# 1NC vs Golden State

## 1

### T

#### Interpretation: The aff must defend a policy implementation

#### ‘Resolved’ denotes a proposal to be enacted by law

Words and Phrases 64 Permanent Edition

Definition of the word “resolve,” given by Webster is “to express an opinion or determination by resolution or vote; as ‘it was resolved by the legislature;” It is of similar force to the word “enact,” which is defined by Bouvier as meaning “to establish by law”.

#### Violation: The affirmative is a general statement, not a proposal or implementation.

#### Standards –

#### Limits – A] By not reading a plan they broaden the scope of what they are debating instead of specifying their advocacy – that justifies tricky perms and aff condo which decks fairness. B] They over-limit their ground by not following the resolution which decks predictability and fairness.

#### Clash – They make it impossible to clash with the affirmative – A] They can shift out of anything I say if they don’t defend a concrete advocacy and B] It’s impossible for me to come up with arguments against you if you don’t defend the resolution – I only prep for the resolution and there are infinite other advocacies you can read.

#### Legal precision – We should focus on the specific definition of words in the resolution – words have precise meaning and if you don’t follow it it’s impossible to understand what they are saying – using exact definitions is key to participating in analyzing governmental positions and making changes in the real world which takes out the reason we are debating in the first place.

#### Paradigm – A. Fairness is a voter – debate is competitive and otherwise people quit. B. Education is a voter – key to school funding. C. Drop the debater – key to normset. D. NC theory first – the aff started the chain of abuse.

## 2

### CP

#### CP Text:

#### The United States should fund the mining of rare earth metals from asteroids by private entities

#### The United States should fund the development of O’Neill Cylinders

#### The United States should fund the development of debris removal technology

#### States should ban the appropriation of outer space by private entities omitting the United States

#### Internal Net-Benefit 1 – REM Gatekeeping

#### The CP is key to beat China and protect against Chinese REM gatekeeping

Stavridis 21 [(James, retired US Navy admiral, chief international diplomacy and national security analyst for NBC News, senior fellow at JHU Applied Physics Library, PhD in Law and Diplomacy from Tufts) “U.S. Needs a Strong Defense Against China’s Rare-Earth Weapon,” Bloomberg Opinion, March 4, 2021, <https://www.bloomberg.com/opinion/articles/2021-03-04/u-s-needs-a-strong-defense-against-china-s-rare-earth-weapon>] TDI Re-Cut Ethan Yang

You could be forgiven if you are confused about what’s going on with rare-earth elements. On the one hand, news reports indicate that China may increase production quotas of the minerals this quarter as a [goodwill gesture](https://www.scmp.com/news/china/diplomacy/article/3122501/china-raises-rare-earth-quotas-goodwill-trade-signal-us) to the Joe Biden administration. But other sources say that China may ultimately ban the export of the rare earths altogether on “[security concerns](https://www.bloomberg.com/news/articles/2021-02-19/china-may-ban-rare-earth-technology-exports-on-security-concerns?sref=QYxyklwO).” What’s really going on here? There are 17 elements considered [rare earths](https://www.bloomberg.com/news/articles/2021-02-16/why-rare-earths-are-achilles-heal-for-europe-u-s-quicktake) — lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium and yttrium — and while many aren’t actually rare in terms of global deposits, extracting them is difficult and expensive. They are used across high-tech manufacturing, including smartphones, fighter aircraft and components in virtually all advanced electronics. Of particular note, they are essential to many of the clean-energy technologies expected to come online in this decade. I began to focus on rare-earth elements when I commanded the North Atlantic Treaty Organization’s presence in Afghanistan, known as the International Security Assistance Force. While Afghans live in an extremely poor country, [studies](https://thediplomat.com/2020/02/afghanistans-mineral-resources-are-a-lost-opportunity-and-a-threat/) have assessed that they sit atop $1 trillion to $3 trillion in a wide variety of minerals, including rare earths. Some [estimates](https://www.fraserinstitute.org/article/afghanistans-rare-earth-element-bonanza) put the rare-earth levels alone at 1.4 million metric tons. But every time I tried to visit a mining facility, the answer I got from my security team was, “It’s too dangerous right now, admiral.” Unfortunately, despite a great deal of effort by the U.S. and NATO, those security challenges remain, deterring the large foreign-capital investments necessary to harvest the lodes. Which brings us back to Beijing. China controls roughly 80% of the rare-earths market, between what it mines itself and processes in raw material from elsewhere. If it decided to wield the weapon of restricting the supply — something it has repeatedly [threatened](https://www.wsj.com/articles/china-trade-fight-raises-specter-of-rare-earth-shortage-11559304000) to do — it would create a significant challenge for manufacturers and a geopolitical predicament for the industrialized world. It could happen. In 2010, Beijing threatened to cut off exports to Japan over the disputed Senkaku Islands. Two years ago, Beijing was reportedly considering restrictions on exports to the U.S. generally, as well as against specific companies (such as defense giant Lockheed Martin Corp.) that it deemed in violation of its policies against selling advanced weapons to Taiwan. President Donald Trump’s administration issued an executive order to spur the production of rare earths domestically, and created an [Energy Resource Governance Initiative](https://www.state.gov/wp-content/uploads/2019/06/Energy-Resource-Governance-Initiative-ERGI-Fact-Sheet.pdf) to promote international mining. The European Union and Japan, among others, are also aggressively seeking newer sources of rare earths. Given this tension, it was superficially surprising that China announced it would boost its mining quotas in the first quarter of 2021 by nearly 30%, reflecting a continuation in strong (and rising) demand. But the increase occurs under a shadow of uncertainty, as the Chinese Communist Party is undertaking a “review” of its policies concerning future sales of rare earths. In all probability, the tactics of the increase are temporary, and fit within a larger strategy. China will go to great lengths to maintain overall control of the global rare-earths supply. This fits neatly within the geo-economic approach of the [One Belt, One Road](https://www.bloomberg.com/opinion/articles/2019-10-30/china-is-determined-to-reshape-the-globe) initiative, which seeks to use a variety of carrots and sticks — economic, trade, diplomatic and security — to create zones of influence globally. In terms of rare earths, the strategy seems to be allowing carefully calibrated access to the elements at a level that makes it economically less attractive for competitors to undertake costly exploration and mining operations. This is similar to the oil-market strategy used by Russia and the Organization of Petroleum Exporting Countries for decades. Some free-market advocates believe that China will not take aggressive action choking off supply because that could [precipitate retaliation](https://www.bloomberg.com/opinion/articles/2021-02-22/china-weaponizing-rare-earths-technology-will-probably-backfire) or accelerate the search for alternate sources in global markets. What seems more likely is a series of targeted shutdowns directed against specific entities such as U.S. defense companies, Japanese consumer electronics makers, or European industrial concerns that have offended Beijing. The path to rare-earth independence for the U.S. must include: Ensuring supply chains of rare earths necessary for national security; promoting the exploitation of the elements domestically (and removing barriers to responsibly doing so); mandating that defense contractors and other critical-infrastructure entities wean themselves off Chinese rare earths; sponsoring research and development to find alternative materials, especially for clean energy technology; and creating a substantial stockpile of the elements in case of a Chinese boycott. This is a bipartisan agenda. The Trump administration’s [strategic assessment](https://www.commerce.gov/news/press-releases/2019/06/department-commerce-releases-report-critical-minerals) of what needs to be done (which goes beyond just 17 rare earths to include a total of 35 critical minerals) is thoughtful, and should serve as a basis for the Biden administration and Congress.

#### REM access key to military primacy and tech advancement – alts fail

Trigaux 12 (David, University Honors Program University of South Florida St. Petersburg) “The US, China and Rare Earth Metals: The Future Of Green Technology, Military Tech, and a Potential Achilles‟ Heel to American Hegemony,” USF St. Petersberg, May 2, 2012, <https://digital.stpetersburg.usf.edu/cgi/viewcontent.cgi?article=1132&context=honorstheses>] TDI Re-Cut Ethan Yang

The implications of a rare earth shortage aren’t strictly related to the environment, and energy dependence, but have distinct military implications as well that could threaten the position of the United States world’s strongest military. The United States place in the world was assured by powerful and decisive deployments in World War One and World War Two. Our military expansion was built upon a large, powerful industrial base that created more, better weapons of war for our soldiers. During the World Wars, a well-organized draft that sent millions of men into battle in a short amount of time proved decisive, but as the war ended, and soldiers drafted into service returned to civilian life, the U.S. technological superiority over its opponents provided it with sustained dominance over its enemies, even as the numerical size of the army declined. New technologies, such as the use of the airplane in combat, rocket launched missiles, radar systems, and later, GPS, precision guided missiles, missile defense systems, high tech tanks, lasers, and other technologies now make the difference between victory and defeat. The United States military now serves many important functions, deterring threats across the world. The United States projects its power internationally, through a network of bases and allied nations. Thus, the United States is a powerful player in all regions of the world, and often serves as a buffer against conflict in these regions. US military presence serves as a buffer against Chinese military modernization in Eastern Asia, against an increasingly nationalist Russia in Europe, and smaller regional actors, such as Venezuela in South America and Iran in the Middle East. The U.S. Navy is deployed all over the world, as the guarantor of international maritime trade routes. The US Navy leads action against challenges to its maritime sovereignty on the other side of the globe, such as current action against Somali piracy. Presence in regions across the world prevents escalation of potential crisis. These could result in either a larger power fighting a smaller nation or nations (Russia and Georgia, Taiwan and China), religious opponents (Israel and Iran), or traditional foes (Ethiopia and Eretria, Venezuela and Colombia, India and Pakistan). US projection is also key deterring emerging threats such as terrorism and nuclear proliferation. While not direct challenges to US primacy, both terrorism and nuclear proliferation can kill thousands. The US Air Force has a commanding lead over the rest of the world, in terms of both numbers and capabilities. American ground forces have few peers, and are unmatched in their ability to deploy to anywhere in the world at an equally unmatched pace. The only perceived challenge to the United States militarily comes from the People’s Republic of China.76 While the United States outspends all other nations in the world put together in terms of military spending, China follows as a close second, and has begun an extensive modernization program to boot.77 The Chinese military however, is several decades behind the United States in air power and nuclear capabilities.78 To compensate, China has begun the construction of access-denial technology, preventing the US from exercising its dominance in China’s sphere of influence.79 Chinese modernization efforts have a serious long-term advantage over the United States; access to rare earth metals, and a large concentration of rare earth chemists doing research.80 This advantage, coupled with the U.S. losing access to rare earth metals, will even the odds much quicker than policymakers had previously anticipated. 81 The largest example is US airpower. With every successive generation of military aircraft, the U.S. Air Force becomes more and more dependent on Rare Earth Metals.82 As planes get faster and faster, they have to get lighter and lighter, while adding weight from extra computers and other features on board.83 To lighten the weight of the plane, scandium is used to produce lightweight aluminum alloys for the body of the plane. Rare Earth metals are also useful in fighter jet engines, and fuel cells.84 For example, rare earths are required to producing miniaturized fins, and samarium is required to build the motors for the F-35 fighter jet.85 F-35 jets are the next generation fighter jet that works together to form the dual plane combination that cements U.S. dominance in air power over the Russian PAK FA.86 Rare earth shortages don’t just affect air power, also compromising the navigation system of Abrams Tanks, which need samarium cobalt magnets. The Abrams Tank is the primary offensive mechanized vehicle in the U.S. arsenal. The Aegis Spy 1 Radar also uses samarium.87 Many naval ships require neodymium. Hell Fire missiles, satellites, night vision goggles, avionics, and precision guided munitions all require rare earth metals. 88 American military superiority is based on technological advancement that outstrips the rest of the world. Command and control technology allows the U.S. to fight multiple wars at once and maintain readiness for other issues, as well as have overwhelming force against rising challengers. This technology helps the U.S. know who, where, and what is going to attack them, and respond effectively, regardless of the source of the threat. Rare Earth Elements make this technological superiority possible. To make matters worse, the defense industrial base is often a single market industry, dependent on government contracts for its business. If China tightens the export quotas further, major US defense contractors will be in trouble.89 Every sector of the defense industrial base is dependent on rare earth metals. Without rare earths, these contractors can’t build anything, which collapses the industry.90 Rare Earth shortages are actually already affecting our military, with shortages of lanthanum, cerium, europium and gadolinium happening in the status quo. This prevents us not only from building the next generation of high tech weaponry, but also from constructing more of the weapons and munitions that are needed in the status quo. As current weapon systems age and they can’t be replaced, the US primacy will be undermined. Of special concern is that U.S. domestic mining doesn’t produce “heavy” rare earth metals that are needed for many advanced components of military technologies. Given the nature of many military applications, substitutions aren’t possible. 91

#### Primacy and allied commitments solve arms races and great power war – unipolarity is sustainable, and prevents power vacuums and global escalation

Brands 18 [(Hal, Henry Kissinger Distinguished Professor at Johns Hopkins University's School of Advanced International Studies and a senior fellow at the Center for Strategic and Budgetary Assessments) "American Grand Strategy in the Age of Trump," Page 129-133] Re-Cut Ethan Yang

Since World War II, the United States has had a military second to none. Since the Cold War, America has committed to having overwhelming military primacy. The idea, as George W. Bush declared in 2002, that America must possess “strengths beyond challenge” has featured in every major U.S. strategy document for a quarter century; it has also been reflected in concrete terms.6 From the early 1990s, for example, the United States consistently accounted for around 35 to 45 percent of world defense spending and maintained peerless global power-projection capabilities.7 Perhaps more important, U.S. primacy was also unrivaled in key overseas strategic regions—Europe, East Asia, the Middle East. From thrashing Saddam Hussein’s million-man Iraqi military during Operation Desert Storm, to deploying—with impunity—two carrier strike groups off Taiwan during the China-Taiwan crisis of 1995– 96, Washington has been able to project military power superior to anything a regional rival could employ even on its own geopolitical doorstep. This military dominance has constituted the hard-power backbone of an ambitious global strategy. After the Cold War, U.S. policymakers committed to averting a return to the unstable multipolarity of earlier eras, and to perpetuating the more favorable unipolar order. They committed to building on the successes of the postwar era by further advancing liberal political values and an open international economy, and to suppressing international scourges such as rogue states, nuclear proliferation, and catastrophic terrorism. And because they recognized that military force remained the ultima ratio regum, they understood the centrality of military preponderance. Washington would need the military power necessary to underwrite worldwide alliance commitments. It would have to preserve substantial overmatch versus any potential great-power rival. It must be able to answer the sharpest challenges to the international system, such as Saddam’s invasion of Kuwait in 1990 or jihadist extremism after 9/11. Finally, because prevailing global norms generally reflect hard-power realities, America would need the superiority to assure that its own values remained ascendant. It was impolitic to say that U.S. strategy and the international order required “strengths beyond challenge,” but it was not at all inaccurate. American primacy, moreover, was eminently affordable. At the height of the Cold War, the United States spent over 12 percent of GDP on defense. Since the mid-1990s, the number has usually been between 3 and 4 percent.8 In a historically favorable international environment, Washington could enjoy primacy—and its geopolitical fruits—on the cheap. Yet U.S. strategy also heeded, at least until recently, the fact that there was a limit to how cheaply that primacy could be had. The American military did shrink significantly during the 1990s, but U.S. officials understood that if Washington cut back too far, its primacy would erode to a point where it ceased to deliver its geopolitical benefits. Alliances would lose credibility; the stability of key regions would be eroded; rivals would be emboldened; international crises would go unaddressed. American primacy was thus like a reasonably priced insurance policy. It required nontrivial expenditures, but protected against far costlier outcomes.9 Washington paid its insurance premiums for two decades after the Cold War. But more recently American primacy and strategic solvency have been imperiled. THE DARKENING HORIZON For most of the post–Cold War era, the international system was— by historical standards—remarkably benign. Dangers existed, and as the terrorist attacks of September 11, 2001, demonstrated, they could manifest with horrific effect. But for two decades after the Soviet collapse, the world was characterized by remarkably low levels of great-power competition, high levels of security in key theaters such as Europe and East Asia, and the comparative weakness of those “rogue” actors—Iran, Iraq, North Korea, al-Qaeda—who most aggressively challenged American power. During the 1990s, some observers even spoke of a “strategic pause,” the idea being that the end of the Cold War had afforded the United States a respite from normal levels of geopolitical danger and competition. Now, however, the strategic horizon is darkening, due to four factors. First, great-power military competition is back. The world’s two leading authoritarian powers—China and Russia—are seeking regional hegemony, contesting global norms such as nonaggression and freedom of navigation, and developing the military punch to underwrite these ambitions. Notwithstanding severe economic and demographic problems, Russia has conducted a major military modernization emphasizing nuclear weapons, high-end conventional capabilities, and rapid-deployment and special operations forces— and utilized many of these capabilities in conflicts in Ukraine and Syria.10 China, meanwhile, has carried out a buildup of historic proportions, with constant-dollar defense outlays rising from US$26 billion in 1995 to US$226 billion in 2016.11 Ominously, these expenditures have funded development of power-projection and antiaccess/area denial (A2/AD) tools necessary to threaten China’s neighbors and complicate U.S. intervention on their behalf. Washington has grown accustomed to having a generational military lead; Russian and Chinese modernization efforts are now creating a far more competitive environment.

#### Internal Net-Benefit 2 – O’Neill Cylinders

#### O’Neill Cylinders are on the way, but funding and companies like SpaceX and Blue Origin are key because governments are insufficient.

Kanchwalla 11-13-21

Hussain Kanchwalla (scholar at the Indian Institute of technology), 11-13-2021, "What is an O’Neill Cylinder?," Science ABC, https://www.scienceabc.com/nature/universe/what-is-oneill-cylinder.html, // HW AW

Many people believe that the Earth will soon be in danger and the sprawling nature of humanity is the undeniable cause. With the rapid [technological progress](https://www.scienceabc.com/nature/universe/what-is-kardashev-scale.html) and advancement of the past few centuries, we’re quickly exhausting the resources from planet Earth in order to power our industrial needs and global commerce. Many futurists feel that we will be left with no option but to explore and colonize space if we intend to survive into a future when resources on Earth can no longer meet our requirements. [Overpopulation is an imminent challenge](https://www.scienceabc.com/humans/malthusian-catastrophe-shortage-of-food-sources-population-explosion.html) that makes the need for interstellar travel and colonization even more urgent. That being said, [**building a space habitat**](https://www.scienceabc.com/nature/universe/can-we-build-a-habitable-planet-from-scratch.html) **is no easy pursuit and is loaded with daunting challenges, such as the need for construction facilities in space, the recreation of livable communities in space, the recycling and processing of waste, the simulation of artificial gravity, and most importantly—convincing governments and global organizations that this venture is worth pursuing.** The prospect of space colonization paves the way for devising methods to extract energy from resources on other planets. On Earth, harnessing energy from the Sun using [solar panels](https://www.scienceabc.com/innovation/why-is-there-a-limit-to-the-efficiency-of-solar-panels.html) isn’t particularly efficient, and faces inevitable barriers caused by the atmosphere and the daily occurrence of darkness (e.g., nighttime). However, in space, solar constructs can perpetually harness energy from the Sun without interruption. Utilizing this copious amount of energy would permit us to travel throughout our solar system without worrying about energy expenditure. Moreover, chemical resources would be in great supply in our solar system. To begin with, NASA has recently embarked on a project to generate fuel, water, and oxygen from resources present on the Moon. Given these foundations for why organizations should foray into developing a space habitat, allow me to introduce the **O’Neill cylinder—a space settlement design consisting of two counter-rotating cylinders** proposed by renowned physicist Gerard O’Neill a few decades ago. Aside from being a physicist, O’Neill was also a professor at Princeton University and a space enthusiast. Although he is most widely acclaimed for his work in physics, where he developed new concepts to explore particle physics at higher energies, his work on space colonization turned out to be his truly long-lasting legacy. Origin of the Idea for the O’Neill Cylinder While teaching physics to his students at Princeton University, O’Neill assigned them the task of designing a megastructure in space in order to demonstrate that living and surviving in space is actually a possibility. His students came up with numerous designs to accommodate human habitation in space. After a long session of brainstorming, O’Neill boiled their theories down to the idea of a cylinder-like space settlement design. Later, additional details and the functioning of this design were published in Physics Today in 1974; the cylinder was aptly called the O’Neill cylinder. Design of the O’Neill Cylinder The O’Neill cylinder design consists of two cylinders rotating in opposite directions on a [bearing](https://www.scienceabc.com/eyeopeners/what-is-a-bearing.html) to mitigate the gyroscopic effect. Each cylinder was proposed to be 20 miles long and 5 miles in diameter, with 6 broad stripes along its length (3 habitable spaces and 3 windows). O’Neill envisioned industrial processes and recreational facilities to be located on the central axis in a virtually zero-gravity environment. Gravity Simulation One key difference between living on Earth and living in space (or on any other astronomical body) is the difference in gravity. [Artificial gravity](https://www.scienceabc.com/innovation/can-create-artificial-gravity.html) is needed for stability, and the O’Neill cylinder has a provision to achieve exactly that. As the two giant cylinders rotate on their axis, they would leverage the centripetal force of any object in the inner surface to create artificial gravity. Considering the cylinder’s dimensions, the acceleration equation: a=v²/r, and substituting the acceleration value of Earth (i.e., 9.81), we can deduce that the cylinder would need to rotate roughly 28 times per hour to simulate an appropriate gravitational force. Earthly Environment Simulation Maintaining an atmosphere with a constitution similar to that of Earth is the next challenge when building a space habitation. The O’Neill cylinder is prudently designed with a ratio of gases similar to what is found on Earth. However, there is a caveat; the pressure is half of that at sea level. This would not impact our breathing substantially, but this minor trade-off would translate into a handful of benefits, such as bringing down the need for gas and the construction of thick walls. The proposed O’Neill cylinder also has provisions wherein the habitat would be able to control its own micro-climate using an arrangement of mirrors and by altering the ratio of gases in the cylinder. Day and Night Simulation With the human habitat situated in a vacuum (space), the cylinder essentially turns into a huge thermos! The theoretical O’Neill cylinder tried to overcome this issue by using a series of mirrors hinged on each of the three windows. This way, direct sunlight could be directed into the cylinder to simulate day time. Similarly, by turning the mirror away, a night-like ambience could be created. This simulated ‘night’ would also permit the heat produced biologically to radiate out of the cylinder. **Despite the design of the O’Neill cylinder being technically sound, the idea is too sophisticated to be implemented with our present technology**. Thus far, its implementation has been confined to the realm of science fiction. However, **given the efforts of organizations like SpaceX and Mars One, perhaps some day O’Neill cylinders will actually help humanity settle in the great vastness of space!**

#### **Permanently solves extinction**

Haynes 19, 5/17, Korey "O’Neill colonies: A decades-long dream for settling space," Astronomy, https://astronomy.com/news/2019/05/oneill-colonies-a-decades-long-dream-for-settling-space Top of Form

Bottom of Form

Last week, Amazon founder Jeff Bezos revealed his spaceship company’s new lunar lander, dubbed Blue Moon, and he spelled out a bold and broad vision for humanity’s future in space. Faced with the limits of resources here on Earth, most fundamentally energy, he pointed to life in space as a solution. “If we move out into the solar system, for all practical purposes, we have unlimited resources,” Bezos said. “We could have a trillion people out in the solar system.” And while colonies on other planets would be plagued by low gravity, long distances to Earth (leading to communication delays), and further limits down the road, those weaknesses are avoided if the colonies remain truly in space. To that end, Bezos instead suggested people consider taking up residence in O’Neill colonies, a futuristic concept for space settlements first dreamed up decades ago. “These are very large structures, miles on end, and they hold a million people or more each.” Gerard O’Neill was a physicist from Princeton University who teamed up with NASA in the 1970s on a series of workshops that explored efficient ways for humans to live off-world. Beyond influencing Bezos, his ideas have also deeply affected how many space experts and enthusiasts think about realistic ways of living in space. “What will space colonies be like?” O’Neill once asked the Space Science Institute he founded. “First of all, there’s no point in going out into space if the future that we see there is a sterile future of living in tin cans. We have to be able to recreate, in space, habitats which are as beautiful, as Earth-like, as the loveliest parts of planet Earth — and we can do that.” Of course, neither O’Neill nor anyone since has actually made such a habitat, but in many ways, the concepts he helped developed half a century ago remain some of the most practical options for large-scale and long-term space habitation. While NASA has mostly focused on exploring the moon and Mars in recent years, O’Neill colonies offer an option untethered to any planetary body. Instead, people would live in enormous circular structures in space that would be capable of hosting many thousands of people — or even millions according to Bezos — on a permanent basis. You may have seen these kinds of colonies in science fiction, from Star Trek, to the movie Interstellar. But in real life, researchers have thought up a a few variations: either a sphere, a cylinder, or a ring-shaped torus. All of these are designed to rotate and create a centrifugal force that mimics gravity for the inhabitants. While the sizes and specifications of the colonies vary, there are a few staples. In general, O’Neill colonies were designed to be permanent, self-sustaining structures. That means they would use solar power for electrical energy and for growing crops. The outer walls of an O’Neill colony are generally pictured as a transparent material, so that mirrors can aim sunlight through its walls as needed to provide light and energy – or to allow darkness, a feature humans also need, especially while we sleep. But building these colonies is a challenge beyond any humans have accomplished so far in space, and Bezos acknowledged that. He referred to two “gates” in his announcement, which he clarified as challenges that humans need to overcome. The first, which his company Blue Origin and other space entrepreneurs have been tackling, is to reduce the cost and difficulty of getting to space at all. But the second involves using resources from space, rather than hauling them from Earth. Bezos isn’t alone in such thinking. Most of NASA’s long-term plans for the Moon and Mars involve rely on harvesting materials and manufacturing products locally, using lunar and martian regolith to build and repair structures. And in the shorter term, three of the dozen experiments NASA selected as the first to fly as part of the new lunar program — possibly even by the end of the year — are what NASA terms “resource prospecting instruments.” That pairs well with O’Neill’s vision. These colonies are meant to use resources gathered from space, whether asteroids, the Moon, or even Mars. Doing so avoids the costly effort of heaving materials and goods out of Earth’s deep gravity well. That means they would be built using materials available cheaply in space. The humans and their attendant plants and animals would need to be carried from Earth. But raw materials like oxygen, nitrogen and aluminum are plentiful in the solar system, and mining for resources in space is a common theme across space settlement discussions. Because of their size, the colonies should be able to act as fully independent ecosystems, with plants to cycle air and water and resource cycles not so dissimilar from Earth. Humans are a long way from being able to launch anything like an O’Neill colony in the near future. But it’s somewhat telling that, after 50 years

#### Turns their debris advantage -

#### Private entities key to debris management

Moore 21 [Moore, Adrian. “It's Time For US To Get Serious About Cleaning Up Space Junk,”.” TheHill. July 27, 2021. Web. December 13, 2021. <https://thehill.com/opinion/technology/564945- its-time-for-us-to-get-serious-about-cleaning-up-space-junk>.] Recut Ethan Yang

Orbital debris management is not well organized within the government. Right now, the Department of Defense (DOD) does most tracking of space debris for the U.S. out of the need to protect military satellites and national security interests. NASA has its own less advanced systems for tracking debris. However, orbital debris management is not just about tracking debris anymore. It is also about forming collision warning systems and safely managing traffic in space. To do this efficiently, we need a civil repository for all orbital debris components, something that many commercial space companies have already created on their own to stay aware of orbital debris and help protect their satellites in space. Tracking debris may be a national security priority, but providing space traffic control is not really in the Defense Department’s mission. We should be utilizing the private sector’s expertise and advancements in this area. For example, Astroscale has contracts with both the Japanese and European space agencies to develop orbital debris removal capability. And responsibility for developing collision warnings and space traffic management would be best suited for the Office of Space Commerce, an office with existing connections to the commercial space industry, NASA and DOD. Partnering with the debris tracking and removal systems private companies are developing while freeing up DOD to focus on military awareness and NASA to focus on research and development would be the most efficient way forward. If government works with private industry through strategic public-private partnerships, the U.S. can best address the threats posed by orbital debris and create sustainable policies for safe space exploration.

## 3

### DA

#### Mega-Constellations generates next-level weather forecasting.

Erwin 20 Sandra Erwin 10-14-2020 "SpaceX to explore ways to provide weather data to U.S. military" <https://spacenews.com/spacex-to-explore-ways-to-provide-weather-data-to-u-s-military/> (Sandra Erwin writes about military space programs, policy, technology and the industry that supports this sector. She has covered the military, the Pentagon, Congress and the defense industry for nearly two decades as editor of NDIA’s National Defense Magazine and Pentagon correspondent for Real Clear Defense.)//Elmer

The $2 million contract is to “assess the feasibility and long term viability of a ‘weather data as a service business model.” WASHINGTON — SpaceX is looking at ways it could provide weather data to the U.S. military. The company is working under a $2 million six-month study contract from the U.S. Space Force’s Space and Missile Systems Center. Charlotte Gerhart, chief of the Space and Missile Systems Center Production Corps Low Earth Orbit Division, said in a statement to SpaceNews that SpaceX received the contract in July from SMC’s Space Enterprise Consortium. The contract is to “assess the feasibility and long term viability of a ‘weather data as a service business model,’” said Gerhart. SpaceX did not respond to questions from SpaceNews on how the company would leverage the Starlink internet constellation to provide weather data. The contract awarded to SpaceX is part of a Space Force program called Electro Optical/Infrared Weather System (EO/IR EWS). The consortium in June awarded $309 million in contracts to Raytheon Technologies, General Atomics Electromagnetic Systems, and Atmospheric & Space Technology Research Associates to develop weather satellite prototypes and payloads. SpaceX won the portion of the EO/IR EWS program that is looking at how weather data could be purchased as a service from a commercial company. “The EWS program goal remains to provide a more resilient and higher refresh capability, enhancing global terrestrial weather capability,” said Gerhart. The SpEC consortium was created in 2017 to attract commercial space businesses to work with the military. The contracts awarded by SpEC are known as “other transaction authority” deals that are used for research projects and prototyping. The consortium on Oct. 8 informed its members that SpaceX had won the weather study contract. “The Air Force is pursuing a space-based environmental monitoring EO/IR system in a multi phased approach,” the SpEC said in an email to members. The EO/IR EWS program is looking at a future proliferated low-Earth orbit constellation to focus on cloud characterization and theater weather imagery that could be supplemented by commercial services. SpaceX’s contract is for the “weather data as a service system architecture exploration phase,” said SpEC. Industry sources speculated that SpaceX could provide weather data collected by sensors hosted on its own Starlink satellites, or it could team with a weather data services company and use Starlink to distribute the data to customers. One executive noted that both the U.S. military and the National Oceanic and Atmospheric Administration have growing demands for data that can be provided at relatively low cost from companies that operate proliferated LEO systems.

#### Solves climate change.

Taylor-Smith 21 Kerry Taylor-Smith 3-25-2021 "What Role can Advanced Weather Forecasting have in Providing Climate Crisis Solutions?" <https://www.azocleantech.com/article.aspx?ArticleID=1193> (Pursuing a passion for science, Kerry completed a degree in Natural Sciences at the University of Bath; where she studied a range of topics, including chemistry, biology, and environmental sciences. Her passion for writing grew as she worked on the university newspaper as a contributor, feature editor, and editor.)//Elmer

Humankind is in the midst of a climate crisis, battling to prevent global temperatures from rising while also keeping up with the energy demands of a growing population. Weather-related disasters cost billions of dollars each year, but it is not just the financial cost that should be considered – there is the loss of life, homes, wildlife, and infrastructure. There are several ways weather monitoring can help solve the climate crisis, from lowing transportation emissions to pinpointing extreme weather events such as wildfires and extraordinary variations in temperature. Tackling Emissions Global travel and shipping contribute significantly to global warming. Aircraft, ships, cars – nearly all modes of transportation emit harmful greenhouse gases, notably carbon dioxide, but also nitrous and sulfur oxides as well as particulates. These greenhouse gases trap heat in the Earth’s atmosphere, causing an overall warming effect and a negative impact on our climate. Aviation accounts for 2.4% of all anthropogenic carbon dioxide emissions, with international flights in 2019 producing 915 million tons of the gas. Weather forecasting technology providing accurate, real-time data on meteorological conditions can help airlines adjust routes to avoid headwinds or take advantage of favorable winds, both of which can help reduce fuel consumption and emissions. Shipping is one of the most fuel-efficient means of transport, but also one of the most polluting, contributing 3% of all greenhouse gas emissions - a figure expected to almost double by 2050. “Burning bunker fuel accounts for almost 90% of global sulfur emissions and the 15 largest ships in the world produce more sulfur each year than all cars put together,” states Renny Vandewege, Vice President of Weather Operations at DTN, a company providing decision support tools and forecast insights across many sectors. Shipping discharges a large and growing source of noxious gas but the sector has the potential to drastically cut emissions through fuel-saving techniques. Among the most promising is weather routing. “Using weather information and analytics can help mitigate risks today caused by climate change and can also reduce emissions further reducing future impacts”, explains Vandewege, a former director of the Broadcast Meteorology Program at Mississippi State University. Weather analytics can optimize routes and “reduce emissions up to 4% and reduce fuel consumption up to 10%, depending on the type of vessel, the season, and the conditions,” states Vandewege. “If there’s bad weather ahead, sophisticated algorithms that use information about the ship and its capabilities and the weather effects on that specific ship can make numerous calculations and provide optimal route alternatives for the mariner.” Extreme Weather Events Advanced weather forecasting alerts us to the probability of extreme meteorological events occurring. While these events are largely unpredictable, accurate meteorological data can identify hotspots where they are likely to occur. The better the data, the better prepared the general public and authorities can be. Wildfires have ravaged the US state of California and huge swathes of land in Australia. Climate change is responsible for the increasing intensity and occurrence of blazes, not just here, but worldwide. It has created the optimal conditions for wildfires to start, including warmer weather, less precipitation, dryer vegetation, and stronger winds. Advanced weather forecasting, such as DTN’s live Geographic Information System (GIS) can monitor atmospheric conditions to evaluate wildfire risk and predict areas where conditions are just right for a wildfire to ignite. “Fire weather forecasting uses atmospheric conditions to evaluate wildfire risk,” explains Vendewege. “Meteorologists can also use their tools and experience to identify the specific location of wildfires. Sophisticated imaging systems can show fire locations in real time, allowing for a live look at the conditions using a GIS layer service containing the latest fire hotspot data and also showing the likelihood of a fire.” Machine learning, a means of artificial intelligence, can also be used in conjunction with current forecasting methods to predicts heat waves or cold snaps. These extreme weather events are the result of unusual atmospheric patterns that researchers from Rice University realized could be taught to a pattern recognition program. The technology, designed to work with current analog forecasting systems rather than replace them, could predict events with 80% accuracy, five days before the event occurred. Although only proof-of-concept, the technology could provide an early warning about when and where an extreme weather event might occur. Conclusion Humans are heavily reliant on the weather; it has a role in every aspect of our lives, from feeding us to providing power for our ever-growing needs. Climate change has warmed the planet and altered our weather, making extreme weather events such as droughts and floods more likely. High-tech weather forecasting technology can help in the fight against climate change by monitoring meteorological conditions to aid decision making, whether that be in the aviation or shipping industry, or by helping us understand and predict natural hazards and disasters, allowing us to reduce the risk of adverse events – and the costs, environmental, economic or otherwise.

#### Climate change causes extinction.

Dr. Peter Kareiva 18 – Ph.D. in Ecology and Applied Mathematics from Cornell University, Director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA, et al., September 2018, “Existential Risk Due To Ecosystem Collapse: Nature Strikes Back”, Futures, Volume 102, p. 39-50

In summary, six of the nine proposed planetary boundaries (phosphorous, nitrogen, biodiversity, land use, atmospheric aerosol loading, and chemical pollution) are unlikely to be associated with existential risks. They all correspond to a degraded environment, but in our assessment do not represent existential risks. However, the three remaining boundaries (climate change, global freshwater cycle, and ocean acidification) do pose existential risks. This is because of intrinsic positive feedback loops, substantial lag times between system change and experiencing the consequences of that change, and the fact these different boundaries interact with one another in ways that yield surprises. In addition, climate, freshwater, and ocean acidification are all directly connected to the provision of food and water, and shortages of food and water can create conflict and social unrest.

Climate change has a long history of disrupting civilizations and sometimes precipitating the collapse of cultures or mass emigrations (McMichael, 2017). For example, the 12th century drought in the North American Southwest is held responsible for the collapse of the Anasazi pueblo culture. More recently, the infamous potato famine of 1846–1849 and the large migration of Irish to the U.S. can be traced to a combination of factors, one of which was climate. Specifically, 1846 was an unusually warm and moist year in Ireland, providing the climatic conditions favorable to the fungus that caused the potato blight. As is so often the case, poor government had a role as well—as the British government forbade the import of grains from outside Britain (imports that could have helped to redress the ravaged potato yields).

Climate change intersects with freshwater resources because it is expected to exacerbate drought and water scarcity, as well as flooding. Climate change can even impair water quality because it is associated with heavy rains that overwhelm sewage treatment facilities, or because it results in higher concentrations of pollutants in groundwater as a result of enhanced evaporation and reduced groundwater recharge. Ample clean water is not a luxury—it is essential for human survival. Consequently, cities, regions and nations that lack clean freshwater are vulnerable to social disruption and disease.

Finally, ocean acidification is linked to climate change because it is driven by CO2 emissions just as global warming is. With close to 20% of the world’s protein coming from oceans (FAO, 2016), the potential for severe impacts due to acidification is obvious. Less obvious, but perhaps more insidious, is the interaction between climate change and the loss of oyster and coral reefs due to acidification. Acidification is known to interfere with oyster reef building and coral reefs. Climate change also increases storm frequency and severity. Coral reefs and oyster reefs provide protection from storm surge because they reduce wave energy (Spalding et al., 2014). If these reefs are lost due to acidification at the same time as storms become more severe and sea level rises, coastal communities will be exposed to unprecedented storm surge—and may be ravaged by recurrent storms.

A key feature of the risk associated with climate change is that mean annual temperature and mean annual rainfall are not the variables of interest. Rather it is extreme episodic events that place nations and entire regions of the world at risk. These extreme events are by definition “rare” (once every hundred years), and changes in their likelihood are challenging to detect because of their rarity, but are exactly the manifestations of climate change that we must get better at anticipating (Diffenbaugh et al., 2017). Society will have a hard time responding to shorter intervals between rare extreme events because in the lifespan of an individual human, a person might experience as few as two or three extreme events. How likely is it that you would notice a change in the interval between events that are separated by decades, especially given that the interval is not regular but varies stochastically? A concrete example of this dilemma can be found in the past and expected future changes in storm-related flooding of New York City. The highly disruptive flooding of New York City associated with Hurricane Sandy represented a flood height that occurred once every 500 years in the 18th century, and that occurs now once every 25 years, but is expected to occur once every 5 years by 2050 (Garner et al., 2017). This change in frequency of extreme floods has profound implications for the measures New York City should take to protect its infrastructure and its population, yet because of the stochastic nature of such events, this shift in flood frequency is an elevated risk that will go unnoticed by most people.

4. The combination of positive feedback loops and societal inertia is fertile ground for global environmental catastrophes.

Humans are remarkably ingenious, and have adapted to crises throughout their history. Our doom has been repeatedly predicted, only to be averted by innovation (Ridley, 2011). However, the many stories of human ingenuity successfully addressing existential risks such as global famine or extreme air pollution represent environmental challenges that are largely linear, have immediate consequences, and operate without positive feedbacks. For example, the fact that food is in short supply does not increase the rate at which humans consume food—thereby increasing the shortage. Similarly, massive air pollution episodes such as the London fog of 1952 that killed 12,000 people did not make future air pollution events more likely. In fact it was just the opposite—the London fog sent such a clear message that Britain quickly enacted pollution control measures (Stradling, 2016). Food shortages, air pollution, water pollution, etc. send immediate signals to society of harm, which then trigger a negative feedback of society seeking to reduce the harm.

In contrast, today’s great environmental crisis of climate change may cause some harm but there are generally long time delays between rising CO2 concentrations and damage to humans. The consequence of these delays are an absence of urgency; thus although 70% of Americans believe global warming is happening, only 40% think it will harm them (http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/). Secondly, unlike past environmental challenges, the Earth’s climate system is rife with positive feedback loops. In particular, as CO2 increases and the climate warms, that very warming can cause more CO2 release which further increases global warming, and then more CO2, and so on. Table 2 summarizes the best documented positive feedback loops for the Earth’s climate system. These feedbacks can be neatly categorized into carbon cycle, biogeochemical, biogeophysical, cloud, ice-albedo, and water vapor feedbacks. As important as it is to understand these feedbacks individually, it is even more essential to study the interactive nature of these feedbacks. Modeling studies show that when interactions among feedback loops are included, uncertainty increases dramatically and there is a heightened potential for perturbations to be magnified (e.g., Cox, Betts, Jones, Spall, & Totterdell, 2000; Hajima, Tachiiri, Ito, & Kawamiya, 2014; Knutti & Rugenstein, 2015; Rosenfeld, Sherwood, Wood, & Donner, 2014). This produces a wide range of future scenarios.

Positive feedbacks in the carbon cycle involves the enhancement of future carbon contributions to the atmosphere due to some initial increase in atmospheric CO2. This happens because as CO2 accumulates, it reduces the efficiency in which oceans and terrestrial ecosystems sequester carbon, which in return feeds back to exacerbate climate change (Friedlingstein et al., 2001). Warming can also increase the rate at which organic matter decays and carbon is released into the atmosphere, thereby causing more warming (Melillo et al., 2017). Increases in food shortages and lack of water is also of major concern when biogeophysical feedback mechanisms perpetuate drought conditions. The underlying mechanism here is that losses in vegetation increases the surface albedo, which suppresses rainfall, and thus enhances future vegetation loss and more suppression of rainfall—thereby initiating or prolonging a drought (Chamey, Stone, & Quirk, 1975). To top it off, overgrazing depletes the soil, leading to augmented vegetation loss (Anderies, Janssen, & Walker, 2002).

Climate change often also increases the risk of forest fires, as a result of higher temperatures and persistent drought conditions. The expectation is that forest fires will become more frequent and severe with climate warming and drought (Scholze, Knorr, Arnell, & Prentice, 2006), a trend for which we have already seen evidence (Allen et al., 2010). Tragically, the increased severity and risk of Southern California wildfires recently predicted by climate scientists (Jin et al., 2015), was realized in December 2017, with the largest fire in the history of California (the “Thomas fire” that burned 282,000 acres, https://www.vox.com/2017/12/27/16822180/thomas-fire-california-largest-wildfire). This catastrophic fire embodies the sorts of positive feedbacks and interacting factors that could catch humanity off-guard and produce a true apocalyptic event. Record-breaking rains produced an extraordinary flush of new vegetation, that then dried out as record heat waves and dry conditions took hold, coupled with stronger than normal winds, and ignition. Of course the record-fire released CO2 into the atmosphere, thereby contributing to future warming.

Out of all types of feedbacks, water vapor and the ice-albedo feedbacks are the most clearly understood mechanisms. Losses in reflective snow and ice cover drive up surface temperatures, leading to even more melting of snow and ice cover—this is known as the ice-albedo feedback (Curry, Schramm, & Ebert, 1995). As snow and ice continue to melt at a more rapid pace, millions of people may be displaced by flooding risks as a consequence of sea level rise near coastal communities (Biermann & Boas, 2010; Myers, 2002; Nicholls et al., 2011). The water vapor feedback operates when warmer atmospheric conditions strengthen the saturation vapor pressure, which creates a warming effect given water vapor’s strong greenhouse gas properties (Manabe & Wetherald, 1967).

Global warming tends to increase cloud formation because warmer temperatures lead to more evaporation of water into the atmosphere, and warmer temperature also allows the atmosphere to hold more water. The key question is whether this increase in clouds associated with global warming will result in a positive feedback loop (more warming) or a negative feedback loop (less warming). For decades, scientists have sought to answer this question and understand the net role clouds play in future climate projections (Schneider et al., 2017). Clouds are complex because they both have a cooling (reflecting incoming solar radiation) and warming (absorbing incoming solar radiation) effect (Lashof, DeAngelo, Saleska, & Harte, 1997). The type of cloud, altitude, and optical properties combine to determine how these countervailing effects balance out. Although still under debate, it appears that in most circumstances the cloud feedback is likely positive (Boucher et al., 2013). For example, models and observations show that increasing greenhouse gas concentrations reduces the low-level cloud fraction in the Northeast Pacific at decadal time scales. This then has a positive feedback effect and enhances climate warming since less solar radiation is reflected by the atmosphere (Clement, Burgman, & Norris, 2009).

The key lesson from the long list of potentially positive feedbacks and their interactions is that runaway climate change, and runaway perturbations have to be taken as a serious possibility. Table 2 is just a snapshot of the type of feedbacks that have been identified (see Supplementary material for a more thorough explanation of positive feedback loops). However, this list is not exhaustive and the possibility of undiscovered positive feedbacks portends even greater existential risks. The many environmental crises humankind has previously averted (famine, ozone depletion, London fog, water pollution, etc.) were averted because of political will based on solid scientific understanding. We cannot count on complete scientific understanding when it comes to positive feedback loops and climate change.

# CASE

## AT: Contention 1

### 1NC – AT: Contention 1

#### Non unique they concede it still happens with public just slower

#### Squo thumps – already happened in the squo

#### Physics and math proofs prove no impact.

Cairncross 17 [Duncan Cairncross, Retired Planetary Science Engineer, BSc in Mechanical Engineering from the University of Glasgow, Diploma in Management DMS, Business Administration and Management, General from Teeside University, Former Asset Management Officer for the Gore District Council, “Is the Kessler Syndrome Disputed By Some Scientists?”, Quora, 10/25/2017, https://www.quora.com/Is-the-Kessler-Syndrome-disputed-by-some-scientists

Lets look at some numbers - we are talking LEO - so anything very small will de-orbit itself quite fast from atmospheric drag

These lumps are going the same direction - at similar speeds - as our satellites - so we are not talking about km/sec impacts - just rifle bullet speeds - 300 m/sec at maximum and the vast majority would have much much lower speeds

Everything is in a torus

Altitude 100 km to 300 km, - 1000 km North to 1000 km South - and about 40,000 km long

200 x 2000 x 40,000 = volume 16 billion cubic km -

18,000 Big bits - 100 mm - including 1,200 satellites

750,000 “bullets” - 10 mm

150 million bits 1 mm

Small bits we will ignore as they will not be going fast enough relative to our satellite to cause damage - and they will de-orbit quite fast

So one “bullet” for every 21,000 cubic km

That does not sound like too dangerous a neighborhood!

What happens if start some sort of cascade?

There is not much to cascade - 18,000 - “big bits” - if each of them became 1000 “bullets” then we would have 18 million “bullets” + the existing 750,000 bullets

And that is erring on the generous side - these bits are mostly metallic and metals don’t shatter into lots of 10 mm bits when hit by rifle bullets

That would be one “bullet” for every 853 cubic km AND most of the “bullets” will not actually be going very fast

Some time in the future when we have a lot mor,e as in a 100,000 times as much stuff in orbit then the Kessler Syndrome may be possible

If you are worried about communication satellites way up there in geostationary orbit then the situation is even better - there is a LOT more space up there and we have boosted a lot less junk up to those orbits

It is worth tracking the big bits and making sure that most satellites are safely de-orbited? - YES

But worrying about a Kessler Syndrome? - no not really

#### Long timeframe and squo solves.

Kurt 15 [Joseph Kurt, JD- William & Mary School of Law, BA-Marquette University, NOTE: TRIUMPH OF THE SPACE COMMONS: ADDRESSING THE IMPENDING SPACE DEBRIS CRISIS WITHOUT AN INTERNATIONAL TREATY, 40 Wm. & Mary Envtl. L. & Pol'y Rev. 305 (2015)]

A. Practical Considerations: Feasible Solutions to the Space Debris Problem Are on Their Way

One key question in assessing whether an international treaty is a requisite for solving the space debris problem is just how difficult it will be to fashion a remedy. The more complex and costly are feasible solutions, the more likely it is that a comprehensive regime is necessary to bind the various actors together. 93Link to the text of the note

A good place to begin is to determine just how imminent is the onset of the cascade of exponentially more frequent debris-creating collisions, known as the Kessler Syndrome. 94Link to the text of the note To be certain, no one can be sure--this phenomenon being subject to highly complex probabilities. 95Link to the text of the note Indeed, experts' estimates of when such a cascade will become irreversible vary [\*316] widely. 96Link to the text of the note The National Research Council produced a report in 2011 that suggested that "space might be just 10 or 20 years away from severe problems." 97Link to the text of the note In fact, the cascading effect has already begun, albeit at a modest pace. 98Link to the text of the note However, Donald Kessler, who first described the eponymous effect in 1978, has significantly recalibrated his own outlook over the years. 99Link to the text of the note Originally, Kessler predicted that catastrophe would result by the year 2000. 100Link to the text of the note That date long passed, Kessler now speaks of a century-long process that "we have time to deal with." 101Link to the text of the note

Nevertheless, few would disagree with Cristophe Bonnal of the Centre National d'Études Spatiales ("CNES"), the French space agency, who says that it is "not yet clear" how much time we have to act. 102Link to the text of the note None of this is to say that interested parties should not act with great dispatch to address the space debris problem. Even if catastrophe is not on the immediate horizon--as some have suggested--Heiner Klinkrad, the European Space Agency's leading authority on space debris points out that "[t]he longer you wait, the more difficult and far more expensive" any solution will be. 103Link to the text of the note

The additional slack in plausible timelines is cause for optimism when one considers the progress being made towards remediating the problem of space debris. Such remediation entails a three-pronged approach: preventive measures to reduce the creation of new debris, 104Link to the text of the note space debris tracking technologies, 105Link to the text of the note and active debris removal ("ADR"). 106Link to the text of the note

In an effort to address the first prong, the United Nations General Assembly in 2007 endorsed the COPUOS Space Debris Mitigation Guidelines. 107Link to the text of the note The recommended measures include design changes which would [\*317] avoid the previously common practice of releasing debris during standard operations, refraining from intentional destruction of space objects, and limiting the risk of collisions through avoidance maneuvers and delaying launch times. 108Link to the text of the note As the COPUOS document points out, many of these practices had already been adopted by spacefaring nations. 109Link to the text of the note

Compliance with the COPUOS Mitigation Guidelines is voluntary and has not been universal; 110Link to the text of the note however, many nations do take steps beyond those called for in the Mitigation Guidelines, recognizing the importance of redressing the issue. 111Link to the text of the note That said, even if no nation ever again launched a single object into outer space, the operation of the Kessler Syndrome would ensure that, over time, continuing collisions amongst already present objects would result in Earth's orbit being rendered unusable. 112Link to the text of the note

Improvements in space debris tracking technology are another partial solution that promises to help actors avoid collisions by identifying orbital debris in the path of satellites or spacecraft. 113Link to the text of the note There are limits on the effectiveness of such tracking, however, including the inability of some optical systems to track objects at night. 114Link to the text of the note Moreover, commonly employed systems cannot continually track objects smaller than thirty centimeters in diameter. 115Link to the text of the note New systems are being developed, however, that will use lasers that can track the location of objects as small as a softball--sometimes to within one meter. 116Link to the text of the note Such technology is still at the planning stage for NASA, 117Link to the text of the note but Lockheed Martin is teaming up with an Australian-based company on a laser-tracking project already in the works. 118Link to the text of the note Another promising development comes from scientists at the Massachusetts Institute of Technology, who are working on soccer-ball-sized robots [\*318] designed to travel alongside the ISS, investigating potentially harmful space debris along the way. 119Link to the text of the note

But while tracking space debris can help avoid specific accidents, and thus slow the machinations of the Kessler Syndrome, only ADR can stabilize the space environment. 120Link to the text of the note

Fortunately, the targets for ADR that scientists believe will allow us to forestall an irreversible cascade of collisions are relatively modest. 121Link to the text of the note The most common estimate is that removing five to ten large pieces of debris per year is enough to keep the Kessler Syndrome at bay. 122Link to the text of the note And even more encouraging is that a broad array of national and private actors are exploring a plethora of ADR methods. 123Link to the text of the note For example, the Japanese hope to deploy, by 2019, a magnetic net that will draw pieces of space debris down to the Earth's atmosphere, where they will burn up. 124Link to the text of the note Such use of the atmosphere to incinerate debris is a common element of many ADR strategies, whether they employ nets, harpoons, tentacles, or ion thrusters to impact the debris. 125Link to the text of the note Meanwhile, a German Space Agency program is developing the means to robotically capture satellites. 126Link to the text of the note Other solutions include using enormous puffs of air, static electricity, or lasers to throw objects out of orbit. 127Link to the text of the note

Obviously, such projects carry a hefty price tag, but funding is coming in from a variety of sources. 128Link to the text of the note A laser-based project being developed by Australian National University, for example, received $ 20 million from the Australian government and an additional $ 130 million from NASA and other international public and private actors. 129Link to the text of the note But even these sums [\*319] are dwarfed by the $ 2 billion that Russia's leading space corporation, Energia, is investing in a nuclear-powered pod that it hopes to deploy by 2023. 130Link to the text of the note This pod will fly around space for fifteen years, knocking debris out of the atmosphere using an ion drive. 131Link to the text of the note

That substantial investments in ADR technologies have seemingly put us on the cusp of possessing the technology to stabilize the space environment significantly undermines claims that incentives to solve the orbital debris problem are lacking because of its nature as a "tragedy of the commons". 132Link to the text of the note Successful implementation of a solution is still years away--and can't be presumed. But taken together with the fact that we likely have a decades-long window to redress the problem, 133Link to the text of the note Col. Joseph Imburgia's 2011 warning that "a binding international agreement is needed to provide stability and order . . . and to preserve mankind's access to and through space" looks less and less prescient. 134Link to the text of the note

#### Non UQ – squo debris thumps

Orwig 16 [(Jessica, MS in science and tech journalism from Texas A&M, BS in astronomy and physics from Ohio State) “Russia says a growing problem in space could be enough to spark a war,” Insider,’ January 26, 2016, <https://www.businessinsider.com/russia-says-space-junk-could-spark-war-2016-1>] TDI

NASA has already [warned that](https://www.businessinsider.com/space-junk-at-critical-density-2015-9) the large amount of space junk around our planet is growing beyond our control, but now a team of Russian scientists has cited another potentially unforeseen consequence of that debris: War. Scientists estimate that anywhere from 500,000 to 600,000 pieces of human-made space debris between 0.4 and 4 inches in size are currently orbiting the Earth and traveling at speeds over [17,000 miles per hour](https://www.nasa.gov/mission_pages/station/news/orbital_debris.html). If one of those pieces smashed into a military satellite it "may provoke political or even armed conflict between space-faring nations,"

### 1NC – AT: Nuke War

#### Empirics – we’ve nuked ourselves 2,000 times and the largest event was only 1/1000th as powerful as natural disasters

Eken 17 [Mattias Eken - PhD student in Modern History at the University of St Andrews. “The understandable fear of nuclear weapons doesn’t match reality”. 3/14/17. <https://theconversation.com/the-understandable-fear-of-nuclear-weapons-doesnt-match-reality-73563>] // Re-Cut Justin

Nuclear weapons are unambiguously the most destructive weapons on the planet. Pound for pound, they are the most lethal weapons ever created, capable of killing millions. Millions live in fear that these weapons will be used again, with all the potential consequences. However, the destructive power of these weapons **has been vastly exaggerated**, albeit for good reasons. Public fear of nuclear weapons being used in anger, whether by terrorists or nuclear-armed nations, has risen once again in recent years. **This is** in no small part **thanks to the current political climate** between states such as the US and Russia and the various nuclear tests conducted by North Korea. But whenever we talk about nuclear weapons, it’s easy to get carried away with doomsday scenarios and apocalyptic language. As the historian Spencer Weart once argued: “**You say ‘nuclear bomb’ and everybody immediately thinks of the end of the world.**” Yet the means necessary to produce a nuclear bomb, let alone set one off, remain incredibly complex – and while the damage that would be done if someone did in fact detonate one might be very serious indeed, **the chances that it would mean “the end of the world” are vanishingly small**. In his 2013 book Command and Control, the author Eric Schlosser tried to scare us into perpetual fear of nuclear weapons by recounting stories of near misses and accidents involving nuclear weapons. One such event, the 1980 Damascus incident, saw a Titan II intercontinental ballistic missile explode at its remote Arkansas launch facility after a maintenance crew accidentally ruptured its fuel tank. Although the warhead involved in the incident didn’t detonate, Schlosser claims that “if it had, much of Arkansas would be gone”. But that’s not quite the case. The nine-megaton thermonuclear warhead on the **Titan II** missile had a blast radius of 10km, or an area of about 315km². The state of Arkansas spreads over 133,733km², meaning the weapon **would have caused destruction across 0.2% of the state.** That would naturally have been a terrible outcome, but certainly not the catastrophe that Schlosser evokes. Claims exaggerating the effects of nuclear weapons have become commonplace, especially after the September 11 terrorist attacks in 2001. In the early War on Terror years, Richard Lugar, a former US senator and chair of the Senate Foreign Relations Committee, argued that terrorists armed with nuclear weapons pose an existential threat to the Western way of life. What he failed to explain is how. It is by no means certain that a single nuclear detonation **(or even several)** would do away with our current way of life. Indeed, **we’re still here despite having nuked our own planet more than 2,000 times** – a tally expressed beautifully in this video by Japanese artist Isao Hashimoto). While the 1963 Limited Test Ban Treaty forced nuclear tests underground, **around 500 of** all **the nuclear weapons detonated were unleashed in the Earth’s atmosphere**. This includes the world’s largest ever nuclear detonation, the 57-megaton bomb known as **Tsar Bomba**, detonated by the Soviet Union on October 30 1961. Tsar Bomba was more than 3,000 times more powerful than the bomb dropped on Hiroshima. That is immense destructive power – but as one physicist explained, **it’s only “one-thousandth the force of an earthquake, one-thousandth the force of a hurricane”.** The Damascus incident proved how incredibly hard it is to set off a nuclear bomb and the limited effect that would have come from just one warhead detonating. Despite this, some scientists have controversially argued that an even limited all-out nuclear war might lead to a so-called nuclear winter, since the smoke and debris created by very large bombs could block out the sun’s rays for a considerable amount of time. To inflict such ecological societal annihilation with weapons alone, we would have to detonate hundreds if not thousands of thermonuclear devices in a short time. Even in such extreme conditions, the area actually devastated by the bombs would be limited: for example, **2,000 one-megaton explosions with a destructive radius of five miles each would directly destroy less than 5% of the territory of the US**. Of course, if the effects of nuclear weapons have been greatly exaggerated, there is a very good reason: since these weapons are indeed extremely dangerous, any posturing and exaggerating which intensifies our fear of them makes us less likely to use them. But it’s important, however, to understand why people have come to fear these weapons the way we do. After all, nuclear weapons are here to stay; they can’t be “un-invented”. If we want to live with them and mitigate the very real risks they pose, we must be honest about what those risks really are. Overegging them to frighten ourselves more than we need to keeps nobody safe.

#### Nuclear war now spurs political will for disarmament without causing extinction.

Deudney 18 [Associate Professor of Political Science at Johns Hopkins University. 03/15/2018. “The Great Debate.” The Oxford Handbook of International Security. www.oxfordhandbooks.com, doi:10.1093/oxfordhb/9780198777854.013.22] Recut Justin

Although nuclear war is the oldest of these technogenic threats to civilization and human survival, and although important steps to restraint, particularly at the end of the Cold War, have been achieved, the nuclear world is increasingly changing in major ways, and in almost entirely dangerous directions. The third “bombs away” phase of the great debate on the nuclear-political question is more consequentially divided than in the first two phases. Even more ominously, most of the momentum lies with the forces that are pulling states toward nuclear-use, and with the radical actors bent on inflicting catastrophic damage on the leading states in the international system, particularly the United States. In contrast, the arms control project, although intellectually vibrant, is largely in retreat on the world political stage. The arms control settlement of the Cold War is unraveling, and the world public is more divided and distracted than ever. With the recent election of President Donald Trump, the United States, which has played such a dominant role in nuclear politics since its scientists invented these fiendish engines, now has an impulsive and uninformed leader, boding ill for nuclear restraint and effective crisis management. Given current trends, it is prudent to assume that sooner or later, and probably sooner, nuclear weapons will again be the used in war. But this bad news may contain a “silver lining” of good news. Unlike a general nuclear war that might have occurred during the Cold War, such a nuclear event now would probably not mark the end of civilization (or of humanity), due to the great reductions in nuclear forces achieved at the end of the Cold War. Furthermore, politics on “the day after” could have immense potential for positive change. The survivors would not be likely to envy the dead, but would surely have a greatly renewed resolution for “never again.” Such an event, completely unpredictable in its particulars, would unambiguously put the nuclear-political question back at the top of the world political agenda. It would unmistakeably remind leading states of their vulnerability It might also trigger more robust efforts to achieve the global regulation of nuclear capability. Like the bombings of Hiroshima and Nagasaki that did so much to catalyze the elevated concern for nuclear security in the early Cold War, and like the experience “at the brink” in the Cuban Missile Crisis of 1962, the now bubbling nuclear caldron holds the possibility of inaugurating a major period of institutional innovation and adjustment toward a fully “bombs away” future.

#### That’s good – war later is worse

Turchin & Denkenberger 18 [Alexey Turchin & David Denkenberger. Turchin is a researcher at the Science for Life Extension Foundation; Denkenberger is with the Global Catastrophic Risk Institute (GCRI) @ Tennessee State University, Alliance to Feed the Earth in Disasters (ALLFED). 09/2018. “Global Catastrophic and Existential Risks Communication Scale.” Futures, vol. 102, pp. 27–38.]

2. “Civilizational collapse risks” As most human societies are fairly complex, a true civilizational collapse would require a drastic reduction in human population, and the break-down of connections between surviving populations. Survivors would have to rebuild civilization from scratch, likely losing much technological abilities and knowledge in the process. Hanson (2008) estimated that the minimal human population able to survive is around 100 people. Like X risks, there is little agreement on what is required for civilizational collapse. Clearly, different types and levels of the civilizational collapse are possible (Diamond, 2005) (Meadows, Randers, & Meadows, 2004). For instance, one definition of the collapse of civilization involves, collapse of long distance trade, widespread conflict, and loss of government (Coates, 2009). How such collapses relate to existential risk needs more research. 3. “Human extinction risks” are risks that all humans die, and no future generations (in the extended sense mentioned above) will ever exist. 4. “All life on Earth ends risks” involve the extinction of all life on earth. As this includes H. sapiens, such risks are at the very least on a par with human extinction, but are likely worse as the loss of biodiversity is higher, and (without life arising a second time) no other civilizations, human or otherwise, would be possible on Earth. 5. “Astronomical scale risks” include the demise of all civilizations in the affectable universe. This of course includes human extinction, and all life on Earth, and so again are at the very least on a par, and very likely much worse outcomes, than those two. 6. “S-risks” include collective infinite suffering (Daniel, 2017). These differ from extinction risks insofar as extinction leads to a lack of existence, whereas this concerns ongoing existence in undesirable circumstances. These also vary in scale and intensity, but are generally out of scope of this work. Even with a focus squarely on X Risk, global catastrophic risks and civilizational collapse are critically important. This is because there is at least some likelihood that global catastrophic risks increase the probability of human extinction risks—and the more extreme end of civilizational collapses surely would. Before shifting to a discussion of probability appropriate to X risk, we’ll discuss some reasons to link these kinds of risk. First, global risks may have a fat tail—that is a low probability of high consequences—and the existence of such fat tails strongly depend on the intrinsic uncertainty of global systems (Ćirković, 2012) (Baum, 2015), (Wiener, 2016) (Sandberg & Landry, 2015). This is especially true for risks associated with future world wars, which may include not only nuclear weapons, but weapons incorporating synthetic biology and nanotechnology, different AI technologies, as well as Doomsday blackmail weapons (Kahn, 1959). Another case are the risks associated with climate change, where runaway global warming is a likely fat tail (Obata & Shibata, 2012a), (Goldblatt & Watson, 2012). Second, global catastrophes could be part of double catastrophe (Baum, Maher, & Haqq-Misra, 2013) or start a chain of catastrophes (Tonn & and MacGregor, 2009), and in this issue (Karieva, 2018). Even if a single catastrophic risk is insufficient to wipe us out, an unhappy coincidence of such events could be sufficient, or under the wrong conditions could trigger a collapse leading to human extinction. Further, global catastrophe could weaken our ability to prepare for other risks. Luke Oman has estimated the risks of human extinction because of nuclear winter: “The probability I would estimate for the global human population of zero resulting from the 150 Tg of black carbon scenario in our 2007 paper would be in the range of 1 in 10,000 to 1 in 100,000” (Robock, Oman, & Stenchikov, 2007), (Shulman, 2012). Tonn also analyzed chains of events, which could result in human extinction and any global catastrophe may be a start of such chain (Tonn and MacGregor, 2009). Because this, we suggest that any global catastrophe should be regarded as a possible cause of human extinction risks with no less than 0.01 probability. Similarly, scenarios involving civilization collapses also plausibly increase the risk of human extinction. If civilization collapses, recovery may be slowed or stopped for a multitude of reasons. For instance, easily accessible mineral and fossil fuel resources might be no longer available, the future climate may be extreme or unstable, we may not regain sufficient social trust after the catastrophe’s horrors, the catastrophe may affect our genetics, a new endemic disease could prevent high population density, and so on. And of course, the smaller populations associated with civilization collapse are more vulnerable to being wiped out by natural events. We estimate that civilization collapse has a 0.1 probability of becoming an existential catastrophe. In section 4, this discussion will form the basis of our analysis of an X risk’s “severity”, which is the main target of our scale. Before getting there, however, we should first discuss the difficulties of measuring X risks, and related worries regarding probabilities. 3. Difficulties of using probability estimates as the communication tool Plain probability estimates are often used as an instrument to communicate X risks. An example is a claim like “Nuclear war could cause human extinction with probability P”. However, in our view, probability measures are inadequate, both for measuring X risks, and for communicating those risks. This is because of conceptual difficulties (3.1), difficulty in providing meaningful measurements (3.2), the possibility of interaction effects (3.3) and the measurement’s inadequacy for prioritization (3.4) purposes. After presenting these worries, we argue that the magnitude of probabilities is a better option, which we use in our tool (3.5). 3.1 Difficulties in defining X risk probabilities Frequentism applies to X risks only with difficulty. One-off events don’t have a frequency, and multiple events are required for frequentist probabilities to apply. Further, on a frequentist reading, claims concerning X risks cannot be falsified. Again, this is because in order to infer from occurrences to probability, multiple instances are required. Although these conceptual and epistemic difficulties may be analyzed and partly overcome in technical scientific and philosophical literature, they would overcomplicate a communication tool. Also, discussion of X risks sometimes involves weird probabilistic effects. Consider, for example, what (Ćirković, Sandberg, & Bostrom, 2010) call the ‘anthropic shadow’. Because human extinction events entail a lack of humans to observe the event after the fact, we will systematically underestimate the occurrence of such events in an extreme case of survivorship bias (the Doomsday Argument (Tegmark & Bostrom, 2005) is similar). All of this makes the probabilities attached to X risks extremely difficult to interpret, bad news for an intended communication tool, and stimulates obscure anthropic reasoning. In addition, the subtle features involved in applying frequentism to one-off events, would otherwise tamper with our decision making process. 3.2 Data & X Risk There are little hard data concerning global risks from which probabilities could be extracted. The risk of an asteroid impact is fairly well understood, both due to the historical record, and because scientists can observe particular asteroids and calculate their trajectories. Studies of nuclear winter (Denkenberger & Pearce, 2016), volcanic eruptions, and climate change also provide some risk probability estimates, but are less rigorously supported. In all other cases, especially technological risks, there are many (often contradicting) expert opinions, but little hard data. Those probability calculations which have been carried out are based on speculative assumptions, which carry their own uncertainty. In the best case, generally, only the order of magnitude of the catastrophe’s probability can be estimated. Uncertainty in GCRs is so high, that predictions with high precision are likely to be meaningless. For example, surveys could produce such meaningless over-precision. A survey on human extinction probability gave an estimate of 19 percent in the 21st century (Sandberg & Bostrom, 2008). Such measurements are problematic for communication, because probability estimates of global risks often do not include corresponding confidence intervals (Garrick, 2008). For some catastrophic risks, uncertainty is much larger than for others, because of objective difficulties in their measurement, as well as subjective disagreements between various approaches (especially in the case of climate change, resource depletion, population growth and other politicized areas). As we’ll discuss below, one response is to present probabilities as magnitudes. 3.3 Probability density, timing and risks’ interactions Two more issues with using discrete frequentist probabilities for communicating X risks are related to probability density and the interactions between risks. For the purpose of responding to the challenges of X risk, the total probability of an event is less useful than the probability density: we want to know not only the probability but the time in which it is measured. This is crucial if policy makers are to prioritize avoidance efforts. Also, probability estimates of the risks are typically treated separate: interdependence is thus ignored. The total probability of human extinction caused by risk A could strongly depend on the extinction probability caused by risks B and C and also of their timing. (See also double catastrophes discussed by Baum, Maher, & HaqqMisra, 2013 and the integrated risk assessment project (Baum, 2017). Further, probability distributions of different risks can have different forms. Some risks are linear, others are barrier-like, other logistical. Thus, not all risks can be presented by a single numerical estimate. Exponentially growing risks may be the best way to describe new technologies, such as AI and synthetic biology. Such risks cannot be presented by a single annual probability. Finally, the probability estimation of a risk depends on whether human extinction is ultimately inevitable. We assume that if humanity becomes an interstellar civilization existing for millions of years, it will escape any near-term extinction risks; the heat death of the universe may be ultimate end, but some think even that is escapable (Dvorsky, 2015). If near-term extinction is inevitable, it is possible to estimate which risks are more probable to cause human extinction (like actuaries do in estimating different causes of death, based in part on the assumption that human death is inevitable). If near-term human extinction is not inevitable, then there is a probability of survival, which is (1- P(all risks)). Such conditioning requires a general model of the future. If extinction is inevitable, the probability of a given risk is just a probability of one way to extinction compared to other ways. 3.4 Preventability, prioritizing and relation to the smaller risks Using bare probability as a communication tool also ignores many important aspects of risks which are substantial for decision makers. First, a probability estimate does not provide sufficient guidance on how to prioritize prevention efforts. A probability estimate does not say anything about the risk’s relation to other risks, e.g. its urgency. Also, if a risk will take place at a remote time in the future (like the Sun becoming a red giant), there is no reason to spend money on its prevention. Second, a probability estimate does not provide much information about the relation of human extinction risks, and corresponding smaller global catastrophic risks. For example, a nuclear war probability estimate does not disambiguate between chances that it will be a human extinction event, a global catastrophic event, or a regional catastrophe. Third, probability measures do not take preventability into account. Hopefully, measures will be taken to try and reduce X risks, and the risks themselves have individual preventability. Generally speaking, it ought to be made clear when probabilities are conditional on whether prevention is attempted or not, and also on the probability of its success. Probability density, and its relation with cumulative probability could also be tricky, especially as the probability density of most risks is changing in time. 3.5 Use of probability orders of magnitude as a communication tool We recommend using magnitudes of probabilities in communicating about X risk. One way of overcoming many of the difficulties of using probabilities as communication tool described above is to estimate probabilities with fidelity of one or even two orders of magnitude, and do it over large fixed interval of time, that is the next 100 years (as it the furthest time where meaningful prognoses exist). This order of magnitude estimation will smooth many of the uncertainties described above. Further, prevention actions are typically insensitive in to the exact value of probability. For example, if a given asteroid impact probability is 5% or 25%, needed prevention action will be nearly the same. For X risks, we suggest using probability intervals of 2 orders of magnitude. Using such intervals will often provide meaningful differences in probability estimates for individual risks. (However, expert estimates sometimes range from “inevitable” to “impossible”, as in AI risks). Large intervals will also accommodate the possibility of one risk overshadowing another, and other uncertainties which arise from the difficulties of defining and measuring X-risks. This solution is itself inspired by The Torino scale of asteroid danger, which we discuss in more detail below. The Torino scale has five probability intervals, each with a two order of magnitude difference from the next. Further, such intervals can be used to present uncertainty in probability estimation. This uncertainty is often very large for even approximately well-defined asteroid risks. For example, Garrick (Garrick, 2008) estimated that asteroid impacts on the contiguous US with at least 10 000 victims to have expected frequency between once 1: 1900 and 1: 520 000 years with 90 percent confidence. In other words, it used more than 2 orders of magnitude uncertainty. Of course, there is a lot more to be said about the relationship between X risks and probability—however here we restrict ourselves to those issues most crucial for our purpose, that is, designing a communication tool for X risks. 4. Constructing the scale of human extinction risks 4.1. Existing scales for different catastrophic risks In section 2 we established the connection between global catastrophic risks, civilizational collapse risks, human extinction and X risks; we explored the difficulty of the use of probabilities as a communication tool for X risks in section 3; now we can construct the scale to communicate the level of risk of all global catastrophic and X risks. Our scale is inspired by the Torino scale of asteroid danger which was suggested by professor Richard Binzel (Binzel, 1997). As it only measures the energy of impact, it is not restricted to asteroids but applies to many celestial bodies (comets, for instance). It was first created to communicate the level of risk to the public, because professionals and decision makers have access to all underlying data for the hazardous object. The Torino scale combines a 5 level color code and 11 level numbered codes. One of the Torino scale’s features is that it connects the size and the probability using diagonal lines, i.e., an event with a bigger size and smaller probability warrants the same level of attention as smaller but more probable events. However, this approach has some difficulties, as was described by (Cox, 2008). There are several other scales of specific global risks based on similar principles: 1. Volcanic explosivity index, VEI, 0-8, (USGS, 2017) 2. DEFCON (DEFense readiness CONdition, used by the US military to describe five levels of readiness), from 5 to 1. 3. “Rio scale” of the Search for Extra-Terrestrial Intelligence (SETI) – complex scale with three subscales (Almar, 2011). 4. Palermo scale of asteroid risks compares the likelihood of the detected potential impactor with the average risk posed by objects of the same size measured both by energy and frequency (NASA, 2017). 5. San-Marino scale of risks of Messaging to Extra-Terrestrial Intelligence (METI) (Almar, 2007). The only more general scale for several global risks is the Doomsday Clock by the Bulletin of the Atomic Scientists, which shows global risks as minutes before midnight. It is oriented towards risks of a nuclear war and climate change and communicates only emotional impact (The Bulletin of the Atomic Scientists, 2017). 4.2. The goals of the scale How good a scale is depends in part on what it is intended to do: who will use it and how will they use it. There are three main groups of people the scale addresses: Public. Simplicity matters: a simple scale is required, similar to the hurricane Saffir-Simpson scale (Schott et al., 2012). This hurricane ACCEPTED MANUSCRIPT 13 measuring scale has 5 levels which present rather obscure wind readings as corresponding to the expected damage to houses and thus can help the public make decisions about preparedness and evacuation. In the case of X risks, personal preparedness is not very important, but the public make decisions about which prevention projects to directly support (via donations or crowdfunding) or voting for policymakers who support said projects. Simplicity is necessary to communicate the relative importance of different dangers to a wide variety of nonexperts. Policymakers. We intend our scale to help initiate communication of the relative importance of the risks to policymakers. This is particularly important as it appears that policymakers tend to overestimate smaller risks (like asteroid impact risks) and underestimate larger risks (like AI risks) (Bostrom, 2013). Our scale helps to make such comparison possible as it does not depend on the exact nature of the risks. The scale could be applicable to several groups of risks thus allowing comparisons between them, as well as providing a perspective across the whole situation. Expert community. Even a scale of the simplicity we suggest may benefit the expert community. It can act as a basis for comparing different risks by different experts. Given the interdisciplinarity inherent in studying X risk, this common ground is crucial. The scale could facilitate discussion about catastrophes’ probabilities, preventability, prevention costs, interactions, and error margins, as experts from different fields present arguments about the importance of the risks on which they work. Thus it will help to build a common framework for the risk discussions. 4.3. Color codes and classification of the needed actions Tonn and Steifel suggested a six-level classification of actions to prevent X risks (Tonn & Steifel, 2017). They start from “do nothing” and end with “extreme war footing, economy organized around reducing human extinction risk”. We suggest a scale which is coordinated with Tonn and Steifel’s classification of actions (Table 1), that is our colors correspond to the needed level of action. Also, our colors correspond to typical nonquantifiable ways of the risks description: theoretical, small, medium, serious, high and immediate. We also add iconic examples, which are risks where the probability distribution is known with a higher level of certainty, and thus could be used to communicate the risk’s importance by comparison. Such ACCEPTED MANUSCRIPT 14 examples may aid in learning the scale, or be used instead of the scale. For instance, someone could say: “this risk is the same level as asteroid risk”. The iconic risks are marked bold in the scale. Iconic examples are also illustrated with the best-known example of that type of event. For example, the best known supervolcanic eruption was the Toba eruption 74,000 years ago (Robock et al., 2009). The Chicxulub impact 66 million years ago is infamous for being connected with the latest major extinction, associated with the non-avian Dinosaur extinction. The scale presents the total risk of one type of event, without breaking categories down into subrisks. For example, it estimates the total risks of all known and unknown asteroids, but not the risk of any particular asteroid, which is a departure from the Torino scale. Although the scale is presented using probability intervals, it could be used instead of probabilities if they are completely unknown, but other factors, such as those affecting scope and severity, are known. For example, we might want to communicate that AI catastrophe is a very significant risk, but its exact probability estimation is complicated by large uncertainties. Thus we could agree to represent the risk as red despite difficulties of its numerical estimation. Note that the probability interval (when it is known) for “red” is shorter and is only 1 order of magnitude, as it is needed to represent most serious risks and here we need better resolution ability. As it is a communication scale, the scientists using it could come to agreement that a particular risk should be estimated higher or lower in this scale. We don’t want to place too many restrictions on how different aspects of a risk’s severity (like preventability or connection with other risks) should affect risks coding, as it should be established in the practical use of the scale. However, we will note two rules: 1. The purple color is reserved to present extreme urgency of the risk 2. The scale is extrapolated from the smaller than extinction risks and larger than extinction risks in Table 2. (This is based on idea that smaller risks have considerable but unknown probability to become human extinction risks, and also on the fact that policy makers may implement similar measures for smaller and larger risks). 4.4. Extrapolated version of scale which accounts for the risk size In Table 2 we extend the scale to include smaller risks like civilization collapse and global catastrophic risks as well as on “larger” ACCEPTED MANUSCRIPT 15 risks like life extinction and universe destruction, in accordance with our discussion in section 2. This is necessary because: 1) Smaller risks could become larger extinction risks by starting chains of catastrophic events. 2) The public and policymakers will react similarly to human extinction level catastrophe and to a global catastrophe where there will be some survival: both present similar dangers to personal survival, and in both similar prevention actions are needed. [[TABLE 2 OMITTED]] 4.5. Accessing risks with shorter timeframes than 100 years In Table 2 above we assessed the risks for the next 100 years. However, without prevention efforts, some risks could approach a probability of 1 in less time: climate change, for instance. We suggest that the urgency of intervening in such cases may be expressed by increasing their color coding. Moreover, the critical issue is less the timing of risks, but the timing of the prevention measures. Again, although extreme global warming would likely only occur at the end of the 21st century, it is also true that cutting emissions now would ameliorate the situation. We suggest, then, three ranks which incorporate these shorter time-frame risks. Note that the timings relate to implementation of interventions not the timings of the catastrophes. 1) Now. This is when a catastrophe has started, or may start in any moment: The Cuban Missile Crisis is an historical example. We reserve purple to represent it. 2) “Near mode”. Near mode is roughly the next 5 years. Typically current political problems (as in current relations with North Korea) are understood in near mode. Such problems are appropriately explored in terms of planning and trend expectations. Hanson showed that people are very realistic in “Near mode”, but become speculative and less moral in “Far mode” thinking (Hanson, 2010). Near mode may require one color code increase. 3) “Next 2-3 decades”. Many futurists predict a Technological Singularity between 2030-2050: that is around 10-30 years from now (Vinge, 1993), (Kurzweil, 2006). As this mode coincides with an adult’s working life, it may also be called “in personal life time”. In this mode people may expect to personally suffer from a catastrophe, or be personally responsible for incorrect predictions. MIRI recently increased its estimation of the probability that AGI will appear around 2035 (MIRI, 2017), pushing AGI into “next 2-3 decades” mode. There is a consideration against increasing the color code too much for near-term risks, as that may lead to myopia regarding longterm risks of human extinction. There will always be smaller but more urgent risks, and although these ought to be dealt with, some resources ought to be put towards understanding and mitigating the longer term. ACCEPTED MANUSCRIPT 19 Having said this, in high impact emergency situations, short term overwhelming efforts may help to prevent impending global catastrophe. Examples include the Cuban missile crisis and fighting the recent Ebola pandemic in Western Africa. Such short-term efforts do not necessarily constrain our long-term efforts towards preventing other risks. Thus, short term global catastrophic and larger risks may get a purple rating. 4.6. Detailed explanation of risk assessment principles in the color coded scale In Table 3, we estimate the main global risks, according to the scale suggested in section 4.4. Table 3. Detailed explanation of the X risks scale Color code Examples of risks White Sun becomes red giant. Although this risk is practically guaranteed, it is very remote indeed. Natural false vacuum decay. Bostrom and Tegmark estimated such events as happening in less than one in 1 billion years, (that is 10-7 in a century) (Tegmark & Bostrom, 2005). Moreover, nothing can be done to prevent it. Green Gamma-ray bursts. Earth threatening gamma-ray bursts are extremely rare, and in most cases they will result only in a crop failure due to UV increases. However, a close gamma-ray burst may produce a deadly muon shower which may kill everything up to 3 km in depth (A. Dar, Laor, & N.J, 1997). However, such events could happen less than once in a billion years (10-7 in a century) (Cirković & Vukotića, 2016). Such an event will probably kill all multicellular life on Earth. Dar estimates risks of major extinction events from gamma ray bursts as 1 in 100 mln years (A. Dar, 2001). Asteroid impacts. No dangerous asteroids have been thus far identified, and the background level of global catastrophic impacts is around 1 in a million years (10- 4 in a century). Extinction-level impact probability is 10-6 per century. There are several prevention options involving deflecting comets/asteroids. Also, food security could be purchased cheaply (Denkenberger, 2015). However, some uncertainty exists. Some periods involve intense comet bombardment, and if we are in such a time investment in telescopes should be larger (Rampino & Caldeira, 2015). High energy accelerator experiments creating false vacuum decay/black hole/strangelet. Vacuum decay seems to have extremely low probability, far below 10-8 currently. One obvious reason for expecting such events to have very low probability is that similar events happen quite often, and haven’t destroyed everything as yet (Kent, 2004). However, we give this event a higher estimation for two reasons. First, as accelerators become more capable such events might become more likely. Second, the risks are at an astronomical scale: it could affect other civilizations in the universe. Other types of accelerator catastrophes, like mini-black hole or strangelet creation, would only kill Earth life. However, these are more likely, with one estimate being <2E-8 risk from a single facility (the Relativistic Heavy Ion Collider) (Arnon Dar, De Rújula, & Heinz, 1999), which should be coded white. There many unknowns about dangerous experiments (Sandberg & Landry, 2015). Overall, these risks should be monitored, so green is advisable. Yellow Supervolcanic eruption. Given historical patterns, the likelihood of living in a century containing a super volcanic eruption is approximately 10-3 (Denkenberger, 2014). However, the chance of human extinction resulting is ACCEPTED MANUSCRIPT 21 significantly lower than this. If such an eruption produces global crop failure, it could end current civilization. Conventional wisdom is that there is nothing that could be done to prevent a super volcano from erupting, but some possible preventive measures have been suggested (Denkenberger, this issue). We estimate supervolcanic risks to be higher than asteroid impacts because of the historical record, as they likely nearly finished us off 74 000 ago (Robock et al., 2009). Natural pandemic. A natural pandemic is fairly likely to kill 1% (to an order of magnitude) of the global population during this century, as the Spanish flu did. However, such a pandemic is very unlikely to cause total extinction because lethality is under 100% and some populations are isolated. Between all natural pandemics, emerging pandemic flus have a shorter timespan and need much more attention. Bird flu has a mortality above 0.5 (WHO, 2017) and could produce widespread chaos and possible civilizational collapse if human-to-human transmission starts. Therefore, we estimate 10% probability this century of 10% mortality. Global warming triggering global catastrophe. According to the IPCC anthropogenic global warming may affect billions of people by the end of the 21st century (Parry, 2007), causing heat waves, crop failures and mass migration. Those events, and downstream consequences such as conflicts, could conceivably kill 1 billion people. However, this would only occur for tail risk scenarios which have order of magnitude 1% probability. Having said this, several experts think that methane release from permafrost and similar positive feedback loops may result in runaway global warming with much larger consequences (Obata & Shibata, 2012). Orange Full-scale nuclear war. There is roughly 0.02-7% chance per year of accidental full-scale nuclear war between the US and Russia (Barrett, Baum, & Hostetler, 2013). With fairly high probabilities of nuclear winter and civilization collapse given nuclear war, this is order of magnitude 10% this century. We should also take into consideration that despite reductions in nuclear weapons, a new nuclear arms race is possible in the 21st century. Such a race may include more devastating weapons or cheaper manufacturing methods. Nuclear war could include the creation of large cobalt bombs as doomsday weapons or attacks on nuclear power plants. It could also start a chain of events which result in civilization collapse. Nanotechnology risks. Although molecular manufacturing can be achieved without self-replicating machines (Drexler & Phoenix, 2004), technological fascination with biological systems makes it likely that self-replicating machines will be created. Moreover, catastrophic uses of nanotechnology needn’t be due to accident, but also due to the actions of purposeful malignant agents. Therefore, we estimate the chance of runaway self-replicating machines causing “gray goo” and thus human extinction to be one per cent in this century. There could also be extinction risks from weapons produced by safe exponential molecular manufacturing. See also (Turchin, 2016). Artificial pandemic and other risks from synthetic biology. An artificial multipandemic is a situation in which multiple (even hundreds) of individual viruses created through synthetic biology are released simultaneously either by a terrorist state or as a result of the independent activity of biohackers (Turchin, Green, & Dekenbergern, 2017). Because the capacity to create such a multipandemic could arrive as early as within the next ten to thirty years (as all the needed technologies already exist), it could overshadow future risks, like nanotech and AI, so we give it a higher estimate. There are also other possible risks, connected with synthetic biology, which are widely recognized as serious (Bostrom, 2002). Agricultural catastrophe. There is about a one per cent risk per year of a ten per cent global agricultural shortfall occurring due to a large volcanic eruption, a medium asteroid or comet impact, regional nuclear war, abrupt climate change, or extreme weather causing multiple breadbasket failures (Denkenberger 2016). This could lead to 10% mortality. Red AI risks. The risks connected with the possible creation of non-aligned Strong AI are discussed by (Bostrom, 2014), (Yudkowsky, 2008), (Yampolskiy & Fox, 2013) and others. It is widely recognized as the most serious X risk. AI could start an “intelligence explosion wave” through the Universe, which could prevent appearance of the other civilizations before they create their own AI. Purple Something like the Caribbean crisis in the past, but larger size. Currently, there are no known purple risks. If we could be sure that Strong AI will appear in the next 100 years and would probably be negative, it would constitute a purple risk. Another example would be the creation of a Doomsday weapon that could kill our species with global radiation poisoning (much greater ionizing radiation release than all of the current nuclear weapons) (Kahn, 1959). A further example would be a large incoming asteroid being located, or an extinction level pandemic has begun. These situations require quick and urgent effort on all levels.

## AT: Contention 2

### 1NC – AT: Contention 2

#### Squo solves – there are already restrictions put on companies right now by US

#### CP solves – it bans space travel

#### Self-link – the aff wants to avoid econ collapse so they link to their own case

#### Can’t solve – it exists in the real world so it’s inev

#### No impact has existed for hundreds of years noe xtinction

### 1NC – Cap Good

#### Cap/neolib is good:

#### It’s sustainable – data proves we’re entering the golden age

**Hausfather 21** – a climate scientist and energy systems analyst whose research focuses on observational temperature records, climate models, and mitigation technologies. He spent 10 years working as a data scientist and entrepreneur in the cleantech sector, where he was the lead data scientist at Essess, the chief scientist at C3.ai, and the cofounder and chief scientist of Efficiency 2.0. He also worked as a research scientist with Berkeley Earth, was the senior climate analyst at Project Drawdown, and the US analyst for Carbon Brief. He has masters degrees in environmental science from Yale University and Vrije Universiteit Amsterdam and a PhD in climate science from the University of California, Berkeley. (Zeke, "Absolute Decoupling of Economic Growth and Emissions in 32 Countries," Breakthrough Institute, 4-6-2021, https://thebreakthrough.org/issues/energy/absolute-decoupling-of-economic-growth-and-emissions-in-32-countries, Accessed 4-11-2021, LASA-SC)

The past 30 years have seen immense progress **in improving the quality of life for much of humanity**. Extreme poverty — the number of people living on less than $1.90 per day — has fallen by nearly two-thirds, from 1.9 **billion to** around 650 **million**. Life expectancy has risen in most of the world, along with literacy and access to education, while infant mortality has fallen. Despite perceptions to the contrary, **the average person born today is likely to have access to more opportunities and have a better quality of life than at any other point in human history**. Much of this increase in human wellbeing has been propelled by rapid economic growth driven largely by state-led industrial policy, particularly in poor-to-middle income countries. However, this growth has come at a cost: between 1990 and 2019, global emissions of CO2 **increased by 56%.** Historically, economic growth has been closely linked to increased energy consumption — and increased CO2 emissions in particular — leading some to argue that a more prosperous world is one that necessarily has more impacts on our natural environment and climate. There is a lively academic debate about our ability to “absolutely decouple” emissions and growth — that is, the extent to which the adoption of clean energy technology can allow emissions to decline while economic growth continues. Over the past 15 years, however, **something has begun to change.** Rather than a 21st century dominated by coal that energy modelers foresaw, **global coal use peaked in 2013 and is now in structural decline**. We have succeeded in making clean energy cheap, with solar power and battery storage costs falling 10-fold since 2009. The world produced more electricity from clean energy — solar, wind, hydro, and nuclear — than from coal over the past two years. And, according to some major oil companies, **peak oil is upon us** — not because we have run out of cheap oil to produce, but because demand is falling and companies expect further decline as consumers increasingly shift to electric vehicles. The world has long been experiencing a relative **decoupling** between economic growth and CO2 emissions, with the emissions per unit of GDP **falling for the past 60 years**. This is the case even in countries like **India and China** that have been undergoing rapid economic growth. But relative decoupling alone is inadequate in a world where global CO2 emissions need to peak and decline in the next decade to give us any chance at limiting warming to well below 2℃, in line with Paris Agreement targets. Thankfully, there is increasing evidence that the world is on track **to absolutely decouple CO2 emissions and economic growth** — with global CO2 emissions potentially having peaked in 2019 **and unlikely to increase substantially in the coming decade**. While an emissions peak is just the first and easiest step towards eventually reaching the net-zero emissions required to stop the world from continuing to warm, it demonstrates that linkages between emissions and economic activity are not an immutable law, but rather simply a result of our current means of energy production. In recent years we have seen more and more examples of absolute decoupling — economic growth accompanied by falling CO2 emissions. Since 2005, 32 countries with a population of at least one million people **have absolutely decoupled** emissions from economic growth, both for terrestrial emissions (those within national borders) and consumption emissions (emissions embodied in the goods consumed in a country). This includes the United States, Japan, Mexico, Germany, United Kingdom, France, Spain, Poland, Romania, Netherlands, Belgium, Portugal, Sweden, Hungary, Belarus, Austria, Bulgaria, El Salvador, Singapore, Denmark, Finland, Slovakia, Norway, Ireland, New Zealand, Croatia, Jamaica, Lithuania, Slovenia, Latvia, Estonia, and Cyprus. Figure 1, below, shows the declines in territorial emissions (blue) and increases in GDP (red). To qualify as having experienced absolute decoupling, we require countries included in this analysis to pass four separate filters: a population of at least one million (to focus the analysis on more representative cases), declining territorial emissions over the 2005-2019 period (based on a linear regression), declining consumption emissions, and increasing real GDP (on a purchasing power parity basis, using constant 2017 international $USD). We chose not to include 2020 in this analysis because it is not particularly representative of longer-term trends, and consumption and territorial emissions estimates are not yet available for many countries. There is a wide range of rates of economic growth between 2005-2019 among countries experiencing absolute decoupling. Somewhat counterintuitively, there is no significant relationship between the rate of economic growth and the magnitude of emissions reductions within the group. **While it is unlikely that there is not at least some linkage between the two factors, there are plenty of examples of countries (e.g., Singapore, Romania, and Ireland) experiencing both extremely rapid economic growth and large reductions in CO2 emissions.** One of the primary criticisms of some prior analyses of absolute decoupling is that they ignore **leakage**. Specifically, the offshoring of manufacturing from high-income countries over the past three decades to countries like China has led to “illusory” drops in emissions, where the emissions associated with high-income country consumption are simply shipped overseas and no longer show up in territorial emissions accounting. There is some truth in this critique, as there was a large increase in emissions embodied in imports from developing countries between 1990 and 2005. After 2005, however, structural changes in China and a growing domestic market led to a reversal of these trends; the amount of emissions “exported” from developed countries to developing countries **has actually declined over the past 15 years.** This means that, for many countries, both territorial emissions and consumption emissions (which include any emissions “exported” to other countries) **have jointly declined**. In fact, on average, consumption emissions have been declining slightly faster than territorial emissions since 2005 in the 32 countries we identify as experiencing absolute decoupling. Figure 2, below, shows the change in consumption emissions (teal) and GDP (red) between 2005 and 2019. There is a pretty wide variation in the extent to which these countries have reduced their territorial and consumption emissions since 2005. Some countries — such as the UK, Denmark, Finland, and Singapore – have seen territorial emissions fall faster than consumption emissions, while the US, Japan, Germany, and Spain (among others) have seen consumption emissions fall faster. Figure 3 shows reductions in consumption and territorial emissions for each country, with the size of the dot representing the size of the population in 2019. **Absolute decoupling is possible.** There is no physical law requiring economic growth — and broader increases in human wellbeing — to necessarily be linked to CO2 emissions. All of the **services that we rely on today that emit fossil fuels** — electricity, transportation, heating, food — can in principle **be replaced by near-zero carbon alternatives**, though these are more mature in some sectors (electricity, transportation, buildings) than in others (industrial processes, agriculture).

#### Yes Transition Wars and they cause Extinction

Nyquist 5 J.R. Nyquist 2-4-2005 “The Political Consequences of a Financial Crash” [www.financialsense.com/stormw...2005/0204.html](http://www.financialsense.com/stormw...2005/0204.html) (renowned expert in geopolitics and international relations)//Elmer

Should the United States experience a severe economic contraction during the second term of President Bush, the American people will likely support politicians who advocate further restrictions and controls on our market economy – guaranteeing its strangulation and the steady pauperization of the country. In Congress today, Sen. Edward Kennedy supports nearly all the economic dogmas listed above. It is easy to see, therefore, that the coming economic contraction, due in part to a policy of massive credit expansion, will have serious political consequences for the Republican Party (to the benefit of the Democrats). Furthermore, an economic contraction will encourage the formation of **anti-capitalist** majorities and a turning away from the free market system. The danger here is not merely economic. The political left openly favors the collapse of America’s strategic position abroad. The withdrawal of the **U**nited **S**tates from the Middle East, the Far East and Europe would **catastrophically impact an international system that presently allows 6 billion** people to live on the earth’s surface in relative peace. Should anti-capitalist dogmas overwhelm the global market and trading system that evolved under American leadership, the planet’s economy would contract and untold **millions would die of starvation**. Nationalistic totalitarianism, fueled by a politics of blame, would once again bring war to Asia and Europe. But this time the war would be **waged with mass destruction weapons** and the United States would be blamed because it is the center of global capitalism. Furthermore, if the anti-capitalist party gains power in Washington, we can expect to see policies of appeasement and unilateral disarmament enacted. American appeasement and disarmament, in this context, would be an admission of guilt before the court of world opinion. Russia and China, above all, would exploit this admission to justify aggressive wars, invasions and mass destruction attacks. A future financial crash, therefore, must be prevented at all costs.

#### The alternative locks in warming – its Try-Or-Die.

**Klein** 8/31/**21**, Opinion Writer at the New York Times, former Founder of Vox, and author of “Why We’re Polarized” (Ezra, “Transcript: Ezra Klein Answers Listener Questions” from ‘The Ezra Klein Show’ podcast, *The New York Times*, <https://www.nytimes.com/2021/08/31/podcasts/transcript-ezra-klein-ask-me-anything.html>, Accessed 09-1-2021)

But now let me talk about degrowth more in the terms of it is a direct political project, which is as an answer to climate change. I would cut this into a few pieces. Is degrowth necessary for addressing climate change? Is it the fastest way to address climate change? And is it desirable? It has to be at least one of those things to be the strategy you’d want to take. And I don’t think it is. Let’s start with necessary. Many countries in Europe, even the United States, are **growing while reducing their carbon footprint**. Now, you could say they’re not doing so fast enough depending on the country. But they could all do so much faster if there was enough political will to deploy more renewable technology, to tax carbon, to do a bunch of things that we have not been able to pass. So it is clearly true that we **can decouple growth and energy usage**. Hickel, to be fair, will say that that may be true. But given the speed at which we need to act, we can’t just be deploying renewable energy technology. It would also help the situation if we stopped using as much through material consumption. That is, I think, conceptually true and politically false. I mean, let’s just state that **speed** is, first and foremost, a **political problem**. There is a delta between where we are right now in terms of what we are doing on climate change and where we could be. That delta is big, and that delta gets bigger every year because it gets harder every year. And the time we have to act before we start getting some of the really truly catastrophic feedback loops in play is **shortening**. So you’re now talking here about the speed at which you can move politics. So for something to be faster, it doesn’t just need to be faster if you implemented it. It needs to be something you can implement such it **accelerates the politics** of radical climate action. And that’s where I think **degrowth** completely **falls apart**. And I have tried to look for the answer people give on this, and I’ve never found one that is convincing.

#### Tech dematerialization secures sustainability.

**McAfee 19**, \*Andrew Paul McAfee, a principal research scientist at MIT, is cofounder and codirector of the MIT Initiative on the Digital Economy at the MIT Sloan School of Management; (2019, “More from Less: The Surprising Story of How We Learned to Prosper Using Fewer Resources and What Happens Next”, https://b-ok.cc/book/5327561/8acdbe)

There is **no shortage** of examples of dematerialization. I chose the ones in this chapter because they illustrate a set of fundamental principles at the intersection of business, economics, innovation, and our impact on our planet. They are:

We do want more all the time, but **not more resources**. Alfred Marshall was right, but William Jevons was wrong. Our wants and desires keep growing, evidently without end, and therefore so do our economies. But our use of the earth’s resources **does not**. We do want more beverage options, but we don’t want to keep using more aluminum in drink cans. We want to communicate and compute and listen to music, but we don’t want an arsenal of gadgets; we’re happy with a single smartphone. As our population increases, we want more food, but we don’t have any desire to consume more fertilizer or use more land for crops.

Jevons was correct at the time he wrote that total British demand for coal was increasing even though steam engines were becoming much more efficient. He was right, in other words, that the price elasticity of demand for coal-supplied power was greater than one in the 1860s. But he was wrong to conclude that this would be permanent. Elasticities of demand can change over time for several reasons, the most fundamental of which is **technological change**. Coal provides a clear example of this. When fracking made natural gas much cheaper, total **demand** for coal in the United States **went down** even though its price decreased.

With the help of **innovation** and **new technologies**, economic growth in America and other rich countries—growth in all of the wants and needs that we spend money on—has become **decoupled** from resource **consumption**. This is a recent development and a **profound** one.

Materials cost money that companies locked in competition would rather **not spend**. The root of Jevons’s mistake is simple and **boring**: resources cost **money**. He realized this, of course. What he didn’t sufficiently realize was how strong the **incentive** is for a company in a contested market to **reduce** its spending on **resources** (or anything else) and so eke out a bit more profit. After all, a penny saved is a penny earned.

Monopolists can just pass costs on to their customers, but companies with a lot of competitors can’t. So American farmers who battle with each other (and increasingly with tough rivals in other countries) are eager to cut their spending on land, water, and fertilizer. Beer and soda companies want to minimize their aluminum purchases. Producers of magnets and high-tech gear run away from REE as soon as prices start to spike. In the United States, the 1980 Staggers Act removed government subsidies for freight-hauling railroads, forcing them into **competition** and **cost cutting** and making them all the more eager to not have expensive railcars sit idle. Again and again, we see that **competition** spurs **dematerialization**.

There are multiple paths to dematerialization. As profit-hungry companies seek to use fewer resources, they can go down four main paths. First, they can simply find ways to use **less** of a **given material**. This is what happened as beverage companies and the companies that supply them with cans teamed up to use less aluminum. It’s also the story with American farmers, who keep getting bigger harvests while using less land, water, and fertilizer. Magnet makers found ways to use fewer rare earth metals when it looked as if China might cut off their supply.

Second, it often becomes possible to **substitute** one resource for **another**. Total US coal consumption started to decrease after 2007 because fracking made natural gas more attractive to electricity generators. If nuclear power becomes more popular in the United States (a topic we’ll take up in chapter 15), we could use both less coal and less gas and generate our electricity from a small amount of material indeed. A kilogram of uranium-235 fuel contains approximately 2–3 million times as much energy as the same mass of coal or oil. According to one estimate, the total amount of energy that humans consume each year could be supplied by just seven thousand tons of uranium fuel.

Third, companies can use **fewer molecules** overall by making better use of the materials they **already own**. Improving CNW’s railcar utilization from 5 percent to 10 percent would mean that the company could cut its stock of these thirty-ton behemoths in half. Companies that own expensive physical assets tend to be fanatics about getting as much use as possible out of them, for clear and compelling financial reasons. For example, the world’s commercial airlines have improved their load factors—essentially the percentage of seats occupied on flights—from 56 percent in 1971 to more than 81 percent in 2018.

Finally, some materials get replaced by **nothing** at all. When a telephone, camcorder, and tape recorder are separate devices, three total microphones are needed. When they all collapse into a smartphone, only one microphone is necessary. That smartphone also uses no audiotapes, videotapes, compact discs, or camera film. The iPhone and its descendants are among the world champions of dematerialization. They use vastly less metal, plastic, glass, and silicon than did the devices they have replaced and don’t need media such as paper, discs, tape, or film.

If we use more renewable energy, we’ll be replacing coal, gas, oil, and uranium with **photons** from the **sun** (solar power) and the **movement** of **air** (wind power) and water (hydroelectric power) on the earth. All three of these types of power are also among dematerialization’s **champions**, since they use up essentially **no resources** once they’re up and running.

I call these four paths to dematerialization slim, swap, optimize, and evaporate. They’re not mutually exclusive. Companies can and do pursue all four at the same time, and all four are going on all the time in ways both obvious and subtle.

Innovation is **hard** to **foresee**. Neither the fracking revolution nor the world-changing impact of the iPhone’s introduction were well understood in advance. Both continued to be underestimated even after they occurred. The iPhone was introduced in June of 2007, with no shortage of fanfare from Apple and Steve Jobs. Yet several months later the cover of Forbes was still asking if anyone could catch Nokia.

Innovation is not **steady** and **predictable** like the orbit of the Moon or the accumulation of interest on a certificate of deposit. It’s instead inherently jumpy, uneven, and **random**. It’s also **combinatorial**, as Erik Brynjolfsson and I discussed in our book The Second Machine Age. Most new technologies and other innovations, we argued, are combinations or recombinations of preexisting elements.

The iPhone was “just” a cellular telephone plus a bunch of sensors plus a touch screen plus an operating system and population of programs, or apps. All these elements had been around for a while before 2007. It took the vision of Steve Jobs to see what they could become when combined. Fracking was the combination of multiple abilities: to “see” where hydrocarbons were to be found in rock formations deep underground; to pump down pressurized liquid to fracture the rock; to pump up the oil and gas once they were released by the fracturing; and so on. Again, none of these was new. Their effective combination was what changed the world’s energy situation.

Erik and I described the set of innovations and technologies available at any time as **building blocks** that ingenious people could combine and recombine into useful new configurations. These new configurations then serve as more blocks that later innovators can use. Combinatorial innovation is exciting because it’s unpredictable. It’s not easy to foresee when or where powerful new combinations are going to appear, or who’s going to come up with them. But as the number of both building blocks and innovators increases, we should have **confidence** that more breakthroughs such as fracking and smartphones are ahead. Innovation is highly decentralized and largely uncoordinated, occurring as the result of **interactions** among **complex** and **interlocking** social, technological, and economic systems. So it’s going to keep surprising us.

As the Second Machine Age progresses, dematerialization **accelerates**. Erik and I coined the phrase Second Machine Age to draw a contrast with the Industrial Era, which as we’ve seen transformed the planet by allowing us to overcome the limitations of muscle power. Our current time of great progress with all things related to **computing** is allowing us to **overcome** the **limitations** of our mental power and is **transformative** in a different way: it’s allowing us to **reverse** the Industrial Era’s bad habit of taking **more** and **more** from the earth every year.

Computer-aided design tools help engineers at packaging companies design generations of aluminum cans that keep getting lighter. Fracking took off in part because oil and gas exploration companies learned how to build **accurate** computer **models** of the rock formations that lay deep underground—models that predicted where hydrocarbons were to be found.

Smartphones took the place of many separate pieces of gear. Because they serve as GPS devices, they’ve also led us to print out many fewer maps and so contributed to our current trend of using less paper. It’s easy to look at generations of computer paper, from 1960s punch cards to the eleven-by-seventeen-inch fanfold paper of the 1980s, and conclude that the Second Machine Age has caused us to chop down ever more trees. The year of peak paper consumption in the United States, however, was 1990. As our devices have become more capable and interconnected, always on and always with us, we’ve sharply turned away from paper. Humanity as a whole probably hit peak paper in 2013.

As these examples indicate, computers and their kin help us with all four paths to **dematerialization**. Hardware, software, and networks let us slim, swap, optimize, and evaporate. I contend that they’re the **best tools** we’ve **ever invented** for letting us tread more **lightly** on our planet.

All of these principles are about the **combination** of technological **progress** and **capitalism**, which are the first of the two pairs of forces causing **dematerialization**.

#### Capitalism solves war – its anti-imperialist.

Mousseau 19, Michael. "The end of war: How a robust marketplace and liberal hegemony are leading to perpetual world peace." International Security 44.1 (2019): 160-196. Props to DML for finding. (Professor in the School of Politics, Security, and International Affairs at the University of Central Florida)//Elmer

Is war becoming obsolete? There is wide agreement among scholars that war has been in sharp decline since the defeat of the Axis powers in 1945, even as there is little agreement as to its cause.1 Realists reject the idea that this trend will continue, citing states' concerns with the “security dilemma”: that is, in anarchy states must assume that any state that can attack will; therefore, power equals threat, and changes in relative power result in conflict and war.2 Discussing the rise of China, Graham Allison calls this condition “Thucydides's Trap,” a reference to the ancient Greek's claim that Sparta's fear of Athens' growing power led to the Peloponnesian War.3 This article argues that there is no Thucydides Trap in international politics. Rather, the world is moving rapidly toward permanent peace, possibly in our lifetime. Drawing on economic norms theory,4 I show that what sometimes appears to be a Thucydides Trap may instead be a function of factors strictly internal to states and that these factors vary among them. In brief, leaders of states with advanced market-oriented economies have foremost interests in the principle of self-determination for all states, large and small, as the foundation for a robust global marketplace. War among these states, even making preparations for war, is not possible, because they are in a natural alliance to preserve and protect the global order. In contrast, leaders of states with weak internal markets have little interest in the global marketplace; they pursue wealth not through commerce, but through wars of expansion and demands for tribute. For these states, power equals threat, and therefore they tend to balance against the power of all states. Fearing stronger states, however, minor powers with weak internal markets tend to constrain their expansionist inclinations and, for security reasons, bandwagon with the relatively benign market-oriented powers. I argue that this liberal global hierarchy is unwittingly but systematically buttressing states' embrace of market norms and values that, if left uninterrupted, is likely to culminate in permanent world peace, perhaps even something close to harmony. My argument challenges the realist assertion that great powers are engaged in a timeless competition over global leadership, because hegemony cannot exist among great powers with weak markets; these inherently expansionist states live in constant fear and therefore normally balance against the strongest state and its allies.5 Hegemony can exist only among market-oriented powers, because only they care about global order. Yet, there can be no competition for leadership among market powers, because they always agree with the goal of their strongest member (currently the United States) to preserve and protect the global order

#### People use low-cost fuels instead of renewables.

George MONBIOT 9. Fellowship and Professorships, Oxford. “Is There Any Point in Fighting to Stave Off Industrial Apocalypse.” *Guardian*. August 17. <http://www.guardian.co.uk/commentisfree/cif-green/2009/aug/17/environment-climate-change>.

The problem we face is not that we have too little fossil fuel but too much. As oil declines, economies will switch to tar sands, shale gas and coal; as accessible coal declines they’ll switch to ultra-deep reserves (using underground gasification to exploit them) and methane clathrates. The same probably applies to almost all minerals: we will find them, but exploiting them will mean trashing an ever greater proportion of the world’s surface. We have enough non-renewable resources of all kinds to complete our wreckage of renewable resources: forests, soil, fish, fresh water, benign weather. Collapse will come one day, but not before we have pulled everything else down with us.¶ And even if there were an immediate economic cataclysm, it’s not clear that the result would be a decline in our capacity for destruction. In east Africa, for example, I’ve seen how, when supplies of paraffin or kerosene are disrupted, people don’t give up cooking; they cut down more trees. History shows us that wherever large-scale collapse has occurred, psychopaths take over. This is hardly conducive to the rational use of natural assets.