# 1NC R6 Emory

## 1

#### Space Commercialization drives Tech Innovation in the Status Quo – it provides a unique impetus.

Hampson 17 Joshua Hampson 1-25-2017 “The Future of Space Commercialization” <https://republicans-science.house.gov/sites/republicans.science.house.gov/files/documents/TheFutureofSpaceCommercializationFinal.pdf> (Security Studies Fellow at the Niskanen Center)//Elmer

The size of the space economy is far larger than many may think. In 2015 alone, the global market amounted to $323 billion. Commercial infrastructure and systems accounted for 76 percent of that 9 total, with satellite television the largest subsection at $95 billion. The global space launch market’s 10 11 share of that total came in at $6 billion dollars. It can be hard to disaggregate how space benefits 12 particular national economies, but in 2009 (the last available report), the Federal Aviation Administration (FAA) estimated that commercial space transportation and enabled industries generated $208.3 billion in economic activity in the United States alone. Space is not just about 13 satellite television and global transportation; while not commercial, GPS satellites also underpin personal navigation, such as smartphone GPS use, and timing data used for Internet coordination.14 Without that data, there could be problems for a range of Internet and cloud-based services.15 There is also room for growth. The FAA has noted that while the commercial launch sector has not grown dramatically in the last decade, there are indications that there is latent demand. This 16 demand may catalyze an increase in launches and growth of the wider space economy in the next decade. The Satellite Industry Association’s 2015 report highlighted that their section of the space economy outgrew both the American and global economies. The FAA anticipates that growth to 17 continue, with expectations that small payload launch will be a particular industry driver.18 In the future, emerging space industries may contribute even more the American economy. Space tourism and resource recovery—e.g., mining on planets, moons , and asteroids—in particular may become large parts of that industry. Of course, their viability rests on a range of factors, including costs, future regulation, international problems, and assumptions about technological development. However, there is increasing optimism in these areas of economic production. But the space economy is not just about what happens in orbit, or how that alters life on the ground. The growth of this economy can also contribute to new innovations across all walks of life. Technological Innovation Innovation is generally hard to predict; some new technologies seem to come out of nowhere and others only take off when paired with a new application. It is difficult to predict the future, but it is reasonable to expect that a growing space economy would open opportunities for technological and organizational innovation. In terms of technology, the difficult environment of outer space helps incentivize progress along the margins. Because each object launched into orbit costs a significant amount of money—at the moment between $27,000 and $43,000 per pound, though that will likely drop in the future —each 19 reduction in payload size saves money or means more can be launched. At the same time, the ability to fit more capability into a smaller satellite opens outer space to actors that previously were priced out of the market. This is one of the reasons why small, affordable satellites are increasingly pursued by companies or organizations that cannot afford to launch larger traditional satellites. These small 20 satellites also provide non-traditional launchers, such as engineering students or prototypers, the opportunity to learn about satellite production and test new technologies before working on a full-sized satellite. That expansion of developers, experimenters, and testers cannot but help increase innovation opportunities. Technological developments from outer space have been applied to terrestrial life since the earliest days of space exploration. The National Aeronautics and Space Administration (NASA) maintains a website that lists technologies that have spun off from such research projects. Lightweight 21 nanotubes, useful in protecting astronauts during space exploration, are now being tested for applications in emergency response gear and electrical insulation. The need for certainty about the resiliency of materials used in space led to the development of an analytics tool useful across a range of industries. Temper foam, the material used in memory-foam pillows, was developed for NASA for seat covers. As more companies pursue their own space goals, more innovations will likely come from the commercial sector. Outer space is not just a catalyst for technological development. Satellite constellations and their unique line-of-sight vantage point can provide new perspectives to old industries. Deploying satellites into low-Earth orbit, as Facebook wants to do, can connect large, previously-unreached swathes of 22 humanity to the Internet. Remote sensing technology could change how whole industries operate, such as crop monitoring, herd management, crisis response, and land evaluation, among others. 23 While satellites cannot provide all essential information for some of these industries, they can fill in some useful gaps and work as part of a wider system of tools. Space infrastructure, in helping to change how people connect and perceive Earth, could help spark innovations on the ground as well. These innovations, changes to global networks, and new opportunities could lead to wider economic growth.

#### Strong Innovation solves Extinction.

Matthews 18 Dylan Matthews 10-26-2018 “How to help people millions of years from now” <https://www.vox.com/future-perfect/2018/10/26/18023366/far-future-effective-altruism-existential-risk-doing-good> (Co-founder of Vox, citing Nick Beckstead @ Rutgers University)//Re-cut by Elmer

If you care about improving human lives, you should overwhelmingly care about those quadrillions of lives rather than the comparatively small number of people alive today. The 7.6 billion people now living, after all, amount to less than 0.003 percent of the population that will live in the future. It’s reasonable to suggest that those quadrillions of future people have, accordingly, hundreds of thousands of times more moral weight than those of us living here today do. That’s the basic argument behind Nick Beckstead’s 2013 Rutgers philosophy dissertation, “On the overwhelming importance of shaping the far future.” It’s a glorious mindfuck of a thesis, not least because Beckstead shows very convincingly that this is a conclusion any plausible moral view would reach. It’s not just something that weird utilitarians have to deal with. And Beckstead, to his considerable credit, walks the walk on this. He works at the Open Philanthropy Project on grants relating to the far future and runs a charitable fund for donors who want to prioritize the far future. And arguments from him and others have turned “long-termism” into a very vibrant, important strand of the effective altruism community. But what does prioritizing the far future even mean? The most literal thing it could mean is preventing human extinction, to ensure that the species persists as long as possible. For the long-term-focused effective altruists I know, that typically means identifying concrete threats to humanity’s continued existence — like unfriendly artificial intelligence, or a pandemic, or global warming/out of control geoengineering — and engaging in activities to prevent that specific eventuality. But in a set of slides he made in 2013, Beckstead makes a compelling case that while that’s certainly part of what caring about the far future entails, approaches that address specific threats to humanity (which he calls “targeted” approaches to the far future) have to complement “broad” approaches, where instead of trying to predict what’s going to kill us all, you just generally try to keep civilization running as best it can, so that it is, as a whole, well-equipped to deal with potential extinction events in the future, not just in 2030 or 2040 but in 3500 or 95000 or even 37 million. In other words, caring about the far future doesn’t mean just paying attention to low-probability risks of total annihilation; it also means acting on pressing needs now. For example: We’re going to be better prepared to prevent extinction from AI or a supervirus or global warming if society as a whole makes a lot of scientific progress. And a significant bottleneck there is that the vast majority of humanity doesn’t get high-enough-quality education to engage in scientific research, if they want to, which reduces the **odds that we have enough trained scientists to come up with the breakthroughs** we need as a civilization to survive and thrive. So maybe one of the best things we can do for the far future is to improve school systems — here and now — to harness the group economist Raj Chetty calls “lost Einsteins” (potential innovators who are thwarted by poverty and inequality in rich countries) and, more importantly, the hundreds of millions of kids in developing countries dealing with even worse education systems than those in depressed communities in the rich world. What if living ethically for the far future means living ethically now? Beckstead mentions some other broad, or very broad, ideas (these are all his descriptions): Help make computers faster so that people everywhere can work more efficiently Change intellectual property law so that technological innovation can happen more quickly Advocate for open borders so that people from poorly governed countries can move to better-governed countries and be more productive Meta-research: improve incentives and norms in academic work to better advance human knowledge Improve education Advocate for political party X to make future people have values more like political party X ”If you look at these areas (economic growth and technological progress, access to information, individual capability, social coordination, motives) a lot of everyday good works contribute,” Beckstead writes. “An implication of this is that a lot of everyday good works are good from a broad perspective, even though hardly anyone thinks explicitly in terms of far future standards.” Look at those examples again: It’s just a list of what normal altruistically motivated people, not effective altruism folks, generally do. Charities in the US love talking about the lost opportunities for innovation that poverty creates. Lots of smart people who want to make a difference become scientists, or try to work as teachers or on improving education policy, and lord knows there are plenty of people who become political party operatives out of a conviction that the moral consequences of the party’s platform are good. All of which is to say: Maybe effective altruists aren’t that special, or at least maybe we don’t have access to that many specific and weird conclusions about how best to help the world. If the far future is what matters, and generally trying to make the world work better is among the best ways to help the far future, then effective altruism just becomes plain ol’ do-goodery.

## 2

#### Xi’s regime is stable now, but its success depends on strong growth and private sector development.

**Mitter and Johnson 21** [Rana Mitter and Elsbeth Johnson, [Rana Mitter](https://hbr.org/search?term=rana%20mitter&search_type=search-all) is a professor of the history and politics of modern China at Oxford. [Elsbeth Johnson](https://hbr.org/search?term=elsbeth%20johnson&search_type=search-all), formerly the strategy director for Prudential PLC’s Asian business, is a senior lecturer at MIT’s Sloan School of Management and the founder of SystemShift, a consulting firm. May-June 2021, "What the West Gets Wrong About China," Harvard Business Review, [https://hbr.org/2021/05/what-the-west-gets-wrong-about-china accessed 12/14/21](https://hbr.org/2021/05/what-the-west-gets-wrong-about-china%20accessed%2012/14/21)] Adam

In China, however, growth has come in the context of stable communist rule, suggesting that democracy and growth are not inevitably mutually dependent. In fact, many Chinese believe that the country’s recent economic achievements—large-scale poverty reduction, huge infrastructure investment, and development as a world-class tech innovator—have come about because of, not despite, China’s authoritarian form of government. Its aggressive handling of Covid-19—in sharp contrast to that of many Western countries with higher death rates and later, less-stringent lockdowns—has, if anything, reinforced that view.

China has also defied predictions that its authoritarianism would inhibit its capacity to [innovate](https://hbr.org/2011/06/what-the-west-doesnt-get-about-china). It is a global leader in AI, biotech, and space exploration. Some of its technological successes have been driven by market forces: People wanted to buy goods or communicate more easily, and the likes of Alibaba and Tencent have helped them do just that. But much of the technological progress has come from a highly innovative and well-funded military that has invested heavily in China’s burgeoning new industries. This, of course, mirrors the role of U.S. defense and intelligence spending in the development of Silicon Valley. But in China the consumer applications have come faster, making more obvious the link between government investment and products and services that benefit individuals. That’s why ordinary Chinese people see Chinese companies such as Alibaba, Huawei, and TikTok as sources of national pride—international vanguards of Chinese success—rather than simply sources of jobs or GDP, as they might be viewed in the West.

Thus July 2020 polling data from the Ash Center at Harvard’s Kennedy School of Government revealed 95% satisfaction with the Beijing government among Chinese citizens. Our own experiences on the ground in China confirm this. Most ordinary people we meet don’t feel that the authoritarian state is solely oppressive, although it can be that; for them it also provides opportunity. A cleaner in Chongqing now owns several apartments because the CCP reformed property laws. A Shanghai journalist is paid by her state-controlled magazine to fly around the world for stories on global lifestyle trends. A young student in Nanjing can study propulsion physics at Beijing’s Tsinghua University thanks to social mobility and the party’s significant investment in scientific research.

#### Xi has committed to the commercial space industry as the linchpin of China’s rise – the plan is seen as a complete 180

**Patel 21** [Neel V. Patel, Neel is a space reporter for MIT Technology Review. 1-21-2021, "China’s surging private space industry is out to challenge the US," MIT Technology Review, <https://www.technologyreview.com/2021/01/21/1016513/china-private-commercial-space-industry-dominance/> accessed 12/14/21] Adam

Until recently, China’s space activity has been overwhelmingly dominated by two state-owned enterprises: the China Aerospace Science & Industry Corporation Limited (CASIC) and the China Aerospace Science and Technology Corporation (CASC). A few private space firms have been allowed to operate in the country for a while: for example, there’s the China Great Wall Industry Corporation Limited (in reality a subsidiary of CASC), which has provided commercial launches since it was established in 1980. But for the most part, China’s commercial space industry has been nonexistent. Satellites were expensive to build and launch, and they were too heavy and large for anything but the biggest rockets to actually deliver to orbit. The costs involved were too much for anything but national budgets to handle.

That all changed this past decade as the costs of making satellites and launching rockets plunged. In 2014, a year after Xi Jinping took over as the new leader of China, the Chinese government decided to treat civil space development as a key area of innovation, as it had already begun doing with AI and solar power. It issued a policy directive called [Document 60](https://archive.md/o/bc9l4/www.cpppc.org/en/zy/994006.jhtml) that year to enable large private investment in companies interested in participating in the space industry.

“Xi’s goal was that if China has to become a critical player in technology, including in civil space and aerospace, it was critical to develop a space ecosystem that includes the private sector,” says Namrata Goswami, a geopolitics expert based in Montgomery, Alabama, who’s been studying China’s space program for many years. “He was taking a cue from the American private sector to encourage innovation from a talent pool that extended beyond state-funded organizations.”

As a result, there are now 78 commercial space companies operating in China, according to a[2019 report by the Institute for Defense Analyses](https://archive.md/o/bc9l4/https:/www.ida.org/-/media/feature/publications/e/ev/evaluation-of-chinas-commercial-space-sector/d-10873.ashx). More than half have been founded since 2014, and the vast majority focus on satellite manufacturing and launch services.

For example, Galactic Energy, founded in February 2018, is building its Ceres rocket to offer rapid launch service for single payloads, while its Pallas rocket is being built to deploy entire constellations. Rival company i-Space, formed in 2016, became the first commercial Chinese company to make it to space with its Hyperbola-1 in July 2019. It wants to pursue reusable first-stage boosters that can land vertically, like those from SpaceX. So does LinkSpace (founded in 2014), although it also hopes to use rockets to deliver packages from one terrestrial location to another.

Spacety, founded in 2016, wants to turn around customer orders to build and launch its small satellites in just six months. In December it launched a miniaturized version of a satellite that uses 2D radar images to build 3D reconstructions of terrestrial landscapes. Weeks later, it [released the first images taken by the satellite](https://archive.md/o/bc9l4/https:/spacenews.com/spacety-releases-first-sar-images/), Hisea-1, featuring three-meter resolution. Spacety wants to launch a constellation of these satellites to offer high-quality imaging at low cost.

To a large extent, China is following the same blueprint drawn up by the US: using government contracts and subsidies to give these companies a foot up. US firms like SpaceX benefited greatly from NASA contracts that paid out millions to build and test rockets and space vehicles for delivering cargo to the International Space Station. With that experience under its belt, SpaceX was able to attract more customers with greater confidence.

Venture capital is another tried-and-true route. The IDA report estimates that VC funding for Chinese space companies was up to $516 million in 2018—far shy of the $2.2 billion American companies raised, but nothing to scoff at for an industry that really only began seven years ago. At least 42 companies had no known government funding.

And much of the government support these companies do receive doesn’t have a federal origin, but a provincial one. “[These companies] are drawing high-tech development to these local communities,” says Hines. “And in return, they’re given more autonomy by the local government.” While most have headquarters in Beijing, many keep facilities in Shenzhen, Chongqing, and other areas that might draw talent from local universities.

There’s also one advantage specific to China: manufacturing. “What is the best country to trust for manufacturing needs?” asks James Zheng, the CEO of Spacety’s Luxembourg headquarters. “It’s China. It’s the manufacturing center of the world.” Zheng believes the country is in a better position than any other to take advantage of the space industry’s new need for mass production of satellites and rockets alike.

Making friends

The most critical strategic reason to encourage a private space sector is to create opportunities for international collaboration—particularly to attract customers wary of being seen to mix with the Chinese government. (US agencies and government contractors, for example, are barred from working with any groups the regime funds.) Document 60 and others issued by China’s National Development and Reform Commission were aimed not just at promoting technological innovation, but also at drawing in foreign investment and maximizing a customer base beyond Chinese borders.

“China realizes there are certain things they cannot get on their own,” says Frans von der Dunk, a space policy expert at the University of Nebraska–Lincoln. Chinese companies like LandSpace and MinoSpace have worked to accrue funding through foreign investment, escaping dependence on state subsidies. And by avoiding state funding, a company can also avoid an array of restrictions on what it can and can’t do (such as constraints on talking with the media). Foreign investment also makes it easier to compete on a global scale: you’re taking on clients around the world, launching from other countries, and bringing talent from outside China.

Although China is taking inspiration from the US in building out its private industry, the nature of the Chinese state also means these new companies face obstacles that their rivals in the West don’t have to worry about. While Chinese companies may look private on paper, they must still submit to government guidance and control, and accept some level of interference. It may be difficult for them to make a case to potential overseas customers that they are independent. The distinction between companies that are truly private and those that are more or less state actors is still quite fuzzy, especially if the government is a frequent customer. “That could still lead to a lack of trust from other partners,” says Goswami. It doesn’t help that the government itself is often [very cagey about what its national program is even up to](https://archive.md/o/bc9l4/https:/www.bbc.com/news/science-environment-54076895).

And Hines adds that it’s not always clear exactly how separate these companies are from, say, the People’s Liberation Army, given the historical ties between the space and defense sectors. “Some of these things will pose significant hurdles for the commercial space sector as it tries to expand,” he says.

#### Shifts in regime perception threatens CCP’s legitimacy from nationalist hardliners

Weiss 19 Jessica Weiss 1-29-2019 “Authoritarian Audiences, Rhetoric, and Propaganda in International Crises: Evidence from China” <http://www.jessicachenweiss.com/uploads/3/0/6/3/30636001/19-01-24-elite-statements-isq-ca.pdf> (Associate Professor of Government at Cornell University)//Elmer

Public support—or the appearance of it—matters to many autocracies. As Ithiel de Sola Pool writes, modern dictatorships are “highly conscious of public opinion and make major efforts to affect it.”6 Mao Zedong told his comrades: “When you make revolution, you must first manage public opinion.”7 Because autocracies often rely on **nationalist mythmaking**,8 success or failure in defending the national honor in international crises could burnish the leadership’s patriotic credentials or spark opposition. **Shared outrage at the regime’s foreign policy failures could galvanize street protests or elite fissures, creating intraparty upheaval** or inviting military officers to step in to restore order. Fearing a domestic backlash, authoritarian leaders may feel compelled to take a tough international stance. Although authoritarian leaders are rarely held accountable to public opinion through free and fair elections, fears of popular unrest and irregular ouster often weigh heavily on autocrats seeking to maximize their tenure in office. Considering the harsh consequences that authoritarian elites face if pushed out of office, even a small increase in the probability of ouster could alter authoritarian incentives in international crises.9 A history of nationalist uprisings make Chinese citizens and leaders especially aware of the linkage between international disputes and domestic unrest. The weakness of the PRC’s predecessor in defending Chinese sovereignty at the Paris Peace Conference in 1919 galvanized protests and a general strike, forcing the government to sack three officials and reject the Treaty of Versailles, which awarded territories in China to Japan. These precedents have made Chinese officials particularly sensitive to the appearance of hewing to public opinion. As the People’s Daily chief editor wrote: “History and reality have shown us that public opinion and regime safety are inseparable.”10 One Chinese scholar even claimed: “the Chinese government probably knows the public’s opinion better and reacts to it more directly than even the U.S. government.”11

#### Xi will launch diversionary war to domestic backlash – escalates in multiple hotspots

Norris 17, William J. Geostrategic Implications of China’s Twin Economic Challenges. CFR Discussion Paper, 2017. (Associate professor of Chinese foreign and security policy at Texas A&M University’s Bush School of Government and Public Service)//Elmer

Populist pressures might tempt the **party leadership** to encourage **diversionary nationalism**. The logic of this concern is straightforward: the Communist Party might seek to **distract a restless domestic population** with **adventurism abroad**.19 The **Xi** administration wants to **appear tough** in its **defense of foreign encroachments** against China’s interests. This need stems from a long-running narrative about how a weak Qing dynasty was unable to defend China in the face of European imperial expansion, epitomized by the Opium Wars and the subsequent treaties imposed on China in the nineteenth century. The party is **particularly sensitive** to **perceptions of weakness** because much of its **claim to legitimacy**—manifested in **Xi’s Chinese Dream** campaign today—stems from the party’s claims of leading the **restoration of Chinese greatness**. For example, the May Fourth Movement, a popular protest in 1919 that helped catalyze the CPC, called into question the legitimacy of the Republic of China government running the country at that time because the regime was seen as not having effectively defended China’s territorial and sovereignty interests at the Versailles Peace Conference. **Diversionary nationalist frictions** would likely occur if the Chinese leadership portrayed a foreign adversary as having made the first move, thus forcing Xi to stand up for China’s interests. An example is the 2012 attempt by the nationalist governor of Tokyo, Shintaro Ishihara, to buy the Senkaku/Diaoyu Islands from a private owner.20 Although the Japanese central government sought to avert a crisis by stepping in to purchase the islands—having them bought and administered by Ishihara’s Tokyo metropolitan government would have dragged Japan into a confrontation with China—China saw this move as part of a deliberate orchestration by Japan to nationalize the islands. Xi seemingly had no choice but to defend China’s claims against an attempt by Japan to consolidate its position on the dispute.21 This issue touched off a period of heated tensions between China and Japan, lasting more than two years.22 Such dynamics are not limited to Japan. Other possible areas of conflict include, but are not necessarily limited to, **Taiwan**, **India**, and the **South China Sea** (especially with the **Philippines** and **Vietnam**). The Chinese government will use such tactics if it believes that the costs are relatively low. Ideally, China would like to appear tough while avoiding material repercussions or a serious diplomatic breakdown. Standing up against foreign encroachment—without facing much blowback—could provide Xi’s administration with a tempting source of noneconomic legitimacy. However, over the next few years, Xi will probably not be actively looking to get embroiled abroad. Cushioning the fallout from slower growth while managing a structural economic transition will be difficult enough. Courting potential international crises that distract the central leadership would make this task even more daunting. Even if the top leadership did not wish to provoke conflict, a smaller budgetary allotment for security could cause **military interests** in China to **deliberately instigate trouble** to **justify** their **claims over increasingly scarce resources**. For example, an air force interested in ensuring its funding for a midair tanker program might find the existence of far-flung territorial disputes to be useful in making its case. Such a case would be made even stronger by a pattern of recent frictions that highlights the necessity of greater air power projection. Budgetary pressures may be partly behind a recent People’s Liberation Army reorganization and headcount reduction. A slowing economy might cause a further deceleration in China’s military spending, thus increasing such pressures as budgetary belts tighten. Challenges to Xi’s Leadership Xi Jinping’s efforts to address economic challenges could fail, unleashing consequences that extend well beyond China’s economic health. For example, an **economic collapse** could give rise to a Vladimir **Putin–like redemption figure** in China. Xi’s approach of centralizing authority over a diverse, complex, and massive social, political, and economic system is a **recipe for brittleness**. Rather than designing a resilient, decentralized governance structure that can gracefully cope with localized failures at particular nodes in a network, a highly centralized architecture **risks catastrophic**, **system-level failure**. Although centralized authority offers the tantalizing chimera of stronger control from the center, it also puts all the responsibility squarely on Xi’s shoulders. With China’s ascension to great power status, the consequences of internecine domestic political battles are increasingly playing out on the world stage. The international significance of China’s domestic politics is a new paradigm for the Chinese leadership, and one can expect an adjustment period during which the outcome of what had previously been relatively insulated domestic political frictions will likely generate **unintended international repercussions**. Such dynamics will influence Chinese foreign policy and security behavior. Domestic arguments over ideology, bureaucratic power struggles, and strategic direction could all have **ripple effects abroad**. Many of China’s party heavyweights still employ a narrow and exclusively domestic political calculus. Such behavior increases the possibility of international implications that are not fully anticipated, **raising the risks** of **strategic miscalculation** on the world stage. For example, the factional power struggles that animated the Cultural Revolution were largely driven by domestic concerns, yet manifested themselves in Chinese foreign policy for more than a decade. During this period, China was not the world’s second largest economy and, for much of this time, did not even have formal representation at the United Nations. If today’s globally interconnected China became engulfed in similar domestic chaos, the effects would be felt worldwide.23 Weakened Fetters of Economic Interdependence If China successfully transitioned away from its export-driven growth model toward a consumption-driven economic engine over the next four or five years, it could no longer feel as constrained by economic interdependence. To the extent that such constraints are loosened, the U.S.-China relationship will be more prone to conflict and friction.24 While China has never been the archetypal liberal economic power bent on benign integration with the global economy, its export-driven growth model produced a strong strategic preference for stability. Although past behavior is not necessarily indicative of future strategic calculus, China’s “economic circuit breaker” logic seems to have held its most aggressive nationalism below the threshold of war since 1979. A China that is both comparatively strong and less dependent on the global economy would be a novel development in modern geopolitics. As China changes the composition of its international economic linkages, global integration could place fewer constraints on it. Whereas China has been highly reliant on the import of raw materials and semifinished goods for reexport, a consumption-driven China could have a different international trade profile. China could still rely on imported goods, but their centrality to the country’s overall economic growth would be altered. Imports of luxury goods, consumer products, international brands, and services may not exert a significant constraining influence, since loss of access to such items may not be seen as strategically vital. If these flows were interrupted or jeopardized, the result would be more akin to an inconvenience than a strategic setback for China’s rise. That said, China is likely to continue to highly depend on imported oil even if the economic end to which that energy resource is directed shifts away from industrial and export production toward domestic consumption.

#### **US–China war goes nuclear – crisis mis-management ensures conventional escalation - extinction**

Kulacki 20 [Dr. Gregory Kulacki focuses on cross-cultural communication between the United States and China on nuclear and space arms control and is the China Project Manager for the Global Security Program at the Union of Concerned Scientists, 2020. Would China Use Nuclear Weapons First In A War With The United States?, Thediplomat.com, https://thediplomat.com/2020/04/would-china-use-nuclear-weapons-first-in-a-war-with-the-united-states/] srey

Admiral Charles A. Richard, the head of the U.S. Strategic Command, recently told the Senate Armed Service Committee he “could drive a truck” through the holes in China’s no first use policy. But when Senator John Hawley (R-MO) asked him why he said that, Commander Richard backtracked, described China’s policy as “very opaque” and said his assessment was based on “very little” information. That’s surprising. **China** has been exceptionally **clear** **about** its **intentions** **on** the possible **first** **use** **of** **nuclear** **weapons**. On the day of its first nuclear test on October 16, 1964, China declared it “will never at any time or under any circumstances be the first to use nuclear weapons.” That **unambiguous** **statement** **has** **been** a **cornerstone** **of** **Chinese** **nuclear** **weapons** policy for 56 years and has been repeated frequently in authoritative Chinese publications for domestic and international audiences, including a highly classified training manual for the operators of China’s nuclear forces. Richard should know about those publications, particularly the training manual. A U.S. Department of Defense translation has been circulating within the U.S. nuclear weapons policy community for more than a decade. The commander’s comments to the committee indicate a familiarity with the most controversial section of the manual, which, in the eyes of some U.S. analysts, indicates there may be some circumstances where **China** **would** **use** **nuclear** **weapons** **first** **in** a **war** **with** **the** **U**nited **S**tates. This U.S. misperception is understandable, especially given the difficulties the Defense Department encountered translating the text into English. The language, carefully considered in the context of the entire book, articulates a strong reaffirmation of China’s no first use policy. But it also reveals **Chinese** military planners are **struggling** **with** **crisis** **management** **and** **considering** **steps** **that** could **create** **ambiguity** **with** **disastrous** **consequences**. Towards the end of the 405-page text on the operations of China’s strategic rocket forces, in a chapter entitled, “Second Artillery Deterrence Operations,” the authors explain what China’s nuclear forces train to do if **“**a strong military power possessing nuclear‐armed missiles and an absolute advantage in high‐tech conventional weapons is carrying out intense and continuous attacks against our major strategic targets and we have no good military strategy to resist the enemy.**”** The military power they’re talking about is the United States. The authors indicate China’s nuclear missile forces train to take specific steps, including increasing readiness and conducting launch exercises, to “dissuade the continuation of the strong enemy’s conventional attacks.” The manual refers to these steps as an “adjustment” to China’s nuclear policy and a “lowering” of China’s threshold for brandishing its nuclear forces. Chinese leaders would only take these steps in extreme circumstances. The text highlights several triggers such as U.S. conventional bombing of China’s nuclear and hydroelectric power plants, heavy conventional bombing of large cities like Beijing and Shanghai, or other acts of **conventional** **warfare** **that** “**seriously** **threatened**” the “safety and **survival**” of the nation. U.S. Misunderstanding Richard seems to believe this planned adjustment in China’s nuclear posture means China is **preparing** **to** **use** **nuclear** **weapons** first under these circumstances. He told Hawley that there are a “number of situations where they may conclude that first use has occurred that do not meet our definition of first use.” The head of the U.S. Strategic Command appears to assume, as do other U.S. analysts, that the **Chinese** would **interpret** **these** types of U.S. conventional **attacks** **as** **equivalent** **to** a **U.S. first use** **of** **nuclear** **weapons** against China. But that’s not what the text says. “Lowering the threshold” refers to China putting its nuclear weapons on alert — it does not indicate Chinese leaders might lower their threshold for deciding to use nuclear weapons in a crisis. Nor does the text indicate Chinese nuclear forces are training to launch nuclear weapons first in a war with the United States. China, unlike the United States, keeps its nuclear forces off-alert. Its warheads are not mated to its missiles. China’s nuclear-armed submarines are not continuously at sea on armed patrols. The manual describes how China’s nuclear warheads and the missiles that deliver them are controlled by two separate chains of command. Chinese missileers train to bring them together and launch them after China has been attacked with nuclear weapons. All of these behaviors are consistent with a no first use policy. The “adjustment” Chinese nuclear forces are preparing to make if the United States is bombing China with impunity is to place China’s nuclear forces in a state of readiness similar to the state the nuclear forces of the United States are in all the time. This step is intended not only to end the bombing, but also to convince U.S. decision-makers they cannot expect to destroy China’s nuclear retaliatory capability if the crisis escalates. Chinese Miscalculation Unfortunately, alerting Chinese nuclear forces at such a moment could have terrifying consequences. Given the relatively small size of China’s nuclear force, a U.S. president might be tempted to try to limit the possible damage from a Chinese nuclear attack by destroying as many of China’s nuclear weapons as possible before they’re launched, especially if the head of the U.S. Strategic Command told the president China was preparing to strike first. One study concluded that if the United States used nuclear weapons to attempt to knock out a small fraction of the Chinese ICBMs that could reach the United States it may kill tens of millions of Chinese civilians. The authors of the text assume alerting China’s nuclear forces would “create a great shock in the enemy’s psyche.” That’s a fair assumption. But they also assume this shock could “dissuade the continuation of the strong enemy’s conventional attacks against our major strategic targets.” That’s highly questionable. There is a **substantial** **risk** **the** **U**nited **S**tates **would** **respond** **to** this implicit **Chinese** **threat** **to** **use** **nuclear** **weapons** **by** **escalating**, rather than halting, its **conventional** **attacks**. If China’s nuclear forces were targeted, it would put even greater strain on the operators of China’s nuclear forces. A **slippery** **slope** **to** **nuclear** **war** Chinese military planners are aware that attempting to coerce the United States into halting conventional bombardment by alerting their nuclear forces could fail. They also know it might trigger a nuclear war. But if it does, they are equally clear China won’t be the one to start it. Nuclear attack is often preceded by nuclear coercion. Because of this, in the midst of the process of a high, strong degree of nuclear coercion we should prepare well for a nuclear retaliatory attack. The more complete the preparation, the higher the credibility of nuclear coercion, the easier it is to accomplish the objective of nuclear coercion, and the lower the possibility that the nuclear missile forces will be used in actual fighting. They assume if China demonstrates it is well prepared to retaliate the United States would not risk a damage limitation strike using nuclear weapons. And even if the United States were to attack China’s nuclear forces with conventional weapons, China still would not strike first. In the opening section of the next chapter on “nuclear retaliatory attack operations” the manual instructs, as it does on numerous occasions throughout the entire text: According to our country’s principle, its stand of no first use of nuclear weapons, the Second Artillery will carry out a nuclear missile attack against the enemy’s important strategic targets, according to the combat orders of the Supreme Command, only after the enemy has carried out a nuclear attack against our country. Richard is wrong. There are no holes in China’s no first use policy. But the worse-case planning articulated in this highly classified military text is a significant and deeply troubling departure from China’s traditional thinking about the role of nuclear weapons. Mao Zedong famously called nuclear weapons “a paper tiger.” Many assumed he was being cavalier about the consequences of nuclear war. But what he meant is that they would not be used to fight and win wars. U.S. nuclear threats during the Korean War and the Taiwan Strait Crisis in the 1950s – threats not followed by an actual nuclear attack – validated Mao’s intuition that nuclear weapons were primarily psychological weapons. Chinese leaders decided to acquire nuclear weapons to free their minds from what Mao’s generation called “**nuclear** **blackmail**.” A former director of China’s nuclear weapons laboratories told me China developed them so its leaders could “sit up with a straight spine.” Countering nuclear blackmail – along with compelling other nuclear weapons states to negotiate their elimination – were the only two purposes Chinese nuclear weapons were meant to serve. Contemporary Chinese military planners appear to have added a new purpose: compelling the United States to halt a conventional attack. Even though it only applies in extreme circumstances, it **increases** the **risk** **that** a **war** between the United States and China **will** **end** **in** a nuclear exchange with unpredictable and **catastrophic** **consequences**. Adding this new purpose could also be the first step on a slippery slope to an incremental broadening the role of nuclear weapons in Chinese national security policy. Americans would be a lot safer if we could avoid that. The United States government should applaud China’s no first use policy instead of repeatedly calling it into question. And it would be wise to adopt the same policy for the United States. If both countries declared they would never use nuclear weapons first it may not guarantee they can avoid a nuclear exchange during a military crisis, but it would make one far less likely.

## 3

#### Text – Private Appropriation of Outer Space except for Space Elevators is Unjust.

#### Space Elevators constitute Appropriation – they impede orbits.

Matignon 19 Louis de Gouyon Matignon 3-3-2019 "LEGAL ASPECTS OF THE SPACE ELEVATOR TRANSPORTATION SYSTEM" <https://www.spacelegalissues.com/space-law-legal-aspects-of-the-space-elevator-transportation-system/> [PhD in space law (co-supervised by both Philippe Delebecque, from Université Paris 1 Panthéon-Sorbonne, France, and Christopher D. Johnson, from Georgetown University || regularly write articles on the website Space Legal Issues so as to popularise space law and public international law]//Elmer

An Earth-based space elevator would consist of a cable with one end attached to the surface near the equator and the other end in space beyond geostationary orbit. An orbit is the curved path through which objects in space move around a planet or a star. The 1967 Treaty’s regime and customary law enshrine the principle of non-appropriation and freedom of access to orbital positions. Space Law and International Telecommunication Laws combined to protect this use against any interference. The majority of space-launched objects are satellites that are launched in Earth’s orbit (a very small part of space objects – scientific objects for space exploration – are launched into outer space beyond terrestrial orbits). It is important to precise that an orbit does not exist: satellites describe orbits by obeying the general laws of universal attraction. Depending on the launching techniques and parameters, the orbital trajectory of a satellite may vary. Sun-synchronous satellites fly over a given location constantly at the same time in local civil time: they are used for remote sensing, meteorology or the study of the atmosphere. Geostationary satellites are placed in a very high orbit; they give an impression of immobility because they remain permanently at the same vertical point of a terrestrial point (they are mainly used for telecommunications and television broadcasting). A geocentric orbit or Earth orbit involves any object orbiting Planet Earth, such as the Moon or artificial satellites. Geocentric (having the Earth as its centre) orbits are organised as follow: 1) Low Earth orbit (LEO): geocentric orbits with altitudes (the height of an object above the average surface of the Earth’s oceans) from 100 to 2 000 kilometres. Satellites in LEO have a small momentary field of view, only able to observe and communicate with a fraction of the Earth at a time, meaning a network or constellation of satellites is required in order to provide continuous coverage. Satellites in lower regions of LEO also suffer from fast orbital decay (in orbital mechanics, decay is a gradual decrease of the distance between two orbiting bodies at their closest approach, the periapsis, over many orbital periods), requiring either periodic reboosting to maintain a stable orbit, or launching replacement satellites when old ones re-enter. 2) Medium Earth orbit (MEO), also known as an intermediate circular orbit: geocentric orbits ranging in altitude from 2 000 kilometres to just below geosynchronous orbit at 35 786 kilometres. The most common use for satellites in this region is for navigation, communication, and geodetic/space environment science. The most common altitude is approximately 20 000 kilometres which yields an orbital period of twelve hours. 3) Geosynchronous orbit (GSO) and geostationary orbit (GEO) are orbits around Earth at an altitude of 35 786 kilometres matching Earth’s sidereal rotation period. All geosynchronous and geostationary orbits have a semi-major axis of 42 164 kilometres. A geostationary orbit stays exactly above the equator, whereas a geosynchronous orbit may swing north and south to cover more of the Earth’s surface. Communications satellites and weather satellites are often placed in geostationary orbits, so that the satellite antennae (located on Earth) that communicate with them do not have to rotate to track them, but can be pointed permanently at the position in the sky where the satellites are located. 4) High Earth orbit: geocentric orbits above the altitude of 35 786 kilometres. The competing forces of gravity, which is stronger at the lower end, and the outward/upward centrifugal force, which is stronger at the upper end, would result in the cable being held up, under tension, and stationary over a single position on Earth. With the tether deployed, climbers could repeatedly climb the tether to space by mechanical means, releasing their cargo to orbit. Climbers could also descend the tether to return cargo to the surface from orbit.

#### Private Companies are pursuing Space Elevators.

Alfano 15 Andrea Alfano 8-18-2015 “All Of These Companies Are Working On A Space Elevator” <https://www.techtimes.com/articles/77612/20150818/companies-working-space-elevator.htm> (Writer at the Tech Times)//Elmer

Space elevators are solid proof that any mundane object sounds way cooler if you stick the word "space" in front of it. But there's much more than coolness at stake when building a space elevator – this technology has the potential to revolutionize space transportation, and the Canadian private space company Thoth Technology that was recently awarded a patent for its space elevator design isn't the only company in the game. One of the other major players is a U.S.-based company called LiftPort Group, founded by space entrepreneur Michael Laine in 2003. Its plan for a space elevator is vastly different from the one for which Thoth received a patent, however. Whereas Thoth's plans entail tethering a 12-mile-high inflatable space elevator to the Earth, LiftPort is shooting for the moon. Originally, LiftPort had planned to build an Earth elevator, too, but it abandoned the idea in 2007 in favor of building a lunar elevator. The basic design for a lunar elevator is an anchor in the moon that is attached to a cable that extends to a space station situated at a very special point. Known as a Lagrange Point, this is the gravitational tipping point between the Earth and the moon, where their gravitational pulls essentially cancel one another out. A robot could then travel up and down the tether, ferrying cargo between the moon and the station. Out farther in space, a counterweight would balance out the system. Both types of space elevator are intended to increase space access, but in very different ways. Thoth's Earth elevator aims to make launches easier by starting off 12 miles above the Earth's surface. LiftPort's space elevator aims to increase access to the moon in particular, because it is much easier to launch a rocket to the Lagrange Point and dock it at a space station than it is to get to the moon directly. There's a third major company based in Japan called Obayashi Corp. whose plans look like a hybrid of Thoth's and LiftPort's. Obayashi is not a space company, however – it's actually a construction company. Like Thoth, Obayashi plans to build an Earth elevator. But its Earth elevator would consist of a cable tethered to the blue planet, a robotic cargo-carrier, a space station, and a counterweight. It essentially looks like LiftPort's plans, but stuck to the Earth instead of to the moon.

#### Yes Space Elevators – NASA confirms.

Snowden 18 Scott Snowden 10-2-2018 "A colossal elevator to space could be going up sooner than you ever imagined" <https://www.nbcnews.com/mach/science/colossal-elevator-space-could-be-going-sooner-you-ever-imagined-ncna915421> (Scott has written about science and technology for 20 years for publications around the world. He covers environmental technology for Forbes.)//Elmer

For more than half a century, rockets have been the only way to go to space. But in the not-too-distant future, we may have another option for sending up people and payloads: a colossal elevator extending from Earth’s surface up to an altitude of 22,000 miles, where geosynchronous satellites orbit. NASA says the basic concept of a space elevator is sound, and researchers around the world are optimistic that one can be built. The Obayashi Corp., a global construction firm based in Tokyo, has said it will build one by 2050, and China wants to build one as soon as 2045. Now an experiment to be conducted soon aboard the International Space Station will help determine the real-world feasibility of a space elevator. “The space elevator is the Holy Grail of space exploration,” says Michio Kaku, a professor of physics at City College of New York and a noted futurist. “Imagine pushing the ‘up’ button of an elevator and taking a ride into the heavens. It could open up space to the average person.”

#### Regardless of completion, Elevators spur investment in Nanotechnology

Liam O’Brien 16. University of Wollongong. 07/2016. “Nanotechnology in Space.” Young Scientists Journal; Canterbury, no. 19, p. 22.

Nanotechnology is at the forefront of scientific development, continuing to astound and innovate. Likewise, the space industry is rapidly increasing in sophistication and competition, with companies such as SpaceX, Blue Origin and Virgin Galactic becoming increasingly prevalent in what could become a new commercial space race. The various space programs over the past 60 years have led to a multitude of beneficial impacts for everyday society. Nanotechnology, through research and development in space has the potential to do the same. Potential applications of nanotechnology in space are numerous, many of them have the potential to capture and inspire generations to come. One of these applications is the space elevator. By using carbon nanotubes, a super light yet strong material, this concept would be an actual physical structure from the surface of the Earth to an altitude of approximately 36 000 km. The tallest building in the world would fit into this elevator over 42 000 times. The counterweight, used to keep the elevator taught, is proposed to be an asteroid. This would need to be at a distance of 100 000 km, a quarter of the distance to the moon. The benefits of such a structure would be enormous. 95% of a space shuttle's weight at take-off is fuel, costing US$ 20 000 per kilogram to send something into space. However, with a space elevator the cost per kilogram can be reduced to as little as US$ 200. Exploration to other planets can begin at the tower, and travel to and from the moon could become as simple as a morning commute to work. Solar sails provide the means to travel large distances and incredible speeds. Much like sails on a boat use wind, the solar sail uses light as a source of propulsion. Ideally these sails would be kilometres in length and only a few micrometres in thickness. This provides us with the ability to travel at speeds previously unheard of. Using carbon nanotubes once again, a solar sail has the capability to travel at 39 756 km/s which is 13% of the speed of light! This sail could reach Pluto in an astonishing 1.7 days, and Alpha Centauri in just 32 years. Space travel to other planets, other stars, could be possible with solar sails. The Planetary Society is funding for a space sail of itself, and has successfully launched one into orbit. NASA has also sent a sail into orbit, allowing it to burn up in the atmosphere after 240 days. Investing time and resources into nanotechnology for space exploration has benefits for society today. Materials such as graphene are being used in modern manufacturing at an increasing rate as the applications become utilised. Carbon nanotubes will change the way we think about materials and their strength. These nanotubes have a tensile strength one hundred times that of steel, yet are only a sixth of the weight. Imagine light weight vehicles using less petrol and energy as well as being just as strong as regular vehicles. With potentials to revolutionize the way we think about space travel, nanotechnology has a bright future. As a new field of science, it has the capability to push the human race to the outer reaches of our galaxy and hopefully one day to other stars. It will inspire generations of explorers and dreamers to challenge themselves and advance the human race into the next era. As Richard Feynman said in his 1959 talk 'There's Plenty of Room at the Bottom' "A field in which little has been done, but in which an enormous amount can be done. There is still plenty more to achieve.

#### Nano tech solves warming

Bhavya Khullar. September 4, 2017. Nanomaterials Could Combat Climate Change and Reduce Pollution. https://www.scientificamerican.com/article/nanomaterials-could-combat-climate-change-and-reduce-pollution/

The list of environmental problems that the world faces may be huge, but some strategies for solving them are remarkably small. First explored for applications in microscopy and computing, nanomaterials—materials made up of units that are each thousands of times smaller than the thickness of a human hair—are emerging as useful for tackling threats to our planet’s well-being. Scientists across the globe are developing nanomaterials that can efficiently use carbon dioxide from the air, capture toxic pollutants from water and degrade solid waste into useful products. “Nanomaterials could help us mitigate pollution. They are efficient catalysts and mostly recyclable. Now, they have to become economical for commercialization and better to replace present-day technologies completely,” says [Arun Chattopadhyay](http://www.iitg.ac.in/arun/), a member of the chemistry faculty at the Center for Nanotechnology, Indian Institute of Technology Guwahati. To help slow the climate-changing rise in atmospheric CO2levels, researchers have developed nanoCO2 harvesters that can suck atmospheric carbon dioxide and deploy it for industrial purposes. “Nanomaterials can convert carbon dioxide into useful products like alcohol. The materials could be simple chemical catalysts or photochemical in nature that work in the presence of sunlight,” says Chattopadhyay, who has been working with nanomaterials to tackle environmental pollutants for more than a decade. Many research groups are working to address a problem that, if solved, could be a holy grail in combating climate change: how to pull CO2 out of the atmosphere and convert it into useful products. Chattopadhyay isn’t alone. Many research groups are working to address a problem that, if solved, could be a holy grail in combating climate change: how to pull CO2 out of the atmosphere and convert it into useful products. Nanoparticles offer a promising approach to this because they have a large surface-area-to-volume ratio for interacting with CO2 and properties that allow them to facilitate the conversion of CO2into other things. The challenge is to make them economically viable. Researchers have tried everything from metallic to carbon-based nanoparticles to reduce the cost, but so far they haven’t become efficient enough for industrial-scale application. One of the most recent points of progress in this area is work by scientists at the CSIR-Indian Institute of Petroleum and the Lille University of Science and Technology in France. The researchers developed a nanoCO2 harvester that uses water and sunlight to convert atmospheric CO2 into methanol, which can be employed as an engine fuel, a solvent, an antifreeze agent and a diluent of ethanol. Made by wrapping a layer of modified graphene oxide around spheres of copper zinc oxide and magnetite, the material looks like a miniature golf ball, captures CO2 more efficiently than conventional catalysts and can be readily reused, according to Suman Jain, senior scientist of the Indian Institute of Petroleum, Dehradun in India, who developed the nanoCO2harvester. Jain says that the nanoCO2 harvester has a large molecular surface area and captures more CO2 than a conventional catalyst with similar surface area would, which makes the conversion more efficient. But due to their small size, the nanoparticles have a tendency to clump up, making them inactive with prolonged use. Jain adds that synthesizing useful nanoparticle-based materials is also challenging because it’s hard to make the particles a consistent size. Chattopadhyay says the efficiency of such materials can be improved further, providing hope for useful application in the future. CLEANSING WATER Most toxic dyes used in textile and leather industries can be captured with nanoparticles. “Water pollutants such as dyes from human-created waste like those from tanneries could get to natural sources of water like deep tube wells or groundwater if wastewater from these industries is left untreated,” says Chattopadhyay. “This problem is rather difficult to solve.” An international group of researchers led by professor Elzbieta Megiel of the University of Warsaw in Poland reports that nanomaterials have been widely studied for removing heavy metals and dyes from wastewater. According to the research team, adsorption processes using materials containing magnetic nanoparticles are highly effective and can be easily performed because such nanoparticles have a large number of sites on their surface that can capture pollutants and don’t readily degrade in water. Chattopadhyay adds that appropriately designed magnetic nanomaterials can be used to separate pollutants such as arsenic, lead, chromium and mercury from water. However, the nanotech-based approach has to be more efficient than conventional water purification technology to make it worthwhile. In addition to removing dyes and metals, nanomaterials can also be used to clean up oil spills. Researchers led by Pulickel Ajayan at Rice University in Houston, Texas, have developed a reusable nanosponge that can remove oil from contaminated seawater.

#### Warming causes Extinction

Kareiva 18, Peter, and Valerie Carranza. "Existential risk due to ecosystem collapse: Nature strikes back." Futures 102 (2018): 39-50. (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)//Re-cut by Elmer

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 c**hallenges 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.

#### Nanotech solves

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The current status of disease and death is staggering. We do know that in the documented world 56 million people die every year. Dissecting the statistics of disease provided by the World Health Organization is overwhelming to weed through. There is a solution. Or there may be in the future. One day there could be a cure for all disease, and you may be able to live forever, in a healthy youthful state. One day it may be possible that scientists will be able to create nanorobots using nanotechnology. Nanotechnology is the ability to see and move atoms around. Everything is made of atoms, the chair you are sitting in, your food, your body, the air we breathe, everything. Atoms are so small they cannot be seen by the human eye. Atoms are on the nanoscale, that's a teeny, tiny size. There are 25,400,000 nanometers in an inch, a sheet of newspaper is 100,000 nanometers thick, human hair is about 80,000 nanometers in diameter. Atoms are the building blocks. Different atoms, arranged in different ways, make molecules that make the different things you see and experience. In the human body atoms come together to make many things, for example water, fats, hair, bones, and DNA. DNA and other molecules build cells; sometimes cells malfunction and cause disease. Where does nanotechnology fit in? That's a self realizing question, that's how, it fits in! Think of it this way, if you were King Kong, could you grab one grain of sand easily? Your hands would be too big. That's how medicine is currently treating disease. Nanotechnology is on the same size and scale as disease. A nanorobot can grab a cell and repair it. This will allow us to cure diseases that have never been cured before. Nanorobots could be released into the blood stream via pill or injection to find and repair damage and then break down and disintegrate. Or nanorobots could remain in the body at all times, perpetually monitoring, identifying and repairing problems immediately, without any external treatment. Nanorobots would cure the aliment so early on that you would never even know you were going to get sick. Chemotherapy releases toxic chemicals throughout the entire body rather than just the affected area, such as a tumor. This process destroys the cancer but also the immune system. Chemotherapy makes patients very sick, and there is risk of permanent damage or death from the treatment itself. There is also a risk of the cancer returning. A nanorobot could have radiation inside of it, locate the tumor, inject it and destroy it directly. Molecular nanorobots wouldn't leave one cancerous cell behind. That's one of the benefits of getting down to the molecular level. Doctors cannot see on the molecular level and could easily miss some cancer cells, which is often the case and the cancer returns. A nanotech gene therapy has successfully killed ovarian cancer in mice; if successful in human clinical trials it could save the lives of 15000 women a year. But it doesn't stop with cancer. Every disease is made out of the same atoms that everything else is. All medical conditions are a result of atoms being out of place; a nanorobot could put them back where they belong, thus immediately alleviating the problem without the side effects that current day medication and treatments cause. What else can be repaired in the human body? EVERYTHING. From cancer to the common cold. There is nothing that nanotechnology could not repair. The injuries or illnesses you have right now will have the capability to be repaired or cured by nanotechnology. Nanotechnology could eliminate diseases, disabilities, and illnesses such as diabetes, malaria, HIV, cardiovascular disease, damage from injuries and accidents, heal wounds, reduce child mortality, regenerate limbs and organs, eliminate inflammatory/infectious diseases, and so on and so forth. Nanotechnology offers hope to people suffering from Alzheimer’s, Parkinson's, brain injuries, tumors and neurological disorders. Nanoconstructs could deliver neuroprotective molecules directly to the brain to recover or protect nerve cells from damage or degeneration. Nanotechnology has been emerging in this field in the form of nanoengineered scaffolds that could one day result in a tool for rewiring the intricate neuronal network. Research by Dr. Samuel I. Stupp designed molecules using nanomaterials and injected them into mice who were paralyzed due to spinal cord injury. After 6 weeks the mice regained the ability to walk. Research like this could one day evolve into real cures for people. 65 billion dollars is wasted every year due to low bioavailability. Meaning that the drug or treatment used is not absorbed into or accessed by the body properly due to a multitude of reasons. For example drug interactions, different molecular arrangements and manufacturing processes by different brands. Drugs with more moisture may form lumps in the stomach which decreases absorption, and a highly compressed pill will slow absorption. Different level changes in the body at any given time may cause drug toxicity. Metabolism, age, activity, stress, previous surgery and syndromes are also factors. These are huge challenges that can be alleviated by using nanotechnology to target the specific areas. Nanorobots can take their cues from mother nature; she is the first nanotechnologist. She is an expert at creating molecular machines. Geneticists have been taking advantage of viruses for use in gene therapy for some time. They modify a virus by removing the viral gene so it doesn't cause disease. They replace it with healthy genes to transport to the faulty cell and cure diseases. This strategy of hacking viruses could be exploited by nanotech. Viruses are biological molecular machines that could be modified into becoming nanorobots or they could become transportation for a nanorobot. Another means is a nanorobot could attach itself to a traveling white blood cell and ride shotgun to assist in the tissue repair of injured tissue. Nanotechnology could even be involved in tissue engineering, creating scaffolds for artificial organs and implants. Tissue from your own body could be used to make new tissue, which assures that your body doesn't reject it. The surgeries of today are painful, costly, can leave scars and can even be life threatening. Repairing nanorobots would eliminate the need for surgeries, incisions, side effects and recovery time. According to the American Academy of Periodontology there are links to poor dental health and stroke, heart disease, respiratory disease, osteoporosis, some cancers and diabetes. Nanorobots as nanodentistry could repair damage without large needles or drills. Nanorobots could also constantly and invisibly maintain and clean your teeth to avoid any dental problems. Hygiene is important for good health; your skin and hair could be cleaned by nanorobots eliminating the need for showers. Spider bites and ticks carrying lyme disease would be detected by nanorobots, blocking penetration. Other skin problems such as eczema would be repaired by dermal nanorobots. Is aging a disease? Could aging be cured? Yes. Since nanorobots would be able to repair single cells on the molecular level they would be able to repair damages created by aging. It's all the same to a nanorobot. Nanotechnology could repair damaged cells. Dead cells are the primary reason for aging and death; nanorobots could replace senescent (old) cells with non-senescent cells, or reprogram cells so they do not senescensce, which would keep the body from aging. Not only would the inside of your body never get sick or age, but neither will the outside. Your skin will be young, elastic, dewy and wrinkle-free. Your hair will be thick, without gray, and intact. Your hearing, your eyesight and memory will be in perfect shape. You wouldn't get arthritis, turkey neck, or saggy parts. You could go out dancing when you are 93 and not worry about sore feet, low energy or suffering any consequences. Unless you party too hard, but that's on you, not the nano. So if you never get sick and never get old could you live forever? Yes. nanorobots could be programmed to rebuild older cells into younger copies on a regular basis thereby the human body could become immortal. You could live a disease-free youthful life, forever. Of course immortality isn't for everyone and everyone should have the right to decide what they want or don't want for their own body. Death will be a choice rather than a requirement. There are well funded countries that have access to researchers and high tech equipment that would love to figure out how to create the nanotechnology that will repair bodies and end disease. In the US despite having a lot of financial resources it's not always easy to get funding. If you are at a university, you need to write a grant, go through a lot of red tape, and there are a lot more near-term projects that seem to get prioritized when it comes to funding. For companies looking for investors, unfortunately not all investors can foresee the amazing future that nano will have because they are used to funding things they can see. For example a company that makes desks seeking an investor can show the investor the money they need for each piece of wood, bolt, and the quantity of desks that will be manufactured within a specific time frame. Nanotechnology is in development and isn't readily available like a piece of wood, the piece of wood has to be built. And the individual processes of each emerging development will have their own variables. Once the recipe has been figured out and formulated, the investment we have made will then be very inexpensive and easy to reproduce. Third world countries would have easy access to nanomedicine. Mother nature puts atoms together all the time and it doesn't cost her anything. The raw materials for making nanorobots would be essentially cost-free because they will be made mostly of carbon. Because nanotechnology would be created on the very small atomic level, traveling to provide treatment would not require large equipment. The size and portability would make treatment easily accessible across the world. The environment and living conditions also impact health. Since nanotechnology is on the atomic level and atoms are everywhere, it can be beneficial to the world all around us, as well as our bodies. Nanotechnology could enrich depleted soil in places like Africa, which is currently facing a food crisis. Vitamins, nutrients and minerals could be delivered to rebuild soil to a fertile state and thus have the ability to grow food. Hunger could one day be a solvable problem. Nanotechnology would make it possible to provide meat and animal products inexpensively without killing animals. E.coli and other pathogens could be detected in soil and eliminated so that food is not harmful. Currently nanomaterials are in development to release fertilizers for plants and nutrients for livestock, nano sensors for monitoring the health of crops and farm animals, and magnetic nanoparticles to remove soil contaminants. According to water.org 750 million people around the world lack access to safe water; approximately one in nine people. 840,000 people die each year from water-related disease. A portable non-chemical nano-filtration water purification device has been developed by Micheal Pritchard. It creates safe and sterile water out of dirty water and would make the cost of water per household an estimated 3 dollars a year. His company has provided clean water to countries who have gone through natural disasters, such as Haiti and the Philippines. In the future nanotechnology particles could destroy bacteria that often cause fatal disease. Pollution in general, global warming, nuclear waste, oil spills, smog, and acid rain, could be remedied and prevented by nanotechnological advances. Large quantities of nanorobots could come together to remove pollutant atoms from the atmosphere, earth and water. These groups of nanorobots could swim in contaminated waters and be released into the polluted atmosphere to destroy or remove contaminating molecules. Nanorobots could pull apart the bad molecules and reassemble the atoms into good molecules for other positive purposes. As a first indicator of the possibility, Brian Mercer created a new pollution control technology using nanofibres that greatly reduce industrial pollution by trapping and removing the pollutants. Currently nanotech is being used to reduce emissions from car fuels. Since nanotechnology builds atom by atom; the process is pollution free. Nanotechnology will not be manufactured in the way we use manufacturing plants today. There will be no chemical by product, no emission, hazardous waste and no pollution.