrorism" almost instantly, along with some online claiming that the region was hit by a large meteorite, but neither Delhi nor Islamabad had anything concrete to say in the immediate aftermath. It was only when the radiation sensors started going crazy that the reality of the situation took hold.

Early estimates that the explosion was in the 10–20 kiloton range were more-or-less correct (the current analysis says that it was a 12.3kt blast), centered in the downtown of the state's capital city, Jammu. The urban center was largely destroyed, and because of the mountainous terrain channeling the blast the immediate effects could be felt in Sialkot, Pakistan, about 20 miles away. It's believed that around 40,000 people died in the initial explosion, with nearly a million showing signs today of being physically affected by the event; almost a hundred thousand people more lost their lives in the ensuing days due to panicked evacuations and riots. The number of people still suffering psychologically from the Jammu Disaster, of course, is far greater.

That neither India nor Pakistan took this crisis as a trigger to declare war is notable, the result of decades of communication building as well as a very real fear of what would ensue. The U.S., Russia, and China immediately pressed the two nations to show restraint, but evidence suggests that neither set of leaders had any stomach for a conflict, nuclear or otherwise, especially as images of the catastrophe started coming in. Nonetheless, in the subsequent years various insiders claimed that factions within the military and intelligence ministries on both sides were demanding a war declaration, fueling the argument that the explosion was an intentional attempt to trigger a military outcome.

One critical consequence of the event was the clear evidence that both India and Pakistan had small nuclear warheads (around the same size as the explosion) secretly deployed in the region, in violation of a number of treaties the nations had signed over the years. This revelation, on top of the unrelenting barrage of images, videos, and simulations of the event and its aftermath, led to the collapse of both governments as well as protests lasting for months. The official United Nations report blames a failure of the safety hardware on an Indian nuclear device being transported, but most people believe that report to be a cover-up. Hostile factions of "Jammu Truthers" variously blame Pakistan's ISI, India's BJP, Russia, the United States, and China.

All of this could have been just another humanitarian nightmare, eventually pushed into the bin of forgotten catastrophes, were it not for the uniquely 21st century twist: the utterly complete documentation of the blast and its results, collected by omnipresent surveillance systems as well as tens of thousands of individuals using

12.3kt

Strength of the blast, according to current analysis







Technology helped monitor both the shape of the explosion and the declining life signs of trapped and injured survivors.

wearables, 3D printed micro-drones, cube satellites (either in orbit already or rushed to launch), and even phones. Wearable fitness and health monitors either marked the shape of the explosion through their sudden failure, or (further out from the blast) charted the declining life signs of trapped and injured survivors. In the minutes, days, and weeks following the blast every square meter of the region, from the western Hindu Kush to the streets of Sialkot, was photographed or recorded in some way, not only by states and international officials, but also by citizens trying to make sense of the senseless.

The Jammu Disaster remains, even 18 years later, the most heavily documented historical event yet. Googlezon donated AI time to the analysis and categorization of the data, estimating that it would take over eight months to accomplish. Surprisingly, it took nearly three years, and cross-sectional deep analysis is said to be still ongoing.

Even more surprising, perhaps, is the end result of that documentation and impossible-to-ignore visibility: active measures by every nuclear armed nation to disassemble their nuclear weapons, as demanded by millions of people in the streets worldwide and even by political leaders feeling something unusual: shame. The undeniable, brutal evidence of the horrors of the explosion and its aftermath reverberated around the world.

A recurring theme across the literally millions of images of the Jammu Disaster blanketing all manner of media was simply "This Could Be Us." In the U.S., 2028 Presidential campaign rallies were repeatedly interrupted by protestors demanding the elimination of nuclear weapons, sometimes even taking over media displays with Jammu Disaster photos. Protests in Russia and China were, if anything, even more active, with the continued reliance on

In the 2028 U.S. Presidential campaign, rallies were repeatedly interrupted by protestors demanding the elimination of nuclear weapons



nuclear weapons often tied to complaints about corruption and oppression. The U.K. was the first to announce that it would be eliminating all of its nuclear weapons, alongside India and Pakistan (which had already quietly begun dismantlement). By 2040, all acknowledged nuclear states had adopted total elimination of nuclear weapons as policy; those who had never admitted to possessing such devices retained their position of ambiguity, even as they quietly began to explore how to manage dismantlement.

By 2045, the official number of nuclear weapons was finally brought to zero, and the unofficial number was believed to be fewer than 100. Not perfect, but much closer than most had dared hoped. □

This scenario uses the very real possibility of an apparent nuclear weapons accident as a catalyst to eliminate nuclear weapons. The disaster, in and of itself, would likely not be a sufficient provocation for such a substantial shift in policies around the world. The actual driver here is the overwhelming documentation of the event, from personal videos to cheap drones to data from the wearable health monitors on the victims. The enormity of the event becomes unavoidable, and coupled with a bottom-up movement, pushes governments to face the need to eliminate these weapons.



By 2040, all nuclear states had adopted total elimination of nuclear weapons as policy and began to explore how to manage dismantlement.

The primary question about this scenario is whether a single apparently accidental explosion would be sufficient to transform global politics. A variation on this scenario might include an escalation of the event into a brief war between India and Pakistan, resulting in far greater casualties and underscoring the potential of an accident to snowball into global disaster. In such a scenario, the aftermath wouldn't be limited to a small region in South Asia; even a small nuclear exchange between India and Pakistan would likely have far-reaching effects in terms of fallout, masses of refugees, political and economic fragility world-wide, and the simple question of how to take care of the millions of dead.

In this scenario, the extensive documentation of the accident and its results serves as a stand-in for the more devastating version. By the late 2020s, the detail and volume of the documentation, coupled with an event greater ability to create simulations and visualizations, would make it hard to avoid facing the ways the situation could have been far worse. Social media and instant sharing of video, images, and more can have a powerful political impact.'

Implications for Innovation

Two things stand out regarding the Jammu scenario that are unknowns today, but are essential to an ultimately positive outcome.

First, would the Indian government have enough information to conclude that the event was not a Pakistani (or Chinese) nuclear attack or a Pakistani-supported terrorist attack using either an improvised nuclear device smuggled into Jammu or a stolen Indian weapon? This conclusion is essential in a crisis so that India does not falsely blame Pakistan and commence retaliation or hostility that could lead to war.

Innovations that would improve the situational awareness of Indian government decision-makers include:

Technological Innovations

- The ability to network and assess the information from all the various platforms mentioned in the scenario including cellphones, drones, weather and seismic monitoring stations, wearable health monitors and space-based sensors.
- Omnipresent cameras and informal citizen monitoring will allow for abundant documentation of any large-scale event. Indeed, the problem may end up being too much available information, making useful analysis more challenging.
- Constant real-time monitoring of the location and security status of their inventory of nuclear weapons.
- Technical capabilities to assess not only the near-term consequences but also the enduring threats from contamination and damage to food and water systems.
- The ability to rapidly identify the origin of the weapon in a post-detonation environment. This would include:
- Trained technical teams with the proper equipment to conduct forensics on sample materials from the blast area.
- Relationships with other nations that could assist in this effort and access to databases on foreign nuclear materials.
- An effective network of border controls and sensors that could detect and defeat attempts to bring unauthorized nuclear materials into the country.

Socio-Political Innovations

- Improved relationships with both Pakistan and China and the capability to communicate clearly with both governments during the crisis.
- Pre-existing regional emergency management organizations that could facilitate Chinese and Pakistani humanitarian aid for the disaster.
- The presence of impartial non-government (NGO) or international (i.e. UN) monitoring organizations that could resist possible Indian government clampdown on information on the consequences of the even
- A statement by the International Court of Justice that the accident proves its conclusion that nuclear weapons could never be used without violating the laws of war, and a renewed call for their elimination.

Media and Communications Innovations

- Reliable communication systems for the Indian government to reassure its population and to provide them with useful response directions.
- Mechanisms for all citizens (perhaps facilitated by NGOs or international organizations) to demand that their governments eliminate nuclear weapons.
- The capability to rapidly and scientifically poll citizens around the world on their preferred reaction to the disaster and to communicate those results to governments.
- A social media platform that enables rapid and reliable multimedia communication with large numbers of people, easily reshared and commented upon.
- A combination of ubiquitous citizen cameras and constant global social connection to enable widespread, abundant, and detailed documentation.
- Low-cost micro-drones and cube satellites to combat on-the-ground censorship.

It's important to note that one reason the Jammu event would cut through media noise is that it would be unlike anything that had happened before (in living memory). It's not just another regional civil war or natural disaster, it's something massive and (effectively) unprecedented. Public interest would be immense and images of the disaster's result would be unavoidable for citizen and politician alike.



EMERGENCY MANAGEMENT

How the search for a solution to climate change led to solving the nuclear weapons problem

BY JAMAIS CASCIO

AS GEM-D got better at implementing designs for resilience, it began to think about other problems such as water access, migration and refugees, and agriculture

[redacted]t's not really an exaggeration to say that the Global Emergency Management Directorate ("GEM-D") probably saved the world. Twice.

The organization emerged in 2027 as a means of grappling with multiple simultaneous climate-driven disasters. Unsurprisingly, observers in Washington and Beijing initially considered GEM-D to be (variously) a way for smaller states to stay out of trouble while the Superpowers bestrode the Earth, an insidious plot by one-world-government types to bypass sovereignty, an insufficient apology by the West for wrecking the planet, or yet another talking-shop destined to fail alongside the UN. Few recognized what it truly would become: a new model institution for managing complex global problems democratically and collaboratively, one that even the self-described Superpowers would eventually join.



GEM-D could build what the United Nations could not: its own "army," in this case one comprising engineers, scientists, architects, laborers, and more, all dedicated to figuring out low-cost, highly-effective methods for dealing with the increasingly complex consequences of global warming-driven climate disruption. Much of its initial work focused on recovery and rebuilding after disasters, but GEM-D soon dedicated more of its resources to disaster prevention. And as the GEM-D teams got better at implementing designs for resilience, some of its leaders began to think about other problems. Pandemics topped the list, along with water access, migration and refugees, and adapting agriculture to a changing environment.

There was another fundamental way in which GEM-D differed from the United Nations: membership was not limited to nation-states. The precursor to GEM-D was a joint effort by several global NGOs working with a handful of insurance, re-insurance, and transnational finance groups to come up with plans for "practical resilience." This initial program joined with a similar multi-state group to form GEM-D; from the beginning, commercial groups and NGOs had a voice in the Directorate's proceedings.

The key political breakthrough for GEM-D came in the early 2030s, as the United States and China came into conflict over the possible deployment of technologies intended to hold down global temperatures by blocking a small percentage of incoming sunlight. Each saw the announced plans of the other as potentially harmful to national interests and a clear violation of sovereignty. Tensions rose as both nations began to speak of climate engineering in military, not environmental, terms. GEM-D stepped in with an unexpected approach: lawsuits and insurance claims. The World Court was flooded with legal action by every member nation against the US and China; American courts were inundated with lawsuits brought by major insurance and re-insurance groups alongside US activists; and China's nascent civil society, slowly emerging after decades of suppression, was nearly overwhelmed by carefully-orchestrated legal proceedings alongside peaceful and polite mass protests.

The main complaint was that the unilateral deployment of geoengineering would nonetheless have a global effect, violating (among other things) basic property rights of non-Superpower nations. GEM-D went one step further, however: they assembled a



team of scientific, financial, and legal experts to serve as an independent climate engineering management group, setting guidelines and limits. If the US and China agreed to participate in this system, GEM-D member nations would be satisfied. Beijing and Washington protested, calling this extortion and decrying GEM-D members for violating various economic treaties. In the end, however, both joined.

By the late 2030s, GEM-D's effectiveness as a transnational institution had become clear. Unlike the UN Security Council, the Superpowers didn't dominate; unlike the General Assembly, the purview was limited and focused. Agendas were set based on scientific data and true long-term analysis. While nearly every big problem (such as famine and water access) had a political component, GEM-D sought to make the problems "less wicked" by focusing solely on the environmental, ecosystem, climate, and biological science issues.

So the 2041 announcement that GEM-D would take on nuclear weapon dismantlement (carefully not calling it "disarmament") left many observers surprised. But the analysis behind the decision was persuasive, especially when visualized as a playable simulation. The decision built on actions taken over the previous 25 years by a majority of nations to make the people of the world aware of the humanitarian consequences of nuclear war as a catalyst to outlaw the weapons. Beginning with a series of conferences convened by NGOs in the late 2010s, a core group of countries had completed a treaty which banned the possession, transfer, and use of nuclear weapons—finally bringing those weapons into the same legal badlands as biological and chemical weapons. Although none of the nine states actually possessing nuclear weapons would sign the treaty, nor those nations believed to be protected by their nuclear umbrellas, by 2040 the treaty had been signed and ratified by more than 100 nations. Over this same period, political movements agitating for nuclear disarmament within the nuclear nations and their allies had been gaining in strength.

100

Number of Nations that signed and ratified the GEM-D Treaty in 2040

By this time, GEM-D had become a key pathway of building trust and clarity, allowing participating states to focus upon cross-border environmental, health, and development issues. For the founding members of GEM-D, taking on the continuing existence of nuclear weapons—weapons that could pose a truly existential risk to civilization—was a logical extension of the original concept for the organization: a collaborative institution to manage planetary-scale problems.

Moreover, by the 2040s even the old Superpowers had begun to participate more fully in the organization, seeing GEM-D as both a useful tool for resolving complex problems without having to weigh in directly (especially given that many countries retained unpleasant memories of historical interventions by the U.S., Russia, and China) and as a way to score support for their own agendas around climate, agriculture, and technologies. European nations took the lead on the nuclear dismantlement program; critics (largely in America) claimed that the Europeans could do so because they remained (at least implicitly) under the U.S. "nuclear umbrella." India's agreement to dismantle was harder to attack, given that historical rivals China and Pakistan had not yet shown willingness to give up their nuclear weapons. Within two years, however, both of these states had agreed to join the global dismantlement program.

By 2044, the only holdouts were the two original nuclear nations: the United States and Russia. Their reluctance to agree on disarmament, however, wavered as both nations went through some of their worst climate-related disasters yet. Although GEM-D support was never officially withheld from either country, the underlying sentiment was clear: you can't afford to still live in the 20th century. □

Nuclear weapons threat isn't the only global-impact problem facing us, and it's not the only problem with both increasing urgency and the potential for catastrophe if not properly handled. Anthropogenic global warming and its consequences is considered by many to be a risk matching that of nuclear weapons; perhaps unsurprisingly, the mechanisms enabling a lasting solution to global warming closely parallel those needed to create a solution to the nuclear weapons problem. This scenario looks at how success in one arena might help make success in another more likely

The primary question about this scenario is whether a novel transnational institution could successfully do what other similar institutions had failed to do in past decades. Here, success comes from two key forces: the inclusion of non-state actors with significant influence at the state level and the external pressure of a potential global catastrophe demanding the development of functional multilateral systems. There is enormous potential for the present-day insurance/re-insurance industry and financial industry to influence political outcomes, and in recent years the re-insurance industry in particular has been vocal about confronting climate disruption.

Although this scenario does not end with a clear declaration of disarmament by the US and Russia, there's strong internal and external pressure on them at this point. Moreover, in this scenario the first half of the 21st century has been characterized by narrowly avoiding large-scale disasters through both thoughtful diplomacy and clever action. The possibility of simply eliminating a vector of catastrophe would be quite appealing here. Although this scenario is predicated upon climate disruption as a trigger for an effort to eliminate nuclear weapons, it's more precisely an institutional success story: climate is the reason it happens, but a meaningful transnational institution is what makes it possible.

Implications for Innovation

This is an especially rich scenario for the variety of ideological and institutional innovation it implies. It is also a hopeful scenario that can inspire such innovation and links to movements already underway. Supporting innovations include:

Ideological and Institutional Innovation

- Broader public understanding of the concept of "national security" that includes food, water and energy security (so that a portion of the massive resources traditionally devoted to military security can be used for these broader purposes)
- Social, political and economic initiatives that build upon the belief that human society can successfully adapt to the multiple challenges of the 21st century
- Reversal of baby boomers' and millennials' belief in a single "greatest generation." Greatness is needed from every generation, especially the current ones, and the generation that eliminates nuclear weapons and adopts sustainable patterns of life will be truly "great."
- Public-private collaborations that anticipate and mitigate the negative consequences of climate change.
- Economic forecasts that place a value on the risks associated with environmental degradation and economic incentives for investing in long-term resilience.
- Visceral experiences that immerse the public in the consequences of nuclear weapons use.
- Characteristics of a successful global response to climate change—international cooperation, willingness to accept oversight, willingness to accept changes to political power that would undermine traditional power structures, and a need for strong transnational institutions—are broadly also the characteristics needed for a successful nuclear dismantlement regime. Success in one arena could hasten success in the other.
- Institutions for managing geo-engineering technologies, particularly "solar radiation management."

How Nuclear Weapons Were Forgotten in a World of Greatly Deteriorating Environmental Conditions

BIGGER PROBLEMS



BY JAMAIS CASCIO

The 2044 abandonment of nuclear weapons in the leading nuclear states happened without much fanfare or notice. There were no elaborate treaty-signing ceremonies or state dinners; in Russia, historical records suggest that the decision was actually made by the Vice-President without consulting the nominal leader. Most media outlets gave the development scant attention. Only the Free Scotland Media foundation celebrated the abandonment, albeit in a harsh "we told you so" tone. It wasn't that the decision to let go of nuclear weapons and nuclear deterrence wasn't important—it was just that it wasn't as important as the rest of what was happening.

By the early 2030s, it had become undeniable that anthropogenic global warming was following the path of the most extreme projection put together by the Intergovern-

mental Panel on Climate Change—the so-called "A2" scenario. The oceans had been absorbing significant amounts of heat in the first two decades of the century, but began to release it back into the atmosphere in the 2020s, greatly overwhelming the effects of the already too-slow reductions in carbon emissions. By 2030, there was no remaining doubt as to the severity of climate disruption around the world.

Relentless drought, agricultural devastation, and raging wildfires were the new normal for much of the world. 2024 was the "year without Winter" in the western half of the US, where temperatures across the region were more typical for late Spring or early Fall, and rainfall levels were under 10% of the historical average; it was the "year of too much Winter" in the Eastern US, however, with more record-breaking cold and snow. Europe saw a summer heat wave in 2028 that killed over 250,000 people, largely the elderly and the very young, more than tripling the 70,000 people killed by the heat back in 2003. Melting permafrost in Siberia threatened to dump megatons of methane—a stronger greenhouse gas than CO2—into the atmosphere, accelerating warming further.

<10%

The "Year Without Winter," 2024, saw rainfall levels fall under 10 percent of historical average

70,000

Deaths due to heat in 2003

250,000

Deaths due to heat in 2028

But by far the most frightening result was the sharp increase in armed conflict. The Syrian Civil War is now considered the first serious global warming-driven war, but its ferocity and humanitarian aftermath pales in comparison to the conflicts of the 2030s. Violent unrest could be found on every continent, and by the middle of the decade there were more than 25 wars (both civil and interstate) happening simultaneously around the world. The UNHRC put the number of climate refugees at over 500 million globally, counting internally-displaced groups, and most were fleeing violence as much as a lack of food or water.

As global tensions mounted, a growing number of analysts began to speak out about the risk that a number of the ongoing conflicts could begin to threaten the survival of a nuclear-armed state. The Iranian civil war became the focus of many such observers; by 2037 rumors (never officially substantiated) spread that a joint Russian-Israeli strike force had managed to disable key components of the Iranian nuclear weapons structure. When the renewed Islamist insurgency in Pakistan appeared to threaten to cause a political collapse, Islamabad reached out to China to help it to secure its nuclear arsenal, moving the warheads outside of Pakistan's borders. Stalled nuclear development programs in Brazil, Singapore, and South Africa were very publicly dismantled, even without the threat of local instability. The overwhelming fear across the globe was that a nuclear conflict could be touched off by a rising tide of violence in the same way an errant spark could ignite a forest fire. Even the darkest periods of the Cold War never saw levels of fear like this.

The six largest nuclear states seemed above the fray at first. Scotland's unilateral secession from the United Kingdom drove England to a rush dismantling of its arsenal. India and France each quietly moved to decouple warheads from launch systems and to increase the layers of security controlling the deployment of nuclear weapons. But while Russia, the United States, and China all saw violent unrest, none of the three thought that they faced the kind of risks the smaller front-line states had confronted.

That was until a particularly bad Northern Hemisphere summer in 2042 caused each of the three to blame the others for intentionally causing weather and climate damage. Early attempts to moderate temperatures through a UN-controlled solar radiation management geoengineering program had proven less-than-effective, but in the early 2040s all three of the great power nations had begun to experiment with different forms of very high-tech climate responses, from synthetic bacteria to consume methane to the use of deep-ocean pumps to attempt to cool the ocean surface.





Relentless drought, agricultural devastation, and raging wildfires were the new normal for much of the world.

The chaotic nature of the climate means that we'll never be certain whether these experiments directly triggered the 2042 Crisis, but Washington, Moscow, and Beijing certainly interpreted it in that way. A complete lack of rainfall in much of North America and East Asia triggered the worst agricultural disaster yet seen, while in Russia, an over-abundance of rainfall was causing record floods, drowning farmland and city streets alike.

Accusations and denials flew, and all three relied on traditional methods of signaling international anger, such as border-skirting overflights and unannounced war games and training exercises. The 2043 detonation of a nuclear weapon test in the Nevada desert—the first such test in decades—ratcheted up tensions even further. Media and government officials in all three nations openly discussed the probability of an armed conflict within the next 12-18 months.

The "what the hell are we doing?!?" moment happened in the middle of 2044, in the midst of another devastating summer. The US, Russian, and Chinese leaders met in person at a small



Violent unrest could be found on every continent. By the middle of the decade there were more than 25 wars happening around the world. Millions fled from the violence as much as a lack of food or water



research installation in northern Greenland. After nearly a week of intense discussion, debate, and negotiation, the three returned to their respective homes to order their militaries to begin immediately to dismantle their nuclear weapons. There's no official record of who first suggested the summit, although all three governments were more than happy to take the credit behind the scenes... and equally happy to let rumors spread that they were the final holdouts demanding the most concessions.

The likelihood of war between the great powers, conventional or otherwise, declined by 2045, driven in part by an unusually mild climate pattern and in part by the success of the rapid dismantlement protocol. This wasn't an outbreak of pacifism, simply a moment to reflect. There was no promise that another deadly Summer wouldn't cause one or more of the brittle governments to break, but for now, each nation was more focused on feeding its people. □

500m

Number of global climate refugees by the 2030s estimated by the UNHRC

As with the previous scenario, "Emergency Management," the acceleration of the climate disruption crisis overtakes nuclear weapons as a source of civilization risk. Unlike the previous narrative, no heroic institution arises to take charge and fix problems. Here, the dilemma comes down to resources, broadly defined. How does the continued existence and maintenance of nuclear weapons combine with a world of devastating environmental conditions?

The global warming scenario presented here is officially on the edge of the predicted range of IPCC scenarios, although some leading researchers argue that the closest fit to our current path is the A2 scenario. Unfortunately, the global warming-triggered events described all have present-day indicators, including the Siberian methane and the assertion that the Syrian Civil War was ultimately caused by climate change. The possibility that misinterpreted or poorly controlled geoengineering experiments could be perceived as threatening is also supported by real-world evidence.

The biggest question of this scenario is whether leaders would recognize the risks that a government collapse or crisis-driven volatility could result in the use of nuclear weapons. In this narrative, Pakistan's unilateral decision to abandon its weapons was the unacknowledged catalyst for the later actions of the Great Powers—an example and precedent that planted the idea. Self-help and support communities often refer to this as a "moment of clarity"—an opportunity to see what will happen if behavior doesn't change.

Implications for Innovation

This scenario takes a less optimistic approach to the interaction between climate and nuclear policies than does *Emergency Management*. In this scenario, a lack of global cooperation around climate management further exacerbates the existing present-day perception in the general public that the nuclear weapon problem is a problem of the past. This, in turn, heightens the levels of fear that arise late in the scenario as the global mood darkens. With sufficient motivation and political innovation, this scenario could potentially morph into *Emergency Management*, with the emergence of effective international institutions. Conversely, an accident along the lines of *The Jammu Disaster* would almost certainly lead to an expansion of the conflict.

Political and Educational Innovation

- Improved forecasting and visualization programs that can vividly demonstrate how temperature rise and water scarcity will impact human needs in particular geographical areas.
- More developed understanding of how human migration might occur and what its consequences may be.
- More effective government response to citizens' needs: National service, choice about where tax dollars are spent, cooperative responses to transnational problems
- Military organizations more attuned to potential social disruption caused by climate change and the consequences for accidental or terrorist use of nuclear weapons in failing states.

STICKS & STONES

Superior Forms of Warfare Change the World

BY JAMAIS CASCIO

Einstein famously said "I know not with what weapons World War III will be fought, but World War IV will be fought with sticks and stones." He was more right than he may have thought. It turns out that "sticks and stones" is an unsettlingly accurate way of describing the "strategic" weapons now deployed in 2045. On the bright side, though, nuclear weapons are completely gone.

As a tool of deterrence, nuclear weapons are messy. Moreover, they're dangerous, not just to one's purported enemy, but to civilians, cities downwind from an explosion, people working on building and storing the weapons—and the radioactive material upon which they were dependent—and arguably the entire planet. People calling for the elimination of all nuclear weapons always had a strong case; it was just that those who believed that nuclear deterrence was essential for their nations' security also believed that they had no other option.







NASA and CNSA spent billions to get ready to go to Mars, but were beaten to the punch by Elon Musk and a handful of other commercial space explorers.

The "Cold Shoulder" between the U.S. and China progressed in a way that echoed the Cold War between the U.S. and the Soviet Union, with proxy fights (this time generally more economic than military) and propaganda (this time even as the citizens of each country bought record amounts of the other country's goods). There was even a space race, but with a twist ending. As NASA and CNSA spent billions to get ready to go to Mars, they were beaten to the punch by Elon Musk and a handful of other commercial space explorers. By the late 2020s, the US and China had both developed all sorts of space launch assets, but had lost their motivating goal.

While space agency representatives offered proposals that vacillated between overly cautious (a bigger space station) and overly ambitious (colonizing Europa), other ideas started to emerge. The notion that these assets could be used to construct space weapons became a popular narrative, both as strategic argument and as conspiracy theory. It wasn't an entirely ludicrous idea. As much as human ingenuity had managed to come up with some devastating weapons, nature had always held the trump card: something big hitting the planet from space would unleash damage many orders of magnitude greater than Edward Teller's most fevered dreams. Historically, nuclear weapons were the largest plausible threat humans could muster. But now both Superpowers had an abundant supply of just the right equipment needed to either get something big up there that could be dropped back down, or to find some big stuff already there for the same purpose.

All of this would make for little more than lively academic conference presentations and frightening shows on DiscoveryVR, except for the worry increasingly consuming nuclear weapon owners about the reliability and effectiveness of their arsenals. The moratorium on testing had proven to be politically and strategically very difficult to overturn, and even "rogue" nuclear states found abiding by a test cessation an easy way to score political points. And while military leaders and civilian specialists would regularly call for some kind of resumption of testing in order to secure and modernize nuclear arsenals, fears of the diplomatic and domestic repercussions blocked any movement in that direction.

2030

Year the Nuclear Era began its decline

At the same time, directed energy weapons demonstrated an increasing effectiveness as strategic defense. Some analysts claimed that missiles would be as obsolete as bombers by 2035. In order to minimize the destabilizing aspects of strategic defense, an idea from the 1990s returned—the United States, Russia, and now China would share common information systems in support of their separate strategic defense networks. The combination of an increasingly viable nuclear defense and increasingly unreliable weapons meant that, by the late 2020s nuclear weapon states began to seriously question the future of nuclear deterrence.

But even as the nuclear era declined, international rivalries remained. In the 2030s, military strategists and engineers in the leading global powers assembled designs for space-based alternatives to nuclear weapons. China, a world leader in the mining of tungsten, took a "sticks" approach: massive, telephone pole-sized tungsten rods on 46 platforms in high Earth circumpolar orbit, able to hit any location on the planet in under six hours, and with a mass and density able to shrug off any directed energy weapon. Tungsten rods would hit with an impact of ten to twenty kilotons, but resulted in no fallout, no radioactive mess, and no EMP—they were, for all intents and purposes, just extremely large spears. Russia took a similar approach.

The United States went a different direction. Seeing that China and Russia had staked out Earth orbit, the US took advantage of a nascent asteroid mining and recovery industry (born in the wake of the successful Mars voyages) to set up a system that could selectively target locations on the Earth with asteroids—literally big "stones." Launch systems were spread throughout nearby Near-Earth Objects, with most going to rocks a few tens of meters across (big enough to survive the atmosphere and hit with a serious impact, but small enough not to cause a global extinction). The US space

military alliance put a few publicly acknowledged asteroids into stable "LaGrange" point orbits, but the identity and location of most of the weaponized space rocks was kept secret.

To say that these new systems were controversial would be a woeful understatement. Critics around the world decried the abrogation of the 1967 Outer Space Treaty banning the deployment of weapons of mass destruction in space. China, Russia, and other states considering orbiting "bolts from the blue" systems came under diplomatic attack for putting weapons of mass destruction literally right over our heads. Critics of American actions went even further, accusing it of trying to engineer a mass extinction event; political cartoonists had a field day depicting the dinosaurs in military uniforms telling each other "it's just a deterrent." But as with nuclear weapons, the initial anger and fear around the world eventually turned into a constant buzz of low-level but inescapable anxiety.

Compared to "thunderbolts" and "dinosaur-killers," nuclear weapons seemed almost charmingly antiquated. They were dirty, complex to maintain, and had distinctly undesirable side effects. Most former nuclear countries were, ultimately, happy to see the weapons go. They now had much more interesting new toys to play with. □

10–20kt

Estimated potential impact of China's Tungsten Rods. The weapons could reach any location on the planet in under six hours.

As this scenario goes forward, China and Russia would be likely to abandon the orbiting high-density rods in favor of their own asteroid-based system. Arguably, the use of Near-Earth Objects as weapons would be less inherently risky than the current nuclear deterrence regime: a surprise first strike would be impossible (the aberrant movement of an asteroid would be readily detectable long before impact), and the potential for an irreversible accidental launch would be extremely low. Still, if the possibility of nuclear war shaped the societies and politics of nations across the 20th century, the possibility of the intentional use of the same kind of event that literally caused a global mass extinction would be the unavoidable symbol of 21st century civilization.

Implications for Innovation

It's important to recognize that, historically, the primary reason for relinquishing a form of military technology has been the introduction of a superior form. There is a very real possibility that we could successfully eliminate nuclear weapons without substantially altering the nature of international politics and behavior. Whether this would be considered an "optimistic" scenario or not depends upon whether the goal is the elimination of weapon systems with the potential to effectively destroy civilization or the transformation of the international system into one which would never consider using such weapons.

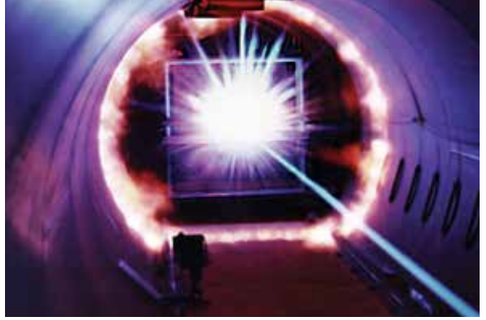
This scenario looks at the adoption of unconventional weapon systems that would be just barely within our grasp today, but very likely quite achievable over the next two decades. If space-based kinetic impactors still seem implausible, targeted synthetic bioweapons or non-nuclear electromagnetic pulse (NNEMP) weapons could lead to a similar scenario.

Technological and Military Innovation

- Space-based impactors, targeted synthetic bioweapons or non-nuclear electromagnetic pulse weapons.
- Near Earth Objects—e.g., asteroids—used both for scientific and military purposes.
- Viability of strategic defense systems based on increasing computing power for design and targeting along with growing capability for production of high-energy technologies.
- Alternative deterrence strategies and advanced conventional weapons.

Socio-Political Innovation

- New forms of activism that counter the replacement of nuclear weapons with similarly abhorrent space-based combat tools.
- Political will and diplomatic skill to address underlying issues.





Critics around the world decried the abrogation of the 1967 Outer Space Treaty banning the deployment of weapons of mass destruction in space. China, Russia, and other states came under attack for putting weapons of mass destruction right over our heads.

The Slow, Irregular DIPLOMATIC FADE to Disaramament

Diplomatic Path



Diplomacy, negotiation, and patience paid off

BY JAMAIS CASCIO

The end of the nuclear weapons era came not with a bang (fortunately) or a whimper, but with a yawn.

Diplomacy, negotiation, and most of all *patience* paid off. Goals were kept near-term and limited in scope, not out of reduced aspirations but so as to be able to show repeated successes. And as a last bit of irony, the eventual elimination of nuclear weapons could actually be credited largely to the concept of "deterrence." The idea that fearing for one's own safety would drive strategy succeeded far beyond the expectations of the architects of the Cold War.

As they had for decades, the various diplomatic conversations about nuclear weapons continued to proceed along multiple simultaneous tracks throughout the 2010s and 2020s. Big, audacious goals received great fanfare, but not a lot of success. Diplomacy that focused on safety, monitoring of storage and nuclear materials, and confidence building seemed to do better, and eventually became the focus of ongoing negotiations between multiple nuclear-armed and nuclear-aspirational states. The explicit goal wasn't to eliminate nuclear weapons, but to reduce the chances of a tragic mistake.

Such an approach soon saw critical successes. The biggest headline came in the 2024 "no first use" pledge agreed to by all NPT signatories. Soon thereafter, the nuclear weapon states agreed to physically separate nuclear warheads from all their land-based missile launchers and long-range bombers.

500

Number of nuclear weapons estimated by the mid-2030s, from 15,700 in 2015

Many who had opposed taking these positions acquiesced by anticipating less-than-full compliance; they were considered this more of an "easier to get forgiveness than permission" situation. Those who had pushed the actions saw these as significant steps towards the continued delegitimization of nuclear weapons.

But even as multilateral disarmament talks slowly progressed, direct state-to-state discussions saw its own success. After a series of harrowing nuclear brinksmanship events in the 2020s, the people of both India and Pakistan were ready for new leadership. Reformist governments in Islamabad and Delhi revealed a pact for total nuclear disarmament in 2031, to great acclaim by the citizens of both countries and great consternation by the leading global powers. After all, conventional deterrence wisdom held that the elimination of nuclear weapons made the world "safe for conventional war." Respected DC think tanks confidently asserted that the subcontinent would be in flames within 36 months.

Surprisingly, the opposite happened. When governments shifted and tensions once again rose between the two countries, the leaders acted just as they had when nuclear weapons were "on the table." Brinksmanship and saber rattling, but the careful avoidance of actual combat. Whether this was simply now a practiced behavior or (as some pundits asserted) each side feared the other had a secret stash of nuclear weapons was, in the end, irrelevant: even without an explicit nuclear threat, deterrence-structured behavior continued. The reality of an adversary's arsenal wasn't as important as the fear of an adversary's possible arsenal.

Meanwhile, talks between the big three nuclear states dragged on, but



The 2041 Vancouver summit, brought together leaders of all three big powers, and produced a welcome result: a plan for rapid dismantlement.

saw in the subcontinent situation a possible next step: minimal deterrence. Almost like a deadly game of "name that tune"—"I can deter your aggression with 50 nukes!" "I can deter your aggression with *40* nukes!"—the arms reduction talks of the 2030s took on a startling acceleration. Arms control activists saw the tantalizing possibility that the world could hold fewer than 500 nuclear weapons by mid-century.

Diplomats pushed for more. In the US, Russia, and China, the literally dirty details of maintaining even a small nuclear arsenal came under scrutiny after whistle-blowers in all three nations catalogued multiple small mishaps with weapon production, storage, and disposal that threatened the health of citizens. Past statements from leaders of these countries, calling for the elimination of nuclear weapons, started to haunt them. Climate disruption, the global near-collapse of multiple forms of agriculture, and the incipient H9N9 pandemic demanded attention and resources that simply



The last American warhead was dismantled in a ceremony in August of 2045, with the go order issued by a grandchild of a Hiroshima survivor



couldn't legitimately be directed towards aging nuclear stockpiles.

The 2041 Vancouver summit, bringing together recently-elected leaders of all three big powers, produced a startling—and welcome—result: a plan for rapid dismantlement of the remaining nuclear weapons in the arsenals of the big powers, along with an invitation to the remaining nuclear-armed states to do the same. A controversial announcement, to be sure, but one that many observers saw as inevitable and long overdue. A friendly joint statement from Pakistan and India read simply, "Welcome to the club!"

The last American warhead was symbolically dismantled in August of 2045, with the go order being issued by a grandchild of a Hiroshima survivor.

Pundits and academics still debate whether or not the various nuclear powers have given up *all* of their weapons. As of yet there has been no revelation of treaty-violating stockpiles of warheads; the most that anyone will (without attribution) admit to is a rapid-production protocol, skirting the line of acceptability under the dismantlement treaty. But a growing number of observers have come to assert that this ambiguity is welcome. Post-nuclear deterrence with only virtual nuclear weapons still offers a far safer world than we had before. □

While the other scenarios rely upon a critical transition to enable the functional elimination of nuclear weapons—a disaster, a crisis, a new technology—this scenario embraces the idea that the current nuclear security path, while slow and irregular, is bending inexorably towards eventual disarmament. However, like the "Sticks and Stones" scenario, this narrative doesn't get rid of the deterrence model along with getting rid of nuclear weapons; instead, it pushes the deterrence concept forward, acknowledging that inherent uncertainty and fear can serve as powerful strategic drivers even in the absence of massive arsenals.

Nuclear deterrence is fundamentally based on the idea that the risk of retaliation—in both likelihood and scale—outweighs any benefit of a nuclear attack. The concepts of minimal deterrence and virtual arsenals offer ways to reduce some of the ancillary risks of deterrence while still holding onto the threat of retaliation. It may also, as seen in this scenario, serve as a meaningful stepping-stone to full nuclear disarmament.

The validity of minimal deterrence of virtual arsenal model rests on assumptions that mirror those of conventional deterrence; a "rogue madman" with nuclear weapons would be no less dangerous in this world than in any other. What does change is the potential for temptation. A smaller number of weapons, kept in a "ready to assemble" condition, essentially eliminates any conceivable utility of a first strike attack. And simply reducing the number of weapons to extremely low levels reduces the likelihood of accident and arguably reduces the potential for escalation.

But "almost zero" isn't the same as actual zero. In this scenario, the public claim among former nuclear nations is that nuclear weapons are gone. This may be true, or (as many would suspect) the various states may still be holding onto a small number of nuclear weapons "just in case." This situation could still lead to an actual zero, over time: the discovery of hidden stockpiles would do enormous political damage (with the risk of exposure likely increasing every year); and the stockpile reliability and degradation problem would remain, requiring the manufacturing of new warheads on a regular basis, again increasing the possibility of discovery.

Implications for Innovation

This scenario imagines the success of incremental arms control and safety measures taken to reduce nuclear dangers ultimately leading to an understanding that nuclear "forces in being" are unnecessary for deterrence and present unacceptable risks. They are therefore dismantled and the possibility of their reconstitution serves as an adequate deterrent to large-scale warfare.

This trend gains momentum in 2024 when a "no first use" pledge is agreed to by all NPT signatories followed by an agreement to physically separate nuclear warheads from all their delivery vehicles so they could not be launched rapidly in a crisis. This progress then dovetails with growing public and governmental awareness of the risks and costs of managing the nuclear stockpile and cleaning up legacy waste. Simultaneously managing the consequences of climate disruption also requires resources that could no longer legitimately be directed towards aging nuclear stockpiles.

The positive outcome of this scenario could be made more likely by innovations such as:

Socio-Technical Innovations

- Better tools to demonstrate both the long-term financial and environmental costs of nuclear weapons and the tradeoffs between national resources spent on nuclear weapons versus other priorities (such as adjusting to the consequences of climate change).
- Simulations that demonstrate the risks of forces kept on high alert versus the benefits that can result from more decision time.
- Technical monitoring systems that provide confidence among nations that deployed nuclear weapons systems have been stood-down and placed in secure storage.

Socio-Political Innovations

- Initiatives that increase dialogue on nuclear security matters between NGOs, citizens groups, scientists and business leaders from nations possessing nuclear weapons.
- "Citizen monitoring" systems or other societal means to verify that nuclear forces are being dismantled.

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ABOUT N SQUARE

N Square is an initiative of the Ploughshares Fund designed to stimulate innovation in the fields of nuclear disarmament, nonproliferation and safety and security. The initiative is a collaborative effort between five of the largest peace and security funders in the United States: The Carnegie Corporation of New York, the William and Flora Hewlett Foundation, the John D. and Catherine T. MacArthur Foundation, the Ploughshares Fund, and the Skoll Global Threats Fund. N Square is based on the idea that new forms of cross-sector collaboration—combined with the sheer ingenuity of an engaged public—will enable us to innovate our way to a world free from the risks associated with nuclear weapons and fissile materials.

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