## Space Mining DA

#### Outer Space Treaty most certainly negates. The appropriation of resources in outer space is absolutely just.

Wrench 19 [J.D. Candidate, Case Western Reserve University School of Law, Cleveland, Ohio, May 2019; B.A., Philosophy & Religious Studies, Pace University, Pleasantville, New York, December 2015. “Non-Appropriation, No Problem: The Outer Space Treaty Is Ready for Asteroid Mining” <https://scholarlycommons.law.case.edu/cgi/viewcontent.cgi?article=2546&context=jil>]

The prior appropriation doctrine serves as a unique example for space law because of how it conceptualizes land ownership. Underlying land is available for use not because it is “unowned,” but because it is owned by a community who has the right to make productive use of it.148 Because the community owns the land, claimants have an obligation to use the land properly and the government is responsible for stewardship.149 This framing fits neatly with proponents of the idea that outer space is collectively “owned” by the international community. Regardless, stewardship and government ownership do not necessarily displace the potential for productive use. Parties do not violate the non-appropriation principle simply by extracting—or as here, diverting—resources from the land. At no point does extraction equate to a sovereign claim over the land. In instances where non-productive use or the like violates those principles, property rights disappear. Furthermore, the OST encourages the idea that outer space is to be used to benefit the broader international community.150 The prior appropriation doctrine illustrates that parties can establish and transfer robust property rights in resources independent from land-ownership, while promoting beneficial use. Conclusion The non-appropriation doctrine restricts parties from making sovereign claims over underlying land—the same restriction embedded in each of previous section’s legal regimes. Without violating the nonappropriation principle, those regimes grant parties the right to extract resources from land they do not own, transfer that right, and limit wasteful use. Each system similarly vests an entity with the authority to regulate and enforce those rules. With some tailoring, those rules could graft onto the uniqueness of outer space resource extraction. The property regimes explored in Part II do not provide answers for all claims likely to arise in cases involving outer space resource extraction. One looming issue is that some attempts at resource extraction are bound to straddle the line between use and sovereign claims over land. For example, in instances where parties continually seek extensions on mining permits (to the exclusion of others) or take blatant steps to unreasonably exclude other parties from nearby locations. Those seeking to preserve the line between use and ownership would be wise to police it. Answers to these granular regulatory questions will require some regulatory flexibility, but these issues are only different in scale from those addressed by our existing property regimes. At least one author explicitly criticizes what they describe as attempts to “merely superimpose an earth-based system of rules and regulations on the realm of space.”151 This reasoning is rooted in the observation that Antarctica and the high seas are property regimes “inexorably…linked to the Earth itself,” reflecting the idea that “a landowner has dominion from the depths of the Earth to the stars above.”152 This is a curious observation, as the laws governing the seas and Antarctica conceive of land ownership as separate from nonwasteful use of that land. In fact, UNCLOS, CRAMRA, and the prior appropriation doctrine all distinguish between land ownership and resource extraction. Existing property regimes reflect attempts to balance a universal set of competing demands—specifically, issues of cost and benefit. Policy-makers should be encouraged to innovate effective rules for outer space resource extraction, but our legal system reflects fundamentally human issues that are here to stay. Regardless of analogous regimes, the OST’s language reflects a consciousness of these issues. Looking to earth-based property regimes is not merely a “misdirected” or “convoluted” attempt to avoid applying the nonappropriation principle.153 Rather, parties to the OST should adhere to the non-appropriation principle. In its current form, the OST is flexible enough to permit nuanced and useful developments in space law; it does not need to be re-tooled to be amenable to outer space resource extraction. Consequently, the non-appropriation principle should not be interpreted as a death-knell for resource extraction, but a functional starting point permitting a robust system of rights and responsibilities.

#### Space Mining is on the rise—Private entities are driving a crucial development for valuable resources in outer space.

Gilbert 21 [a complex systems researcher and a PhD student in space resources at the Colorado School of Mines., “Mining in Space is Coming” <https://www.milkenreview.org/articles/mining-in-space-is-coming>]

Space exploration is back. after decades of disappointment, a combination of better technology, falling costs and a rush of competitive energy from the private sector has put space travel front and center. indeed, many analysts (even some with their feet on the ground) believe that commercial developments in the space industry may be on the cusp of starting the largest resource rush in history: mining on the Moon, Mars and asteroids. While this may sound fantastical, some baby steps toward the goal have already been taken. Last year, NASA awarded contracts to four companies to extract small amounts of lunar regolith by 2024, effectively beginning the era of commercial space mining. Whether this proves to be the dawn of a gigantic adjunct to mining on earth — and more immediately, a key to unlocking cost-effective space travel — will turn on the answers to a host of questions ranging from what resources can be efficiently. As every fan of science fiction knows, the resources of the solar system appear virtually unlimited compared to those on Earth. There are whole other planets, dozens of moons, thousands of massive asteroids and millions of small ones that doubtless contain humungous quantities of materials that are scarce and very valuable (back on Earth). Visionaries including Jeff Bezos imagine heavy industry moving to space and Earth becoming a residential area. However, as entrepreneurs look to harness the riches beyond the atmosphere, access to space resources remains tangled in the realities of economics and governance. Start with the fact that space belongs to no country, complicating traditional methods of resource allocation, property rights and trade. With limited demand for materials in space itself and the need for huge amounts of energy to return materials to Earth, creating a viable industry will turn on major advances in technology, finance and business models. That said, there’s no grass growing under potential pioneers’ feet. Potential economic, scientific and even security benefits underlie an emerging geopolitical competition to pursue space mining. The United States is rapidly emerging as a front-runner, in part due to its ambitious Artemis Program to lead a multinational consortium back to the Moon. But it is also a leader in creating a legal infrastructure for mineral exploitation. The United States has adopted the world’s first spaceresources law, recognizing the property rights of private companies and individuals to materials gathered in space. However, the United States is hardly alone. Luxembourg and the United Arab Emirates (you read those right) are racing to codify space-resources laws of their own, hoping to attract investment to their entrepot nations with business-friendly legal frameworks. China reportedly views space-resource development as a national priority, part of a strategy to challenge U.S. economic and security primacy in space. Meanwhile, Russia, Japan, India and the European Space Agency all harbor space-mining ambitions of their own. Governing these emerging interests is an outdated treaty framework from the Cold War. Sooner rather than later, we’ll need new agreements to facilitate private investment and ensure international cooperation. What’s Out There Back up for a moment. For the record, space is already being heavily exploited, because space resources include non-material assets such as orbital locations and abundant sunlight that enable satellites to provide services to Earth. Indeed, satellite-based telecommunications and global positioning systems have become indispensable infrastructure underpinning the modern economy. Mining space for materials, of course, is another matter. In the past several decades, planetary science has confirmed what has long been suspected: celestial bodies are potential sources for dozens of natural materials that, in the right time and place, are incredibly valuable. Of these, water may be the most attractive in the near-term, because — with assistance from solar energy or nuclear fission — H2O can be split into hydrogen and oxygen to make rocket propellant, facilitating in-space refueling. So-called “rare earth” metals are also potential targets of asteroid miners intending to service Earth markets. Consisting of 17 elements, including lanthanum, neodymium, and yttrium, these critical materials (most of which are today mined in China at great environmental cost) are required for electronics. And they loom as bottlenecks in making the transition from fossil fuels to renewables backed up by battery storage. The Moon is a prime space mining target. Boosted by NASA’s mining solicitation, it is likely the first location for commercial mining. The Moon has several advantages. It is relatively close, requiring a journey of only several days by rocket and creating communication lags of only a couple seconds — a delay small enough to allow remote operation of robots from Earth. Its low gravity implies that relatively little energy expenditure will be needed to deliver mined resources to Earth orbit. The Moon may look parched — and by comparison to Earth, it is. But recent probes have confirmed substantial amounts of water ice lurking in permanently shadowed craters at the lunar poles. Further, it seems that solar winds have implanted significant deposits of helium-3 (a light stable isotope of helium) across the equatorial regions of the Moon. Helium-3 is a potential fuel source for secondand third-generation fusion reactors that one hopes will be in service later in the century. The isotope is packed with energy (admittedly hard to unleash in a controlled manner) that might augment sunlight as a source of clean, safe energy on Earth or to power fast spaceships in this century. Between its water and helium-3 deposits, the Moon could be the resource stepping-stone for further solar system exploration. Asteroids are another near-term mining target. There are all sorts of space rocks hurtling through the solar system, with varying amounts of water, rare earth metals and other materials on board. The asteroid belt between the orbits of Mars and Jupiter contains most of them, many of which are greater than a kilometer in diameter. Although the potential water and mineral wealth of the asteroid belt is vast, the long distance from Earth and requisite travel times and energy consumption rule them out as targets in the near term. Wannabe asteroid miners will thus be looking at smaller near-Earth asteroids. While they are much further away than the Moon, many of them could be reached using less energy — and some are even small enough to make it technically possible to tow them to Earth orbit for mining. Space mining may be essential to crewed exploration missions to Mars. Given the distance and relatively high gravity of Mars (twice that of the Moon), extraction and export of minerals to Earth seems highly unlikely. Rather, most resource extraction on Mars will focus on providing materials to supply exploration missions, refuel spacecraft and enable settlement. Technology Is the Difference The prospects for space mining are being driven by technological advances across the space industry. The rise of reusable rocket components and the now-widespread use of off-the-shelf parts are lowering both launch and operations costs. Once limited to government contract missions and the delivery of telecom satellites to orbit, private firms are now emerging as leaders in developing “NewSpace” activities — a catch-all term for endeavors including orbital tourism, orbital manufacturing and mini-satellites providing specialized services. The space sector, with a market capitalization of $400 billion, could grow to as much as $1 trillion by 2040 as private investment soars. But despite the high-profile commercial advances, governments still call the shots on the leading edge of space resource technologies. The United States extracted the first extraterrestrial materials in space from the Moon during the Apollo missions, followed by the Soviet Union’s recoveries from crewless Luna missions. President Biden recently borrowed one of the Apollo lunar rocks for display in the Oval Office, highlighting the awe that deep space can still summon. For the time being, scientific samples remain the goal of mining. Last October, NASA’s OSIRIS-REx mission — due to return to Earth in 2023 — collected a small amount of material from the asteroid Bennu. In December, Japan returned a sample of the asteroid Ryugu with the Hayabusa2 spacecraft. And several weeks later, China’s Chang’e 5 mission returned the first lunar samples since the 1970s. Sample collection is accelerating, with recent missions targeting Mars. Japan is planning to visit the two moons of Mars and extract a sample from one. NASA’s robotic Perseverance rover will collect and cache drilled samples on Mars that could later be returned to Earth. Perseverance also carries gear for the unique MOXIE experiment on Mars — an attempt to produce oxygen on the planet with technologies that could eventually extract oxygen for astronauts to breath and refuel spacecraft. To be viable, commercial space mining will, of course, have to operate at a much larger scale than the scientific digs. Whereas all samples collected to date consist of less than one ton of material, a single space mining operation would have to be able to manage hundreds or thousands of tons. Stripped to the basics, the stages of a space mining operation resemble those of terrestrial mining, with prospecting followed by extraction, processing and distribution to users. But the unique conditions of outer space environments make this progression far more daunting. Most space mining targets have little or no atmosphere and experience extreme temperature swings between shade and sunlight. Radiation, from both the sun and cosmic sources, permeates the space environment and threatens electronics — not to mention human health. The most basic technologies needed for space mining are as simple as shovels and drills. But water and other materials that are volatile will have to be extracted using more exotic techniques. The list of challenges goes on. Launching to space is a stressful process, and equipment must survive high acceleration and acoustic forces. Due to orbital mechanics and the immense energies required to navigate large distances, all space missions are limited to minimal payloads. Missions in deep space operate in microgravity — a challenge when mining an asteroid — or reduced gravity on the Moon or Mars. Even the surfaces of celestial bodies pose a challenge to mining machinery, since they consist of unconsolidated rocky materials called regolith instead of more familiar soil. The most basic technologies needed for space mining are as simple as shovels and drills. But water and other materials that are volatile can be extracted using more exotic techniques: on the Moon, thermal mining would sublimate ice directly to vapor and trap it in a tent. One of the space mining startups, Transastra, proposes a similar method on a far grander scale for small asteroids, trapping the volatile resource in a bag surrounding the whole body. Remember, too, that after space resources are gathered, a supply chain must deliver the material to customers. If you’re curious about the details, check out a 2018 report, Commercial Lunar Propellant Architecture, which describes a mining cycle to extract water on the Moon, convert it to fuel and deliver it to customer spacecraft. Before committing billions to the real thing, public and private investors will need to spend millions testing plans in environments that resemble the conditions of outer space. Regolith simulants, vacuum chambers, computer modeling and other aerospace testing equipment are all needed to verify mining technologies can work in space. Beyond space technologies, advances in other sectors could aid space mining missions. Among them: additive manufacturing (3D printing) to support base construction, AI to run robots and even nuclear power reactors to provide large amounts of energy. The Economics of Mining the Cosmos Claims about the economic value of space mining are often nine parts hyperbole. Newspaper headlines point to asteroids like 16 Psyche, a 226-kilometer-diameter rock whose iron and nickel resources are estimated to be worth $10 quintillion dollars at current commodity prices (100,000 times the size of the Earth’s GDP). But setting aside the blarney, there really is gold (water? helium-3? praseodymium?) in them thar hills. Neil DeGrasse Tyson famously predicted that the world’s first trillionaire will be a space miner. Great minds seem to agree: many of the major private players in space (a group that includes Jeff Bezos, Elon Musk and Richard Branson) are billionaires prepared to risk a whole lot of money to add a few more zeros to their net worth. That said, a common joke in this new industry (as in many others) is that the best way to become a millionaire in space is to start as a billionaire. Even with recent commercial advances, the cost of putting a payload into space remains very high, and the elasticity of demand for space-mined resources is uncertain. A chicken-egg problem underlies all NewSpace activities, but especially mining: without space miners supplying materials, there will be no customers. But without customers, there is no incentive to mine. Even NASA’s solicitation for four companies to extract lunar regolith on the Moon and sell samples to the agency underscores the nascent nature of mining: NASA is paying no more than $15,000 for a half-kilo, a fraction of a fraction of the cost of such a mission. Large asteroid valuations, like that of 16 Psyche, also do not reflect market realities, since delivering large quantities of expensive commodities like platinum or gold would crash market prices. Markets for such metals are small on a mass basis, and it is not clear that Earth markets provide sufficient demand to support enough space mining to Second Quarter 2021 55 justify the fixed costs of production. In broad terms, the uses of space resources can be broken into two categories: return to Earth or use in space. Early startups, like Planetary Resources and Deep Space Industries, focused on mining metals with the goal of selling them back on Earth. However, the market uncertainty was a major factor in the decline of both industry leaders. In the long term, production in space to supply Earth could drive massive growth in the space industry — but not with commodities competing with terrestrial production. Rather, Earth markets are likely to be most receptive to the exotic: specialized materials and alloys manufactured in microgravity conditions, large-satellite services such as space-based solar power, or unique products like helium-3. The latter two are particularly promising, as they could provide large contributions to global decarbonization after 2050. Although uncertainties remain high, sooner or later space mining promises to greatly accelerate space exploration and bolster terrestrial economies. While industrial activities in space may well cause conflict with scientific priorities, the infrastructure created in its development could serve science with orbital refueling, reduced mission costs, space manufacturing and, more generally, deeper knowledge of how to operate in space environments. There will no doubt be plenty of slips twixt cup and lip. But while, just a few decades ago, it was easy to dismiss the idea of space industry in general and space mining in particular as the stuff of science fiction, the worm has definitely turned. Today, it is pretty clear that space mining — along with its attendant exploration and industrialization — is coming soon.

#### An Abundance of Helium-3 Exists on the Moon. Key To Solving World’s Climate and Energy Crises.

Whittington 21 [Mark Whittington, who writes frequently about space and politics, has published a political study of space exploration entitled Why is It So Hard to Go Back to the Moon? as well as "The Moon, Mars and Beyond." He blogs at Curmudgeons Corner. He is published in the Wall Street Journal, Forbes, The Hill, USA Today, the LA Times and the Washington Post, among other venues., The Hill. “Solving the climate and energy crises: Mine the Moon's helium-3?” [https://thehill.com/opinion/technology/540856-solving-the-climate-and-energy-crises-mine-the-moons-helium-3]

Recently, U.S. Nuclear Corp. and Solar System Resources Corporation signed a letter of intent that will either change the history of the world or be just a footnote in humanity’s quest to develop clean, abundant sources of energy. Solar System Resources has agreed to provide 500 kilograms of helium-3 mined from the Moon to U.S. Nuclear Corp. in the 2028-2032 timeframe. According to a paper published by Jeff Bonde and Anthony Tortorello, helium-3 is an isotope that has been deposited in lunar soil over billions of years by solar wind. Roughly 1.1 million metric tons of the isotope exists on the Moon down to a depth of several meters. Twenty-five metric tons of helium-3, about a quarter of the cargo capacity of a SpaceX Starship, would suffice to fuel all the power needs of the United States for a year. The announcement does not reveal how Solar System Resource proposes to mine the helium-3. The company’s website is very heavy on breathtakingly inspirational verbiage and light on how it intends to raise the money and develop the technology to mine the solar system’s resources. However, the paper suggests that a rover could scoop up lunar regolith, separate helium-3 along with oxygen and hydrogen, store them and eject the processed lunar soil. The gasses would be taken back to a lunar base where the oxygen and hydrogen would be put to good use and the helium-3 stored for later export to Earth. The announcement also does not reveal what U.S. Nuclear Corp. intends to do with the helium-3 once it takes delivery. The company, which builds radiation detection devices, has a subsidiary, Magneto-Inertial Fusion Technology, Inc., that is researching a fusion technology called staged Z-pinch. This would create a fusion reaction long enough and sustained enough to become a power source. Presumably, an abundant store of helium-3 could be an asset for those experiments. Fusion using helium-3 has advantages and disadvantages over using deuterium, an isotope of hydrogen and tritium, another isotope of hydrogen. Deuterium and tritium fusion releases radioactive neutrons that will damage and weaken the containment vessel. Periodically, a fusion reactor using this method would have to be taken offline for decontamination. Tritium is also radioactive, making its handling difficult and dangerous. A deuterium and helium-3 fusion creates helium and charged protons as byproducts and few or no radioactive particles. The main disadvantage of fusion using helium-3 is that it would take a far greater amount of energy to achieve it than the conventional deuterium and tritium variety. According to Open Mind, Frank Close, a physicist at the University of Oxford, regards fusion using helium-3 as “moonshine.” Close suggests that a deuterium and helium-3 fusion will still produce some radioactive neutrons. Gerald Kulcinski, director of the Fusion Technology Institute at the University of Wisconsin at Madison, disagrees. Close’s objection is based on using conventional fusion technology. The Fusion Technology Institute has achieved some progress in minimizing radioactive neutron production using different technology. Helium-3 fusion is an even more promising technology, albeit a more difficult and complicated one to develop. The consensus seems to be that such reactors will not be achieved for some decades, say mid-century. No one can guarantee that enough helium-3 will be mined from the Moon to jump-start serious development of technology using the isotope as a fusion fuel in the foreseeable future. There is no guarantee that such a development will see practical results anytime soon. However, the effort would be well worth pursuing, with substantial money and effort deployed behind it. If not the two aforementioned companies, someone should undertake the effort. Fusion using helium-3 as fuel would change the world in profoundly beneficial ways. The great problem civilization faces is access to clean, affordable and reliable energy. Recent events in Texas prove that not having energy, even for a few days, can be catastrophic. At the same time, humankind needs sources of energy that do not harm the environment, especially by emitting greenhouse gasses. It appears that humankind is returning to the Moon, at long last. President Trump started the Artemis Project. President Biden has thrown his support behind the effort. There are many reasons to return to the Moon, from science, to commerce, to soft political power. Solving the decades-long energy crisis could be the singular benefit for expanding human activity to Earth’s nearest neighbor.

#### Space Mining is the only way to solve global warming. Lack of resources on Earth means outer space.

Duran 21 [Journalist and Industry Analyst at Mexico Business News. “Is Space Mining the Best Option to Face Climate Change?” <https://mexicobusiness.news/mining/news/space-mining-best-option-face-climate-change>]

Going to net zero means that more mining is needed. Experts have said that the current supply cannot support the necessary metals demand for the green transition. As a result, new mining alternatives have gained greater relevance, among them is space mining. Several countries, including Mexico, have shown their interest in this alternative, creating a new space race. “The solar system can support a billion times greater industry than we have on Earth. When you go to vastly larger scales of civilization, beyond the scale that a planet can support, then the types of things that civilization can do are incomprehensible to us … We would be able to promote healthy societies all over the world at the same time that we would be reducing the environmental burden on the Earth,” said Dr. Phil Metzger, Planetary Scientist at the University of Central Florida. Currently, there are several attempts to address global warming and transition to a net zero carbon economy. There has been an increasing interest in renewable energy and infrastructure, which has increased demand for various minerals, especially lithium, cobalt, nickel, copper and rare earth elements. However, according to experts, the world is close to entering a metals super cycle, where demand will exceed available supply, causing prices to skyrocket. Consequently, the mining industry has sought alternatives to achieve the required supply. Options include recycling and improved mine waste management, sea mining and space mining. The latter is considered one of the alternatives with the greatest potential. However, a regulatory framework is still lacking and there is almost no experience in this regard. Despite the lack of knowledge regarding space mining, it has become a very attractive option since the planet is running out of resources. While some people believe that land-based mining is cheaper than space mining, experts believe this may change in the long term. Furthermore, within the solar system there are countless bodies rich in minerals, ores and elements that will accelerate the fight against climate change. “There will come a point when there is nothing left to mine on the surface, prompting mines to reach even further below. But even those resources are destined to run out and so we will aim toward ocean mining, which already has specific technologies that are being developed. Nevertheless, even those mines are limited as well. The mine of the future, which today may seem unlikely, will no longer be on our planet. There will be a time when space mining will be as common as an open leach mine,” Eder Lugo, Minerals Head at Siemens, told MBN. More than 150 million asteroids measuring approximately 100m are believed to be in the inner solar system alone. In addition, astronomers have also identified abundant minerals near the Earth’s space and the Main Asteroid Belt. There are three main groups into which asteroids are divided: C- type, S- type, and M- type. The last two groups are the most abundant in minerals such as gold, platinum, cobalt, zinc, tin, lead, indium, silver, copper and rare earth metals. "Energy is limited here. Within just a few hundred years, you will have to cover all of the landmass of Earth in solar cells. So, what are you going to do? Well, what I think you are going to do is you are going to move out in space … all of our heavy industry will be moved off-planet and Earth will be zoned residential and light-industrial,” said Jeff Bezos, Founder of Amazon and the Space Launch Provider Blue Origin.

#### Warming causes extinction and turns every impact – no adaptation and each degree is worse

Klein 14[(Naomi Klein, award-winning journalist, syndicated columnist, former Miliband Fellow at the London School of Economics, member of the board of directors of 350.org), *This Changes Everything: Capitalism vs. the Climate*, pp. 12-14]

In a 2012 report, the World Bank laid out the gamble implied by that target. “As global warming approaches and exceeds 2-degrees Celsius, there is a risk of triggering nonlinear tipping elements. Examples include the disintegration of the West Antarctic ice sheet leading to more rapid sea-level rise, or large-scale Amazon dieback drastically affecting ecosystems, rivers, agriculture, energy production, and livelihoods. This would further add to 21st-century global warming and impact entire continents.” In other words, once we allow temperatures to climb past a certain point, where the mercury stops is not in our control.¶ But the bigger problem—and the reason Copenhagen caused such great despair—is that because governments did not agree to binding targets, they are free to pretty much ignore their commitments. Which is precisely what is happening. Indeed, emissions are rising so rapidly that unless something radical changes within our economic structure, 2 degrees now looks like a utopian dream. And it’s not just environmentalists who are raising the alarm. The World Bank also warned when it released its report that “we’re on track to a 4-C warmer world [by century’s end] marked by extreme heat waves, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea level rise.” And the report cautioned that, “there is also no certainty that adaptation to a 4-C world is possible.” Kevin Anderson, former director (now deputy director) of the Tyndall Centre for Climate Change, which has quickly established itself as one of the U.K’s premier climate research institutions, is even blunter; he says 4 degrees Celsius warming—7.2 degrees Fahrenheit—is “incompatible with an organized, equitable, and civilized global community.”¶ We don’t know exactly what a 4 degree Celsius world would look like, but even the best-case scenario is likely to be calamitous. Four degrees of warming could raise global sea levels by 1 or possibly even 2 meters by 2100 (and would lock in at least a few additional meters over future centuries). This would drown some island nations such as the Maldives and Tuvalu, and inundate many coastal areas from Ecuador and Brazil to the Netherlands to much of California and the northeastern United States as well as huge swaths of South and Southeast Asia. Major cities likely in jeopardy include Boston, New York, greater Los Angeles, Vancouver, London, Mumbai, Hong Kong, and Shanghai.¶ Meanwhile, brutal heat waves that can kill tens of thousands of people, even in wealthy countries, would become entirely unremarkable summer events on every continent but Antarctica. The heat would also cause staple crops to suffer dramatic yield losses across the globe (it is possible that Indian wheat and U.S. could plummet by as much as 60 percent), this at a time when demand will be surging due to population growth and a growing demand for meat. And since crops will be facing not just heat stress but also extreme events such as wide-ranging droughts, flooding, or pest outbreaks, the losses could easily turn out to be more severe than the models have predicted. When you add ruinous hurricanes, raging wildfires, fisheries collapses, widespread disruptions to water supplies, extinctions, and globe-trotting diseases to the mix, it indeed becomes difficult to imagine that a peaceful, ordered society could be sustained (that is, where such a thing exists in the first place).¶ And keep in mind that these are the optimistic scenarios in which warming is more or less stabilized at 4 degrees Celsius and does not trigger tipping points beyond which runaway warming would occur. Based on the latest modeling, it is becoming safer to assume that 4 degrees could bring about a number of extremely dangerous feedback loops—an Arctic that is regularly ice-free in September, for instance, or, according to one recent study, global vegetation that is too saturated to act as a reliable “sink”, leading to more carbon being emitted rather than stored. Once this happens, any hope of predicting impacts pretty much goes out the window. And this process may be starting sooner than anyone predicted. In May 2014, NASA and the University of California, Irvine scientists revealed that glacier melt in a section of West Antarctica roughly the size of France now “appears unstoppable.” This likely spells down for the entire West Antarctic ice sheet, which according to lead study author Eric Rignot “comes with a sea level rise between three and five metres. Such an event will displace millions of people worldwide.” The disintegration, however, could unfold over centuries and there is still time for emission reductions to slow down the process and prevent the worst. ¶ Much more frightening than any of this is the fact that plenty of mainstream analysts think that on our current emissions trajectory, we are headed for even more than 4 degrees of warming. In 2011, the usually staid International Energy Agency (IEA) issued a report predicting that we are actually on track for 6 degrees Celsius—10.8 degrees Fahrenheit—of warming. And as the IEA’s chief economist put it: “Everybody, even the school children, knows that this will have catastrophic implications for all of us.” (The evidence indicates that 6 degrees of warming is likely to set in motion several major tipping points—not only slower ones such as the aforementioned breakdown of the West Antarctic ice sheet, but possibly more abrupt ones, like massive releases of methane from Arctic permafrost.) The accounting giant PricewaterhouseCoopers as also published a report warning businesses that we are headed for “4-C , or even 6-C” of warming.¶ These various projections are the equivalent of every alarm in your house going off simultaneously. And then every alarm on your street going off as well, one by one by one. They mean, quite simply, that climate change has become an existential crisis for the human species. The only historical precedent for a crisis of this depth and scale was the Cold War fear that we were headed toward nuclear holocaust, which would have made much of the planet uninhabitable. But that was (and remains) a threat; a slim possibility, should geopolitics spiral out of control. The vast majority of nuclear scientists never told us that we were almost certainly going to put our civilization in peril if we kept going about our daily lives as usual, doing exactly what we were already going, which is what climate scientists have been telling us for years. ¶ As the Ohio State University climatologist Lonnie G. Thompson, a world-renowned specialist on glacier melt, explained in 2010, “Climatologists, like other scientists, tend to be a stolid group. We are not given to theatrical rantings about falling skies. Most of us are far more comfortable in our laboratories or gathering data in the field than we are giving interviews to journalists or speaking before Congressional committees. When then are climatologists speaking out about the dangers of global warming? The answer is that virtually all of us are now convinced that global warming poses a clear and present danger to civilization.”

## Space Race DA

#### U.S. hold on Space Power is waning. China and Russia are increasingly overtaking.

Donovan 21 [Matthew Donovan is the director of the Mitchell Institute for Aerospace Studies’ Spacepower Advantage Research Center. He previously served as the undersecretary of defense for personnel and readiness, the acting secretary of the U.S. Air Force, and the undersecretary of the Air Force. He also served on the Senate Armed Services Committee as majority policy director and a professional staff member. He served more than 30 years as an active-duty airmen before retiring in 2008. DefenseNews: “It’s imperative America preserve its space power advantage”. <https://www.defensenews.com/opinion/commentary/2021/04/27/its-imperative-america-preserve-its-space-power-advantage/>]

A few weeks ago, Director of National Intelligence Avril Haines released the 2021 edition of the Office of the Director of National Intelligence’s “Annual Threat Assessment” — a document that is considered to be one of the most authoritative assessments of the global security environment. According to the report, Russian and Chinese space capabilities stand as top dangers facing the United States and its allies. Given this reality, it is critical to set U.S. Space Command and the Space Force up for success to defend our space architecture. This will be a team effort. For decades, Russia has stood as a top space competitor — with the legendary “space race” of the 1950s and 1960s yielding one of the most technologically innovative periods in world history. Tensions still exist today as Russia continues to expand its arsenal of counter-space capabilities by testing and fielding new ground-launched, anti-satellite missiles as well as launching on-orbit satellite kill vehicles. More concerning are its increasingly provocative actions in space over the last decade, with the highly unusual maneuvering of Russian satellites in close proximity to both U.S. and other nations’ space assets — activity highly escalatory in nature. Nor is Russia the only threat. China’s enormous push in recent years to match and overtake the U.S. in space should trouble all Americans. Space permeates nearly every facet of our daily lives, and we cannot afford to unilaterally cede this domain to an adversary with opposed interests and values. Ever since China demonstrated over 14 years ago its ability to destroy a satellite in orbit from the ground, the Chinese Communist Party and the People’s Liberation Army have kicked efforts into overdrive to overtake the U.S. in space. Their intent is far from benign or peaceful. China has aggressively developed a broad roster of counter-space capabilities including ground-based, anti-satellite missiles as well as on-orbit, electronic-warfare and directed-energy weapons. Make no mistake: There is no alternate peaceful application for these systems. They are entirely military offensive capabilities. The PLA also centralized China’s strategic space, cyber, electronic, and psychological warfare missions and capabilities into a single theater-level organization, demonstrating the seriousness with which China views space and its integral relationship with war fighting. Both Russia and China outwardly express their desire for expanding the use of space for peaceful purposes such as exploration and commerce. But at the same time, both nations also published their own military strategy and doctrine emphasizing their intent to employ counter-space weapons that threaten U.S. and allied space assets. Both nations were “first movers” in this regard, and the United States is in a position of responding to ensure continued access to the space domain for peaceful and military purposes. One of the most meaningful set of responses from the U.S. government was the reestablishment of U.S. Space Command and the creation of the U.S. Space Force, the first new American military service since 1947. While the space domain was historically viewed by America as a benign and peaceful environment, Russian and Chinese actions have proved otherwise. Standing up U.S. Space Command and the U.S. Space Force were not gimmicks or political stunts; they were necessary and crucial steps to ensure America preserves her space power advantage. However, solutions are not created through press releases and organizational moves alone. These new entities must now receive the necessary resources and authorities to fulfill their intended purposes. To help meet this objective, I am proud to now lead the newly established Spacepower Advantage Research Center within the Mitchell Institute for Aerospace Studies. Foundational to the MI-SPARC undertaking is advancing the thought leadership and strong advocacy for the resources and authorities necessary to meet the next generation of space challenges. We need to ensure the men and women at U.S. Space Command and the U.S. Space Force are properly equipped to provide uniquely powerful and dominant space capabilities for our nation. This also means championing fully informed and cogent space policy options for our nation’s leaders. This also encompasses educating the American public, Congress, the defense industry and the media on the increasing threats to America’s dominance in space, the implications of rapidly evolving technologies in the global space industry, and the clear articulation of emerging military space power requirements. A few short years ago, the Department of Defense was not even permitted to use the terms “space” and “war fighting” in the same sentence. While the U.S. did not seek to make space a war-fighting domain, over those same years our adversaries greatly accelerated their development of capabilities aimed at diminishing the advantages the U.S. possesses in the space domain. Advancing the body of knowledge on these issues richly deserves rigorous analysis, vigorous debate and strong advocacy to ensure America preserves her space power advantage.

#### American Private Entities are the silver bullet to maintaining an edge in Space.

Weichert 21 [Brandon J. Weichert is a former Congressional staff member who holds a Master of Arts in Statecraft & National Security Affairs from the Institute of World Politics in Washington, D.C. He is the founder of The Weichert Report: An Online Journal of Geopolitics, and is currently completing a book on national security space policy. NationalReview: “The Future of Space Exploration Depends on the Private Sector”. <https://www.nationalreview.com/2021/07/the-future-of-space-exploration-depends-on-the-private-sector/#slide-1>]

As Jeff Bezos, the wealthiest man on the planet, readies to launch himself into space aboard one of his own rockets, the world is watching the birth of a new dawn in space. Previously, America relied on its government agency, NASA, to propel it to the cosmos during the last space race with the Soviet Union. Today, America’s greatest hopes are with its private sector. Jeff Bezos is not engaging in such risky behavior simply because he’s an adrenaline junky. No, he’s launching himself into orbit because his Blue Origins is in a titanic struggle with Elon Musk’s SpaceX — and Bezos’s firm is losing. Whatever happens, the American people will benefit from the competition that is shaping up between America’s space entrepreneurs. This has always been how innovation occurs: through the dynamic, often cutthroat competition between actors in the private sector. While money is their ultimate prize, fame and fortune are also alluring temptations to make men like Musk and Bezos risk much of their wealth to change the world. The private space race among these entrepreneurs is part of a far more important marathon between Red China and the United States. Whichever nation wins the new space race will determine the future of the earth below. Consider this: Since winning its initial contracts to launch sensitive U.S. military satellites into orbit, SpaceX has lowered the cost of military satellite launches on taxpayers by “over a million dollars less” than what bigger defense contractors can do. Elon Musk is convinced that he can bring these costs down even more, thanks to his reusable Falcon 9 rocket. The competition between the private space start-ups is fierce — just as the competition between Edison and Westinghouse was — but the upshot is ultimately greater innovation and lower costs for you and me. In fact, Elon Musk insists that if NASA gives SpaceX the contract for building the Human Landing System for the Artemis mission, NASA would return astronauts to the lunar surface by 2024 — four years before NASA believes it will do so. (Incidentally, 2024 is also when China anticipates having a functional base on the moon’s southern pole.) Whereas China has an all-of-society approach to its space race with the United States, Washington has yet to fully galvanize the country in the way that John F. Kennedy rallied America to wage — and win — the space race in the Cold War. America’s private sector, therefore, is the silver bullet against China’s quest for total space dominance. If left unrestricted by meddlesome Washington bureaucrats, these companies will ensure that the United States retains its overall competitive advantage over China — and all other challengers, for that matter. Enter the newly minted NASA director, Bill Nelson, whose station at the agency has effectively poured cold water on the private sector’s ambitious space plans. “Space is not going to be the Wild West for billionaires or anyone else looking to blast off,” Nelson admonished an inquiring reporter. Why not? America’s actions during its western expansion created a dynamic and advanced nation that was well-positioned to dominate the world for the next century. Should we not attempt to emulate this in order to remain dominant in the next century? More important, this is precisely how China treats space: as a new Wild West . . . but one in which Beijing’s forces will dominate. China takes a leap-without-looking approach to space development — everything that can be done to further its grand ambition of becoming the world’s most dominant power by 2049 will be done. Meanwhile, the Biden administration wants to prevent America’s greatest strength, the free market, from helping to beat its foremost geopolitical competitor. Nelson’s comments are fundamentally at odds with America’s spirit and animating principles. Whatever one’s opinion about Bezos or Musk, the fact is that their private space companies are inspiring greater innovation today in the space sector after years of its being left in the sclerotic hands of the U.S. government. Sensing that the federal government’s dominance of U.S. space policy is waning, the Biden administration would rather cede the strategic high ground of space to China than let wildcatting innovators do the hard work. Today, the Federal Aviation Authority (FAA) and NASA are contriving new ways for strangling the budding private space sector, just as it is taking flight. Risk aversion is not how one innovates. Risk is what led Americans to the moon just 66 years after the Wright brothers flew their first airplane. A willingness for risk doesn’t exist today in the federal government — which is why the feds shouldn’t be running space policy. The U.S. government should be partnering with the new space start-ups, not shunning them. The FAA should be automatically approving SpaceX launches, not stymying them. The federal government will not win space any more than it could win the West or build the locomotive. It takes strong-willed, brilliant individuals of a rare caliber to do that. All government can do is to give the resources and support to private-sector innovators and let them make history for us. The next decade will decide who wins space. Let it be America — and let America’s dynamic start-ups win that race, not China’s state capitalism.

#### U.S. Space Dominance key to overall U.S. Hegemony

Weichert 17 [Brandon J. Weichert is a former Congressional staff member who holds a Master of Arts in Statecraft & National Security Affairs from the Institute of World Politics in Washington, D.C. He is the founder of The Weichert Report: An Online Journal of Geopolitics, and is currently completing a book on national security space policy. “The High Ground: The Case for U.S. Space Dominance”. https://doi.org/10.1016/j.orbis.2017.02.006]

Even if deterrence did facilitate a significant reduction in hostility—thereby creating the bipolar stability—no such hope for stability exists in space today. As argued earlier, U.S. reliance on space assets for its most basic functions is far greater than that of other countries. Furthermore, there is no way that the United States can—or should—abandon its use of space as a strategic domain. Thus, a hegemonic model for space dominance is the only hope to create the stability that most planners seek, while at the same time defending the American position in space. Space dominance as a model for stability is nothing new. Indeed, Hegemonic Stability Theory (HST) asserts that the most stable global systems are those in which one actor dominates the system. In such a system, power is aggregated so greatly into a single, dominant actor that such a hegemonic power acts as a stabilizing force. Due to its relative strength, the hegemonic power can set the agenda and the rules that govern the system. The relative weakness of the other actors in the system is well understood, which then prompts these weak actors to abandon any hope of challenging the hegemonic power’s rule. Eventually, they end up accommodating the hegemonic power. The lack of challenge creates peaceful stability.14 The fact that one actor is setting the rules means that the system is simple to operate in, as well. The same logic that buttresses the HST international relations theory arguably undergirds the military strategy of space dominance. If this claim is so, then American hegemony in space is essential for the continued survival of the United States. Whereas there are legitimate arguments to be made regarding the reliance on deterrence-based models for creating stability during the Cold War, the fact is that the world is more multipolar today than it was 25 years ago. Despite what writer Fareed Zakaria has dubbed “the rise of the rest,”15 the United States still retains greater relative power. Therefore, it is inevitable and logical that the United States should expand its hegemonic position in space, in order to secure its place there. Whereas deterrence-based models, such as space superiority, may have worked in a less chaotic international system, no such stability can be achieved today. Many of America’s competitors are revanchist states intent on redefining the world order. They are not interested in preserving the American position in space. Also, they are not cowed by a U.S. deterrence strategy in space. Rather, they view such a policy as a concession that the United States is becoming weaker. Space dominance would create greater stability than space superiority. Missile defense systems, tungsten rods, and even directed-energy weapons potentially would all be placed in key orbits around the Earth. This, on top of the existing U.S. space infrastructure, would prove to the world that the United States is committed to preserving its position in space. In a world of rogue states, space-based weapons likely would prevent surprise nuclear attacks. Failing that, the fact that the United States possessed strategic, offensive weapons in orbit—that could be brought down against any hostile actor—undoubtedly, would make even the most intractable foe hesitant. It is arguable that overwhelming U.S. space power would trickle down from the strategic high ground to lower strategic domains. Rather than wasting time demonstrating resolve by “temporarily blinding Chinese satellites,”16 for example, the overwhelming American presence in space presumably would dissuade potential attackers. Our Dangerous World Today’s world is chaotic. While more states are becoming wealthier and more powerful, those increased assets can serve as the basis of increased military spending. The United States now relies on space to such a degree that any disruption in the linkages between the U.S. and its space infrastructure could be cataclysmic on a scale not yet imagined. Deterrence-based space strategies rely on defensive and proportional responses to protect valuable areas. In keeping with this theme, the military strategies that rising states are developing are asymmetrical. Accordingly, it is imperative that the United States not be lulled into passivity by embracing such flawed strategies as the “more modest”17 space superiority. Conclusion The global order is currently disordered. New states with completely different values from the United States are rising to prominence. Many of those states possess strategic cultures opposed to the American hegemony that has defined the post-Cold War order. Yet, the United States still maintains greater power, wealth, and capabilities than the other states seeking to displace her. For the United States to maintain its hegemonic position, it must also maintain a dominant position in space. As has been noted before, space is the ultimate high ground from which a state can dominate all of the other strategic domains (land, air, sea, and cyberspace). The United States has enjoyed the benefits from dominating this region. Yet, states like China and Russia are moving forward with their own plans not only to deny America access to space, but also to dominate this realm. These states would then benefit from commanding the high ground of space at America’s expense. Since at least the Nixon Administration, space has come to be viewed in a militarized light. By the end of the Cold War, space had not only been militarized, but many were searching for a way to weaponize it. Just as the drift toward militarization of space was inexorable, so too is the desire for weaponization. As rival states begin to hone their space skills, the United States should seek to obtain the first move advantage by capitalizing on its already sizable lead in space by weaponizing it first. The placing of weapons in orbit would not only increase the costs of attacking existing U.S. space architecture, but it would also lend itself to increasing global stability by raising the costs of aggressive behavior on belligerents. Whatever negatives the weaponization of space may have, nothing is more negative for America than to find itself losing its dominance of space to a state that has placed weapons in orbit first.

## Case

#### Overview: We imperatively solve for CC better- prefer our DA since we are providing a way to SOLVE, not just supposedly mitigating the effect.

#### Kessler Syndrome false – less debris and existing guidelines solve

Lewis 15 (Hugh, Senior Lecturer in Aerospace Engineering at the University of Southampton, “Space debris, Kessler Syndrome, and the unreasonable expectation of certainty.” Room, <https://room.eu.com/article/Space_debris_Kessler_Syndrome_and_the_unreasonable_expectation_of_certainty>, Accessed 8/10/19, JMoore)

There is now widespread awareness of the space debris problem amongst policymakers, scientists, engineers and the public. Thanks to pivotal work by J.C. Liou and Nicholas Johnson in 2006 we now understand that the continued growth of the debris population is likely in the future even if all launch activity is halted. The reason for this sustained growth, and for the concern of many satellite operators who are forced to act to protect their assets, are collisions that are expected to occur between objects – satellites and rocket stages – already in orbit. In spite of several commentators warning that these collisions are just the start of a collision cascade that will render access to low Earth orbit all but impossible – a process commonly referred to as the ‘Kessler Syndrome’ after the debris scientist Donald Kessler – the reality is not likely to be on the scale of these predictions or the events depicted in the film Gravity. Indeed, results presented by the Inter-Agency Space Debris Coordination Committee (IADC) at the Sixth European Conference on Space Debris show an expected increase in the debris population of only 30% after 200 years with continued launch activity. Collisions are still predicted to occur, but this is far from the catastrophic scenario feared by some. Constraining the population increase to a modest level can be achieved, the IADC suggested, through widespread and good compliance with existing space debris mitigation guidelines, especially those relating to passivation (whereby all sources of stored energy on a satellite are depleted at the end of its mission) and post-mission disposal, such as de-orbiting the satellite or re-orbiting it to a graveyard orbit. Nevertheless, the anticipated growth of the debris population in spite of these robust efforts merits the investigation of additional measures to address the debris threat, according to the IADC.

#### Risk is low – sat designs and cleanup checks.

O’Gorman 18 (John, MA thesis submitted to Rochester Institute of Technology, “The Cost of Clean Space- A Study of the Additional Fuel Costs of Launching Above Low Earth Orbit,” 5-18, <https://pdfs.semanticscholar.org/d703/101d657334d2e1575d08005e290578770cd1.pdf?_ga=2.70400848.1753078645.1567896134-909185996.1567896134>)

To conclude, orbital debris is a current issue and has the potential to be a serious problem in the coming decades and centuries if business as usual is conducted. Fortunately, steps are being taken now which can mitigate this disastrous scenario. The space community is still relatively small and better rocket and satellite design is helping to avoid the accidental creation of debris. Studies over the feasibility of pulling large objects from orbit have already been done and they show a large amount of promise for managing the future creation of debris very effectively. Although current international policies managing debris do not yet exist, the discussion over how space will be managed is already well underway. If sound debris policies can come out of these discussions, the utility of LEO can be preserved for future generations.

#### Probability – 0.1% chance of a collision.

**Salter 16** [(Alexander William, Economics Professor at Texas Tech) “SPACE DEBRIS: A LAW AND ECONOMICS ANALYSIS OF THE ORBITAL COMMONS” 19 STAN. TECH. L. REV. 221 \*numbers replaced with English words] TDI

The probability of a collision is currently low. Bradley and Wein estimate that the maximum probability in LEO of a collision over the lifetime of a spacecraft remains below one in one thousand, conditional on continued compliance with NASA’s deorbiting guidelines.3 However, the possibility of a future “snowballing” effect, whereby debris collides with other objects, further congesting orbit space, remains a significant concern.4 Levin and Carroll estimate the average immediate destruction of wealth created by a collision to be approximately $30 million, with an additional $200 million in damages to all currently existing space assets from the debris created by the initial collision.5 The expected value of destroyed wealth because of collisions, currently small because of the low probability of a collision, can quickly become significant if future collisions result in runaway debris growth.

for rendezvous and proximity operations improve.

#### The space junk has been put there by PUBLIC entities like governments as well as private entities, even a ban on private entities in space couldn’t solve the problem. As long as anyone is launching anything it is inevitable

**Polyakov 21**, Dr. Max Polyakov, Founder, Noosphere Ventures, Firefly Aerospace, EOS Data Analytics, 5-5-2021, "Where does space junk come from – and how do we clean it up?," World Economic Forum,<https://www.weforum.org/agenda/2021/05/why-we-need-to-clean-up-space-junk-debris-low-earth-orbit-pollution-satellite-rocket-noosphere-firefly/> Livingston RB

Where does space junk come from? **As long as humans launch objects into orbit, space debris is inevitable.** Rocket launches leave boosters, fairings, interstages, and other debris in LEO. So do rocket explosions, which currently account for seven of the top 10 debris-creating events. **Human presence also creates orbital flotsam** – such as cameras, pliers, an astronaut’s glove, a wrench, a spatula, even a tool bag lost during space walks. Some debris is created naturally from the impacts of micrometeoroids – dust-sized fragments of asteroids and comets. With limited lifetimes, **operational satellites can become space debris**. Satellites run out of maneuvering fuel, batteries wear out, solar panels degrade – causing an orbital debris feedback loop, in which the problem is exacerbated when solar panels are sandblasted by micrometeoroids and tiny debris. As with rocket debris, spent satellites eventually re-enter Earth’s atmosphere and burn up, but the process can take years – and the higher they orbit above Earth, the longer those orbits take to decay.