## NTM 1AC

### Plan---1AC

#### The United States federal government should cooperate with the Russian Federation to prohibit interference with satellites used for national technical means of verification.

### Stability---1AC

#### Advantage One is Stability:

#### Collapse of New START creates short term threats to nuke strategic stability and space stability---risks nuke miscalc with Russia and China.

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After nearly 50 years, the mutual US-Russian ban on interfering with early warning and reconnaissance satellites — fondly known as National Technical Means — will disappear if the Trump Administration abandons (as is likely) the bilateral New START treaty.

Besides capping nuclear force levels, the New START treaty — like every other bilateral nuclear arms control treaty dating back to the early 1970s — includes a prohibition on interference with “national technical means of verification” known as NTMs.

New START expires in February 2021, and the Trump Administration is leaning against extending it for five years in favor of pursuing a highly unlikely trilateral deal that would include China. The administration also intends in August to withdraw from the only other extant nuclear arms treaty that includes this provision, the 1987 Intermediate-Range Nuclear Forces (INF) Treat, over violations by Russia.

“With the end of New START, there is no longer going to be any prohibition on interference with NTMs … for the first time in 50 years,” Gleason, a former Air Force officer now at the Aerospace Corporation’s Center for Space Policy and Strategy, told a conference cosponsored by Aerospace and the George Washington University’s Space Policy Institute on Monday.

This could lead to a “changed strategic context for the national security space community,” he said, in which satellites linked to the nuclear kill chain are legitimized as targets for interference, which in turn would increase the likelihood of “misunderstanding, misperception and miscalculation” and erodes strategic stability as well as stability in space.

While neither New START nor the past nuclear arms control treaties (or their negotiating records) clearly define NTMs, Washington and Moscow have tacitly included in that definition pretty much all satellites — although most specifically for the US, the Air Force’s aging Defense Support Program (DSP) satellites that detect missile launches as well as the follow-on Space-Based Infrared System (SBIRS) satellites, the Department of Energy nuclear detection (NUDET) payloads on Global Positioning System (GPS) satellites, and other reconnaissance satellites, such as the Orion/Mentor signals intelligence satellites, operated by the National Reconnaissance Office (NRO).

“Since neither Russia nor the US wanted to specify which satellites were engaged in verifying compliance with arms control treaties, both extended the ban on non-interference to the entire national space constellation of the other,” Gleason explained. “In addition,” he said, “the term interference has never been defined but is generally assumed to include jamming, dazzling and other types of interference.”

At least two other international treaties signed by the US have provisions relating to non-interference with satellites: the 1967 Outer Space Treaty (OST) and the International Telecommunication Union (ITU) Constitution and Convention. The OST does not provide a hard ban on interference with satellites, although it is implied (via Article 9). The ITU treaty, under the Radio Regulations governing use of radio frequency by satellites, does contain a prohibition on “harmful interference” with satellite operations, and goes further to set up a dispute resolution mechanism for dealing with cases of interference deliberate or not. However, neither treaty directly mentions NTMs.

But despite these treaties, the US is already seeing an increase in interference with its satellites by Russia, especially with GPS satellites, according to a number of recent studies including the Defense Intelligence Agency’s (DIA) January 2019 “Challenges to Security in Space.”

A study on the counterspace capabilities of Russia, China, the US and several other countries by the independent Secure World Foundation (SWF) further noted that the Finland and Norway have accused Russia of jamming GPS signals during a November 2018 NATO exercise in the region. The SWF report said: In November 2018, there were media reports of widespread jamming of civil GPS signals in Norway and Finland at the same time as a major North Atlantic Treaty Organization (NATO) exercise. The jamming reportedly affected military systems as well as civilian airliners, cars, trucks, ships, and smartphones. In March 2019 the Norwegian government claimed they had proof that the disruption was caused by Russian interference and demanded an explanation. (Russia, of course, denied that it had anything to do with the problem.)

So, one might ask what real world affect might the demise of the NTM noninterference agreement have? The difference is that up to now, Russia (and China) have avoided jamming or spoofing missile warning satellites and those directly linked to nuclear operations.

Gleason argues that a key concern for the national security space community is that the US may face destabilizing Russian interference with NTMs “while demand for strategic intelligence on Russian strategic nuclear forces from space-based NTMs goes up significantly” because, in the absence of New START, there will no longer be requirements for Russia to share data about its nuclear activities, allow on-site inspections by US officials of nuclear weapons and materials production facilities, and refrain from concealing nuclear testing activities and facilities. Thus, he said, “US confidence in its understanding of Russian nuclear forces may erode over time.”

Indeed, a March 2019 study by the Center for Naval Analyses (CNA), “Nuclear Arms Control Without A Treaty: Risks and Options after New START,” made similar findings:

“Without New START’s cooperative transparency practices, the US intelligence community would likely devote more resources to monitoring Russian strategic nuclear forces but have less insight and less confidence in its analytical judgements. The United States would face an opportunity cost of diverting scarce national technical means (NTM), such as satellites, and technical analysts from other missions. Russian defense officials would also navigate increased uncertainty and lose the ability to confirm that the United States has not reversed its New START reductions. Neither country would have the same degree of confidence in its ability to assess the other’s precise warhead levels. Worst-case scenario planning is also more likely as a result. Over the longer term, both countries are likely to face greater uncertainty about each other’s strategic nuclear forces and operations.”

This situation would put more demands on the “national security space workforce and intelligence analysts,” Gleason said.

Further, some historians argue that the then-Soviet Union, despite the success of Sputnik and President Dwight Eisenhower’s political machinations, did not actually accept that spy satellite overflights of their territory were legitimate until the 1972 negotiations of the NTM clause in the SALT I nuclear arms control treaty and the concomitant Anti-Ballistic Missile Treaty. So the question is whether Russia might, in a post New START world, reanimate its old stance.

More worrying, however, is the specter of Russian and Chinese interference with nuclear command and control satellites and/or early warning satellites in a crisis being interpreted by US leadership — or vice versa — as a harbinger of nuclear attack.

According to a 2017 study by James Miller and Richard Fontaine of the Center for a New American Security, the increasing integration of counterspace technologies (as well as cyber offenses) into US and Russian arsenals is creating “new escalatory risks and threatening to erode strategic stability between the two nations. Because of the extensive dependence on information technology within both nations’ militaries, and likely perceptions of lower risk for the use of “non-kinetic” nonlethal attacks, there are growing incentives on both sides for early use of cyber capabilities in particular and, potentially in coming years, counter-space ones as well. These and other technologies also are impacting the stability of the strategic nuclear balance.”

#### Nuclear strategic stability is key to prevent extinction.

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Nevertheless, these concepts, their dynamics, and their dialectical interrelationship create new problems time and again. They give rise to paradoxes that, were it not a life-and-death matter for modern civilization, could be considered intellectually fascinating. But, unfortunately, these concepts concern actual matters of life and death. In the current military and political environment, it is no longer inconceivable that war between the United States and Russia could break out in just a few days in the event of a crisis. Such a conflict might culminate with an exchange of nuclear strikes taking as long as just a few hours.

During those hours, hundreds of millions of people in the northern hemisphere would be killed, and everything created by human civilization in the last thousand years would be destroyed. The direct effects would be irreversible, and the secondary effects would likely kill the rest of the world’s population within a number of years, or at least send the remaining population back into a prehistoric existence. The prevention of nuclear war is an indispensable condition for the survival of human civilization, and it is inextricably linked to the concepts of nuclear deterrence, strategic stability, nuclear disarmament, and nonproliferation.

It might seem that all of the above goes without saying, and that all of this has long been accepted both in theory and practice by politicians, military leaders, civilian experts, and the enlightened public of the world’s advanced nations. Over the past three decades, the nuclear arsenals of Russia and the United States have been reduced substantially—both in terms of the number of warheads and in terms of total destructive power. Yet despite all of this, the danger of nuclear war is today much greater than it was in the late 1980s.

#### Second strike doesn’t guarantee stability---crisis pressures from vulnerable command systems overwhelm.

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The US nuclear posture is programmed for three basic wartime contingencies: After absorbing an enemy nuclear strike, it can execute a counterattack so devastating that it would deter an adversary from striking in the first place; after an enemy has begun launching its nuclear forces but before they reach their targets, the US system can execute what is known as “launch on warning,” requiring early detection of the enemy first strike, quick presidential decision making, and the rapid launch by individual commanders of deployed US nuclear forces; or the US command system can, before the enemy has fired its nuclear forces, initiate a preemptive first strike.

The president would discover that all of these contingencies are highly unstable in a crisis. “Second-strike” retaliation (“assured destruction” of economic and industrial infrastructure and/or counterforce strikes against opposing nuclear forces withheld from a first strike) leans precariously on a vulnerable command system. Launch on warning is infeasible and unsafe because of limitations in and questionable reliability of the command and early warning systems. “First use” of nuclear weapons in any realistic situation confronting an American president would not be rational and moral, and the fear of preemptive attack incited by this contingency is the textbook definition of crisis instability.

#### Space instability goes nuclear---more probable than terrestrial impacts.

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Why space is a particular problem for crisis stability

For a number of reasons, space poses particular challenges in preventing a crisis from starting or from being managed well. Some of these are to do with the physical nature of space, such as the short timelines and difficulty of attribution inherent in space operations. Some are due to the way space is used, such as the entanglement of strategic and tactical missions and the prevalence of dual-use technologies. Some are due to the history of space, such the absence of a shared understanding of appropriate behaviors and consequences, and a dearth of stabilizing personal and institutional relationships. While some of these have terrestrial equivalents, taken together, they present a special challenge.

The vulnerability of satellites and first strike incentives

Satellites are inherently fragile and difficult to protect; in the language of strategic planners, space is an “offense-dominant” regime. This can lead to a number of pressures to strike first that don‘t exist for other, better-protected domains. Satellites travel on predictable orbits, and many pass repeatedly over all of the earth‘s nations. Low-earth orbiting satellites are reachable by missiles much less capable than those needed to launch satellites into orbit, as well as by directed energy which can interfere with sensors or with communications channels. Because launch mass is at a premium, satellite armor is impractical. Maneuvers on orbit need costly amounts of fuel, which has to be brought along on launch, limiting satellites‘ ability to move away from threats. And so, these very valuable satellites are also inherently vulnerable and may present as attractive targets.

Thus, an actor with substantial dependence on space has an incentive to strike first if hostilities look probable, to ensure these valuable assets are not lost. Even if both (or all) sides in a conflict prefer not to engage in war, this weakness may provide an incentive to approach it closely anyway.

A RAND Corporation monograph commissioned by the Air Force15 described the issue this way:

First-strike stability is a concept that Glenn Kent and David Thaler developed in 1989 to examine the structural dynamics of mutual deterrence between two or more nuclear states.16 It is similar to crisis stability, which Charles Glaser described as ―a measure of the countries‘ incentives not to preempt in a crisis, that is, not to attack first in order to beat the attack of the enemy,‖17 except that it does not delve into the psychological factors present in specific crises. Rather, first strike stability focuses on each side‘s force posture and the balance of capabilities and vulnerabilities that could make a crisis unstable should a confrontation occur.

For example, in the case of the United States, the fact that conventional weapons are so heavily dependent on vulnerable satellites may create incentives for the US to strike first terrestrially in the lead up to a confrontation, before its space-derived advantages are eroded by anti-satellite attacks.18 Indeed, any actor for which satellites or space-based weapons are an important part of its military posture, whether for support missions or on-orbit weapons, will feel “use it or lose it” pressure because of the inherent vulnerability of satellites.

Short timelines and difficulty of attribution

The compressed timelines characteristic of crises combine with these “use it or lose it” pressures to shrink timelines. This dynamic couples dangerously with the inherent difficulty of determining the causes of satellite degradation, whether malicious or from natural causes, in a timely way.

Space is a difficult environment in which to operate. Satellites orbit amidst increasing amounts of debris. A collision with a debris object the size of a marble could be catastrophic for a satellite, but objects of that size cannot be reliably tracked. So a failure due to a collision with a small piece of untracked debris may be left open to other interpretations. Satellite electronics are also subject to high levels of damaging radiation. Because of their remoteness, satellites as a rule cannot be repaired or maintained. While on-board diagnostics and space surveillance can help the user understand what went wrong, it is difficult to have a complete picture on short timescales. Satellite failure on-orbit is a regular occurrence19 (indeed, many satellites are kept in service long past their intended lifetimes).

In the past, when fewer actors had access to satellite-disrupting technologies, satellite failures were usually ascribed to “natural” causes. But increasingly, even during times of peace operators may assume malicious intent. More to the point, in a crisis when the costs of inaction may be perceived to be costly, there is an incentive to choose the worst-case interpretation of events even if the information is incomplete or inconclusive.

Entanglement of strategic and tactical missions

During the Cold War, nuclear and conventional arms were well separated, and escalation pathways were relatively clear. While space-based assets performed critical strategic missions, including early warning of ballistic missile launch and secure communications in a crisis, there was a relatively clear sense that these targets were off limits, as attacks could undermine nuclear deterrence. In the Strategic Arms Limitation Treaty, the US and Soviet Union pledged not to interfere with each other‘s ―national technical means‖ of verifying compliance with the agreement, yet another recognition that attacking strategically important satellites could be destabilizing.20 There was also restraint in building the hardware that could hold these assets at risk.

However, where the lines between strategic satellite missions and other missions are blurred, these norms can be weakened. For example, the satellites that provide early warning of ballistic missile launch are associated with nuclear deterrent posture, but also are critical sensors for missile defenses. Strategic surveillance and missile warning satellites also support efforts to locate and destroy mobile conventional missile launchers. Interfering with an early warning sensor satellite might be intended to dissuade an adversary from using nuclear weapons first by degrading their missile defenses and thus hindering their first-strike posture. However, for a state that uses early warning satellites to enable a “hair trigger” or launch-on-attack posture, the interference with such a satellite might instead be interpreted as a precursor to a nuclear attack. It may accelerate the use of nuclear weapons rather than inhibit it.

Misperception and dual-use technologies

Some space technologies and activities can be used both for relatively benign purposes but also for hostile ones. It may be difficult for an actor to understand the intent behind the development, testing, use, and stockpiling of these technologies, and see threats where there are none. (Or miss a threat until it is too late.) This may start a cycle of action and reaction based on misperception. For example, relatively low-mass satellites can now maneuver autonomously and closely approach other satellites without their cooperation; this may be for peaceful purposes such as satellite maintenance or the building of complex space structures, or for more controversial reasons such as intelligence-gathering or anti-satellite attacks.

Ground-based lasers can be used to dazzle the sensors of an adversary‘s remote sensing satellites, and with sufficient power, they may damage those sensors. The power needed to dazzle a satellite is low, achievable with commercially available lasers coupled to a mirror which can track the satellite. Laser ranging networks use low-powered lasers to track satellites and to monitor precisely the Earth‘s shape and gravitational field, and use similar technologies. 21

Higher-powered lasers coupled with satellite-tracking optics have fewer legitimate uses. Because midcourse missile defense systems are intended to destroy long-range ballistic missile warheads, which travel at speeds and altitudes comparable to those of satellites, such defense systems also have inherent ASAT capabilities. In fact, while the technologies being developed for long-range missile defenses might not prove very effective against ballistic missiles—for example, because of the countermeasure problems associated with midcourse missile defense— they could be far more effective against satellites. This capacity is not just theoretical. In 2007, China demonstrated a direct-ascent anti-satellite capability which could be used both in an ASAT and missile defense role, and in 2009, the United States used a ship-based missile defense interceptor to destroy a satellite, as well. US plans indicated a projected inventory of missile defense interceptors with capability to reach all low earth orbiting satellites in the dozens in the 2020s, and in the hundreds by 2030.22

Discrimination

The consequences of interfering with a satellite may be vastly different depending on who is affected and how, and whether the satellite represents a legitimate military objective.

However, it will not always be clear who the owners and operators of a satellite are, and users of a satellite‘s services may be numerous and not public. Registration of satellites is incomplete23 and current ownership is not necessarily updated in a readily available repository. The identification of a satellite as military or civilian may be deliberately obscured. Or its value as a military asset may change over time; for example, the share of capacity of a commercial satellite used by military customers may wax and wane. A potential adversary‘s satellite may have different or additional missions that are more vital to that adversary than an outsider may perceive. An ASAT attack that creates persistent debris could result in significant collateral damage to a wide range of other actors; unlike terrestrial attacks, these consequences are not limited geographically, and could harm other users unpredictably.

In 2015, the Pentagon‘s annual wargame, or simulated conflict, involving space assets focused on a future regional conflict. The official report out24 warned that it was hard to keep the conflict contained geographically when using anti-satellite weapons:

As the wargame unfolded, a regional crisis quickly escalated, partly because of the interconnectedness of a multi-domain fight involving a capable adversary. The wargame participants emphasized the challenges in containing horizontal escalation once space control capabilities are employed to achieve limited national objectives.

Lack of shared understanding of consequences/proportionality

States have fairly similar understandings of the implications of military actions on the ground, in the air, and at sea, built over decades of experience. The United States and the Soviet Union/Russia have built some shared understanding of each other‘s strategic thinking on nuclear weapons, though this is less true for other states with nuclear weapons. But in the context of nuclear weapons, there is an arguable understanding about the crisis escalation based on the type of weapon (strategic or tactical) and the target (counterforce—against other nuclear targets, or countervalue—against civilian targets).

Because of a lack of experience in hostilities that target space-based capabilities, it is not entirely clear what the proper response to a space activity is and where the escalation thresholds or “red lines” lie. Exacerbating this is the asymmetry in space investments; not all actors will assign the same value to a given target or same escalatory nature to different weapons.

#### Space arms racing spills over to South Asia---escalates the nuclear security trilemma.

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The peculiar nature of bilateral relations between the United States and China in space is the triggering point of a space security trilemma in South Asia. The spillover effect of a misperception-misunderstanding dynamic between the United States and China in outer space has brought strategic transformation between the bilateral relations among India-China, India-Pakistan, and China Pakistan, accentuating a security trilemma. All three states give high importance to their national space programs to achieve socio economic goals and to fulfil their national security needs. All three states also recognize the strategic importance of space as a new arena of war. However, the power asymmetry in South Asia has highlighted space-related capabilities as a potent medium of progress and power accumulation. As a result, the challenges in space have triggered and magnified the security trilemma for the South Asian rivals, interconnecting China, India, and Pakistan in the context of an international security complex.

The concept of a security trilemma was primarily conceived by Linton Brooks and Mira Rapp-Hooper in their scholarly work titled, ‘Strategic Asia 2013-2014: Asia in the Second Nuclear Age.’ Brooks and Rapp-Hooper argue that the concept is applicable to South Asia, where the three nuclear powers of China, India, and Pakistan interact in a triangular security matrix that is formed around the imperative of an offense-defence security environment. The theme of a security trilemma is based on the relations among India and Pakistan, China and India, China and Pakistan, and China and the United States.

South Asia has remained a region of concern for the international community, particularly for the United States in the past, and it is likely to remain so in the future. This reflects the importance of the South Asian region in the world politics and U.S. foreign security policy calculus, primarily due to its political, strategic, and economic significance, as well as the interests of other states associated with the region. The United States and India presently have a convergence of geostrategic interests in the region that has led to realignment of their strategic relations. On the other hand, the United States and Pakistan have unstable relations due to multiple factors, including the presence of U.S. and coalition forces in Afghanistan, and due to terrorism. The most interesting factor is U.S. rebalance policy in the region, which envisions containing the rise of China and where India is playing an instrumental role in helping the United States to achieve its strategic interests in the region. This constitutes a strategic chain reaction when China tries to balance its relations with the United States, which, in turn, negatively impacts its relations with India, which disturbs its relations with Pakistan. This causes a ripple effect in the bilateral relations between China-India, India-Pakistan, and China-United States.

Space is a strategic domain. It is also one of the most important global commons, most notably in the twenty-first century technologically driven security world where the future of geostrategic affairs is expected to be largely determined by the technological, cyber, and space capabilities of competing states. Strategically, space has become the fourth medium of warfare, in addition to land, sea, and air mediums. Concomitantly, space is analogous to these more traditional mediums. Overall, the strategic importance of space for the major powers has increased substantially since the launch of the first satellite into outer space in 1957. Hence,the value and reliance on space capabilities and their applications in the realms of communication networking, navigation, intelligence gathering, photographic reconnaissance, surveillance, and early warning purposes have increased manifold for the major powers and other state actors.

In the twenty-first century, states aspire to accumulate power and influence over economic, political, and technological areas, as well as military power and space power. All of this is considered synonymous with the symbols of power and prestige for technologically advanced states. The desire to gather power is akin to technological advancement. However, technological advancement cannot be achieved without exploration of space for peaceful, strategic, and military uses to achieve states’ national security goals. Space has strategic connotations for both spacefaring and non-spacefaring states because space related capability has emerged as a potent medium of progress and power. The uses of the global commons of space for various conflicting objectives are emerging as a potential cause of future conflicts. In addition, space politics at the global level among the major spacefaring states impacts international and regional security environments, particularly in South Asia. The ongoing space competition between the United States and China has created a space security trilemma for Pakistan and India. This is primarily due to international and regional geostrategic transformations that are rooted in the Indo-U.S. space and strategic partnerships. This, in turn, impacts the security dynamics of South Asia, and negatively affects Pakistan, which is at a power disadvantage in comparison to India.

The utilization of space power for states’ national defence has become an integral part of the national security strategy for India and Pakistan. In this regard, India is also focusing on expanding the orbit of its space program for national defence and power projection goals. This will prompt Pakistan to follow suit. The primary factor behind India’s growing space progress is partly due to its perceived fear of China’s expanding space program, and the latter’s growing militarization and weaponization capabilities. On the other hand, China’s primary concern is U.S. space weaponization capabilities. The concerns, vulnerabilities, and challenges in space trigger and magnify the security trilemma for these South Asian rivals, interconnecting China, India, and Pakistan in the context of an international security complex. This causes geopolitical dynamics and predicaments, such as China versus the United States, India versus China, and Pakistan versus India. Moreover, India has accelerated its space cooperation with the United States and other countries that will complement its BMD systems, which, from a Pakistani perspective, is a potent security threat and a destabilizing development that undermines the strategic stability of South Asia. Such developments place Pakistan under the sway of India’s increasing military and space dominance in the region. In sum, the space and technological programs of the United States, China, and India magnify the security trilemma between the regional states in South Asia.

#### Conflict in South Asia causes extinction.

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The strategic environment of South Asia is complex, ambiguous, volatile, and unpredictable. South Asia is an important region geostrategically and geopolitically. The stability and security of the region are dependent on Indo–Pakistani relations, which have been strained for many years. The conventional asymmetry led to Pakistan’s reliance on nuclear weapons and a first-use policy. The nuclear deterrence between the two has been successful: no major war has occurred since nuclearization (aside from the Kargil standoff). Through its nuclear posture Islamabad has been able to achieve objectives like dissuading the enemy from considering aggression, deterring potential enemies, reducing dependence on allies, and militaryindependence.46 Pakistan has been trying to preserve the credibility of its minimum nuclear deterrent since 1998. Pakistan’s proposed Strategic Restraint Regime would ban anti-ballistic missiles and submarinelaunched missiles in the region.47 But India rejected the proposal, wanting to balance the growing Chinese military muscle and engaging Pakistan in an expensive arms race.

India’s space weapons program will solidify its defense and increase its options. It will also have serious repercussions for Indo–Pakistani relations and strategic stability in South Asia. It will heighten the asymmetry between the declared rivals, India and Pakistan. Further advancement and deployment of Agni V will give New Delhi second-strike capability. This will obviously have a negative effect on Pakistan’s security. Pakistan’s space program is only in its initial phases. India is very far ahead, and its rapid advancement in the field of space is alarming for Pakistan.

To preserve its space assets, India has showed interest in building satellite killer devices, lasers, and military satellites to support Indian forces. Space weapons are unpredictable and fragile. It will be disastrous for mankind if these weapons are placed in outer space. To attain space dominance by developing such dangerous weapons would not be a rational approach. It is therefore recommended that alternative options be considered. India’s space weapons would have direct implications for Pakistan in particular. Indian activities in space will force Pakistan to make changes in its nuclear posture, imperiling stability and security.

Indian space weaponization will force Pakistan to take measures to strengthen its defense forces. India’s having information about silos and the movement of troops, along with the ability to hit them, will require precautionary measures from Pakistan. Technological developments in the Indian space program could be a great threat to Pakistan, so the Pakistani government must now pay full attention to its space satellite program, to counter the Indian hegemonic space threat, and not always rely on the US and China. Pakistan receives technology from the US and China and does not possess indigenous technology production. Pakistan’s F-16s were provided by the US, and Pakistan’s space program is largely contingent on China’s help. Plansshould be made to speed the development of Pakistan’s space program. India has always impelled Pakistan to take defensive security measures, as it did in 1998, when Pakistan had to test nuclear weapons in the aftermath of India’s nuclear tests.

Pakistan doesn’t have its own launch vehicles or a launch pad for space vehicles. Pakistan needs to have its own launch vehicle and a geographically suitable place to build a launch pad. It is time for Pakistan to have an indigenous space program, not reliant on anyone else. Given the changing geostrategic environment, Pakistan must focus on internal balancing.

India is working on expanding its conventional and nonconventional military might, as is evident in its rising defense budget allocations. Pakistan needs to pay special attention to this trend. Pakistan needs to work on a more robust nuclear triad with the development of nuclear submarines. Pakistan has made a significant development in this regard, with the successful test of its Nasr solid-fueled multi-tube tactical ballistic missile. Pakistan should go for nuclear submarines, which are hard to detect and can remain underwater for long periods. It must devise ways to overcome the economic challenge, to meet these increasing defense demands. And Pakistan can take this issue to the United Nations with the collaboration of other states, as its adversarial relations with India endanger the security of all states.

The prevailing strategic environment will force Pakistan to take measures to counter the threats to its security. The measures will trigger an arms race in outer space and will create further instability in an already vulnerable South Asia. Efforts should be made at the global level to curb the proliferation of weapons in space, which is a global common and should be prevented from becoming a battleground.

India’s space program is growing at a very brisk pace. The main regional issues of South Asia pivot around India–Pakistan rivalry. Space weaponization in South Asia will have dire implications for strategic stability. India’s quest for space weaponization is motivated by aspiration for supremacy and regional hegemony. India also wants to balance its capabilities with those of China to counter China’s growing influence in South Asia. Closer analysis of the issue suggests that given the historical relations between India and Pakistan, India’s quest for space weaponization will threaten the security of the region.

#### The plan solves:

#### 1. Bilateral mutual restraint is key---it establishes an international norm of noninterference and drives regular dialogue---independently shapes Chinese and Indian behavior.

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Scenario B: Codified, Bilateral Mutual Restraint

In Scenario B, the United States and Russia sign a bilateral agreement to continue noninterference with their respective space-based NTM. This bilateral, noninterference agreement stands on its own, unconnected to other arms control treaties. Since prospects for new, broader arms control treaties are dim, noninterference with NTM by itself provides the basis for a narrower agreement and provides a way forward in preserving stability in the space domain.

A bilateral agreement between the United States and Russia that simply prohibits interference with NTM is feasible, given that all it does is maintain the status quo as it has been since the 1970s. Moreover, the United States finds the agreement meets U.S. prerequisites to enter into a new arms control agreement as required in the 2010 U.S. National Space Policy; i.e., such an agreement must be equitable, effectively verifiable, and enhance the national security of the United States and its allies. 24 Also, the Russians find it difficult to argue convincingly against reestablishing the 50-year-old status quo in space. Indeed, the United States, chided internationally for years over its opposition to the Russian “No First Placement of Weapons in Outer Space” (NFP) initiative and the Russian and Chinese draft “Treaty on the Prevention of Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects” (PPWT), could offer an agreement on noninterference with NTM as an alternative to Russia and, eventually, to China and the international community. A formally ratified agreement may be difficult to achieve, given the troubled nature of the current U.S.–Russia strategic relationship and with the high hurdle of U.S. Senate consent. If so, such an arrangement might be accomplished through a non-legally binding MOU that does not necessitate ratification.

As in Scenario A, the collection requirements for tracking Russia’s nuclear forces grow due to the lack of onsite inspections, while at the same time the Russian concealment of their activities makes monitoring their nuclear forces more challenging. However, the stability of the space domain would be unaffected in Scenario B, and the challenges arising from the increasing contested nature of the space domain would not be exacerbated. The bilateral U.S.–Russian agreement means NTM overflight’s legitimacy in international law would not be challenged by either party, and the incidence of interference between the United States and Russia would remain at the same level as the current status quo (reflected in light green in Table 2, Scenario B).

Contrary to noncodified mutual restraint outlined in Scenario A, a new formal U.S.–Russian agreement reduces the impetus for China, India, and other countries to change their attitudes, beliefs, and practices regarding interference with NTM. This finding is based on a key assumption that runs throughout all the scenarios: that the United States and Russia, as the traditional space powers, influence what other countries consider legitimate, acceptable behavior in space. It is reasonable to predict that more antagonistic behavior in space by the United States and Russia will likely lead to more antagonistic behavior in space by other nations and a less stable space domain. Conversely, U.S.– Russian mutual restraint, especially codified bilateral mutual restraint, will ideally shape the strategic environment toward restraint among all spacefaring nations and build a more stable space domain. The international community’s development of norms of behavior for outer space will be shaped correspondingly.

The United States and Russia approach space control activities more cautiously than in Scenario A, due to the codified agreement raising the threshold for initiating active interference with the others NTM. The agreement also drives regular dialogue between the United States and Russia, further supporting stability. The opportunity for miscommunication, misunderstanding, and miscalculation remains at today’s level, as well as the level of risk to crisis stability.

#### 2. Satellite specification makes deterrence credible.

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Enabling the bilateral or multilateral agreements on which Scenario B and C are based may also require decisionmakers to identify NTM satellites. As noted earlier, the United States and Russia have preferred to keep the precise definition and identity of NTM purposefully ambiguous. Nevertheless, reaching a separate agreement on noninterference with NTM seems more likely if specific satellites, on all sides, are identified as NTM. That does not mean specific NTM spacecraft capabilities would need to be revealed, but removing the ambiguity over which satellites are NTM might be judged worthwhile in order to proactively shape the future strategic context in space.

Today, deterring aggression in space is more important than ever, so decisionmakers might also judge that revealing the identity of NTM spacecraft may strengthen deterrence, benefiting stability in space across all four future scenarios. In September 2019, during a discussion on space and deterrence, the commander of U.S. Air Force Central Command, Lieutenant General Joseph Guastella, implied that some senior leaders need to make tough decisions about which NTM capabilities should be revealed in order to make deterrence credible, explaining that adversaries have to know about one’s capability to be deterred by it. “At some point,” he said, “we have to reveal some things.”26

#### 3. Predictability and certainty are key to strategic stability---verification measures specifically.

Vincent Manzo 19. Research Analyst, CNA. “Nuclear Arms Control Without a Treaty? Risks and Options After New START.” CNA. 03-2019. https://www.cna.org/CNA\_files/PDF/IRM-2019-U-019494.pdf

Russian Ambassador Sergei Ryabkov also listed predictability as one of the core contributions of arms control to Russian national security in an August 2018 interview, suggesting that arms control fills this role in Russian strategy as well.12

How does predictability in the US-Russian relationship contribute to the arms control objectives outlined in the previous section?

A predictable nuclear balance helps policymakers in both countries understand how their current and planned forces compare to their potential adversary’s forces. It gives them confidence that their military postures are sufficient to meet their security objectives.

In a geopolitical crisis, this confidence can reduce both countries’ fears that the other might initiate a strategic attack, thereby improving the chances of avoiding war.13 From a longer-term perspective, predictability can help two rival nations avoid a costly and dangerous arms competition. Building each country’s confidence that it is not at risk of being caught in a position of acute vulnerability in the future can help reduce the pressure to expand or enhance military capabilities in order to prevent the other from achieving an advantage. Finally, predictability can manifest in mutual confidence among leaders of rival nations that each understands the profound risks of nuclear war.

In practice, predictability stems from an arms control treaty’s verification regime, which establishes mutual transparency, and binding constraints on numbers and/or types of strategic nuclear forces. The verification regime functions as the circulatory system of a treaty, pumping information from each country’s secure military sites into the other’s national security establishment. Without this transparency, the treaty’s constraints would be less effective for fostering predictability because both countries would have less insight into whether the other is complying with the provisions. “Arms control allows you to build a box and then look inside it,” according to one arms control expert.14

#### Russia says yes:

#### 1. Statements from top generals---Russia wants NTM to enhance transparency.

CSIS 15. Center for Strategic and International Studies. “CSIS Track-II Dialogue on Liming Non-Strategic Nuclear Weapons.” Final Technical Report. N00244-14-1-0034. 09-04-2015. <https://www.hsdl.org/?view&did=789634>

1) Among the proposed ideas I found the most interesting the one on discussing remote sensing technologies that may enhance transparency (#8). Particularly notable is a statement made recently by General Ryzhkov, Head of the Directorate of Arms Control Treaties Implementation of the Russian MoD. He said that future arms control should be based more on confidence measures and national technical means (NTMs) rather than on inspections.1 Therefore discussing remote sensing technologies could be of interest to Russia, if Russia wants to put more emphasis on NTMs in the implementation of arms control agreements in future.

#### 2. Self-interest---Russian leaders want the plan’s stability.

Vincent Manzo 19. Research Analyst, CNA. “Nuclear Arms Control Without a Treaty? Risks and Options After New START.” CNA. 03-2019. https://www.cna.org/CNA\_files/PDF/IRM-2019-U-019494.pdf

Yet Russian interests in mutual restraint make cheating and false accusations a risky strategy. It may be difficult for the United States to disprove Russian cheating accusations and prove Russian cheating in the court of global opinion, but the United States is unlikely to accept politically imposed constraints indefinitely if Russia is acting in bad faith and not honoring its commitment. The forthcoming US withdrawal from INF demonstrates that the United States does not treat arms control as an end unto itself and is willing to walk away from an agreement that is no longer serving its purpose. Thus, if Russian leadership’s goal is to avoid an unrestrained strategic nuclear arms competition with the United States, they have strong incentives to avoid chicanery.

Finally, we must consider these risks in the context of what the United States is likely to encounter if it has no vision for cooperating with Russia after New START. Discord over US nuclear policy within the Congress, NATO, and the NPT are guaranteed under that scenario. The mutual restraint pledge, alternatively, offers some chance of dampening this blowback while avoiding a large increase in the number of deployed Russian nuclear weapons.

### Overflight---1AC

#### Advantage Two is Overflight:

#### NTM interference will increase soon without the plan---US-Russian bilateral restraint is key to enshrine overflight’s legitimacy.

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The likely demise of the US-Russia New START treaty could lead to a dangerous uptick in jamming, lazing and possibly even kinetic attacks of US satellites designed to monitor Russia nuclear weapons and forces, says a new study by the respected Aerospace Corp.

Noting that prospects for extension of the New START treaty by the Trump Administration are “dim,” the study says: “This change will stress the national security space community’s capabilities, assumptions, and habits, and is likely to raise new risks for the stability of the space domain.”

The study, “Noninterference With National Technical Means: The Status Quo Will Not Survive,” lays out four possible scenarios regarding the fate of “national technical means, NTM” operated by the Air Force and the National Reconnaissance Office if New START collapses.

All of the scenarios predict “opportunity costs” as intelligence, surveillance and reconnaissance (ISR) satellites are swamped with new and more difficult tasking to keep tabs on Russian nuclear forces to compensate for the disappearance of onsite inspections and information exchanges required under the current treaty. Authors Michael Gleason and Luc Riesbeck say that increased demand will come on top of ever-growing competing requirements for monitoring China, North Korea, Iran, and terrorist organizations.

NTM is the arms control term of art for methods of verifying treaty compliance. Although no treaty specifies NTM systems, in practice they encompass all US intelligence and national security satellites (as well as aircraft, drones and fixed radar). “It’s not just IC satellites,” said Gleason during a rollout of the study today.

For the past 50 years, as the Aerospace study points out, nuclear arms control agreements — including New START, signed in 2010 and currently the only remaining US-Russia treaty capping nuclear weapons arsenals — have included prohibitions against any interference with NTM.

The study warns, the collapse of New START could undermine “NTM overflight’s legitimacy in international law,” especially since the US position from the 1960s—that overflight by military and intelligence satellites is a “peaceful use” of outer space—already is becoming “difficult to reconcile while avowedly preparing for warfighting in, through, and from space.”

New START limits Russia and the US each to no more than 1,550 deployed strategic warheads and 700 deployed strategic delivery vehicles (meaning ICBMs, submarines and bombers). As Breaking D readers know, the Trump Administration has been waffling on whether it will pursue a five-year treaty extension when the treaty expires in February 2021. Instead, President Donald Trump has ordered his staff to begin work on a possible new trilateral nuclear arms control treaty that would include China and cover sub-strategic weapons (of which the Russians have more than the US) that are not covered by New START. Such a multilateral treaty is widely considered pie-in-the-sky by nuclear arms control experts.

Rose Gottemoeller, who was instrumental in negotiating New START and recently retired as deputy ambassador to NATO, stressed that the expiration of New START “is not inevitable,” and argued that it was in the US national interest to maintain it. On the other hand, she agreed that the norm against interference with NTM has been eroding for some time.

“The norm is worth preserving and extending,” she said, although “it may need some updating and strengthening.” In particular, she said, nations need to consider how to better protect drones used for verification of various international agreements.

She also questioned China’s current commitment to the norm and Beijing’s willingness to simply follow US and Russian precedent. She urged Washington and Moscow to work together to convince China that not interfering with NTM is in Beijing’s interest too.

The four scenarios, which the study stresses represent only a continuum of possibilities, are:

Scenario 1 “Noncodified, bilateral mutual restraint:” The United States and Russia decide separately that it is in their national interest to continue current practices regarding noninterference with NTM, even in the absence of a bilateral agreement.” However, the study says, the lack of a legal agreement on NTM probably will undercut international adherence to what up to now has been a generally agreed norm — in particular emboldening China and India to test interference methods. It could also lower the “threshold for initiating the first-use of offensive space control capabilities, resulting in less crisis stability.” Further, efforts to develop multilateral norms of behavior and transparency and confidence-building measures in space — efforts the Trump Administration has pledged to support — would be undermined.

Scenario 2 “Codified, bilateral mutual restraint:” The two sides sign a new detailed agreement on noninterference with NTM. While more optimistic than Scenario 1, the collection requirements for tracking Russia’s nuclear forces would still grow, the study says. However, the stability of the space domain would be unaffected in Scenario B, and the challenges arising from the increasing contested nature of the space domain would not be exacerbated.

Scenario 3 “Multilateral restraint:” A multilateral treaty, including China or maybe the P5 nuclear weapons states (that’s China, France, Russian, the United Kingdom, and the US), is signed to prevent NTM interference. The most optimistic of the scenarios, it would strengthen the norm legitimizing ISR satellite overflights. As is often the case in arms control, the most optimistic scenario is also the least likely, given the current difficulties facing multilateral fora such as the United Nations in reaching such any new space agreements.

Scenario 4 “No mutual restraint:” This is the most pessimistic case. “Tracking Russia’s nuclear forces becomes increasingly difficult. The stability of the space domain deteriorates severely due to the absence of mutual restraint and the degradation of existing processes for developing international norms of behavior for space. The danger of miscommunication, misperception, and miscalculation swells along with the risk of conflict quickly extending into space. Current threats to stability in the space domain are greatly exacerbated, resulting in its full destabilization.”

#### AND---failure to jointly define which sats constitute NTM puts all sats at risk of attack---this ambiguity has created a de facto ASAT ban, but it will erode---mutual clarity of NTM assets is key to protect all sats and enforce the limited test ban treaty.

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The 2010 New Strategic Arms Reduction Treaty (New START) currently in force between the United States and Russia is set to expire on February 5, 2021. When that happens, formal prohibitions on interference with national technical means (NTM) of verification expire along with limits on U.S. and Russian nuclear arms. This will mark a significant change in the strategic context within which U.S. national security space forces operate. U.S. space forces’ resources will be taxed, and the stability of the space domain will face new risks.

The United States needs a comprehensive strategy to address these challenges. This paper introduces a thought experiment to identify the key factors that should be considered when such a strategy is formulated. It does this by contemplating four alternative futures. Each alternative future assesses the implications of New START’s expiration for the U.S. national security space enterprise and for the strategic stability of the space domain. No alternative future foresees the existing status quo surviving after New START expires.

What are National Technical Means of Verification and why are they important?

Formal prohibitions on interference with NTM of verification began with the 1972 Anti-Ballistic Missile (ABM) Treaty between the United States and the Soviet Union. Subsequent arms control treaties also included protections for NTM satellites used to verify treaty compliance.

However, the systems and sensors that constitute NTM for treaty verification have never been defined in the text of the arms control treaties or in the treaty negotiating records.1 The United States and Russia have preferred to keep the precise definition and identity of NTM purposefully ambiguous for the following reasons: to protect the sources of sensitive information; to protect the methods used to gather such information; to permit maximum flexibility in what methods are used to gather information; to create uncertainty on the other side about specific capabilities being used as a deterrent against cheating; and to allow flexibility to introduce new technological innovations.

NTM for treaty verification may include sensors based on the ground, on aircraft, or even underwater.9 However, arms control experts consider satellites the most important type of NTM. Indeed, many different types of satellites may be considered NTM.10 For example, various types of photoreconnaissance satellites and synthetic aperture radar satellites collect detailed imagery of things on the ground, such as inter-continental ballistic missiles (ICBMs) and aircraft. Other satellites detect electronic signals, which may provide insights into a missile’s or missile launcher’s performance.11 U.S. missile launch warning satellites such as Defense Support Program (DSP) and Space-Based Infrared System (SBIRS) spacecraft detect the intense heat generated by a missile launch and may be considered NTM since they monitor Russian ICBM and submarine-launched ballistic missiles (SLBM) launch tests and can thereby reveal their capabilities.12

The lack of clarity around which space systems are considered NTM of verification also suggests that other satellite systems that aid in the detection of treaty violations can be considered NTM for treaty purposes. For example, the nuclear detection capability of global positioning satellites (GPS), which detect the flash and radiation of nuclear detonations, may be considered NTM for verification of compliance with the Limited Test Ban Treaty (LTBT) and the Comprehensive Test Ban Treaty (CTBT).13 Furthermore, the CTBT’s International Monitoring System (IMS) is part of a verification regime detecting nuclear explosions and includes a global infrastructure for satellite communications from IMS stations to an international data center (IDC), which processes and distributes data to state parties. In that regard, even commercial telecommunication satellites may be considered NTM for treaty verification.14

In this milieu of purposeful ambiguity, the United States and Russia extended the ban on interference to be effectively a de facto ban on interfering with the entire national security space constellation of the other.15 In short, for treaty verification purposes NTM include all military and intelligence satellites, broadly defined. Despite this intentional vagueness concerning what NTM are, arms control treaty language for the last 50 years has consistently included protections for NTM because they remain critical to the overall compliance verification process and for detecting cheating against treaty requirements.

Arms control treaties have long included protections for NTM satellites used to verify treaty compliance.16 As such, noninterference with NTM has always been linked tightly to arms control, forming a key component of the strategic context in which U.S. and Russian behavior in space has taken place for nearly five decades.

Since prospects for New START’s extension are dim, consideration should be given to what the change in strategic context may entail. For example, New START’s expiration could have negative implications for the legitimacy of NTM overflight. The formal prohibition on interference with NTM of verification, beginning with the 1972 ABM Treaty, was key to establishing NTM overflight legitimacy. The Eisenhower administration began the process of legitimizing overflight by not objecting to Sputnik’s overflight of the United States. Indeed, many observers believe that NTM overflight was legitimized in Russian minds with the launch of Sputnik, but that is not completely true.17 Overflight was considered legitimate when done for peaceful purposes. However, while the United States asserted that peaceful means “nonaggressive” beginning in the early 1960s, the Soviets did not recognize that definition and continued to object to overflight of “spy” satellites as a form of espionage. In 1962, the Soviet Union submitted to the United Nations a “Draft Declaration of Basic Principles Governing the Use of Outer Space,” which asserted “use of artificial satellites for the collection of intelligence information in the territory of foreign states is incompatible with the objectives of mankind in its conquest of outer space [emphasis added].”18 Some Soviet officials continued to object to U.S. spy satellite overflights into the late 1970s, even after the ABM Treaty came into force.19

Eventually, with the ABM Treaty, the Soviets accepted the legitimacy of NTM overflight for treaty verification purposes, but it is not clear if they (or Russia) ever accepted the legitimacy of overflight for intelligence collection. For example, in 1979, a member of the Institute of State and Law of the USSR Academy of Sciences argued that NTM overflight activities are unlawful if they go beyond treaty compliance monitoring to gather information for intelligence purposes.20 Although the United States consistently rejected these objections, the United States also kept U.S. spy satellites’ existence secret from 1962 until 1978, when President Carter publicly acknowledged the existence of photo-reconnaissance satellites in the context of their importance as NTM for monitoring arms control agreements.21

With this history in mind, the current trends and rhetoric toward a conception of space as a warfighting domain may also contribute to undermining NTM overflight’s legitimacy in international law, since the U.S. position from the 1960s—that overflight is a “peaceful use” of outer space—is difficult to reconcile while avowedly preparing for warfighting in, through, and from space. Again, the Soviet Union accepted the “nonaggressive” definition for what peaceful use means only in connection with NTM use to verify compliance with arms control treaties. But Russia’s continued acceptance of that definition in lieu of New START and in the face of a more aggressive U.S. posture in space should not be taken for granted. Indeed, active interference with NTM might not be considered illegitimate when NTM are used for finding, tracking, and fixing targets in a crisis or conflict. And perhaps other countries also will begin to question the legitimacy in international law of NTM overflight.

#### Scenario One: LTBT

#### Erosion of the Limited Test Ban Treaty destroys the environment, and causes Russia, China, Indo-Pak arms racing.

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Combined, the two documents suggest that the Trump administration is laying the groundwork to resume explosive nuclear testing at its discretion. History reminds us that this would have catastrophic consequences. Resumed nuclear testing would bring with it not just environmental and health risks, but also the erosion of an important international norm and the likely setting off an international testing race – with no benefits for the United States.

Over the course of nearly 50 years prior to Bush’s signature, the United States conducted over 1,000 explosive nuclear tests (five underwater, approximately 200 in the atmosphere, and about 800 underground), the most of any country on Earth. These tests, particularly the atmospheric explosions, created environmental, social, and health consequences through radiation dispersal and other effects, some of which continue to be evident.

New explosive tests, even if only underground, would also present many dangers. Visitors in high-rise hotels in sprawling Las Vegas, 70 miles south of the test site, would physically feel the ground shake. And since underground tests sometimes leak, the surrounding area may be exposed to radioactive fallout.

The geopolitical consequences would be worse, amounting to a nuclear testing race. In 1961, the Soviet Union caught the world by surprise and broke its pledge with the United States and Great Britain to refrain from testing, conducting well over 100 tests over the next two years. The United States rushed to keep up, also carrying out more than 100 tests, mostly underground, by the end of 1962. France and Great Britain also tested during this time period, and China conducted its first test in 1964.

If the United States were to resume nuclear testing today, a similar international reaction would likely occur. Russia and China, attempting to keep up, would almost certainly resume testing themselves. India and Pakistan, bitter archrivals that both reserve the right to resume nuclear testing, would likely see a green light to explode nuclear weapons once more. India may see an opportunity to test new, unproven thermonuclear weapons – which it is allegedly pursuing – and Pakistan would be compelled to respond, similar to the infamous nuclear tests conducted by both countries in 1998.

In the early 1960s, with nuclear explosions taking place at a rate of roughly every other day, international and domestic pressure brought the United States, Great Britain, and the Soviet Union to the negotiating table once again. (The Cuban Missile Crisis was also a major factor). What resulted was the Limited Test Ban Treaty, a 1963 agreement still in effect that bans all nuclear explosions, except underground.

#### Biodiversity loss risks extinction and turns all impacts.

Phil Torres 16. Affiliate scholar at the Institute for Ethics and Emerging Technologies. “Biodiversity loss: An existential risk comparable to climate change.” *Bulletin of the Atomic Scientists* 4/11/2016. http://thebulletin.org/biodiversity-loss-existential-risk-comparable-climate-change9329

Such considerations warrant decoupling biodiversity loss from climate change, because the former has been consistently subsumed by the latter as a mere effect. Biodiversity loss is a distinct environmental crisis with its own unique syndrome of causes, consequences, and solutions—such as restoring habitats, creating protected areas (“biodiversity parks”), and practicing sustainable agriculture. The sixth extinction. The repercussions of biodiversity loss are potentially as severe as those anticipated from climate change, or even a nuclear conflict. For example, according to a 2015 study published in Science Advances, the best available evidence reveals “an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way.” This conclusion holds, even on the most optimistic assumptions about the background rate of species losses and the current rate of vertebrate extinctions. The group classified as “vertebrates” includes mammals, birds, reptiles, fish, and all other creatures with a backbone. The article argues that, using its conservative figures, the average loss of vertebrate species was 100 times higher in the past century relative to the background rate of extinction. (Other scientists have suggested that the current extinction rate could be as much as 10,000 times higher than normal.) As the authors write, “The evidence is incontrovertible that recent extinction rates are unprecedented in human history and highly unusual in Earth’s history.” Perhaps the term “Big Six” should enter the popular lexicon—to add the current extinction to the previous “Big Five,” the last of which wiped out the dinosaurs 66 million years ago. But the concept of biodiversity encompasses more than just the total number of species on the planet. It also refers to the size of different populations of species. With respect to this phenomenon, multiple studies have confirmed that wild populations around the world are dwindling and disappearing at an alarming rate. For example, the 2010 Global Biodiversity Outlook report found that the population of wild vertebrates living in the tropics dropped by 59 percent between 1970 and 2006. The report also found that the population of farmland birds in Europe has dropped by 50 percent since 1980; bird populations in the grasslands of North America declined by almost 40 percent between 1968 and 2003; and the population of birds in North American arid lands has fallen by almost 30 percent since the 1960s. Similarly, 42 percent of all amphibian species (a type of vertebrate that is sometimes called an “ecological indicator”) are undergoing population declines, and 23 percent of all plant species “are estimated to be threatened with extinction.” Other studies have found that some 20 percent of all reptile species, 48 percent of the world’s primates, and 50 percent of freshwater turtles are threatened. Underwater, about 10 percent of all coral reefs are now dead, and another 60 percent are in danger of dying. Consistent with these data, the 2014 Living Planet Report shows that the global population of wild vertebrates dropped by 52 percent in only four decades—from 1970 to 2010. While biologists often avoid projecting historical trends into the future because of the complexity of ecological systems, it’s tempting to extrapolate this figure to, say, the year 2050, which is four decades from 2010. As it happens, a 2006 study published in Science does precisely this: It projects past trends of marine biodiversity loss into the 21st century, concluding that, unless significant changes are made to patterns of human activity, there will be virtually no more wild-caught seafood by 2048. Catastrophic consequences for civilization. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. There could be surprising effects of biodiversity loss that scientists are unable to fully anticipate in advance. For example, prior research has shown that localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point. According to a 2012 paper published in Nature, there are reasons for thinking that we may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization. As the authors write, a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.” An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.” According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive. Biodiversity loss is a “threat multiplier” that, by pushing societies to the brink of collapse, will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors. Indeed, it could even fuel the rise of terrorism. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.) The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,” as the aforementioned 2012 Nature paper notes. Furthermore, the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime. The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right. As such, it ought to be considered alongside climate change and nuclear weapons as one of the most significant contemporary risks to human prosperity and survival.

#### Radiation causes extinction

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Three years after the Fukushima catastrophe, Japan’s stricken power plant is still struggling to contain radioactive water leaks that are making the area uninhabitable, while TEPCO’s effort to clean up what remains of the crippled nuclear site has turned into a disaster of its own. The Voice of Russia spoke with Majia H. Nadesan, Associate Dean of the New College at Arizona State University and the author of a blog on Fukushima, who believes humanity might have already “forged its extinction” with nuclear technology and is now just waiting for it to unfold. Three years ago, a disastrous tsunami and earthquake killed nearly 20,000 people and settled the nuclear crisis in Japan. Did the region manage to recover from the catastrophe and what are the current results of its recovery? The situation at the Daiichi site remains unstable. Contaminated water production is continuing as ground water and the water injected for cooling encounter uncontained nuclear fuel. And TEPCO has admitted that ground water is indeed encountering uncontained nuclear fuel, and some of that water is ending up in the ocean, some of that water is saturating the site and some of that water is being captured and stored in tanks, and those tanks are emitting radiation, including X-rays and Beta-radiation. There are about a thousand tanks that hold approximately 350,000 tons of highly contaminated water and the IAEA is recommending that some of that water, the less contaminated among it, be put into the ocean. So what we are having is a situation of catastrophic contamination that is ongoing for the Pacific ocean and increased water saturation at the site, simultaneously atmosphere contamination is continuing through emissions and also through the reactions of the contaminated water in the tanks. So we have a situation of great instability and ongoing significant levels of contamination. What are the other consequences of Fukushima disaster? What have been done to struggle against them? Is it possible that the region will be safe to live in again? The thing is that people in Japan are living in contaminated land. For example, The Asahi Shimbun described one resident who is living near 500 tons of stored radioactive waste measuring at least 8,000 becquerels per kilogram of cesium and that is the only radionulcide that they provided the measurements for, there could be uranium and plutonium, other nuclear waste stored there as well. So people are living amidst contaminated waste; reservoirs in Japan are contaminated. There was an article also in The Asahi Shimbun, that indicated that the highest level of contamination measured in one of the contaminated reservoirs was 390,000 becquerels per kilogram of soil at the bottom of the reservoir, so people are potentially going to be drinking contaminated water. People are living in areas that measure up to twenty millisieverts a year and there is even temporary living that is available in more contaminated areas. And people who are living in areas of twenty millisieverts a year or less are responsible for clean-up, and the clean-up plan doesn't address hot spots or recontamination and it doesn't help people dispose of the radioactive waste. People are living in highly contaminated areas with children. There have been some surveys that looked at what the consequences are for children: diabetes rates have increased, thyroid nodules have increased, thyroid cancer has increased. And there was one recent survey that was published in The Mainichi that one in four children in the disaster hit areas need mental care for problematic behavior and that was interesting because the problematic behavior included things such as dizziness and nausea and symptoms that might be caused by psychological problems but also could be symptomatic of radiation exposure. So the consequences of this disaster is that people who are living in highly contaminated areas and the region are not going to be safe again for generations because the amount of radiation contamination is increasing daily. So it is going to be land of dispossessed people. What prospects does the region have in its future development? Is there any risk that Fukushima disaster can repeat? The thing that so tragic is that radiation damage accumulates across time for a variety of reasons. First, because animals and plants and people all bioaccumulate radionuclides. And so across time people and animals and vegetation will become more contaminated rather than less contaminated. And the effects of radiation don't just affect one generation, they affect multiple generations. There is quite a bit of research, done in the Chernobyl region, for example, by Anders Møller and Timothy Mousseau, who found that the increased background radiation from Chernobyl has significant effects on immunology, mutation and disease frequency across animal species and in fact they found decline in population and long-term mutation accumulations. Over time, each generation inherits the mutations of their parents and acquires their own. And then children have even more germline cell mutation and micro delusions in DNA than their parents. Micro-deletions in DNA are increasingly linked to diseases such as autism and congenital heart disease. So we can assume that over the long-term the health of the people in the zones and the animals in the zones – their health also is going to decrease as bioaccumulation, bio-magnification and trans-generational mutations increase. And it is a human tragedy what is occurring there. It can happen anywhere in the world because of a solar flare that knocks out a transformer, an earthquake, for example, that might affect Diablo Canyon in California which is sitting on a fault, terrorism - all of these forces could create another Fukushima any place in the world. Nuclear power is going to be the road to our extinction. We don't know what the trans-generational effects are going to be, but we know they are going to be detrimental. And as humans acquire more of them, their ability to successfully reproduce is going to decline. So we might already have forged our extinction and we are just waiting for it to unfold. We need to make changes very quickly to find ways of dealing successfully with storing nuclear waste. And we've just discovered in New Mexico of the US, there is a site near Carlsbad, they've just had a salt cave-in collapse and there is nuclear waste which is now venting into the atmosphere, even though it is being filtered, it is still coming out. That is not a successful solution. So we have to find solutions that work for nuclear waste and we need to find alternative energy that will allow us to sustain civilization in the future.

#### Scenario Two: Methane

#### NTM sats are key to low cost detection of methane super-emitters---that reduces the cost of regulatory compliance.

Robert Kleinberg 19. Senior Fellow, Boston University Institute for Sustainable Energy; Principal, Presidio Energy Technology; adjunct senior research scholar at the Center on Global Energy Policy of Columbia University; PhD Physics, UCSD. “Better Rules for Natural Gas Leak Detection and Repair.” Boston University Institute for Sustainable Energy. https://www.bu.edu/ise/2019/01/02/better-rules-for-natural-gas-leak-detection-and-repair/

As a hypothetical, consider a methane detection system based on national technical means of verification, e.g. an earth-orbiting satellite capable of locating methane emission anomalies. Such satellites are already in operation (e.g. GHGSat, GOSAT), though not yet necessarily capable of usefully directing repair efforts. Foreseeable improvements may lead to satellite-based detection of super-emitters – sources of unusually large quantities of vented or fugitive methane – which may be responsible for the bulk of methane emissions [Ravikumar et al., Environ. Sci. Technol. (2017) 51 718, Supporting Information].

Satellite or aerial surveillance is not capable of locating super-emitters at the component level, but it can eliminate facilities or groups of facilities from suspicion. Then component-level leak detection can be focused on limited areas defined by the spatial resolution of the overhead measurement. Sites which overhead surveillance shows do not host super-emitters can be exempted from component-level inspection.

Thus, I contend that the detection effective and repair of super-emitters, with on-site component-level inspection triggered by overhead surveillance, may come to constitute a more means of mitigating anthropogenic methane emissions than sole reliance on methods specified by the 2016 OOOOa regulation, while materially reducing the costs of compliance. However, space-based and overflight means of surveillance are clearly outside the scope of both the 2016 and 2018 AMEL provisions.

#### Global methane regs are coming now, but only sats can make them effective----verifying reductions ensures compliance.

Mark Brownstein 19. Senior Vice President of Energy at Environmental Defense Fund. "Satellites become valuable new tool for governments, industry to cut emissions." Energy Exchange. 2-5-2019. <http://blogs.edf.org/energyexchange/2019/02/05/satellites-become-valuable-new-tool-for-governments-industry-to-cut-emissions/>

For years, people used satellites to observe the Earth’s climate. Now, orbital sensing offers a crucial new way to protect it, by giving us new abilities to identify, measure, and ultimately verify cuts in emissions of methane – a highly potent greenhouse gas.

Two new pieces of research led by EDF scientists demonstrate the growing potential of space-based monitoring tools, and offer a preview of things to come when EDF launches its own dedicated methane satellite in 2021.

Offshore Flaring in Mexico

First is a paper published this week in Geophysical Research Letters, explaining how researchers used space-based readings to calculate the enormous volume of natural gas being burned off (or “flared”) by oil and gas platforms in the Southern Gulf of Mexico. From 2005 and 2017, data from NASA’s Aura satellite show that operators flared as much as 710 billion cubic feet of gas per year.

The team was able to determine the amount of gas burned using satellite measurements of the sulfur- and nitrogen dioxide pollution coming from the flares – a scientific first.

Methane has more than 80 times the warming power of carbon dioxide (CO2) over the first 20 years after it’s emitted. Flaring converts much of the gas into CO2 – a massive climate footprint – but inefficient combustion means a considerable amount of methane continues to escape unburned, making the total climate impact of flaring many times worse. The practice is also incredibly wasteful. The gas flared by Mexico’s offshore operators in 2016 was four times the amount used by the country’s entire commercial, residential and public sectors.

The data show that flaring peaked in 2008, as operators ramped up oil production using methods that also yield large amounts of excess natural gas alongside the petroleum. Regulations introduced by the Mexican government in 2009 cut the amount of gas flared in half by 2017. While that marks a significant improvement, operators in Mexico are still burning off more than 40 percent of the gas associated with offshore oil production (compared with a flaring rate of less than three percent in U.S. offshore production).

This waste is happening even as Mexico imports tremendous quantities of natural gas from the U.S. and elsewhere because not enough domestic production finds its way to market. The satellite data shows is that aggressive steps to reduce flaring further could yield both environmental and energy security benefits.

Flaring in the Permian Basin

Separately, our team used data from a satellite operated jointly by NASA, the National Oceanic and Atmospheric Administration, and the Department of Defense to analyze flaring rates and volumes in the Texas portions of a sprawling oil and gas region known as the Permian Basin. EDF researchers found that operators there burned off more than 100 billion cubic feet of natural gas in 2017 alone – 4.4 percent of all gas produced, and nearly twice the 55 billion cubic feet that companies reported to state officials.

Some parts of the Permian are even worse. In the section known as the Delaware Basin, which accounts for about half of all gas produced in the Permian, satellite data shows operators burned almost eight percent of the gas they produced.

EDF’s satellite analysis lines up with a recent S&P Global Market Intelligence report, which also shows significant discrepancies between satellite data and industry-reported figures in Texas, North Dakota and New Mexico. Based on statewide readings from 2012 through 2017, S&P estimates that Texas wasted nearly a trillion cubic feet of gas through flaring, enough gas to supply every household in Texas two-and-a-half times over.

The Next Big Thing

Space-based measurements like these offer a glimpse into the near future. As more countries, like Mexico, adopt oil and gas methane regulations, and oil and gas companies announce methane reduction commitments, regular accounting for methane escaping across the global oil and gas supply chain becomes essential.

#### Effective methane regs are key to avoid emissions overshoot.

Deborah Gordon 19. \*\*Senior Fellow in International and Public Affairs, Watson Institute; Former Director, Energy and Climate Program, Carnegie Endowment for International Peace; taught at the Yale School of Forestry and Environmental Studies; directed the Energy Policy Program at the Union of Concerned Scientists. \*\*Frances Reuland, Researcher, Watson Institute. “Mapping, Measuring, and Managing Methane: The Critical Role of a Potent Climate Pollutant.” Watson Institute. 11-2019.https://watson.brown.edu/files/watson/imce/news/ResearchMatters/2019/Methane%20Report-6%20November%202019.pdf

Earth’s temperature is rising to dangerous levels. Cutting greenhouse gas emissions is increasingly urgent. Although carbon dioxide is the major climate pollutant, from the moment it is emitted, a ton of methane is at least 120 times more potent than a ton of carbon dioxide. While methane may not last long in the atmosphere, new research suggests that its potential to warm the planet may be 25 percent greater than previously believed. 1

Methane’s rapid multiplier effect accelerates global warming. To avoid an emissions overshoot that destabilizes the climate past 1.5 degrees Celsius, policymakers, industry, and civil society should focus their attention on short-lived climate pollutants, like methane.

Methane is a stealthy gas—invisible, odorless, minute, and forceful. Monitoring methane to chart its release into the atmosphere is an ongoing challenge. Measurement systems are continually improving to detect and quantify methane using multi-pronged approaches that entail top-down satellite monitoring systems, bottom-up reporting, basin-level measurements, regional assessments, and oil and gas system emissions models. Taken together, these methods can create a comprehensive view of methane from its various sources.

The petroleum industry is a principal source of methane emissions, as methane is the main component of natural gas. Methane can escape through different routes in the petroleum value chain, wherever oil and gas are extracted, processed, shipped, stored, or combusted. Preventing the leakage of methane can be profitable for petroleum companies who sell non-leaked gas. In fact, an estimated one-half of methane currently escaping from natural gas systems could return a profit, even after considering costs of installing leak prevention measures.

#### Unchecked climate change causes extinction.

Bill McKibben 19. Schumann Distinguished Scholar at Middlebury College; fellow of the American Academy of Arts and Sciences; holds honorary degrees from 18 colleges and universities; Foreign Policy named him to their inaugural list of the world’s 100 most important global thinkers. "This Is How Human Extinction Could Play Out." Rolling Stone. 4-9-2019. https://www.rollingstone.com/politics/politics-features/bill-mckibben-falter-climate-change-817310/

Oh, it could get very bad.

In 2015, a study in the Journal of Mathematical Biology pointed out that if the world’s oceans kept warming, by 2100 they might become hot enough to “stop oxygen production by phyto-plankton by disrupting the process of photosynthesis.” Given that two-thirds of the Earth’s oxygen comes from phytoplankton, that would “likely result in the mass mortality of animals and humans.”

A year later, above the Arctic Circle, in Siberia, a heat wave thawed a reindeer carcass that had been trapped in the permafrost. The exposed body released anthrax into nearby water and soil, infecting two thousand reindeer grazing nearby, and they in turn infected some humans; a twelve-year-old boy died. As it turns out, permafrost is a “very good preserver of microbes and viruses, because it is cold, there is no oxygen, and it is dark” — scientists have managed to revive an eight-million-year-old bacterium they found beneath the surface of a glacier. Researchers believe there are fragments of the Spanish flu virus, smallpox, and bubonic plague buried in Siberia and Alaska.

Or consider this: as ice sheets melt, they take weight off land, and that can trigger earthquakes — seismic activity is already increasing in Greenland and Alaska. Meanwhile, the added weight of the new seawater starts to bend the Earth’s crust. “That will give you a massive increase in volcanic activity. It’ll activate faults to create earthquakes, submarine landslides, tsunamis, the whole lot,” explained the director of University College London’s Hazard Centre. Such a landslide happened in Scandinavia about eight thousand years ago, as the last Ice Age retreated and a Kentucky-size section of Norway’s continental shelf gave way, “plummeting down to the abyssal plain and creating a series of titanic waves that roared forth with a vengeance,” wiping all signs of life from coastal Norway to Greenland and “drowning the Wales-sized landmass that once connected Britain to the Netherlands, Denmark, and Germany.” When the waves hit the Shetlands, they were sixty-five feet high.

There’s even this: if we keep raising carbon dioxide levels, we may not be able to think straight anymore. At a thousand parts per million (which is within the realm of possibility for 2100), human cognitive ability falls 21 percent. “The largest effects were seen for Crisis Response, Information Usage, and Strategy,” a Harvard study reported, which is too bad, as those skills are what we seem to need most.

I could, in other words, do my best to scare you silly. I’m not opposed on principle — changing something as fundamental as the composition of the atmosphere, and hence the heat balance of the planet, is certain to trigger all manner of horror, and we shouldn’t shy away from it. The dramatic uncertainty that lies ahead may be the most frightening development of all; the physical world is going from backdrop to foreground. (It’s like the contrast between politics in the old days, when you could forget about Washington for weeks at a time, and politics in the Trump era, when the president is always jumping out from behind a tree to yell at you.)

But let’s try to occupy ourselves with the most likely scenarios, because they are more than disturbing enough. Long before we get to tidal waves or smallpox, long before we choke to death or stop thinking clearly, we will need to concentrate on the most mundane and basic facts: everyone needs to eat every day, and an awful lot of us live near the ocean.

FOOD SUPPLY first. We’ve had an amazing run since the end of World War II, with crop yields growing fast enough to keep ahead of a fast-rising population. It’s come at great human cost — displaced peasant farmers fill many of the planet’s vast slums — but in terms of sheer volume, the Green Revolution’s fertilizers, pesticides, and machinery managed to push output sharply upward. That climb, however, now seems to be running into the brute facts of heat and drought. There are studies to demonstrate the dire effects of warming on coffee, cacao, chickpeas, and champagne, but it is cereals that we really need to worry about, given that they supply most of the planet’s calories: corn, wheat, and rice all evolved as crops in the climate of the last ten thousand years, and though plant breeders can change them, there are limits to those changes. You can move a person from Hanoi to Edmonton, and she might decide to open a Vietnamese restaurant. But if you move a rice plant, it will die.

A 2017 study in Australia, home to some of the world’s highest-tech farming, found that “wheat productivity has flatlined as a direct result of climate change.” After tripling between 1900 and 1990, wheat yields had stagnated since, as temperatures increased a degree and rainfall declined by nearly a third. “The chance of that just being variable climate without the underlying factor [of climate change] is less than one in a hundred billion,” the researchers said, and it meant that despite all the expensive new technology farmers kept introducing, “they have succeeded only in standing still, not in moving forward.” Assuming the same trends continued, yields would actually start to decline inside of two decades, they reported. In June 2018, researchers found that a two-degree Celsius rise in temperature — which, recall, is what the Paris accords are now aiming for — could cut U.S. corn yields by 18 percent. A four-degree increase — which is where our current trajectory will take us — would cut the crop almost in half. The United States is the world’s largest producer of corn, which in turn is the planet’s most widely grown crop.

Corn is vulnerable because even a week of high temperatures at the key moment can keep it from fertilizing. (“You only get one chance to pollinate a quadrillion kernels of corn,” the head of a commodity consulting firm explained.) But even the hardiest crops are susceptible. Sorghum, for instance, which is a staple for half a billion humans, is particularly hardy in dry conditions because it has big, fibrous roots that reach far down into the earth. Even it has limits, though, and they are being reached. Thirty years of data from the American Midwest show that heat waves affect the “vapor pressure deficit,” the difference between the water vapor in the sorghum leaf’s interior and that in the surrounding air. Hotter weather means the sorghum releases more moisture into the atmosphere. Warm the planet’s temperature by two degrees Celsius — which is, again, now the world’s goal — and sorghum yields drop 17 percent. Warm it five degrees Celsius (nine degrees Fahrenheit), and yields drop almost 60 percent.

It’s hard to imagine a topic duller than sorghum yields. It’s the precise opposite of clickbait. But people have to eat; in the human game, the single most important question is probably “What’s for dinner?” And when the answer is “Not much,” things deteriorate fast. In 2010 a severe heat wave hit Russia, and it wrecked the grain harvest, which led the Kremlin to ban exports. The global price of wheat spiked, and that helped trigger the Arab Spring — Egypt at the time was the largest wheat importer on the planet. That experience set academics and insurers to work gaming out what the next food shock might look like. In 2017 one team imagined a vigorous El Niño, with the attendant floods and droughts — for a season, in their scenario, corn and soy yields declined by 10 percent, and wheat and rice by 7 percent. The result was chaos: “quadrupled commodity prices, civil unrest, significant negative humanitarian consequences . . . Food riots break out in urban areas across the Middle East, North Africa, and Latin America. The euro weakens and the main European stock markets lose ten percent.”

At about the same time, a team of British researchers released a study demonstrating that even if you can grow plenty of food, the transportation system that distributes it runs through just fourteen major choke-points, and those are vulnerable to — you guessed it — massive disruption from climate change. For instance, U.S. rivers and canals carry a third of the world’s corn and soy, and they’ve been frequently shut down or crimped by flooding and drought in recent years. Brazil accounts for 17 percent of the world’s grain exports, but heavy rainfall in 2017 stranded three thousand trucks. “It’s the glide path to a perfect storm,” said one of the report’s authors.

Five weeks after that, another report raised an even deeper question. What if you can figure out how to grow plenty of food, and you can figure out how to guarantee its distribution, but the food itself has lost much of its value? The paper, in the journal Environmental Research, said that rising carbon dioxide levels, by speeding plant growth, seem to have reduced the amount of protein in basic staple crops, a finding so startling that, for many years, agronomists had overlooked hints that it was happening. But it seems to be true: when researchers grow grain at the carbon dioxide levels we expect for later this century, they find that minerals such as calcium and iron drop by 8 percent, and protein by about the same amount. In the developing world, where people rely on plants for their protein, that means huge reductions in nutrition: India alone could lose 5 percent of the protein in its total diet, putting 53 million people at new risk for protein deficiency. The loss of zinc, essential for maternal and infant health, could endanger 138 million people around the world. In 2018, rice researchers found “significantly less protein” when they grew eighteen varieties of rice in high–carbon dioxide test plots. “The idea that food became less nutritious was a surprise,” said one researcher. “It’s not intuitive. But I think we should continue to expect surprises. We are completely altering the biophysical conditions that underpin our food system.” And not just ours. People don’t depend on goldenrod, for instance, but bees do. When scientists looked at samples of goldenrod in the Smithsonian that dated back to 1842, they found that the protein content of its pollen had “declined by a third since the industrial revolution — and the change closely tracks with the rise in carbon dioxide.”

Bees help crops, obviously, so that’s scary news. But in August 2018, a massive new study found something just as frightening: crop pests were thriving in the new heat. “It gets better and better for them,” said one University of Colorado researcher. Even if we hit the UN target of limiting temperature rise to two degrees Celsius, pests should cut wheat yields by 46 percent, corn by 31 percent, and rice by 19 percent. “Warmer temperatures accelerate the metabolism of insect pests like aphids and corn borers at a predictable rate,” the researchers found. “That makes them hungrier[,] and warmer temperatures also speed up their reproduction.” Even fossilized plants from fifty million years ago make the point: “Plant damage from insects correlated with rising and falling temperatures, reaching a maximum during the warmest periods.”

#### AND---effective Mexican methane regs are key to its energy independence and economy.

Drew Nelson 18. Director International Affairs, Environmental Defense Fund. “Mexico Unveils Practical Oil and Gas Regs to Cut Climate-Damaging Methane.” Environmental Defense Fund. 6-30-2018. https://www.edf.org/media/mexico-unveils-practical-oil-and-gas-regs-cut-climate-damaging-methane

The Mexican Government proposed new regulations today to cut harmful oil and gas methane emissions, helping Mexico advance its international climate commitments. The rules, once finalized, will place Mexico among the leading governments controlling methane emissions as a way to meet their climate goals and avoid energy waste.

Methane is a powerful pollutant and the primary ingredient in natural gas. Large quantities of methane can escape through leaks and venting across the oil and gas supply chain.

“Getting strong methane rules in place quickly can help secure Mexico’s energy independence and ensure that its growing oil and gas industry operates as efficiently as possible. Reducing methane gas leaks benefits the environment, economy and Mexico’s communities.

“Mexico has shown real leadership in developing sound regulations to address methane pollution. The draft rules draw on learnings from other oil and gas jurisdictions already successfully controlling methane emissions across North America.

“Mexico is the latest example of growing international action to tackle a critical, yet solvable climate problem. The next administration can build on this leadership by swiftly implementing the methane regulations and continuing to position Mexico at the forefront of climate issues.”

The oil and gas industry is recognizing the importance of reducing methane. Recently, Pemex agreed to a near-zero methane emissions future with nine other major producers. Big investors in Mexico’s revitalized energy sector, ExxonMobil and Equinor, are also working to advance the technologies to control methane. Concerted industry and policy actions to reduce methane, a greenhouse gas that drives 25 percent of warming, could be a climate game-changer.

EDF shared international regulatory best practices for reducing oil and gas methane emissions with the Mexican government during the development of the draft regulations. Mexico’s proposed methane regulations are in line with those international best practices.

#### Mexican growth is key to combat cartels.

Kimberly Breir 17. Director, US-Mexico Futures Initiatives, Center for Strategic and International Studies; MA, Latin American Studies, Georgetown. “What Could a U.S.-Mexico Partnership Look Like? New Approaches Could Advance Cooperation with Mexico.” Global Trade. 1-3-2017. <http://www.globaltrademag.com/global-trade-daily/u-s-mexico-partnership-look-like>

As one of only two land neighbors, Mexico is a critical partner of the United States on both national security and economic security. Despite this fact, U.S. policy toward Mexico often lacks a big-think vision that recognizes both the breadth and depth of issues that matter greatly to the American people. The relationship often gets out of balance and ends up in a reactive, tit-for-tat cycle. This is deeply counterproductive and must be avoided if for no other reason than to ensure that the two governments deliver results.

The priorities outlined by President-elect Trump during the campaign, including immigration reform and border security improvements, suggest a quick focus on Mexico. Done carefully, an immigration reform can be a win-win, and border security upgrades would include not only more physical barriers, but stepped-up cooperation and a focus on border infrastructure. Any border security measures must take into account that $2.4 billion worth of goods cross the United States’ northern and southern borders every day. The goal should be to balance security challenges with the needs of cross-border commerce that are fundamental to the U.S. economy.

In fact, the Trump administration has a great opportunity to put serious attention on border infrastructure, which is a long-neglected issue and a drag on U.S. competitiveness. Mexican and Canadian leaders have also made infrastructure a priority and cooperation in this area could present an early win all around. The three countries need to work together to prioritize what new points of entry are needed and also on how to fund new projects. Recent estimates suggest that border infrastructure improvements in North America could increase U.S. GDP by one percentage point, or about $220 billion a year, creating new jobs along with it.

The Trump campaign emphasized the need for the United States to get better deals on trade. If it pursues trade discussions, they must be framed by the reality that the U.S. economic relationship with Mexico is not a zero-sum game. U.S. companies and the products they produce are competitive in the global economy in part thanks to imported components from Mexico and Canada. In fact, the private sectors in the United States and Mexico and Canada not only trade with each other, but make products together with supply chains that are deeply integrated. Those ties have made the United States more competitive in the global marketplace, and far from being a net liability, are an asset.

The starting point of any discussions should also recognize that NAFTA dramatically increased U.S. exports to Mexico. In 1992, prior to NAFTA, U.S. exports to Mexico totaled about $42 billion. In 2015, the United States exported goods and services valued at $267 billion, making it the United States’ second-largest export market and the source of millions of U.S. jobs. The total two-way trade in goods and services in 2015 was over $580 billion.

While it is not clear what the priorities the administration would have in a NAFTA discussion (Mexico gave up more on tariffs than did the United States in 1993), it is important to recognize that all parties agree that NAFTA could be looked at with modern eyes and that there is an opportunity to do this in a win-win-win fashion. In fact, the three countries already began to modernize the deal, under the talks for the now-stalled Trans Pacific Partnership (TPP). TPP talks included Canada and Mexico and all sides agreed to add new labor and environment provisions, as well as subjecting them to dispute settlement mechanisms. Additional low-hanging fruit of a NAFTA discussion could include issues as mundane as visa categories—occupations that exist now in the technology sector, for example, did not exist 22 years ago.

When NAFTA was conceived, the internet did not exist. New rules are needed for sectors like e-commerce. Mexico’s energy sector was not open to private investment when NAFTA was negotiated. The three countries now have the opportunity to work together toward North American energy independence with all of the positive geostrategic implications that could have.

Done properly, both the United States and Mexico (and Canada) could find benefits from the process of updating the trade relationship and addressing issues including the skills gap across the continent, particularly in manufacturing. For those that have lost jobs due to globalization, the three countries could revisit adjustment assistance and job-training programs to help our three societies better adapt and ensure that skills match jobs already available. According to recent estimates, the number of manufacturing jobs unfilled in the United States because of a skills gap numbers in the millions. North America has the opportunity to tackle these issues as allies, not competitors.

Further, Mexico’s prosperity is in the interest of the United States. A stronger Mexican economy means fewer Mexicans will leave their homes seeking opportunity in the United States. (Net immigration flows from Mexico are already less than zero, according to a 2015 Pew study.) Strong growth and job creation in Mexico also spur the expansion of Mexico’s middle class and make Mexico a better partner as citizens’ demands, for improved security and rule of law for example, dovetail with U.S. security interests.

Outside of the economic relationship, the United States has a direct stake in Mexico’s success in strengthening its security and rule of law. The U.S. Mérida Initiative was conceived to support implementation of Mexico´s rule-of-law reforms, recognizing the fundamental importance of working with Mexico to address organized crime, violence, and impunity and its effects in both countries. There is much more that could be done to weaken the influence of the cartels responsible for exporting drugs into the United States, but success will depend primarily on U.S.-Mexican intelligence and law enforcement partnerships and the mutual sharing of information. That is, success in this area will center around trust and would be at risk in a climate of confrontation.

#### Cartels will partner with terrorists to use narco-subs to launch a WMD attack.

Byron Ramirez 16. Adjunct Professor of Strategic Management, University of La Verne; PhD, Economics and Political Science, Claremont Graduate School. “The Criminal and Terrorist Threat of Narco Submarine Technology.” *Geopolitical Monitor*. 6-7-2016. <https://www.geopoliticalmonitor.com/the-criminal-and-terrorist-threat-of-narco-submarine-technology/>

The conceivable threats to international security become increasingly complex and acute when we recognize that some drug trafficking organizations have been linked with terrorism. For over 50 years, FARC has carried out bombings, extortions, assassinations, and kidnappings throughout Colombia. In an effort to finance its agenda, FARC has engaged in drug trafficking operations that include the use of narco submarines. There are also the cases of individuals with suspected ties to Al-Qaida, the Taliban, and Hezbollah who have been involved in drug related activities. Some of these funds from drug trafficking activities have been used to finance terrorist activities.

It is not clear to what extent criminal organizations are involved in financially, logistically, and operationally supporting the efforts of terrorist groups. Yet, there are indications that these networks could facilitate the movement of terrorist operatives or weapons of mass destruction toward U.S. borders as well as high-value targets in the Western Hemisphere. Despite the fact that law enforcement has seized several vessels, many other narco submarines have traveled undetected and almost completely unrestricted. This makes them increasingly perilous to international security.

It is feasible that criminal-terrorist cooperation could deliver great damage via the use of narco submarines that could carry weapons or parts of weapons of mass destruction, biological warfare agents, and chemical weapons. Terrorist organizations have in the past used the international illicit marketplace to finance their activities, purchase equipment, and potentially could deploy narco submarines as vessels of mass destruction.

Hezbollah has supporters in Lebanese diaspora communities in Latin America. There have been illicit activities such as money laundering and drug trafficking in the Tri-Border Area of Argentina, Brazil, and Paraguay, which generated revenue that was later transferred to Hezbollah. For decades, Iran has funded, provided weapons, and trained terrorists. During the past several years there has been increased cooperation between Iran and Ecuador, Nicaragua, Venezuela, and Cuba. Although the nature of the cooper ation appears to be related to economic exchange, it is important to realize that other types of cooperation could potentially exist between individuals from these countries which could in turn pose threats to U.S. national security and the security of other countries in the region. Furthermore, there are some recent cases of terrorists who have traveled to Latin America and have been arrested near the U.S. border.

Narco submarines constitute an eminent threat when we consider that their design and technology have evolved, and thus they are proficient in avoiding detection and capture. These vessels are equipped with advanced navigation systems, satellite communication, and radars. They can travel long distances undetected evidenced by the copious narco submarines that have been detected throughout the Pacific Ocean and Caribbean Sea.

A terrorist group such as FARC could feasibly collaborate with Al Qaeda or Hezbollah and equip narco submarines with added technical features that would enable terrorist organizations to launch destructive attacks on U.S. targets throughout the Americas. Given their capacity to travel long distances, narco submarines could also be deployed to European coasts and coastal cities. In addition to carrying biological and chemical weapons, narco submarines could also transport terrorist operatives to target locations.

#### Causes nuke retal and war.

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The escalating threats between North Korea and the United States make it easy to forget the “nuclear nightmare,” as former US Secretary of Defense William J. Perry put it, that could result even from the use of just a single terrorist nuclear bomb in the heart of a major city. At the risk of repeating the vast literature on the tragedies of Hiroshima and Nagasaki—and the substantial literature surrounding nuclear tests and simulations since then—we attempt to spell out here the likely consequences of the explosion of a **single terrorist nuclear bomb** on a major city, and its **subsequent ripple effects** on the rest of the planet. Depending on where and when it was detonated, the blast, fire, initial radiation, and long-term radioactive fallout from such a bomb could leave the heart of a major city a smoldering radioactive ruin, killing tens or **hundreds of thousands of people** and wounding hundreds of thousands more. Vast areas would have to be evacuated and might be uninhabitable for years. Economic, political, and social **aftershocks** would **ripple throughout the world**. A single terrorist nuclear bomb would change history. The country attacked—and the world—would never be the same. The idea of terrorists accomplishing such a thing is, unfortunately, not out of the question; it is far easier to make a crude, unsafe, unreliable nuclear explosive that might fit in the back of a truck than it is to make a safe, reliable weapon of known yield that can be delivered by missile or combat aircraft. **Numerous government studies** have concluded that **it is plausible** that a sophisticated terrorist group could make a crude bomb if they got the needed nuclear material. And in the last quarter century, there have been some 20 seizures of stolen, weapons-usable nuclear material, and at least two terrorist groups have made significant efforts to acquire nuclear bombs. Terrorist use of an actual nuclear bomb is a low-probability event—but the **immensity** of the consequences means that even a small chance is enough to justify an intensive effort to reduce the risk. Fortunately, since the early 1990s, countries around the world have significantly reduced the danger—but **it remains very real**, and there is more to do to ensure this nightmare never becomes reality. Brighter than a thousand suns. Imagine a crude terrorist nuclear bomb—containing a chunk of **highly enriched uranium** just under the size of a regulation bowling ball, or a much smaller chunk of plutonium—suddenly detonating inside a delivery van parked in the heart of a major city. Such a terrorist bomb would release as much as 10 kilotons of explosive energy, or the equivalent of 10,000 tons of conventional explosives, a volume of explosives large enough to fill all the cars of a mile-long train. In a millionth of a second, all of that energy would be released inside that small ball of nuclear material, creating temperatures and pressures as high as those at the center of the sun. That furious energy would **explode outward**, releasing its energy in three main ways: **a powerful blast wave**; **intense heat**; **and deadly radiation**. The ball would expand almost **instantly** into a fireball the width of four football fields, **incinerating** essentially everything and **everyone** within. The heated fireball would rise, sucking in air from below and expanding above, creating the **mushroom cloud** that has become the symbol of the terror of the nuclear age. The ionized plasma in the fireball would create a localized **electromagnetic pulse** more powerful than lightning, **shorting out communications and electronics nearby**—though most would be destroyed by the bomb’s other effects in any case. (Estimates of heat, blast, and radiation effects in this article are drawn primarily from Alex Wellerstein’s “Nukemap,” which itself comes from declassified US government data, such as the 660-page government textbook The Effects of Nuclear Weapons.) At the instant of its detonation, the bomb would also release an **intense** burst of gamma and neutron radiation which would be lethal for nearly everyone directly exposed within about two-thirds of a mile from the center of the blast. (Those who happened to be shielded by being inside, or having buildings between them and the bomb, would be partly protected—in some cases, reducing their doses by ten times or more.) The nuclear flash from the heat of the fireball would radiate in both visible light and the infrared; it would be “brighter than a thousand suns,” in the words of the title of a book describing the development of nuclear weapons—adapting a phrase from the Hindu epic the Bhagavad-Gita. Anyone who looked directly at the blast would be blinded. The heat from the fireball would ignite fires and horribly burn everyone exposed outside at distances of nearly a mile away. (In the Nagasaki Atomic Bomb Museum, visitors gaze in horror at the bones of a human hand embedded in glass melted by the bomb.) No one has burned a city on that scale in the decades since World War II, so it is difficult to predict the full extent of the fire damage that would occur from the explosion of a nuclear bomb in one of today’s cities. Modern glass, steel, and concrete buildings would presumably be less flammable than the wood-and-rice-paper housing of Hiroshima or Nagasaki in the 1940s—but many questions remain, including exactly how thousands of broken gas lines might contribute to fire damage (as they did in Dresden during World War II). On 9/11, the buildings of the World Trade Center proved to be much more vulnerable to fire damage than had been expected. Ultimately, even a crude terrorist nuclear bomb would carry the possibility that the countless fires touched off by the explosion would **coalesce** into a **devastating firestorm**, as occurred at Hiroshima. In a firestorm, the rising column of hot air from the massive fire sucks in the air from all around, creating **hurricane-force winds**; everything flammable and everything alive within the firestorm would be consumed. The fires and the dust from the blast would make it extremely difficult for either rescuers or survivors to see. The explosion would create a **powerful blast** wave rushing out in every direction. For more than a quarter-mile all around the blast, the pulse of pressure would be over 20 pounds per square inch above atmospheric pressure (known as “overpressure”), destroying or severely damaging even sturdy buildings. The combination of blast, heat, and radiation would kill virtually everyone in this zone. The blast would be accompanied by winds of many hundreds of miles per hour. The damage from the explosion would extend far beyond this inner zone of almost total death. Out to more than half a mile, the blast would be strong enough to collapse most residential buildings and create a serious danger that office buildings would topple over, killing those inside and those in the path of the rubble. (On the other hand, the office towers of a modern city would tend to block the blast wave in some areas, providing partial protection from the blast, as well as from the heat and radiation.) In that zone, almost anything made of wood would be destroyed: Roofs would cave in, windows would shatter, gas lines would **rupture**. Telephone poles, street lamps, and utility lines would be severely damaged. Many roads would be blocked by mountains of wreckage. In this zone, many people would be killed or injured in building collapses, or trapped under the rubble; many more would be burned, blinded, or injured by flying debris. In many cases, their charred skin would become ragged and fall off in sheets. The effects of the detonation would act in deadly synergy. The smashed materials of buildings broken by the blast would be far easier for the fires to ignite than intact structures. The effects of radiation would make it far more difficult for burned and injured people to recover. The combination of burns, radiation, and physical injuries would cause **far more death** and **suffering** than any one of them would alone. The silent killer. The bomb’s immediate effects would be followed by a slow, lingering killer: **radioactive fallout**. A bomb detonated at ground level would dig a huge crater, hurling tons of earth and debris thousands of feet into the sky. Sucked into the rising fireball, these particles would mix with the radioactive remainders of the bomb, and over the next few hours or days, the debris would rain down for miles downwind. Depending on weather and wind patterns, the fallout could actually be deadlier and make a far larger area unusable than the blast itself. Acute radiation sickness from the initial radiation pulse and the fallout would likely affect tens of thousands of people. Depending on the dose, they might suffer from vomiting, watery diarrhea, fever, sores, loss of hair, and bone marrow depletion. Some would survive; some would die within days; some would take months to die. Cancer rates among the survivors would rise. Women would be more vulnerable than men—children and infants especially so. Much of the radiation from a nuclear blast is short-lived; radiation levels even a few days after the blast would be far below those in the first hours. For those not killed or terribly wounded by the initial explosion, the best advice would be to take shelter in a basement for at least several days. But many would be too terrified to stay. Thousands of panic-stricken people might receive deadly doses of radiation as they fled from their homes. Some of the radiation will be longer-lived; areas most severely affected would have to be abandoned for many years after the attack. The combination of radioactive fallout and the devastation of nearly all life-sustaining infrastructure over a vast area would mean that hundreds of thousands of people would have to evacuate. **Ambulances to nowhere**. The explosion would also destroy much of the city’s ability to respond. Hospitals would be leveled, doctors and nurses killed and wounded, ambulances destroyed. (In Hiroshima, 42 of 45 hospitals were destroyed or severely damaged, and 270 of 300 doctors were killed.) Resources that survived outside the zone of destruction would be utterly overwhelmed. Hospitals have no ability to cope with tens or hundreds of thousands of terribly burned and injured people all at once; the United States, for example, has 1,760 burn beds in hospitals nationwide, of which a third are available on any given day. And the problem would not be limited to hospitals; firefighters, for example, would have little ability to cope with thousands of fires raging out of control at once. Fire stations and equipment would be destroyed in the affected area, and firemen killed, along with police and other emergency responders. Some of the first responders may become casualties themselves, from radioactive fallout, fire, and collapsing buildings. Over much of the affected area, **communications would be destroyed**, by both the physical effects and the electromagnetic pulse from the explosion. Better preparation for such a disaster could save thousands of lives—but ultimately, there is no way any city can genuinely be prepared for a catastrophe on such a historic scale, occurring in a flash, with zero warning. Rescue and recovery attempts would be impeded by the destruction of most of the needed personnel and equipment, and by fire, debris, radiation, fear, lack of communications, and the immense scale of the disaster. The US military and the national guard could provide critically important capabilities—but federal plans assume that “no significant federal response” would be available for 24-to-72 hours. Many of those burned and injured would wait in vain for help, food, or water, perhaps for days. The scale of death and suffering. How many would die in such an event, and how many would be terribly wounded, would depend on where and when the bomb was detonated, what the weather conditions were at the time, how successful the response was in helping the wounded survivors, and more. Many estimates of casualties are based on census data, which reflect where people sleep at night; if the attack occurred in the middle of a workday, the numbers of people crowded into the office towers at the heart of many modern cities would be far higher. The daytime population of Manhattan, for example, is roughly twice its nighttime population; in Midtown on a typical workday, there are an estimated 980,000 people per square mile. A 10-kiloton weapon detonated there might well kill half a million people—not counting those who might die of radiation sickness from the fallout. (These effects were analyzed in great detail in the Rand Corporation’s Considering the Effects of a Catastrophic Terrorist Attack and the British Medical Journal’s “Nuclear terrorism.”) On a typical day, the wind would blow the fallout north, seriously contaminating virtually all of Manhattan above Gramercy Park; people living as far away as Stamford, Connecticut would likely have to evacuate. Seriously injured survivors would greatly outnumber the dead, their suffering magnified by the complete inadequacy of available help. The psychological and social effects—overwhelming sadness, depression, post-traumatic stress disorder, myriad forms of anxiety—would be profound and long-lasting. The scenario we have been describing is a groundburst. An **airburst**—such as might occur, for example, if terrorists put their bomb in a small aircraft they had purchased or rented—would extend the blast and fire effects over a wider area, killing and injuring even larger numbers of people **immediately**. But an airburst would not have the same lingering effects from fallout as a groundburst, because the rock and dirt would not be sucked up into the fireball and contaminated. The 10-kiloton blast we have been discussing is likely toward the high end of what terrorists could plausibly achieve with a crude, improvised bomb, but even a 1-kiloton blast would be a catastrophic event, having a deadly radius between one-third and one-half that of a 10-kiloton blast. These hundreds of thousands of people would not be mere statistics, but countless individual stories of loss—parents, children, entire families; all religions; rich and poor alike—killed or horribly mutilated. Human suffering and tragedy on this scale does not have to be imagined; it can be remembered through the stories of the survivors of the US atomic bombings of Hiroshima and Nagasaki, the only times in history when nuclear weapons have been used intentionally against human beings. The pain and suffering caused by those bombings are almost beyond human comprehension; the eloquent testimony of the Hibakusha—the survivors who passed through the atomic fire—should stand as an eternal reminder of the need to prevent nuclear weapons from ever being used in anger again. **Global economic disaster**. The economic impact of such an attack would be **enormous**. The effects would **reverberate** for so far and so long that they are difficult to estimate in all their complexity. Hundreds of thousands of people would be too injured or sick to work for weeks or months. Hundreds of thousands more would evacuate to locations far from their jobs. Many places of employment would have to be abandoned because of the radioactive fallout. Insurance companies would reel under the losses; but at the same time, many insurance policies exclude the effects of nuclear attacks—an item insurers considered beyond their ability to cover—so the owners of thousands of buildings would not have the insurance payments needed to cover the cost of fixing them, thousands of companies would go bankrupt, and banks would be left holding an immense number of mortgages that would never be repaid. Consumer and investor confidence would likely be **dramatically affected**, as worried people slowed their spending. Enormous new homeland security and military investments would be very likely. If the bomb had come in a shipping container, the targeted country—and possibly others—might stop all containers from entering until it could devise a system for ensuring they could never again be used for such a purpose, throwing a **wrench into the gears of global trade** for an extended period. (And this might well occur even if a shipping container had not been the means of delivery.) Even the far smaller 9/11 attacks are estimated to have caused economic aftershocks costing almost $1 trillion even excluding the multi-trillion-dollar costs of the wars that ensued. The cost of a terrorist nuclear attack in a major city would likely be **many times higher**. The most severe effects would be local, but the effects of **trade disruptions**, **reduced economic activity**, and more would **reverberate** around the world. Consequently, while some countries may feel that nuclear terrorism is only a concern for the countries most likely to be targeted—such as the United States—in reality it is a threat to everyone, everywhere. In 2005, then-UN Secretary-General Kofi Annan warned that these global effects would push “tens of millions of people into dire poverty,” creating “a second death toll throughout the developing world.” One recent estimate suggested that a nuclear attack in an urban area would cause a **global recession**, cutting global Gross Domestic Product by some two percent, and pushing an additional 30 million people in the developing world into **extreme poverty**. Desperate dilemmas. In short, an act of nuclear terrorism could rip the heart out of a major city, and cause ripple effects throughout the world. The government of the country attacked would face desperate decisions: How to help the city attacked? How to prevent further attacks? How to respond or retaliate? Terrorists—either those who committed the attack or others—would probably claim they had more bombs already hidden in other cities (whether they did or not), and threaten to detonate them unless their demands were met. The fear that this might be true could lead people to flee major cities in a large-scale, uncontrolled evacuation. There is very little ability to support the population of major cities in the surrounding countryside. The potential for widespread havoc and economic chaos is very real. If the detonation took place in the capital of the nation attacked, much of the government might be destroyed. A bomb in Washington, D.C., for example, might kill the President, the Vice President, and many of the members of Congress and the Supreme Court. (Having some plausible national leader survive is a key reason why one cabinet member is always elsewhere on the night of the State of the Union address.) Elaborate, classified plans for “continuity of government” have already been drawn up in a number of countries, but the potential for chaos and confusion—if almost all of a country’s top leaders were killed—would still be enormous. Who, for example, could address the public on what the government would do, and what the public should do, to respond? Could anyone honestly assure the public there would be no further attacks? If they did, who would believe them? In the United States, given the practical impossibility of passing major legislation with Congress in ruins and most of its members dead or seriously injured, some have argued for passing legislation in advance giving the government emergency powers to act—and creating procedures, for example, for legitimately replacing most of the House of Representatives. But to date, no such legislative preparations have been made. In what would inevitably be a desperate effort to prevent further attacks, traditional standards of civil liberties might be **jettisoned**, at least for a time—particularly when people realized that the fuel for the bomb that had done such damage would easily have fit in a suitcase. Old rules limiting search and surveillance could be among the first to go. The government might well impose martial law as it sought to control the situation, hunt for the perpetrators, and find any additional weapons or nuclear materials they might have. Even the far smaller attacks of 9/11 saw the US government authorizing torture of prisoners and mass electronic surveillance. And what standards of international order and law would still hold sway? The country attacked might well **lash out militarily** at whatever countries it thought might bear a portion of responsibility. (A terrifying description of the kinds of discussions that might occur appeared in Brian Jenkins’ book, Will Terrorists Go Nuclear?) With the nuclear threshold already crossed in this scenario—at least by terrorists—it is **conceivable** that some of the **resulting conflicts might escalate to nuclear use**. International politics could become more brutish and violent, with powerful states taking unilateral action, by force if necessary, in an effort to ensure their security. After 9/11, the United States led the invasions of two sovereign nations, in wars that have since cost hundreds of thousands of lives and trillions of dollars, while plunging a region into chaos. Would the reaction after a far more devastating nuclear attack be any less?

#### Bioterror causes extinction---tech advances overwhelm defense.

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How worthwhile is it spending resources to study and mitigate the chance of human extinction from biological risks? The risks of such a catastrophe are presumably low, so a skeptic might argue that addressing such risks would be a waste of scarce resources. In this article, we investigate this position using a cost-effectiveness approach and ultimately conclude that the expected value of reducing these risks is large, especially since such risks jeopardize the existence of all future human lives.

Historically, disease events have been responsible for the greatest death tolls on humanity. The 1918 flu was responsible for more than 50 million deaths,1 while smallpox killed perhaps 10 times that many in the 20th century alone.2 The Black Death was responsible for killing over 25 [percent] % of the European population,3 while other pandemics, such as the plague of Justinian, are thought to have killed 25 million in the 6th century—constituting over 10% of the world's population at the time.4 It is an open question whether a future pandemic could result in outright human extinction or the irreversible collapse of civilization.

A skeptic would have many good reasons to think that existential risk from disease is unlikely. Such a disease would need to spread worldwide to remote populations, overcome rare genetic resistances, and evade detection, cures, and countermeasures. Even evolution itself may work in humanity's favor: Virulence and transmission is often a trade-off, and so evolutionary pressures could push against maximally lethal wild-type pathogens.5,6

While these arguments point to a very small risk of human extinction, they do not rule the possibility out entirely. Although rare, there are recorded instances of species going extinct due to disease—primarily in amphibians, but also in 1 mammalian species of rat on Christmas Island.7,8 There are also historical examples of large human populations being almost entirely wiped out by disease, especially when multiple diseases were simultaneously introduced into a population without immunity. The most striking examples of total population collapse include native American tribes exposed to European diseases, such as the Massachusett (86% loss of population), Quiripi-Unquachog (95% loss of population), and the Western Abenaki (which suffered a staggering 98% loss of population).9

In the modern context, no single disease currently exists that combines the worst-case levels of transmissibility, lethality, resistance to countermeasures, and global reach. But many diseases are proof of principle that each worst-case attribute can be realized independently. For example, some diseases exhibit nearly a 100 [percent] % case fatality ratio in the absence of treatment, such as rabies or septicemic plague. Other diseases have a track record of spreading to virtually every human community worldwide, such as the 1918 flu,10 and seroprevalence studies indicate that other pathogens, such as chickenpox and HSV-1, can successfully reach over 95 [percent] % of a population.11,12 Under optimal virulence theory, natural evolution would be an unlikely source for pathogens with the highest possible levels of transmissibility, virulence, and global reach. But advances in biotechnology might allow the creation of diseases that combine such traits. Recent controversy has already emerged over a number of scientific experiments that resulted in viruses with enhanced transmissibility, lethality, and/or the ability to overcome therapeutics.13-17 Other experiments demonstrated that mousepox could be modified to have a 100% case fatality rate and render a vaccine ineffective.18 In addition to transmissibility and lethality, studies have shown that other disease traits, such as incubation time, environmental survival, and available vectors, could be modified as well.19-21

Although these experiments had scientific merit and were not conducted with malicious intent, their implications are still worrying. This is especially true given that there is also a long historical track record of state-run bioweapon research applying cutting-edge science and technology to design agents not previously seen in nature. The Soviet bioweapons program developed agents with traits such as enhanced virulence, resistance to therapies, greater environmental resilience, increased difficulty to diagnose or treat, and which caused unexpected disease presentations and outcomes.22 Delivery capabilities have also been subject to the cutting edge of technical development, with Canadian, US, and UK bioweapon efforts playing a critical role in developing the discipline of aerobiology.23,24 While there is no evidence of state-run bioweapons programs directly attempting to develop or deploy bioweapons that would pose an existential risk, the logic of deterrence and mutually assured destruction could create such incentives in more unstable political environments or following a breakdown of the Biological Weapons Convention.25 The possibility of a war between great powers could also increase the pressure to use such weapons—during the World Wars, bioweapons were used across multiple continents, with Germany targeting animals in WWI,26 and Japan using plague to cause an epidemic in China during WWII.27

Non-state actors may also pose a risk, especially those with explicitly omnicidal aims. While rare, there are examples. The Aum Shinrikyo cult in Japan sought biological weapons for the express purpose of causing extinction.28 Environmental groups, such as the Gaia Liberation Front, have argued that “we can ensure Gaia's survival only through the extinction of the Humans as a species … we now have the specific technology for doing the job … several different [genetically engineered] viruses could be released”(quoted in ref. 29). Groups such as R.I.S.E. also sought to protect nature by destroying most of humanity with bioweapons.30 Fortunately, to date, non-state actors have lacked the capabilities needed to pose a catastrophic bioweapons threat, but this could change in future decades as biotechnology becomes more accessible and the pool of experienced users grows.31,32

#### AND---methane leakage control is key to prevent pipeline explosions and environmental degradation.

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Looking Beyond Global Impacts

Reducing methane leakage will not only significantly slow global warming, it will also benefit the local environment. Natural gas comprises a hazardous brew of benzene, hexane and other alkanes, hydrogen sulfide, oil residues, and more, which pollutes the air and water and threatens public health. A recent Colorado School of Public Health study found that people who live within 500 feet of a natural gas well in the state are eight times more likely to develop cancer.

On top of pressing climate change concerns and local health impacts, methane leakage raises public safety considerations. Methane is flammable and thus poses a hazard as experienced in the 2010 Deepwater Horizon spill from the blow out of BP’s Macondo platform offshore in the Gulf of Mexico, an event that killed 11 workers and severely damaged the region’s ecosystem and economy. More recently, explosions of pipelines and well pads in Ohio caused fires and forced evacuations of residents. In 2019, leaking gas killed 64 and seriously injured nearly 100 people in a Chinese petrochemical facility in Jiangsu Province. And evidence is mounting that oil and gas drilling and extraction can cause earthquakes that damages buildings, stresses residents, and devastates communities. The list of methane’s hazards goes on.

Clearly, both global and local welfare call for more effective methane management. This simplest of organic compounds that is classified technically as non-toxic and is not considered a criteria or hazardous air pollutant has been historically overlooked and under-controlled by industry, environmentalists, and policymakers. Methane is a pressing concern in need of heightened attention. Its fast and powerful climate forcing abilities, along with the potential to create dangerous warming feedback loops, underscore the importance of effective methane mitigation.

#### Pipeline explosions crush utility reliability---gas is key.

Samuel Lederer 14. MBA student at Duke. “Increases in natural gas-fired generation bring new risks for utilities.” 10-10-2014. https://centers.fuqua.duke.edu/edge/2014/10/10/increases-in-natural-gas-fired-generation-bring-new-risks-for-utilities/

As utilities like Duke Energy become increasingly reliant on natural gas in their generation portfolios, they increase the risk of fuel supply disruptions due to infrastructure limitations.

According to the U.S. Energy Information Administration, natural gas-fired plants are projected to make up 73% of generation capacity additions until 2040, at which point such assets will produce 43% of U.S. electricity. Such natural-gas fired plants typically do not store fuel onsite, relying on “just in time” delivery contracts. This contrasts with coal-fired plants and nuclear plants which typically store enough fuel onsite for two months and two years of operations, respectively. Due to persistent strains on pipeline infrastructure, particularly in the Northeast, and the growing demand from the power sector, it is possible that utilities will face challenges in meeting reliability requirements in the summer and winter months. With more natural gas plants being shifted from peaking to base load operations, moreover, electric power companies like Duke Energy must assess the fuel supply risks inherent in the shift toward natural gas.

Natural gas price volatility presents risks

In addition to these supply constraints associated with power plant design and infrastructure, price volatility for natural gas could emerge as a significant risk for power generators. Many analysts predict Henry Hub prices for natural gas to remain around $4.00/MMBtu for the next decade. While it is difficult to reject such assertions, one must not lose sight of the emerging levers for volatility that could affect natural gas prices quickly and dramatically. Increased demand from U.S. chemical companies and liquid natural gas (LNG) exporters should gradually increase prices in the near-term. The lag in pipeline capacity expansion could exacerbate this trend, particularly in the Northeast. At the same time, the U.S. Department of Transportation has recorded an increase in both the frequency and property damage impact of natural gas transmission incidents over the past five years. As natural gas markets become more globalized due to the rise of U.S. LNG exports and the phasing out of oil-linked pricing contracts, Henry Hub prices will become more susceptible to shocks from abroad. All of these risk drivers might interact with each other in complex ways; for example, a pipeline explosion in the Northeast occurs just as new LNG export facilities come online, pushing up prices for natural gas in the Southeast. Such complexity necessitates sophisticated models to properly hedge against future risks at a time when volatility appears to have disappeared from the market.

#### Reliability loss causes blackouts.

Scott Segal 12. Electricity Reliability Coordinating Council Director; JD, Baylor. “ERCC Comments Submitted to EPA on the New Source Performance Standards for Power Plant Carbon Emissions.” 6-25-2012. www.electricreliability.org/ercc-comments-submitted-epa-new-source-performance-standards-power-plant-carbon-emissions

EPA needs to carefully consider the consequences of polices that may not allow for a flexible and reliable supply of electricity, because the impacts of reliability problems can be devastating. The downside impacts of reduced electric reliability are substantial and must be taken into account in any responsible analysis of the proposed rule. As ISO New England has stated:

A reliable supply of electricity is a foundation of our prosperity and quality of life. Without it, our world literally grinds to a halt—businesses cannot plan and operate productively, hospitals and schools cannot provide their essential services, and residents cannot depend on the electricity they need simply to live their daily lives. Without reliable electricity, the financial and societal costs would be enormous.[15]

The Institute of Electrical and Electronics Engineers of the U.S. (IEE-USA) has further observed that even minor occurrences in the electric power grid can sometimes lead to catastrophic ‘cascading’ blackouts, and that the loss of a single generator can result in an imbalance between load and generation. The resulting blackouts cause incalculable economic damage. For example, the direct costs to high-technology manufacturing in the San Francisco Bay Area alone during the California blackouts alone ran as high as one million dollars a minute due to lost production, and the relatively brief Northeast blackout of 2003 cost business about $13 billion in lost productivity.[16] These are costs that the our economy and communities cannot afford to bear, and EPA needs to carefully consider reliability concerns before moving forward with the proposed rule.

#### Blackouts cause nuke war.

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Grid Vulnerability. DOD is unable to provide its bases with electricity when the civilian electrical grid is offline for an extended period of time. Currently, domestic military installations receive 99 percent of their electricity from the civilian power grid. As explained in a recent study from the Defense Science Board: DOD’s key problem with electricity is that critical missions, such as national strategic awareness and national command authorities, are almost entirely dependent on the national transmission grid . . . [which] is fragile, vulnerable, near its capacity limit, and outside of DOD control. In most cases, neither the grid nor on-base backup power provides sufficient reliability to ensure continuity of critical national priority functions and oversight of strategic missions in the face of a long term (several months) outage.7 The grid’s fragility was demonstrated during the 2003 Northeast blackout in which 50 million people in the United States and Canada lost power, some for up to a week, when one Ohio utility failed to properly trim trees. The blackout created cascading disruptions in sewage systems, gas station pumping, cellular communications, border check systems, and so forth, and demonstrated the interdependence of modern infrastructural systems.8 More recently, awareness has been growing that the grid is also vulnerable to purposive attacks. A report sponsored by the Department of Homeland Security suggests that a coordinated cyberattack on the grid could result in a third of the country losing power for a period of weeks or months.9 Cyberattacks on critical infrastructure are not well understood. It is not clear, for instance, whether existing terrorist groups might be able to develop the capability to conduct this type of attack. It is likely, however, that some nation-states either have or are working on developing the ability to take down the U.S. grid. In the event of a war with one of these states, it is possible, if not likely, that parts of the civilian grid would cease to function, taking with them military bases located in affected regions. Government and private organizations are currently working to secure the grid against attacks; however, it is not clear that they will be successful. Most military bases currently have backup power that allows them to function for a period of hours or, at most, a few days on their own. If power were not restored after this amount of time, the results could be disastrous. First, military assets taken offline by the crisis would not be available to help with disaster relief. Second, during an extended blackout, global military operations could be seriously compromised; this disruption would be particularly serious if the blackout was induced during major combat operations. During the Cold War, this type of event was far less likely because the United States and Soviet Union shared the common understanding that blinding an opponent with a grid blackout could escalate to nuclear war. America’s current opponents, however, may not share this fear or be deterred by this possibility. In 2008, the Defense Science Board stressed that DOD should mitigate the electrical grid’s vulnerabilities by turning military installations into “islands” of energy self-sufficiency.10 The department has made efforts to do so by promoting efficiency programs that lower power consumption on bases and by constructing renewable power generation facilities on selected bases. Unfortunately, these programs will not come close to reaching the goal of islanding the vast majority of bases. Even with massive investment in efficiency and renewables, most bases would not be able to function for more than a few days after the civilian grid went offline.