# 1NC

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## 1

#### Interp - If the Affirmative specifies “Appropriation that produces Debris” – they must clearly de-lineate a clear parameter and definition for what “produces Debris” constitutes.

#### Violation – they don’t. They will outline particular examples BUT that doesn’t meet since they haven’t produced a metric or brightline for determining what type of appropriation is banned by the Plan.

#### Three Implications:

#### 1] The term “debris” itself is meaningless in international agreements – impossible to come to consensus – independently means you Vote Negative on Presumption since the Plan does nothing since everyone will deny they produce “Debris”.

Munters 16 Ward Munters 2016 "Space debris conundrum for international law makers" <https://room.eu.com/article/space-debris-conundrum-for-international-law-makers> (Leuven Centre for Global Governance Studies, Belgium)//Elmer

A fundamental and abstract legal matter in this regard, that appears almost too simple and too basic to present an obstacle, is the question: what is space debris? Technical definitions used by scientists and engineers, as well as in the technical and non-binding Space Debris Mitigation Guidelines [3] of the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) focus unvaryingly on the non-functional nature of debris: space debris are all man-made objects, including fragments or elements thereof, in Earth orbit or re-entering into Earth’s atmosphere that are non-functional. However, this definition, intuitive as it may be, cannot easily be construed into an international legal definition. The existing space law treaties simply do not mention ‘space debris’ anywhere. The closest related, applicable and rather vague term in the treaties is that of ‘space object’. The treaties apply this term to any object launched into space to determine important legal consequences such as which State has sole jurisdiction and control over the object, which State can register the object or which States are liable for damage caused by the object in space or on Earth. Nevertheless, the treaties do not define what exactly is a ‘space object’ and, more importantly, they do not consider the functional or non-functional nature of the space object in applying these important legal consequences to it. Therefore, international space law does not contain any provisions that could form the basis for a legal distinction between valuable spacecraft and supposedly worthless space debris. Faced with this legal uncertainty, the majority of legal experts appear to agree that even if a satellite were to become non-functional or to catastrophically break up into separate fragments, these will still constitute a ‘space object’ for the purposes of the treaties and carry with them all legal ramifications thereof. The Outer Space Treaty declares that any State that has registered a space object shall retain legal and de facto jurisdiction and control over that object. As a piece of space debris is considered a ‘space object’ for legal purposes, even if the State were to lose de facto control over the space object when it becomes non-functional or uncontrollable, it retains sole legal jurisdiction and control as per the treaty. Therefore, it is uncertain whether space objects, their component parts or fragments thereof can legally be abandoned or considered abandoned, irrespective of their non-functional status. This notion is reinforced by the fact that space faring States have hitherto not expressed a right to abandon their non-functional satellites in space. This sheds severe doubt on the possibility of introducing a legal regime of ‘salvage’, similar to maritime law, whereby actors other than the State of registry could freely remove pieces of debris that pose a threat in Earth orbit.

#### 2] Neg Ground – without anything de-lineated in the 1AC – it can become as limiting or under-limiting as they deem strategic given the 1NC which makes Negative prep impossible since they will always shift the ground of “what produces debris”. Fairness is a voter since its necessary for Debate to continue to occur.

#### 3] At worst – auto-grant us competition for Links since they haven’t grounded a definition of the Plan which means any No Link is arbitrary – best remedy for vague and un-predictable Plan Texts.

#### CX checks is arbitrary and unlimiting – allows them to change from round-to-round which ruins pre-round prep since we can’t predict it.

#### [Competing Interps] – Reasonability is arbitrary and causes a race to the bottom of questionable argumentation.

#### [No RVI’s] – 1] Forces the 1NC to go all-in on Theory which kills substance education, 2] Encourages Baiting since the 1AC will purposely be abusive, and 3] Illogical – you shouldn’t win for not being abusive. And dtd to deter future abuse

## 2

#### CP: Space-faring nations should

#### Establish a unified system of space traffic management modeled after the International Telecommunication Union

#### Collaborate on techniques to track and display the location of objects in real time and AI to automate debris-avoidance maneuvers

#### The United States Federal Government should:

#### Shift responsibility for the Space-Track catalogue to the civilian Department of Commerce, allocating necessary funds

Nature 8/11 [(Nature Editorial Board, peer-reviewed, comprises experimental scientists and data-standards experts from across different fields of science) “The world must cooperate to avoid a catastrophic space collision,” Nature, 8/11/2021] JL

But there are no traffic cops in space, nor international borders with clearly delineated areas of responsibility. To avoid further damage, it’s crucial that satellite operators have an accurate and up-to-date list of where objects are in space. At present, the main global catalogue of space objects is published at Space-Track.org by the US Space Command, a branch of the military. The catalogue is the most widely used public listing available, but it lacks some satellites that countries — including the United States, China and Russia — have not acknowledged publicly. In part because of this lack of transparency, other nations also track space objects, and some private companies maintain commercially available catalogues.

Rather than this patchwork of incomplete sources, what the world needs is a unified system of space traffic management. Through this, spacefaring nations and companies could agree to share more of their tracking data and cooperate to make space safer. This might require the creation of a new global regime, such as an international convention, through which rules and technical standards could be organized. One analogy is the International Telecommunication Union, the United Nations agency that coordinates global telecommunications issues such as who can transmit in which parts of the radio spectrum.

It won’t be easy to create such a system for space traffic. For it to succeed, questions of safety (such as avoiding smashing up a satellite) will need to be disentangled from questions of security (such as whether that satellite is spying on another nation) so that countries can be assured that participating in such an effort would not compromise national security. Countries could, for instance, share information about the location of a satellite without sharing details of its capabilities or purpose for being in space.

One near-term move that would help would be for the United States to complete a planned shift of responsibility for the Space-Track.org catalogue from the military to the civilian Department of Commerce. Because this catalogue has historically been the most widely used around the world, shifting it to a civilian agency could start to defuse geopolitical tensions and so improve global efforts to manage space debris. It might one day feed into a global space-traffic agreement between nations; even the nascent space superpower China would have a big incentive to participate, despite rivalries with the United States. The transition was called for in a 2018 US presidential directive that recognizes that companies are taking over from national governments as the dominant players in space, but it has yet to occur, in part because Congress has not allocated the necessary funds.

On 25 August, the UN Committee on the Peaceful Uses of Outer Space will meet to discuss a range of topics related to international cooperation in space. The UN is the right forum through which spacefaring nations can work together to establish norms for responsible space behaviour, and that should include how the world can track objects to make space safer. It should continue recent work it has been doing emphasizing space as a secure and sustainable environment, which at least brings countries such as the United States and China into the same conversation.

Basic research has a role, too: innovations such as techniques to track and display the locations of orbiting objects in real time, and artificial intelligence to help automate debris-avoidance manoeuvres, could bolster any global effort to monitor and regulate space.

If governments and companies around the world do not take urgent action to work together to make space safer, they will one day face a catastrophic collision that knocks out one or more satellites key to their safety, economic well-being or both. Space is a global commons and a global resource. A global organization responsible for — and capable of — managing the flow of space traffic is long overdue.

## 3

#### Climate change makes water shortages inevitable – that causes hydro-political conflict escalation which goes nuclear

Harvey 8/17 [(Fiona, the Guardian's environment correspondent, won the Foreign Press Association award for Environment Story of the Year and the British Environment and Media Awards journalist of the year) “Global water crisis will intensify with climate breakdown, says report,” The Guardian, 8/17/2021] JL

Mark’s words should be a call to attention, and a call to action. The plight of farmers in Australia illustrates a larger reality: As planetary temperatures continue to increase and rainfall patterns shift due to human-caused climate disruption, our ability to grow crops and have enough drinking water will become increasingly challenged, and the outlook is only going to worsen.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

#### Asteroid mining solves water access – only NEOs are sufficiently proximate and hydrated – independently, storing launch fuel on asteroids reduces space debris – turns case

Tillman 19 [(Nola Taylor, has been published in Astronomy, Sky & Telescope, Scientific American, New Scientist, Science News (AAS), Space.com, and Astrobiology magazine, BA in Astrophysics) “Tons of Water in Asteroids Could Fuel Satellites, Space Exploration,” Space, 9/29/2019] JL

When it comes to mining space for water, the best target may not be the moon: Entrepreneurs' richest options are likely to be asteroids that are larger and closer to Earth.

A recent study suggested that roughly 1,000 water-rich, or hydrated, asteroids near our planet are easier to reach than the lunar surface is. While most of these space rocks are only a few feet in size, more than 25 of them should be large enough to each provide significant water. Altogether, the water locked in these asteroids should be enough to fill somewhere around 320,000 Olympics-size swimming pools — significantly more than the amount of water locked up at the lunar poles, the new research suggested.

Because asteroids are small, they have less gravity than Earth or the moon do, which makes them easier destinations to land on and lift off from. If engineers can figure out how to mine water from these space rocks, they could produce a source of ready fuel in space that would allow spacecraft designers to build refuelable models for the next generation of satellites. Asteroid mining could also fuel human exploration, saving the expense of launching fuel from Earth. In both cases, would-be space-rock miners will need to figure out how to free the water trapped in hydrated minerals on these asteroids.

"Most of the hydrated material in the near-Earth population is contained in the largest few hydrated objects," Andrew Rivkin, an asteroid researcher at Johns Hopkins University Applied Physics Research Laboratory in Maryland, told Space.com. Rivkin is the lead author on the paper, which estimated that near Earth asteroids could contain more easily accessible water than the lunar poles.

According to the United Nations Office for Outer Space Affairs, more than 5,200 of the objects launched into space are still in orbit today. While some continue to function, the bulk of them buzz uselessly over our heads every day. They carry fuel on board, and when they run out, they are either lowered into destructive orbits or left to become space junk, useless debris with the potential to cause enormous problems for working satellites. Refueling satellites in space could change that model, replacing it with long-lived, productive orbiters.

"It's easier to bring fuel from asteroids to geosynchronous orbit than from the surface of the Earth," Rivkin said. "If such a supply line could be established, it could make asteroid mining very profitable."

Hunting for space water from the surface of the Earth is challenging because the planet's atmosphere blocks the wavelength of light where water can be observed. The asteroid warming as it draws closer to the sun can also complicate measurements.

Instead, Rivkin and his colleagues turned to a class of space rocks called Ch asteroids. Although these asteroids don't directly exhibit a watery fingerprint, they carry the telltale signal of oxidized iron seen only on asteroids with signatures of water-rich minerals, which means the authors felt confident assuming that all Ch asteroids carry this rocky water.

Based on meteorite falls, a previous study estimated that Ch asteroids could make up nearly 10% of the near-Earth objects (NEOs). With this information, the researchers determined that there are between 26 and 80 such objects that are hydrated and larger than 0.62 miles (1 km) across.

Right now, only three NEOs have been classified as Ch asteroids, although others have been spotted in the asteroid belt. Most NEOs are discovered and observed at wavelengths too short to reveal the iron band that marks the class. Carbon-rich asteroids, which include Ch asteroids and other flavors, are also darker than the more common stony asteroids, making them more challenging to observe.

Although Ch asteroids definitely contain water-rich minerals, that doesn’t necessarily mean that they will always be the best bet for space mining. It comes down to risk. Would an asteroid-mining company rather visit a smaller asteroid that definitely has a moderate amount of water, or a larger one that could yield a larger payday but could also come up dry?

"Whether getting sure things with no false positives, like the Ch asteroids, is more important or if a greater range of possibilities is acceptable with the understanding that some asteroids will be duds is something the miners will have to decide," Rivkin said.

In addition to estimating the number of large, water-rich asteroids might be available, the study also found that as many as 1,050 smaller objects, roughly 300 feet (100 meters) across, may also linger near Earth. Their small bulk will make them easier to mine because their low gravity will require less fuel to escape from, but they will produce less water overall, and Rivkin expects that the handful of larger space rocks will be the first targets.

"It seems likely that the plan for these companies will be to find the largest accessible asteroid with mineable material with the expectation that it will be more cost-effective than chasing down a large number of smaller objects," Rivkin said. "How 'accessible' and 'mineable material' and 'cost-effective' are defined by each company is to be seen."

## 4

#### Manchin’s back in negotiations. New deal will include climate and natural gas support. Biden’s key.

Nilsen 3/25 [Ella Nilsen and Lauren Fox, CNN, "Manchin engaging with Biden administration on new climate and economic bill but timeline unclear", 3/25/22, https://www.cnn.com/2022/03/25/politics/manchin-climate-economic-package-negotiations/index.html]

Sen. Joe Manchin, the moderate Democrat from West Virginia who torpedoed President Joe Biden's climate and economic bill in December, is having informal discussions with White House officials about measures involving energy, prescription drug costs, tax changes and deficit reduction that he could potentially support in a new version of that package.

Democrats and climate advocates have stressed the importance of passing clean energy measures while Democrats have a majority in the Senate -- albeit slim -- as the climate crisis takes an increasing toll on Americans and US infrastructure.

After informal conversations over the weekend, the White House engaged with Manchin on several items that could be included in a plan. A source familiar with the talks told CNN these conversations are still in their infancy and the ideas aren't close to being finalized.

Still, the new talks come amid a flurry of meetings Manchin has had with high-ranking economic and climate officials in the Biden administration.

Last week, Manchin hosted Biden's top economic adviser Brian Deese in West Virginia, along with US Energy Secretary Jennifer Granholm and US Interior Secretary Deb Haaland at a series of events last Friday focused on coal communities and the energy transition in Manchin's home state. A tweet from Manchin on Friday evening showed Deese went zip-lining with the senator near the New River Gorge.

After the visit, Granholm told CNN she thinks Manchin understands the need to act on clean energy in Congress.

"I think he's very receptive to it," Granholm said. "He understands as he continues to say we're in a transition.

Manchin also had dinner Wednesday with Biden's top international climate official -- US Climate Envoy John Kerry -- during his trip to Paris for the International Energy Agency's annual meeting.

"We talked and shared a table last night at dinner and we had a nice conversation about it all," Kerry told CNN Thursday, not going into details about what was discussed.

Manchin's spokesperson Sam Runyon told CNN that Manchin "remains seriously concerned" about inflation, and believes paying down the national debt and raising taxes on high earners and corporations "must be our first priority."

Runyon also said Manchin wants to prioritize measures to lower the cost of prescription drugs and promote US energy independence and combat climate change.

"He has made clear that we can protect energy independence and respond to climate change at the same time," Runyon said. "We must maintain energy independence by advancing an all-of-the-above energy policy to continue producing energy cleaner than anywhere else in the world."

More fossil fuel, in addition to clean energy

An economic package and the fate of Biden's climate agenda are riding mostly on Manchin's shoulders. Build Back Better -- the original version of this bill that was scrapped in December -- included more than $500 billion in clean energy measures, without which analysts say the US will be unable to meet its climate targets.

Two sources familiar with the discussions said even as a line of communication between the White House and Manchin are open again, White House officials are proceeding with caution in their talks with Manchin. The sources requested anonymity due to the sensitivity with of the discussions.

"I think they're cautious because they've been burned a couple times and they don't want to be burned again," a source close to the White House told CNN.

Manchin had signaled he would support Build Back Better for months last year before publicly coming out in opposition of the bill in December.

Manchin has previously said he's supportive of clean energy tax credits. But amid Russia's invasion of Ukraine, the chair of the Senate Energy Committee has also called for more fossil fuel production and infrastructure to be built in the US to help Europe move away from Russia's natural gas.

"We went from basically six weeks ago having no clear idea what the impetus would be for Chairman Manchin to want to get anything done, and now there is at least a clear reason for him and for all of the Senate to act on energy policy," Christy Goldfuss, senior vice president for energy and environment policy at the Center for American Progress told CNN.

Goldfuss said that while the current global energy crunch opened the door to new conversations on energy and clean energy, it's still a "big question mark" as to whether those result in a new bill.

Kerry told CNN he is optimistic a climate action bill will pass through Congress, calling it "absolutely imperative."

"I don't want to speculate what happens if we don't," Kerry told CNN. "I'm going to count on doing it, because we've got to do it."

#### Restrictions on space appropriatioin upset Republicans

Foust 15 [(Jeff Foust - writes about space policy, commercial space, and related topics for SpaceNews, Ph.D. in planetary sciences from the Massachusetts Institute of Technology, bachelor’s degree with honors in geophysics and planetary science from the California Institute of Technology) “Senators, Bolden Clash over the “Core Mission” of NASA” Space News, March 12, 2015] TDI

WASHINGTON — Members of the Senate Commerce space subcommittee used a March 12 hearing on the NASA budget to debate with each other, and the head of the agency, about what the agency’s priorities should be.

Sen. Ted Cruz (R-Texas), chairman of the subcommittee, expressed concern that NASA was spending too much money on Earth science and not enough on exploration programs.

“Since the end of the last administration, we have seen a disproportionate increase in the amount of federal funds that have been allocated to the Earth science program, at the expense of, and in comparison to, exploration and space operations, planetary science, heliophysics, and astrophysics,” he said in his opening remarks.

To illustrate his point, Cruz displayed a chart showing that NASA’s request for Earth science funding had increased 41 percent between the 2009 and the 2016 budget proposals, while other NASA programs saw either decreases or far smaller increases. “In my judgment, this does not represent a fair or appropriate allocation of resources,” he said. “It is shifting resources away from the core functions of NASA.”

NASA Administrator Charles Bolden

“Essentially, our core mission from the very beginning has been to investigate and explore space and the Earth environment, and to help us make this place a better place,” NASA Administrator Charles Bolden said responding to a question from Sen. Ted Cruz. Credit: NASA/Joel Kowsky

Bolden, asked by Cruz to define the “core mission” of NASA, defended the agency’s work by citing language in the National Aeronautics and Space Act that created the space agency. “Essentially, our core mission from the very beginning has been to investigate and explore space and the Earth environment, and to help us make this place a better place,” he said.

Cruz disagreed. “I would suggest that almost any American would agree that the core function of NASA is to explore space,” he said. “It’s what sets NASA apart from any other agency.”

Another Republican on the subcommittee, Sen. Cory Gardner (R-Colo.), also said NASA was investing too much in Earth science over exploration. “It seems to me that NASA has perhaps drifted away from its core mission, and I’m concerned about that,” he said.

Democratic members, however, defended the agency’s work in Earth science as part of its overall scope of missions. Gary Peters (D-Mich.), who was named the ranking member of the space subcommittee March 3, argued that an increase in Earth science funding was a recovery from past cuts.

“We must avoid false choices between robotic exploration, human exploration, the study of the universe, or the study of our own planet,” he said in his opening statement. “We must avoid the temptation to view NASA’s mission as a set of competing priorities.”

“In some quarters, it seems to be fashionable to say that Earth science is not part of the exploration program,” said Sen. Bill Nelson (D-Fla.), ranking member of the full committee. Work on Earth science, he said, was linked to all of the agency’s initiatives.

Bolden made a similar argument, arguing that NASA’s exploration program was dependent on a variety of other NASA programs, including Earth science. “We can’t go anywhere if the Kennedy Space Center goes underwater and we don’t know it,” he said.

Cruz indicated at the end of the hearing that he planned to revisit the issue in a future authorization bill. “It is my hope that this committee will work in a bipartisan manner to help refocus those priorities where they should be: to get back to the hard sciences, to get back to space, to focus on what makes NASA special,” he said.

#### Space policy causes immense partisan backlash that wrecks the delicate balance

Dreier 16 [Casey Dreier, Chief Advocate & Senior Space Policy Adviser for The Planetary Society, April 13, 2016. “Does Presidential Intervention Undermine Consensus for NASA?” https://www.planetary.org/blogs/casey-dreier/2016/0413-does-a-strong-president-help-or-hurt-consensus-on-NASA.html]

To see how this happens, I recommend reading the book “[Beyond Ideology](http://smile.amazon.com/Beyond-Ideology-Politics-Principles-Partisanship/dp/0226470768/ref=smi_www_rco2_go_smi_g2243582042?_encoding=UTF8&*Version*=1&*entries*=0&ie=UTF8)” by Frances Lee. The author’s larger premise is that issues having no intrinsic relation to stated party ideology have become increasingly polarized in recent years. This is a function of the two party nature of our political system. If your party coalition wins, the other one loses. It’s [It is] zero-sum. Your party can win in one of two ways: you can make a better pitch to voters by demonstrating the superiority of your agenda; or you can undermine and stymie the agenda of the opposition party, making them unpopular with voters, and pick up the seats that they lose. Since you’re the only other political party, you gain in either scenario. I’m not sure if you’ve noticed, but the “undermine and stymie” approach has been popular for quite some time now in the U.S. Congress. Given this situation, the President and their policies naturally become the symbolic target of the opposition party. Anything promoted by the President effectively induces opposition by association. Lee demonstrates the magnitude of this induced polarization on various types of issues. For highly polarized issues like the role of government in the economy, or social issues, the impact is minimal—the opposition has already been clearly defined and generally falls into clearly defined ideologies of the Republican and Democratic parties. But for issues that do not fit readily into a predefined political ideology—like space—the induced polarization by the President can be significant. In fact, Lee showed that space, science, and technology issues incur the greatest increase in partisanship based on their inclusion in the Presidential agenda. One need only look to at the responses by political operatives of the opposing party to the strong human spaceflight proposals by [Barack Obama in 2010](http://www.shelby.senate.gov/public/index.cfm/mobile/newsreleases?ID=25F3AD2E-802A-23AD-4960-F512B9E205D2), [George W. Bush in 2004](http://www.nbcnews.com/id/3950099/ns/technology_and_science-space/t/bush-sets-new-course-moon-beyond/#.Vw3UMRMrKHo), and [George H.W. Bush in 1989](http://www.nytimes.com/1989/07/21/us/president-calls-for-mars-mission-and-a-moon-base.html) to see this reflected in recent history. This isn’t to say that Presidents can’t have a significant impact on the space program. Clearly they can. But the broad consensus needed for stability after their departure from office may be undermined by the very priority they gave it during their tenure. It what amounts to a mixed blessing for NASA, the U.S. space program does have an unusually strong bipartisan group of politicians who support the program due to NASA centers in a variety of states throughout the union. Berger notes this throughout his article, and it does, in a way, act as force that is resistant to change for good and bad. This mitigates somewhat the pure polarization seen on other science and technology issues. But for a Journey to Mars—a major effort that would, at best, require stability and significant funding over many Presidential administrations—that may not be enough. Perhaps the solution is for the next President to maintain a light touch on space. Maybe they should speak softly through the budget process, and avoid the Kennedyesque speeches and declarations to Congress that induce the types of partisanship we so dearly need to avoid.

#### Warming causes extinction—US action is key.

Fuchs 18—(Senior Fellow @ The Center For American Progress, A Former Deputy Assistant Secretary Of State For East Asian and Pacific Affairs And A Guardian Us Contributing Opinion Writer). Michael H Fuchs. 11/29/2018. The Guardian. "The ticking bomb of climate change is America's biggest threat". https://www.theguardian.com/commentisfree/2018/nov/29/ticking-bomb-climate-change-america-threat.

Imagine that US leaders were told that hundreds of nuclear weapons were set on a timer to detonate across the planet, progressively and in increasing numbers, over the coming years and decades. The lives of millions would be upended, if not made nearly impossible to survive, by transformed weather patterns and resource scarcity. Tens of millions would become migrants as regions became uninhabitable. Millions would die, more and more as time went on. If this science fiction were reality, US leaders would lead an international effort to immediately disarm and dismantle the weapons.

But this isn’t science fiction. Climate change is a ticking time bomb, literally threatening to end human life on earth over the coming centuries. As climate journalist Peter Brannen describes it, Earth faced a similar crisis hundreds of millions of years ago during the “Great Dying” when volcanoes spewed so much carbon dioxide into the air – including magma that blanketed an area as large as the lower 48 US states, 1km deep – that it almost killed all life. Today, Brannen says, “we’re shooting carbon dioxide up into the atmosphere 10 times faster than the ancient volcanoes”.

Even in the shorter term, climate change will make the world far more dangerous. A World Bank Group report estimates that climate change could drive 140 million people to move within their countries’ borders by 2050. A report by the Trump administration finds climate change could reduce the size of the US economy by 10% – more than twice as bad as the worst part of the Great Recession – by 2100. Growing resource scarcity could cause more wars. Deadly and destructive extreme weather events such as Hurricanes Harvey and Maria and California’s Camp fire are mild symptoms of the plague to come.

There is no greater national security threat than climate change. Even the specter of nuclear war between great powers – the only thing that could remotely mimic the effects of climate change over time – is a much lower risk than climate change, which is already happening.

Every year we fail to act the problem grows, and the solution becomes more difficult. As America dithers, climate change is sparking a slow-motion nuclear-scale holocaust. If the world fails to urgently mitigate climate change, no other challenge – not the rise of China, Russian aggression, terrorism, nor some other future geopolitical peril – will matter because humans won’t survive to be the cause of these threats or suffer from them.

America’s failure is not for lack of capacity to safeguard against future threats – the US invests hundreds of billions of dollars every year in defense to deter adversaries such as Russia and China, and tens of billions more in intelligence capabilities to monitor threats. Instead, America is paralyzed by a lack of political will. Donald Trump and his allies in Congress – many of whom deny the existence of climate change – are making the problem worse. The president announced his intent to withdraw the US from the Paris climate agreement and is rolling back regulations that would have cut emissions.

Despite this dark reality, there is reason for hope. In 2015, the world came together to negotiate the Paris agreement, which set the goal of limiting global temperature increases to well below 2C. Despite a hostile Trump administration, many US governors, mayors, businesses and private citizens are already leading the way. So are other countries as they seize the economic and public health opportunity that comes with a clean energy future.

The path ahead, to say the least, is daunting. Even if the US were not to leave the Paris climate agreement, the action required to realize its potential is enormous. US policymakers will need to use every policy tool in their toolbox to drive unprecedented deployment of clean energy and build out zero-carbon transportation infrastructure. When the US leads by example, domestic emissions will fall, and new diplomatic doors to more ambitious climate action will open.

## Case

#### Private entities are crucial to innovation in space technology and reducing debris – empirics prove.

**INN '20,** Innovation News Network, "Innovation in space: the private sector’s role in the 2020 space race", 6-11-2020, accessed 7-11-2021, <https://www.innovationnewsnetwork.com/innovation-in->space-the-private-sectors-role-in-the-2020-space-race/5490/ DHS//JL

SpaceX has paved the way for a new wave of commercial space technologies. However, **private actors have been influencing the space industry for many years.** In May 2003, Scaled Composites first launched SpaceShipOne, an experimental and reusable space plane that uses a hybrid rocket to achieve speeds of up to speeds of up to 900 m/s. SpaceShipOne completed the first crewed private spaceflight in 2004, which was then retired that year. In 2013, The Spaceship Company announced the first powered flight of SpaceShipTwo, another suborbital spaceplane designed for space tourism. Unfortunately, in October 2014, the first SpaceShipTwo VSS Enterprise crashed in the Mojave Desert. Further investigation suggested that the craft’s descent device deployed too early, killing the pilot, Michael Alsbury. Virgin Galactic plans to operate a fleet of five improved SpaceShipTwo spaceplanes in a private passenger-carrying service and has been taking bookings for some time, with a suborbital flight carrying an updated ticket price of $250,000. **SpaceX is responsible for some of the most innovative space technologies** produced in the last decade.SpaceX has created the most powerful rocket ever developed, Falcon Heavy, which can lift more than twice the payload of the next closest operational vehicle, the Delta IV Heavy. Although the nature is of the commercial space sector is competitive, many private companies share common goals.How can commercialisation reduce overcrowding in space? Almost 60 years of space activities and more than 5,450 launches have resulted in approximately 23,000 objects remaining in orbit. Around 24% of the catalogued objects are satellites. This catastrophic waste of technology can have a negative effect of future launches and it has been theorised that sending objects into Earth’s orbit could become impossible due the risk of collision. This debris must be removed from orbit if the space industry is to continue to grow. Many **private companies have taken on the burden of removing debris from Earth’s orbit.** Aviosonic Space Tech has pioneered the first Debris Collision Alert System (DeCAS) for the monitoring of space vehicles and satellites as they re-enter Earth’s atmosphere. Avisonic’s patented space debris management system, DeCAS, addresses the vital issue of protecting people and institutions across the globe through a precise, efficient, and cost-effective system which will make the world a safer place. Although the removal of space debris is an important step in sustainable space travel, many businesses are developing nanosatellites to reduce the volume of technology in orbit. Another benefit of developing nanosatellites is that they can do almost everything a conventional satellite does at a fraction of the cost, making this technology more popular in the commercial sector.

#### No debris cascades, but even a worst case is confined to low LEO with no impact

Fange 17 [Daniel Von Fange, Web Application Engineer, Founder and Owner of LeanCoder, Full Stack, Polyglot Web Developer, “Kessler Syndrome is Over Hyped”, 05/21/17, *Braino*, http://braino.org/essays/kessler\_syndrome\_is\_over\_hyped/]

Kessler Syndrome is overhyped. A chorus of online commenters great any news of upcoming low earth orbit satellites with worry that humanity will to lose access to space. I now think they are wrong. What is Kessler Syndrome? Here’s the popular view on Kessler Syndrome. Every once in a while, a piece of junk in space hits a satellite. This single impact destroys the satellite, and breaks off several thousand additional pieces. These new pieces now fly around space looking for other satellites to hit, and so exponentially multiply themselves over time, like a nuclear reaction, until a sphere of man-made debris surrounds the earth, and humanity no longer has access to space nor the benefits of satellites. It is a dark picture. Is Kessler Syndrome likely to happen? I had to stop everything and spend an afternoon doing back-of-the-napkin math to know how big the threat is. To estimate, we need to know where the stuff in space is, how much mass is there, and how long it would take to deorbit. The orbital area around earth can be broken down into four regions. Low LEO - Up to about 400km. Things that orbit here burn up in the earth’s atmosphere quickly - between a few months to two years. The space station operates at the high end of this range. It loses about a kilometer of altitude a month and if not pushed higher every few months, would soon burn up. For all practical purposes, Low LEO doesn’t matter for Kessler Syndrome. If Low LEO was ever full of space junk, we’d just wait a year and a half, and the problem would be over. High LEO - 400km to 2000km. This where most heavy satellites and most space junk orbits. The air is thin enough here that satellites only go down slowly, and they have a much farther distance to fall. It can take 50 years for stuff here to get down. This is where Kessler Syndrome could be an issue. Mid Orbit - GPS satellites and other navigation satellites travel here in lonely, long lives. The volume of space is so huge, and the number of satellites so few, that we don’t need to worry about Kessler here. GEO - If you put a satellite far enough out from earth, the speed that the satellite travels around the earth will match the speed of the surface of the earth rotating under it. From the ground, the satellite will appear to hang motionless. Usually the geostationary orbit is used by big weather satellites and big TV broadcasting satellites. (This apparent motionlessness is why satellite TV dishes can be mounted pointing in a fixed direction. You can find approximate south just by looking around at the dishes in your northern hemisphere neighborhood.) For Kessler purposes, GEO orbit is roughly a ring 384,400 km around. However, all the satellites here are moving the same direction at the same speed - debris doesn’t get free velocity from the speed of the satellites. Also, it’s quite expensive to get a satellite here, and so there aren’t many, only about one satellite per 1000km of the ring. Kessler is not a problem here. How bad could Kessler Syndrome in High LEO be? Let’s imagine a worst case scenario. An evil alien intelligence chops up everything in High LEO, turning it into 1cm cubes of death orbiting at 1000km, spread as evenly across the surface of this sphere as orbital mechanics would allow. Is humanity cut off from space? I’m guessing the world has launched about 10,000 tons of satellites total. For guessing purposes, I’ll assume 2,500 tons of satellites and junk currently in High LEO. If satellites are made of aluminum, with a density of 2.70 g/cm3, then that’s 839,985,870 1cm cubes. A sphere for an orbit of 1,000km has a surface area of 682,752,000 square KM. So there would be one cube of junk per .81 square KM. If a rocket traveled through that, its odds of hitting that cube are tiny - less than 1 in 10,000. So even in the worst case, we don’t lose access to space. Now though you can travel through the debris, you couldn’t keep a satellite alive for long in this orbit of death. Kessler Syndrome at its worst just prevents us from putting satellites in certain orbits. In real life, there’s a lot of factors that make Kessler syndrome even less of a problem than our worst case though experiment. Debris would be spread over a volume of space, not a single orbital surface, making collisions orders of magnitudes less likely. Most impact debris will have a slower orbital velocity than either of its original pieces - this makes it deorbit much sooner. Any collision will create large and small objects. Small objects are much more affected by atmospheric drag and deorbit faster, even in a few months from high LEO. Larger objects can be tracked by earth based radar and avoided. The planned big new constellations are not in High LEO, but in Low LEO for faster communications with the earth. They aren’t an issue for Kessler. Most importantly, all new satellite launches since the 1990’s are required to include a plan to get rid of the satellite at the end of its useful life (usually by deorbiting) So the realistic worst case is that insurance premiums on satellites go up a bit. Given the current trend toward much smaller, cheaper micro satellites, this wouldn’t even have a huge effect. I’m removing Kessler Syndrome from my list of things to worry about.

#### Low altitude orbits zeroes risk of collision and doesn’t contribute to overall debris in dense areas – even if satellites fail no impact

Grush 18 – [Loren, “SpaceX wants to fly some internet satellites closer to Earth to cut down on space trash,” 10/9/2018, <https://www.theverge.com/2018/11/9/18016962/spacex-internet-satellites-space-debris-trash-orbit-closer-earth-distance-atmosphere>]

SpaceX is revising its satellite internet initiative, Starlink, and it now hopes to operate some of its spacecraft at a lower altitude than originally planned. In a new filing to the Federal Communications Commission (FCC), SpaceX is asking the agency to modify its license so that more than 1,500 Starlink satellites can operate at an altitude 600 kilometers lower than the company originally requested.

SpaceX argues that this change will make the space environment safer, as it will be easier to get rid of these satellites at this new altitude when they run low on fuel or can no longer function properly in orbit. This update could also explain the unexpected behavior of two of SpaceX’s test satellites for Starlink, which have remained in lower orbits than expected.

Back in March, the FCC approved SpaceX’s license for the first phase of its ambitious Starlink initiative — the company’s long-term plan to launch nearly 12,000 satellites into orbit to beam internet coverage down to Earth. Initially, SpaceX asked the FCC for permission to launch 4,425 satellites into orbits ranging between 1,110 to 1,325 kilometers high. But with this new filing, SpaceX is requesting that 1,584 of those satellites, which were supposed to operate at 1,110 kilometers, be allowed to operate at 550 kilometers instead.

SpaceX says moving the satellites to a lower altitude means it can do more with less. Originally, the company said it needed 1,600 satellites to operate at the 1,110-kilometer altitude, but moving them lower means the company can get the same results with 16 fewer spacecraft. And the lower altitude makes it easy to dispose of these satellites once they’re done in space. At this height, particles from Earth’s atmosphere bombard the spacecraft more rapidly, pushing them out of orbit and dragging them down to the planet. And on the way down, they burn up in the atmosphere.

Making sure these spacecraft come out of orbit in a timely manner is crucial because of the vast number of vehicles that SpaceX wants to put into orbit. A constellation the size of Starlink could dramatically increase the number of operational satellites in space, raising the risk of in-space collisions. A recent NASA study argued that 99 percent of these satellites will need to be taken out of orbit, reliably, within five years of launch, or the risk of satellite collisions goes up quite a bit.

De-orbiting a satellite typically entails bringing the vehicle to a low enough altitude with thrusters where Earth’s air particles and gravity drag the probe down so that it burns up. Now, with this new filing, SpaceX won’t have to significantly move 1,584 of its satellites to get rid of them. The atmosphere at 550 kilometers should do the job within a few years. That’s also helpful in case the spacecraft fails in orbit. Satellites that fail in higher altitudes could turn into unoperational space debris that stay in orbit for long periods of time. At lower altitudes, they can still fail, and the atmosphere will still swallow them up in a timely manner.

#### Squo debris thumps

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Earth orbit is getting more and more crowded as the years go by. Humanity has launched about 12,170 satellites since the dawn of the space age in 1957, [according to the European Space Agency](https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers) (ESA), and 7,630 of them remain in orbit today — but only about 4,700 are still operational. That means there are nearly 3,000 defunct spacecraft zooming around Earth at tremendous speeds, along with other big, dangerous pieces of debris like upper-stage rocket bodies. For example, orbital velocity at 250 miles (400 kilometers) up, the altitude at which the ISS flies, is about 17,100 mph (27,500 kph). At such speeds, even a tiny shard of debris can do serious damage to a spacecraft — and there are huge numbers of such fragmentary bullets zipping around our planet. ESA estimates that Earth orbit harbors at least 36,500 debris objects that are more than 4 inches (10 centimeters) wide, 1 million between 0.4 inches and 4 inches (1 to 10 cm) across, and a staggering 330 million that are smaller than 0.4 inches (1 cm) but bigger than 0.04 inches (1 millimeter). These objects pose more than just a hypothetical threat. From 1999 to May 2021, for example, the ISS conducted 29 debris-avoiding maneuvers, including three in 2020 alone, [according to NASA officials](https://www.nasa.gov/mission_pages/station/news/orbital_debris.html). And that number continues to grow; the station performed [another such move in November 2021](https://www.space.com/space-station-dodging-chinese-space-junk-spacex-crew-3), for example. Many of the smaller pieces of space junk were spawned by the explosion of spent rocket bodies in orbit, but others were more actively emplaced. In January 2007, for instance, China intentionally destroyed one of its defunct weather satellites in a much-criticized test of anti-satellite technology that generated [more than 3,000 tracked debris objects](https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf) and perhaps 32,000 others too small to be detected. The vast majority of that junk remains in orbit today, experts say. Spacecraft have also collided with each other on orbit. The most famous such incident occurred in February 2009, when Russia's defunct Kosmos 2251 satellite slammed into the operational communications craft Iridium 33, producing [nearly 2,000 pieces of debris](https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf) bigger than a softball. That 2009 smashup might be evidence that the Kessler Syndrome is already upon us, though a cataclysm of "Gravity" proportions is still a long way off. "The cascade process can be more accurately thought of as continuous and as already started, where each collision or explosion in orbit slowly results in an increase in the frequency of future collisions," [Kessler told Space Safety Magazine in 2012](http://www.spacesafetymagazine.com/space-debris/kessler-syndrome/don-kessler-envisat-kessler-syndrome/).

#### Grid impact doesn’t cascade

Boyle 17 – Rebecca Boyle, citing Rob Manning, vice president for transmission at the Electric Power Research Institute, and Thomas Berger, Director of Space Weather Prediction Center at NOAA. [How we’ll safeguard Earth from a solar storm catastrophe, 6-14-2017, https://www.nbcnews.com/mach/space/how-we-ll-safeguard-earth-solar-storm-catastrophe-n760021]

Odds are an EMP attack would be on a local scale, which means the grid would likely be fine overall, notes Scott Aaronson, senior director of national security policy at the Edison Electric Institute. There's no single point of failure in the country’s electrical system. The grid is somewhat of a misnomer because it’s really hundreds of independently operated utilities, each of which manages resources in its own way. Private industry owns 85 percent of the U.S.'s critical electrical infrastructure.

“To incidents on a smaller scale, the grid is extraordinarily resilient," Aaronson says. "There are 50,000 substations, and hundreds of control centers. The failure of one, or even several of those, has very limited impact on the broader set of infrastructure.”He argues an EMP is less of a concern than everyday problems — from solar storms to Earth generated lightning, to the most mundane threats.

#### No Escalation over Satellites:

#### 1] Planning Priorities

Bowen 18 Bleddyn Bowen 2-20-2018 “The Art of Space Deterrence” <https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/> (Lecturer in International Relations at the University of Leicester)//Elmer

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.

#### 2] Military Precedent

Zarybnisky 18, Eric J. Celestial Deterrence: Deterring Aggression in the Global Commons of Space. Naval War College Newport United States, 2018. (Senior Materiel Leader at United States Air Force)//Elmer

PREVENTING AGGRESSION IN SPACE While deterrence and the Cold War are strongly linked in the public’s mind through the nuclear standoff between the United States and the Soviet Union, the fundamentals of deterrence date back millennia and deterrence remains relevant. Thucydides alludes to the concept of deterrence in his telling of the Peloponnesian War when he describes rivals seeking advantages, such as recruiting allies, to dissuade an adversary from starting or expanding a conflict.6F 6 Aggression in space was successfully avoided during the Cold War because both sides viewed an attack on military satellites as highly escalatory, and such an action would likely result in general nuclear war.7F 7 In today’s more nuanced world, attacking satellites, including military satellites, does not necessarily result in nuclear war. For instance, foreign countries have used highpowered lasers against American intelligence-gathering satellites8F 8 and the United States has been reluctant to respond, let alone retaliate with nuclear weapons. This shift in policy is a result of the broader use of gray zone operations, to which countries struggle to respond while limiting escalation. Beginning with the fundamentals of deterrence illuminates how it applies to prevention of aggression in space.

#### No space war – prefer data over political rhetoric

Klimas interviewing Weeden 18 [Brian Weeden, smart space guy. Is the space war threat being hyped? August 3, 2018. https://www.politico.com/story/2018/08/03/space-war-threat-hype-force-760781]

There’s been increasing rhetoric...about the militarization of space and the potential for conflicts on Earth to extend into space. That’s driven in part by reports about anti-satellite testing in Russia and China...The report really grew out of our frustration at the level of publicly available information on this topic. A lot of what you get are public statements from military leadership or politicians, or sometimes news articles talking about something and it’s really hard to get down to details and...sort through what might be real, what might be hype. Our goal was to dig into the open source material and see what we could determine from a factual standpoint was really going on -- what types of capabilities were being developed and how might they be used in a future conflict. Ultimately we hoped that would lead to a more informed debate about what U.S. strategy should be to address those threats. What sort of feedback have you gotten so far? A lot of the feedback has been either informal or private because a lot of the issues we talk about, people in the government research using classified materials. So it’s difficult for them to give detailed feedback. In general, the feedback we’ve gotten has been pretty positive. People have said they like the fact that this sort of stuff is being put in the public domain and encouraged us to continue. Were your findings better or worse than the picture public discourse paints? In general, it’s a little bit better. A lot of political rhetoric and news stories focus on the most extreme examples, so using kinetic weapons to blow up satellites. While there is research and development going on to develop those capabilities, what we found is there’s yet to be any publicly-known example of them being used. What is being used and what seems to be of the most utility are the non-kinetic things, like jamming and cyber attacks. The good news is we have yet to see the most destructive kinetic attacks that can cause really harmful long-term damage to the space environment, but unfortunately we are seeing non-kinetic attacks being used, and that’s likely to continue.

#### Deterrence solves.

**Evanoff 19** [Kyle Evanoff, Kyle is a research associate in international economics and U.S. foreign policy at the Council on Foreign Relations “Big Bangs, Red Herrings, and the Dilemmas of Space Security”, Council on Foreign Relations, 6/27/2019, <https://www.cfr.org/blog/big-bangs-red-herrings-and-dilemmas-space-security> accessed 12/11/21] Adam

More important, U.S. policymakers should avoid making decisions on the basis of a possible, though highly improbable, space Pearl Harbor. They should recognize that latent counterspace capabilities—as exemplified in 2008’s Operation Burnt Frost, which saw the United States repurpose a ballistic missile interceptor to destroy a satellite—are more than sufficient to deter adversaries from launching a major surprise attack in almost all scenarios, especially in light of the aforementioned deep interdependence in the space domain. Adding to the deterrence effect are uncertain offensive cyber capabilities. The United States continues to launch incursions into geopolitical competitors’ critical systems, such as the Russian power grid, and has demonstrated a willingness to employ cyberattacks in the wake of offline incidents, as it did after Iran shot down a U.S. drone last week. Unlike in the nuclear arena, where anything short of the prospect of nuclear retaliation holds limited dissuasive power, space deterrence can stem from military capabilities in various domains. For this reason, an attack on a U.S. satellite could elicit any number of responses. The potential for cross-domain retaliation, combined with the high strategic value of space assets, means that any adversary risks extreme escalation in launching a major assault on American space architectures. Again, well-conceived diplomatic efforts are useful in averting such scenarios altogether.

#### No Kessler

Drmola and Hubik 18 [Jakub Drmola, Division of Security and Strategic Studies, Department of Political Science at the Faculty of Social Sciences of Masaryk University. Tomas Hubik, Department of Theoretical Computer Science and Mathematical Logic, Faculty of Mathematics and Physics, Charles University. Kessler Syndrome: System Dynamics Model. Space Policy Volumes 44–45, August 2018, Pages 29-39. https://www.sciencedirect.com/science/article/pii/S0265964617300966?via%3Dihub]

The baseline scenario represents a continuation of the current trends, which are simply extended into the future. An average 1% growth rate of yearly launches of new satellites (starting at 89) is assumed, together with constant success rate in satellites’ ability to actively avoid collisions with debris and other satellites, constant lifetime, and failure rate. This basic model lacks any sudden events or major policy changes that would markedly influence the debris propagation. However, it serves both as a foundation for all the following scenarios and as a basis of comparison to see what the impact would be.

Given high uncertainty regarding future state of the satellite industry (how many satellites will be launched per year, of what type and size, etc.), we elected to limit our simulations to 50 years. The model can certainly continue beyond this point, but the associated unknowns make the simulations progressively less useful.

Running this model for its full 50 years (2016–2066) yields the expected result of perpetually growing amount of debris in the LEO. One can observe nearly 2-fold increase in the large debris (over 10 cm) and 3-fold increase in small debris (less than 1 cm) quantities (Fig. 5). The oscillations visible in the graph are caused by the aforementioned solar cycles which influence the rate of reentry for all simulated populations except the still active (i.e. powered) satellites. Also please note that throughout the article, the graphs use quite different scales for debris populations because of the considerable variations between scenarios. Using any single scale for all graphs would render some of them unintelligible.

We can see that this increase in numbers still does not result in realization of the Kessler syndrome as most of the satellites being launched remain intact for their full expected service life. However, it comes with a considerable increase in risk to satellites, which is manifested by their higher yearly losses, making satellites operations riskier and more expensive for governments and private companies alike. This increased amount of debris in LEO combined with the larger number of active satellites makes it approximately twice as likely that an active satellite will suffer a disabling hit or a total disintegration during its lifetime. It should be noted that this risk might possibly be offset by future improvements in satellite reliability, debris tracking, and navigation [17].

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