# T – Appropriation

#### T – Appropriation:

#### Interpretation: Appropriation means use, exploitation, or occupation that is permanent and to the exclusion of others

Babcock 19 Professor of Law, Georgetown University Law Cente. Babcock, Hope M. "The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET." Syracuse L. Rev. 69 (2019): 191.

Article II is one of those succeeding provisions that curtails “the freedom of use outlined in Article [I] by declaring that outer space, including the [m]oon and other celestial bodies, is not subject to national appropriation.”147 It flatly prohibits national appropriation of any celestial body in outer space “by means of use or occupation, or by any other means.”148 However, “many types of ‘use’ or ‘exploitation’. . . are inconceivable without appropriation of some degree at least of any materials taken,” like ore or water.149 If this view of Article II’s prohibitory language is correct, then “it is not at all farfetched to say that the OST actually installs a blanket prohibition on many beneficial forms of development.”150 However, the OST only prohibits an appropriation that constitutes a “long-term use and permanent occupation, to the exclusion of all others.”151

#### Violation: Constellations do not appropriate – reject non-legal interpretations

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No, This Is Not Impermissible Appropriation

An opposite conclusion can also be reasonably arrived at when approached along the following lines. The counter argument would assert that the deployment and operation of these global constellations, such as SpaceX’s Starlink, OneWeb, Kepler, etc., are aligned with and in full conformity with the laws applicable to outer space. These constellations are merely the exercise and enjoyment of the freedom of exploration and use of outer space and do not constitute any impermissible appropriation of the orbits that they transit.

Freedom of Access and Use Permits Constellations

Rather than being a violation of other’s rights to access and explore outer space, the deployment of these constellations is more correctly viewed as the exercise and enjoyment of the right to access and use outer space. Article I of the Outer Space Treaty establishes a right to access and use space without discrimination.

Not allowing an actor to deploy spacecraft, regardless of their number or destination, would be infringing with the exercise of their freedom. It would be discriminatory. Additionally, actors do not need permission from any other State, or group of States, to access and explore outer space.

Aligned with the Intentions of the Outer Space Treaty

This use of outer space by constellations in LEO, while not explicitly mentioned by the drafters of the Outer Space Treaty or other space law, actually is the fulfillment of their visions for the use of outer space. The preamble to the Outer Space Treaty (which contains the subject matter and purpose of the treaty and can be used for interpreting the operative articles of the treaty) speaks of the aspirations of humanity in exploring and using outer space. It is easy to see constellations that will provide Internet access to the world as fulfilling the visions of the drafters:

The States Parties to this Treaty,

Inspired by the great prospects opening up before mankind as a result of man’s entry into outer space,

Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,

Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,

Desiring to contribute to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

Believing that such cooperation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

As such, subsequent article of the Outer Space Treaty should be read in a permissive light, as permitting constellations, rather than a restrictive light which only sees potential negative aspects of constellations.

Due Regard and Harmful Contamination Will be Addressed

Operators in LEO are well aware of the challenges to space sustainability that their constellations will pose and will be taking efforts to mitigate the creation of debris. OneWeb is keenly focused on space sustainability and has even argued that the current norm, whereby spacecraft are not in space for longer than 25 years and are deorbited from lower orbits at the end of their lifetime (aka post mission disposal), is not sufficient to keep outer space clean and that shorter lifespan limits should be imposed on operators, especially operators in LEO, and operators of small satellites.

Additionally, these systems will be able to cooperate with emerging space safety and space traffic management plans and can operate in ways that do not restrict or impinge on other users of the space domain. Because due regard is therefore displayed for the space domain, and to the interests of others, these constellations do not prejudice or infringe upon the freedoms of use and exploration of the space domain and are therefore not occupation, or possession, much less appropriation.

This Does Not Constitute Possession, or Ownership, or Occupation

The use of LEO by satellite constellations is substantially similar to the use of GSO, and therefore permissible. In each region, individual actors are given permission - either from a national administrator or from an international governing body (the ITU) via a national administer–to use precoordinated subsections of space. In a way that is overwhelmingly similar to the use of orbital slots in GSO, the placement of spacecraft into orbits in LEO or higher orbits does not constitute possession, ownership, or occupation of those orbits. This is because States (and their companies) have been occupying orbital slots in GSO for decades, and these uses of GSO have never been accused of “appropriating” GSO. The users have never claimed to be appropriating GSO, and their exercising of rights to use GSO is respected by other actors in the space domain. This is the same situation for other orbits, including LEO and other non-Geostationary orbits.

And while GSO locations are relatively stable (subject to space weather and other perturbations, and require stationkeeping), spacecraft in LEO are actually moving through space and are not stationary, so it is even more difficult to see this use by constellations as occupation, much less appropriation. Moreover, Space Situational Awareness (SSA) and Space Traffic Management (STM) will allow other uses to use these orbits, and nothing about the use of any one user necessarily precludes others. Lastly, there is no intention by operators of constellations to exclusively occupy, must less possess or appropriate, these orbits. Would not the appropriation of outer space be an intentional, volutional act? No such intention can be found in the operators of global constellations.

#### 1] Precision – if we win definitions the aff doesn’t defend a shift from the squo or solve their advantages – so at best vote negative on presumption. The resolution is the only predictable stasis point for dividing ground—any deviation justifies the aff arbitrarily jettisoning words in the resolution at their whim which decks negative ground and preparation because the aff is no longer bounded by the resolution.

#### 2] Predictable limits—including satellite slots offers huge explosion in the topic since they get permutations of different satellite systems – LEO MEO and HEO, plus different companies, plus sizes of constellations, et cetera. Letting temporary occupation be appropriation is a limits diaster - any aff about a single space ship, satellite, or weapon would be T because they temporarily occupy space. Limits explodes neg prep burden and draws un-reciprocal lines of debate, where the aff is always ahead, turns their pragmatics offense

#### Topicality is a voting issue that should be evaluated through competing interpretations – it tells the negative what they do and do not have to prepare for—there’s no way for the negative to know what constitutes a “reasonable interpretation” when we do prep – reasonability is arbitrary and causes a race to the bottom, proliferating abuse

#### No RVIs—it’s your burden to be topical.

# Space Col DA

#### Starlink funding key to colonization and a pre-requisite to communications networks in space

Crist 22 – [Ry, CNET, “Starlink explained: Everything you should know about Elon Musk's satellite internet venture,” 1/10/2022, https://www.cnet.com/home/internet/starlink-satellite-internet-explained/]

And don't forget that this is Elon Musk we're talking about. SpaceX is the only company on the planet with a landable, reusable rocket capable of delivering payload after payload into orbit. That's a mighty advantage in the commercial space race. On top of that, Musk said in 2018 that Starlink will help provide SpaceX with revenue needed to fund the company's long-held ambition to establish a base on Mars.

If that day arrives, it's also likely that SpaceX will try to establish a satellite constellation on the red planet, too. That means that Starlink customers are potentially doubling as guinea pigs for the Martian wireless networks of the future.

"If you send a million people to Mars, you better provide some way for them to communicate," Shotwell said in 2016, speaking about the company's long-term vision for Starlink. "I don't think the people who go to Mars are going to be satisfied with some terrible, old-fashioned radios. They'll want their iPhones or Androids on Mars."

As CNET's Jesse Orral noted in a recent video about Starlink, you'll even find hints of Musk's plans for Mars in the Starlink terms of service, which at one point reads:

"For services provided on Mars, or in transit to Mars via Starship or other colonization spacecraft, the parties recognize Mars as a free planet and that no Earth-based government has authority or sovereignty over Martian activities."

#### Colonization solves extinction

Drake '16 – a science journalist and contributing writer at National Geographic. She earned an A.B. in biology, psychology, and dance at Cornell University, worked in a clinical genetics lab at The Johns Hopkins University School of Medicine, then returned to Cornell for her Ph.D. in genetics and development. (Bynadia, "Elon Musk: A Million Humans Could Live on Mars By the 2060s," Science, 9-27-2016, https://www.nationalgeographic.com/science/article/elon-musk-spacex-exploring-mars-planets-space-science, Accessed 6-22-2021)

In perhaps the most eagerly anticipated aerospace announcement of the year, SpaceX founder Elon Musk has revealed his grand plan for establishing a human settlement on Mars. In short, Musk thinks it’s possible to begin shuttling thousands of people between Earth and our smaller, redder neighbor sometime within the next decade or so. And not too long after that—perhaps 40 or a hundred years later, Mars could be home to a self-sustaining colony of a million people. “This is not about everyone moving to Mars, this is about becoming multiplanetary,” he said on September 27 at the International Astronautical Congress in Guadalajara, Mexico. “This is really about minimizing existential risk and having a tremendous sense of adventure.” Musk’s timeline sounds ambitious, and that's something he readily acknowledges. “I think the technical outline of the plan is about right. He also didn’t pretend that it was going to be easy and that they were going to do it in ten years,” says Bobby Braun, NASA’s former chief technologist who’s now at Georgia Tech University. “I mean, who’s to say what’s possible in a hundred years?” And for those wondering whether we should go at all, the reason for Musk making Mars an imperative is simple. “The future of humanity is fundamentally going to bifurcate along one of two directions: Either we’re going to become a multiplanet species and a spacefaring civilization, or we’re going be stuck on one planet until some eventual extinction event,” Musk told Ron Howard during an interview for National Geographic Channel’s MARS, a global event series that premieres worldwide on November 14. “For me to be excited and inspired about the future, it’s got to be the first option. It’s got to be: We’re going to be a spacefaring civilization.” Mars Fleet Though he admitted his exact timeline is fuzzy, Musk thinks it’s possible humans could begin flying to Mars by the mid-2020s. And he thinks the plan for getting there will go something like this: It starts with a really big rocket, something at least 200 feet tall when fully assembled. In a simulation of what SpaceX calls its Interplanetary Transport System, a spacecraft loaded with astronauts will launch on top of a 39-foot-wide booster that produces a whopping 28 million pounds of thrust. Using 42 Raptor engines, the booster will accelerate the assemblage to 5,374 miles an hour. Overall, the whole thing is 3.5 times more powerful than NASA’s Saturn V, the biggest rocket built to date, which carried the Apollo missions to the moon. Perhaps not coincidentally, the SpaceX rocket would launch from the same pad, 39A, at Kennedy Space Center in Cape Canaveral, Florida. The rocket would deliver the crew capsule to orbit around Earth, then the booster would steer itself toward a soft landing back at the launch pad, a feat that SpaceX rocket boosters have been doing for almost a year now. Next, the booster would pick up a fuel tanker and carry that into orbit, where it would fuel the spaceship for its journey to Mars. Once en route, that spaceship would deploy solar panels to harvest energy from the sun and conserve valuable propellant for what promises to be an exciting landing on the Red Planet. As Musk envisions it, fleets of these crew-carrying capsules will remain in Earth orbit until a favorable planetary alignment brings the two planets close together—something that happens every 26 months. “We’d ultimately have upward of a thousand or more spaceships waiting in orbit. And so the Mars colonial fleet would depart en masse,” Musk says. The key to his plan is reusing the various spaceships as much as possible. “I just don’t think there’s any way to have a self-sustaining Mars base without reusability. I think this is really fundamental,” Musk says. “If wooden sailing ships in the old days were not reusable, I don’t think the United States would exist.” Musk anticipates being able to use each rocket booster a thousand times, each tanker a hundred times, and each spaceship 12 times. At the beginning, he imagines that maybe a hundred humans would be hitching a ride on each ship, with that number gradually increasing to more than 200. By his calculations, then, putting a million people on Mars could take anywhere from 40 to a hundred years after the first ship launches. And, no, it would not necessarily be a one-way trip: “I think it’s very important to give people the option of returning,” Musk says. Colonizing Mars After landing a few cargo-carrying spacecraft without people on Mars, starting with the Red Dragon capsule in 2018, Musk says the human phase of colonization could begin. For sure, landing a heavy craft on a planet with a thin atmosphere will be difficult. It was tough enough to gently lower NASA’s Curiosity rover to the surface, and at 2,000 pounds, that payload weighed just a fraction of Musk’s proposed vessels. For now, Musk plans to continue developing supersonic retrorockets that can gradually and gently lower a much heavier spacecraft to the Martian surface, using his reusable Falcon 9 boosters as a model. And that’s not all these spacecraft will need: Hurtling through the Martian atmosphere at supersonic speeds will test even the most heat-tolerant materials on Earth, so it’s no small task to design a spacecraft that can withstand a heated entry and propulsive landing—and then be refueled and sent back to Earth so it can start over again. The first journeys would primarily serve the purpose of delivering supplies and establishing a propellant depot on the Martian surface, a fuel reservoir that could be tapped into for return trips to Earth. After that depot is set up and cargo delivered to the surface, the fun can (sort of) begin. Early human settlers will need to be good at digging beneath the surface and dredging up buried ice, which will supply precious water and be used to make the cryo-methane propellant that will power the whole enterprise. As such, the earliest interplanetary spaceships would probably stay on Mars, and they would be carrying mostly cargo, fuel, and a small crew: “builders and fixers” who are “the hearty explorer type,” Musk said to Howard. “Are you prepared to die? If that’s OK, then you’re a candidate for going.” While there will undoubtedly be intense competition and lots of fanfare over the first few seats on a Mars-bound mission, Musk worries that too much emphasis will be placed on those early bootprints. “In the sort of grander historical context, what really matters is being able to send a large number of people, like tens of thousands if not hundreds of thousands of people, and ultimately millions of tons of cargo,” he says.

# Internet DA

#### Starlink key to global internet spread – improves global economic stability, new business and skilled labor

Antin 20 – [Doug, “Why Elon Musk’s Starlink Will Change Your Life,” 7/15/2020, https://medium.com/predict/why-elon-musks-starlink-will-change-your-life-31a2f9a84f3b]

The year is 2020 and nearly 40% of the world still does not have stable access to the internet. That’s about 12 times the number of people in the entire United States of America that don’t connect to the internet. For a large number of them, the reason is that they don’t have access to the infrastructure necessary to get online. But that’s about to change with Elon Musks company SpaceX and their Starlink project.

Starlink is an ambitious project that aims to put nearly 2,000 small satellites into orbit by the end of 2021 to provide a globalized network of internet access. The ultimate goal is to get affordable internet to every part of the world. As Starlink provides access and the remaining 40% of the global population comes online, the fundamental cultural makeup of the internet will change.

If you think about it in terms of the technology adoption lifecycle, change is inevitable. A massive influx of new users joining the globalized digital network will redefine the meaning of digital life. Assuming Musk succeeds, the world will be significantly impacted by adding nearly half the world’s population to the web.

As the entire world gains access to the internet, we will see a wave of cultural change to preexisting digital communities as well as the formation of new digital ecosystems. The economic engine that is the internet will provide new forms of prosperity to billions of people and fundamentally alter the traditional power dynamics of the world.

40% of the World Doesn’t Have Internet Access

The world currently has a population of nearly 7.8 billion people. A little under half of them do not have regular internet access.

Those without access are disproportionately low income and non-English speaking regions of the world. Despite this lack of access, the data indicate that although there is limited access in these regions, there does exist an appetite for connectivity. This is showcased by a significant surge in mobile broadband use over the last few years.

So what does this mean to you, a person that already has internet?

As Starlink comes online and makes access possible for nearly 4 billion people, we can expect the fundamental makeup of the internet to change. That includes the language and cultural norms of digital communities. Here’s how it might happen.

Language Composition of the Internet Will Change

According to stats on the top 10 languages used on the internet, the English language narrowly beats out Chinese for the number one spot.

China’s domestic internet penetration rate is only around 60% compared to the US rate of 75% as of 2020. While these may not seem too different, consider that China’s population is nearly 1.5 billion people to 330 million in the US. The point being, as more Chinese come online, we can expect the top language used on the internet may shift towards Chinese.

Not sold? Consider the Chinese Government’s aggressive approach to building infrastructure in Africa which is disproportionately under-represented in internet access. As China continues to integrate with Africa, will these new internet users ultimately opt for English or Chinese as their preferred language of the internet?

These factors create an interesting paradigm for a shift in the dominant language of the web.

Digital Culture Will Change

Regardless of the predominant language of the internet, it’s clear that a cultural shift will also take place as the global population comes online. New people joining global communities from developing locations will bring considerably different worldviews.

It’s unclear how their mobile-first use of the internet will impact web traffic and technology preferences in the future.

According to the widely used SEO tool Ahrefs, these are the top 5 most popular websites by traffic around the world. (Visits per month)

youtube.com 8,564,946,8852

facebook.com 3,483,131,2643

en.wikipedia.org 2,223,668,8554

twitter.com 2,008,820,3155

amazon.com 618,747,155

These are unlikely to change positions because they are mobile-friendly and offer utility and convenience to just about everyone. But we can expect a fundamental shift in where web traffic flows based on the unique preferences of new user demographics. As web traffic changes, we can expect the advertising dollars to shift towards these new areas. Creating new opportunities and harming incumbent businesses.

New Business Opportunities Will Arise

As the internet becomes available to the second half of the world there is no doubt that massive business opportunities will proliferate. Entrepreneurs will ask questions such as what services will these new users need and seek out?

In low access regions, there is a clear deficit in IT skills. We can expect to see growth in easy to access programs for upskilling individuals as they gain internet access. Globalized versions of Khan Academy. These programs will be mobile friendly and focus on core business skills such as communications, file transfers, and other basic competencies.

There will also be an opportunity to provide training in mobile-oriented financial security and privacy tools. Proper online banking habits, understanding the threat of phishing schemes, and lessons on the importance of strong passwords.

The connection of global populations will also present interesting labor arbitrage opportunities. As more low-income regions gain access and become skilled in information technology, they alter the global labor wage dynamic. Businesses in developed countries will gain access to more affordable digital labor while simultaneously, developed world workers may experience wage disruption. Possibly even employment displacement. This is a boon for business expenditures and a potential pitfall for the labor economy as a global wage equilibrium is found.

#### Starlink makes fast internet globally accessible

Crist 22 – [Ry, CNET, “Starlink explained: Everything you should know about Elon Musk's satellite internet venture,” 1/10/2022, https://www.cnet.com/home/internet/starlink-satellite-internet-explained/]

Starlink's business is accelerating, as well. In February of 2021, Musk's company disclosed that Starlink was serving more than 10,000 customers. Now, after expanding preorders to even more potential customers, releasing a second-gen home internet satellite dish, and exploring the possibility of providing in-flight Wi-Fi for passenger aircraft, Musk says that Starlink has shipped more than 100,000 satellite internet terminals to customers in 14 countries.

During a talk at Mobile World Congress in June 2021, Musk told an audience that Starlink would be available worldwide except at the North and South Poles starting in August, though regional availability will depend on regulatory approval. In September, Musk tweeted that Starlink would exit its initial beta phase in October, which indicates that the service is continuing to ramp up and expand -- though the budding broadband provider faces a backlog of prospective customers waiting to receive equipment and start service.

Starlink isn't without its controversies. Members of the scientific community have raised concerns about the impact of Starlink's low-earth orbit satellites on night sky visibility. Meanwhile, satellite internet competitors including Viasat, HughesNet and Amazon's Project Kuiper have taken notice of Starlink's momentum, too, prompting plenty of regulatory jousting and attempts to slow Musk down.

We'll continue to monitor Starlink's progress in 2022. For now, here's everything you should know about it.

OK, start at the beginning: What is Starlink, exactly?

Technically a division within SpaceX, Starlink is also the name of the spaceflight company's growing network -- or "constellation" -- of orbital satellites. The development of that network began in 2015, with the first prototype satellites launched into orbit in 2018.

In the years since, SpaceX has deployed nearly 2,000 Starlink satellites into orbit across dozens of successful launches, the most recent of which took place on Jan. 6 and delivered another 49 satellites into orbit. That brings the total number of satellites in the constellation up to 1,993, though some of those satellites are prototypes or nonoperational units that aren't functioning parts of the network.

And those satellites can connect my home to the internet?

That's the idea, yes.

Just like existing providers of satellite internet like HughesNet or Viasat, Starlink wants to sell internet access -- particularly to people in rural areas and other parts of the world who don't already have access to high-speed broadband.

"Starlink is ideally suited for areas of the globe where connectivity has typically been a challenge," the Starlink website reads. "Unbounded by traditional ground infrastructure, Starlink can deliver high-speed broadband internet to locations where access has been unreliable or completely unavailable."

#### Internet access global dampener on existential risk

David **Eagleman 10**, Neuroscientist at Baylor College of Medicine, where he directs the Laboratory for Perception and Action and the Initiative on Neuroscience and Law and author of Sum (Canongate). Nov. 9, “Six ways the internet will save civilization,” http://www.wired.co.uk/magazine/archive/2010/12/start/apocalypse-no

Many great civilisations have fallen, leaving nothing but cracked ruins and scattered genetics. Usually this results from: natural disasters, resource depletion, economic meltdown, disease, poor information flow and corruption. But we’re luckier than our predecessors because we command a technology that no one else possessed: a rapid communication network that finds its highest expression in the internet. I propose that there are six ways in which the net has vastly reduced the threat of **societal collapse**. Epidemics can be deflected by telepresence One of our more dire prospects for collapse is an infectious-disease epidemic. Viral and bacterial epidemics precipitated the fall of the Golden Age of Athens, the Roman Empire and most of the empires of the Native Americans. **The internet** **can be our key to survival** because the ability to work telepresently can inhibit microbial transmission by reducing human-to-human contact. In the face of an otherwise devastating epidemic, businesses can keep supply chains running with the maximum number of employees working from home. This can reduce host density below the tipping point required for an epidemic. If we are well prepared when an epidemic arrives, we can fluidly shift into a self-quarantined society in which microbes fail due to host scarcity. Whatever the social ills of isolation, they are worse for the microbes than for us. The internet will **predict** natural disasters We are witnessing the downfall of slow central control in the media: news stories are increasingly becoming user-generated nets of up-to-the-minute information. During the recent California wildfires, locals went to the TV stations to learn whether their neighbourhoods were in danger. But the news stations appeared most concerned with the fate of celebrity mansions, so Californians changed their tack: they uploaded geotagged mobile-phone pictures, updated Facebook statuses and tweeted. The balance tipped: the internet carried news about the fire more quickly and accurately than any news station could. In this grass-roots, decentralised scheme, there were embedded reporters on every block, and the news shockwave kept ahead of the fire. This head start could provide the extra hours that save us. If the Pompeiians had had the internet in 79AD, they could have easily marched 10km to safety, well ahead of the pyroclastic flow from Mount Vesuvius. If the Indian Ocean had the Pacific’s networked tsunami-warning system, South-East Asia would look quite different today. Discoveries are retained and shared Historically, critical information has required constant rediscovery. Collections of learning -- from the library at Alexandria to the entire Minoan civilisation -- have fallen to the bonfires of invaders or the wrecking ball of natural disaster. Knowledge is hard won but easily lost. And information that survives often does not spread. Consider smallpox inoculation: this was under way in India, China and Africa centuries before it made its way to Europe. By the time the idea reached North America, native civilisations who needed it had already collapsed. The net solved the problem. **New** **discoveries** catch on immediately; information spreads widely. In this way, societies can optimally ratchet up, using the latest bricks of knowledge in their fortification against risk. Tyranny is **mitigated** Censorship of ideas was a familiar spectre in the last century, with state-approved news outlets ruling the press, airwaves and copying machines in the USSR, Romania, Cuba, China, Iraq and elsewhere. In many cases, such as Lysenko’s agricultural despotism in the USSR, it directly contributed to the collapse of the nation. Historically, a more successful strategy has been to confront free speech with free speech -- and the internet allows this in a natural way. It democratises the flow of information by offering access to the newspapers of the world, the photographers of every nation, the bloggers of every political stripe. Some posts are full of doctoring and dishonesty whereas others strive for independence and impartiality -- but all are available to us to sift through. Given the attempts by some governments to build firewalls, it’s clear that this benefit of the net requires constant vigilance. Human capital is **vastly** **increased** Crowdsourcing brings people together to solve problems. Yet far fewer than one per cent of the world’s population is involved. We need expand human capital. Most of the world not have access to the education afforded a small minority. For every Albert Einstein, Yo-Yo Ma or Barack Obama who has educational opportunities, uncountable others do not. This squandering of talent translates into reduced economic output and a smaller pool of problem solvers. The net opens the gates education to anyone with a computer. A motivated teen anywhere on the planet can walk through the world’s knowledge -- from the webs of Wikipedia to the curriculum of MIT’s OpenCourseWare. The new human capital will serve us well when we **confront** existential threats we’ve never imagined before. Energy expenditure is reduced Societal collapse can often be understood in terms of an energy budget: when energy spend outweighs energy return, collapse ensues. This has taken the form of deforestation or soil erosion; currently, the worry involves fossil-fuel depletion. The internet addresses the energy problem with a natural ease. Consider the massive energy savings inherent in the shift from paper to electrons -- as seen in the transition from the post to email. Ecommerce reduces the need to drive long distances to purchase products. Delivery trucks are more eco-friendly than individuals driving around, not least because of tight packaging and optimisation algorithms for driving routes. Of course, there are energy costs to the banks of computers that underpin the internet -- but these costs are less than the wood, coal and oil that would be expended for the same quantity of information flow. The tangle of events that triggers societal collapse can be complex, and there are several threats the net does not address. But vast, networked communication can be an **antidote** to several of the most deadly diseases **threatening civilisation.** The next time your coworker laments internet addiction, the banality of tweeting or the decline of face-to-face conversation, you may want to suggest that the net may just be the technology that saves us.

# Case

#### Commercial megaconstellations solve communication deserts and intel shortages – that’s key to military dominance and forward deployment in the Arctic, East Asia, and Eastern Europe. Independently, it solves missile threats to precision strike systems.

Hallex and Cottom 20 — (Matthew A. Hallex, Research Staff Member at the Institute for Defense Analyses, Travis S. Cottom, a Research Associate at the Institute for Defense Analyses, “Proliferated Commercial Satellite Constellations: Implications for National Security”, JFQ 97, 2nd Quarter 2020, Available Online at <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97_20-29_Hallex-Cottom.pdf?ver=2020-03-31-130614-940>, accessed 1-30-22, HKR-AM)

The emergence of proliferated constellations will lead to easier access to satellite communications, space imagery, and other capabilities that can support U.S. and adversary military operations in the ground, maritime, and air domains. Adapting to these changes will likely require the development of new joint operational concepts to better exploit space systems in support of the joint fight as well as address new force protection challenges when fighting space-enabled state and nonstate actors. Proliferated constellations will substantially increase the availability of communications bandwidth for military operations. These satellites would provide high bandwidth to forces with less latency than existing GEO satellites,32 which, in turn, would improve access to reachback communications to forward-deployed military forces, and would also help meet the growing demand for transfer capacity for data collected by unmanned systems and other forward sensors. Proliferated LEO communications constellations would also offer coverage in theaters that are poorly served by commercial satellite communications today. Satellites in GEO do not sufficiently support **operations in the Arctic** and other high-latitude regions that are growing in economic and national security importance.33 Similarly, naval and air forces **operating in the Pacific** theater have less access to commercial communications than other theaters due to the lack of commercial customers in the open ocean. P

roliferated commercial LEO constellations would provide greater communications handling in both regions because of their global coverage. While unable to provide the high-resolution imagery and other specialized capabilities of existing national security satellites, proliferated LEO constellations could help to address some of the intelligence challenges the U.S. military faces. During the first Gulf War, the United States was unable to track and target Iraq’s Scud missile systems despite enjoying almost total air superiority. Since then, mobile missiles and other elusive targets have multiplied as potential adversaries seek to defeat U.S. conventional precision and nuclear strike systems. Imagery proliferated constellations could provide continuous or near-continuous coverage of missile operating areas to better enable the United States to find and eliminate these threat systems. The near continuous imagery coverage proliferated constellations offers—particularly if they include radar satellites that can see through clouds— combined with ground processing capabilities that can automatically detect changes in imagery would also make adversary deception operations less effective.34 Because the United States is likely to be on the defensive in the most worrying scenarios for conflict—such as **defending allies in Eastern Europe or East Asia**—these new capabilities will support U.S. efforts to detect adversary mobilization and to avoid operational surprise.

## Collisions

### Squo Solves – Laundry List – Includes Starlink

#### Squo solves debris – private tracking, surveillance, in-orbit servicing and green satellite tech all happening now – includes Starlink

CSTP 20 – OECD Committee, The strategic objectives of the Committee as defined in its Mandate and by the work priorities agreed by Member countries' Ministers responsible for science and technology provide the framework for the Secretariat's proposals for activities to be developed or initiated under the aegis of the Committee itself or its subsidiary bodies (NESTI, TIP, GSF, BNCT and IPSO) [This paper was approved and declassified by written procedure by the Committee for Scientific and Technological Policy (CSTP) on 11 March 2020 and prepared for publication by the OECD Secretariat, “SPACE SUSTAINABILITYTHE ECONOMICS OF SPACE DEBRIS IN PERSPECTIVE,” OECD Science, Technology and Industry Policy Papers, April 2020, No. 87, https://www.oecd-ilibrary.org/science-and-technology/space-sustainability\_a339de43-en]

An emerging “space debris economy”?

* Will we see a more intensive use of cubesats and miniaturised technologies in lower orbits? Cubesats have been the fastest-growing category of launched satellites in the last years and, when launched at lower altitudes, are naturally compliant with debris mitigation guidelines. They are also ever more performant and affordable, and dedicated launch opportunities become more widespread. Furthermore, they increasingly receive preferential treatment in risk-based national legislations (e.g. introduction of sliding scale in the UK Outer Space Act for insurance requirements).
* Space surveillance and tracking capabilities, in both GEO and LEO: New (private) sources of situational awareness data are becoming increasingly important, with data analytics and modelling fuelled by advances in digital technologies. Private sector debris catalogues and tracking capabilities for the geostationary orbit may now be almost as good as government capabilities (IDA, 2016[76]), while solutions for the low-earth orbit are emerging. Start-ups such as LeoLabs provide data and services based on low-cost ground equipment and sophisticated data analysis. The company, which in October 2019 had three radars in the United States and New Zealand, has developed a cloud-based “Space Regulatory and Sustainability Platform” for the New Zealand Space Agency, a first of its kind, destined to track objects launched from New Zealand to ensure compliance with permit conditions (MBIE, 2019[77]). A novel project called TruSat intends to use blockchain technology to crowdsource and validate satellite orbital positions worldwide via open source software (TruSat, 2019[78]). The US Air Force Research Laboratory has signed agreements with several commercial space situational awareness data providers (e.g. Numerica, LeoLabs, ExoAnalytics) to get access to sensor networks and algorithms (Numerica, 2019[79]). The Space Situational Awareness (SSA) open-architecture data-sharing platform under development by the US Department of Commerce, including data from different government agencies, is also expected to spur innovative value-added products and services.
* In-orbit servicing solutions: Several governmental agencies and commercial companies have developed, or are in the process of acquiring, some capabilities for in-orbit servicing (e.g. NASA, DARPA, ESA, JAXA). In-orbit servicing involves a number of complex operations in space: the servicing of space platforms (e.g. satellite, space station) to replenish consumables and degradables (e.g. propellants, batteries, solar array); replacing failed functionality; and/or enhancing the mission through software and hardware upgrades. This is a major challenge as, when on orbit, space platforms can move at speeds of several kilometres a minute. The first commercial in-orbit servicing mission was launched in 2019, by a MEV-1 spacecraft developed by Orbital ATK for an Intelsat geostationary satellite. The main short-term market is seen in the life extension of geostationary satellites, with some 300 potential candidates, at least in theory (Kennedy, 2018[80]). However, the key benefits of in-orbit servicing are expected in the future. Satellite design is currently heavily restricted by extreme launch conditions, but the possibility of servicing could enable a much more flexible and modular satellite design, able to take advantage of the latest advances in materials and electronics, beyond software upgrades (Jaffart, 2018[81]). Market forecasts estimate a USD 3 billion market for in-orbit servicing over the 2017-27 period, mainly driven by life extension services (Northern Sky Research, 2018[82]).
* Active debris removal solutions: Active debris removal is at a less mature technological level, but several firms are preparing demonstration missions (e.g. Astroscale in 2020). Potential candidates for removal include more than 200 critical debris objects
* (3-9 tonnes); mainly rocket bodies, but also the European Envisat satellite. JAXA, has formally launched a project to remove a large piece of debris by 2025 (a Japanese rocket body) in a public-private partnership (Japanese Delegation to UNCOPUOS, 2019[83]). Both Airbus and Thales Alenia Space are developing in-orbit servicing vehicles with debris removal functions, some of which have been tested on the RemoveDEBRIS mission (Surrey Space Centre, 2019[84]; OECD, 2019[11]).

• “Green” satellite design and technology: The demand for space-environment friendly satellite design is picking up. This includes features to reduce or avoid debris creation (explosion-safe batteries, deorbit technologies) and/or facilitating active removal (e.g. markers or grapple fixtures). One example is OneWeb, which is installing grapple fixtures on their satellites. In Europe, all future Sentinel satellites will be designed for demise. Affordable deorbit technologies are already being tested on orbit. Canada’s three-kilo CanX-7 satellite was launched in 2016 and is currently using its four 1 m2 drag sails to deorbit at a significantly faster rate than it would have without the sails. Amazon’s Kuiper constellation intends to use unpressurised and non-explosive propellant to mitigate accidental explosions, and satellites losing contact with ground control would automatically deactivate themselves, first by self-passivation and orbit-lowering, then depleting all energy reservoirs and switching off charging circuits (FCC, 2019[85]). SpaceX’ Starlink satellites are equipped with automated collision avoidance systems (although it is unclear which role the system played in the near-collision with the ESA Aeolus satellite).

A recent promising initiative is the “Space Sustainability Rating” scheme, originally conceived by teams from the MIT Media Lab, European Space Agency, and World Economic Forum. The initiative intends to be similar to the most widely used green building rating system in the construction industry, called the LEED certification for Leadership in Energy and Environmental Design. The objective is to promote mission designs and operational concepts that mitigate debris creation, and create a label that can encourage operators to behave more responsibly.

### Starlink =/= Debris

#### Starlink ACA systems and de-orbiting solves any debris impact – Russian ASAT test proves and also non-uniques their impact

Kan 21 – [Michael, “Starlink Satellite Orbits Changed to Avoid Debris After Russia's Missile Test,” PC Mag, 12/1/2021, https://www.pcmag.com/news/starlink-satellite-orbits-changed-to-avoid-debris-after-russias-missile]

SpaceX has altered the orbits for its Starlink satellites, likely to prevent them from colliding with debris from Russia’s anti-satellite missile test.

On Tuesday, SpaceX CEO Elon Musk mentioned the issue after NASA abruptly delayed a spacewalk on the International Space Station due to the threat of space debris. In his tweet, Musk said: “We had to shift some Starlink satellite orbits to reduce probability of collision. Not great, but not terrible either.”

Musk didn’t explicitly blame the space debris on Russia’s anti-satellite missile test. Nevertheless, the “Not great, but not terrible” quote may be a subtle jab at the Russian government. The same line is used in the HBO series Chernobyl, which dramatizes the 1986 nuclear plant disaster in the Soviet Union. (In the show, a nuclear plant worker utters the line “Not great, but not terrible,” when in reality the conditions at the facility are catastrophic.)

Last month, the US was quick to condemn Russia’s anti-satellite missile test, which involved the Kremlin sending up a missile to destroy one of its own defunct satellites. The ensuing impact caused hundreds of thousands of pieces of debris to spill out into orbit, according to the US.

Because space debris can travel up to 17,500 miles per hour, even a small artifact can cause serious damage if strikes a spacecraft or an astronaut. "Russia's dangerous and irresponsible behavior jeopardizes the long-term sustainability of outer space,” the US State Department said at the time.

However, Russia claims the resulting debris poses no danger to any space activity. The Kremlin also points out other countries have embarked on their own anti-satellite missile tests too.

To avoid space debris, SpaceX has equipped each Starlink satellite with an “autonomous collision avoidance” system. The same satellites will eventually descend and burn up in Earth’s atmosphere within one to five years if the propulsion system on board ever fails.

In his tweet, Musk added that the International Space Station and SpaceX’s own Dragon craft possess “micrometeorite shields,” which can withstand high-velocity impacts. However, spacesuits lack such protection, hence the need for NASA to cancel the spacewalk.

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

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

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

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

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

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

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

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

#### No Kessler

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

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

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

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

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

## Astronomy

**Solar Flares empirically overhyped**

Ian **O’Neill**, 6/21/**08**, founder and editor of Astroengine, “2012: No Killer Solar Flare”, http://www.universetoday.com/14645/2012-no-killer-solar-flare/

“Killer” solar flares have been observed on other stars. In 2006, NASA’s Swift observatory saw the largest stellar flare ever observed 135 light-years away. Estimated to have unleashed an energy of 50 million trillion atomic bombs, the II Pegasi flare will have wiped out most life on Earth if our Sun fired X-rays from a flare of that energy at us. However, our Sun is not II Pegasi. II Pegasi is a violent red giant star with a binary partner in a very close orbit. It is believed the gravitational interaction with its binary partner and the fact II Pegasi is a red giant is the root cause behind this energetic flare event. Doomsayers point to the Sun as a possible Earth-killer source, but the fact remains that our Sun is a very stable star. It does not have a binary partner (like II Pegasi), it has a predictable cycle (of approximately 11 years) and there is no evidence that our Sun contributed to any mass extinction event in the past via a huge Earth-directed flare. Very large solar flares have been observed (such as the 1859 Carrington white light flare)… but we are still here. In an added twist, solar physicists are surprised by the lack of solar activity at the start of this 24th solar cycle, leading to some scientists to speculate we might be on the verge of another Maunder minimum and “Little Ice Age”. This is in stark contrast to NASA solar physicist’s 2006 prediction that this cycle will be a “doozy”. This leads me to conclude that we still have a long way to go when predicting solar flare events. Although space weather prediction is improving, it will be a few years yet until we can read the Sun accurately enough to say with any certainty just how active a solar cycle is going to be. So, regardless of prophecy, prediction or myth, there is no physical way to say that the Earth will be hit by any flare, let alone a big one in 2012. Even if a big flare did hit us, it will not be an extinction event.

#### Current grid prevents renewable transition

Halper 13 Halper, Evan. "Power struggle: Green energy versus a grid that's not ready." latimes.com, 2 Dec. 2013, [www.latimes.com/nation/la-xpm-2013-dec-02-la-na-grid-renewables-20131203-story.html](http://www.latimes.com/nation/la-xpm-2013-dec-02-la-na-grid-renewables-20131203-story.html).

WASHINGTON — In a sprawling complex of laboratories and futuristic gadgets in Golden, Colo., a supercomputer named Peregrine does a quadrillion calculations per second to help scientists figure out how to keep the lights on. Peregrine was turned on this year by the U.S. Energy Department. It has the world's largest "petascale" computing capability. It is the size of a Mack truck. Its job is to figure out how to cope with a risk from something the public generally thinks of as benign — renewable energy. Energy officials worry a lot these days about the stability of the massive patchwork of wires, substations and algorithms that keeps electricity flowing. They rattle off several scenarios that could lead to a collapse of the power grid — a well-executed cyberattack, a freak storm, sabotage. But as states, led by California, race to bring more wind, solar and geothermal power online, those and other forms of alternative energy have become a new source of anxiety. The problem is that renewable energy adds unprecedented levels of stress to a grid designed for the previous century. Green energy is the least predictable kind. Nobody can say for certain when the wind will blow or the sun will shine. A field of solar panels might be cranking out huge amounts of energy one minute and a tiny amount the next if a thick cloud arrives. In many cases, renewable resources exist where transmission lines don't. "The grid was not built for renewables," said Trieu Mai, senior analyst at the National Renewable Energy Laboratory. The frailty imperils lofty goals for greenhouse gas reductions. Concerned state and federal officials are spending billions of dollars in ratepayer and taxpayer money in an effort to hasten the technological breakthroughs needed for the grid to keep up with the demands of clean energy. Making a green energy future work will be "one of the greatest technological challenges industrialized societies have undertaken," a group of scholars at Caltech said in a recent report. The report notes that by 2030, about $1 trillion is expected to be spent nationwide in bringing the grid up to date. The role of the grid is to keep the supply of power steady and predictable. Engineers carefully calibrate how much juice to feed into the system as everything from porch lights to factory machines are switched on and off. The balancing requires painstaking precision. A momentary overload can crash the system. California has taken some of the earliest steps to address the problems. The California Public Utilities Commission last month ordered large power companies to invest heavily in efforts to develop storage technologies that could bottle up wind and solar power, allowing the energy to be distributed more evenly over time. Whether those technologies will ever be economically viable on a large scale is hotly debated. The commission mandate nonetheless requires companies to produce enough storage by 2024 to power about 1 million homes. "Energy storage has the potential to be a game changer for our electric grid," Commissioner Mark Ferron said. Some utility officials warn, however, that the only guarantee is that ratepayers will be spending a lot. The commission's goals, while laudable, "could cost up to $3 billion with uncertain net benefits for customers," Southern California Edison declared in a filing. But regulators are desperate to move past the status quo. Already, power grid operators in some states have had to dump energy produced by wind turbines on blustery days because regional power systems had no room for it. Officials at the California Independent System Operator, which manages the grid in California, say renewable energy producers are making the juggling act increasingly complex. "We are getting to the point where we will have to pay people not to produce power," said Long Beach Mayor Bob Foster, a system operator board member. A bigger fear is that the grid is becoming more vulnerable to collapse, leaving the public exposed to the kind of blackouts that hit San Diego, parts of Arizona and a chunk of Baja California on a blistering hot September day in 2011. Rush-hour traffic jammed as streetlights went dark. Flights were grounded. Pumping stations came to a halt, causing sewage to flow onto beaches. People were trapped in office elevators and on rides at Sea World. An employee's misstep at a substation near Yuma, Ariz., caused that blackout, but energy experts see it as a harbinger of the sorts of problems that could become frequent if the nation fails to refashion its outmoded power grid. Foster has been working with other regulators and power company executives to redesign the system. The work involves ideas for mapping and building vast networks of electrical lines, industrial-scale solar- and wind-power plants and backup natural gas plants that can keep the lights on when shifts in weather cause renewable sources to falter. That's the tangible stuff they can easily explain. But the grid is also built on an antiquated tangle of market rules, operational formulas and business models. It makes for a formidable riddle. Planners are struggling to plot where and when to deploy solar panels, wind turbines and hydrogen fuel cells without knowing whether regulators will approve the transmission lines to support them. "One of the biggest challenges is you can't create a market for these resources without solving the demands of moving electricity from one physical place to another," said Neil Fromer, executive director of Caltech's Resnick Sustainability Institute. "But you can't solve that problem until you understand what the market structure looks like." Back in Colorado, Peregrine is furiously working to map out grid scenarios involving wind, solar and other forms of renewable energy. Sharing space with Peregrine at the Energy Systems Integration Facility is a "visualization room" with a 16-foot screen that creates 3-D images of how different wind patterns interact with turbines, or how molecules interact inside a solar cell. Federal regulators see an expanded role for themselves as the best hope for powering the nation with as much as 80% renewable energy within the next 35 or so years. Maintaining stability will hinge increasingly on interstate cooperation, they say. But state regulators are reluctant to cede authority. That's particularly true in California, where bitterness over the energy crisis of more than a decade ago remains intense and makes officials reluctant to cede an inch of jurisdiction to Washington. Regardless of who wins that power struggle, some of those involved in the day-to-day business of keeping the lights on in California say the limitations of the grid will undermine efforts by activists to move more quickly to reduce greenhouse gas emissions from power plants. At the Independent Energy Producers Assn. in Sacramento, which represents owners of renewable and gas power plants, Executive Director Jan Smutny-Jones says proposals by academics and others to move California to as much as 80% renewable energy within the next two decades are bumping up against the challenges of avoiding another San Diego-type blackout. "Some day that may be the way the world is going to work," he said. "But in the next five or six years, it is not."

#### U.S renewable leadership is key to cause broader zero-emissions policy- The timeframe is now

Ellsmoor 19 Ellsmoor, James. James Ellsmoor is a Forbes 30 Under 30 entrepreneur, dedicated to his passion for sustainable development and renewable energy. James is Co-Founder and Director of Solar Head of State, an international nonprofit working with governments in the Caribbean and Pacific islands to raise awareness of renewable energy through high-profile solar installations and associated publicity campaigns. "Renewable Energy Could Save $160 Trillion In Climate Change Costs by 2050." Forbes, 14 Apr. 2019, www.forbes.com/sites/jamesellsmoor/2019/04/14/renewable-energy-could-save-160-trillion-in-climate-change-costs-by-2050/#3d436f2d4878.

In the face of rising global emissions, intensified electrification and an increase in renewable energy could make the difference that ensures we reach future climate goals . With development and energy demands soaring worldwide, there is an opportunity for clean, renewable energy to supplant fossil fuels and take over as the main form of electricity generation. New findings published by the International Renewable Energy Agency (IRENA) have emphasized the need to scale up efforts to transition away from fossil fuels and towards renewable energy. The Global Energy Transformation: A Roadmap to 2050 outlines how the world can successfully implement large-scale renewable programs that will not only help reduce carbon emissions but improve global socioeconomic development. The analysis provided by IRENA shows that global energy demands are expected to double by 2050, and that 86% of global electrical needs could be met by renewable energy within that same timeframe. A large scale up from current levels, the extra energy load would be carried mostly by wind and solar installations. Despite the optimistic outlook, IRENA warns that more needs to be done in order to reach the goal they anticipated. IRENA’s Director-General Francesco La Camera explains that, “The energy transformation is gaining momentum, but it must accelerate even faster, The UN’s 2030 Sustainable Development Agenda and the review of national climate pledges under the Paris Agreement are milestones for raising the level of ambition. Urgent action on the ground at all levels is vital, in particular unlocking the investments needed to further strengthen the momentum of this energy transformation. Speed and forward-looking leadership will be critical – the world in 2050 depends on the energy decisions we take today.” Whilst the push for renewable energy certainly has its benefits, there remains a wide range of obstacles in the way of their large-scale development and implementation. For example, the past two years have seen the United States’ solar industry lose momentum over President Donald Trump’s tariffs, whilst lawmakers in Australia are failing to adhere to the nation’s COP21 emissions reduction goals and have continued on with their plans to open the world’s largest open-air coal mine despite widespread public condemnation. These political setbacks are relatively widespread and have been reducing the ability of the renewable energy sector to efficiently evolve and develop, and could have a lasting impact on global emissions. IRENA’s report has noted that transitions have been slow and that current rates of emission reduction are not in line with global climate goals. The report recommends that nations take more aggressive actions to ensure a quick and effective transition away from fossil fuels that will help reach the previously agreed-upon goals and ensure that mitigation of climate change remains a priority. In order to do so, IRENA advocates for stronger national policy focusing on long-term zero-carbon strategies as well as promoting innovation in the fields of renewable energy, technology and smart-grids. Commenting on the report’s findings, La Camera said that “The race to secure a climate safe future has entered a decisive phase. Renewable energy is the most effective and readily-available solution for reversing the trend of rising CO2 emissions. A combination of renewable energy with deeper electrification can achieve 75% of the energy-related emission reduction needed.” What La Camera is describing has already happened in many places worldwide - many islands have been leading the charge in renewable energy transitions, and are becoming incubators for energy innovation. Race Against The Clock The benefits stemming from embracing clean, renewable energy go a lot farther than just reducing pollution and carbon emissions. IRENA has illustrated the risks of a slow transition, and every year that carbon emissions increase is another year that negatively affects the environment, social welfare, and the wider economy. Likewise, IRENA has also been quick to point out the knock-on effects of a renewable energy transition in its report, outlining how a rapid transition could save the global economy US$160 trillion in costs associated with climate change. “The shift towards renewables makes economic sense,” emphasizes La Camera, “By mid-century, the global economy would be larger, and jobs created in the energy sector would boost global employment by 0.2%. Policies to promote a just, fair and inclusive transition could maximize the benefits for different countries, regions and communities. This would also accelerate the achievement of affordable and universal energy access. The global energy transformation goes beyond a transformation of the energy sector. It is a transformation of our economies and societies.” With time of the essence as nations grapple to reduce the current and future effects of climate change, IRENA’s report punctuates the emergency of the situation - but also how beneficial an efficient transition away from fossil fuels will be for the economy.

#### Warming causes extinction – a confluence of nonlinear and unpredictable effects will make human and natural systems inhospitable while increasing escalatory conflicts – even if the impacts are far off, only drastic action now solves

Melton 19 [Michelle Melton is a 3L at Harvard Law School. Before law school, she was an associate fellow in the Energy and National Security Program at the Center for Strategic and International Studies, where she focused on climate policy. Climate Change and National Security, Part II: How Big a Threat is the Climate? January 7, 2019. https://www.lawfareblog.com/climate-change-and-national-security-part-ii-how-big-threat-climate]

At least until 2050, and possibly for decades after, climate change will remain a creeping threat that will exacerbate and amplify existing, structural global inequalities. While the developed world will be negatively affected by climate change through 2050, the consequences of climate change will be felt most acutely in the developing world. The national security threats posed by climate change to 2050 are likely to differ in degree, not kind, from the kinds of threats already posed by climate change. For the next few decades, climate change will exacerbate humanitarian crises—some of which will result in the deployment of military personnel, as well as material and financial assistance. It will also aggravate natural resource constraints, potentially contributing to political and economic conflict over water, food and energy.

The question for the next 30 years is not “can humanity survive as a species with 1.5°C or 2°C of warming,” but, “how much will the existing disparities between the developed and developing world widen, and how long (and how successfully) can these widening political/economic disparities be sustained?” The urgency of the climate threat in the next few decades will depend, to a large degree, on whether and how much the U.S. government perceives a widening of these global inequities as a threat to U.S. national security.

By contrast, if emissions continue to creep upward (or if they do not decline rapidly), by 2100 climate-related national security threats could be existential. The question for the next hundred years is not, “are disparities politically and economically manageable?” but, “can the global order, premised on the nation-state system, itself based on territorial sovereignty, survive

in a world in which substantial swathes of territory are potentially uninhabitable?”

National Security Consequences of Climate Change to 2050

Scientists can predict the consequences of climate change to 2050 with some measure of certainty. (Beyond that date, the pace and magnitude of climate change—and therefore, the national security threat posed by it—depend heavily on the level of emissions in the coming years, as I have explained.) There is relative agreement across modeled climate scenarios that the world will likely warm, on average, at least 1.5°C above pre-industrial levels by about 2050—but perhaps as soon as 2030. This level of warming is likely to occur even if the world succeeds in dramatically reducing greenhouse gas emissions, as even the recent Intergovernmental Panel on Climate Change (IPCC) report implicitly admits. In other words, a certain amount of additional warming—at least 1.5°C, and probably more than that—is presumptively unavoidable.

Looking ahead to 2050, it can be said with relative confidence that the national security consequences of climate change will vary in degree, not in kind, from the national security threats already facing the United States. This is hardly good news. Even small differences in global average temperatures result in significant environmental changes, with attendant social, economic and political consequences. By 2050, climate change will wreak increasing havoc on human and natural systems—predominantly, but not exclusively, in the developing world—with attenuated but profound consequences for national security.

In particular, changes in temperature, the hydrological cycle and the ranges of insects will impact food availability and food access in much of the world, increasing food insecurity. Storms, flooding, changes in ocean pH and other climate-linked changes will damage infrastructure and negatively impact labor productivity and economic growth in much of the world. Vector-borne diseases will also become more prevalent, as climate change will expand the geographic range and intensity of transmission of diseases like malaria, West Nile, Zika and dengue fever, and cholera. Rising public health challenges, economic devastation and food insecurity will translate into an increased demand for humanitarian assistance provided by the military, increased migration—especially from tropical and subtropical regions—and geopolitical conflict.

Long-term trends such as declining food security, coupled with short-term events like hurricanes, could sustain unprecedented levels of migration. The 2015 refugee crisis in Europe portends the kinds of population movements that will only accelerate in the coming decades: people from Africa, Southwest and South Asia and elsewhere crossing land and water to reach Europe. For the United States, this likely means greater numbers of people seeking entry from both Central America and the Caribbean. Such influxes are not unprecedented, but they are unlikely to abate and could increase in volume over the next few decades, driven in part by climate change-related food insecurity, climate change-related storms and also by economic and political instability. Food insecurity, economic losses and loss of human life are also likely to exacerbate existing political tensions in the developing world, especially in regions with poor governance and/or where the climate is particularly vulnerable to warming (e.g., the Mediterranean basin). While the Arab Spring had many underlying causes, it also coincided with a period of high food prices, which arguably contributed to the protests. In some situations, food insecurity, economic losses and public health crises, combined with weak and ineffectual governance, could precipitate future conflicts of this kind—although it will be difficult to know where and when without more precise local studies of both underlying political dynamics and the regionally-specific impacts of climate change.

2100 and Beyond

While the national security impacts of climate change to 2050 are likely to be costly and disruptive for the U.S. military—and devastating for many people around the world—at some point after 2050, if warming continues at its current pace, changes to the climate could fundamentally reshape geopolitics and possibly even the current nation-state basis of the current global order.

To be clear, both the ultimate level of warming and its attendant political consequences is highly speculative, for the reasons I explained in my last post. Nonetheless, we do know that the planet is currently on track for at least 3-4°C of warming by 2100. The “known knowns” of higher levels of warming—say, 3°C—are frightening. At that 3°C of warming, for example, scientists project that there will be a nearly 70 percent decline in wheat production in Central America and the Caribbean, 75 percent of the land area in the Middle East and more than 50 percent in South Asia will be affected by highly unusual heat, and sea level rise could displace and imperil the lives hundreds of millions of people, among other consequences.

But even higher levels of warming are physically possible within this century. At these levels of warming, some regions of the world would be literally uninhabitable, likely resulting in the depopulation of the tropics, to say nothing of the consequences of sea-level rise for economically important cities such as Amsterdam and New York. Even if newly warmed regions of the far north could theoretically accommodate the resulting migrants, this presumes that the political response to this unprecedented global displacement would be orderly and conflict-free borders on fantasy.

The geopolitical consequences of significant levels of warming are severe, but if these changes occur in a linear way, at least there will be time for human systems to adjust. Perhaps more challenging for national security is the possibility that the until-now linear changes give way to abrupt and irreversible ones. Scientists forecast that, at higher levels of warming—precisely what level is speculative—humanity could trigger catastrophic, abrupt and unavoidable consequences to the ecosystem. The IPCC has considered nine such abrupt changes; one example is the potential shutting down of the Indian summer monsoon. Over a billion people are dependent upon the Indian monsoon, which provides parts of South Asia with about 80 percent of its annual rainfall; relatively minor changes in the monsoon in either direction can cause disasters. In 2010, a wetter monsoon led to the catastrophic flooding in Pakistan, which directly affected 20 million people; a drier monsoon in 2002 led to devastating drought. Studies suggest that the Indian summer monsoon has two stable states: wet (i.e., the current state) and dry (characterized by low precipitation over the subcontinent). At some point, if warming continues, the monsoon could abruptly shift into the second, “dry” state, with catastrophic consequences for over a billion people dependent on monsoon-fed agriculture. The IPCC suggests that such a state-shift is “unlikely”—that is, there is a 10 to 33 percent chance that a state-shift will happen in the 21st century—but scientists also have relatively low confidence in their understanding of the underlying mechanisms in this and other large-scale natural systems.

The consequences of abrupt, severe warming for national security are obvious in general, if unclear in the specifics. In 2003, the Defense Department asked a contractor to explore such a scenario. The resulting report outlined the offensive and defensive national security strategies countries may adopt if faced with abrupt climate change, and highlighted the increased risk of inter- and intra-state conflict over natural resources and immigration. Although the report may be off in its imagined timeframe (positing abrupt climate change by 2020), the world it conjures is improbable but not outlandish. If the Indian monsoon were to switch to dry state, and a billion people were suddenly without reliable food sources, for example, it is not clear how the Indian government would react, assuming it would survive in its current form. Major wars or low-intensity proxy conflicts seem likely, if not inevitable, in such a scenario.

This is not to say that a parade of climate horribles is certain—or even likely—to come to pass. Scientific understanding of the sensitivities in the climate system are far from perfect. It is also possible that emissions will decline more rapidly than anticipated, averting the worst consequences of climate change. But this outcome is far from guaranteed. And even if global emissions decline precipitously, humanity cannot be sure when or whether the planet has crossed a climate tipping point beyond which the incremental nature of the current changes shifts from the current linear, gradual progression to a non-linear and abrupt process.

Within the next few decades, the most likely scenario involves manageable, but costly, consequences on infrastructure, food security and natural disasters, which will be borne primarily by the world’s most impoverished citizens and the members of the military who provide them with humanitarian assistance and disaster relief. But while the head-turning national security impacts of climate change are probably several decades away, the nature of the threat is such that waiting until these changes manifest is not a viable option. By the time the climate consequences are severe enough to compel action, there is likely to be little that can be done on human timescales to undo the changes to environmental systems and the human societies dependent upon them.

## Ozone

#### The ozone layer doesn’t matter – empirical ozone holes solve

**Ridley 14** [Matt, DPhil from Oxford, Fellow of the Academy of Medical Sciences, The Times, September 15, 2014, “The ozone hole isn’t fixed. But that’s no worry,” http://www.thetimes.co.uk/tto/opinion/columnists/article4206440.ece]

How much damage did the ozone hole ever threaten to do anyway? It is fascinating to go back and read what the usual hyperventilating eco-exaggerators said about ozone thinning in the 1980s. As a result of the extra ultraviolet light coming through the Antarctic ozone hole, southernmost parts of Patagonia and New Zealand see about 12 per cent more UV light than expected. This means that the weak September sunshine, **though it feels much the same**, has the power to cause sunburn more like that of latitudes a few hundred miles north. **Hardly Armageddon**. The New York Times reported “an increase in Twilight Zone-type reports of sheep and rabbits with cataracts” in southern Chile. Not to be outdone, Al Gore wrote that “hunters now report finding blind rabbits; fisherman catch blind salmon”. Zoologists briefly blamed the near extinction of many amphibian species on thin ozone. Melanoma in people was also said to be on the rise as a result. **This was nonsense**. Frogs were dying out because of a fungal disease spread from Africa — nothing to do with ozone. Rabbits and fish blinded by a little extra sunlight proved to be as mythical as unicorns. An eye disease in Chilean sheep was happening outside the ozone-depleted zone and was caused by an infection called pinkeye — nothing to do with UV light. And melanoma incidence in people actually levelled out during the period when the ozone got thinner. Then remember that the ozone hole appears when the sky is dark all day, and over an uninhabited continent. **Even if it persists into the Antarctic spring and spills north briefly, the hole allows 50 times less ultraviolet light through than would hit your skin at the equator at sea level** (let alone at a high altitude) in the tropics. So it would be bonkers to worry about UV as you sailed round Cape Horn in spring, say, but not when you stopped at the Galapagos: the skin cancer risk is 50 times higher in the latter place.

#### No ozone impact

**Ridley 14** -- Matthew White Ridley, 5th Viscount Ridley DL FRSL FMedSci, known commonly as Matt Ridley, is a British journalist, businessman and author of popular science books. Since 2013 Ridley has been a Conservative hereditary peer in the House of Lords. “THE OZONE HOLE WAS EXAGGERATED AS A PROBLEM” http://www.rationaloptimist.com/blog/the-ozone-hole-was-exaggerated-as-a-problem.aspx

Serial hyperbole does the environmental movement no favours My recent Times column argued that the alleged healing of the ozone layer is exaggerated, but so was the impact of the ozone hole over Antarctica: The ozone layer is healing. Or so said the news last week. Thanks to a treaty signed in Montreal in 1989 to get rid of refrigerant chemicals called chlorofluorocarbons (CFCs), the planet’s stratospheric sunscreen has at last begun thickening again. Planetary disaster has been averted by politics. For reasons I will explain, this news deserves to be taken with a large pinch of salt. You do not have to dig far to find evidence that the ozone hole was never nearly as dangerous as some people said, that it is not necessarily healing yet and that it might not have been caused mainly by CFCs anyway. The timing of the announcement was plainly political: it came on the 25th anniversary of the treaty, and just before a big United Nations climate conference in New York, the aim of which is to push for a climate treaty modelled on the ozone one. Here’s what was actually announced last week, in the words of a Nasa scientist, Paul Newman: “From 2000 to 2013, ozone levels climbed 4 per cent in the key mid-northern latitudes.” That’s a pretty small change and it is in the wrong place. The ozone thinning that worried everybody in the 1980s was over Antarctica. Over northern latitudes, ozone concentration has been falling by about 4 per cent each March before recovering. Over Antarctica, since 1980, the ozone concentration has fallen by 40 or 50 per cent each September before the sun rebuilds it. So what’s happening to the Antarctic ozone hole? Thanks to a diligent blogger named Anthony Watts, I came across a press release also from Nasa about nine months ago, which said: “ Two new studies show that signs of recovery are not yet present, and that temperature and winds are still driving any annual changes in ozone hole size.” As recently as 2006, Nasa announced, quoting Paul Newman again, that the Antarctic ozone hole that year was “the largest ever recorded”. The following year a paper in Nature magazine from Markus Rex, a German scientist, presented new evidence that suggested CFCs may be responsible for less than 40 per cent of ozone destruction anyway. Besides, nobody knows for sure how big the ozone hole was each spring before CFCs were invented. All we know is that it varies from year to year. How much damage did the ozone hole ever threaten to do anyway? It is fascinating to go back and read what the usual hyperventilating eco-exaggerators said about ozone thinning in the 1980s. As a result of the extra ultraviolet light coming through the Antarctic ozone hole, southernmost parts of Patagonia and New Zealand see about 12 per cent more UV light than expected. This means that the weak September sunshine, though it feels much the same, has the power to cause sunburn more like that of latitudes a few hundred miles north. Hardly Armageddon. The New York Times reported “an increase in Twilight Zone-type reports of sheep and rabbits with cataracts” in southern Chile. Not to be outdone, Al Gore wrote that “hunters now report finding blind rabbits; fisherman catch blind salmon”. Zoologists briefly blamed the near extinction of many amphibian species on thin ozone. Melanoma in people was also said to be on the rise as a result. This was nonsense. Frogs were dying out because of a fungal disease spread from Africa — nothing to do with ozone. Rabbits and fish blinded by a little extra sunlight proved to be as mythical as unicorns. An eye disease in Chilean sheep was happening outside the ozone-depleted zone and was caused by an infection called pinkeye — nothing to do with UV light. And melanoma incidence in people actually levelled out during the period when the ozone got thinner. Then remember that the ozone hole appears when the sky is dark all day, and over an uninhabited continent. Even if it persists into the Antarctic spring and spills north briefly, the hole allows 50 times less ultraviolet light through than would hit your skin at the equator at sea level (let alone at a high altitude) in the tropics. So it would be bonkers to worry about UV as you sailed round Cape Horn in spring, say, but not when you stopped at the Galapagos: the skin cancer risk is 50 times higher in the latter place. This kind of eco-exaggeration has been going on for 50 years. In the 1960s Rachel Carson said there was an epidemic of childhood cancer caused by DDT; it was not true — DDT had environmental effects but did not cause human cancers.