## FW

**My value is justice as the word unjust in the resolution denotes a referendum on whether appropriation is just or unjust. Unjust means** unjust adjective US /ʌnˈdʒʌst/ not morally right; not fair: New laws will protect employees against unjust dismissals. (Definition of unjust from the Cambridge Academic Content Dictionary © Cambridge University Press)

**That’s from Cambridge Dictionary** [“Meaning of unjust in English” Cambridge Dictionary, [https://dictionary.cambridge.org/us/dictionary/english/unjust]](https://dictionary.cambridge.org/us/dictionary/english/unjust%5d)

#### My value criterion is preventing death – you should prefer this metric because it is objective – moral calculations can always delineate body-counts whereas every other harm is subjective and unverifiable. You can lie about being sad but you can’t lie about being dead.

#### There are 3 distinct justifications –

#### 1] Prerequisite – being alive is a prior question to other theories

Craig Paterson, a Professor of Philosophy at Providence College, wrote 2003 (20**03**, Department of Philosophy, Providence College, Rhode Island. , “A Life Not Worth Living?”, Studies in Christian Ethics, https://pubmed.ncbi.nlm.nih.gov/15000090/)

Contrary to those accounts, I would argue that it is death per se that is really the objective evil for us, not because it deprives us of a prospective future of overall good judged better than the alter- native of non-being. It cannot be about harm to a former person who has ceased to exist, for no person actually suffers from the sub-sequent non-participation. Rather, death in itself is an evil to us because it ontologically destroys the current existent subject — it is the ultimate in metaphysical lightening strikes.80 The evil of death is truly an ontological evil borne by the person who already exists, independently of calculations about better or worse possible lives. Such an evil need not be consciously experienced in order to be an evil for the kind of being a human person is. Death is an evil because of the change in kind it brings about, a change that is destructive of the type of entity that we essentially are. Anything, whether caused naturally or caused by human intervention (intentional or unintentional) that drastically interferes in the process of maintaining the person in existence is an objective evil for the person. What is crucially at stake here, and is dialectically supportive of the self-evidency of the basic good of human life, is that death is a radical interference with the current life process of the kind of being that we are. In consequence, death itself can be credibly thought of as a ‘primitive evil’ for all persons, regardless of the extent to which they are currently or prospectively capable of participating in a full array of the goods of life.81 In conclusion, concerning willed human actions, it is justifiable to state that any intentional rejection of human life itself cannot therefore be warranted since it is an expression of an ultimate disvalue for the subject, namely, the destruction of the present person; a radical ontological good that we cannot begin to weigh objectively against the travails of life in a rational manner. To deal with the sources of disvalue (pain, suffering, etc.) we should not seek to irrationally destroy the person, the very source and condition of all human possibility.82

**2] a priori Moral obligation – allowing people to die is unethical and should be prevented because it creates ethics towards other people.**

**3] Uncertainty – if we’re unsure about which interpretation of the world is true – we ought to preserve the world to keep debating about it**

## Innovation

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

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

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

#### Strong Innovation solves Extinction.

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

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

## ON CASE (Private good)

#### While it may seem that private exploration is bad it’s vastly better than public exploration and is able to solve for space colonization

Diakovska & Aliieva 20 [Halyna Diakovska and Olga Aliieva, Ph.D.s in Philosophy, Associate Professors, Donbass State Pedagogical University, “Consequentialism and Commercial Space Exploration,” 2020, *Philosophy and Cosmology*, Vol. 24, pp. 5-24, https://doi.org/10.29202/phil-cosm/24/1, EA]

The experience of the USA showed that leadership in space exploration, which is maintained solely through public funding, could be erroneous. Since 1984, the share of public funding has gradually decreased in space telecommunications, commercial space transportation, remote sensing, etc., while the share of participation of non-state enterprises has increased rapidly. A legal and regulatory framework has been modified to stimulate space commercialization. The stages of space law development are discussed in the research of Valentyn Halunko (Halunko, 2019), Larysa Soroka (Soroka & Kurkova, 2019), etc. Larysa Soroka and Kseniia Kurkova explored the specifics of the legal regulation of the use and development of artificial intelligence for the space area (Soroka & Kurkova, 2019).

As a result of changing the legal framework and attracting private investors to the space market, the US did not lose its leadership in space exploration, but rather secured it. Private investment along with government funding have significantly reduced the risk of business projects in the space industry. The quality and effectiveness of space exploration programs have increased.

In 2018, Springer published an eloquent book The Rise of Private Actors in the Space Sector. Alessandra Vernile, the author of the book, explores a broad set of topics that reveal the role of private actors in space exploration (Vernile, 2018). The book covers the following topics: “Innovative Public Procurement and Support Schemes,” “New Target Markets for Private Actors,” etc. In the “Selected Success Stories,” Vernile provides examples of successful private actors in space exploration (Vernile, 2018).

The current level of competition, which has developed on the space market, allows us to state the following fact. Private space companies have been able to compete with entire states in launching spacecraft, transporting cargo to orbital stations, and exploring space objects. The issue of mining on space objects, the creation of space settlements and the intensive development of the space tourism market are on the agenda.

In the 21st century, the creation of non-governmental commercial organizations specializing in the field of commercial space exploration, is regarded as an ordinary activity. They are established as parts of the universities around projects funded by private investors. For example, Astropreneurship & Space Industry Club based on the MIT community (Astropreneurship, 2019).

Large-scale research in the field of commercial space exploration, as well as the practical results achieved, led to the formation of a new paradigm called “New Space” ecosystem. The articles of Deganit Paikowsky’s (Paikowsky, 2017), Clelia Iacomino (Iacomino & Ciccarelli, 2018) et al. reveal its key meanings and the opportunities it offers in the space sector. The “New Space” ecosystem is a new vision for commercial space exploration. It is the formation of a cosmic worldview, in which the near space with all the wealth of its resources and capabilities, becomes a part of the global economy and the sustainable development of the society. The “New Space” ecosystem offers the following ways for commercial space exploration (Iacomino & Ciccarelli, 2018):

1. Innovative public procurement and support schemes, which significantly expand the role of commercial actors in space exploration.

2. Attracting new entrants in the space sector. First of all, these are companies working in the domain of Information and communications technology, artificial intelligence, etc. that are expanding their research in space markets. They offer innovative business models and new solutions to space commercialization.

3. Innovative industrial approaches based on new processes, methods, and industrial organization for the development and production of space systems or launchers.

4. Disruptive market solutions, which significantly reduce commercial space exploration prices, increase labor productivity, provide new types of services, etc.

5. Substantial private investment from different sources and involving different funding mechanisms. For instance, these are private fortunes, venture capital firms, business angels, private equity companies, or banks, etc.

6. Involvement of an increasing number of space-faring nations investing in the acquisition of turnkey space capabilities or even in the development of a domestic space industrial base. This expands the space markets and makes it more competitive.

The analysis of the research and advances in commercial space exploration allows us to draw the following conclusions:

1. In fact, the space market has already been created. It is currently undergoing continuous development that will integrate the resources and capabilities of the near space into the global economy over the next decade.

2. A new paradigm, denoted by the term “New Space” ecosystem, is at the heart of the created space market. The “New Space” ecosystem is a step towards the formation of cosmic thinking, in which outer space, with its resources and capabilities, is considered as a sphere of human activities.

3. Space market regulates space law, which is constantly evolving. The space law develops within the bounds of international law. In essence, the space market is integrated into the international legal field and is governed by its laws.

#### This exploration spills over into other sectors and solves for many existential threats

Green 21 [Brian Patrick Green, director of technology ethics at the Markkula Center for Applied Ethics, Santa Clara University, “Space Ethics,” 2021, Rowman, pp. 4-5, EA]

In favor of going into space are such basics as gaining scientific knowledge and developing beneficial new technologies, both of which space exploration and use have already begun to accomplish with dramatic and sometimes unexpected effects for humankind. Scientific advancements include astronomical and cosmological knowledge from various orbiting experiments and telescopes that have let us gain unprecedented understanding about our universe. But space activities have also contributed to a great deal of scientific knowledge about our Earth, including measurements of environmental status, habitat conversion and destruction, detailed knowledge of anthropogenic climate change, and much about Earth’s chemistry and geology. We have also learned a great deal about our local planets, for example, that a runaway “greenhouse effect” in the atmosphere of Venus makes the surface scorchingly hot, while too little greenhouse effect on Mars leaves the surface quite cold. There have also been significant contributions made to medical science, especially concerning the behavior of the human body when subjected to radiation, microgravity, nutritional restrictions, and so on.

On the technological side, everything with American global positioning system (GPS), Russian Glonass, or other global navigation systems—from smartphones to military vehicles—relies on a network of satellites above us, placed there by rocketry and painstakingly tracked with instruments developed for the task. So many technologies have been pioneered by space exploration and use that it is hard to list them all, but some of the more important ones include weather satellites (which are not only convenient but also allow preparation for and evacuation from severe weather), communication satellites, solar photovoltaic (PV) cells, advances in electronics and computers, advances in materials science, and so on.

Space is also an important location for the contention of national interests in a geopolitical and military sense. As the ultimate “high ground” in battle, space allows certain asset classes such as spy satellites to exist in a position unassailable by many or most opponents. While permanent weapons stations and weapons of mass destruction are banned from space by the United Nations Outer Space Treaty (OST), 6 that has not stopped the development of weapons that are impermanent (such as missiles, missile interceptors, and antisatellite weapons) or the research and development of possible space-based weapons platforms, such as were envisioned by U.S. president Ronald Reagan’s Strategic Defense Initiative, nicknamed “Star Wars.” While military and political interests may ultimately seem to be a less noble reason to explore and use space, relative power, safety, and security certainly are very human interests and are valuable to those who feel they are being protected by them.

Space activities are also a key way of promoting international cooperation and global awareness. While the international competition of the “space race” fueled one nation all the way to the Moon, shortly afterward, the Apollo-Soyuz program announced a thawing of this competition and commenced a period of cooperation between the United States of America and the Union of Soviet Socialist Republics. Currently the International Space Station continues this cross-national cooperation in space, with five space agencies (representing Canada, the European Space Agency nations, Japan, Russia, and the United States) participating. In addition to cooperation in space exploration itself, the perspective given from space has itself helped to produce some feelings of unity on Earth, with the famous “Blue Marble” and “Earthrise” pictures showing Earth’s oneness and scientific discoveries supported by space science, such as those related to climate change, helping to promote international cooperation to address these problems.

Gaining access to new critical resources may be another reason to go into space. Earth is a finite planet, and certain elements on Earth are very rare in the planetary crust, particularly platinum group metals that are very dense and siderophilic (iron-loving) and so have tended to sink toward the core over the natural history of the planet. However, asteroids and other objects in space (for example, planets, comets, and moons) can sometimes have these elements in abundance and in more available locations, making them potentially excellent sources for these valuable materials. Now-defunct asteroid-mining startup Planetary Resources once estimated that one “platinum-rich 500 meter wide asteroid contains . . . 1.5 times the known world-reserves of platinum group metals (ruthenium, rhodium, palladium, osmium, iridium, and platinum).” 7 In addition to returning elements to a resource-hungry Earth, further exploration and development of space will require access to resources that are not purely sourced from Earth. In particular, it will be necessary to gain access to water, which is relatively rare in the inner solar system and which would be far too costly to transport in any significant amounts from the Earth’s surface.

Another reason that humans may want to explore space would be to create a “backup Earth” to hedge against global catastrophic and existential risks (risks that may cause widespread disaster or human extinction, respectively) on our home planet. 8 Earth has always been a dangerous place for humans, with asteroid impacts, supervolcanic eruptions, pandemic disease, and other natural hazards threatening civilization. Now, in addition to these natural threats, human-made hazards such as nuclear weapons, climate change, biotechnology, nanotechnology, and artificial intelligence may threaten not only the viability of technological civilization but perhaps the survival of human life itself. A serious global-scale catastrophe could set back civilization many decades or centuries, and the worst disasters could cause human extinction. In one scenario, in which 100 percent of humanity dies, all of human effort for all of history would be for nothing. However, were the same global catastrophe to happen to Earth, yet humans were a multiplanetary species with just one self-sustaining settlement off-Earth, it would not result in the end of human civilization or human extinction. Instead while the same unimaginable fate would befall the Earth (certainly no mere triviality, with perhaps the deaths of 99.999 percent of all humans and possibly the destruction of the ecosphere and everything in it), at least all of human and planetory history would not be for nothing. Human life and culture would go on elsewhere, as well as other Earth species. This is a dire fate, but less terrible than the first.

#### Private actors are less radical and actively deter war in space

Cobb 21 [Wendy N. Whitman Cobb, Associate Professor of Strategy and Security Studies at the School of Advanced Air and Space Studies, “Privatizing Peace: How Commerce Can Reduce Conflict in Space,” 2021, Routledge, pp. 68-69, EA]

Finally, given the involvement of an ever-larger number of private actors in space, states also need to consider the lost opportunity costs if private actors choose to forego research, development, and deployment of new technologies because the danger in space is too high. As space becomes more commercialized, these private actors can exert pressure on states to behave peacefully in order to promote further economic development. Gartzke and Quan Li argue that this can happen through the movement of capital from conflict-prone states or areas to non-conflictual states.50 This is not necessarily applicable to space because there is no area in space which is formally protected, but commercial space actors may choose not to engage in new economic investment which can in turn affect a state’s economic performance. To date, the size of the space sector is comparatively small, so, arguably, the potential economic loss would not be that great. Where the harm comes from is state reliance on private actors for military and national security space services. As states contract out space services to a greater extent, private actors exert an even greater influence over the state by having a capability they do not.

Why might private companies want a more conflict-free space? If there is weaponized conflict in space, they could potentially benefit through new launches to send up replacement satellites; this is similar to an argument that war can actually be beneficial to an economy because companies are needed to create materiel and weapons.51 But, in a debris filled environment, sending replacements is more difficult and dangerous. Some private companies want to engage in human spaceflight; a conflictual or more dangerous orbital environment would likely prevent those activities or increase their costs to such an extent that it becomes economically infeasible. James Clay Moltz argues specifically that “the growing presence of space tourists in low-Earth orbit would greatly increase the incentives for restraint in any future [ASAT] test programs.”52 Those foregone development costs and commercial activities can have a similar cost to states simply by discouraging private actors from participating in the market.

#### Commercial mining of asteroids solves a plethora of existential threats from scarcity, climate, terror, war, and disease.

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 overcrowded 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 terrorist 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 technologies 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 airplanes, 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, artificial intelligence 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 warfare 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.

#### Resource scarcity coming now and causes extinction—asteroid mining is the only way to solve

Crombrugghe 18 – Guerric, Business Development Manager Brussels, Brussels Capital Region, “Asteroid mining as a necessary answer to mineral scarcity”, LinkedIn, 1/11/2018, <https://www.linkedin.com/pulse/asteroid-mining-necessary-answer-mineral-scarcity-de-crombrugghe>

We need minerals, and we always will. Yet, our reserves are finite and a 100% end-of-life recycling rate is impossible to achieve. Eventually, new entrants will therefore be required to sustain our system. While the business case for asteroid mining can obviously not be closed with current technologies, it will someday become a necessity. We may as well start preparing ourselves. Scarcity of resources, the challenge of the 21st century According to the World Bank, in 2016 humanity's growth rate was of 1.18% in terms of population, and 2.50% in terms of GDP. Both of these, in turn, drive our staggering resource consumption: there are more of us, and each of us needs more. On the other, the Earth is a closed system, and resources are only available in a finite amount. We all know by now that there is only this much oil & gas, but the same can actually be said for water, arable land, minerals, etc. These two simple observations have sparkled the debate around the scarcity of resources. Even with the best intentions, mathematics teaches us that it is impossible to indefinitely extract resources from a given finite supply [1]. The problem arising in the short-term is the exhaustion of the existing supply. That limit is actually coming in fast. In a paper published in 2007, Stephen Kessler demonstrates that the global mineral reserves are only sufficient for the next 50 years. The figure on the right shows the ratio of known global reserve to global annual consumption, given a rough indication of adequacy in years. It dates from an earlier paper, published in 1994. Since then, the development of environmental-friendly technologies (e.g. batteries, electric engines, etc.) has drastically increased the consumption rate of high-tech metals such as cobalt, platinum, rare earths, or titanium. On the other hand, exploration programs have allowed to discover new deposits, notably of gold and diamond. We will certainly be able to continue to increase - or at least sustain - our reserves, but only temporarily. Recycling and other temporary fixes An obvious solution is recycling, i.e. rejuvenating our stocks. A popular concept to illustrate this idea is that of urban mining: retrieving the ores present in smartphones and other electronic devices. It may prove to be not only more environmental-friendly, be also safer and more cost-effective. Nevertheless, every solution based on recycling is, again, nothing more than a temporary fix, buying us a finite amount of time. The United Nations Environment Programme studied in a report the current recycling rate of 60 metals. More than half of them have an end-of-life recycling rate below 1%, and less than one-third are above 50%. Nickel, for example, is relatively easy to retrieve, with and end-of-life recycling rate of up to 63% under the best conditions. At that rate, less than 1% of the initial stock is available after only 10 cycle. Even with a staggering 99% efficiency, the same 1% limit is achieved in less than 460 cycles. Not bad, of course, but still not enough. Should our hunger for resources continue, and even with the most optimised recycling techniques, a second problem will arise in the longer term: the amount of resources needed at a given time will simply exceed the total available stock. Unless we manage to find growth vectors that do not require raw materials, that tipping point is an impassable limit. Its proximity obviously depends on our consumption rate. Asteroid mining? No matter which way we look at it, we will thus be short on resources, either through sheer exhaustion (i.e. transformation in an unrecoverable form) or because the demand will exceed the total reserves. We can - and should - talk about recycling, dematerialisation, and other more ethically questionable solutions such as bio-engineering. Nonetheless, no matter how good they are, these are only temporary fixes. If we don't radically change our lifestyle, we will sooner or later have to address the elephant in the room: the Earth is a closed system, we need new entrants. How can space help? Short answer: all these minerals can be found in space. Some are difficult to obtain, others are even more difficult, none are straightforward. The most accessible destination is near-Earth asteroids, a reservoir of over 17,000 known - and counting - giant rocks that regularly cross the orbit of our planet. They are commonly classified in three main families. The most interesting one, for our case, is that of the S-type asteroids. These are metallic bodies, containing first and foremost nickel, iron and cobalt, but also gold, ores from the platinum group. But the list doesn't stop there, many other minerals can be found in smaller amounts: iridium, silver, osmium, palladium, rhenium, rhodium, ruthenium, manganese, molybdenum, aluminium, titanium, etc. How do we get there? Let's take an example: Ryugu, formerly known as 1999 JU3. It's a C-type asteroid measured to be approximately one kilometre in size [2]. In addition to nickel, iron and cobalt, it also contains a fair share of water, nitrogen, hydrogen, and ammonia. Its total value is estimated to be approximately 80 billion USD. Fantastic! But how do we get there and, most importantly, how much does it cost? Well, we may have the start of an answer to these questions. Reaching Ryugu is a technological challenge, but it is feasible. In December 2014, the Japanese space agency has launched a spacecraft, Hayabusa2, heading to the asteroid. Its mission includes the collection of a small sample which will be sent back to the Earth, with a landing planned for December 2020. The target for the sample size is at least 100 µg. The total cost of the mission was projected to be around 200 million USD. That's 2 trillion USD per gram. Let's be optimistic and assume that the sample retrieved is pure gold. At today's rate, it is worth 42.5 USD per gram. That's a difference of over 10 orders of magnitude. Some may argue that Hayabusa2 has many other objectives that retrieving a sample. The mission does indeed include multiple landers, thorough scientific investigations, etc. There is actually another asteroid sample return mission underway, which we could you as a second point of comparison: OSIRIS-Rex, from NASA. It's heading for Bennu, also a C-type asteroid, which it will reach in August 2018. Total cost of the mission: 980 million USD. Target sample size: at least 60 g. We achieve thus roughly speaking 16 million USD per gram. Better, but still 6 orders of magnitude off compared to pure gold. It's pretty much as good as it gets with existing state-of-the-art technologies. Not much of a business case. Should we forget about it? Referring back to our earlier conclusion on resource scarcity, we had two options. Either we drastically reduce our resource consumption, to such a degree that reserves can last for longer than humanity itself, or we extend our closed system, the Earth, to nearby asteroids. In the current state of affairs, I am honestly not sure which course of action is the easiest. As they get increasingly rare, the cost of minerals will go up. On the other hand, as explained in a previous article, we can expect the cost of space activities to go steadily down. Step by step, these 6 orders of magnitude will slowly get munched away from both ends, until eventually asteroid mining becomes a viable operation. In other words: it will only become financially interesting once minerals become a thousand times more expensive and space activities a thousand times cheaper. As a point of reference, the introduction of reusable rockets by SpaceX, widely considered as one of the few truly disruptive changes in the aerospace sector in the last few decades, has "only" brought a cost reduction of 30%. While it's clearly amazing, we still need at least 220 innovations of the same calibre [3] before we can make it work (again: assuming the price of minerals simultaneously goes up by a factor of a thousand). It's therefore quite likely that space mining will not take place within our lifetime [4]. How can we accelerate the process? Firstly, we can only celebrate and support the numerous private initiatives which contribute to make that reality happen, either indirectly (e.g. launchers, space systems, etc.) or directly (e.g. in-space manufacturing, lunar exploration, etc.). Shout out to all the folks who manage to keep the flame of space exploration burning while generating profit for their investors. Secondly, space agencies and other institutional actors should continue to act as promoters of pioneering mission such as Hayabusa2, OSIRIS-REx, or DART. We can only regret that the Asteroid Redirect Mission from NASA and the Asteroid Impact Mission from ESA were not funded. From my perspective, these should actually be amongst the top priorities of our space exploration agenda. Not only are they instrumental to our understanding of the solar system, but they are also essential if we want to avoid the same fate as the dinosaurs. It's a question of survival. As a bonus, they also pave the way towards cost-efficient asteroid mining. In the meantime, we might want to consume existing resources a bit more efficiently.