## 1

### Framework – Short

#### The meta-ethic is practical reason—

#### [1] Inescapability— I can question why to follow or the validity of an ethical theory, which concedes the authority of reason as if I question reason, I use reason to question. Outweighs on validity—any other truth risks falsity Reality may be fake, our experiences may be arbitrary, and experience may be descriptive not normative, but questioning the validity of reason requires reason, conceding its validity. Any other ethic begs the question of why, meaning it’s arbitrary and nonbinding

#### [2] Action theory— Only reason can explain why we take transitional action to an overall end. For example, setting the end of tea provides me a reason to unify the necessary actions to produce tea, like getting a pot, filling it with water, etc. Any other explanation fails since it can’t give meaning to why we take transitioning action – freezing action. 2 Impacts—

#### [a] That’s a side constraint on the AC—ethics is a guide to action so it must appeal to a structure of action.

#### [b] Bindingness—reason is intrinsic to actions since only it can provide value to transitioning action, which justifies universality

#### That justifies universality—

#### If we are all reasoners, we must all be able to determine if an action is good. An action that maximizes my freedom at the cost of others then would have to be recognized as good by everyone, but that leads to a contradiction where everyone takes other’s freedoms to maximize theirs, making it impossible to reach my end

#### Thus, the standard is respecting a system of inner and outer freedom

**Offense**

#### Deontology’s theorization of humans being valuable as ends in themselves not just means necessitates privatization because each individuals ownership over themselves is converted into ownership of objects over space

Blodger 16 [Ian Blodger The Minnesota Journal of Law, Science & Technology 2016 Reclassifying Geostationar Reclassifying Geostationary Earth Orbit as Priv th Orbit as Private Property: Why ty: Why Natural Law and Utilitarian Theories of Property Demand Privatization <https://scholarship.law.umn.edu/cgi/viewcontent.cgi?article=1006&context=mjlst> ]//aaditg

--Works w any NC that defends natural rights

--Geo = geostationary earth orbit

Analyzing the situation first from a Lockean perspective, GEO should be open to private ownership when individuals have invested their labor in the space.93 Companies that currently have satellites in orbit have invested time and resources sufficient to attain a property right in the orbital zone.94 Looking to the theories of Lockes work, which argue that an increase in value is a necessary condition for labor, satellites in GEO clearly meet the standard.95 Since space is essentially void,96 a satellites presence will increase the value of the space by generating industry and allowing for communications and other activities, which were not possible because that space was empty to begin with.97 One argument against this theory is that the space is at its highest value as void, since the voided area itself allows for travel through that point on future space missions.98 However, this argument would overstate the need for a spacecraft to cross the very narrow belt of satellites in GEO.99 It is also possible to argue that the satellite would produce higher values elsewhere, suggesting an opportunity cost and thus a net loss compared to the current location.100 However, this argument relies on the fluctuating value of the satellite and not the value of the GEO. Since the party launching the satellite already owns it, the question of its value has no bearing on whether they have improved the GEO area for purposes of Lockes theory.101 Thus, under this interpretation of Lockes labor requirement, the space is sufficiently increased in value so that it can be considered property. The same conclusion results under different interpretations of Lockes theory of property. The more general interpretation of Lockes theory is that any time someone interacts with something with the purpose of bringing about a better result, then that interaction constitutes labor and confers a property right in the object.102 The satellites themselves currently occupy a physical location, which does not change relative to Earths position.103 This position prevents other satellites from entering a wide area around the existing satellite, and prevents other satellites from transmitting on frequencies, which are already in use.104 These qualities denote at least a transitive interaction between the person and the GEO area through the satellite, since it was the individuals purpose to place the satellite in that location. Lockes example of tilling the land suggests that transitive relationships between a person and the object of his action are sufficient to confer a property interest.105 Thus, tilling and planting do not necessarily require the actor to physically touch the soil with his body, but rather allow him to do so through the use of tools.106 In the context of a satellite as well, the person who sends the satellite into orbit has a connection with his property and that of the orbital zone.107 This makes sense on the metaphysical level. For Locke, the reason a persons labor converts common areas into private zones is because each person owns his body.108 Here, ownership over the body is converted into ownership over a satellite, and that satellite is used in an exertion of great labor to settle a voided location in space.109 Since a person owns the fruits of his labor, a satellite owner gains a property interest in the GEO occupied by his satellite.110 Therefore under this reading of Lockes theory, anyone who places a satellite in geostationary orbit should be conferred a property right in that space. The labor need not alter the orbit itself, since the orbit is simply a scientific property of a location in space allowing the satellite to remain in a fixed point relative to the earth.111 In this way, the satellite is no different from a house built on Earth since both are bound to a fixed point, and improve the area generally.112 It could be argued that the house inherently alters the ground beneath it by laying foundations and is therefore distinct from a satellite that simply occupies a position. However, pouring concrete in an Earth bound location is the same kind of action taken by placing a satellite in a location bound to Earth, just farther away. Placing a satellite in orbit is similar to transporting materials from one area and erecting them in another location which does confer a property right under Lockes theory (just as a farmer might harvest trees and transport them to his plot to build a house, so the scientist combines electronic components and shoots them off to GEO to make a functioning satellite).113 Spaces lack of matter makes little difference to the question of whether the actor invested labor in a specific location.114

#### Space Commercialization is the extension of free market – every transaction is voluntary and no coercion is involved

Sowers’19 [George Sowers, professor of practice in mechanical engineering at Colorado School of Mines. Space News. “Op-ed | Commercializing Space: Before a commercial LEO market can flourish, the ISS must be retired” March 19, 2019 <https://spacenews.com/op-ed-commercializing-space-before-a-commercial-leo-market-can-flourish-the-iss-must-be-retired/>] //aaditg

The last two decades have seen a great upswing in commercial space endeavors with hundreds of new companies formed and a few prominent billionaires entering the fray. This is all good, but it remains devilishly hard to make money in space without tapping into government space markets. Nevertheless, I’m a firm believer that the commercialization of space is absolutely essential for the growth of the space economy and achieving all of the goals we espouse for human activities in space. So, what do I mean by commercial space? This has been a great topic of debate ever since NASA initiated the commercial cargo and commercial crew programs. There are many definitions and which is appropriate depends on the context. The real distinction is between the public sector and the private sector. Any given space activity can include a mixture of both elements. The purest form of commercial activity takes place entirely within the private sector. It is performed by private-sector companies for the benefit of private-sector customers using private-sector capital. Something like Direct TV would be an example. At the other end of the spectrum is a pure public-sector activity where the activity is performed entirely by public-sector agencies using public-sector employees, entirely funded by public funds for a public purpose. An example would be SLS, but even it is not purely public as several private sector companies are employed. In between are all manner of hybrids involving a mix of investment funds, executing entities and customers. When I talk about commercializing space, I’m talking about growing the purely private sector part of the space economy while recognizing that the space economy in total intertwines public and private in many complex ways. Given that government funding of space activities will likely not grow much, any growth in the overall space economy must come from the private sector. ECON 101 Now the only economic system that can reliability deliver growth is the free market. Some people call it capitalism, but I prefer free market as being more descriptive and without the negative connotations that have arisen around the term capitalism. The free market is based on the principle of economic freedom. That is, every transaction that occurs between one or more parties is completely voluntary. No coercion of any kind is involved. For example, when you walk into a grocery store and buy a bag of apples, no one forced you to do it. It was your choice. And no one forced the store to sell apples. It was their choice. The transaction is governed by a price, the value of the exchange amenable to both the buyer and the seller. In that sense, every free market transaction is a win-win situation for both sides. Each gained something. You gained some tasty apples, and the store made a small profit. Of course, there is competition within the free market. That’s one of its strengths. But the competition is between sellers to attract the business of the buyers or consumers as they’re known. Competition among sellers results in choices for consumers, and we all like choices. The supermarket across the street may attract your business by offering more selection or better quality or lower prices or better service. It short, it must provide more value where value is defined by you, the individual consumer.

#### Private entities utilize their own property and resources to fund and conduct space exploration which means – Prohibition of it is a violation of a) Their ability to use their own property (like their rocketships or fuel) to set their ends in space and b). Their freedom to explore unknown horizons such as space.

## 2

#### CP Text: The appropriation of outer space by private entities is unjust except for the appropriation of the sun for Solar Energy.

#### Space-solar tech coming now, private entities are key – it’s impossible to be weaponized

Snowden 19 (Mar 12, 2019,01:29pm EDT|48,669 views Solar Power Stations In Space Could Supply The World With Limitless Energy Scott Snowden Scott SnowdenContributor Sustainability, Forbes, <https://www.forbes.com/sites/scottsnowden/2019/03/12/solar-power-stations-in-space-could-supply-the-world-with-limitless-energy/?sh=229b778b4386)//ww> pbj

While on the surface of the Earth, society still struggles to adopt solar energy solutions, many scientists maintain that giant, space-based solar farms could provide an environmentally-friendly answer to the world's energy crisis. Only last week, we reported that China was planning to build the world's first solar power station to be positioned in Earth's orbit. Because the sun always shines in space, an orbital solar power station is seen as an inexhaustible source of clean energy. "Above the Earth, there's no day and night cycle and no clouds or weather or anything else that might obstruct the sun's ray, so a constant power source is available," said Ali Hajimiri, professor of electrical engineering at the California Institute of Technology and co-director of the university’s Space Solar Power Project. The multi-rotary SPS (MR-SPS) concept is one with multiple independent solar sub-arrays used to... [+] point to the sun. The multi-rotary SPS (MR-SPS) concept is one with multiple independent solar sub-arrays used to... [+] NASA Collecting solar power in space and wirelessly transmitting was first described by Isaac Asimov in 1941 in his short story Reason. In 1968, American aerospace engineer Peter Glaser published the first technical article on the concept – Power From The Sun: Its Future in the journal Science. Space-based solar power attracted considerable attention in the 1970s as the necessary individual technical components – in essence, photovoltaic cells, satellite technology and wireless power transmission – were developed. Despite the concept being technically feasible, it was considered economically unrealistic at the time and research ultimately stalled. “The idea seems to be going through a resurgence and it’s probably because the technology exists to make it happen,” said John Mankins, a former NASA scientist who was at the forefront of this field in the 1990s, before it was abandoned. Aerospace engineer Peter Glaser first wrote about the idea in 1968. Aerospace engineer Peter Glaser first wrote about the idea in 1968. SCIENCE MAGAZINE Global energy demands are only going to grow, says Hajimiri. The global population is expected to reach a staggering 9.6 billion by 2050, according to a United Nations report, so methods of generating large quantities of clean energy must be found. A space-based solar power system could provide energy to everyone, even in places that don't receive sunlight all year round, like northern Europe and Russia. In April of 2015, a research agreement between Northrop Grumman and Caltech provided up to $17.5m for the development of innovations necessary to enable a space solar power system. Three Caltech professors head up the project: joining Hajimiri were Harry Atwater and Sergio Pellegrino. Caltech is just one institution working on developing this technology. We know that scientists at the Chongqing Collaborative Innovation Research Institute for Civil-Military Integration in China are constructing a facility to test the theoretical viability of the concept and plans to develop an orbital photovoltaic array were announced in Japan some time ago. One of the biggest issues to overcome is that of getting an array of solar panels large enough to make the project viable into orbit. Early concept designs in the 1970s featured giant arrays that would've proved very difficult to actually get into orbit. "The systems of the 70s for solar power satellites, the cost estimates suggested, at that time, that it might be as much as a trillion dollars to get to the first kilowatt hour because of the way the designs worked. Essentially a single satellite, a platform, an integrated, monolithic platform about the size of Manhattan," said Mankins. However, with SpaceX and Blue Origin slowly driving the cost of orbital delivery down, suddenly the concept seems a little closer to reality. "Going to modular systems to allow mass production, I believe was the answer to how to get solar power satellite costs down to something more reasonable," said Mankins. Proposed space solar array SPS-ALPHA, image and concept courtesy John C. Mankins. Proposed space solar array SPS-ALPHA, image and concept courtesy John C. Mankins. JOHN C. MANKINS Details of China's proposed plans have not been made public, but most concept designs that exist today are based around an idea that the photovoltaic array is composed of a lightweight, deployable structure made of many smaller "solar satellites" that could easily connect together in space to form much larger array and "harvest sunlight." Equally, this approach also makes assembly, maintenance and repair considerably easier. "I've seen a presentation on what they [China] are presumably doing. I can't guarantee that's actually it, but it was by them, about the space solar system. What I've seen appears to be a conventional approach, which is similar to what people are currently contemplating," said Hajimiri. This completed array would orbit about 22,000 miles above the Earth and "beam" the energy back down to the surface. The photovoltaic array converts the sunlight into electricity, which in turn is converted into RF electrical power (microwaves) that are beamed wirelessly to ground-based receivers. These would take the form of giant wire nets measuring up to four miles across that could be installed across deserts or farmland or even over lakes. A solar facility like this could generate a constant flow of 2,000 gigawatts of power, Mankins estimates, compared to the largest solar farm that exists today in Aswan, southern Egypt, that only generates in the region of 1.8 gigawatts. It's unlikely the solar array could be weaponized into a "death ray" like the one seen in Diamonds... [+] Are Forever. It's unlikely the solar array could be weaponized into a "death ray" like the one seen in Diamonds... [+] MGM/UNITED ARTISTS An orbiting solar array, collecting and storing massive amounts of energy that's beamed to the surface... You'd be forgiven for thinking this could be the plot of a James Bond movie, if this array was somehow weaponized. Thankfully, that's not how it works. "The energy densities will not exceed what you normally would get. It would definitely not exceed what you get from the sun," said Hajimiri. The microwaves that transmit the energy to the surface would be at the so-called non-ionizing radiation frequency. "What that means is that the frequencies are such that unlike x-rays, these are the frequencies at which their photons don't have enough energy to induce chemical change, like that ultraviolet or x-rays do," said Hajimiri. "I've been working on wireless power transmitters that would operate in the microwave frequency range, between about 2 gigahertz and 8 gigahertz, roughly. Wavelengths on the order of 10 to 2 inches. Those wavelengths of electromagnetic radiation can pass through the Earth's atmosphere, including clouds and weather, without interruption, without interference." However, Mankins expects there might still be some problems. "There's always the geopolitics issue. Because when you're at an equatorial orbit, geostationary Earth orbit, you can see a great deal of the Earth below you. For me, it's challenging to envision how there would ever be agreement to allow such a thing." The team at Caltech have successfully tested their proof of concept on the ground, their photovoltaic prototypes demonstrated they can collect and wirelessly transmit 10 gigahertz of power, so the next step is to perform scaled down experiments in space. The biggest challenge is to reduce the mass as much as possible without sacrificing efficiency. Of course, that would also help reduce cost, which is probably still the biggest hurdle. "Hopefully, we'll be able to test it in space within a couple of years," said Hajimiri. "Space solar power would transform our future in space and could provide a new source of virtually limitless and sustainable energy to markets across the world," said Mankins. "Why wouldn't we pursue it?"

#### Space renewable shift is inevitable and good – squo energy habits are unsustainable, only space-solar energy solves

Crawford 10/5 (Mark Crawford is an engineering and technology writer in Corrales, N.M. Space-Based Solar Power Offers Out-of-This World Challenges Oct 5, 2021, ASME, <https://www.asme.org/topics-resources/content/space-based-solar-power-offers-out-of-this-world-challenges)//ww> pbj

Fossil fuels comprise over three-quarters of the world’s energy consumption. These dwindling resources can only support our transportation and energy needs for another 50 to 100 years. In addition, the energy sector is the world’s greatest polluter, releasing nearly one-third of global greenhouse gas emissions, according to the Center for Climate and Energy Solutions. Depletion of oil, gas, and coal reserves will eventually force the world to shift to clean, renewable resources, especially solar energy, which is plentiful. However, solar panels have a maximum efficiency of about 22 percent and are further impacted by external factors, such as limited daylight hours or bad weather. During winter in Europe, for example, as little as three percent of sunlight reaches the earth. These limitations on solar efficiency would be removed by using satellites to collect solar energy in space and beam it to collection sites on Earth. Space-based solar panels can generate 2,000 GW of power constantly, or about 40 times more energy than a solar panel would generate on Earth, according to the National Space Society. More for You: Infographic: Floating Solar Rides the Waves To make space-based solar power (SBSP) feasible on a global scale, several main systems are required: Low-cost, reusable launch vehicles to get materials into space Very large, lightweight, advanced satellite solar panels for in-orbit construction Microwave-transmitting satellites and laser-transmitting satellites, equipped with solar collectors, reflectors, and transmitters Receiving centers built on Earth to receive and distribute this energy. “There are many technical challenges to overcome to ensure that these systems are practical and affordable such as safety, cost, and durability,” states Karen L. Jones, senior project leader and technology strategist with the Center for Space Policy and Strategy. “For example, when beaming power down to Earth, the power densities of microwave beams must be low enough to avoid any real or perceived health and safety concerns.” Other challenges include figuring out how to launch such large solar collection systems into orbit in an affordable way. Solar panels on the International Space Station cover about 2,500 square meters; SBSP solar reflectors could stretch to three kilometers. Space-based solar energy innovators and operators will also need to design their systems to withstand the harsh space environment and offer reliable energy. Key mechanical engineering challenges include robotics and on-orbit assembly and modularity. “Modularity will be essential for assembling lightweight structures that are large enough to capture solar rays in a heliostat reflector array,” said Jones. “These building blocks must be both interoperable and have some level of autonomy. So we need standards in key areas that enable on-orbit assembly, for example, mechanical, electrical, power, thermal, and data interfaces. ASME has been a key player in standards development and should consider a role in standards development as space-based solar power continues to mature.” The U.S. Naval Research Laboratory launched an orbital SPS experiment on the X-37B space plane in May 2020 to test the viability of space-based solar power systems, including converting sunlight to microwaves and analyzing the antenna’s energy conversion process and resulting thermal performance. The U.S. Air Force Laboratory has partnered with Northrop Grumman and others to develop advanced SBSP technologies. For example, the University of Toledo is developing photovoltaic energy sheets that would harvest solar energy and transmit the power wirelessly to Earth. These flexible solar cell sheets would be assembled and interconnected into much larger structures that could include tens of millions of sheets and extend to sizes as large as a square mile. China also plans to use a new super heavy-lift rocket to construct a large space-based solar gigawatt-level power station by 2050. One way to create such a large system is by launching tens of thousands of “solar satellites” covered with photovoltaic panels that are programmed to connect in space to form an enormous cone-shaped collection and transmission system. The solar energy would be beamed wirelessly to ground-based receivers of large wire nets measuring up to four miles across. Researchers at the Japan Aerospace Exploration Agency continue to work on using microwaves to transmit energy, based on their successful experiments in 2015 that successfully used microwaves to transmit electric power. The team was able to deliver 1.8 kW of power through the air with pinpoint accuracy to a receiver about 170 feet away, proving that the technology is viable. The target market for space-based solar power, at least in its early operational stages, could be discrete applications rather than broad commercial opportunities with utility-scale terrestrial facilities that supply power grids. Jones, who recently wrote Space-Based Solar Power: A Near Term Investment Decision wrote with co-author James Vedda, notes that emerging markets for space-based solar power could include on-demand power-beaming for for forward-deployed military bases. "These bases have relied on very dangerous caravans to deliver fuel to the troops," she said. "Nearly two-thirds of coaltion deaths in Iraq and Afghanistan were related to fuel-transporation activities." Similar opportunities may include other terrestrial applications where agile and on-deman beaming capabilities are needed for disaster zones and other types of remote and isolated communities, and powering untethered remote assets such as drones and distributed infrastructure and Internet of Things devices. "Regardless of how we envision the future," said Jones, "there will be surprises regarding future applications for wireless power transmission."

**Warming causes extinction & turns every impact – no adaptation & each degree is worse**

**Krosofsky ’21** [Andrew, Green Matters Journalist, “How Global Warming May Eventually Lead to Global Extinction”, Green Matters, 03-11-2021, https://www.greenmatters.com/p/will-global-warming-cause-extinction]//pranav

Eventually, yes. **Global warming will invariably result in the mass extinction of millions of different species,** humankind included. In fact, **the Center for Biological Diversity says that global warming is currently the greatest threat to life on this planet**. **Global warming causes a number of detrimental effects on the environment that many species won’t be able to handle long-term**. Extreme weather patterns are shifting climates across the globe, eliminating habitats and altering the landscape. **As a result, food and fresh water sources are being drastically reduced**. Then, of course, **there are the rising global temperatures themselves, which many species are physically unable to contend with**. Formerly frozen arctic and antarctic regions are melting, increasing sea levels and temperatures. Eventually, **these effects will create a perfect storm of extinction conditions**. The melting glaciers of the arctic and the searing, **unmanageable heat indexes being seen along the Equator are just the tip of the iceberg, so to speak.** **The species that live in these climate zones have already been affected by the changes caused by global warming.** Take polar bears for example, whose habitats and food sources have been so greatly diminished that they have been forced to range further and further south. **Increased carbon dioxide levels in the atmosphere and oceans have already led to ocean acidification**. **This has caused many species of crustaceans to either adapt or perish and has led to the mass bleaching of more than 50 percent of Australia’s Great Barrier Reef**, according to National Geographic. According to the Center for Biological Diversity, the current trajectory of global warming predicts that more than 30 percent of Earth’s plant and animal species will face extinction by 2050. By the end of the century, that number could be as high as 70 percent. We won’t try and sugarcoat things, humanity’s own prospects aren’t looking that great either. According to The Conversation, **our species has just under a decade left to get our CO₂ emissions under control. If we don’t cut those emissions by half before 2030, temperatures will rise to potentially catastrophic levels. It may only seem like a degree or so, but the worldwide ramifications are immense.** The human species is resilient. We will survive for a while longer, even if these grim global warming predictions come to pass, **but it will mean less food, less water, and increased hardship across the world — especially in low-income areas and developing countries. This increase will also mean more pandemics, devastating storms, and uncontrollable wildfires**.

## Case

### Util Indicts

1. **Problem of induction—I predict based on past experiences, but there’s no justification for why those past experiences are true besides they worked in the past, which is based on experiences and is circular**
2. **Infinite consequences—each action has a consequence which leads to another consequence—if I drop a pen, that could lead to a hurricane so there is no consequence that can be predicted**
3. **Util triggers skep—if our bodies naturally know pain is bad and pleasure is good, we automatically act off pain and pleasure ie I automatically remove my hand from a hot stove bc receptors unconsciously trigger my hand to move—means we don’t have control over action and there can’t be moral prescription**
4. **There’s always infinite pleasure and pain in the universe—util is incoherent since we can’t add or subtract from that.**

**Bostrom ’08** (Bostrom, Nick [Professor at University of Oxford, director of Oxford’s Future of Humanity Institute, PhD from London School of Economics]. The Infinitarian Challenge to Aggregative Ethics. 2008. http://www.nickbostrom.com/ethics/infinite.pdf)

In the standard Big Bang model, assuming the simplest topology (i.e., that space is singly connected), there are three basic possibilities: the universe can be open, flat, or closed. **Current data suggests a flat or open universe**, although the final verdict is pending. **If the universe is either open or flat, then it is spatially infinite at every point in time and the model entails that it contains an infinite number of galaxies, stars, and planets**. There exists a common misconception which confuses the universe with the (finite) ‘observable universe’. But **the observable part**—the part that coulsd causally affect us—**would be just an infinitesimal fraction of the whole**. Statements about the “mass of the universe” or the “number of protons in the universe” generally refer to the content of this observable part; see e.g. [1]. **Many cosmologists believe that our universe is just one in an infinite ensemble of universes** (a multiverse), **and this adds to the probability that the world is canonically infinite**; for a popular review, see

### IF THEY WIN UTIL

#### [3] Extinction First –

#### [a] Forecloses future improvement – we can never improve society because our impact is irreversible

#### [b] Turns suffering – mass death causes suffering because people can’t get access to resources and basic necessities

#### [c] Moral uncertainty – if we’re unsure about which interpretation of the world is true – we ought to preserve the world to keep debating about it

### Advantage 1

#### [5] Kessler’s Syndrome wrong and super long timeframe---he’s adjusted it recently AND their johnson ev is from 2013 – perfer ours on recency

**Kurt 15** – JD-William & Mary

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

A. Practical Considerations: Feasible Solutions to the Space Debris Problem Are on Their Way One **key question in assessing** whether an international treaty is a **requisite** for solving the space debris problem is just **how difficult** it will be to fashion a remedy. The more complex and costly are feasible solutions, the more likely it is that a **comprehensive regime** is necessary to **bind the various actors together**. 93Link to the text of the note A good place to begin is to determine **just how imminent is the onset of the cascade** of exponentially more frequent debris-creating collisions, known as the Kessler Syndrome. 94Link to the text of the note To be certain, no one can be sure--this phenomenon being subject to highly complex probabilities. 95Link to the text of the note Indeed, experts' estimates of when such a cascade will become irreversible **vary** [\*316] **widely**. 96Link to the text of the note The National Research Council produced a report in 2011 that suggested that "space might be just 10 or 20 years away from severe problems." 97Link to the text of the note In fact, the cascading effect has already begun, albeit at a modest pace. 98Link to the text of the note However, Donald **Kessler**, who **first described** the eponymous effect in **1978**, has **significantly recalibrated his own outlook** over the years. 99Link to the text of the note Originally, Kessler predicted that catastrophe would **result by the year 2000**. 100Link to the text of the note That date **long passed**, Kessler **now speaks of a century-long process** that "**we have time to deal with**."

#### [3] their munoz ev says that collisions and the syndrome should have happened in 2021 - a

#### [4] Alt cause – broad space privatization and existing debris.

**Muelhapt et al 19** [(Theodore J., Center for Orbital and Reentry Debris Studies, Center for Space Policy and Strategy, The Aerospace Corporation, 30 year Space Systems Analyst and Operator, Marlon E. Sorge, Jamie Morin, Robert S. Wilson), “Space traffic management in the new space era,” Journal of Space Safety Engineering, 6/18/19, <https://doi.org/10.1016/j.jsse.2019.05.007>] TDI

The last decade has seen rapid growth and change in the space industry, and an explosion of commercial and private activity. Terms like NewSpace or democratized space are often used to describe this global trend to develop faster and cheaper access to space, **distinct from more traditional government-driven activities** focused on security, political, or scientific activities. The easier access to space has opened participation to many more participants than was historically possible. This new activity could profoundly worsen the space debris environment, particularly in low Earth orbit (**LEO**), but there are also signs of progress and the outlook is encouraging. Many NewSpace operators are actively working to mitigate their impact. Nevertheless, NewSpace represents a significant break with past experience and business as usual will not work in this changed environment. New standards, space policy, and licensing approaches are powerful levers that can shape the future of operations and the debris environment. 2. Characterizing NewSpace: a step change in the space environment In just the last few years, commercial companies have proposed, funded, and in a few cases begun deployment of very large constellations of small to medium-sized satellites. These constellations will add much more complexity to space operations. Table 1 shows some of the constellations that have been announced for launch in the next decade. Two dozen companies, when taken together, have proposed placing well over ~~20,000~~ [twenty thousand] satellites in orbit in the next ~~10~~ [10]years. For perspective, fewer than ~~8100~~[eight thousand one hundred] payloads have been placed in Earth orbit in the entire history of the space age, only 4800 [1] remain in orbit and approximately 1950 [2] of those are still active. And it isn't simply numbers – the mass in orbit will increase substantially, and long-term debris generation is strongly correlated with mass. [Table 1 Omitted] This table is in constant flux. It is based largely on U.S. filings with the Federal Communications Commission (FCC) and various press releases, but many of the companies here have already altered or abandoned their original plans, and new systems are no doubt in work. Although many of these large constellations may never be launched as listed, the **traffic created if just half are successful would be more than double the number of payloads launched in the last 60 years and more than 6 times the number of currently active satellites.** Current space safety, space surveillance, collision avoidance (COLA) and debris mitigation processes have been designed for and have evolved with the current population profile, launch rates and density of LEO space. By almost **any metric** used to measure activity in space, whether it is payloads in orbit, the size of constellations, the rate of launches, the economic stakes, the potential for debris creation, the number of conjunctions, NewSpace represents a **fundamental change.** 3. Compounding effects of better SSA, more satellites, and new operational concepts The changes in the space environment can be seen on this figurative map of low Earth orbit. Fig. 1 shows the LEO environment as a function of altitude. The number of objects found in each 10 km “bin” is plotted on the horizontal axis, while the altitude is plotted vertically. Objects in elliptical orbits are distributed between bins as partial objects proportional to the time spent in each bin. Some notable resident systems are indicated in blue text on the right to provide an altitude reference. The (dotted) red line shows the number of objects in the current catalog tracked by the U.S. Space Surveillance Network (SSN). All the COLA alerts and actions that must be taken by the residents are due to their neighbors in the nearby bins, so the currently visible risk is proportional to the red line. The red line of the current catalog does not represent the complete risk; it indicates the risk we can track and perhaps avoid. A rule of thumb is that the current SSN LEO catalog contains objects about 10 cm or larger. It is generally accepted that an impact in LEO with an object 1 cm or larger will cause damage likely to be fatal to a satellite's mission. Therefore, there is a large latent risk from unobserved debris. While we cannot currently track and catalog much smaller than 10 cm, experiments have been performed to detect and sample much smaller objects and statistically model the population at this size [3]. The (solid) blue line represents the model of the 1 cm and larger debris that is likely mission-ending, usually called lethal but not trackable. If LEO operators avoid collisions with all the objects in the red line, they are nonetheless inherently accepting the risk from the blue line. This risk is already present. The (dashed) orange line is an estimate of the population at 5 cm and larger and is thus an estimate of what the catalog might conservatively be a few years after the Space Fence, a new radar system being built by the Air Force, comes on line (currently planned for 2019) [4]. Commercial companies offering space surveillance services, such as LeoLabs, ExoAnalytics, Analytic Graphics Inc., Lockheed, and Boeing, might also add to the number of objects currently tracked. Space Policy Directive 3 (SPD-3) [13] specifically seeks to expand the use of commercial SSA services. Existing operators can expect a sharp increase in the number of warnings and alerts they will receive because of the increase in the cataloged population. Almost all the increase will come from newly detected debris [5]. The pace of safety operations for each satellite on orbit will significantly change because of the increase in the catalog from the Space Fence. This effect is compounded because the NewSpace constellations described in Table 1 will drastically change the profile of satellites in LEO. The green bars in Fig. 1 represent the number of objects that will be added to the catalog (red or orange lines) from only the NewSpace large LEO constellations at their operational altitudes. This does not include the rocket stages that launch them, or satellites in the process of being phased into or removed from the operational orbits. Neighbors of one of these new constellations may face a radically different operations environment than their current practices were designed to address. Satellites in these large LEO constellations typically have planned operational lifetimes of 5–10 years. Some companies have proposed to dispose of their satellites using low thrust electric propulsion systems, which would spiral satellites down over a period of months or years from operating altitudes as high as 1500 km through lower orbits where the Hubble Space Telescope, the International Space Station, and other critical LEO satellites operate [6]. Similar propulsive techniques would raise replacement satellites from lower launch injection orbits to higher operational orbits. These disposal and replenishment activities will add thousands of satellites each year transiting through lower altitudes and posing a risk to all resident satellites in those lower orbits. More importantly, failures will occur both among transiting satellites and operational constellations, potentially leaving hundreds more stranded along the transit path.

### Advantage 2

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

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

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

### 1NC – Impact – Asteroid Mining

**Private appropriation for asteroid mining solves rare earth metal shortages**

**Manufacturing 20** [ Manafacturing,net “Asteroid Mining Could Solve Rare Metal Shortage” 1/31/2020 https://www.manufacturing.net/technology/blog/21113380/asteroid-mining-could-solve-rare-metal-shortage ] //aaditg

The infancy of a space industry This may sound like science fiction, but since at least the 1970s, **organizations like NASA have been considering the possible advantages of asteroid mining for resources**. While space travel is still extremely risky and expensive, there are certain advantages that make asteroid mining an appealing possibility. In the midst of a new privatized space race, companies are revisiting the possibility of sourcing materials from outer space, and that is because: Earth faces a global rare metal shortage A single asteroid could contain trillions of dollars worth of precious metals Sourcing materials from asteroids could enable large-scale construction in space Global material shortages **The world demand for rare and precious metals is growing, and a mix of political turmoil and natural scarcity are contributing to fears that the global supply will be unable to keep up. As supplies dwindle, demand grows, and prices rise, the new private company-based space race might offer a solution to the shortage.** The asteroid mining would require major investments in new technologies, but **there has been enough interest that companies have been formed to prospect for asteroids to harvest.** asteroid mining - mining ores Global demand for technologically critical metals is still growing. On the image: aerial view of enormous copper mine at Palabora, South Africa. **Asteroids can be grouped broadly into those that are primarily carbonaceous, silicates, or metallic. Metallic asteroids are primarily iron and nickel but can contain rare metals like platinum, gold, iridium, palladium, osmium, ruthenium and rhodium (see the links to find properties of these materials) at concentration several times higher than what is found on Earth.** A single asteroid could be worth hundreds of millions of dollars, billions, or more if humans could overcome the formidable challenge of harvesting it. Mine in space to build in space Bringing rare metals to Earth is not the only possible use for asteroid-derived materials. Building equipment on Earth then lifting it into space is, in fact, expensive. Every kilogram of material costs money to lift into orbit, and individual space launches cost upwards of $100 million USD. So even the more common materials in asteroids, like iron and nickel, take on new value because they are already in outer space.

#### That beats China and protects against Chinese REM gatekeeping

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

You could be forgiven if you are confused about what’s going on with rare-earth elements. On the one hand, news reports indicate that China may increase production quotas of the minerals this quarter as a [goodwill gesture](https://www.scmp.com/news/china/diplomacy/article/3122501/china-raises-rare-earth-quotas-goodwill-trade-signal-us) to the Joe Biden administration. But other sources say that China may ultimately ban the export of the rare earths altogether on “[security concerns](https://www.bloomberg.com/news/articles/2021-02-19/china-may-ban-rare-earth-technology-exports-on-security-concerns?sref=QYxyklwO).” What’s really going on here?

There are 17 elements considered [rare earths](https://www.bloomberg.com/news/articles/2021-02-16/why-rare-earths-are-achilles-heal-for-europe-u-s-quicktake) — lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium and yttrium — and while many aren’t actually rare in terms of global deposits, extracting them is difficult and expensive. They are used across high-tech manufacturing, including smartphones, fighter aircraft and components in virtually all advanced electronics. Of particular note, they are essential to many of the clean-energy technologies expected to come online in this decade.

I began to focus on rare-earth elements when I commanded the North Atlantic Treaty Organization’s presence in Afghanistan, known as the International Security Assistance Force. While Afghans live in an extremely poor country, [studies](https://thediplomat.com/2020/02/afghanistans-mineral-resources-are-a-lost-opportunity-and-a-threat/) have assessed that they sit atop $1 trillion to $3 trillion in a wide variety of minerals, including rare earths. Some [estimates](https://www.fraserinstitute.org/article/afghanistans-rare-earth-element-bonanza) put the rare-earth levels alone at 1.4 million metric tons.

But every time I tried to visit a mining facility, the answer I got from my security team was, “It’s too dangerous right now, admiral.” Unfortunately, despite a great deal of effort by the U.S. and NATO, those security challenges remain, deterring the large foreign-capital investments necessary to harvest the lodes. Which brings us back to Beijing.

China controls roughly 80% of the rare-earths market, between what it mines itself and processes in raw material from elsewhere. If it decided to wield the weapon of restricting the supply — something it has repeatedly [threatened](https://www.wsj.com/articles/china-trade-fight-raises-specter-of-rare-earth-shortage-11559304000) to do — it would create a significant challenge for manufacturers and a geopolitical predicament for the industrialized world.

It could happen. In 2010, Beijing threatened to cut off exports to Japan over the disputed Senkaku Islands. Two years ago, Beijing was reportedly considering restrictions on exports to the U.S. generally, as well as against specific companies (such as defense giant Lockheed Martin Corp.) that it deemed in violation of its policies against selling advanced weapons to Taiwan.

President Donald Trump’s administration issued an executive order to spur the production of rare earths domestically, and created an [Energy Resource Governance Initiative](https://www.state.gov/wp-content/uploads/2019/06/Energy-Resource-Governance-Initiative-ERGI-Fact-Sheet.pdf) to promote international mining. The European Union and Japan, among others, are also aggressively seeking newer sources of rare earths.

Given this tension, it was superficially surprising that China announced it would boost its mining quotas in the first quarter of 2021 by nearly 30%, reflecting a continuation in strong (and rising) demand. But the increase occurs under a shadow of uncertainty, as the Chinese Communist Party is undertaking a “review” of its policies concerning future sales of rare earths. In all probability, the tactics of the increase are temporary, and fit within a larger strategy.

China will go to great lengths to maintain overall control of the global rare-earths supply. This fits neatly within the geo-economic approach of the [One Belt, One Road](https://www.bloomberg.com/opinion/articles/2019-10-30/china-is-determined-to-reshape-the-globe) initiative, which seeks to use a variety of carrots and sticks — economic, trade, diplomatic and security — to create zones of influence globally. In terms of rare earths, the strategy seems to be allowing carefully calibrated access to the elements at a level that makes it economically less attractive for competitors to undertake costly exploration and mining operations. This is similar to the oil-market strategy used by Russia and the Organization of Petroleum Exporting Countries for decades.

Some free-market advocates believe that China will not take aggressive action choking off supply because that could [precipitate retaliation](https://www.bloomberg.com/opinion/articles/2021-02-22/china-weaponizing-rare-earths-technology-will-probably-backfire) or accelerate the search for alternate sources in global markets. What seems more likely is a series of targeted shutdowns directed against specific entities such as U.S. defense companies, Japanese consumer electronics makers, or European industrial concerns that have offended Beijing.

The path to rare-earth independence for the U.S. must include: Ensuring supply chains of rare earths necessary for national security; promoting the exploitation of the elements domestically (and removing barriers to responsibly doing so); mandating that defense contractors and other critical-infrastructure entities wean themselves off Chinese rare earths; sponsoring research and development to find alternative materials, especially for clean energy technology; and creating a substantial stockpile of the elements in case of a Chinese boycott.

This is a bipartisan agenda. The Trump administration’s [strategic assessment](https://www.commerce.gov/news/press-releases/2019/06/department-commerce-releases-report-critical-minerals) of what needs to be done (which goes beyond just 17 rare earths to include a total of 35 critical minerals) is thoughtful, and should serve as a basis for the Biden administration and Congress.

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

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

The implications of a rare earth shortage aren’t strictly related to the environment, and energy dependence, but have distinct military implications as well that could threaten the position of the United States world’s strongest military. The United States place in the world was assured by powerful and decisive deployments in World War One and World War Two. Our military expansion was built upon a large, powerful industrial base that created more, better weapons of war for our soldiers. During the World Wars, a well-organized draft that sent millions of men into battle in a short amount of time proved decisive, but as the war ended, and soldiers drafted into service returned to civilian life, the U.S. technological superiority over its opponents provided it with sustained dominance over its enemies, even as the numerical size of the army declined. New technologies, such as the use of the airplane in combat, rocket launched missiles, radar systems, and later, GPS, precision guided missiles, missile defense systems, high tech tanks, lasers, and other technologies now make the difference between victory and defeat.

The United States military now serves many important functions, deterring threats across the world. The United States projects its power internationally, through a network of bases and allied nations. Thus, the United States is a powerful player in all regions of the world, and often serves as a buffer against conflict in these regions. US military presence serves as a buffer against Chinese military modernization in Eastern Asia, against an increasingly nationalist Russia in Europe, and smaller regional actors, such as Venezuela in South America and Iran in the Middle East. The U.S. Navy is deployed all over the world, as the guarantor of international maritime trade routes. The US Navy leads action against challenges to its maritime sovereignty on the other side of the globe, such as current action against Somali piracy. Presence in regions across the world prevents escalation of potential crisis. These could result in either a larger power fighting a smaller nation or nations (Russia and Georgia, Taiwan and China), religious opponents (Israel and Iran), or traditional foes (Ethiopia and Eretria, Venezuela and Colombia, India and Pakistan). US projection is also key deterring emerging threats such as terrorism and nuclear proliferation. While not direct challenges to US primacy, both terrorism and nuclear proliferation can kill thousands.

The US Air Force has a commanding lead over the rest of the world, in terms of both numbers and capabilities. American ground forces have few peers, and are unmatched in their ability to deploy to anywhere in the world at an equally unmatched pace.

The only perceived challenge to the United States militarily comes from the People’s Republic of China.76 While the United States outspends all other nations in the world put together in terms of military spending, China follows as a close second, and has begun an extensive modernization program to boot.77 The Chinese military however, is several decades behind the United States in air power and nuclear capabilities.78 To compensate, China has begun the construction of access-denial technology, preventing the US from exercising its dominance in China’s sphere of influence.79 Chinese modernization efforts have a serious long-term advantage over the United States; access to rare earth metals, and a large concentration of rare earth chemists doing research.80 This advantage, coupled with the U.S. losing access to rare earth metals, will even the odds much quicker than policymakers had previously anticipated. 81

The largest example is US airpower. With every successive generation of military aircraft, the U.S. Air Force becomes more and more dependent on Rare Earth Metals.82 As planes get faster and faster, they have to get lighter and lighter, while adding weight from extra computers and other features on board.83 To lighten the weight of the plane, scandium is used to produce lightweight aluminum alloys for the body of the plane. Rare Earth metals are also useful in fighter jet engines, and fuel cells.84 For example, rare earths are required to producing miniaturized fins, and samarium is required to build the motors for the F-35 fighter jet.85 F-35 jets are the next generation fighter jet that works together to form the dual plane combination that cements U.S. dominance in air power over the Russian PAK FA.86

Rare earth shortages don’t just affect air power, also compromising the navigation system of Abrams Tanks, which need samarium cobalt magnets. The Abrams Tank is the primary offensive mechanized vehicle in the U.S. arsenal. The Aegis Spy 1 Radar also uses samarium.87 Many naval ships require neodymium. Hell Fire missiles, satellites, night vision goggles, avionics, and precision guided munitions all require rare earth metals. 88

American military superiority is based on technological advancement that outstrips the rest of the world. Command and control technology allows the U.S. to fight multiple wars at once and maintain readiness for other issues, as well as have overwhelming force against rising challengers. This technology helps the U.S. know who, where, and what is going to attack them, and respond effectively, regardless of the source of the threat.

Rare Earth Elements make this technological superiority possible.

To make matters worse, the defense industrial base is often a single market industry, dependent on government contracts for its business. If China tightens the export quotas further, major US defense contractors will be in trouble.89 Every sector of the defense industrial base is dependent on rare earth metals. Without rare earths, these contractors can’t build anything, which collapses