### 1

Ill concede util

#### 1] Extinction first –

#### a – reversibility and magnitude – precludes infinite future potential lives and destroys millennium of human progress

#### 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

#### d – precludes the possibility of any kind of moral value – we can’t confer value onto anything if we’re not alive.

#### e – Objectivity – body count is the most objective way to calculate impacts because comparing suffering is unethical

### 2

#### US heg is strong now, but Russia and China are gaining.

Hunt 17 [Edward Hunt, () "The American Empire Isn’t In Decline" Jacobin, 3-13-2017, https://www.jacobinmag.com/2017/03/obama-trump-mattis-united-states-empire/, DOA:9-15-2017 // WWBW]

Some insist that the answer is yes — that the period of US global dominance that has reigned since the end of the Cold War is coming to an end. As things now stand, “the post–Cold War, unipolar moment has passed,” the National Intelligence Council [reported](https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf) earlier this year. Former CIA officials John E. McLaughlin and Gen. David H. Petraeus [made](https://armedservices.house.gov/legislation/hearings/full-committee-hearing-state-world-national-security-threats-and-challenges) a similar assessment before the House Armed Services Committee this past February. In the years ahead, McLaughlin argued, “the world will be without a hegemonic power — that is, without a country so powerful as to exert dominant influence and advance policy with little reference to others.” Petraeus agreed, saying that the post–Cold War era of “US domination of the world” is ending. Still, there are some reasons to think otherwise. As former US diplomat R. Nicholas Burns recently [observed](http://www.armed-services.senate.gov/hearings/16-07-07-north-atlantic-treaty_organization-russia-and-european-security), the United States maintains “alliances in Europe and Asia, and the Russians and Chinese do not.” In addition, the American military has begun to [wipe out](https://lobelog.com/the-new-exterminatory-warfare/) ISIS, killing more than [sixty thousand](http://www.military.com/daily-news/2017/02/14/specops-commander-60000-isis-fighters-killed-by-us-troops.html) fighters over the past two and a half years. So do a resurgent Russia, an ascendant China, and the emergence of the Islamic State suggest that US power is ebbing, or are these challenges exaggerated? What do US officials really think about these matters? If we take stock of their public statements as a whole, the foreign policy establishment certainly appears concerned about the latest challenges to US empire, especially the uncertainty that Trump’s election has introduced. But they also remain quite confident in their power to shape the world and steer the United States into a new age of global hegemony. Over the past few years, a number of high-level officials have expressed great confidence in the durability of US hegemony. Not only have they insisted that the declinist thesis is wrong, but they have argued that the United States will remain the world’s dominant power well into the future. In May 2016, two former high-level officials [laid out](https://www.foreign.senate.gov/hearings/examining-americas-role-in-the-world-051216) the more confident view for the Senate Committee on Foreign Relations. In a statement to the panel, former Secretary of State James Baker said that the United States would continue to lead the international system. Certainly, “much of the rest of the world — countries like China, Brazil and India — are catching up with us,” Baker conceded. “Still, we should remain the world’s preeminent leader for the foreseeable future.” Former National Security Advisor Thomas Donilon agreed. As long as the United States takes the proper precautions, he said, it “will continue to be the world’s leading and most powerful nation for a long time to come.” Donilon also rejected the declinist thesis, calling it a “myth” that should not be taken seriously: “The idea that America is in decline does not stand up to a rigorous analysis of our national balance sheet of strategic assets and liabilities,” Donilon asserted. “The truth is that no nation can match our comprehensive set of enduring strengths.” Other Obama administration officials offered similar views. Last October, for example, Secretary of State John Kerry noted that the United States maintains tremendous economic advantages. “We’re the richest country on the face of the planet,” Kerry [said](https://2009-2017.state.gov/secretary/remarks/2016/10/263891.htm). In fact, the Obama administration made great strides in expanding US economic power across the globe. President Obama, who [acknowledged](https://obamawhitehouse.archives.gov/the-press-office/2016/11/20/press-conference-president-obama-lima-peru) during his final months in office that he had “made it a priority to open up new markets overseas,” boasted that his administration had “increased US exports to the world by more than 40 percent — to record levels.” At the same time, administration officials also pointed to their other great advantage in world affairs: American military power. As Secretary of Defense Ashton Carter [noted](http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=5610) in April 2015, “it will take decades — and let me repeat that: decades — for anyone to build the kind of military capability the United States possesses today.” Obama expressed similar sentiments during his farewell tour. The United States possesses “the greatest military in the history of the world,” Obama [declared](https://obamawhitehouse.archives.gov/the-press-office/2017/01/04/remarks-president-armed-forces-full-honor-review-farewell-ceremony). “Make no mistake,” he continued, “even with the challenges of recent years — and there have been challenges — our allies and adversaries alike understand America’s military remains, by far, the most capable fighting force on the face of the Earth.” In short, contrary to those who warn of waning US hegemony, high-ranking officials insist that the United States remains the most powerful country in the world. “We are, without a doubt, the world’s superpower,” CIA Director John Brennan [said](https://csis-prod.s3.amazonaws.com/s3fs-public/160914_Brennan_Keynote.pdf) this past September. Of course, every great power faces challengers. Not even the mighty United States is immune from pushback. As Carter [noted](https://www.defense.gov/News/Transcripts/Transcript-View/Article/1003751/remarks-by-secretary-carter-in-an-interview-forum-hosted-by-the-atlantic-and-17) last November, the United States faces enemies that are “extremely competitive,” ranging from terrorists to “high-end opponents.” Facing such a broad range of adversaries, foreign policy elites have tried to assess how seriously to treat each, weighing whether current and potential enemies can significantly weaken the United States’ hold over the world. For the most part, they agree on the issue of terrorism. Although American leaders regularly denounce terrorism as the modern world’s greatest plague, most don’t see it as a major challenge. Last November, former State Department official Daniel Serwer [warned](https://2009-2017-fpc.state.gov/264203.htm), “We shouldn’t blow up terrorism into an existential threat. It’s not.” A month later, Obama agreed that ISIS and other groups stand no real chance of defeating the United States. “Today’s terrorists can kill innocent people,” Obama [stated](https://obamawhitehouse.archives.gov/the-press-office/2016/12/06/remarks-president-administrations-approach-counterterrorism), “but they don’t pose an existential threat to our nation.” Instead, officials have grown more concerned about other challenges. Taking a more traditional view of the world, they have largely concluded that rising powers in the international system now pose the most serious threat to US hegemony. Early last year, Carter [articulated](http://www.armed-services.senate.gov/hearings/16-03-17-department-of-defense-budget-posture) this basic rationale, describing the latest trends as “a return, in some ways, to great power competition.” Without diminishing the US’s capacity to fight terrorism, he contended that the nation should prepare for new confrontations with Russia and China. These countries, he argued, “are our most stressing competitors, as they’ve both developed and are continuing to advance military systems that threaten our advantages in specific areas.”

#### Space is crucial to US heg – China is beating the DoD now but commercial companies cement US advantage. Pullback greenlights Chinese dominance across the board

Autry and Kwast 19 Greg Autry and Steve Kwast 8-22-2019 "America Is Losing the Second Space Race to China" (Greg Autry, a clinical professor of space leadership, policy, and business at Arizona State University’s Thunderbird School of Global Management, and Steve Kwast)//Elmer

America Is Losing the Second Space Race to China The private sector can give the United States a much-needed rocket boost. The current U.S. space defense strategy is inadequate and on a path to failure. President Donald Trump’s vision for a Space Force is big enough. As he said on June 18, “It is not enough to merely have an American presence in space. We must have American dominance in space.” But the Air Force is not matching this vision. Instead, the leadership is currently focused on incremental improvements to existing equipment and organizational structures. Dominating the vast and dynamic environment of space will require revolutionary capabilities and resources far deeper than traditional Department of Defense thinking can fund, manage, or even conceive of. Success depends on a much more active partnership with the commercial space industry— and its disruptive capabilities. U.S. military space planners are preparing to repeat a conflict they imagined back in the 1980s, which never actually occurred, against a vanished Soviet empire. Meanwhile, China is executing a winning strategy in the world of today. It is burning hard toward domination of the future space markets that will define the next century. They are planning infrastructure in space that will control 21st-century telecommunications, energy, transportation, and manufacturing. In doing so, they will acquire trillion-dollar revenues as well as the deep capabilities that come from continuous operational experience in space. This will deliver space dominance and global hegemony to China’s authoritarian rulers. Despite the fact that many in the policy and intelligence communities understand exactly what China is doing and have been trying to alert leadership, Air Force leadership has convinced the White House to fund only a slightly better satellite command with the same leadership, while sticking a new label onto their outmoded thinking. A U.S. Space Force or Corps with a satellite command will never fulfill Trump’s call to dominate space. Air Force leadership is demonstrating the same hubris that Gen. George Custer used in convincing Congress, over President Ulysses S. Grant’s better experience intuition, that he could overtake the Black Hills with repeating rifles and artillery. That strategy of technological overconfidence inflamed conflict rather than subduing it, and the 7th Cavalry were wiped out at the Battle of the Little Bighorn. The West was actually won by the settlers, ranchers, miners, and railroad barons who were able to convert the wealth of the territory itself into the means of holding it. They laid the groundwork that made the 20th century the American Century and delivered freedom to millions of people in Europe and Asia. Of course, they also trampled the indigenous people of the American West in their wake—but empty space comes with no such bloody cost. The very emptiness and wealth of this new, if not quite final, frontier, however, means that competition for resources and strategic locations in cislunar space (between the Earth and moon) will be intense over the next two decades. The outcome of this competition will determine the fate of humanity in the next century. China’s impending dominance will neutralize U.S. geopolitical power by allowing Beijing to control global information flows from the high ground of space. Imagine a school in Bolivia or a farmer in Kenya choosing between paying for a U.S. satellite internet or image provider or receiving those services for free as a “gift of the Chinese people.” It will be of little concern to global consumers that the news they receive is slanted or that searches for “free speech” link to articles about corruption in Western democracies. Nor will they care if concentration camps in Tibet and the Uighur areas of western China are obscured, or if U.S. military action is presented as tyranny and Chinese expansion is described as peacekeeping or liberation. China’s aggressive investment in space solar power will allow it to provide cheap, clean power to the world, displacing U.S. energy firms while placing a second yoke around the developing world. Significantly, such orbital power stations have dual use potential and, if properly designed, could serve as powerful offensive weapons platforms. China’s first step in this process is to conquer the growing small space launch market. Beijing is providing nominally commercial firms with government-manufactured, mobile intercontinental ballistic missiles they can use to dump launch services on the market below cost. These start-ups are already undercutting U.S. pricing by 80 percent. Based on its previous success in using dumping to take out U.S. developed industries such as solar power modules and drones, China will quickly move upstream to attack the leading U.S. launch providers and secure a global commercial monopoly. Owning the launch market will give them an unsurmountable advantage against U.S. competitors in satellite internet, imaging, and power. The United States can still build a strategy to win. At this moment, it holds the competitive advantage in every critical space technology and has the finest set of commercial space firms in the world. It has pockets of innovative military thinkers within groups like the Defense Innovation Unit, under Mike Griffin, the Pentagon’s top research and development official. If the United States simply protects the intellectual property its creative minds unleash and defend its truly free markets from strategic mercantilist attack, it will not lose this new space race. The United States has done this before. It beat Germany to the nuclear bomb, it beat the Soviet Union to the nuclear triad, and it won the first space race. None of those victories was achieved by embracing the existing bureaucracy. Each of them depended on the president of the day following the only proven path to victory in a technological domain: establish a small team with a positively disruptive mindset and empower that team to investigate a wide range of new concepts, work with emerging technologies, and test innovative strategies. Today that means giving a dedicated Space Force the freedom to easily partner with commercial firms and leverage the private capital in building sustainable infrastructure that actually reduces the likelihood of conflict while securing a better economic future for the nation and the world.

#### Heg solves every threat – collapse means return to spheres of influence and great power rivalry

Ikenberry 20 John Ikenberry 6-9-2020 “The Next Liberal Order: The Age of Contagion Demands More Internationalism, Not Less” <https://www.foreignaffairs.com/articles/united-states/2020-06-09/next-liberal-order> (Albert G. Milbank Professor of Politics and International Affairs at Princeton University and Global Eminence Scholar at Kyung Hee University, in South Korea)//Elmer

The rivalry between the United States and China will preoccupy the world for decades, and the problems of anarchy cannot be wished away. But for the United States and its partners, a far greater challenge lies in what might be called “the problems of modernity”: the deep, worldwide transformations unleashed by the forces of science, technology, and industrialism, or what the sociologist Ernest Gellner once described as a “tidal wave” pushing and pulling modern societies into an increasingly complex and interconnected world system. Washington and its partners are threatened less by rival great powers than by emergent, interconnected, and cascading transnational dangers. Climate change, pandemic diseases, financial crises, failed states, nuclear proliferation—all reverberate far beyond any individual country. So do the effects of automation and global production chains on capitalist societies, the dangers of the coming revolution in artificial intelligence, and other, as-yet-unimagined upheavals. The coronavirus is the poster child of these transnational dangers: it does not respect borders, and one cannot hide from it or defeat it in war. Countries facing a global outbreak are only as safe as the least safe among them. For better or worse, the United States and the rest of the world are in it together. Past American leaders understood that the global problems of modernity called for a global solution and set about building a worldwide network of alliances and multilateral institutions. But for many observers, the result of these efforts—the liberal international order—has been a failure. For some, it is tied to the neoliberal policies that produced financial crises and rising economic inequality; for others, it evokes disastrous military interventions and endless wars. The bet that China would integrate as a “responsible stakeholder” into a U.S.-led liberal order is widely seen to have failed, too. Little wonder that the liberal vision has lost its appeal. Liberal internationalists need to acknowledge these missteps and failures. Under the auspices of the liberal international order, the United States has intervened too much, regulated too little, and delivered less than it promised. But what do its detractors have to offer? Despite its faults, no other organizing principle currently under debate comes close to liberal internationalism in making the case for a decent and cooperative world order that encourages the enlightened pursuit of national interests. Ironically, the critics’ complaints make sense only within a system that embraces self-determination, individual rights, economic security, and the rule of law—the very cornerstones of liberal internationalism. The current order may not have realized these principles across the board, but flaws and failures are inherent in all political orders. What is unique about the postwar liberal order is its capacity for self-correction. Even a deeply flawed liberal system provides the institutions through which it can be brought closer to its founding ideals. However serious the liberal order’s shortcomings may be, they pale in comparison to its achievements. Over seven decades, it has lifted more boats—manifest in economic growth and rising incomes—than any other order in world history. It provided a framework for struggling industrial societies in Europe and elsewhere to transform themselves into modern social democracies. Japan and West Germany were integrated into a common security community and went on to fashion distinctive national identities as peaceful great powers. Western Europe subdued old hatreds and launched a grand project of union. European colonial rule in Africa and Asia largely came to an end. The G-7 system of cooperation among Japan, Europe, and North America fostered growth and managed a sequence of trade and financial crises. Beginning in the 1980s, countries across East Asia, Latin America, and eastern Europe opened up their political and economic systems and joined the broader order. The United States experienced its greatest successes as a world power, culminating in the peaceful end to the Cold War, and countries around the globe wanted more, not less, U.S. leadership. This is not an order that one should eagerly escort off the stage. Any alternative is worse and causes great power war. The major alternatives to a modernized world order supported by the United States appear unlikely, unappealing, or both. A Chinese-led order, for example, would be an illiberal one, characterized by authoritarian domestic political systems and statist economies that place a premium on maintaining domestic stability. There would be a return to spheres of influence, with China attempting to domi-nate its region, likely resulting in clashes with other regional powers, such as India, Japan, and Vietnam, which would probably build up their conventional or even nuclear forces. A new democratic, rules-based order fashioned and led by medium powers in Europe and Asia, as well as Canada, however attractive a concept, would simply lack the military capacity and domestic political will to get very far. A more likely alternative is a world with little order—a world of deeper disarray. Protectionism, nationalism, and populism would gain, and democracy would lose. Conflict within and across borders would become more common, and rivalry between great powers would increase. Cooperation on global challenges would be all but precluded. If this picture sounds familiar, that is because it increasingly corresponds to the world of today. The deterioration of a world order can set in motion trends that spell catastrophe. World War I broke out some 60 years after the Concert of Europe had for all intents and purposes broken down in Crimea. What we are seeing today resembles the mid-nineteenth century in important ways: the post– World War II, post–Cold War order cannot be restored, but the world is not yet on the edge of a systemic crisis. Now is the time to make sure one never materializes, be it from a breakdown in U.S.-Chinese relations, a clash with Russia, a conflagration in the Middle East, or the cumulative effects of climate change. The good news is that it is far from inevitable that the world will eventually arrive at a catastrophe; the bad news is that it is far from certain that it will not.

#### US-China war goes nuclear

[Caitlin Talmadge (10-15-2018), PhD in Political Science from MIT, BA in Government from Harvard, Professor of Security Studies at Georgetown University, “Beijing’s Nuclear Option,” Foreign Affairs, [https://www.foreignaffairs.com/articles/china/2018-10-15/beijings-nuclear-option]//recut](https://www.foreignaffairs.com/articles/china/2018-10-15/beijings-nuclear-option%5d//recut) CHS PK

As China’s power has grown in recent years, so, too, has the risk of war with the United States. Under President Xi Jinping, China has increased its political and economic pressure on Taiwan and built military installations on coral reefs in the South China Sea, fueling Washington’s fears that Chinese expansionism will threaten U.S. allies and influence in the region. U.S. destroyers have transited the Taiwan Strait, to loud protests from Beijing. American policymakers have wondered aloud whether they should send an aircraft carrier through the strait as well. Chinese fighter jets have intercepted U.S. aircraft in the skies above the South China Sea. Meanwhile, U.S. President Donald Trump has brought long-simmering economic disputes to a rolling boil. A war between the two countries remains unlikely, but the prospect of a military confrontation—resulting, for example, from a Chinese campaign against Taiwan—no longer seems as implausible as it once did. And the odds of such a confrontation going nuclear are higher than most policymakers and analysts think. Members of China’s strategic community tend to dismiss such concerns. Likewise, U.S. studies of a potential war with China often exclude nuclear weapons from the analysis entirely, treating them as basically irrelevant to the course of a conflict. Asked about the issue in 2015, Dennis Blair, the former commander of U.S. forces in the Indo-Pacific, estimated the likelihood of a U.S.-Chinese nuclear crisis as “somewhere between nil and zero.” This assurance is misguided. If deployed against China, the Pentagon’s preferred style of conventional warfare would be a potential recipe for nuclear escalation. Since the end of the Cold War, the United States’ signature approach to war has been simple: punch deep into enemy territory in order to rapidly knock out the opponent’s key military assets at minimal cost. But the Pentagon developed this formula in wars against Afghanistan, Iraq, Libya, and Serbia, none of which was a nuclear power. China, by contrast, not only has nuclear weapons; it has also intermingled them with its conventional military forces, making it difficult to attack one without attacking the other. This means that a major U.S. military campaign targeting China’s conventional forces would likely also threaten its nuclear arsenal. Faced with such a threat, Chinese leaders could decide to use their nuclear weapons while they were still able to. As U.S. and Chinese leaders navigate a relationship fraught with mutual suspicion, they must come to grips with the fact that a conventional war could skid into a nuclear confrontation. Although this risk is not high in absolute terms, its consequences for the region and the world would be devastating. As long as the United States and China continue to pursue their current grand strategies, the risk is likely to endure. This means that leaders on both sides should dispense with the illusion that they can easily fight a limited war. They should focus instead on managing or resolving the political, economic, and military tensions that might lead to a conflict in the first place.

### 3

#### Private mega-constellations make space solar power a reality – low costs, operational benefits and mass production – that solves warming and creates effective energy transition

Leonard **David, 21** (Leonard David, Space solar power's time may finally be coming, Space, https://www.space.com/space-solar-power-research-advances, 11-3-2021)//iLake-💣🍔

Over the past decade, researchers have made impressive advances that increase the likelihood that space solar power (SSP) will be realized during the next decade, said John Mankins, president of Artemis Innovation Management Solutions of Santa Maria, California. His view: the longstanding vision for SSP as a sustainable energy alternative should be revisited in light of such recent advances. Bolstering that outlook is a set of key perspectives, Mankins told Space.com. "Climate change is really going to be a disaster. Nations are committed to go [carbon net-zero](https://www.livescience.com/climate-report-net-zero.html) … and they have no idea how to do it." The rapidly unfolding value of "New Space" is also reshaping the landscape of 21st century space activities, he added. "Two of the biggest hurdles to the realization of SSP have always been the cost of launch and the cost of hardware," said Mankins. "Add flight rate, and all of a sudden you're looking at numbers always talked about for solar power satellites." Another recent change is the dawn of the megaconstellations, Mankins added.  That's exemplified by SpaceX's [Starlink](https://www.space.com/spacex-starlink-satellites.html) broadband network, a mass-production effort that now cranks out 30 tons of satellites a month. SpaceX is on course to potentially manufacture 40,000 satellites within five years, and launch all of them.  "The path to low-cost hardware has been shown," Mankins said. "It's modular and mass-produced. The hurdles of less-expensive launch and lowering hardware costs have been overcome." Mankins said that the economics of SSP concepts in the near term, within the next decade, have never been more viable. He flagged advances in space launch capabilities; progress in robotics for space assembly, maintenance and servicing systems; and the growth in various component technologies, such as high-efficiency solid state power amplifiers. As a result, SSP is ready to see the light of day, Mankins said. An early entrant in focusing on understanding the energy policy needed and establishment of SSP is James Michael Snead, president of the Spacefaring Institute. He's adopted the use of the term "astroelectricity" to describe the transmitted electrical power produced by SSP systems. In looking at what he terms the "[coming age of astroelectricity](https://www.youtube.com/watch?v=5E-0NYnAaUA)," he sees a world needing a replacement for oil and natural gas, the two primary sources of energy currently maintaining an industrial standard of living.  Snead envisions a world in the year 2100 where about 20% of electrical power comes from terrestrial nuclear and renewables, with 80% supplied by astroelectricity. "Just as the military, economic and diplomatic control of Middle East oil has substantially influenced world events for the past 80 years, the control of space solar power platforms will come to dominate outer space activities this century," Snead told Space.com. If SSP becomes a reality later this century, Snead said, the U.S. military will be required to protect and defend these new sources of national energy security just as it guards oil infrastructure in the Persian Gulf today. "While some people are developing SSP concepts that would be launched from the Earth and autonomously assembled in geostationary Earth orbit, I do not see this as a successful proposition," said Snead. He believes that building the thousands of SSP platforms needed requires a substantial [space industrialization effort](https://www.space.com/nasa-low-earth-orbit-iss-commercialization.html) involving more than a million people in space by the end of the century.  The starting point, Snead said, will be establishing the enabling "astrologistics" infrastructure operating throughout the Earth-moon system. He stressed that those astrologistics require high-priority U.S. Air Force — not [Space Force](https://www.space.com/42089-space-force.html) — leadership to draw upon nearly a century of human flight/operational logistics experience and expertise. That is necessary to manage industry's efforts to design and build the required new human spaceflight systems, with a clearly needed emphasis on safety and effectiveness, Snead said. As these new military astrologistics capabilities begin, Snead contends, commercialization of these capabilities will extend these safety and operational benefits to support the coming space industrial revolution needed to undertake SSP. "This is exactly what happened to enable U.S. airline manufacturers to dominate the airline and air cargo industry for decades. It is a successful model to now replicate in space — a model that neither NASA nor the U.S. Space Force can effectively execute," Snead said. While new artwork, economic plots and conceptual SPS thinking and visions flow, there's an in-space technology experiment already underway.  On its latest mission, which launched in May 2020, the Space Force's robotic [X-37B space plane](https://www.space.com/25275-x37b-space-plane.html) is toting the Photovoltaic Radio-frequency Antenna Module Flight Experiment (PRAM-FX), a Naval Research Laboratory (NRL) investigation into transforming solar power into radio-frequency microwave energy.  The focus of that X-37B investigation is not establishing an actual power-beaming link, but more on appraising the performance of sunlight-to-microwave conversion. "It is performing like a champ," said Paul Jaffe, an NRL electronics engineer working on power beaming and solar power satellites. "We are getting data regularly, and that data is exceeding our expectations," he told Space.com. [PRAM-FX](https://www.space.com/x-37b-space-plane-solar-power-beaming) is principally made out of commercial parts, not "space-grade" hardware. "The fact that it is continuing to operate and give us positive results is quite encouraging," Jaffe said. Commercial parts are mass-produced, while many space-grade parts are one-offs. Solar power satellites, like those envisioned in high Earth orbit, would have thousands of elements made out of similar components being tested onboard the X-37B, Jaffe said. There's much more work ahead, of course.  "The big strike against space solar power has always been making the economics work. People who have looked at the idea seriously do understand that, from a physics standpoint, there is no reason you couldn't do it," Jaffe said.  "With mass production of space hardware, and with the cost reduction of space access, it is more plausible that it could work," he added. "I would caution against excessive optimism … but also point out that things are changing. There are a lot of encouraging developments." SPS will assuredly be compared to a "levelized cost of energy" metric, Jaffe concluded. "There's just not enough data to come up with a levelized cost of energy basis for space solar power. It's premature. What you are seeing now is laying the foundation for that sort of evaluation." To that end, Mankins of Artemis Innovation Management Solutions has rolled out SPS-ALPHA ("Solar Power Satellite by means of Arbitrarily Large Phased Array"), a design he showcased at the 72nd International Astronautical Congress, which was held from Oct. 25 to Oct. 29 in Dubai, United Arab Emirates. Detailing a business model and step-by-step SSP roadmap, he feels the concept promises a clear, affordable path to deploying a critically needed new energy option. "I believe you could have operational solar power satellites to scale within a decade," Mankins said.  That possibility, combined with the fact that multiple nations are eying SSP as a promising power generation system of the future, begs a question: Is there a solar power satellite race afoot? It is close to that, Mankins said. "I think it has to be cooperation among friends and allies. But I think it's very likely to end up being competition with China. The longer we wait with regard to the urgency of policies on [climate change](https://www.space.com/climate-change-dimming-earth), the more likely it is we're going to miss the boat." Mankins is a 26-year veteran of assessing SSP and the technologies required. "The moment has come," he said. "I think the right answer is really clear: We need to just go do it."

#### SSP has net 0 emissions with no pollution

Esther **Katete, 21** (Esther Katete, Is Space-Based Solar Power Our Future? (2022), No Publication, https://www.greenmatch.co.uk/blog/2020/02/space-based-solar-power, 12-17-2021)//iLake-💣🍔

According to the [National Space Society](https://space.nss.org/space-solar-power/), space-based solar power has the potential to dwarf all the other sources of energy combined. They argue that space-based solar power can provide large quantities of energy with very little negative environmental impact. It can also solve our current energy and greenhouse gas emissions problems. The infographic below highlights information about space-based solar power, current related trends, and what different countries are doing in terms of research and funding. Current Global Energy Consumption and Trends The world’s energy consumption is only growing. According to a report by the University of Oxford’s Our World in Data, on the global primary energy consumption, the current world consumption is over 160,000 TWh annually. Solar energy contributes only 585 TWh. Although there is an increase in renewable energy solutions, investments, and usage, oil, coal, and gas still generate more than 80% of the global energy that is consumed - with solar energy generating less than 1%. Between 2004 and 2015, investments in renewable energy increased by 600% from £36.2 billion (US$46.7 billion) to £220.6 billion (US$284.8 billion). Current predictions indicate that the world population will reach [9.7 billion by 2050](https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html). With the increase in population, the world energy consumption is also predicted to grow by 50% by 2050. In addition, climate change impacts are accelerating. Although we generate a big percentage of the world energy from fossil fuels, fossil fuels contribute significantly to the increase of climate change. Comparatively, solar energy is the [safest source of energy](https://ourworldindata.org/uploads/2020/02/Safest-source-of-energy.png) today - though it still only contributes a small percentage of the global energy production. The death rates from solar production are 1,230 times lower than coal, and it has one of the lowest CO2 emissions, at 5g CO2 eq per kWh. Why Space-Based Solar Power? Space-based solar power has several benefits; unlike solar panels on our roofs that can only generate electricity during the day, space-based solar power can generate continuous electricity, 24 hours a day, 99% of the year. This is because, unlike Earth, the space environment does not have night and day, and the satellites are in the Earth's shadow for only a maximum of 72 minutes per night. Space-based solar panels can generate 2,000 gigawatts of power constantly. This is 40 times more energy than a solar panel would generate on Earth annually. This is also several folds higher than the [efficiency of solar panels](https://www.greenmatch.co.uk/blog/2014/11/how-efficient-are-solar-panels) today. What’s more, is that space-based solar power would generate [0% greenhouse gas emissions](https://space.nss.org/space-solar-power/) unlike other alternatives energy like nuclear, coal, oil, gas, and ethanol. The current source of energy that generates the lowest CO2 is nuclear power, which generates CO2 of 5g CO2 eq per kWh. Space-based solar power generates almost 0% hazardous waste to our environment compared to nuclear power.

#### Warming leads to extinction -- it’s a conflict-multiplier and unknown feedback loops means we need to stop now

Kareiva 18, Ph.D. in ecology and applied mathematics from Cornell University, director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA, et al. (Peter, “Existential risk due to ecosystem collapse: Nature strikes back,” *Futures*, 102)

In summary, six of the nine proposed planetary boundaries (phosphorous, nitrogen, biodiversity, land use, atmospheric aerosol loading, and chemical pollution) are unlikely to be associated with existential risks. They all correspond to a degraded environment, but in our assessment do not represent existential risks. However, the three remaining boundaries (climate change, global freshwater cycle, and ocean acidification) do pose existential risks. This is because of intrinsic positive feedback loops, substantial lag times between system change and experiencing the consequences of that change, and the fact these different boundaries interact with one another in ways that yield surprises. In addition, climate, freshwater, and ocean acidification are all directly connected to the provision of food and water, and shortages of food and water can create conflict and social unrest. Climate change has a long history of disrupting civilizations and sometimes precipitating the collapse of cultures or mass emigrations (McMichael, 2017). For example, the 12th century drought in the North American Southwest is held responsible for the collapse of the Anasazi pueblo culture. More recently, the infamous potato famine of 1846–1849 and the large migration of Irish to the U.S. can be traced to a combination of factors, one of which was climate. Specifically, 1846 was an unusually warm and moist year in Ireland, providing the climatic conditions favorable to the fungus that caused the potato blight. As is so often the case, poor government had a role as well—as the British government forbade the import of grains from outside Britain (imports that could have helped to redress the ravaged potato yields). Climate change intersects with freshwater resources because it is expected to exacerbate drought and water scarcity, as well as flooding. Climate change can even impair water quality because it is associated with heavy rains that overwhelm sewage treatment facilities, or because it results in higher concentrations of pollutants in groundwater as a result of enhanced evaporation and reduced groundwater recharge. Ample clean water is not a luxury—it is essential for human survival. Consequently, cities, regions and nations that lack clean freshwater are vulnerable to social disruption and disease. Finally, ocean acidification is linked to climate change because it is driven by CO2 emissions just as global warming is. With close to 20% of the world’s protein coming from oceans (FAO, 2016), the potential for severe impacts due to acidification is obvious. Less obvious, but perhaps more insidious, is the interaction between climate change and the loss of oyster and coral reefs due to acidification. Acidification is known to interfere with oyster reef building and coral reefs. Climate change also increases storm frequency and severity. Coral reefs and oyster reefs provide protection from storm surge because they reduce wave energy (Spalding et al., 2014). If these reefs are lost due to acidification at the same time as storms become more severe and sea level rises, coastal communities will be exposed to unprecedented storm surge—and may be ravaged by recurrent storms. A key feature of the risk associated with climate change is that mean annual temperature and mean annual rainfall are not the variables of interest. Rather it is extreme episodic events that place nations and entire regions of the world at risk. These extreme events are by definition “rare” (once every hundred years), and changes in their likelihood are challenging to detect because of their rarity, but are exactly the manifestations of climate change that we must get better at anticipating (Diffenbaugh et al., 2017). Society will have a hard time responding to shorter intervals between rare extreme events because in the lifespan of an individual human, a person might experience as few as two or three extreme events. How likely is it that you would notice a change in the interval between events that are separated by decades, especially given that the interval is not regular but varies stochastically? A concrete example of this dilemma can be found in the past and expected future changes in storm-related flooding of New York City. The highly disruptive flooding of New York City associated with Hurricane Sandy represented a flood height that occurred once every 500 years in the 18th century, and that occurs now once every 25 years, but is expected to occur once every 5 years by 2050 (Garner et al., 2017). This change in frequency of extreme floods has profound implications for the measures New York City should take to protect its infrastructure and its population, yet because of the stochastic nature of such events, this shift in flood frequency is an elevated risk that will go unnoticed by most people. 4. The combination of positive feedback loops and societal inertia is fertile ground for global environmental catastrophes Humans are remarkably ingenious, and have adapted to crises throughout their history. Our doom has been repeatedly predicted, only to be averted by innovation (Ridley, 2011). However, the many stories of human ingenuity successfully addressing existential risks such as global famine or extreme air pollution represent environmental challenges that are largely linear, have immediate consequences, and operate without positive feedbacks. For example, the fact that food is in short supply does not increase the rate at which humans consume food—thereby increasing the shortage. Similarly, massive air pollution episodes such as the London fog of 1952 that killed 12,000 people did not make future air pollution events more likely. In fact it was just the opposite—the London fog sent such a clear message that Britain quickly enacted pollution control measures (Stradling, 2016). Food shortages, air pollution, water pollution, etc. send immediate signals to society of harm, which then trigger a negative feedback of society seeking to reduce the harm. In contrast, today’s great environmental crisis of climate change may cause some harm but there are generally long time delays between rising CO2 concentrations and damage to humans. The consequence of these delays are an absence of urgency; thus although 70% of Americans believe global warming is happening, only 40% think it will harm them (http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/). Secondly, unlike past environmental challenges, the Earth’s climate system is rife with positive feedback loops. In particular, as CO2 increases and the climate warms, that very warming can cause more CO2 release which further increases global warming, and then more CO2, and so on. Table 2 summarizes the best documented positive feedback loops for the Earth’s climate system. These feedbacks can be neatly categorized into carbon cycle, biogeochemical, biogeophysical, cloud, ice-albedo, and water vapor feedbacks. As important as it is to understand these feedbacks individually, it is even more essential to study the interactive nature of these feedbacks. Modeling studies show that when interactions among feedback loops are included, uncertainty increases dramatically and there is a heightened potential for perturbations to be magnified (e.g., Cox, Betts, Jones, Spall, & Totterdell, 2000; Hajima, Tachiiri, Ito, & Kawamiya, 2014; Knutti & Rugenstein, 2015; Rosenfeld, Sherwood, Wood, & Donner, 2014). This produces a wide range of future scenarios. Positive feedbacks in the carbon cycle involves the enhancement of future carbon contributions to the atmosphere due to some initial increase in atmospheric CO2. This happens because as CO2 accumulates, it reduces the efficiency in which oceans and terrestrial ecosystems sequester carbon, which in return feeds back to exacerbate climate change (Friedlingstein et al., 2001). Warming can also increase the rate at which organic matter decays and carbon is released into the atmosphere, thereby causing more warming (Melillo et al., 2017). Increases in food shortages and lack of water is also of major concern when biogeophysical feedback mechanisms perpetuate drought conditions. The underlying mechanism here is that losses in vegetation increases the surface albedo, which suppresses rainfall, and thus enhances future vegetation loss and more suppression of rainfall—thereby initiating or prolonging a drought (Chamey, Stone, & Quirk, 1975). To top it off, overgrazing depletes the soil, leading to augmented vegetation loss (Anderies, Janssen, & Walker, 2002). Climate change often also increases the risk of forest fires, as a result of higher temperatures and persistent drought conditions. The expectation is that forest fires will become more frequent and severe with climate warming and drought (Scholze, Knorr, Arnell, & Prentice, 2006), a trend for which we have already seen evidence (Allen et al., 2010). Tragically, the increased severity and risk of Southern California wildfires recently predicted by climate scientists (Jin et al., 2015), was realized in December 2017, with the largest fire in the history of California (the “Thomas fire” that burned 282,000 acres, https://www.vox.com/2017/12/27/16822180/thomas-fire-california-largest-wildfire). This catastrophic fire embodies the sorts of positive feedbacks and interacting factors that could catch humanity off-guard and produce a true apocalyptic event. Record-breaking rains produced an extraordinary flush of new vegetation, that then dried out as record heat waves and dry conditions took hold, coupled with stronger than normal winds, and ignition. Of course the record-fire released CO2 into the atmosphere, thereby contributing to future warming. Out of all types of feedbacks, water vapor and the ice-albedo feedbacks are the most clearly understood mechanisms. Losses in reflective snow and ice cover drive up surface temperatures, leading to even more melting of snow and ice cover—this is known as the ice-albedo feedback (Curry, Schramm, & Ebert, 1995). As snow and ice continue to melt at a more rapid pace, millions of people may be displaced by flooding risks as a consequence of sea level rise near coastal communities (Biermann & Boas, 2010; Myers, 2002; Nicholls et al., 2011). The water vapor feedback operates when warmer atmospheric conditions strengthen the saturation vapor pressure, which creates a warming effect given water vapor’s strong greenhouse gas properties (Manabe & Wetherald, 1967). Global warming tends to increase cloud formation because warmer temperatures lead to more evaporation of water into the atmosphere, and warmer temperature also allows the atmosphere to hold more water. The key question is whether this increase in clouds associated with global warming will result in a positive feedback loop (more warming) or a negative feedback loop (less warming). For decades, scientists have sought to answer this question and understand the net role clouds play in future climate projections (Schneider et al., 2017). Clouds are complex because they both have a cooling (reflecting incoming solar radiation) and warming (absorbing incoming solar radiation) effect (Lashof, DeAngelo, Saleska, & Harte, 1997). The type of cloud, altitude, and optical properties combine to determine how these countervailing effects balance out. Although still under debate, it appears that in most circumstances the cloud feedback is likely positive (Boucher et al., 2013). For example, models and observations show that increasing greenhouse gas concentrations reduces the low-level cloud fraction in the Northeast Pacific at decadal time scales. This then has a positive feedback effect and enhances climate warming since less solar radiation is reflected by the atmosphere (Clement, Burgman, & Norris, 2009). The key lesson from the long list of potentially positive feedbacks and their interactions is that runaway climate change, and runaway perturbations have to be taken as a serious possibility. Table 2 is just a snapshot of the type of feedbacks that have been identified (see Supplementary material for a more thorough explanation of positive feedback loops). However, this list is not exhaustive and the possibility of undiscovered positive feedbacks portends even greater existential risks. The many environmental crises humankind has previously averted (famine, ozone depletion, London fog, water pollution, etc.) were averted because of political will based on solid scientific understanding. We cannot count on complete scientific understanding when it comes to positive feedback loops and climate change

### Case

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

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

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

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

Everything is in a torus

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

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

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

750,000 “bullets” - 10 mm

150 million bits 1 mm

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

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

That does not sound like too dangerous a neighborhood!

What happens if start some sort of cascade?

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

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

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

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

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

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

But worrying about a Kessler Syndrome? - no not really

#### 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](http://www.thetimes.co.uk/tto/opinion/columnists/article4206440.ece) 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](http://bigstory.ap.org/article/scientists-say-ozone-layer-recovering) 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](http://wattsupwiththat.com/2014/09/12/is-the-atmospheric-ozone-recovery-real-or-just-for-scoring-political-points/) 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](http://www.wunderground.com/resources/climate/holefaq.asp?MR=1) 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](http://www.heritage.org/research/commentary/2007/09/ozone-the-hole-truth). 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.