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### Advantage 1: Space Debris

#### The amount of space junk orbiting Earth is currently at a tipping point, there is a high chance of fatal leaks and catastrophic outcomes.

**BBC 11**, (2011, September 2). “Space junk at tipping point, says report.” BBC News. Accessed December 27, 2021, from https://www.bbc.com/news/world-us-canada-14757926

[A report](http://www.nap.edu/catalog.php?record_id=13244) by the National Research Council says the debris could cause **fatal leaks** in spaceships or **destroy** valuable **satellites**. It calls for international regulations to limit the junk and more research into the possible use of launching large magnetic nets or giant umbrellas. The debris includes clouds of minuscule fragments, old boosters and satellites. Some computer models show the amount of **orbital rubbish** "has **reached a tipping point,** with enough currently in orbit to continually collide and create even more debris, **raising the risk of spacecraft failures,"** the research council said in a statement on Thursday. Hopes of limiting the amount of space junk in orbit suffered two major setbacks in recent years. In 2007, China conducted an anti-satellite weapon test which destroyed a decommissioned weather satellite, smashing the object into 150,000 pieces larger than 1cm. Two years later, two satellites - one defunct and one active - crashed in orbit, creating even more debris. "Those two single events doubled the amount of fragments in Earth orbit and completely wiped out what we had done in the last 25 years," said Donald Kessler, who led the research. **There are 22,000 pieces of debris** large enough to track from the ground, but smaller objects could still cause serious damage. The International Space Station must occasionally dodge some of the junk, which flies around the Earth at speeds of up to 17,500 mph (28,164 km/h). In June, some debris narrowly missed the space station, forcing its six crew to go to their escape capsules and prepare for an emergency evacuation back to Earth. The situation is critical, said Mr Kessler, a retired Nasa scientist, because **colliding debris creates even more** of the junk. "We've lost control of the environment," he said.

#### Moreover, private companies are cramming more satellites into space, producing even more pieces of space junk.

**Wood, 20** (Therese)- “Who owns our orbit: Just how many satellites are there in space?” World Economic Forum. Accessed December 27, 2021, from https://www.weforum.org/agenda/2020/10/visualizing-easrth-satellites-sapce-spacex

Right now, There are nearly **6,000 satellites** circling our tiny planet. About 60% of those are defunct satellites—space junk—and roughly 40% are operational. As highlighted in the chart above, [The Union of Concerned Scientists (UCS)](https://www.ucsusa.org/resources/satellite-database), determined that **2,666 operational satellites** circled the globe in April of 2020. Over the coming decade, it’s estimated by Euroconsult that 990 satellites will be launched every year. This means that by 2028, there could be **15,000 satellites** in orbit. With SpaceX’s planned Starlink constellation of 12,000 satellites and Amazon’s proposed constellation in the works, the new space race continues its acceleration. Let’s take a closer look at who operates those satellites and how they apply their technology. Humans have long used space for navigation. While sailors once relied on the stars, today we use satellites for GPS, navigation, and various other applications. **More than half of Earth’s** operational **satellites are launched for commercial purposes.**

#### Lethal nontrackable debris form clusters uniquely escalates the risk of collisions.

#### Dr. Darren **McKnight 17**, “Proposed Series of Orbital Debris Remediation Activities,” Retrieved December 27, 2021, from <https://iaaspace.org/wp> content/uploads/iaa/Scientific%20Activity/debrisminutes0321.pdf

While protecting operational satellites from the trackable population via collision warnings provides a quantifiable risk mitigation mission, the primary threat to operational spacecraft comes from the lethal nontrackable (LNT) environment that will produce the vast majority of the anomalies and failures examined by the activity just outlined. LNT debris ranges from about 5mm to 10cm; these are fragments that are large enough to disrupt and terminate a satellite’s mission upon impact but are too small to be cataloged. There is an estimated 500,000-700,000 LNT in LEO currently. Therefore, the cataloged population (~18,000 in LEO) that is evaded through active maneuvering is less than 5% of the lethal population. In the future, this population will be added to primarily **form collisions between large objects** in orbit as the number of LNT produced is **proportional to the mass involved in a collision** (or explosion).2 Cataloged debris produced from a catastrophic collision will be liberated at about 1-3 fragments per kilogram of mass involved while LNT production is around 10-40 fragments per kilogram of mass involved. The Iridium/Cosmos collision involved a total mass of 2,000kg and produced over 3,000 trackable fragments and likely 10,000-15,0003 LNT debris. The Feng-Yun purposeful collision yielded over 2,200 trackable fragments and likely over 30,000 LNT from only ~850kg of mass involved. While it is important to prevent these types of events from occurring in the future, the consequence of a collision (based on number of LNT produced) will be proportional to the mass involved in the collision. The term “mass involved” implies a good coupling of the impactor mass with the target mass. For a large fragment (e.g., several kilograms) striking a typical payload (that is densely built) in its main satellite body (vice striking a solar array or other appendage) at hypervelocity speeds (i.e., above 6km/s) will result in all the mass being “involved” in the debris. However, a large fragment striking a derelict rocket body, due to the way that the mass is concentrated at the ends of a rocket body, will likely not result in all of the mass being “involved” in the liberated debris. However, it is likely that **when two large** derelicts, either rocket **bodies** or payloads, **collide** with each other, then **all of the mass will be involved** due to the likely direct physical interaction between the mass. The table below summarizes the mass involvement scenarios which highlight why the massive-on-massive collisions are the focus of our analyses. Therefore, it is best to prevent the collision of the most massive objects with each other (higher consequence) and the ones that are the most likely (higher probability) since risk is probability multiplied by consequence. Our ability to model and predict the rate of collisions is based empirically upon only one catastrophic accidental collision event and a model developed on the kinetic theory of gases (KTG). However, **clusters of massive objects** that have identical inclinations plus similar and overlapping apogees/perigees may indeed **have a greater** **probability of collision than predicted by** the KTG-based **algorithms** as they are not randomly distributed and their orbital element evolution (e.g., change in right ascension of ascending node and argument of perigee) is also similar. It is hypothesized that these similarities could result in resonances of collision dynamics that may lead to larger probability of collision values than predicted with current algorithms. The not well-known fact is that many of the most **massive objects are in** tightly clumped **clusters that** will likely **produce greater probability of collision** than estimated by the KTG approach (see attached paper) and with the much larger consequence (i.e., creation of catalogued LNT fragments). The attached paper that studied this possibility shows some initial indications that this may indeed be true but much more analysis is needed to provide this conclusively. This table of clusters represents well over 50% of the total derelict mass in LEO (low earth orbit). However, **no one is** currently **monitoring** these potential events.

#### Collisions renders the orbit unusable – cascades cause nuclear war, mass starvation, and economic destruction.

Les Johnson 13, Deputy Manager for NASA's Advanced Concepts Office at the Marshall Space Flight Center, Co-Investigator for the JAXA T-Rex Space Tether Experiment and PI of NASA's ProSEDS Experiment, Master's Degree in Physics from Vanderbilt University, Popular Science Writer, and NASA Technologist, Frequent Contributor to the Journal of the British Interplanetary Sodety and Member of the American Institute of Aeronautics and Astronautics, National Space Society, the World Future Society, and MENSA, Sky Alert!: When Satellites Fail, p. 9-12 [language modified]

Whatever the initial cause, the result may be the same. A satellite destroyed in orbit will break apart into thousands of pieces, each traveling at over 8 km/sec. This virtual shotgun blast, with pellets traveling 20 times faster than a bullet, will quickly spread out, with each pellet now following its own orbit around the Earth. With over 300,000 other pieces of junk already there, the tipping point is crossed and a runaway series of collisions begins. A few orbits later, two of the new debris pieces strike other satellites, causing them to explode into thousands more pieces of debris. The rate of collisions increases, now with more spacecraft being destroyed. Called the "Kessler Effect", after the NASA scientist who first warned of its dangers, these debris objects, now numbering in the millions, cascade around the Earth, destroying every satellite in low Earth orbit. Without an atmosphere to slow them down, thus allowing debris pieces to bum up, most debris (perhaps numbering in the millions) will remain in space for hundreds or thousands of years. Any new satellite will be threatened by destruction as soon as it enters space, effectively rendering many Earth orbits unusable. But what about us on the ground? How will this affect us? Imagine a world that suddenly loses all of its space technology. If you are like most people, then you would probably have a few fleeting thoughts about the Apollo-era missions to the Moon, perhaps a vision of the Space Shuttle launching astronauts into space for a visit to the International Space Station (ISS), or you might fondly recall the "wow" images taken by the orbiting Hubble Space Telescope. In short, you would know that things important to science would be lost, but you would likely not assume that their loss would have any impact on your daily life. Now imagine a world that suddenly loses network and cable television, accurate weather forecasts, Global Positioning System (GPS) navigation, some cellular phone networks, on-time delivery of food and medical supplies via truck and train to stores and hospitals in virtually every community in America, as well as science useful in monitoring such things as climate change and agricultural sustainability. Add to this the [disabling] ~~crippling~~ of the US military who now depend upon spy satellites, space-based communications systems, and GPS to know where their troops and supplies are located at all times and anywhere in the world. The result is a nightmarish world, one step away from nuclear war, economic disaster, and potential mass starvation. This is the world in which we are now perilously close to living. Space satellites now touch our lives in many ways. And, unfortunately, these satellites are extremely vulnerable to risks arising from a half-century of carelessness regarding protecting the space environment around the Earth as well as from potential adversaries such as China, North Korea, and Iran. No government policy has put us at risk. It has not been the result of a conspiracy. No, we are dependent upon them simply because they offer capabilities that are simply unavailable any other way. Individuals, corporations, and governments found ways to use the unique environment of space to provide services, make money, and better defend the country. In fact, only a few space visionaries and futurists could have foreseen where the advent of rocketry and space technology would take us a mere 50 years since those first satellites orbited the Earth. It was the slow progression of capability followed by dependence that puts us at risk. The exploration and use of space began in 1957 with the launch of Sputnik 1 by the Soviet Union. The United States soon followed with Explorer 1. Since then, the nations of the world have launched over 8,000 spacecraft. Of these, several hundred are still providing information and services to the global economy and the world's governments. Over time, nations, corporations, and individuals have grown accustomed to the services these spacecraft provide and many are dependent upon them. Commercial aviation, shipping, emergency services, vehicle fleet tracking, financial transactions, and agriculture are areas of the economy that are increasingly reliant on space. Telestar 1, launched into space in the year of my birth, 1962, relayed the world's first live transatlantic news feed and showed that space satellites can be used to relay television signals, telephone calls, and data. The modern telecommunications age was born. We've come a long way since Telstar; most television networks now distribute most, if not ali, of their programming via satellite. Cable television signals are received by local providers from satellite relays before being sent to our homes and businesses using cables. With 65% of US households relying on cable television and a growing percentage using satellite dishes to receive signals from direct-to-home satellite television providers, a large number of people would be cut off from vital information in an emergency should these satellites be destroyed. And communications satellites relay more than television signals. They serve as hosts to corporate video conferences and convey business, banking, and other commercial information to and from all areas of the planet. The first successful weather satellite was TIROS. Launched in 1960, TIROS operated for only 78 days but it served as the precursor for today's much more long-lived weather satellites, which provide continuous monitoring of weather conditions around the world. Without them, providing accurate weather forecasts for virtually any place on the globe more than a day in advance would be nearly impossible. Figure !.1 shows a satellite image of Hurricane Ivan approaching the Alabama Gulf coast in 2004. Without this type of information, evacuation warnings would have to be given more generally, resulting in needless evacuations and lost economic activity (from areas that avoid landfall) and potentially increasing loss of life in areas that may be unexpectedly hit. The formerly top-secret Corona spy satellites began operation in 1959 and provided critical information about the Soviet Union's military and industrial capabilities to a nervous West in a time of unprecedented paranoia and nuclear risk. With these satellites, US military planners were able to understand and assess the real military threat posed by the Soviet Union. They used information provided by spy satellites to help avert potential military confrontations on numerous occasions. Conversely, the Soviet Union's spy satellites were able to observe the United States and its allies, with similar results. It is nearly impossible to move an army and hide it from multiple eyes in the sky. Satellite information is critical to all aspects of US intelligence and military planning. Spy satellites are used to monitor compliance with international arms treaties and to assess the military activities of countries such asChina**,** Russia**,** Iran**,** andNorth Korea**.** Figure 1.2 shows the capability of modem unclassified space-based imaging. The capability of the classified systems is presumed to be significantly better, providing much more detail. Losing these satellites would place global militaries on high alert and have them operating, literally, in the blind. Our military would suddenly become vulnerable in other areas as well. GPS, a network of 24-32 satellites in medium-Earth orbit, was developed to provide precise position information to the military, and it is now in common use by individuals and industry. The network, which became fully operational in 1993, allows our armed forces to know their exact locations anywhere in the world. It is used to guide bombs to their targets with unprecedented accuracy, requiring that only one bomb be used to destroy a target that would have previously required perhaps hundreds of bombs to destroy in the pre-GPS world (which, incidentally, has resulted in us reducing our stockpile of non-GPS-guided munitions dramatically). It allows soldiers to navigate in the dark or in adverse weather or sandstorms. Without GPS, our military advantage over potential adversaries would be dramatically reduced or eliminated.

### Advantage 2: Heritage

#### Without restrictions on property rights in space, conflict over resources is inevitable.

John Myers 16, 2017 J.D. Candidate, University of San Diego School of Law, Extraterrestrial Property Rights: Utilizing the Resources of the Final Frontier, San Diego International Law Journal, Volume 18, Page 77–128, 2016, Accessed via Hein Online

The doctrine of discovery is a “top-down” approach to the acquisition of property: sovereignty and property are inherently intertwined. The topdown view of property traces its roots to the 1648 Peace of Westphalia; however, there is a strong tradition in Western scholarship and law that property law is grown and developed from the bottom up. For example, in Roman law, the Institutes of Justinian advanced the idea of ownership through occupancy. In addition, John Locke in England promoted the labor theory that allows ownership to be earned by the “sweat of your brow.” Most importantly, property today is largely viewed as a bundle of rights that include the rights to possess, use, exclude, and transfer. This bundle of rights is subject to reconfiguration depending on the form of property. Property rights in space are novel and therefore require a new configuration in the bundle of rights associated with that property. Moreover, the grant of property rights in space will prevent both the Tragedy of the Commons and the Tragedy of the Anticommons. In the first case, if property rights are not granted in space, it is foreseeable that conflicts will arise because multiple corporations could land on the same asteroid. Hypothetically, if a particularly resource-rich asteroid that would be easy to land on and mine is discovered, both an American corporation and a Chinese corporation could land on it and this would result in issues both in space and on Earth. In the second case, if property rights are not granted in space, it is as likely foreseeable that corporations will not invest in space and the resources of space will go underexploited. Currently there are analogous situations on Earth that the recognition of property rights in space will either avoid or emulate. In the case of African land grabs, there is virtually no government oversight **and** therefore **resources are being** overexploited. On the other hand, in the East and South China Seas, there are several governments claiming a number of islands and island groups leading to under-utilization of resources. Space offers an opportunity for a blank slate, provided the rights and obligations of nations are clear from the beginning. The deep seabed is perhaps the most closely analogous situation on Earth. Like outer space, the deep seabed is considered the “Common Heritage of Mankind.” The UNCLOS was intended to create an agreement to regulate the use and exploitation of the resources in the deep seabed. The **U**nited **S**tates, along with **Japan**, **West Germany**, and the **U**nited **K**ingdom, did not sign the convention, and instead created national legislation and other schemes to explore and exploit the deep seabed. The United States legislature enacted the DSHMRA that authorizes U.S. citizens to explore and exploit deep seabed resources. This Act further asserts that the United States is not exerting sovereignty over the deep seabed and recognizes the rights of other nations to engage in the same activities. Most importantly, the United States currently has bilateral and multilateral agreements with almost every nation capable of exploiting the deep seabed.

#### With the already rising tensions, conflicts could quickly escalate and cause disastrous impacts.

#### Impey 21’ Chris Impey, opinion contributor. (2021, October 8). Is conflict in space inevitable? TheHill. Retrieved January 2, 2022, from https://thehill.com/opinion/international/575903-is-conflict-in-space-inevitable?rl=1

Four years ago, China [destroyed one of its weather satellites](https://www.space.com/3415-china-anti-satellite-test-worrisome-debris-cloud-circles-earth.html) with a missile, creating tens of thousands of pieces of shrapnel, all large enough and traveling fast enough to destroy another satellite or pose a threat to the International Space Station. Two years later, [India joined the list of nations capable of space warfare](https://www.newscientist.com/article/2197903-india-tests-anti-satellite-missile-by-destroying-one-of-its-satellites/) by destroying one of its own satellites. Just last year, [Russia conducted an anti-satellite missile test](https://www.defensenews.com/battlefield-tech/space/2020/04/15/russia-conducted-anti-satellite-missile-test-says-us-space-command/), and the United States activated two command centers for the [Space Force](https://www.spaceforce.mil/About-Us/About-Space-Force/), the branch of the military designed to conduct its operations in outer space. Is this crescendo of activity a harbinger of international space warfare? For now, **we are witnessing nations testing their space technology**. There has never been an armed conflict in space — but it is the next arena for combat. Space junk is a headache, but space weapons are a nightmare. China is a rapidly rising space power, with ambitious plans for a space station, a Moon base and a Mars base. Unlike the United States, where NASA is a civilian agency with plans available for scrutiny, China’s space program is blended with its military and operates under a veil of secrecy. A [recent report](https://www.defensenews.com/congress/2021/04/14/china-aims-to-weaponize-space-says-intel-community-report/) from the Office of the Director of National Intelligence said China is working on an array of capabilities to weaponize space, and it plans to “match or exceed U.S. capabilities in space to gain the military, economic, and prestige benefits that Washington has accrued from space leadership.” Expanding our footprint beyond Earth risks replaying the colonial and acquisitive history of the Western world in a new arena. With few laws and regulations in space, companies will face no ethical constraints on their behavior. If **companies out-muscling countries** sounds implausible, consider this: In big tech, it has already happened. Apple’s market cap is [larger than the GDPs](https://www.visualcapitalist.com/the-tech-giants-worth-compared-economies-countries/) of all but seven countries. Amazon, which fuels the space enterprise of [Jeff Bezos](https://thehill.com/people/jeffrey-jeff-bezos), has a market cap similar to that of Russia or Brazil. But even these tech giants were [dwarfed by the Dutch East India Company](https://www.fool.com/investing/general/2012/08/22/a-history-of-ridiculously-big-companies.aspx). Four hundred years ago, this megacorporation controlled [half the world’s trade](https://www.tandfonline.com/doi/abs/10.1080/17518350.2003.11428634) and enforced its grip on power with 40 warships and 10,000 soldiers. We’ll need to take action to ensure that history doesn’t repeat itself.

#### Regulation that decouples commercial mining from research is key to prevent conflict and make room for sustainable mining.

Ramin Skibba 16, Formerly Assistant Project Scientist and Lecturer at the Center for Astrophysics and Space Sciences at the University of California, San Diego, Journalist, 4-19-2016, Mining in Space Could Lead to Conflicts on Earth, Nautilus, <http://nautil.us/blog/mining-in-space-could-lead-to-conflicts-on-earth>

For one thing, it appears to violate international law, according to Congressional testimony by Joanne Gabrynowicz, a space law expert at the University of Mississippi. Before NASA’s moon landing, the United States—along with other United Nations Security Council members and many other countries—signed the 1967 Outer Space Treaty. “Outer space, including the moon and other celestial bodies,” it states, “is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” The 1979 Moon Agreement went further, declaring outer space to be the “common heritage of mankind” and explicitly forbidding any state or organization from annexing (non-Earth) natural resources in the solar system. Major space-faring nations are not among the 16 countries party to the treaty, but they should arguably come to some equitable agreement, since international competition over natural resources in space may very well transform into conflict. Take platinum-group metals. Mining companies have found about 100,000 metric tons of the stuff in deposits worldwide, mostly in South Africa and Russia, amounting to $10 billion worth of production per year, according to the U.S. Geological Survey. These supplies should last several decades if demand for them doesn’t rise dramatically. (According to Bloomberg, supply for platinum-group metals is constrained while demand is increasing.) Palladium, for example, valued for its conductive properties and chemical stability, is used in hundreds of millions of electronic devices sold annually for electrodes and connector platings, but it’s relatively scarce on Earth. A single giant, platinum-rich asteroid could contain as much platinum-group metals as all reserves on Earth, the Google-backed Planetary Resources claims. That’s a massive bounty. As Planetary Resources and other U.S. and foreign companies scramble for control over these valuable space minerals, competing “land grabs” by armed satellites may come next. Platinum-group metals in space may serve the same role as oil has on Earth, threatening to extend geopolitical struggles into astropolitical ones. NASA’s increasing collaboration with space mining companies could distort and divert efforts previously focused on space exploration. Moreover, the technology that might enable this free-for-all—versatile “nanosatellites,” no larger than a loaf of bread—is relatively inexpensive. In December, while reporting for a story about these tiny satellites, also known as CubeSats, I came across some missions applicable to mining asteroids. In mid-2018, NASA will launch a satellite for a mission called Near-Earth Asteroid Scout, for example. It will deploy a solar sail, propel itself with sunlight, and journey to the asteroid belt, where it will scope out a particular asteroid and analyze its properties. Last June, NASA also awarded grants to Planetary Resources to advance the designs of spectral imagers and propulsion systems for CubeSats, and other missions will develop the satellites’ abilities to communicate and network with each other. NASA also awarded Deep Space Industries contracts to assess commercial approaches for NASA’s asteroid goals, which may involve hosting DSI’s asteroid-prospecting equipment on its missions. Like all forms of mining, it will be dangerous. If space-mining activities break up asteroids, the resulting debris could be hazardous for satellites, other spacecraft, and astronauts nearby. On the other hand, in a best-case scenario, space mining could be environmentally safe, capture only necessary minerals and water, and, in the more distant future even lead to the construction of a far-flung space station led by NASA and other space agencies, orbiting 200 million miles from Earth and serving as both a mining depot and a pit-stop for passing spacecraft. But it’s not clear that a pact between the commercial space mining industry and NASA would align with the public’s interest. NASA’s increasing collaboration with space mining companies could distort and divert efforts previously focused on space exploration and basic research and discourage public interest and engagement in astronomy. Last October, for example, Seager advocated for space mining at a science writing conference I attended. She’s part of a motley group of advisors for Planetary Resources, including the movie director James Cameron, a lawyer for a prominent Washington D.C. firm, and Dante Lauretta, another astronomer whom I respect. Seager seems to believe that encouraging private space mining will lead to more investments and technological innovation that would enable more scientific research. In a 2012 interview with The Atlantic, for instance, she said, “The bottom line is that NASA is not working the best that it could for space science right now, and so in order for people like me to succeed with my own research goals, the commercial space industry needs to be able to succeed independently of government contracts.” But if the U.S. and U.S.-based companies lay claim to the richest and most easily accessible prospecting sites, not allowing other companies and nations to share in the wealth, economic and political relations could be damaged. That’s why this seems to be a dangerous path for space explorers. Once you’re on board with the commercial space industry, then you as a researcher must accept, if not support, everything that comes with it. Seager and a few other researchers may be willing to take this risk, but what about the rest of the space science community? Moreover, to succeed, these businesses will seek profitable missions, while science, exploration, and discovery—goals that stimulate public interest—will inevitably have lower priority. (Other commercial spaceflight companies, like Elon Musk’s SpaceX, do generate public interest, but they’re not directly involved in mining asteroids.) NASA may have its shortcomings, but at least its missions and research goals answer to the public. It’s not exactly a welcome thought to imagine more and more of our presence and activity in space being ceded, with NASA’s help, to private industry. What should happen instead? Commercial space mining and science would both be served well by decoupling from each other. We should treat outer space like we do Antarctica. That icy landscape is humankind’s common heritage, where we encourage scientific investigations and conservation and forbid territorial claims. If some organizations want to mine asteroids, then we should take the time to develop and establish an international framework to regulate it properly. Space-mining is an exciting opportunity to articulate our species’ role in our little galactic fragment. But it’s not just about sustainably managing limited or dwindling resources. It’s about our interactions with the nature beyond our humble world. We should explore the solar system as its steward without repeating our economically rapacious past.

#### Asteroid mining solves rare earth mineral shortages and resource conflicts.

#### Manufacturing net 20’“Asteroid mining could solve rare metal shortage.” Manufacturing.net. (2020, January 31). Retrieved January 2, 2022, from https://www.manufacturing.net/technology/blog/21113380/asteroid-mining-could-solve-rare-metal-shortage

This may sound like science fiction, but since at least the 1970s, organisations like NASA have been considering the possible advantages of asteroid mining for resources. Now, in the midst of a new privatized space race and a global rare metal shortage, companies are revisiting the possibility of sourcing materials from outer space. A single asteroid could contain trillions of dollars’ worth of precious metals, and sourcing materials from asteroids could enable large-scale construction in space. The world demand for rare and precious metals is growing, and a mix of political turmoil and natural scarcity are contributing to fears that the [**global supply will be unable to keep up.**](http://tracking.vuelio.co.uk/tracking/click?d=3Fwrw5dNGXhiTKV7j1N-VsX8Jmt4HMhvn1bjd_NKnMhonrRR2S6HgDBGxyt7L6poeZ8pX9hI7Z3jL3Kc3SMwpw7vX_4PZqS0JfF9JTJYl9U9f_sk8Txvdvwvm8Gw5hHFLXarAqesC9DRrlwej9PILivBCcDRo5DfKgN1-NB0nZrb0) As supplies dwindle, demand grows, and prices rise, the new private company-based space race might offer a solution to the shortage. Asteroid mining would require major investments in new technologies, but there has been enough interest that companies have been formed to prospect for asteroids to harvest. Asteroids can be grouped broadly into those that are primarily carbonaceous, silicates, or metallic. Metallic asteroids are primarily iron and nickel, but can contain rare metals like platinum [and] gold, iridium, palladium, osmium, ruthenium and rhodium at concentration several times higher than what is found on Earth. A single asteroid could be worth hundreds of millions of dollars, or more, if humans could overcome the formidable challenge of harvesting it.

#### The lack of earth minerals prevents the transition to clean energy necessary to solve warming.

Nafeez Ahmed 18, DPhil in international relations from the School of Global Studies at Sussex University, an investigative journalist and international security scholar, Dec 12 2018, "We Don't Mine Enough Rare Earth Metals to Replace Fossil Fuels With Renewable Energy", Vice, https://www.vice.com/en\_us/article/a3mavb/we-dont-mine-enough-rare-earth-metals-to-replace-fossil-fuels-with-renewable-energy

A new scientific study supported by the Dutch Ministry of Infrastructure warns that the renewable energy industry could be about to face a fundamental obstacle: shortages in the supply of rare metals. To meet greenhouse gas emission reduction targets under the Paris Agreement, renewable energy production has to scale up fast. This means that global production of several rare earth minerals used in solar panels and wind turbines—especially neodymium, terbium, indium, dysprosium, and praseodymium—must grow twelvefold by 2050.But according to the new study by Dutch energy systems company Metabolic, the “current global supply of several critical metals is insufficient to transition to a renewable energy system.” The study focuses on demand for rare metals in the Netherlands and extrapolates this to develop a picture of how global trends are likely to develop.“If the rest of the world would develop renewable electricity capacity at a comparable pace with the Netherlands, a considerable shortage would arise,” the study finds. This doesn’t include other applications of rare earth metals in other electronics industries (rare earth metals are widely used in smartphones, for example). “When other applications (such as electric vehicles) are also taken into consideration, the required amount of certain metals would further increase.”Demand for rare metals is pitched to rise exponentially across the world, and not just due to renewables. Demand is most evident in “consumer electronics, military applications, and other technical equipment in industrial applications. The growth of the global middle class from 1 billion to 3 billion people will only further accelerate this growth.”But the study did not account for those other industries. This means the actual problem could be far more intractable. In 2017, a study in Nature found that a range of minerals essential for smartphones, laptops, electric cars and even copper wiring could face supply shortages in coming decades.

#### Warming causes extinction

#### Krosofsky 21’ (2021, March 11). “How global warming May eventually lead to global extinction.” Green Matters. Retrieved January 3, 2022, from https://www.greenmatters.com/p/will-global-warming-cause-extinction//westridge-ky/

#### Eventually, yes. Global warming will invariably result in the mass extinction of millions of different species, humankind included. In fact, [the Center for Biological Diversity](https://www.biologicaldiversity.org/programs/climate_law_institute/global_warming_and_life_on_earth/index.html) says that global warming is currently the greatest threat to life on this planet. Global warming causes a number of detrimental effects on the environment that many species won’t be able to handle long-term.  Extreme weather patterns are shifting climates across the globe, eliminating habitats and altering the landscape. As a result, food and fresh water sources are being drastically reduced. Then, of course, there are the rising global temperatures themselves, which many species are physically unable to contend with. Formerly frozen [arctic and antarctic regions are melting](https://www.greenmatters.com/p/arctic-ice-melting), increasing [sea levels](https://www.greenmatters.com/news/2019/01/15/bPhgWvMpZ/oceans-warming-climate-change) and temperatures. Eventually, these effects will create a perfect storm of extinction conditions. We won’t try and sugarcoat things, humanity’s own prospects aren’t looking that great either. According to [The Conversation](https://theconversation.com/will-climate-change-cause-humans-to-go-extinct-117691), our species has just under a decade left to get our CO₂ emissions under control. If we don’t cut those emissions by half before 2030, [temperatures will rise](https://www.greenmatters.com/p/global-temperature-rise-predictions) to potentially catastrophic levels. It may only seem like a degree or so, but the worldwide ramifications are immense.  The human species is resilient. We will survive for a while longer, even if these grim global warming predictions come to pass, but it will mean less food, less water, and increased hardship across the world — especially in low-income areas and developing countries. This increase will also mean more [pandemics](https://www.greenmatters.com/p/climate-crisis-leads-to-pandemics), devastating storms, and uncontrollable wildfires.

#### Rising tension and conflicts over water scarcity leads to war and extinction.

#### Milne 21’ BBC. (n.d.). “How water shortages are brewing wars.” BBC Future. Retrieved January 4, 2022, from https://www.bbc.com/future/article/20210816-how-water-shortages-are-brewing-wars

#### Over the course of the 20th Century, global water use grew at more than twice the rate of population increase. Today, this dissonance is leading many cities – from [Rome](https://www.bbc.com/news/world-europe-41081066) to [Cape Town](https://www.wri.org/insights/3-things-cities-can-learn-cape-towns-impending-day-zero-water-shut), [Chennai](https://www.npr.org/sections/goatsandsoda/2019/06/25/734534821/no-drips-no-drops-a-city-of-10-million-is-running-out-of-water?t=1626365858497) to [Lima](http://news.bbc.co.uk/1/hi/world/americas/3697647.stm) – to ration water. Water crises have been ranked in the top five of the World Economic Forum's [Global Risks by Impact](http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf) list nearly every year since 2012. In 2017, severe droughts contributed to the [worst humanitarian crisis since World War Two](https://www.un.org/press/en/2017/sc12748.doc.htm), when 20 million people across Africa and the Middle East were forced to leave their homes due to the accompanying food shortages and conflicts that erupted. Peter Gleick, head of the Oakland-based Pacific Institute, has spent the last three decades studying the link between water scarcity, conflict and migration and believes that water conflict is on the rise. "With very rare exceptions, no one dies of literal thirst," he says. "But more and more people are dying from contaminated water or conflicts over access to water." "The latest research on the subject does indeed [show water-related violence increasing over time](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3076402/)," says Charles Iceland, global director for water at the World Resources Institute. "Population growth and economic development are driving increasing water demand worldwide. Meanwhile, climate change is decreasing water supply and/or making rainfall increasingly erratic in many places." Nowhere is the dual effect of water stress and climate change more evident than the wider Tigris-Euphrates Basin – comprising Turkey, Syria, Iraq and western Iran. According to satellite imagery, the region is [losing groundwater faster than almost anywhere else in the world](https://www.stimson.org/2021/joint-working-group-on-international-and-eu-water-diplomacy-in-focus-the-euphrates-tigris-river-basin/). And as some countries make desperate attempts to secure their water supplies, their actions are affecting their neighbours. India's Northern Plains, for example, are one of the most fertile farming areas in the world, yet today,  [villagers regularly clash over water scarcity](https://www.thekashmirmonitor.net/2-haryana-villages-clash-over-water-8-bikes-set-on-fire-12-injured/). The underlying data reveals that population growth and high levels of irrigation have outstripped available groundwater supplies. Despite the area's lush-looking cropland, the WPS map ranks nearly every district in Northern India as "extremely high" in terms of baseline water stress. Several key rivers which feed the area – the Indus, Ganges and Sutlej – all originate on the Tibetan side of the border yet are vital for water supplies in both India and Pakistan. compounds the problem. Several border skirmishes have broken out recently between India and China, which lays claim to upstream areas. A violent clash in May last year in the Galwan Valley, through which a tributary to the Indus flows, left 20 Indian soldiers dead. Less than a month later there were reports that China was building "structures" that might dam the river and so restrict its flow into India. Around the world, there's plenty of examples where tensions are high though – the Aral Sea conflict comprising Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan; the Jordan River conflict amongst the Levantine states; the Mekong River dispute between China and its neighbours in Southeast Asia. None have yet boiled over into conflict. But Schmeier also points towards one dispute that is showing signs it might. Egypt, Sudan, and Ethiopia all depend on inflow from the Blue Nile and have long exchanged political blows over the upstream Great Ethiopian Renaissance Dam (GERD) project – a dam built at $5bn (£3.6bn), and three times the size of the country's Lake Tana. When the Ethiopian government announced plans to press ahead regardless, Egypt and Sudan held a joint war exercise in May this year, pointedly called "Guardians of the Nile." It has perhaps the highest risk of spilling into a water war of all the disputes in today's political landscape, but there are several other hotspots around the world. Pakistani officials, for example, have previously referred to India's upstream usage strategy as "fifth-generation warfare", whilst Uzbek President Islam Karimov has warned that [regional disputes over water could lead to war](https://www.reuters.com/article/centralasia-water-idUSL6E8K793I20120907).

### Solvency

#### Plan: States ought to apply the Public Trust Doctrine to reduce the appropriation of outer space by private entities.

#### The Public Trust Doctrine protects “peoples’ common heritage” by preventing alienation for private benefit and assuring public access.

#### **Babcock 19 “**The public trust doctrine, outer space ... - georgetown law.” (n.d.). Retrieved January 4, 2022, from https://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=3219&context=facpub

F. The Public Trust Doctrine (PTD) as a Gap Filling, Place-Holding Management Approach506

The PTDoffers both an approach for managing an open access to commons and a gap-filling tool until a regulatory regime is adopted.507 The doctrine is based on the idea that the “**sovereign holds certain common properties in trust**” in perpetuity for the free and unimpeded use of the general public.”508 The public’s right to access and use trust resources is never lost, and neither the government nor private individuals can alienateor otherwise adversely affect those resources unless for a comparable public purpose.509 The resources the doctrine protects “have long been part of a ‘taxonomy of property’ [that recognizes] the division of natural wealth into private and public property.”510 “The doctrine places on governments ‘an affirmative, ongoing duty to safeguard the long-term preservation of those resources for the benefit of the general public,’”511 thus limiting the sovereign’s power on behalf of both present and future individuals.512 It directs the government to manage trust resources for public benefit, not private gain.513 It applies to private as well as public resources and is used to preserve the public’s access to Common Pool Rresources.514 Government agencies have the non-rescindable power to revoke uses of trust resources that are inconsistent with the doctrine.515 This effectively places a permanent easement over trust resources that burdens their ownership with an overriding public interest in the preservation of those resources.516 However, trust resources can be alienated in favor of private ownership, if the alienation will still serve the public’s interest in those resources and not interfere with trust uses of the remaining land.517 The PTD, therefore, protects the “people’s common heritage,”518 just as Article 11 of the Moon Treaty protects outer space as part of the common heritage of mankind.519 The doctrine also appears to be infinitely malleable. Original uses of the doctrine were restricted to only that “aspect of the public domain below the low-water mark on the margin of the sea and the great lakes, the waters over those lands, and the waters within rivers and streams of any consequence,”520 and covered only traditional uses of those lands, like fishing and navigation.521 Over time, the scope and application ofthe doctrine broadened to protect more public resources and different uses.522 Thus, the doctrine expanded to protect new trust resources, such as dry sand beaches, inland lakes, groundwater, dry riverbeds, and wildlife,523 and passive uses of those resources, like scientific study.524 The original link to navigable water and tidelands disappeared.525 Supporters of the doctrine successfully advocated that it be applied to “wildlife, parks, cemeteries, and even works of fine art,”526 while arguing more recently its application to the atmosphere.527 A doctrine that imposes a perpetual duty on the sovereign to preserve trust resources, prevents their alienation for private benefit, assures public access to them, and can be invoked by anyone, seems particularly useful as a management tool in outer space.528 The fact that public access to trust resources is so central to the doctrine makes it reflective, not contradictory, of international space law’s bar against appropriation of outer space and of the principle of space being the “province of all mankind.”529 It avoids the problems of alienation and exclusion associated with any of the management approaches associated with some form of private property and requires neither the creation of a new administrative authority nor the presence of a close-knit group of like-minded people.530 Members of the public, both rich and poor, can invoke and enforce the doctrine as easily as the sovereign.531 It is cost effective to the extent that no separate apparatus is required to implement it, and the doctrine has shown itself to be highly adaptable and innovative as different needs arise.532 It could also fill the gap in international law with respect to managing celestial property.

**There is an urgency for global regulation and management in space, only the PTD ensures sustainable mining and prevents debris cascades.**

Babcock 19 “The public trust doctrine, outer space ... - georgetown law.” (n.d.). Retrieved January 4, 2022, from https://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=3219&context=facpub

Space exploration is heating up. Governments and private interests are on a fast track to develop technologies to send people and equipment to celestial bodies, like the moon and asteroids, to extract their untapped resources.1 Near-space is rapidly filling up with public and private satellites, causing electromagnetic interference problems and dangerous space debris from collisions and earlier launches.2 The absence of a global management system for the private commercial development of outer space resources will allow these near space problems to be exported further into the galaxy.3 Moreover, without a governing authority or rulescontrolling entry or limiting despoliation, **outer space could turn into the “Wild West”** of the twenty-first century.4 Space treaties executed in the last century espoused the principle that space should be developed for the benefit of all mankind and banned both private ownership and militarization of space resources.5 But, they left development of a system for managing non-military activities in outer space to another day.6 Private commercial interests, which would be absorbing the risks and paying the high costs of space development, oppose any management scenario premised on that principle, as it would enable less developed countries to free ride on their investments.7 These interests, unsurprisingly, support privatizing outer space.8 But acceding to their wishes by establishing a system of property-based rules would transport Earth’s current division between haves and have-nots into outer space, and could lead to destabilizing hostilities—the exact consequences that the early treaty drafters hoped to avoid.9 To date, most scholars in this area have focused on developing management systems premised on private ownership or possession of the surface of some celestial body.10 This Article explores an alternative concept, the commons, in which no individual owns the property in question or can exclude others from it. Viewing property as a commons is closer to the principles set out in the various space treaties than implementation of a private property regime, and also offers a workable property regime. This Article demonstrates these conclusions by showing similarities between a large, Earth-bound commons, like the ocean and outer space, and how various commons management scenarios allow equitable use of resources**,** while preventing their despoliation and devolution into hostile disputes over entitlements to them. However, each of these commons management scenarios is flawed in some way and runs a similar risk to management approaches for private property of allowing the resource to be over-used or inequitably distributed. **The** public trust doctrine (**PTD**), an ancient doctrine that governments and individuals have used effectively for centuriestoprotect the public’s interests in terrestrial common pool resources (CPR) and to fill regulatory gaps, can be helpful in both respects.11 An examination of the doctrine identifies commonalities between outer space and terrestrial public trust resources.12 The ease and low cost of its implementation and enforcement, as well as its infinite malleability, are additional reasons to select it as a stopgap measure with some modification.13 This Article’s structure is straight forward. Part I acquaints the reader with the problem. It explains why the need to develop a management regime for space is becoming increasingly critical as advancing technology is allowing more and more private commercial interests to play at the edge of outer space with attendant negative externalities. 14 Soon these technological advances will allow private commercial interests to invade outer space with the potential for similar adverse impacts.15 Part II examines the international legal framework governing those activities and finds it lacks any capacity to regulate activities in outer space, in part because it is riddled with ambiguities and contradictions when it comes to ownership of outer space and its resources. Part III turns to that problem by discussing two types of property: private property and property owned in common with others. It examines the key features of each as well as their positive and negative attributes, how each might function in outer space, and what the consequences might be if one or the other prevailed. Because any property arrangement that results in its appropriation by the owner and the exclusion of others violates international space law, Part III also identifies various less-thanfull fee property arrangement, like leases and easements, to see if these problems can be avoided and concludes they cannot.16 It then examines property held in common to determine its viability under international space law and finds it consistent. Part IV investigates various approaches to managing property in outer space, be it held in private ownership or in common. Different approaches for managing private property in space are explored, including the right of first possession, tradable property claims, and establishing an exclusive economic zone, as well for managing an open access commons, such as the application of stewardship principles, norms, and the PTD. Each approach is evaluated in terms of its consistency with international law; its ability to promote and protect a sustainable, equitable, non-monopolistic, non-hostile environment in outer space; its efficiency; and its cost effectiveness. Only **the** PTD, which has been used for centuries to protect the public’s interests in CPRs and has demonstrated its ability to adaptto new circumstances, may be able to meet these goals.17 This Article finds commonalities between outer space and Earth-bound public trust resources, like the oceans. Additionally, the doctrine’s open access purpose resonates withlanguage found in international treaties governing activities in outer space.18 This Article concludes that using the PTD **will** lead to a **durable, equitable management** regime in a commons where the wealthy are neither able to accumulate and control the resources that outer space has to offer nor over-exploit and deplete them.

### Framing

**The standard is maximizing expected wellbeing**

**First, pleasure and pain are intrinsically valuable, they manifest in the ways of our actions and represent the absolute ends of our moral compasses.**

**Moen 16** [Ole Martin Moen, Research Fellow in Philosophy at University of Oslo “An Argument for Hedonism” Journal of Value Inquiry (Springer)] Retrieved January 5, 2022

Let us start by observing, empirically, that a widely shared judgment about intrinsic value and disvalue is that **pleasure is intrinsically valuable and pain is intrinsically disvaluable**. On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues**.** This inclusion makes intuitive sense, moreover, for **there is something undeniably good about** the way **pleasure** feels **and something undeniably bad about** the way **pain** feels, and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have. “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative.2 The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values**.** If you tell me that you are heading for the convenience store, I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so, not merely for the sake of going to the convenience store, but for the sake of achieving something further that you deem to be valuable**.** You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good.3 As Aristotle observes**:** “We never ask [a man] what his end is in being pleased, because we assume that **pleasure is choice worthy in itself**.”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that **if something is painful, we have a sufficient explanation of why it is bad**. If we are onto something in our everyday reasoning about values, it seems that **pleasure and pain are** both **places where we reach the end of the line in matters of value.**

**Moreover, *only* pleasure and pain are intrinsically valuable. All other values can be explained with reference to pleasure.**

**Moen 16** [Ole Martin Moen, Research Fellow in Philosophy at University of Oslo “An Argument for Hedonism” Journal of Value Inquiry (Springer), 50 (2) 2016: 267–281] Retrieved january 5, 2022

I think several things should be said in response to Moore’s challenge to hedonists. First, I do not think the burden of proof lies on hedonists to explain why the additional values are not intrinsic values. If someone claims that X is intrinsically valuable, this is a substantive, positive claim, and it lies on him or her to explain whywe should believe that X is in fact intrinsically valuable. Possibly, this could be done through thought experiments analogous to those employed in the previous section. Second, there is something peculiar about the list of **additional** intrinsic **values** that counts in hedonism’s favor: the listed values **have a strong tendency to be well explained as things that help promote pleasure and avert pain.** To go through Frankena’s list, life and consciousness are necessary presuppositions for pleasure; activity, health, and strength bring about pleasure; and happiness, beatitude, and contentment are regarded by Frankena himself as “pleasures and satisfactions.” The same is arguably true of beauty, harmony, and “proportion in objects contemplated,” and also of affection, friendship, harmony, and proportion in life, experiences of achievement, adventure and novelty, self-expression, good reputation, honor and esteem. Other things on Frankena’s list, such as understanding, wisdom, freedom, peace, and security, although they are perhaps not themselves pleasurable, are important means to achieve a happy life, and as such, they are things that hedonists would value highly. **Morally good dispositions** and virtues, cooperation, and just distribution of goods and evils, moreover, are things that, on a collective level, **contribute a happy society**, and thus the traits that would be promoted and cultivated if this were something sought after. To a very large extent, the intrinsic values suggested by pluralists tend to be hedonic instrumental values. Indeed, pluralists’ suggested intrinsic values all point toward pleasure, for while the other values are reasonably explainable as a means toward pleasure, pleasure itself is not reasonably explainable as a means toward the other values. Some have noticed this. Moore himself, for example, writes that though his pluralistic theory of intrinsic value is opposed to hedonism, its application would, in practice, look very much like hedonism’s: “Hedonists,” he writes “do, in general, recommend a course of conduct which is very similar to that which I should recommend.”24 Ross writes that “[i]t is quite certain that by promoting virtue and knowledge we shall inevitably produce much more pleasant consciousness. These are, by general agreement, among the surest sources of happiness for their possessors.”25 Roger Crisp observes that “those goods cited by non-hedonists are goods we often, indeed usually, enjoy.”26 What Moore and Ross do not seem to notice is that their observations give rise to two reasons to reject pluralism and endorse hedonism. The first reason is that if **the suggested non-hedonic intrinsic values are** potentially **explainable by appeal to just pleasure and pain** (which, following my argument in the previous chapter, we should accept as intrinsically valuable and disvaluable), then—by appeal to Occam’s razor—**we have** at least a pro tanto **reason to resist** the introduction of **any further intrinsic values** and disvalues. It is ontologically more costly to posit a plurality of intrinsic values and disvalues, so in case **all values admit of explanation by reference to a single intrinsic value** and a single intrinsic disvalue, we have reason to reject more complicated accounts. The fact that suggested non-hedonic intrinsic values tend to be hedonistic instrumental values does not, however, count in favor of hedonism solely in virtue of being most elegantly explained by hedonism; it also does so in virtue of creating an explanatory challenge for pluralists. The challenge can be phrased as the following question: If the non-hedonic values suggested by pluralists are truly intrinsic values in their own right, then why do they tend to point toward pleasure and away from pain?

**Priority number one should always be reducing extinction risk.  
Bostrom 12** [Faculty of Philosophy and Oxford Martin School, University of Oxford.], Existential Risk Prevention as Global Priority. <http://www.existenti...org/concept.pdf>. Retrieved January 5, 2022Even if we use the most conservative of these estimates, which entirely ignores the   possibility of space colonization and software minds, we find that **the** expected **loss of an existential catastrophe is greater than the value of 10^16 human lives**.  This implies that the expected value of reducing existential risk by a mere one millionth of one percentage point is at least a hundred times the value of a million human lives.  The more technologically comprehensive estimate of 10  54 humanbrain-emulation subjective life-years (or 10  52  lives of ordinary length) makes the same point even more starkly.  Even if we give this allegedly lower bound on the cumulative output potential of a technologically mature civilization a mere 1% chance of being correct, we find that the expected value of reducing existential risk by a mere one billionth of one billionth of one percentage point is worth a hundred billion times as much as a billion human lives. One might consequently argue that **even the tiniest reduction of existential risk has a**n  expected **value greater than** that of the definite provision of any ordinary good, such as the direct benefit of **saving 1 billion lives.**  And, further, that the absolute value of the indirect effect of saving 1  billion lives on the total cumulative amount of existential riskâ€”positive or negativeâ€”is almost certainly larger than the positive value of the direct benefit of such an action.