# 2NR

### 1NC – AT: Debris

#### Debris risk is overstated – objects are small compared to the size of space and even when collisions happen, damage is minimal

Paradise 15 (Lee A., writer for Science Clarified encyclopedia. 2001, accessed July 29 2015 "Does the accumulation of "space debris" in Earth's orbit pose a significant threat to humans, in space and on the ground?" [www.scienceclarified.com/dispute/Vol-1/Does-the-accumulation-of-space-debris-in-Earth-s-orbit-pose-a-significant-threat-to-humans-in-space-and-on-the-ground.html](http://www.scienceclarified.com/dispute/Vol-1/Does-the-accumulation-of-space-debris-in-Earth-s-orbit-pose-a-significant-threat-to-humans-in-space-and-on-the-ground.html) DD)

Considering the small size of objects like satellites or the shuttle placed against an environment as vast as space, the risk of severe collisions is minimal. Even when an object in space is hit by space debris, the damage is typically negligible even considering the high rate of speed at which the debris travels. Thanks to precautions such as debris shielding, the damage caused by space debris has been kept to a minimum. Before it was brought back to Earth via remote control, the MIR space station received numerous impacts from space debris. None of this minor damage presented any significant problems to the operation of the station or its various missions. The International Space Station (ISS) is designed to withstand direct hits from space debris as large as 0.4 in (1 cm) in size.¶ Most scientists believe that the number of satellites actually destroyed or severely damaged by space debris is extremely low. The Russian Kosmos 1275 is possibly one of these rare instances. The chance of the Hubble Space Telescope suffering the same fate as the Russian satellite is approximately 1% according to Phillis Engelbert and Diane L. Dupuis, authors of The Handy Space Answer Book . Considering the number of satellites and other man-made objects launched into space in the last 40 years, the serious risk posed to satellites is astronomically low.¶ In fact, monitoring systems such as the Space Surveillance Network (SSN) maintain constant track of space debris and Near Earth Orbits. Thanks to ground-based radar and computer extrapolation, this provides an early warning system to determine if even the possibility of a collision with space debris is imminent. With this information, the Space Shuttle can easily maneuver out of the way. The Space Science Branch at the Johnson Space Center predicts the chance of such a collision occurring to be about 1 in 100,000, which is certainly not a significant enough risk to cause panic. Soon the ISS will also have the capability to maneuver in this way as well.

#### Cleanup is working – multiple countries actively co-operate, treaties solve, and new tech is more careful

Paradise 15 (Lee A., writer for Science Clarified encyclopedia. 2001, accessed July 29 "Does the accumulation of "space debris" in Earth's orbit pose a significant threat to humans, in space and on the ground?" [www.scienceclarified.com/dispute/Vol-1/Does-the-accumulation-of-space-debris-in-Earth-s-orbit-pose-a-significant-threat-to-humans-in-space-and-on-the-ground.html](http://www.scienceclarified.com/dispute/Vol-1/Does-the-accumulation-of-space-debris-in-Earth-s-orbit-pose-a-significant-threat-to-humans-in-space-and-on-the-ground.html) DD)

In addition, space agencies around the world have taken steps to reduce space clutter. The United States, for example, has taken an official stand that is outlined in the 1996 National Space Policy that clearly states: "The United States will seek to minimize the creation of new orbital debris." For example, space mechanics are far more careful with regard to their tools. In the past, space mechanics sometimes let go of their tools and were unable to recover them. Strident efforts are now made to retain all objects used to repair satellites and conduct other missions. The Russians have also agreed to do their part. They used to purposely destroy their equipment in space to prevent it from falling into the wrong hands, but now refrain from that practice. Newly designed crafts and operating procedures also play a part in helping to keep space clean, while researchers continue to investigate safe ways to clean up the debris that currently exists. Everything from forcing the debris to reenter the atmosphere in a controlled manner to nudging it away from the Earth's orbit has been discussed. An activity such as collecting garbage from inside the space station and sending it back to Earth to burn up at reentry is one tangible way space explorers are helping to ensure the reduction of space clutter.¶ At this time there is no international treaty on how to deal with space debris; however, several nations have joined together to form the Inter-Agency Space Debris Coordination Committee (IADC). The IADC assesses the subject of space debris and how it should be handled in the future. Japan, like the United States, has developed a list of safety policies regarding space debris. Because this is ultimately a global issue, other countries such as France, The Netherlands, and Germany have jumped on the bandwagon with regard to addressing this issue.

#### Space lasers solve – explode the debris so it doesn’t damage space craft.

Venton 15 (Danielle Venton, science writer for Wired 5/12/15 "The Mad Plan to Clean Up Space Junk With a Laser Cannon" [www.wired.com/2015/05/laser-cannon-space-debris/](http://www.wired.com/2015/05/laser-cannon-space-debris/) DD)

IF A TEAM of astronomers has its way, the International Space Station will be outfitted with a spiffy laser-wielding telescope. No, no, hold on—it’s not to kill aliens or rebel civilizations. It’s to clean up a huge mess.¶ If anything rivals the human drive for exploration, it is the apparent need to leave a spectacular plume of trash in our wake. In space, the problem is becoming acute. Decades of discarded satellites and unchecked collisions have left some 3,000 tons of debris in orbit. That’s roughly 15 blue whales, 600 elephants, or 1,500 cars.¶ Mankind’s slovenly ways threaten our continued use of space-based satellites, which have become a core component of modern technological infrastructure. You’ve probably used those satellites dozens of ways so far today. Have you sent a text? Watched TV? Used GPS? Checked the weather? If you’d like to keep doing these things, astronomers will soon need to find a way of tidying up low Earth orbit. In that region, between 100 and 1,250 miles above the planet, mere flecks of paint (of which there are many) travel with sufficient force to sever electrical wires, dent spacecraft, and kill astronauts.¶ Lasers could be the saviors in operation Orbital Clean House. A team of astronomers at Japan’s RIKEN, a network of basic-research laboratories, have proposed adding debris-zapping capabilities to a telescope they are already developing for the ISS. They plan to start on a small scale, with a laser no more powerful than the pointer you use to play with your cat. In time, the power could be increased to become a proper laser cannon. (Yes, dear reader, a laser cannon.)¶ If the notion of lasers in space sounds slightly terrifying, you’re not alone. “The problem with it is mostly political,” says Don Kessler, who spent more than 30 years at NASA’s Johnson Space Center. “Everyone is afraid you are going to weaponize space.” Kessler began the field of studying orbital debris and lends his name to “Kessler syndrome,” a scenario in which colliding debris begins a cascade of increasing debris and destruction.¶ If you can take out a derelict satellite or rocket body, you also have the ability to kill a working satellite. And given how important satellites are to militaries, an attack could prompt a war. But if astronomers are going to put a laser cannon anywhere above Earth, the ISS would be the place to do it. Bolting the proposed laser to the ostensibly neutral space station—which already must make frequent maneuvers to avoid larger, tracked pieces of debris—might be a way to make a scientifically sound idea politically sound as well.¶ For the team at RIKEN, the proposed laser cannon is a way to not only clean up their beloved orbits but also make their telescope, the Extreme Universe Space Observatory, more practically relevant, says project scientist Marco Casolino. With its wide field of view and the ability to register even the quickest flashes of light, the scope would be well suited for spotting debris as it whizzes past the ISS.¶ Now, the RIKEN team isn’t the first to suggest lasers as debris-fighting tools: Scientists have for at least 30 years kicked around the idea of laser-vaporizing an object’s surface and knocking it into the atmosphere to burn up. Nor is it the only plan currently in development.¶ The European Union is supporting a project called Stardust which is analyzing how to handle space debris and threatening asteroids (items they call “non-cooperative targets”)—and may settle on lasers as the best plan. Stardust is led by Massimiliano Vasile, of the University of Strathclyde’s Department of Mechanical and Aerospace Engineering. Vasile and his team previously came up with a proposal to use a swarm of navigable laser-equipped satellites to launch coordinated attacks against non-cooperative targets. The project was known, appropriately, as Laser Bees.¶ In the United States, the National Aeronautics and Space Administration—which publishes Orbital Debris Quarterly News, a must read for space junk enthusiasts—proposes fighting space debris with a ground-based laser. (No NASA official could be reached before deadline for comment.) Non-lasery ideas are abundant too, coming in the form of reusable spacecraft launched off modified jumbo jets or electrodynamic space tethers to slow orbiting junk by accosting it with electricity.

#### CleanSpace proves

Coxworth 15 (Ben Coxworth experienced freelance writer July 7, 2015 "EPFL's CleanSpace One satellite will "eat" space junk" [www.gizmag.com/cleanspace-one-orbital-debris-satellite/38348/](http://www.gizmag.com/cleanspace-one-orbital-debris-satellite/38348/) DD)

Three years ago, Swiss research institute EPFL announced its plans to build a spacecraft that could grab orbital debris and then carry it back towards Earth, burning up in the atmosphere with it on its way down. Called CleanSpace One, the satellite was depicted at the time as using a claw-like grasping tool. Now, however, EPFL has announced that it will utilize a folding conical net to essentially gobble up bits of space garbage.¶ When it's launched – possibly as early as 2018 – CleanSpace One's first target will be the now-defunct SwissCube satellite. Because the 10 x 10-cm (3.9 x 3.9-in) object will likely be spinning, swallowing it in a net should be easier than trying to grab it with a claw.¶ Additionally, however, SwissCube's spinning action will make it more difficult to image, as its surfaces will alternately be brilliantly sunlit or hidden in shadow. That's why CleanSpace One's computer vision system will be running algorithms that account for variables such as the angle of the sun, the dimensions of the target, the speed at which that target is moving, and the rate at which CleanSpace One itself is spinning. High dynamic range cameras will also allow it to simultaneously expose for both bright and dark surfaces.¶ Once SwissCube is within range, CleanSpace One will then extend its net around the satellite, subsequently closing that net back down with the target inside.¶ The net was designed by students at the Western Switzerland University of Applied Sciences. Animation of it in action can be seen in the following video.

### 1NC – AT: Megaconstellations

#### Impact is overstated – constellation sats are significantly smaller which makes both their collision risk and potential debris output much smaller

Skibba 20 (Ramin, MIT Technology Review, "How satellite mega-constellations will change the way we use space," <https://www.technologyreview.com/2020/02/26/905733/satellite-mega-constellations-change-the-way-we-use-space-moon-mars/>DD)

“It’s a rather dynamic environment right now, with a lot of people starting to look at space as a means to answer certain business models,” says Roger Hunter, manager of NASA’s Small Spacecraft Technology program. “I call it the democratization of space.” Constellations offer new levels of versatility. Smaller, cheaper satellites—some just the size of a briefcase—can be arranged in different configurations depending on their goal. Lined up in a string that follows a single orbit, for example, a constellation can repeatedly photograph or surveil the same spot. Starlink, meanwhile, is arranged in a crisscross formation to blanket the planet with internet service. “I think that as an industry we’re trying to figure out how to increase the level of great space-based services that come down and help people on Earth every day, while doing it in a responsible and sustainable way in the orbital environment,” says Mike Safyan, vice president of launch and global ground systems at Planet Labs, which operates the second-largest constellation in operation.

## OFF

### 1NC – Mining DA

#### Private companies are set to mine in space – new tech and profit motives make space lucrative

Gilbert 21, (Alex Gilbert is a complex systems researcher and PhD student in Space Resources at the Colorado School of Mines, “Mining in Space is Coming”), 4-26-21, Milken Institute Review, https://www.milkenreview.org/articles/mining-in-space-is-coming // MNHS NL

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](https://payneinstitute.mines.edu/wp-content/uploads/sites/149/2020/09/Payne-Institute-Commentary-The-Era-of-Commercial-Space-Mining-Begins.pdf). 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](https://www.fastcompany.com/90347364/jeff-bezos-wants-to-save-earth-by-moving-industry-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](https://issues.org/new-policies-needed-to-advance-space-mining/) to facilitate private investment and ensure international cooperation.

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 valuabl**e**. 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](http://lroc.sese.asu.edu/posts/1105) 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 second and 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](https://foreignpolicy.com/2016/04/28/the-asteroid-miners-guide-to-the-galaxy-space-race-mining-asteroids-planetary-research-deep-space-industries/). 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. 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.

#### OST defines appropriation as occupation, use, or any other means – the aff definitely links

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Based on the premise of ‘res communis’, the magna carta of space law, the OST, illustrates outer space as “the province of all mankind”.[l] Under Article I, States are free to explore and use outer space and to access all celestial bodies “on the basis of equality and in accordance with international law.”[li] Although the OST does not explicitly mention “mining” activities, under Article II, outer space including the Moon and other celestial bodies are “not subject to national appropriation by claim of sovereignty” through use, occupation or any other means.[lii] Furthermore, the Moon Agreement, 1979, not only defines outer space as “common heritage of mankind” but also proscribes commercial exploitation of planets and asteroids by States unless an international regime is established to govern such activities for “rational management,” “equitable sharing” and “expansion of opportunities” in the use of these resources.[liii]

#### Squo private companies are willing to invest, but the plan crosses a perception barrier which destroys investment

Shaw 13 - Lauren E, J.D. from Chapman University School of Law, ”Asteroids, the New Western Frontier: Applying Principles of the General Mining Law of 1872 to Incentive Asteroid Mining”, JOURNAL OF AIR LAW AND COMMERCE, Volume 78, Issue 1, Article 2, <https://scholar.smu.edu/cgi/viewcontent.cgi?article=1307&context=jalc> // recut MNHS NL

To some, the mining of asteroids might sound like the premise of a science fiction novel' or the solution to the heartwrenching, fictional scenario depicted in the film Armageddon.2 To others, it evokes a fantastical idea that may come to fruition in a distant reality. However, impressively funded companies have plans to send spacecraft to begin prospecting on asteroids within the next two years.' The issues associated with the mining of asteroids should be addressed before these plans are set in motion. Much has been written about the issues that might arise from allowing nations to own these space bodies and the minerals they contain; one such issue is the impact on international treaties.4 However, little has been written about the applicability of preexisting mining laws-which provide a basic property right scheme for the private sector-such as the General Mining Law of 1872 (Mining Law) to the management of asteroid mining.' The literature to date on how to legally address asteroid mining is minimal.' The articles that do address it propose the creation of different systems, such as a "property rights-based system that relies on the doctrine of first possession"7 or an international authority that would regulate mining operations.' Implementing a scheme that offers ownership of extracted resources without bestowing complete sovereignty is necessary to avoid an impending legal limbo-that is, an outer space "Wild West" equivalent where there is neither certainty nor security in who owns what.9 If private sector miners of asteroids know this right already exists, they will have more incentive to extract resources.' 0 This, in turn, would increase the chances of successful missions, resulting in numerous scientific and explorative benefits, along with the potential replenishment of key elements that are becoming increasingly depleted on Earth yet are still needed for modern industry. Scientists speculate that key elements needed for modern industry, including platinum, zinc, copper, phosphorus, lead, gold, and indium, could become depleted on Earth within the next fifty to sixty years." Many of these metals, such as platinum, are chemical elements that, unlike oil or diamonds, have no synthetic alternative.12 Once the reserves on Earth are mined to complete depletion, industries will be forced to recycle the existing supply of minerals, which will result in increased costs due to increased scarcity.' 3 However, evidence is accumulating that asteroids only a few hundred thousand miles away from Earth may be composed of an abundance of natural resources-including many of the minerals being mined to depletion on Earth-that could lead to vast profits." Most of the minerals being mined on Earth, including gold, iron, platinum, and palladium, originally came from the many asteroids that hit the Earth after the crust cooled during the planet's formation.'

#### Space mining is the only way to solve climate change

Duran 21, (Paloma Duran is a journalist and industry analyst at Mexico Business News, “Is Space Mining the Best Option to Face Climate Change?”), 11-03-21, Mexico Business News, https://mexicobusiness.news/mining/news/space-mining-best-option-face-climate-change // MNHS NL

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 supercycle, 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.

#### Anthropogenic warming causes extinction --- mitigation efforts now are key

Griffin, 2015 (David, Professor of Philosophy at Claremont, “The climate is ruined. So can civilization even survive?”, CNN, 4/14/2015, <http://www.cnn.com/2015/01/14/opinion/co2-crisis-griffin/> )

Although most of us worry about other things, climate scientists have become increasingly worried about the survival of civilization. For example, Lonnie Thompson, who received the U.S. National Medal of Science in 2010, said that virtually all climatologists "are now convinced that global warming poses a clear and present danger to civilization." Informed journalists share this concern. The climate crisis "threatens the survival of our civilization," said Pulitzer Prize-winner Ross Gelbspan. Mark Hertsgaard agrees, saying that the continuation of global warming "would create planetary conditions all but certain to end civilization as we know it." These scientists and journalists, moreover, are worried not only about the distant future but about the condition of the planet for their own children and grandchildren. James Hansen, often considered the world's leading climate scientist, entitled his book "Storms of My Grandchildren." The threat to civilization comes primarily from the increase of the level of carbon dioxide (CO2) in the atmosphere, due largely to the burning of fossil fuels. Before the rise of the industrial age, CO2 constituted only 275 ppm (parts per million) of the atmosphere. But it is now above 400 and rising about 2.5 ppm per year. Because of the CO2 increase, the planet's average temperature has increased 0.85 degrees Celsius (1.5 degrees Fahrenheit). Although this increase may not seem much, it has already brought about serious changes. The idea that we will be safe from "dangerous climate change" if we do not exceed a temperature rise of 2C (3.6F) has been widely accepted. But many informed people have rejected this assumption. In the opinion of journalist-turned-activist Bill McKibben, "the one degree we've raised the temperature already has melted the Arctic, so we're fools to find out what two will do." His warning is supported by James Hansen, who declared that "a target of two degrees (Celsius) is actually a prescription for long-term disaster." The burning of coal, oil, and natural gas has made the planet warmer than it had been since the rise of civilization 10,000 years ago. Civilization was made possible by the emergence about 12,000 years ago of the "Holocene" epoch, which turned out to be the Goldilocks zone - not too hot, not too cold. But now, says physicist Stefan Rahmstorf, "We are catapulting ourselves way out of the Holocene." This catapult is dangerous, because we have no evidence civilization can long survive with significantly higher temperatures. And yet, the world is on a trajectory that would lead to an increase of 4C (7F) in this century. In the opinion of many scientists and the World Bank, this could happen as early as the 2060s. What would "a 4C world" be like? According to Kevin Anderson of the Tyndall Centre for Climate Change Research (at the University of East Anglia), "during New York's summer heat waves the warmest days would be around 10-12C (18-21.6F) hotter [than today's]." Moreover, he has said, above an increase of 4C only about 10% of the human population will survive. Believe it or not, some scientists consider Anderson overly optimistic. The main reason for pessimism is the fear that the planet's temperature may be close to a tipping point that would initiate a "low-end runaway greenhouse," involving "out-of-control amplifying feedbacks." This condition would result, says Hansen, if all fossil fuels are burned (which is the intention of all fossil-fuel corporations and many governments). This result "would make most of the planet uninhabitable by humans." Moreover, many scientists believe that runaway global warming could occur much more quickly, because the rising temperature caused by CO2 could release massive amounts of methane (CH4), which is, during its first 20 years, 86 times more powerful than CO2. Warmer weather induces this release from carbon that has been stored in methane hydrates, in which enormous amounts of carbon -- four times as much as that emitted from fossil fuels since 1850 -- has been frozen in the Arctic's permafrost. And yet now the Arctic's temperature is warmer than it had been for 120,000 years -- in other words, more than 10 times longer than civilization has existed. According to Joe Romm, a physicist who created the Climate Progress website, methane release from thawing permafrost in the Arctic "is the most dangerous amplifying feedback in the entire carbon cycle." The amplifying feedback works like this: The warmer temperature releases millions of tons of methane, which then further raise the temperature, which in turn releases more methane. The resulting threat of runaway global warming may not be merely theoretical. Scientists have long been convinced that methane was central to the fastest period of global warming in geological history, which occurred 55 million years ago. Now a group of scientists have accumulated evidence that methane was also central to the greatest extinction of life thus far: the end-Permian extinction about 252 million years ago. Worse yet, whereas it was previously thought that significant amounts of permafrost would not melt, releasing its methane, until the planet's temperature has risen several degrees Celsius, recent studies indicate that a rise of 1.5 degrees would be enough to start the melting. What can be done then? Given the failure of political leaders to deal with the CO2 problem, it is now too late to prevent terrible developments. But it may -- just may -- be possible to keep global warming from bringing about the destruction of civilization. To have a chance, we must, as Hansen says, do everything possible to "keep climate close to the Holocene range" -- which means, mobilize the whole world to replace dirty energy with clean as soon as possible.

### 1NC – Innovation DA

#### Private sector innovation in the commercial space industry is high and rising.

**Smith 18** [Matthew Smith, 6-11-2018, "Commercialized Space and You," Science in the News, https://sitn.hms.harvard.edu/flash/2018/commercialized-space-and-you/]//DDPT

Step aside, NASA. The 20th century model of space exploration is running out of fuel, and private companies are now leading the race for human expansion across the galaxy. Elon Musk, Richard Branson, and Jeff Bezos are three of the billionaires leading this extraterrestrial adventure with their respective companies, SpaceX, Virgin Galactic, and Blue Origin. Bezos, the founder of Amazon and currently the wealthiest person in the world, has a vision of sending autonomous rovers to the Moon and helping to eventually create a Moon Village. He has explained that collaborations with the National Aeronautics and Space Administration (NASA) and other government agencies are encouraged and appreciated, but are no longer essential to achieve his goal. [Musk](https://www.geekwire.com/2018/jeff-bezos-blue-origin-space-venture-go-moon-settlements/), who co-founded Tesla, has already launched nine rockets within the first five months of 2018, one of which was the most powerful private spacecraft [ever sent into orbit](http://sitn.hms.harvard.edu/flash/2018/spacex-launches-falcon-heavy-rocket-successfully/). Looking forward, SpaceX aims to complete its first manned mission to Mars in 2024, almost a decade earlier than NASA’s projections. Even the current US president is encouraging this shift to private companies driving [innovation in space](https://www.washingtonpost.com/news/the-switch/wp/2018/02/11/the-trump-administration-wants-to-turn-the-international-space-station-into-a-commercially-run-venture/?noredirect=on&utm_term=.d2c1eccab4ca). With almost [$1 billion](https://www.forbes.com/sites/alexknapp/2018/04/10/nearly-1-billion-was-invested-in-space-startups-in-1q2018-new-report-says/#5fdd019b285c) invested in space-focused startups in the first quarter of 2018, the commercialized space industry shows no sign of slowing down.

#### Private space companies must be allowed to have freedom in space in order to continue innovation – they’re key for space colonization.

**Smith 18** [Matthew Smith, 6-11-2018, "Commercialized Space and You," Science in the News, https://sitn.hms.harvard.edu/flash/2018/commercialized-space-and-you/]//DDPT

To Low Earth Orbital and Beyond

Most of NASA’s manned missions have been conducted in Low Earth Orbit (LEO), which is anything with an altitude above 100 miles and below 1240 miles (Figure 2) and circling the Earth with an interval of [85-127 minutes](https://web.archive.org/web/20130215143933/http:/orbitaldebris.jsc.nasa.gov/library/NSS1740_14/nss1740_14-1995.pdf). An orbit is defined as a regularly repeating path that an object takes around another object, and objects that are orbiting Earth (both natural and man-made) are called [satellites](https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-orbit-58.html). If an object doesn’t reach an altitude of around 100 miles, then it will not enter Earth’s orbit and will plummet quickly down to Earth. Companies have been populating LEO since the early 1960s by launching manufactured satellites for television, surveillance, communication, and other purposes. All commercial space operations currently occur within LEO, but this is projected to change in the next few years. For example, a company named Moon Express has a name that fits its mission to become the first private company to land on the moon. Moon Express has engineered autonomous robot explorers specialized to function on the moon, and its inaugural mission is projected for 2019. Jeff Bezos also recently announced Blue Origin’s plans to build a 4-legged Moon Lander to further explore the moon. He is collaborating with NASA to arrive by 2020. In 2017, Elon Musk projected that SpaceX would send two citizens to the moon and back in 2018, but recent statements have suggested that this flight will most likely occur around 2020. Elon Musk and SpaceX are also leading the race to Mars, with the first Mars mission projected to take place in 2022. SpaceX has already started to build the rocket and spacecraft that will make the journey, the BFR. The abbreviation has no official name, but it is professionally referred to as the “Big Falcon Rocket” (and casually referred to as the Big \*explicative\*-ing Rocket).

Figure 2. Earth’s orbitals Different objects exist at different altitudes above Earth. These altitudes are separated into three main groups: Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and High Earth Orbit (HEO). Low Earth Orbit is around an altitude of 100-1200 miles above Earth’s surface. The international space station resides inside LEO at around 211 miles above sea level. The Medium Earth Orbit is defined by an altitude from 1201-22,236 miles above sea level. Most GPS satellites exist in this region. Lastly is High Earth Orbit, which is anything with an altitude greater than 22,237 miles above sea level. The moon resides at an altitude of 238,607 miles above sea level, which is in [HEO](https://web.archive.org/web/20100527132541/http:/gcmd.nasa.gov/User/suppguide/platforms/orbit.html).

How can I get to space?

Companies like Virgin Galactic hope to make trips to space available for purchase by non-astronauts. Led by billionaire Richard Branson, Virgin Galactic has already sold over 600 seats on its commercial spacecraft for $250,000 each. As of now, Virgin Galactic is only planning flights just below an altitude of 100 miles (sub-orbital) and are using a unique two-ship system, which requires less power (and therefore less money) than competitors’ systems (Figure 1). The WhiteKnightTwo carries a smaller passenger shuttle, called the [SpaceShipTwo](https://www.virgingalactic.com/learn/), up to 50,000 feet, where the SpaceShipTwo is launched and ignites its rocket. Having the passenger shuttle launch from the air provides more freedom and flexibility because it [eliminates the need for a launch pad](https://www.virgingalactic.com/learn/).

There are, however, some incredible opportunities to get yourself and/or ideas to space for free. Although NASA just ended its latest search for astronauts, they will surely be looking for new recruits within the coming years. The odds of being selected, however, are low: only 17 individuals were selected from almost 20,000 applicants, ranging in ages from 29-41. If you’re not quite old enough to be launched into space, then you can try launching your science experiment with Genes in Space (GiS). [This program](https://www.nasa.gov/audience/foreducators/stem_on_station/index.html), which is a collaboration between miniPCR, Boeing, and NASA, is a national competition for middle and high schoolers to pitch projects for astronauts to conduct in space. The winning proposals for 2017 included experiments to design a cheap and efficient test to evaluate cancer risk for astronauts and measure immune health.

The barriers to space are weakening as society advances and private companies continue to push innovation, and this trend shows no signs of slowing down. What was once extraterrestrial science fiction has already become reality. In the next few years, we’ll begin to see construction of a space station by the Moon, the first manned missions to Mars, and the beginning of a new era of space colonization. All of these missions will require heavy involvement from private companies. We’re entering a defining moment in space exploration and it’s exciting to see what discoveries will be realized through our collaborative advancements into space.

#### Strong commercial space industry catalyzes tech innovation – progress at the margins and spinoff tech change global information networks.

**Hampson 17** [Joshua Hampson, 1-27-2017, "The Future of Space Commercialization," Niskanen Center, <https://www.niskanencenter.org/wp-content/uploads/old_uploads/2017/01/TheFutureofSpaceCommercializationFinal.pdf>]//DDPT

Innovation is generally hard to predict; some new technologies seem to come out of nowhere and others only take off when paired with a new application. It is difficult to predict the future, but it is reasonable to expect that a growing space economy would open opportunities for technological and organizational innovation.

In terms of technology, the difficult environment of outer space helps incentivize progress along the margins. Because each object launched into orbit costs a significant amount of money—at the moment between $27,000 and $43,000 per pound, though that will likely drop in the future —each 19 reduction in payload size saves money or means more can be launched. At the same time, the ability to fit more capability into a smaller satellite opens outer space to actors that previously were priced out of the market. This is one of the reasons why small, affordable satellites are increasingly pursued by companies or organizations that cannot afford to launch larger traditional satellites. These small 20 satellites also provide non-traditional launchers, such as engineering students or prototypers, the opportunity to learn about satellite production and test new technologies before working on a full-sized satellite. That expansion of developers, experimenters, and testers cannot but help increase innovation opportunities.

Technological developments from outer space have been applied to terrestrial life since the earliest days of space exploration. The National Aeronautics and Space Administration (NASA) maintains a website that lists technologies that have spun off from such research projects. Lightweight 21 nanotubes, useful in protecting astronauts during space exploration, are now being tested for applications in emergency response gear and electrical insulation. The need for certainty about the resiliency of materials used in space led to the development of an analytics tool useful across a range of industries. Temper foam, the material used in memory-foam pillows, was developed for NASA for seat covers. As more companies pursue their own space goals, more innovations will likely come from the commercial sector.

Outer space is not just a catalyst for technological development. Satellite constellations and their unique line-of-sight vantage point can provide new perspectives to old industries. Deploying satellites into low-Earth orbit, as Facebook wants to do, can connect large, previously-unreached swathes of 22 humanity to the Internet. Remote sensing technology could change how whole industries operate, such as crop monitoring, herd management, crisis response, and land evaluation, among others. 23 While satellites cannot provide all essential information for some of these industries, they can fill in some useful gaps and work as part of a wider system of tools. Space infrastructure, in helping to change how people connect and perceive Earth, could help spark innovations on the ground as well. These innovations, changes to global networks, and new opportunities could lead to wider economic growth.

#### Tech innovation solves every existential threat – cumulative extinction events outweigh the aff

**Matthews 18** [Dylan Matthews, 10-26-2018, "How to help people millions of years from now," Vox, <https://www.vox.com/future-perfect/2018/10/26/18023366/far-future-effective-altruism-existential-risk-doing-good>]

If you care about improving human lives, you should overwhelmingly care about those quadrillions of lives rather than the comparatively small number of people alive today. The 7.6 billion people now living, after all, amount to less than 0.003 percent of the population that will live in the future. It’s reasonable to suggest that those quadrillions of future people have, accordingly, hundreds of thousands of times more moral weight than those of us living here today do.

That’s the basic argument behind Nick Beckstead’s 2013 Rutgers philosophy dissertation, “[On the overwhelming importance of shaping the far future](https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxuYmVja3N0ZWFkfGd4OjExNDBjZTcwNjMxMzRmZGE).” It’s a glorious mindfuck of a thesis, not least because Beckstead shows very convincingly that this is a conclusion any plausible moral view would reach. It’s not just something that [weird utilitarians](https://plato.stanford.edu/entries/consequentialism/) have to deal with.

And Beckstead, to his considerable credit, walks the walk on this. He works at the Open Philanthropy Project on grants relating to the far future and runs a [charitable fund](https://app.effectivealtruism.org/funds/far-future) for donors who want to prioritize the far future. And arguments from him and others have turned “long-termism” into a very vibrant, important strand of the effective altruism community.

But what does prioritizing the far future even mean?

The most literal thing it could mean is preventing human extinction, to ensure that the species persists as long as possible. For the long-term-focused effective altruists I know, that typically means identifying concrete threats to humanity’s continued existence — like unfriendly artificial intelligence, or a [pandemic](https://www.vox.com/future-perfect/2018/10/15/17948062/pandemic-flu-ebola-h1n1-outbreak-infectious-disease), or global warming/out of control geoengineering — and engaging in activities to prevent that specific eventuality.

But in a [set of slides](https://intelligence.org/wp-content/uploads/2013/07/Beckstead-Evaluating-Options-Using-Far-Future-Standards.pdf) he made in 2013, Beckstead makes a compelling case that while that’s certainly part of what caring about the far future entails, approaches that address specific threats to humanity (which he calls “targeted” approaches to the far future) have to complement “broad” approaches, where instead of trying to predict what’s going to kill us all, you just generally try to keep civilization running as best it can, so that it is, as a whole, well-equipped to deal with potential extinction events in the future, not just in 2030 or 2040 but in 3500 or 95000 or even 37 million.

In other words, caring about the far future doesn’t mean just paying attention to low-probability risks of total annihilation; it also means acting on pressing needs now.

For example: We’re going to be better prepared to prevent extinction from AI or a supervirus or global warming if society as a whole makes a lot of scientific progress. And a significant bottleneck there is that the vast majority of humanity doesn’t get high-enough-quality education to engage in scientific research, if they want to, which reduces the odds that we have enough trained scientists to come up with the breakthroughs we need as a civilization to survive and thrive.

So maybe one of the best things we can do for the far future is to improve school systems — here and now — to harness the group economist Raj Chetty calls [“lost Einsteins”](https://www.nytimes.com/2017/12/03/opinion/lost-einsteins-innovation-inequality.html) (potential innovators who are thwarted by poverty and inequality in rich countries) and, more importantly, the hundreds of millions of kids in developing countries dealing with even worse education systems than those in depressed communities in the rich world.

What if living ethically for the far future means living ethically now?

Beckstead mentions some other broad, or very broad, ideas (these are all his descriptions):

Help make computers faster so that people everywhere can work more efficiently

Change intellectual property law so that technological innovation can happen more quickly

Advocate for open borders so that people from poorly governed countries can move to better-governed countries and be more productive

Meta-research: improve incentives and norms in academic work to better advance human knowledge

Improve education

Advocate for political party X to make future people have values more like political party X

”If you look at these areas (economic growth and technological progress, access to information, individual capability, social coordination, motives) a lot of everyday good works contribute,” Beckstead writes. “An implication of this is that a lot of everyday good works are good from a broad perspective, even though hardly anyone thinks explicitly in terms of far future standards.”

Look at those examples again: It’s just a list of what normal altruistically motivated people, not effective altruism folks, generally do. Charities in the US love talking about the lost opportunities for innovation that poverty creates. Lots of smart people who want to make a difference become scientists, or try to work as teachers or on improving education policy, and lord knows there are plenty of people who become political party operatives out of a conviction that the moral consequences of the party’s platform are good.

All of which is to say: Maybe effective altruists aren’t that special, or at least maybe we don’t have access to that many specific and weird conclusions about how best to help the world. If the far future is what matters, and generally trying to make the world work better is among the best ways to help the far future, then effective altruism just becomes plain ol’ do-goodery.\*

## Case