## asteroid mining da

#### Private entities are key to asteroid mining and fulfilling demand for rare earth elements

**Britt 21** (Hugo Britt, August 19, 2021, Companies Are Preparing for Space Mining, <https://www.thomasnet.com/insights/companies-are-preparing-for-space-mining/>) SJ

Rare Earth Materials Are Abundant. There are around two million near-earth asteroids brimming with rare earth minerals, precious metals, iron, and nickel. The Moon contains helium-3, yttrium, samarium, and lanthanum, while Mars contains an abundance of magnesium, aluminum, titanium, iron, chromium, and trace amounts of lithium, cobalt, tungsten, and other metals. Importantly, many planetary bodies contain water, which through hydrolysis can be used as rocket fuel. It Helps with Sustainability Earth’s resources are finite. [Non-renewable metal resources are inherently unsustainable](https://www.nature.com/articles/s43247-020-0011-0), and mining causes environmental degradation all over the world. The answer is to source our minerals off-world. Off-world minerals are exhaustible as well, but the argument is that mining lifeless rocks such as the Moon or asteroids is infinitely preferable to continuing to damage Earth’s fragile biosphere. Discoveries May Be Made Opening space to commercial mining does not mean that science takes a back seat. Space-mining interests could drive scientific advancement by discovering extremely rare or unknown minerals on other planetary bodies. Robotics Would Do the Work While countless lives have been lost on Earth over the centuries due to mining accidents and disasters, it is likely that humans will not have to risk their lives by traveling in-person to off-world mining sites. [Regolith-sampling probes](https://www.thomasnet.com/insights/nasa-uses-pogo-stick-probe-to-retrieve-sample-from-asteroid-that-may-one-day-hit-earth/) are already in use and provide an early glimpse of what a scaled-up robotic mining craft may one day look like. Off-Earth Mining and Space Law The [1967 Outer Space Treaty](https://www.thomasnet.com/insights/is-the-outer-space-treaty-outdated/) is unclear in terms of whether any country — or private company — can claim mineral rights in space. It states that “exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind.” The [1979 Moon Treaty](https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html) was an attempt to declare the Moon and its natural resources to be CHM (Common Heritage of Mankind). Significantly, it called for “an equitable sharing [by all countries] in the benefits derived from these resources.” Most nations, including the U.S., did not ratify this treaty. Recently, the U.S. has accelerated its efforts to create a legal framework for the exploitation of resources in space. The Obama administration signed the [U.S. Commercial Space Launch Competitiveness Act of 2015](https://www.faa.gov/about/office_org/headquarters_offices/ast/media/US-Commercial-Space-Launch-Competitiveness-Act-2015.pdf), allowing U.S. citizens to “engage in the commercial exploration and exploitation of space resources.” In April 2020, the Trump administration issued an [executive order](https://www.space.com/trump-moon-mining-space-resources-executive-order.html) supporting U.S. mining on the Moon and asteroids. In May 2020, NASA unveiled the [Artemis Accords](https://www.washingtonpost.com/technology/2020/05/15/moon-rules-nasa-artemis/), which included the development of safety zones around lunar mining sites. Former NASA administrator Jim Bridenstine said: “It’s time to establish the regulatory certainty to extract and trade space resources,” and clarified in a separate statement that: “We do believe we can extract and utilize the resources of the moon, just as we can extract and utilize tuna from the ocean.” NASA planned an [Asteroid Redirect Mission](https://www.nasa.gov/content/what-is-nasa-s-asteroid-redirect-mission) which involved collecting a multi-ton boulder from an asteroid and redirecting it into a stable orbit around the moon, but the mission was canceled in 2017. What Companies Are Preparing for a Future of Space Mining? One thing that is becoming clear is that off-earth mining is unlikely to be a state-run activity. Instead, several private companies are jockeying to be first in line to access minerals in space. [iSpace](https://ispace-inc.com/) (Japan) has a mission to “help companies access new business opportunities on the moon,” including the extraction of water and mineral resources to spearhead a space-based economy. Planetary Resources (defunct) was founded in 2009 with the goal of developing a robotic asteroid mining industry. Despite having high-profile founding investors including Alphabet’s Larry Page, Eric Schmidt, and Virgin Group founder Richard Branson, Planetary ran into financial trouble in 2018 and was gone by 2020. Deep Space Industries (defunct) was another early mover that intended to explore, examine, sample, and harvest minerals from asteroids. DSI was acquired by Bradford Space in 2019. [Offworld](https://www.offworld.ai/) is an AI company building “universal industrial robots to do the heavy lifting [including mining] on Earth, the Moon, asteroids, and Mars.” [The Asteroid Mining Corporation](https://asteroidminingcorporation.co.uk/) (UK) is a venture currently crowdfunding for a 2023 satellite mission called “El Dorado,” which will conduct a spectral survey of 5,000 asteroids to identify the most valuable for mining. Alongside the U.S., the tiny European nation of Luxembourg has also developed a space mining framework and has subsequently [emerged as a European hub](https://www.businesswire.com/news/home/20201118005699/en/) for the fledgling industry.

#### Space mining releases less emissions than Earth-based mining by a LOT

**Emerging Technology 18**, 10-19-2018, "Asteroid mining might actually be better for the environment," MIT Technology Review, <https://www.technologyreview.com/2018/10/19/139664/asteroid-mining-might-actually-be-better-for-the-environment/>]//pranav

But profit margins are only part of the picture. A potentially more significant aspect of these missions is the impact they will have on Earth’s environment. But nobody has assessed this environmental impact in detail. Today, that changes thanks to the work of Andreas Hein and colleagues at the University of Paris-Saclay in France. These guys have calculated the greenhouse-gas emissions from asteroid-mining operations and compared them with the emissions from similar Earth-based activities. Their results provide some eyebrow-raising insights into the benefits that asteroid mining might provide. The calculations are relatively straightforward. Rocket launches release significant amounts of greenhouse gases into the atmosphere. The fuel on board the first stage of a rocket burns in Earth’s atmosphere to form carbon dioxide. For kerosene-burning rockets, one kilogram of fuel creates three kilograms of CO2. (The second and third stages operate outside the Earth’s atmosphere and so can be ignored.) Reentries are just as damaging. That’s because a significant mass of a re-entering vehicle ablates in the upper atmosphere, producing NOx such as nitrous oxide (N2O), a greenhouse gas that is about 300 times more potent than CO2. By one estimate, the space shuttle released about 20% of its mass in the form of N2O every time it returned to Earth. Hein and co use these numbers to calculate that a kilogram of platinum mined from an asteroid would release some 150 kilograms of CO2 into Earth’s atmosphere. However, economies of scale from large asteroid-mining operations could lower this to about 60 kilograms of CO2 per kilogram of platinum. That needs to be compared with the emission from Earth-based mining. Here, platinum mining generates significant greenhouse gases, mostly from the energy it takes to remove this stuff from the ground. Indeed, the numbers are huge. The mining industry estimates that producing one kilogram of platinum on Earth releases around 40,000 kilograms of carbon dioxide. “The global warming effect of Earth-based mining is several orders of magnitude larger,” say Hein and co. The figures for water are also encouraging. In this case, the authors calculate the greenhouse-gas emissions from an asteroid-mining operation that returns water to anywhere within the moon’s orbit, a so-called cis-lunar orbit. They compare this to the emissions from sending the same volume of water from Earth into orbit. The big difference is that a water-carrying vehicle from Earth can haul only a small percentage of its mass as water. But an asteroid-mining spacecraft can transport a significant multiple of its mass as water to cis-lunar orbit. “Substantial savings in greenhouse gas emissions can be achieved,” say Hein and co. This interesting work should help to focus minds on the environmental impacts of mining, which are rapidly increasing in profile. But it is only a first step. There is significant uncertainty in the numbers here, so these will need to be better understood.

#### Commercial mining solves adaptation better

**Pelton 17**—(Director Emeritus of the Space and Advanced Communications Research Institute at George Washington University, PHD in IR from Georgetown). Pelton, Joseph N. 2017. The New Gold Rush: The Riches of Space Beckon! Springer. Accessed 8/30/19.

Are We Humans Doomed to **Extinction**? What will we do when Earth’s resources are used up by humanity? The world is now hugely **over populated**, with billions and billions crammed into our over**crowded** cities. By 2050, we may be 9 billion strong, and by 2100 well over 11 billion people on Planet Earth. Some at the United Nations say we might even be an amazing 12 billion crawling around this small globe. And over 80 % of us will be living in congested cities. These cities will be ever more vulnerable to **terror**ist attack, **natural disaster**, and other plights that come with overcrowding and a dearth of jobs that will be fueled by rapid automation and the rise of artifi cial intelligence across the global economy. We are already rapidly **running out of water** and **minerals**. **Climate change** is threatening our very **existence**. Political leaders and even the Pope have cautioned us against inaction. Perhaps the naysayers are right. **All humanity is at tremendous risk.** Is there no hope for the future? This book is about hope. We think that there is literally heavenly hope for humanity. But we are not talking here about divine intervention. We are envisioning a new space economy that recognizes that there is more water in the skies that all our oceans. Th ere is a new wealth of natural resources and clean energy in the reaches of outer space—more than most of us could ever dream possible. There are those that say why waste money on outer space when we have severe problems here at home? Going into space is not a waste of money. It is our future. It is our hope for new jobs and resources. The great challenge of our times is to reverse public thinking to see space not as a resource drain but as the doorway to opportunity. The new space frontier can literally open up a “gold rush in the skies.” In brief, we think there is new hope for humanity. We see a new a pathway to the future via new ventures in space. For too long, space programs have been seen as a money pit. In the process, we have overlooked the great abundance available to us in the skies above. It is important to recognize there is already the beginning of a new gold rush in space—a pathway to astral abundance. “New Space” is a term increasingly used to describe radical new commercial space initiatives—many of which have come from Silicon Valley and often with backing from the group of entrepreneurs known popularly as the “space billionaires.” New space is revolutionizing the space industry with lower cost space transportation and space systems that represent significant cost savings and new technological breakthroughs. “New Commercial Space” and the “New Space Economy” represent more than a new way of looking at outer space. These new pathways to the stars could prove vital to **human survival**. If one does not believe in spending money to probe the mysteries of the universe then perhaps we can try what might be called “calibrated greed” on for size. One only needs to go to a cubesat workshop, or to Silicon Valley or one of many conferences like the “Disrupt Space” event in Bremen, Germany, held in April 2016 to recognize that entrepreneurial New Space initiatives are changing everything [ 1 ]. In fact, the very nature and dimensions of what outer space activities are today have changed forever. It is no longer your grandfather’s concept of outer space that was once dominated by the big national space agencies. The entrepreneurs are taking over. The hopeful statements in this book and the hard economic and technical data that backs them up are more than a minority opinion. It is a topic of growing interest at the World Economic Forum, where business and political heavyweights meet in Davos, Switzerland, to discuss how to stimulate new patterns of global economic growth. It is even the growing view of a group that call themselves “space ethicists.” Here is how Christopher J. Newman, at the University of Sunderland in the United Kingdom has put it: Space ethicists have offered the view that space exploration is not only desirable; it is a duty that we, as a species, must undertake in order to secure the survival of humanity over the longer term. Expanding both the resource base and, eventually, the habitats available for humanity means that any expenditure on space exploration, far from being viewed as frivolous, can legitimately be rationalized as an ethical investment choice. (Newman) On the other hand there are space ethicists and space exobiologists who argue that humans have created ecological ruin on the planet—and now space debris is starting to pollute space. Th ese countervailing thoughts by the “no growth” camp of space ethicists say we have no right to colonize other planets or to mine the Moon and asteroids—or at least no right to do so until we can prove we can sustain life here on Earth for the longer term. However, for most who are planning for the new space economy the opinion of space philosophers doesn’t really fl oat their boat. Legislators, bankers, and aspiring space entrepreneurs are far more interested in the views of the super-rich capitalists called the space billionaires. A number of these billionaires and space executives have already put some very serious money into enterprises intent on creating a new pathway to the stars. No less than five billionaires with established space ventures—Elon Musk, Paul Allen, Jeff Bezos, Sir Richard Branson, and Robert Bigelow—have invested millions if not billions of dollars into commercializing space. They are developing **new tech**nologies and establishing space enterprises that can bring the wealth of outer space down to Earth. This is not a pipe dream, but will increasingly be the **economic reality** of the 2020s. These wealthy space entrepreneurs see major new economic opportunities. To them space represents the last great frontier for enterprising pioneers. Th us they see an ever-expanding space frontier that offers opportunities in low-cost space transportation, satellite solar power satellites to produce clean energy 24h a day, space mining, space manufacturing and production, and eventually space habitats and colonies as a trajectory to a better human future. Some even more visionary thinkers envision the possibility of terraforming Mars, or creating new structures in space to protect our planet from cosmic hazards and even raising Earth’s orbit to escape the rising heat levels of the Sun in millennia to come. **Some**, of course, will say this is **sci-fi hogwash**. It can’t be done. We say that this is what people would have said in 1900 about air**planes**, rocket ships, cell phones and nuclear devices. The skeptics **laughed** at **Columbus** and his plan to sail across the oceans to discover new worlds. When Thomas Jefferson bought the Louisiana Purchase from France or Seward bought Alaska, there were plenty of naysayers that said such investment in the unknown was an extravagant waste of money. A healthy skepticism is useful and can play a role in economic and business success. Before one dismisses the idea of an impending major new space economy and a new gold rush, it might useful to see what has already transpired in space development in just the past five decades. The world’s first geosynchronous communications satellite had a throughput capability of about 500 kb / s. In contrast, today’s state of the art Viasat 2 —a half century later— has an impressive throughput of some 140 Gb/s. Th is means that the relative throughput is nearly 300,000 greater, while its lifetime is some ten times longer (Figs. 1.1 and 1.2 ). Each new generation of communications satellite has had more power, better antenna systems, improved pointing and stabilization, and an extended lifetime. And the capabilities represented by remote sensing satellites , meteorological satellites , and navigation and timing satellites have also expanded their capabilities and performance in an impressive manner. When satellite applications first started, the market was measured in millions of dollars. Today commercial satellite services exceed a quarter of a billion dollars. Vital services such as the Internet, aircraft traffi c control and management, international banking, search and rescue and much, much more depend on application satellites. Th ose that would doubt the importance of satellites to the global economy might wish to view on You Tube the video “If Th ere Were a Day Without Satellites?” [ 2 ]. Let’s check in on what some of those very rich and smart guys think about the new space economy and its potential. (We are sorry to say that so far there are no female space billionaires, but surely this, too, will come someday soon.) Of course this twenty-fi rst century breakthrough that we call the New Space economy will not come just from new space commerce. It will also come from the amazing new technologies here on Earth. Vital new terrestrial technologies will accompany this cosmic journey into tomorrow. Information technology, robotics, **a**rtificial **i**ntelligence and commercial space travel systems have now set us on a course to allow us humans to harvest the amazing riches in the skies—new natural resources, new energy, and even totally new ways of looking at the **purpose of human existence**. If we pursue this course steadfastly, it can be the beginning of a New Space renaissance. But if we don’t seek to realize our **ultimate destiny** in space, Homo sapiens can end up in the **dustbin of history**—just like literally **millions of already failed species**. In each and every one of the five mass extinction events that have occurred over the last 1.5 billion years on Earth, some 50–80 % of all species have gone the way of the **T. Rex**, the **woolly mammoth**, and the **Dodo bird** along with extinct **ferns**, **grasses** and **cacti**. On the other hand, the best days of the human race could be just beginning. If we are smart about how we go about discovering and using these riches in the skies and applying the best of our new technologies, it could be the start of a new beginning for humanity. Konstantin Tsiokovsky, the Russian astronautics pioneer, who fi rst conceived of practical designs for spaceships, famously said: “A planet is the cradle of mankind, but one cannot live in a cradle forever.” Well before Tsiokovsky another genius, Leonardo da Vinci, said, quite poetically: “Once you have tasted flight, you will forever walk the earth with your eyes turned skyward, for there you have been, and there you will always long to return.” The founder of the X-Prize and of Planetary Resources, Inc., Dr. Peter Diamandis, has much more brashly said much the same thing in quite diff erent words when he said: “The meek shall inherit the Earth. The rest of us will go to Mars.” The New Space Billionaires Peter Diamandis is not alone in his thinking. From the list of “visionaries” quoted earlier, Elon Musk, the founder of SpaceX; Sir Richard Branson, the founder of Virgin Galactic; and Paul Allen, the co-founder of Microsoft and the man who financed SpaceShipOne, the world’s first successful spaceplane have all said the future will include a vibrant new space economy. Th ey, and others, have said that we can, we should and we soon shall go into space and realize the bounty that it can offer to us. Th e New Space enterprise is today indeed being led by those so-called space billionaires , who have an exciting vision of the future. They and others in the commercial space economy believe that the exploitation of outer space may open up a new golden age of astral abundance. They see outer space as a new frontier that can be a great source of new materials, energy and various forms of new wealth that might even save us from excesses of the past. Th is gold rush in the skies represents a new beginning. We are not talking about expensive new space ventures funded by NASA or other space agencies in Europe, Japan, China or India. No, these eff orts which we and others call New Space are today being forged by imaginative and resourceful commercial entrepreneurs. Th ese twenty-fi rst century visionaries have the fortitude and zeal to look to the abundance above. New breakthroughs in technology and New Space enterprises may be able to create an “astral life raft” for humanity. Just as Columbus and the Vikings had the imaginative drive that led them to discover the riches of a new world, we now have a cadre of space billionaires that are now leading us into this New Space era of tomorrow. These **bold leaders**, such as **Paul Allen** and Sir **Richard Branson**, plus other space entrepreneurs including **Jeff Bezos of Amazon** and **Blue Origin**, and **Robert Bigelow**, Chairman of Budget Suites and Bigelow Aerospace, not only dream of their future in the space industry but also have **billions** of dollars in assets. These are the **bright stars of an entirely new industry** that are leading us into the age of New Space commerce. These space billionaires, each in their own way, are proponents of a new age of astral abundance. Each of them is launching new commercial space industries. They are literally transforming our vision of tomorrow. These new types of entrepreneurial aerospace companies—the New Space enterprises—give new hope and new promise of transforming our world as we know it today. The New Space Frontier What happens in space in the next few decades, plus corresponding new information technologies and advanced robotics, will change our world forever. These changes will redefi ne wealth, change our views of work and employment and upend almost everything we think we know about economics, wealth, jobs, and politics. Th ese changes are about truly disruptive technologies of the most fundamental kinds. If you thought the Internet, smart phones, and spandex were disruptive technologies, just hang on. You have not seen anything yet. In short, if you want to understand a transition more fundamental than the changes brought to the twentieth century world by computers, communications and the Internet, then read this book. There are truly riches in the skies. Near-Earth asteroids largely composed of platinum and **rare earth metals** have an incredible value. Helium-3 isotopes accessible in outer space could provide **clean and abundant energy**. There is far more water in outer space than is in our oceans. In the pages that follow we will explain the potential for a cosmic shift in our global economy, our ecology, and our commercial and legal systems. These can take place by the end of this century. And if these changes do not take place we will be in trouble. Our conventional petro-chemical energy systems will fail us economically and eventually blanket us with a hydrocarbon haze of smog that will threaten our health and our very survival. Our rare precious metals that we need for modern electronic appliances will skyrocket in price, and the struggle between “haves” and “have nots” will grow increasingly **ugly**. A lack of affordable and readily available **water**, natural **resources**, **food**, **health care** and medical supplies, plus systematic threats to **urban security** and **systemic war**fare are the alternatives to astral abundance. The choices between astral abundance and a downward spiral in global standards of living are stark. Within the **next few decades** these problems will be increasingly real. By then the world may almost be **begging** for new, out of- the-box thinking. International peace and security will be an indispensable prerequisite for exploitation of astral abundance, as will good government for all. No one nation can be rich and secure when everyone else is poor and insecure. In short, global space security and strategic space defense, mediated by global space agreements, are part of this new pathway to the future.

## solar power satellites da

#### [Horowitz] There is an energy crisis and its only going to get worse in the next couple months

**Horowitz 21** (Julia Horowitz, a senior writer. She leads CNN Business international coverage of global markets and business , October 7th, 2021, A global energy crisis is coming. There's no quick fix, CNN Business, <https://www.cnn.com/2021/10/07/business/global-energy-crisis/index.html>) SJ

A global energy crunch caused by weather and a resurgence in demand is getting worse, stirring alarm ahead of the winter, when more energy is needed to light and heat homes. Governments around the world are trying to limit the impact on consumers, but acknowledge they may not be able to prevent bills spiking. Further complicating the picture is mounting pressure on governments to accelerate the transition to cleaner energy as world leaders prepare for a critical climate summit in November. In China, [rolling blackouts](https://edition.cnn.com/2021/09/28/economy/china-power-shortage-gdp-supply-chain-intl-hnk/index.html) for residents have already begun, while in India power stations are scrambling for coal. [Consumer advocates in Europe](https://twitter.com/beuc/status/1445702126336761865?s=20) are calling for a ban on disconnections if customers can't promptly settle what they owe. "This price shock is an unexpected crisis at a critical juncture," EU energy chief Kadri Simson said Wednesday, confirming the bloc will outline its longer-term policy response next week. "The immediate priority should be to mitigate social impacts and protect vulnerable households." In Europe, natural gas is now trading at the equivalent of $230 per barrel, in oil terms — up more than 130% since the beginning of September and more than eight times higher than the same point last year, according to data from Independent Commodity Intelligence Services. In East Asia, the cost of natural gas is up 85% since the start of September, hitting roughly $204 per barrel in oil terms. Prices remain much lower in the United States, a net exporter of natural gas, but still have shot up to their highest levels in 13 years. "A lot of it is feeding off of fear about what the winter's going to look like," said Nikos Tsafos, an energy and geopolitics expert at the Center for Strategic and International Studies, a Washington-based think tank. He thinks that anxiety has caused the market to break away from the fundamentals of supply and demand. The frenzy to secure natural gas is also pushing up the price of coal and oil, which can be used as substitutes in some cases, but are even worse for the climate. India, which remains extremely dependent on coal, said this week that as many as 63 of its 135 coal-fired power plants have [two days or less](https://edition.cnn.com/2021/10/06/energy/india-energy-crisis-coal-hnk-intl/index.html) of supplies. The circumstances are causing central banks and investors to worry. Rising energy prices are contributing to inflation, which already was a major concern as the global economy tries to shake off the lingering effects of Covid-19. Dynamics over the winter could make matters worse.

#### [Stossel] Government space programs are ineffective at innovating

**Stossel 20** (John Stossel, July 29, 2020, The Private Space Race, <https://www.capitalismmagazine.com/2020/07/the-private-space-race/>) SJ

An Obama administration committee had concluded that launching such a vehicle would take 12 years and cost $36 billion. But this rocket was finished in half that time — for less than $1 billion (1/36th the predicted cost). That’s because it was built by Elon Musk’s private company, Space X. He does things faster and cheaper because he spends his own money. “This is the potential of free enterprise!” explains aerospace engineer Robert Zubrin in my newest video. Of course, years ago, NASA did manage to send astronauts to the moon. That succeeded, says Zubrin, “because it was purpose-driven. (America) wanted to astonish the world what free people could do.” But in the 50 years since then, as transportation improved and computers got smaller and cheaper, NASA made little progress. Fortunately, President Obama gave private companies permission to compete in space, saying, “We can’t keep doing the same old things as before.” Competition then cut the cost of space travel to a fraction of what it was. Why couldn’t NASA have done that? Because after the moon landing, it became a typical government agency — overbudget and behind schedule. Zubrin says NASA’s purpose seemed to be to “supply money to various suppliers.” Suppliers were happy to go along. Zubrin once worked at Lockheed Martin, where he once discovered a way for a rocket to carry twice as much weight. “We went to management, the engineers, and said, ‘Look, we could double the payload capability for 10% extra cost.’ They said, ‘Look, if the Air Force wants us to improve the Titan, they’ll pay us to do it!'” NASA was paying contractor’s development costs and then adding 10% profit. The more things cost, the bigger the contractor’s profit. So contractors had little incentive to innovate. Even NASA now admits this is a problem. During its 2020 budget request, Administrator Jim Bridenstine confessed, “We have not been good at maintaining schedule and … at maintaining costs.” Nor is NASA good at innovating. Their technology was so out of date, says Zubrin, that “astronauts brought their laptops with them into space — because shuttle computers were obsolete.” I asked, “When (NASA) saw that the astronauts brought their own computers, why didn’t they upgrade?” “Because they had an entire philosophy that various components had to be space rated,” he explains. “Space rating was very bureaucratic and costly.” NASA was OK with high costs as long as spaceships were assembled in many congressmen’s districts. “NASA is a very large job program,” says Aerospace lawyer James Dunstan. “By spreading its centers across the country, NASA gets more support from more different congressmen.” Congressmen even laugh about it. Randy Weber, R-Texas, joked, “We’ll welcome (NASA) back to Texas to spend lots of money any time.” Private companies do more with less money. One of Musk’s cost-saving innovations is reusable rocket boosters. For years, NASA dropped its boosters into the ocean. “Why would they throw it away?” I ask Dunstan. “Because that’s the way it’s always been done!” he replies. Twenty years ago, at Lockheed Martin, Zubrin had proposed reusable boosters. His bosses told him: “Cute idea. But if we sell one of these, we’re out of business.” Zubrin explains, “They wanted to keep the cost of space launch high.” Thankfully, now that self-interested entrepreneurs compete, space travel will get cheaper. Musk can’t waste a dollar. Space X must compete with Jeff Bezos’ Blue Origin, Richard Branson’s Virgin Galactic, Boeing, Lockheed Martin and others.The private sector always comes up with ways to do things that politicians cannot imagine. Government didn’t invent affordable cars, airplanes, iPhones, etc. It took competing entrepreneurs, pursuing profit, to nurture them into the good things we have now. Get rid of government monopolies.

#### [Snowden] Solar power satellites solves the energy crisis

**Snowden 19** (Scott Snowden, Mar 12, 2019, has written about science and technology for 20 years for publications around the world, Solar Power Stations In Space Could Supply The World With Limitless Energy, Forbes, <https://www.forbes.com/sites/scottsnowden/2019/03/12/solar-power-stations-in-space-could-supply-the-world-with-limitless-energy/?sh=23471fec4386> ) SJ

While on the surface of the Earth, society still struggles to adopt solar energy solutions, many scientists maintain that giant, space-based solar farms could provide an environmentally-friendly answer to the world's energy crisis. Only last week, we reported that China [was planning to](https://www.forbes.com/sites/scottsnowden/2019/03/05/china-plans-to-build-the-worlds-first-solar-power-station-in-space/#51f7f9c35c94) build the world's first solar power station to be positioned in Earth's orbit. Because the sun always shines in space, an orbital solar power station is seen as an inexhaustible source of clean energy. "Above the Earth, there's no day and night cycle and no clouds or weather or anything else that might obstruct the sun's ray, so a constant power source is available," said Ali Hajimiri, professor of electrical engineering at the California Institute of Technology and co-director of the university’s [Space Solar Power Project](https://www.spacesolar.caltech.edu/). Collecting solar power in space and wirelessly transmitting was first described by Isaac Asimov in 1941 in his short story Reason. In 1968, American aerospace engineer Peter Glaser published the first technical article on the concept – Power From The Sun: Its Future in the journal [Science](http://www.sciencemag.org/). Space-based solar power attracted considerable attention in the 1970s as the necessary individual technical components – in essence, photovoltaic cells, satellite technology and wireless power transmission – were developed. Despite the concept being technically feasible, it was considered economically unrealistic at the time and research ultimately stalled. “The idea seems to be going through a resurgence and it’s probably because the technology exists to make it happen,” said John Mankins, a former NASA scientist who was at the forefront of this field in the 1990s, before it was abandoned. Global energy demands are only going to grow, says Hajimiri. The global population is expected to reach a staggering 9.6 billion by 2050, according to a [United Nations report](http://www.un.org/en/development/desa/news/population/un-report-world-population-projected-to-reach-9-6-billion-by-2050.html), so methods of generating large quantities of clean energy must be found. A space-based solar power system could provide energy to everyone, even in places that don't receive sunlight all year round, like northern Europe and Russia. In April of 2015, a research agreement between Northrop Grumman and Caltech provided up to $17.5m for the development of innovations necessary to enable a space solar power system. Three Caltech professors head up the project: joining Hajimiri were Harry Atwater and Sergio Pellegrino. Caltech is just one institution working on developing this technology. We know that scientists at the Chongqing Collaborative Innovation Research Institute for Civil-Military Integration in China are constructing a facility to test the theoretical viability of the concept and plans to develop an orbital photovoltaic array [were announced](https://phys.org/news/2009-11-japan-eyes-solar-station-space.html) in Japan some time ago. One of the biggest issues to overcome is that of getting an array of solar panels large enough to make the project viable into orbit. Early concept designs in the 1970s featured giant arrays that would've proved very difficult to actually get into orbit. "The systems of the 70s for solar power satellites, the cost estimates suggested, at that time, that it might be as much as a trillion dollars to get to the first kilowatt hour because of the way the designs worked. Essentially a single satellite, a platform, an integrated, monolithic platform about the size of Manhattan," said Mankins.However, with SpaceX and Blue Origin slowly driving the cost of orbital delivery down, suddenly the concept seems a little closer to reality. "Going to modular systems to allow mass production, I believe was the answer to how to get solar power satellite costs down to something more reasonable," said Mankins.

#### [Klare] Energy crisis results in war

**Klare 14** (Micheal T Klare, July 15, 2014, Twenty-first century energy wars: how oil and gas are fuelling global conflicts, a Five Colleges professor of Peace and World Security Studies, <https://energypost.eu/twenty-first-century-energy-wars-oil-gas-fuelling-global-conflicts/>) SJ

As these conflicts and others like them suggest, fighting for control over key energy assets or the distribution of oil revenues is a [critical factor](http://www.tomdispatch.com/blog/175540/) in most contemporary warfare. While ethnic and religious divisions may provide the political and ideological fuel for these battles, it is the potential for mammoth oil profits that keeps the struggles alive. Without the promise of such resources, many of these conflicts would eventually die out for lack of funds to buy arms and pay troops. So long as the oil keeps flowing, however, the belligerents have both the means and incentive to keep fighting. In a fossil-fuel world, control over oil and gas reserves is an essential component of national power. “Oil fuels more than automobiles and airplanes,” Robert Ebel of the Center for Strategic and International Studies [told](http://2001-2009.state.gov/s/p/of/proc/tr/10187.htm) a State Department audience in 2002. “Oil fuels military power, national treasuries, and international politics.” Far more than an ordinary trade commodity, “it is a determinant of well being, of national security, and international power for those who possess this vital resource, and the converse for those who do not.” If anything, that’s even truer today, and as energy wars expand, the truth of this will only become more evident. Someday, perhaps, the development of renewable sources of energy may invalidate this dictum. But in our present world, if you see a conflict developing, look for the energy. It’ll be there somewhere on this fossil-fueled planet of ours.

#### [Dvorsky 12] Conventional War Causes Extinction

**Dvorsky 12** (George Dvorsky, [George P. Dvorsky is a Canadian bioethicist, transhumanist and futurist. He is a contributing editor at io9[1] and producer of the Sentient Developments blog and podcast. He was Chair of the Board for the Institute for Ethics and Emerging Technologies (IEET)[2][3] and is the founder and chair of the IEET's Rights of Non-Human Persons Program,[4] a group that is working to

Secure human-equivalent rights and protections for highly sapient animals. He also serves on the Advisory Council of METI (Messaging Extraterrestrial Intelligence], 12-12-2012, io9, "9 Ways Humanity Could Bring About Its Own Destruction", <https://io9.gizmodo.com/9-ways-humanity-could-bring-about-its-own-destruction-5967660>)

Given the incredible degree to which technology has advanced in the nearly seven decades since this war, it's reasonable to assume that the next global ‘conventional war' — i.e. one fought without

nuclear weapons — would be near apocalyptic in scope. The degree of human suffering that could be unleashed would easily surpass anything that came before it, with combatants using many of the technologies already described in this list, including autonomous killing machines and weaponized nanotechnology. And in various acts of desperation (or sheer malevolence),some belligerent nations could choose to unleash chemical and biological agents that would result in countless deaths. And like WWII, food could be used as a weapon; agricultural yields could be brought to a grinding halt.

## collaboration cp

#### CP text: we advocate for public-private partnerships in space in line with the ISS model or a sponsored program model

**ISS National Lab** [International Space Station National Laboratory – Center for the Advancement of Science in Space, “Research on the ISS, No Date, <https://www.issnationallab.org/research-on-the-iss/public-private-partnerships-in-space/>] //neth

Public-private partnerships are a key component to driving innovation and national leadership. With the potential to address a wide array of modern challenges from technology development to infrastructure modernization, and from education to the economic development of space, public-private partnerships unlock new possibilities unavailable when we rely solely on public or private investment. The International Space Station (ISS) National laboratory is a great example of a public-private partnership model that is working in space. The ISS National Lab opens up the incredible possibilities of the space station research environment to a diverse range of researchers, entrepreneurs, and innovators that could create entirely new markets in space. The ISS National Laboratory – Accelerating Utilization of the ISS The ISS offers a unique research and development platform, unlike any on Earth, enabling research that benefits both exploration and life on Earth. In an effort to expand the research opportunities this unparalleled platform provides to the nation, the ISS United States Orbital Segment, through bipartisan legislation, was designated as a U.S. National Laboratory in 2005, enabling research and development access to a broad range of commercial, academic, and government users. After final assembly of the ISS in 2011, the Center for the Advancement of Science in Space, a (501)(c)(3) organization, was selected by NASA to manage the ISS U.S. National Laboratory. The ISS National Lab fulfills its mission to accelerate space-based research by engaging a variety of nontraditional space users, operating in the fields of life science, physical science, technology development, and remote sensing. The ISS National Lab engages primarily with organizations that pay toward the value obtained on the ISS, as well as with other organizations addressing national science and research priorities. This research serves commercial and entrepreneurial needs and other important goals such as the pursuit of new knowledge and education. Since 2011, the ISS National Lab has stewarded more than 200 ISS research projects, ranging from developing new drug therapies, to monitoring tropical cyclones, to improving equipment for first-responders, to producing unique fiber-optics materials in space. Working together with NASA, the ISS National Lab aims to advance the nation’s leadership in commercial space, pursue groundbreaking science not possible on Earth, and leverage the space station to inspire the next generation. Prior to the ISS National Lab model, NASA traditionally funded all aspects of ISS research, whether it was research needed to further exploration, or discovery-based space research that expanded upon its scientific agenda. As the ISS evolved into a National Laboratory, the ISS National Lab has increased the diversity of users by accelerating utilization of the ISS as an innovation platform for a wide variety of partners. These include Fortune 500 organizations, small businesses, educational institutions, philanthropic and research foundations, federal and state government agencies, and other thought leaders in pursuit of groundbreaking technology and innovation who are interested in leveraging microgravity to solve complex research problems on Earth. The ISS National Lab plays a role in not only attracting a diverse set of users, including private companies, to utilize the ISS, but also in engaging the private sector through various research and cost-sharing arrangements. Sponsored Programs – Accelerating Third-Party Funding for Space Research. The ISS National Lab has developed a successful Sponsored Program model that attracts third-party funding from private industry and other government agencies to solve big problems or address target challenges. These programs translate into projects on the ISS National Lab. The Sponsored Program model enables an organization to ask new questions and explore key variables, using the ISS National Lab environment as a tool in their innovation portfolio. In return, the organization creates opportunities for targeted research and development projects and STEM education projects or fosters novel ideas of startup companies. Fortune 500 companies, government agencies, and regional incubators have successfully used the ISS National Lab Sponsored Program model. This unique research and development model is flexible to meet the needs and budget of a partnering organization. Successful Sponsored Programs include Boeing Mass Challenge, Massachusetts Life Sciences Center, National Science Foundation (NSF) fluid dynamics and combustion Sponsored Program, and the National Institutes of Health (NIH) National Center for Advancing Translational Sciences (NCATS) organ-on-chip technologies Sponsored Program, totaling more than $20 million in third-party funding over the last two years. Additional Sponsored Programs totaling close to $5 million in 2017 with Fortune 500 organizations are imminent and will target major challenges to humankind as well as STEM education initiatives.

#### Private organizations already have debris tracking technology – partnership would be the safest and most efficient

**Moore & van Burken 2021** [Adrian Moore, Vice President of Policy, and Rebecca van Burken, Policy Analyst, “As Commercial Space Travel Becomes Reality, Debris and Space Traffic Management Becomes More Important,” Reason Foundation, August 5, 2021, <https://reason.org/commentary/as-commerical-space-travel-becomes-reality-debris-and-space-traffic-management-becomes-more-important/>] //neth

With Richard Branson and Jeff Bezos soaring into suborbital space, three U.S. flights to the International Space Station (ISS) in July, and SpaceX delivering 88 satellites to orbit in the last six weeks, space traffic is surging. And this is just the beginning of increased commercial and governmental activity in space. August will see several more trips to the ISS and more launches of satellites. Additionally, the Biden administration signed an agreement with the European Space Agency to use more satellites to address climate change through earth science research. This increased space traffic serves a wide array of purposes and represents vast investments by the private space industry and government. But these investments are going to increasingly be jeopardized by the massive amount of space junk already circling Earth. There’s plenty of room to fly up there, but, believe it or not, NASA estimates there are already 23,000 pieces of debris larger than 10 centimeters and over 500,000 pieces of smaller junk in orbit. This space junk, or orbital debris, travels at high speeds and even a small piece can cause serious damage or destruction if it hits a spacecraft or satellite. The space debris includes thousands of dead and retired satellites, parts of spacecraft from decades of missions, items exploded in warfare testing, and more. Dodging space junk is a regular requirement for spacecraft in orbit. The International Space Station had to maneuver 25 times between 1999 and 2018 to avoid collisions, and it had to dodge debris three times in 2020. Monitoring this debris is going to be a major issue as private space travel and the space economy grow. In 2019, the global space economy amounted to about $366 billion. Of this, $271 billion was in the satellite industry and $123 billion was directly in satellite services. As the world increasingly becoming reliant on satellites U.S. and global satellite businesses bear the brunt of the failure to track and remove orbital debris. As Sen. John Hickenlooper (D-Colo.), chair of the Senate Commerce Committee’s Subcommittee on Science and Space, said recently, we need to be proactive on space debris “rather than learning by a terrible accident … but we don’t quite have the sense of urgency we need.” Urgency means committing to better space traffic management, and tracking and removing orbital debris. Orbital debris management is not well organized within the government. Right now, the Department of Defense (DOD) does most tracking of space debris for the U.S. out of the need to protect military satellites and national security interests. NASA has its own less advanced systems for tracking debris. However, orbital debris management is not just about tracking debris anymore. It is also about forming collision warning systems and safely managing traffic in space. To do this efficiently, we need a civil repository for all orbital debris components, something that many commercial space companies have already created on their own to stay aware of orbital debris and help protect their satellites in space. Tracking debris may be a national security priority, but providing space traffic control is not really in the Defense Department’s mission. We should be utilizing the private sector’s expertise and advancements in this area. For example, Astroscale has contracts with both the Japanese and European space agencies to develop orbital debris removal capability. And responsibility for developing collision warnings and space traffic management would be best suited for the Office of Space Commerce, an office with existing connections to the commercial space industry, NASA and DOD. Partnering with the debris tracking and removal systems private companies are developing while freeing up DOD to focus on military awareness and NASA to focus on research and development would be the most efficient way forward. If the government works with private industry through strategic public-private partnerships, the U.S. can best address the threats posed by orbital debris and create sustainable policies for safe space exploration.

#### Private collaboration with the USFG led to a legal framework that allows asteroid mining – solves the aff b/c it’s government regulated

**Marquez 2016** [Peter Marquez, Vice President – Global Engagement, Planetary Resources Inc., “Commercial space development spurs trend for public-private collaboration,” 2016, <https://room.eu.com/article/commercial-space-development-spurs-trend-for-public-private-collaboration>] //neth

The 1967 Outer Space Treaty (OST) provides the framework by which all nations utilise and operate in space. The OST is an incredibly forward-thinking document that has kept space a useful and peaceful environment since the beginning of the Space Age, and fostered a variety of space activities ranging from military to science to commercial operations. Whilst the OST describes the general concepts for responsible and peaceful use of space, the actual implementation and effect of the OST is found in domestic laws. Over time, many nations have developed their own laws to meet their OST obligations and have used the United Nations and other international forums to discuss the relationship between their respective domestic laws. For years the space law community debated whether the OST permitted a private company to own resources it obtained from an asteroid. Many in the community believed the right to own resources was inferred in the OST while others believed that it strictly forbade such ownership. In 2009, asteroid mining company Planetary Resources was formed and rapidly brought this decades old debate to the forefront. Recognising the value of having companies like Planetary Resources on its home territory, the US Government set out to determine the legality of asteroid resource ownership. In November 2015, the United States’ Congress passed carefully crafted legislation that recognised the right of private companies to own resources they obtain from asteroids and a few days later President Obama signed the legislation into law. Planetary Resources started this discussion and two years later we had this this momentous legal event. It was the culmination of thorough research and informative discussion between industry, government officials and the international community. The new US law is fully compliant with the OST and creates a stable foundation for a new industry. The legislative milestone passed in the United States was just the beginning. In February, the Government of Luxembourg announced its intent to foster a space resource utilisation industry. Luxembourg announced in June that it would implement a law that recognised the right of private companies to own space resources. Much of the legal discussion now is about implementation and the proper frameworks for space resource utilisation. What had been a decades-old debate of ‘can we?’ has now turned into a discussion of ‘how do we?’ In multilateral settings, there are new discussions about other countries adopting similar laws. The reason for the adoption of these laws is clear. The United States and Luxembourg are leading the discussion and creating a fertile environment for their nations to reap the benefits from supporting companies that are generating new technologies, access to scarce resources, scientific discoveries, employment and new sources of taxable revenue.

## Case

C1--

#### No guarantee space tourism ever becomes affordable enough for average people, until then it will be reserved for the rich and famous making the effects limited.

**Roulette 21** (Roulette, Joey. “The Space Tourism Industry Is Stuck In Its Billionaire Phase.” The Verge. July 17, 2021. Web. December 13, 2021. <https://www.theverge.com/2021/7/17/22573791/space-tourism-industry-bezos-branson-musk-billionaire-phase>.) SJ

“There’s going to be a fairly large learning curve as companies go from the process of developing a capability and testing it, to operating it routinely,” Christensen said. It’s possible that space tourism will follow the same path as computers or airplanes, but there’s no guarantee that it will succeed. In part, that’s because there’s no single solution to driving down the cost of launching people to space. Virgin Galactic earlier this year unveiled a new version of SpaceShipTwo that’s tailored for quick production rates, signaling it’s gearing up to accommodate its hefty customer backlog and reopen ticket sales, which have been closed since a fatal 2014 accident during a test flight. (Branson’s presence on Sunday’s flight also served as a visual reassurance to customers that the ship is safe.) Musk is focusing on better rocket fuel efficiency with SpaceX’s Starship, a fully reusable launch system being developed to slash the cost of sending humans to space. But again, what exactly those next-generation prices will be remain a mystery. Musk hasn’t said how much it’ll cost prospective passengers to fly on Starship. And Virgin Galactic hasn’t said how much it plans to charge for tickets for its newer spaceplane, SpaceShipThree, just like Blue Origin, which hasn’t revealed its New Shepard prices. Currently, you either have to be talented (hand-picked by a billionaire) or lucky to book a ride on one of these rockets without paying the steep price tag. Raffling off tickets, like Virgin Galactic plans to do, and donating seats to space enthusiasts who can’t afford them keeps the public dream of normalized, low-cost space travel alive while the industry races to find the right recipe for bringing prices down. “I think that in any competitive market you’re going to see products improve and/or prices drop,” Christensen added.

2—ca the mining disad—even if rocket launches do release emissions using rocket launches for asteorid mining results in significantly lower, nearly 300 times lower emissions than terrestrial mining’s

C2—

#### Too much debris exists in space now – that destroys satellites—means cp sovles better than aff

**Wall 21** [Mike Wall, Michael Wall is a Senior Space Writer with [Space.com](http://space.com/) and joined the team in 2010. He primarily covers exoplanets, spaceflight and military space. He has a Ph.D. in evolutionary biology from the University of Sydney, Australia, a bachelor's degree from the University of Arizona, and a graduate certificate in science writing from the University of California, Santa Cruz. 11/15/21, "Kessler Syndrome and the space debris problem," Space, [https://www.space.com/kessler-syndrome-space-debris accessed 12/10/21](https://www.space.com/kessler-syndrome-space-debris%20accessed%2012/10/21)] Adam

Earth orbit is getting more and more crowded as the years go by. Humanity has launched about 12,170 satellites since the dawn of the space age in 1957, [according to the European Space Agency](https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers) (ESA), and 7,630 of them remain in orbit today — but only about 4,700 are still operational. That means there are nearly 3,000 defunct spacecraft zooming around Earth at tremendous speeds, along with other big, dangerous pieces of debris like upper-stage rocket bodies. For example, orbital velocity at 250 miles (400 kilometers) up, the altitude at which the ISS flies, is about 17,100 mph (27,500 kph). At such speeds, even a tiny shard of debris can do serious damage to a spacecraft — and there are huge numbers of such fragmentary bullets zipping around our planet. ESA estimates that Earth orbit harbors at least 36,500 debris objects that are more than 4 inches (10 centimeters) wide, 1 million between 0.4 inches and 4 inches (1 to 10 cm) across, and a staggering 330 million that are smaller than 0.4 inches (1 cm) but bigger than 0.04 inches (1 millimeter). These objects pose more than just a hypothetical threat. From 1999 to May 2021, for example, the ISS conducted 29 debris-avoiding maneuvers, including three in 2020 alone, [according to NASA officials](https://www.nasa.gov/mission_pages/station/news/orbital_debris.html). And that number continues to grow; the station performed [another such move in November 2021](https://www.space.com/space-station-dodging-chinese-space-junk-spacex-crew-3), for example. Many of the smaller pieces of space junk were spawned by the explosion of spent rocket bodies in orbit, but others were more actively emplaced. In January 2007, for instance, China intentionally destroyed one of its defunct weather satellites in a much-criticized test of anti-satellite technology that generated [more than 3,000 tracked debris objects](https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf) and perhaps 32,000 others too small to be detected. The vast majority of that junk remains in orbit today, experts say. Spacecraft have also collided with each other on orbit. The most famous such incident occurred in February 2009, when Russia's defunct Kosmos 2251 satellite slammed into the operational communications craft Iridium 33, producing [nearly 2,000 pieces of debris](https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf) bigger than a softball. That 2009 smashup might be evidence that the Kessler Syndrome is already upon us, though a cataclysm of "Gravity" proportions is still a long way off. "The cascade process can be more accurately thought of as continuous and as already started, where each collision or explosion in orbit slowly results in an increase in the frequency of future collisions," [Kessler told Space Safety Magazine in 2012](http://www.spacesafetymagazine.com/space-debris/kessler-syndrome/don-kessler-envisat-kessler-syndrome/)

#### Only profit motive solves debris.

**Nelson & Block 18** [Peter Lothian Nelson and Walter E. Block, \*\* Harold E. Wirth Endowed Chair and Professor of Economics, College of Business, Loyola University New Orleans, “Space Capitalism: How Humans will Colonize Planets, Moons, and Asteroids,” 2018, Springer, pp. 108, EA]

Space debris is a major challenge to space exploration (Goldsmith 2015). The higher the speed (see Chap. 1 on the need for hyper speeds), the worse will be the issue of impact avoidance or damage in the event of impact. It is through the **unregulated free market** that solutions to intractable problems are found. Explorers will be well **motivated** to **develop** **methods for detection of** both minuscule and massive invisible **objects** and **quick reaction mechanisms** for avoidance of things large and small.

On subpoints b—we make mining feasible

C3

We make it gov regulated and collab w public entties means no human rights abuses

Establishing colonies on mars unfeasible