# FW

#### The standard is maximizing expected well-being.

#### 1] Only pleasure and pain are intrinsically valuable – all other frameworks collapse.

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] TDI

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.

#### ] Util is a lexical pre-requisite to any other framework-threats to bodily security and life preclude the ability for moral actors to effectively utilize and act upon other moral theories since they are in a constant state of crisis that inhibit the ideal moral conditions which other theories presuppose – so, util comes first and my offense outweighs theirs under their own framework.

#### ] Actor specificity: util is the best for governments, which is the actor in the rez – multiple warrants:

#### [a] Governments must aggregate since every policy benefits some and harms others, which also means side constraints freeze action.

#### [d] Actor-specificity comes first since different agents have different ethical standings. Takes out util calc indicts since they’re empirically denied and link turns them because the alt would be no action.

#### 4] Only consequentialism explains degrees of wrongness—if I break a promise to meet up for lunch, that is not as bad as breaking a promise to take a dying person to the hospital. Only the consequences of breaking the promise explain why the second one is much worse than the first. That impacts to weighing meaning rounds are only resolvable under our interp

#### ] Extinction outweighs

Pummer 15 [Theron, Junior Research Fellow in Philosophy at St. Anne's College, University of Oxford. “Moral Agreement on Saving the World” Practical Ethics, University of Oxford. May 18, 2015] AT

There appears to be lot of disagreement in moral philosophy. Whether these many apparent disagreements are deep and irresolvable, I believe there is at least one thing it is reasonable to agree on right now, whatever general moral view we adopt: that it is very important to reduce the risk that all intelligent beings on this planet are eliminated by an enormous catastrophe, such as a nuclear war. How we might in fact try to reduce such existential risks is discussed elsewhere. My claim here is only that we – whether we’re consequentialists, deontologists, or virtue ethicists – should all agree that we should try to save the world. According to consequentialism, we should maximize the good, where this is taken to be the goodness, from an impartial perspective, of outcomes. Clearly one thing that makes an outcome good is that the people in it are doing well. There is little disagreement here. If the happiness or well-being of possible future people is just as important as that of people who already exist, and if they would have good lives, it is not hard to see how reducing existential risk is easily the most important thing in the whole world. This is for the familiar reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. There are so many possible future people that reducing existential risk is arguably the most important thing in the world, even if the well-being of these possible people were given only 0.001% as much weight as that of existing people. Even on a wholly person-affecting view – according to which there’s nothing (apart from effects on existing people) to be said in favor of creating happy people – the case for reducing existential risk is very strong. As noted in this seminal paper, this case is strengthened by the fact that there’s a good chance that many existing people will, with the aid of life-extension technology, live very long and very high quality lives. You might think what I have just argued applies to consequentialists only. There is a tendency to assume that, if an argument appeals to consequentialist considerations (the goodness of outcomes), it is irrelevant to non-consequentialists. But that is a huge mistake. Non-consequentialism is the view that there’s more that determines rightness than the goodness of consequences or outcomes; it is not the view that the latter don’t matter. Even John Rawls wrote, “All ethical doctrines worth our attention take consequences into account in judging rightness. One which did not would simply be irrational, crazy.” Minimally plausible versions of deontology and virtue ethics must be concerned in part with promoting the good, from an impartial point of view. They’d thus imply very strong reasons to reduce existential risk, at least when this doesn’t significantly involve doing harm to others or damaging one’s character. What’s even more surprising, perhaps, is that even if our own good (or that of those near and dear to us) has much greater weight than goodness from the impartial “point of view of the universe,” indeed even if the latter is entirely morally irrelevant, we may nonetheless have very strong reasons to reduce existential risk. Even egoism, the view that each agent should maximize her own good, might imply strong reasons to reduce existential risk. It will depend, among other things, on what one’s own good consists in. If well-being consisted in pleasure only, it is somewhat harder to argue that egoism would imply strong reasons to reduce existential risk – perhaps we could argue that one would maximize her expected hedonic well-being by funding life extension technology or by having herself cryogenically frozen at the time of her bodily death as well as giving money to reduce existential risk (so that there is a world for her to live in!). I am not sure, however, how strong the reasons to do this would be. But views which imply that, if I don’t care about other people, I have no or very little reason to help them are not even minimally plausible views (in addition to hedonistic egoism, I here have in mind views that imply that one has no reason to perform an act unless one actually desires to do that act). To be minimally plausible, egoism will need to be paired with a more sophisticated account of well-being. To see this, it is enough to consider, as Plato did, the possibility of a ring of invisibility – suppose that, while wearing it, Ayn could derive some pleasure by helping the poor, but instead could derive just a bit more by severely harming them. Hedonistic egoism would absurdly imply she should do the latter. To avoid this implication, egoists would need to build something like the meaningfulness of a life into well-being, in some robust way, where this would to a significant extent be a function of other-regarding concerns (see chapter 12 of this classic intro to ethics). But once these elements are included, we can (roughly, as above) argue that this sort of egoism will imply strong reasons to reduce existential risk. Add to all of this Samuel Scheffler’s recent intriguing arguments (quick podcast version available here) that most of what makes our lives go well would be undermined if there were no future generations of intelligent persons. On his view, my life would contain vastly less well-being if (say) a year after my death the world came to an end. So obviously if Scheffler were right I’d have very strong reason to reduce existential risk. We should also take into account moral uncertainty. What is it reasonable for one to do, when one is uncertain not (only) about the empirical facts, but also about the moral facts? I’ve just argued that there’s agreement among minimally plausible ethical views that we have strong reason to reduce existential risk – not only consequentialists, but also deontologists, virtue ethicists, and sophisticated egoists should agree. But even those (hedonistic egoists) who disagree should have a significant level of confidence that they are mistaken, and that one of the above views is correct. Even if they were 90% sure that their view is the correct one (and 10% sure that one of these other ones is correct), they would have pretty strong reason, from the standpoint of moral uncertainty, to reduce existential risk. Perhaps most disturbingly still, even if we are only 1% sure that the well-being of possible future people matters, it is at least arguable that, from the standpoint of moral uncertainty, reducing existential risk is the most important thing in the world. Again, this is largely for the reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. (For more on this and other related issues, see this excellent dissertation). Of course, it is uncertain whether these untold trillions would, in general, have good lives. It’s possible they’ll be miserable. It is enough for my claim that there is moral agreement in the relevant sense if, at least given certain empirical claims about what future lives would most likely be like, all minimally plausible moral views would converge on the conclusion that we should try to save the world. While there are some non-crazy views that place significantly greater moral weight on avoiding suffering than on promoting happiness, for reasons others have offered (and for independent reasons I won’t get into here unless requested to), they nonetheless seem to be fairly implausible views. And even if things did not go well for our ancestors, I am optimistic that they will overall go fantastically well for our descendants, if we allow them to. I suspect that most of us alive today – at least those of us not suffering from extreme illness or poverty – have lives that are well worth living, and that things will continue to improve. Derek Parfit, whose work has emphasized future generations as well as agreement in ethics, described our situation clearly and accurately: “We live during the hinge of history. Given the scientific and technological discoveries of the last two centuries, the world has never changed as fast. We shall soon have even greater powers to transform, not only our surroundings, but ourselves and our successors. If we act wisely in the next few centuries, humanity will survive its most dangerous and decisive period. Our descendants could, if necessary, go elsewhere, spreading through this galaxy…. Our descendants might, I believe, make the further future very good. But that good future may also depend in part on us. If our selfish recklessness ends human history, we would be acting very wrongly.” (From chapter 36 of On What Matters)

# Disads

## DA - Innovation

#### Competition in space between private entities lowers costs and barriers of entry for other companies increasing technological innovation

Lizzy Gurdus, FEB 27 **2021**, CNBC, “Private companies such as SpaceX are driving costs down for everyone in the space race, says man behind UFO ETF”, [https://www.cnbc.com/2021/02/27/private-companies-like-spacex-are-driving-industry-costs-down-ceo.html] ahs ja

Private space companies are paving the industry’s path to profits, says the man behind the Procure Space ETF (UFO). By taking part in the rapidly developing “space race,” billionaire-backed entities such as Elon Musk’s SpaceX and Jeff Bezos’s Blue Origin are lowering costs across the board, ProcureAM CEO Andrew Chanin told CNBC’s “ETF Edge” this week. “They’re able to get the cost of launch down and that’s going to allow more companies to send things into outer space cheaper,” Chanin said in the Wednesday interview. “They’re really opening up the entire environment for space companies and future would-be space companies to lower those barriers of entry.” They’re also lowering costs for government-sponsored space programs by competing amongst themselves for NASA contracts, Chanin said. “They’re actually freeing up more of NASA’s budget to be able to invest in other areas of space, he said. “This competition I think is very healthy. Not necessarily every company’s going to be a winner, but hopefully this competition can drive down prices and also let the best technologies win.” NASA now also has contracts with more than 300 publicly traded U.S. companies, said Chanin, whose UFO ETF counts Loral Space & Communications and Gilat Satellite Networks as its top two holdings. “It’s not just necessarily a pure-play space company that might get a contract,” the CEO said. “It’s really opening up opportunities for everyone.” That’s why it’s important to look beyond name recognition in this particular area of investing, Matthew Bartolini, State Street’s head of SPDR Americas research, said in the same “ETF Edge” interview. State Street offers the SPDR S&P Kensho Final Frontiers ETF (ROKT), the first space ETF to hit the market. The fund’s top three holdings are Maxar Technologies, Virgin Galactic and Aerojet Rocketdyne. Bartolini recommended “to not just look at the high-flying names like SpaceX or Blue Origin that are in the private markets, but showcase what companies in the public markets help supply them.” Aerojet Rocketdyne, which defense giant Lockheed Martin is buying in hopes of competing with private space companies, played a key role in Blue Origin’s New Shepard rocket launch, Bartolini said. “You can see the derivative effects of a private company impacting the public markets just from that one example of Lockheed and Aerojet,” he said. “It helps underscore the opportunity that you’re seeing in space.” As space companies embrace greater efficiency, more government support and more commercial applications on Earth in areas such as satellite technology, that opportunity is likely to grow and continue to filter into public markets, Bartolini said. Morgan Stanley has said the global space industry could produce revenues of over $1 trillion by 2040. Current global revenues are roughly $350 billion. UFO and ROKT both fell by more than 1% on Friday. UFO is up over 14% year to date, while ROKT is up nearly 2%.

#### This innovation is occurring in the squo – the aff plan will only harm progress

Seetha Raghava, August 4th **2021**, UFC TODAY, “The Impact of Innovation in the New Era of Space Exploration”, [https://www.ucf.edu/news/the-impact-of-innovation-in-the-new-era-of-space-exploration/] ahs ja

Every once in a while, a confluence of discoveries, events and initiatives results in a breakthrough so significant that it propels the entire world to a higher level, redefining what is possible in so many different fields. This breakthrough is taking centerstage now, as the new era of space exploration — catalyzed by increasing launch access — dawns upon us. The surge of innovation that comes with this will create new opportunities and inspire the next generation of doers. When this happens, boundaries between scientific and social impact are blurred. Innovation leading to scientific discovery can benefit society in the same way that social innovation can diversify and support scientific innovators, who can contribute to global progress. To ride this wave of progress, we must all participate and innovate in the new era of space exploration. The intersection of space exploration, innovation and impact isn’t a new phenomenon. In the past, technology developments and spin-offs from space research have consistently found their way into communities worldwide sometimes with lifesaving benefits. The International Space Station supports experiments that have led to discoveries and inventions in communication, water purification, and remote guidance for health procedures and robotic surgeries. Satellite-enabled Earth observation capabilities that monitor natural disasters, climate and crops often support early warnings for threats and mitigation strategies. Space exploration has always been relevant to everyone no matter the discipline or interest. Commercialization of space has been key in many ways to the current boost in “firsts” over the last few years. It has spurred innovation in launch vehicles and related technologies that led to firsts in vertical-takeoff-vertical landing rocket technology, reusability of rocket boosters and privately developed crewed missions to orbit. Concurrently, NASA has continued to captivate our imagination with the first flight of a helicopter in another world, a mission to return an asteroid sample to Earth and sending a probe to make the closest ever approach to the sun. While we celebrate the scientific progress, there is a vastly important question that we all need to focus on: How can we drive the surge in innovation offered by increased access to space, to benefit humankind? Access to low-Earth orbit, and eventually human exploration of space, is a portal to achieve many impactful outcomes. The numbers and completion rate of microgravity experiments conducted by scientists will be greatly increased as a range of offerings in suborbital flights provide more opportunities to advance critical research in health, agriculture, energy, and more. Lunar, planetary, and even asteroid exploration may lead to discoveries of new materials — busting the limitations now imposed on capabilities for energy, transportation, and infrastructure or creating new sensors and devices that enhance safety on Earth. Space tourism —one can hope — has the power to potentially create an awareness of our oneness that may lead to social change. But much like all scientific endeavors, we cannot ignore the importance of pre-emptively identifying and mitigating negative impacts of new ventures some of which may have already taken shape. We need to consider space debris that threatens the very access that facilitates it, safety and rescue readiness to support increased crewed missions and space tourism, national security, and effects of light pollution on astronomy. Much of these can be approached and mitigated with new concepts and ideas that have already been set in motion. One thing is for certain, space has always been the inspiration for the next generation of innovators and creative thinkers. Architects of new ideas in this era will inspire many more. Ingenuity must also come from academic and research institutions building a new space-ready generation through innovative curriculum, scholarships, and research opportunities for key fields at all levels. Most of all, engaging participation is a responsibility anyone can take by steering the conversation and gathering ideas on how we can make this era one of positive benefit for all, while making opportunities inclusive to all.

#### 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

## AT – Commercial Mining

#### Asteroid mining is an unqualified good – it’s essential to advanced asteroid deflection, deep space travel, and fighting climate change

Heise 18 -- Jack Heise (Judicial Law Clerk at U.S. Courts of Appeals), Space, the Final Frontier of Enterprise: Incentivizing Asteroid Mining Under a Revised International Framework, 40 Mich. J. Int'l L. 189 (2018). https://repository.law.umich.edu/mjil/vol40/iss1/5 WJ

Asteroid mining has the potential to facilitate space travel, an outcome the OST holds to be in the interest of humanity as a whole.39 The potential of asteroid mining to reduce the cost of spaceflight, moreover, could facilitate the growth of the space economy. Asteroid mining thus aligns with another stated purposes of the OST in the sense that an expanded space econ- omy could provide substantial benefits to all mankind.40 First, in seeking to face the challenges posed by space travel, the public sector space race gave rise to numerous technological innovations, ranging from LEDs to emergency blankets to memory foam.41 It seems likely that the private space race would result in a similar degree of innovation, the products of which could benefit people across the globe.

Second, a successful mission to Mars could provide benefits beyond a mere sense of interplanetary accomplishment. NASA suggests that, given the parallels between the formation and evolution of Mars and Earth, a voyage there could help “us learn more about our own planet’s history and future.”42 The scientific advancements from such a mission cannot currently be anticipated and are difficult to predict, but “expand[ing] the frontiers of knowledge” in this manner could well bring benefits to all mankind.43

Third, the development of asteroid mining technology could also help advance asteroid diversion tactics. The development of the technology required to conduct successful asteroid mining operations could “help us to divert any incoming asteroids.”44 This is of great importance since NASA recently eliminated its Asteroid Redirect Mission due to funding cuts;45 NASA’s project was hailed by some scientists as a “critical step in demonstrating we can protect our planet from a future asteroid impact . . . .”46 Asteroid mining could step in and fill an important void. While the probability of an Armageddon-causing impact is low, the effects of an impact would be extremely severe.47 Even some mitigation of this risk as a byproduct of as- teroid mining would be a benefit to humanity as a whole.

Finally, reduced launch costs could facilitate measures to combat global climate change. One proposed solution for canceling out predicted increases in average worldwide temperature is to “prevent[] . . . about 1% of incoming solar radiation—insolation—from reaching the Earth. This could be done by scattering into space from the vicinity of Earth an appropriately small frac- tion of total insolation.”48 Asteroid mining could facilitate such measures in that “[t]echnologies that could greatly decrease the cost of space-launch could make a telling difference in the practicality of all types of space- deployed scattering systems of scales appropriate to insolation modulation.”49 There are certainly intermediate measures to combat climate change that ought to be taken first, but asteroid mining would facilitate this expedited solution. While some of the benefits of asteroid mining would doubtless accrue primarily to those nations with asteroid mining companies within their borders, the benefits noted in this section—space exploration as a gen- eral proposition, technological and scientific development, improvement of asteroid diversion technology, and facilitated means of swiftly countering climate change—would inure substantially to the benefit of all mankind.

#### Prohibitions on appropriation prevent asteroid mining despite growing space industries

Myers 16 -- Ross Myers (J.D. candidate at the University of Oregon Law School.), The Doctrine of Appropriation and Asteroid Mining: Incentivizing the Private Exploration and Development of Outer Space, 2016, Oregon Review of International Law, https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/19850/Meyers.pdf?sequence=1 WJ

Despite a decrease in national space program funding, corporate space missions are on the rise. In 2010, President Obama proposed that NASA exit the business of flying astronauts from Earth to low Earth orbit and move it to private companies.52 Several companies have stepped up to bat, and corporate space programs now include space tourism, supply missions, and in one case a one-way colonization mission to Mars.53 Corporate interest in space tourism and development demonstrates a strong private commercial interest in space as an industry, which could serve to finance the exploration of space in a period where national governments do not have an active financial interest in space. However, under current international treaties, the ownership of asteroids is prohibited, preventing corporations willing to invest in asteroid mining from having a secure claim.

#### 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.

#### Resource Shortages Exacerbate Conflict

Wingo 13 - Dennis Wingo, Former CTO of the Orbital Recovery Corporation, Founder & CEO of Skycorp Inc, and Greentrail Energy Inc., Co-Founder & CTO of Orbital Recovery Inc. Leader of NASA's the Lunar Orbiter Image Recovery Project (LOIRP), First in history to rescue and operate a spacecraft (ISEE-3) in interplanetary space, and University of Alabama in Huntsville Consortium for Materials Development in Space Researcher At University of Alabama in Huntsville Consortium for Materials Development in Space “Commentary | The Inevitability of Extraterrestrial Mining”, *Space News*, 7/29/2013, https://spacenews.com/36511the-inevitability-of-extraterrestrial-mining/

I am honored to provide the counterpoint to my esteemed colleague Ambassador Roger Harrison’s negative contention concerning the mining of extraterrestrial materials off of planet Earth. Let’s begin with his ending: “The conclusion is inescapable, though liable to be escaped, i.e., that raw materials will never be mined in space and sold profitably within the atmosphere or anywhere else. … Asteroids will continue unvexed in their obits, and the Moon too.” I bring a different quote, from the book “Empire Express,” the story of the intercontinental railroad, from U.S. Army Lt. Zebulon Pike, for whom Pike’s Peak is named: “In various places there were tracts of many leagues, where the wind had thrown up sand in all the fanciful forms of the ocean’s rolling wave, and on which not a spear of vegetable matter existed.” Pike’s visions of sand dunes, pathless wastes and sterile soils were reported, widely read and faithfully believed by geographers. The myth became innocently embellished by subsequent visitors, especially those in the party of Maj. Stephen H. Long, who traversed the whole area in 1820. It was reported to be “an unfit residence for any but a nomad population … forever to remain the unmolested haunt of the native hunter, the bison, and the jackal.” The delicious irony is that Mr. Harrison today lives in the shadow of Pike’s Peak, and the U.S. Air Force Academy where he teaches is in the middle of the confidently prophesied unmolested haunt. When Long’s report was written, the Erie Canal across New York was five years from completion and it was another 31 years before the first railroad was completed across the state. Mr. Harrison’s technical objections are for the most part valid today for his scenario, just as objections to a railroad across the North American continent were valid in the 1820s. However, technology is being developed today that will enable extraterrestrial mining, manufacturing and development just as technology was developed that would enable the creation of the national railroad. Mr. Harrison says it is an illusion that we are running out of resources. He is correct. That is not our claim. The claim is that extraction costs of economically viable terrestrial resources are rising dramatically and may soon exceed the cost of extraction from much more plentiful extraterrestrial sources. Today rapidly advancing costs and diminishing returns are rapidly redefining mining due to diminishing ore grades. This fact is developed in a 2012 distinguished lecture by Dan Wood before the Society of Environmental Geologists, “Crucial Challenges to Discovery and Mining — Tomorrow’s Deeper Ore Bodies.” This is a vitally important issue to solve as resource conflict has been the impetus for most wars in human history. We live in a global civilization of over 7 billion people, which will expand to over 9 billion before plateauing in mid-century. While American politicians are not paying attention to what this means, the rest of the world is noticing. Gross domestic product (GDP) growth and increasing global resource demand are addressed in “Iron Ore Outlook 2050,” a report commissioned for the Indian government. The GDP of the major powers (the United States, Europe, China, India and Japan) is forecast to rise from $48 trillion in 2010 to $149 trillion by 2050. The report’s substance is that with this massive increase in global GDP, an intensifying scramble for metal resources is inevitable. If the trend of resource consumption demand increase continues unabated, there are three likely potential outcomes. The first is collapse, forecast by the “Limits to Growth” school of thought. The second and more likely scenario is fierce national economic competition leading to wars over diminishing resources. The third, and most desirable, is to increase the global resource base by the economic and industrial development of the inner solar system. Mr. Harrison uses cost as the primary reason that extraterrestrial mining will never happen by focusing on a straw man argument related to mining asteroids in orbits far from Earth. Just as the U.S. railroad infrastructure began on shorter routes with lower capital requirements and shorter payback periods, asteroid mining can begin with our nearest neighbor, the Moon, where telepresence robotics, high-bandwidth communications and a short three-day trip for humans negate his premise. We know from the Apollo samples that plentiful metallic asteroidal materials exist in the lunar highlands. We also know from several missions that extensive water, titanium, thorium, uranium, aluminum and native iron all exist on the Moon, in easily separable oxide form. Improvements in remote sensing data from current missions and computer modeling continue to increase the amount of potential asteroidal material on the Moon, increasing confidence in the Moon first premise. The extensive resources of the Moon become the catalyst for an inner solar system-wide economy providing fuel, vehicles and the all-important experience in developing an industrial infrastructure off planet. The asteroids then become the force multiplier of inner solar system development with billions of tons of water, metals and free space energy from solar power. Mars figures in here as well as the second home of humanity, creating further demand for asteroidal resources, and providing something else that is becoming increasingly scarce on the Earth: hope for the future. The technical barriers that Mr. Harrison points to are being overcome just as those of the 19th century were. New technology developments in 3-D printing, additive manufacturing and advanced robotics are breaking down the final barriers to exploiting off-planet resources and indeed the industrial development of the inner solar system. It is not a question if, it is a question of when, and by whom. Just as the Pacific Railway Act of 1862 was a primary catalyst for a century of American economic growth, it should be the role of government to develop policies and concrete legislation to support this development for the continued health of the American economy and the future of all mankind.

#### Those Conflicts go Nuclear

Klare 13 – Michael T., professor emeritus of peace and world-security studies at Hampshire College and senior visiting fellow at the Arms Control Association in Washington, DC, " How Resource Scarcity and Climate Change Could Produce a Global Explosion", *The Nation*, 4/22/2013, <https://www.thenation.com/article/how-resource-scarcity-and-climate-change-could-produce-global-explosion/> JHW

Resource Shortages and Resource Wars Start with one simple given: the prospect of future scarcities of vital natural resources, including energy, water, land, food and critical minerals. This in itself would guarantee social unrest, geopolitical friction and war. It is important to note that absolute scarcity doesn’t have to be on the horizon in any given resource category for this scenario to kick in. A lack of adequate supplies to meet the needs of a growing, ever more urbanized and industrialized global population is enough. Given the wave of extinctions that scientists are recording, some resources—particular species of fish, animals and trees, for example—will become less abundant in the decades to come, and may even disappear altogether. But key materials for modern civilization like oil, uranium and copper will simply prove harder and more costly to acquire, leading to supply bottlenecks and periodic shortages. Oil—the single most important commodity in the international economy—provides an apt example. Although global oil supplies may actually grow in the coming decades, many experts doubt that they can be expanded sufficiently to meet the needs of a rising global middle class that is, for instance, expected to buy millions of new cars in the near future. In its 2011 World Energy Outlook, the International Energy Agency claimed that an anticipated global oil demand of 104 million barrels per day in 2035 will be satisfied. This, the report suggested, would be thanks in large part to additional supplies of “unconventional oil” (Canadian tar sands, shale oil and so on), as well as 55 million barrels of new oil from fields “yet to be found” and “yet to be developed.” However, many analysts scoff at this optimistic assessment, arguing that rising production costs (for energy that will be ever more difficult and costly to extract), environmental opposition, warfare, corruption and other impediments will make it extremely difficult to achieve increases of this magnitude. In other words, even if production manages for a time to top the 2010 level of 87 million barrels per day, the goal of 104 million barrels will never be reached and the world’s major consumers will face virtual, if not absolute, scarcity. Water provides another potent example. On an annual basis, the supply of drinking water provided by natural precipitation remains more or less constant: about 40,000 cubic kilometers. But much of this precipitation lands on Greenland, Antarctica, Siberia and inner Amazonia where there are very few people, so the supply available to major concentrations of humanity is often surprisingly limited. In many regions with high population levels, water supplies are already relatively sparse. This is especially true of North Africa, Central Asia and the Middle East, where the demand for water continues to grow as a result of rising populations, urbanization and the emergence of new water-intensive industries. The result, even when the supply remains constant, is an environment of increasing scarcity. Wherever you look, the picture is roughly the same: supplies of critical resources may be rising or falling, but rarely do they appear to be outpacing demand, producing a sense of widespread and systemic scarcity. However generated, a perception of scarcity—or imminent scarcity—regularly leads to anxiety, resentment, hostility and contentiousness. This pattern is very well understood, and has been evident throughout human history. In his book Constant Battles, for example, Steven LeBlanc, director of collections for Harvard’s Peabody Museum of Archaeology and Ethnology, notes that many ancient civilizations experienced higher levels of warfare when faced with resource shortages brought about by population growth, crop failures or persistent drought. Jared Diamond, author of the bestseller Collapse, has detected a similar pattern in Mayan civilization and the Anasazi culture of New Mexico’s Chaco Canyon. More recently, concern over adequate food for the home population was a significant factor in Japan’s invasion of Manchuria in 1931 and Germany’s invasions of Poland in 1939 and the Soviet Union in 1941, according to Lizzie Collingham, author of The Taste of War. Although the global supply of most basic commodities has grown enormously since the end of World War II, analysts see the persistence of resource-related conflict in areas where materials remain scarce or there is anxiety about the future reliability of supplies. Many experts believe, for example, that the fighting in Darfur and other war-ravaged areas of North Africa has been driven, at least in part, by competition among desert tribes for access to scarce water supplies, exacerbated in some cases by rising population levels. “In Darfur,” says a 2009 report from the UN Environment Programme on the role of natural resources in the conflict, “recurrent drought, increasing demographic pressures, and political marginalization are among the forces that have pushed the region into a spiral of lawlessness and violence that has led to 300,000 deaths and the displacement of more than two million people since 2003.” Anxiety over future supplies is often also a factor in conflicts that break out over access to oil or control of contested undersea reserves of oil and natural gas. In 1979, for instance, when the Islamic revolution in Iran overthrew the Shah and the Soviets invaded Afghanistan, Washington began to fear that someday it might be denied access to Persian Gulf oil. At that point, President Jimmy Carter promptly announced what came to be called the Carter Doctrine. In his 1980 State of the Union Address, Carter affirmed that any move to impede the flow of oil from the Gulf would be viewed as a threat to America’s “vital interests” and would be repelled by “any means necessary, including military force.” In 1990, this principle was invoked by President George H.W. Bush to justify intervention in the first Persian Gulf War, just as his son would use it, in part, to justify the 2003 invasion of Iraq. Today, it remains the basis for US plans to employ force to stop the Iranians from closing the Strait of Hormuz, the strategic waterway connecting the Persian Gulf to the Indian Ocean through which about 35 percent of the world’s seaborne oil commerce passes. Recently, a set of resource conflicts have been rising toward the boiling point between China and its neighbors in Southeast Asia when it comes to control of offshore oil and gas reserves in the South China Sea. Although the resulting naval clashes have yet to result in a loss of life, a strong possibility of military escalation exists. A similar situation has also arisen in the East China Sea, where China and Japan are jousting for control over similarly valuable undersea reserves. Meanwhile, in the South Atlantic Ocean, Argentina and Britain are once again squabbling over the Falkland Islands (called Las Malvinas by the Argentinians) because oil has been discovered in surrounding waters. By all accounts, resource-driven potential conflicts like these will only multiply in the years ahead as demand rises, supplies dwindle and more of what remains will be found in disputed areas. In a 2012 study titled Resources Futures, the respected British think-tank Chatham House expressed particular concern about possible resource wars over water, especially in areas like the Nile and Jordan River basins where several groups or countries must share the same river for the majority of their water supplies and few possess the wherewithal to develop alternatives. “Against this backdrop of tight supplies and competition, issues related to water rights, prices, and pollution are becoming contentious,” the report noted. “In areas with limited capacity to govern shared resources, balance competing demands, and mobilize new investments, tensions over water may erupt into more open confrontations.” Heading for a Resource-Shock World Tensions like these would be destined to grow by themselves because in so many areas supplies of key resources will not be able to keep up with demand. As it happens, though, they are not “by themselves.” On this planet, a second major force has entered the equation in a significant way. With the growing reality of climate change, everything becomes a lot more terrifying. Normally, when we consider the impact of climate change, we think primarily about the environment—the melting Arctic ice cap or Greenland ice shield, rising global sea levels, intensifying storms, expanding desert and endangered or disappearing species like the polar bear. But a growing number of experts are coming to realize that the most potent effects of climate change will be experienced by humans directly through the impairment or wholesale destruction of habitats upon which we rely for food production, industrial activities or simply to live. Essentially, climate change will wreak its havoc on us by constraining our access to the basics of life: vital resources that include food, water, land and energy. This will be devastating to human life, even as it significantly increases the danger of resource conflicts of all sorts erupting. We already know enough about the future effects of climate change to predict the following with reasonable confidence: \* Rising sea levels will in the next half-century erase many coastal areas, destroying large cities, critical infrastructure (including roads, railroads, ports, airports, pipelines, refineries and power plants) and prime agricultural land. \* Diminished rainfall and prolonged droughts will turn once-verdant croplands into dust bowls, reducing food output and turning millions into “climate refugees.” \* More severe storms and intense heat waves will kill crops, trigger forest fires, cause floods and destroy critical infrastructure. No one can predict how much food, land, water and energy will be lost as a result of this onslaught (and other climate-change effects that are harder to predict or even possibly imagine), but the cumulative effect will undoubtedly be staggering. In Resources Futures, Chatham House offers a particularly dire warning when it comes to the threat of diminished precipitation to rain-fed agriculture. “By 2020,” the report says, “yields from rain-fed agriculture could be reduced by up to 50%” in some areas. The highest rates of loss are expected to be in Africa, where reliance on rain-fed farming is greatest, but agriculture in China, India, Pakistan and Central Asia is also likely to be severely affected. Heat waves, droughts and other effects of climate change will also reduce the flow of many vital rivers, diminishing water supplies for irrigation, hydro-electricity power facilities and nuclear reactors (which need massive amounts of water for cooling purposes). The melting of glaciers, especially in the Andes in Latin America and the Himalayas in South Asia, will also rob communities and cities of crucial water supplies. An expected increase in the frequency of hurricanes and typhoons will pose a growing threat to offshore oil rigs, coastal refineries, transmission lines and other components of the global energy system. The melting of the Arctic ice cap will open that region to oil and gas exploration, but an increase in iceberg activity will make all efforts to exploit that region’s energy supplies perilous and exceedingly costly. Longer growing seasons in the north, especially Siberia and Canada’s northern provinces, might compensate to some degree for the desiccation of croplands in more southerly latitudes. However, moving the global agricultural system (and the world’s farmers) northward from abandoned farmlands in the United States, Mexico, Brazil, India, China, Argentina and Australia would be a daunting prospect. It is safe to assume that climate change, especially when combined with growing supply shortages, will result in a significant reduction in the planet’s vital resources, augmenting the kinds of pressures that have historically led to conflict, even under better circumstances. In this way, according to the Chatham House report, climate change is best understood as a “threat multiplier…a key factor exacerbating existing resource vulnerability” in states already prone to such disorders. Like other experts on the subject, Chatham House’s analysts claim, for example, that climate change will reduce crop output in many areas, sending global food prices soaring and triggering unrest among those already pushed to the limit under existing conditions. “Increased frequency and severity of extreme weather events, such as droughts, heat waves and floods, will also result in much larger and frequent local harvest shocks around the world….These shocks will affect global food prices whenever key centers of agricultural production area are hit—further amplifying global food price volatility.” This, in turn, will increase the likelihood of civil unrest. When, for instance, a brutal heat wave decimated Russia’s wheat crop during the summer of 2010, the global price of wheat (and so of that staple of life, bread) began an inexorable upward climb, reaching particularly high levels in North Africa and the Middle East. With local governments unwilling or unable to help desperate populations, anger over impossible-to-afford food merged with resentment toward autocratic regimes to trigger the massive popular outburst we know as the Arab Spring. Many such explosions are likely in the future, Chatham House suggests, if current trends continue as climate change and resource scarcity meld into a single reality in our world. A single provocative question from that group should haunt us all: “Are we on the cusp of a new world order dominated by struggles over access to affordable resources?” For the US intelligence community, which appears to have been influenced by the report, the response was blunt. In March, for the first time, Director of National Intelligence James R. Clapper listed “competition and scarcity involving natural resources” as a national security threat on a par with global terrorism, cyberwar and nuclear proliferation. “Many countries important to the United States are vulnerable to natural resource shocks that degrade economic development, frustrate attempts to democratize, raise the risk of regime-threatening instability, and aggravate regional tensions,” he wrote in his prepared statement for the Senate Select Committee on Intelligence. “Extreme weather events (floods, droughts, heat waves) will increasingly disrupt food and energy markets, exacerbating state weakness, forcing human migrations, and triggering riots, civil disobedience, and vandalism.” There was a new phrase embedded in his comments: “resource shocks.” It catches something of the world we’re barreling toward, and the language is striking for an intelligence community that, like the government it serves, has largely played down or ignored the dangers of climate change. For the first time, senior government analysts may be coming to appreciate what energy experts, resource analysts and scientists have long been warning about: the unbridled consumption of the world’s natural resources, combined with the advent of extreme climate change, could produce a global explosion of human chaos and conflict. We are now heading directly into a resource-shock world.