### FW

#### The standard is consistency with utilitarianism

#### 1] Actor specificity – Util is the only moral system available to policymakers. Even if the government uses Kant right now doesn’t mean they should. Goodin 95

Robert E. Goodin 95 [professor of government at the University of Essex, and professor of philosophy and social and political theory at Australian National University], “Utilitarianism as a Public Philosophy”, Cambridge Studies in Philosophy and Public Policy, May 1995, BE

Consider, first, the argument from necessity. Public officials are obliged to make their choices under uncertainty, and uncertainty of a very special sort at that. All choices - public and private alike - are made under some degree of uncertainty, of course. But in the nature of things, private individuals will usually have more complete information on the peculiarities of their own circumstances and on the ramifications that alternative possible choices might have for them. Public officials, in contrast, are relatively poorly informed as to the effects that their choices will have on individuals, one by one. What they typically do know are generalities: averages and aggregates. They know what will happen most often to most people as a result of their various possible choices. But that is all. That is enough to allow public policy-makers to use the utilitarian calculus - if they want to use it at all - to choose general rules of conduct. Knowing aggregates and averages, they can proceed to calculate the utility payoffs from adopting each alternative possible general rule. But they cannot be sure what the payoff will be to any given individual or on any particular occasion. Their knowledge of gener- alities, aggregates and averages is just not sufficiently fine-grained for that.

#### 2] Pleasure and pain are intrinsically valuable.

**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] SJDI, brackets in original

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.**

#### 3] The assumption that there are self-evident truths is the basic error of Kantian metaethics. A pragmatic, intersubjective conception of truth is preferable.

**Habermas ’98 -** Jurgen Habermas [Former Chair of Philosophy and Sociology, Johann Wolfgang Goethe University Frankfurt am Main Institute for Social Research, Permanent Visiting Professor at Northwestern University, "Theodor Heuss Professor" at The New School, New York.], The Inclusion of the Other: Studies in Political Theory. Cambridge: MIT Press (1998), p. 36-37 AT

A sentence or proposition is justified on the semantic conception if it can be derived from basic sentences according to valid rules of inference, where a class of basic sentences is distinguished by specific (logical, epistemological, or psychological) criteria. But the foundationalist assumption that there exists such a class of basic sentences whose truth is immediately accessible to perception or to intuition has not withstood linguistic arguments for the holistic character of language and interpretation: every justification must at least *proceed from* a pre-understood context or background understanding. This failure of foundationalism recommends a pragmatic conception of justification as a public practice in which criticizable validity claims can be defended with good reasons. Of course, the criteria of rationality that determine which reasons count as good reasons can themselves be made a matter for discussion. Hence procedural characteristics of the process of argumentation itself must ultimately bear the burden of explaining why results achieved in a procedurally correct manner enjoy the presumption of validity. For example, the communicative structure of rational discourse can ensure that all relevant contributions are heard and that the unforced force of the better argument alone determines the “yes” and “no” responses of the participants.¶ The pragmatic conception of justification opens the way from an epistemic concept of truth that overcomes the well-known problems with the correspondence theory. The truth predicate refers to the language game of justification, that is, to the public redemption of validity claims. On the other hand, truth cannot be identified with justifiability or warranted assertability. The “cautionary” use of the truth predicate – regardless of how well “p” is justified, it still may not be true – highlights the difference in meaning between “truth” as an irreducible property of statements and “rational acceptability” as a context-dependent property of utterances. This difference can be understood within the horizon of possible justifications in terms of the distinction between “justified in our context” and “justified in every context.” This difference can be cashed out in turn through a weak idealization of our processes of argumentation, understood as capable of being extended indefinitely over time. When we assert “p” and thereby claim truth for “p” we accept the obligation to defend “p” in argumentation – in full awareness of its fallibility – against all future objections.

#### 4] Collapses to util: Moreover, maximizing utility is the only way to affirm equal and unconditional human dignity.

**Cummiskey ’90 -** David Cummiskey. [Associate Philosophy Professor at Bates College].Kantian Consequentialism. Ethics, Vol. 100, No. 3. 1990. <http://www.jstor.org/stable/2381810>.

We must not obscure the issue by characterizing this type of case as the sacrifice of individuals for some abstract “social entity.” It is not a question of some persons having to bear the cost for some elusive “overall social good.” Instead, the question is whether some persons must bear the inescapable cost for the sake of other persons. Robert Nozick, for example, argues that “to use a person in this way does not sufficiently respect and take account of the fact that he is a separate person, that his is the only life he has.” But why is this not equally true of all those whom we do not save through our failure to act? **By emphasizing solely the one who must bear the cost if we act, we fail to** sufficiently **respect** and take account of **the many other separate persons**, **each with only one life, who will bear the cost of our inaction.** In such a situation, what would a conscientious Kantian agent, an agent motivated by the unconditional value of rational beings, choose? A morally good agent recognizes that the basis of all particular duties is the principle that “rational nature exists as an end in itself” (GMM 429). Rational nature as such is the supreme objective end of all conduct. **If one** truly **believes** that **all rational beings have** an **equal value**, then **the** rational **solution** to such a dilemma **involves maximally promoting the lives and liberties of as many** rational beings **as possible** (chapter 5). In order to avoid this conclusion, the non-consequentialist Kantian needs to justify agent-centered constraints. As we saw in chapter 1, however, even most Kantian deontologists recognize that agent-centered constraints require a non- value-based rationale. But we have seen that Kant’s normative theory is based on an unconditionally valuable end. How can a concern for the value of rational beings lead to a refusal to sacrifice rational beings even when this would prevent other more extensive losses of rational beings? **If the moral law is based on the value of rational beings and their ends, then what is the rationale for prohibiting a moral agent from maximally promoting these two tiers of value? If I sacrifice some for the sake of others, I do not use them arbitrarily, and I do not deny the unconditional value of rational beings. Persons may have “dignity**, **that** is, an unconditional and incomparable worth” that **transcends** any **market value** (GMM 436), **but persons also have a fundamental equality that dictates that some must sometimes give way for the sake of others** (chapters 5 and 7). The concept of the end-in-itself does not support the view that we may never force another to bear some cost in order to benefit others. If one focuses on the equal value of all rational beings, then equal consideration suggests that one may have to sacrifice some to save many.

#### 6] Deontology fails to account for the unchosen moral demands of particular identities and so fails to account for indispensable aspects of the moral experience.

**Sandel ’98 -** Michael J. Sandel [Professor of Political Philosophy, Harvard University], Liberalism and the Limits of Justice: Second Edition. Cambridge: Cambridge University Press (1998). P. 178-179 AT

If the deontological ethic fails to redeem its own liberating promise, it also fails plausibly to account for certain indispensable aspects of our moral experience.For **deontology insists that we view ourselves as** independent selves, **independent in the sense that our identity is never tied to our aims and attachments.** Given our ‘moral power to form, to revise, and rationally to pursue a conception of the good’ (Rawls 1980: 544), the continuity of our identity is unproblematically assured. No transformation of my aims and attachments could call into question the person I am, for no such allegiances, however deeply held, could possibly engage my identity to begin with.

**But we cannot regard ourselves as independent in this way without great cost to those loyalties and convictions whose moral force consists partly in the fact that living by them is inseparable from understanding ourselves as the particular persons we are - as members of this** family or **community or nation or people,** as bearers of this history, as sons and daughters of that revolution, as citizens of this republic. **Allegiances such as these are more than values I happen to have** or aims I ‘espouse at any given time’. **They go beyond the obligations I voluntarily incur** and the ‘natural duties’ I owe to human beings as such. **They allow that to some I owe more than justice requires or even permits, not by reason of agreements I have made but instead in virtue of those** more or less **enduring attachments** and commitments **which** taken togetherpartly **define the person I am.**

**To imagine a person incapable of constitutive attachments such as these is not to conceive an ideally free and rational agent, but to imagine a person wholly** without character, **without moral depth. For to have character is to know that I move in a history I neither summon nor command, which carries consequences none the less for my choices** and conduct.It draws me closer to some and more distant from others; it makes some aims more appropriate, others less so. **As a self-interpreting being, I am able to reflect on my history and in this sense to distance myself from it, but the distance is always precarious and provisional, the point of reflection never finally secured outside the history itself. A person with character thus knows that he is implicated in various ways even as he reflects, and feels the moral weight of what he knows.**

#### And hold the neg to a high burden of proof to exclude aff impacts. The neg is going to get up in the next speech and say that the aff impacts don’t link without giving a clearly warranted reason for doing so (and a warrant that actually makes sense), so you give more weight to arguments from the aff about how the AC arguments link in.

#### Even if you don’t buy that, Kantianism opens the door to racism and sexism—anyone labeled irrational is stripped of their autonomy and moral worth. Means women, the mentally ill, animals, indigenous groups, animals, etc will lose moral value

### 1

**The aff fails to aid global justice and promotion of the Global South, and space-based solar power solves.**

#### SSP is viable and requires privatization.

Oberhaus 8/18 [DANIEL OBERHAUS, “Space Solar Power: An Extraterrestrial Energy Resource For The U.S.,” Innovation Frontier Project, August 18, 2021. <https://innovationfrontier.org/space-solar-power-an-extraterrestrial-energy-resource-for-the-u-s/>] CT

FUTURE OF SSP

The United States’ reluctance to pursue SSP can be attributed to a number of causes. In the 1970s and 80s, the exorbitant projected costs of an SSP station guaranteed that the project would not be pursued by NASA, the DOE, or the DOD. At the same time, the agency’s emphasis on developing nuclear space technologies — a trend that continues to this day — undermined enthusiasm for other ambitious energy projects like SSP. Finally, the fact that SSP is a space project meant to provide commercial levels of electrical power on Earth meant that it wasn’t obvious whether it fell within the purview of NASA or the DOE, and so both agencies were reluctant to allocate a substantial portion of their budget for its development. Today, the low cost of natural gas and renewables like wind and solar makes it seem challenging to justify a space energy project of this scale. But SSP offers several unique benefits as an energy resource, including its resiliency, its ability to provide flexible baseload power to geographically distant locations, its capacity to accelerate decarbonization directly by providing clean energy and indirectly by expediting the transition to off-world heavy industry, and its strategic benefits as a tool for diplomacy and national security. Given SSP’s benefits and the interest in the technology from most other space agencies, it’s puzzling that policymakers in the United States have not prioritized SSP R&D. The development of key technologies such as reusable rockets and thin film solar panels has finally made SSP economically and technically viable. But there is still a lot of fundamental research on SSP that needs to be done and it is in the United States’ national interest to begin this research program as soon as possible. So far, the only glimmer of hope for an American SSP program has come from the DOD’s efforts. In 2019, the Air Force Research Lab awarded a $100 million contract to Northrop Grumman as part of the new Space Solar Power Incremental Demonstrations and Research (SSPIDR) Project, which aims to develop hardware for in-orbit SSP experiments based on the design developed at Caltech.105 This is by far the United States’ largest federal expenditure on SSP R&D, but it is only a fraction of what will be required to build a large-scale SSP station and the specific technologies included in the SSPIDR program will not result in a system that could ever provide commercial power to civilians. SSP is a key tool for ensuring the prosperity and security of the United States in the latter half of the 21st century. It is imperative that NASA and the DOE prioritize the development of SSP. We believe the federal government should earmark approximately $1 billion for SSP research over the next five years with a special emphasis on advancing emerging technologies and in-space hardware demonstrations. Congress must take the first step in establishing a civilian SSP platform by directing NASA and the DOE to collaborate on a public-private initiative similar to NASA’s commercial crew program or its more recent commercial lunar payload services program. The directive must clearly delineate responsibilities between the agencies in order to avoid leadership paralysis that has stymied domestic SSP research in the past. Furthermore, a public-private program must be structured so that there is competition among multiple private companies, which must hit key milestones in order to continue receiving contracts. These contracts should be awarded with a fixed-price structure to avoid the massive cost overruns and delays that are typical of cost-plus contracts in the aerospace and defense sector. This is also an approach likely to find support among new launch providers and spacecraft manufacturers that have demonstrated the innovation that occurs when operating within the relative constraints of fixed price contracts. In fact, the main trade group for the aerospace sector has advocated for the increased use of fixed-price contracts in the past.106 Alternatively, it may be more efficient to establish a focused research organization (FRO) dedicated to SSP technologies to avoid delays associated with collaboration between two federal agencies on multi-year—and perhaps multi-decade—projects. FROs are independent entities that exist outside of national laboratories and universities. They are effectively a startup for basic research and deep technological development that requires large-scale engineering collaboration on technologies that may not yet have a market or are not readily monetizable.107 Recently, the U.S. Congress created five FRO-like centers in the DOE’s national labs as part of the National Quantum Initiative Act, which can serve as a framework for the creation of similar FROs dedicated to space solar power.108 While there are several approaches to a large-scale SSP system, we believe the most fruitful pathway is to focus on cost reduction over energy efficiency. This would prioritize highly modular systems similar to ALPHA, which benefit from the substantially reduced costs of mass manufacturing standardized components. We believe that it is possible to conduct a civilian SSP demonstration in low-Earth orbit within three years of the program’s start with less than $250 million in funding. The first phase of this program would involve conducting a series of ground tests with prototype systems over the course of about 18 months. Based on the results of this program, a system could be selected for an in-space demonstration capable of generating up to 300kw of power in low-Earth orbit. After a successful LEO demonstration mission, the next step would be to build a larger SSP system in mid-Earth orbit capable of producing commercial amounts of power (e.g., 1-10 MW). While this orbital altitude is not sufficient for maintaining the SSP system over a fixed spot on the Earth, it would stay on a fixed path so that it always passed over the same spots on the Earth. While the power from this MEO demonstrator would not be competitive with terrestrial electricity prices — we expect a cost of about $1/kwh — it would be a critical step toward proving the system’s ability to provide commercial power. We expect that the MEO demonstrator could be built and launched for approximately $1 billion. The success of the MEO demonstrator would lay the foundation for an SSP system in geostationary orbit that would be large enough to provide meaningful amounts of baseload power. We expect the initial version of this SSP system to be capable of delivering around 2 GW of solar energy to the surface. We expect that a 2 GW SSP system in geostationary orbit could be built for about $10 billion. Here we start to see the cost savings of mass manufacturing modular SSP components. This system would be capable of delivering more than 200 times more power than the MEO demonstrator for only 10 times the cost. We believe that a public-private SSP program jointly led by NASA and the DOE could result in a commercially viable SSP platform in geostationary orbit by the end of the decade. In addition to providing a critical pathway for SSP, it also has the potential to lead to substantial advancements in solar power and wireless power transmission technologies that would be useful on Earth. If policymakers do not take action on advancing domestic SSP capabilities soon, the United States will find itself losing its leadership position in space and increasingly vulnerable to natural and human-made disasters on the ground.

#### SSP Constellations are coming now--key to solve warming. SSP is technologically and economically feasible aBests studies prove.

Patel 12/1 [Sonal Patel, “Space-Based Solar Power May Be Closer Than You Think,” POWER, 12/1/21. Accessed 2/16/22. <https://www.powermag.com/space-based-solar-power-may-be-closer-than-you-think/>] CT

The vision sounds far-fetched: If a kilometer-scale satellite could be outfitted with a hybrid array of photovoltaic (PV) and concentrating solar power (CSP) panels and launched into orbit 22,400 miles above Earth, it could continuously harvest 3.4 GW of solar power and beam it down to Earth via microwave radiation for grid consumption, potentially delivering 2 GW of dispatchable and baseload power. But according to a “whole systems” set of detailed engineering and economic feasibility studies conducted by systems, engineering, and technology-oriented Frazer-Nash Consultancy for the UK government, this concept of a typical space-based solar power (SBSP) system is both technically and economically feasible—and it can be achieved within the next 18 years.

While still at an early stage of technical maturity, SBSP systems research and development has progressed steadily since the 1970s, spearheaded by several government space programs, including in the U.S., Japan, China, South Korea, and the European Union. And while it has existed for more than a century—it derives from Nicolas Tesla’s grand vision for wireless power transfer (WPT)—the world’s white-knuckle fight against climate change in the context of energy security, affordability, and scalability is making SBSP an extraordinarily attractive pursuit, noted Martin Soltau, lead of Frazer-Nash’s Space business, and a lead developer of the report for the UK government.

UK Actively Exploring Space-Based Solar Power Systems

“It can provide baseload power but it can also provide this dispatchable power,” said Soltau, who notably also co-chairs the Space Energy Initiative, a UK-based alliance of research and commercial energy, space, materials, and manufacturing entities that are dedicated to space power delivery by 2050. “But then it’s got these other real exciting advantages,” Soltau told POWER at the end of September as the UK’s Department for Business, Energy, and Industrial Strategy (BEIS) endorsed the SBSP feasibility studies. “It doesn’t produce waste, it doesn’t have problems with fuel supply, it’s very environmentally clean, and the carbon payback is very short,” he said.

Also notable is that SBSP’s “extra-terrestrial” footprint—which essentially only requires a receiving antenna and a conversion facility—is also “much smaller, only a third of the size compared to terrestrial solar, and only about 3% of the size of an equivalent wind farm,” Soltau said. As uniquely, “it is possible to beam energy to other parts of the world,” opening up new international collaboration to net-zero, potentially helping developing nations to decarbonize, and even shaking up traditional power markets.

The Frazer-Nash Consultancy study is especially significant because it represents one of the world’s first “whole system” space power-based independent assessments. The UK’s interest in space power stems from an economic opportunity to establish a foothold in rapidly burgeoning civil and defense space activities around the world, essentially boosting private investment, and capitalize on its unique engineering and manufacturing strengths, like satellite manufacturing. But Soltau said the study, which stems from a government-sponsored innovation “competition,” could also offer international insight through its stakeholder-reviewed findings, which were gleaned over a six-month period and encapsulated two phases: one focused on technical opportunities and challenges, and the other on costs.

In its study, Frazer-Nash recommended that the SBSP system concept be established to define user and system requirements, which would ultimately align more focused research activities. The UK government told POWER that as a next step, it is already exploring how it can potentially support innovation in the development of these “dual-use” space power and terrestrial power systems.

A Gigawatt-Scale Baseload Solar Plant on a Satellite

Still, the undertaking is markedly broad. As part of its engineering study, Frazer-Nash proposed a “typical” SBSP system based on three leading concepts, which it chose as reference designs for its investigation. The typical system comprises a massive kilometer-scale satellite that would be launched to Geostationary Earth Orbit (GEO, about 36,000 kilometers above a point on the Earth) to enable gigawatt-scale generation.

“At this altitude, the Sun is visible over 99% of the time,” it noted. The satellite harvests solar power using large lightweight solar panels, often with a system of mirrors to reflect and concentrate sunlight onto the panels (Figure 2). That generated power is then converted into microwave radiation and beamed—in a “safe” frequency of 2.45 GHz and intensity 230 W per square meter (which is one-quarter of the intensity of midday sunlight)—to a rectifying antenna (or “rectenna”) on the ground. The ground rectenna then converts the electromagnetic energy into direct-current electricity, which can be converted and transformed to provide power to the grid with acceptable characteristics.

Significantly, the concept envisions a complete system that would comprise a “constellation” of such satellites with a combined 10 GW capacity. However, the study also embeds the core generating system into a larger power study that includes “enabling systems,” such as spacelift, control station construction, ground station maintenance, and even potential legislation, permits, international agreements, and standards.

According to Soltau, the study concluded that leading satellite power concepts do not require any substantial advance in materials’ technology or performance, but building them economically will require two principal capabilities that are today immature but rapidly developing: robotic in-orbit assembly, and a low-cost reusable space transportation infrastructure. This poses a “substantial undertaking,” he noted, given that the size of the system, and the need to assemble and integrate them in space, “would be an order of magnitude larger in mass and extent than any spacecraft currently in orbit.” Key to achieving the scale and ambition of the system will be to address the “considerable engineering risk” through a program of design and technology demonstration, he said.

Costs Competitive with Cheap Earth-Based Renewables

The study also identified an array of technical challenges, from maintaining the angle between the sun-pointing solar collector and the ground-pointing microwave transmitter, to the size and scaling of the microwave antenna. Optimizing the specific power of SBSP satellites—which have a mass of several thousand tons—and managing their components’ thermal aspects will also be crucial.

Finding an optimum choice of power beaming frequency will also “require a trade-off between the satellite orbit, satellite sizing, power level transmitted, power beaming efficiency, the transmitter diameter and receiver diameter, the thermal limits on the sandwich panel, and the upper safe limit of Radio Frequency (RF) intensity at the center of the received beam,” the study acknowledges. Keeping frequencies at 2.45 GHz for larger (2 GW) systems, and 5.8 GHz for lower-power, lower-mass systems, may be a good guideline, it concluded.

The given technical challenges (and scope of engineering risks), the relatively low technical maturity of several technologies, and the diversity of technical concepts that have been proposed pose a long list of methodology limitations when assessing SBSP costs, the study acknowledges. However, by developing a “bespoke cost model” that addresses uncertainty and focuses only on the CASSIOPeiA design, the study concludes that a typical SBSP could deliver a levelized cost of electricity (LCOE) of between £35 ($47)/MWh and £79 ($107)/MWh, assuming a successful development program.

The cost analysis included “end-to-end production, launch, assembly, operational service life, and decommissioning,” Soltau noted. “The LCOE we calculated is for the nth of a kind, which would be quickly reached in the fourth or fifth system,” given the modularity and repeatability of the design, he said. “Each solar power satellite is highly modular, so you reduce production costs when you’ve got high production runs,” he said.

Assuming a system is commissioned in 2040, the LCOE at the midpoint of £50/MWh “includes this very high hurdle rate of 20%” to account for estimated uncertainty as required by institutional investors, he noted. “And what you’d expect is as the development proceeded, and we matured the technology, and all the development risk was retired, that the hurdle rate is going to fall well under 10%. At a 10% hurdle rate, the LCOE is only £26/MWh—that’s cheaper than the cheapest renewable technology in the UK at the moment,” he said. “This is why our government is excited because it’s actually looking not only at the technology’s great characteristics, but it’s actually very affordable as well.”

Still, for now, to propel research and development, the UK government is looking at a net present value—a representation of overall development costs—of about £16.3 billion ($22.1 billion), the study suggests. Another £1 billion will also be necessary to support operating expenditure over the life of the system.

In its policy roadmap, however, Frazer-Nash suggests the public sector may only need to fully fund Phase 1, totaling £350 million ($474 million) over the first five years. “Thereafter the private sector could reasonably be expected to start investing an increasing proportion as shown,” it says. As an incrementally valuable benefit, the program would potentially provide “broader spillover economic benefits,” including in areas that span wireless power transmission, semiconductor technology, PV technology, space-grade electronics, robotics, space freight and transportation, and general skill development to support space activities, it said.

### 2

#### TEXT: The Outer Space Treaty ought to be amended to establish an international legal trust system governing outer space.

Finoa 21 [Ivan Finoa (Department of Law University of Turin), “Building a New Legal Model for Settlements on Mars,” A. Froehlich (ed.), Assessing a Mars Agreement Including Human Settlements, Studies in Space Policy 30, 2021. <https://doi.org/10.1007/978-3-030-65013-1_7>]CT

7.5 A Proposal for an International Legal Trust System

Since several legal and policy issues may arise from the actual legal framework, a new international legal regime for outer space shall: (a) Provide for property rights or a lease allocation system, both incentivising investments in the space sector. The system would be supervised and led by the United Nations (UN) through the United Nations Office for Outer Space Affairs (UNOOSA). (b) Establish the rule of law in outer space. A laissez faire system could turn into anarchy whereby countries and companies could race to grab as many resources as possible bringing considerable potential conflict. (c) Recognise outer space as common heritage of mankind, instead of res communis.24 (d) Provide a sustainable exploitation of celestial bodies, to avoid the uncontrolled production of space debris or to prevent the complete exhaustion of the celestial bodies’ masses or their natural orbits.25 The United Nations should manage the ordered and sustainable economic development in outer space for the present and future generations. (e) Prevent the militarisation of outer space and favours the international collaboration, which are the same aims of the Outer Space Treaty’ drafters. (f) Consider the weak points of the Moon Agreement which led to nations’ refusal to sign. Only a widely accepted agreement would have the power of law in the international context.

The abovementioned requirements could be met by establishing an international Legal Trust System (ILTS). A trust is an arrangement that assigns assets to one or more trustees that will manage them in the interest of one or more beneficiaries. The latter may include the trustee or the settlor.26 Translated in the ILTS, mankind would assume the role of settlor and beneficiary of the outer space resources. The UNOOSA would act as main trustee of outer space resources and trading property rights and leases to companies and countries. The rights over the celestial bodies or over its resources would depend on the nature of the celestial body itself. For example, property rights are preferable to a lease over asteroids, as they could just disappear after the exploitation. Both leases and property rights can be provided over lands and mining sites on Mars. Leases or defeasible titles are preferable for some land mass on those celestial bodies which could hypothetically be used by humankind pending an Earth disaster. In the case of lucrative activities, such as mining, companies will choose whether to get the exclusive use over the resource through payment of the lease or through annual payment linked to net proceeds or to production charges.

7.6 The Functioning of the International Legal Trust System

When a company is interested in leasing or buying an outer space resource, before starting any operations, it must send a plan of work to the United Nations. The plan of work shall include all the details of the activity that would be carried out; it shall be consistent with pre-established parameters of sustainability and shall not interfere with other space activities. If the UN approves the company plan of work, the country of the company assumes the role of co-trustee for the specific resource. Thus, as a cotrustee, countries must investigate whether all activities of their national companies are consistent with the plan of work authorised by the UN. These supervisory duties would be added to the responsibility of nations for all space objects that are launched within their territory.27 The UN, as main trustee, would oversee that countries are performing their duties. This model would be the ordinary one. There would be also an extraordinary model, in which the UN would be the only trustee. This model would be possible in two instances: when the country of the applicant for a private company is not technologically able to act as a trustee or when the applicant of the activity is a country itself. Furthermore, as stated previously, the beneficiaries of this trust are the countries of the world and their citizens; hence all mankind would take concrete profit from lease transactions and benefit sharing. The income from the sales, leases and benefit sharing can be distributed to mankind by financing international global goals, following a similar model of the 17 Sustainable Development Goals adopted by the United Nations in 2015, which addressed poverty, inequality, climate change, environmental degradation, and peace and justice. Finally, the International Legal Trust System would meet acceptance because every country would obtain benefit sharing to improve its living standard and space faring nations would rely on property rights.

#### The legal trust would incentivize investment in space while preventing conflict and ensuring sustainable development and the equitable distributions of resources.

Finoa ’20 – Ivan Finoa [Department of Law, University of Turin], “An international legal trust system to deal with the new space era,” 71st International Astronautical Congress (IAC) – The CyberSpace Edition, (12-14 October 2020). <<https://d1wqtxts1xzle7.cloudfront.net/66728932/_IAC_20_E7.VP.8.x58518_An_international_legal_trust_system_to_deal_with_the_new_space_era_BY_IVAN_FINO-with-cover-page-v2.pdf?Expires=1642044926&Signature=asvt6StaK5n9UnpXuJIlo4ziI839WzFYjDZy37bm70ObGy3vFJyHwWNGxhn2beze4QzYDPPX0pVEXAwYvDaINVNxN01Ify8YwG5loNRddlat-grf3iawic7KvwqPowxFe2GuemVvbB-KW8ZVBxigwS-gelSKIVy4KYR9UgiDrM6e6deEBnUTcULSwmsH-JdHNg13ytZ3vNVMMlxZW2MPOCRuB2WlOHdCLoC86VqafSoMwuec-d~Aisbgyt5F2vO-GjvI60bR7h2MSp0iT6P7apIDUUpHUsDGbvcdxp22HSxXdlvr7lSqtLnL5rKxujGDYq~R9B~WuGiorVL2hn74UQ__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA>>CT

Considering the worsening climate change, in the future outer space might be our last Noah’s Ark. Now, humans must look to space as an opportunity to support growing resource requirements. Asteroids are rich in metals, which could be transported back to Earth. Unfortunately, the existing international legal framework discourages investments in the space economy. Once an enterprise invests billions of dollars in discovering and developing a mining site, it cannot claim any ownership because of the non-appropriation principle stipulated in Article 2 of the Outer Space Treaty (OST). Thus, other entities could legally access and exploit the same resource without any participation in the initial financial investment, increasing the risk of potential conflict. Bearing this in mind, the question arises, which legal regime could ensure effective allocation of resources, avoiding a chaotic space race to acquire valuable assets? The aim of this research is to argue that the first two articles of OST should be amended, to set up an international legal trust system which would guarantee different kinds of rights, dependently on the nature of the celestial body. E.g., property rights could be preferable to a lease over asteroids, as they could be exploited to their disappearance. This proposed system would be led by the United Nations Office for Outer Space Affairs (UNOOSA), as the main trustee. The co-trustees would be the nations of the world. Prior to initiating any space activity, every entity would send a request to their national government. If all the legal parameters are respected, the nation would forward the operational request to the UNOOSA. In the case of acceptance, UNOOSA would record the permit on an international public registry. The country in which the company has been registered would investigate whether the activities of its national company are consistent with the permit. This would be the ordinary model. The extraordinary model would be when the applicant for the space activity is a state, then the trustee would be the UN. All lucrative activities would be subject to benefit-sharing. Finally, this research will demonstrate the valuable outcome of the International Legal Trust System and its advantages for all humankind. Private companies would rely on property rights, while the benefit-sharing could be used to finance the 17 Sustainable Development Goals adopted by the UN in 2015, which address peace, climate change, inequalities and poverty.

### 3

#### The private sector is essential for asteroid mining – competition is key and government development is not effective, efficient, or cheap enough. Thiessen 21:

Marc Thiessen, 6-1, 21, Washington Post, Opinion: SpaceX’s success is one small step for man, one giant leap for capitalism, https://www.washingtonpost.com/opinions/2020/06/01/spacexs-success-is-one-small-step-man-one-giant-leap-capitalism/

It was one small step for man, one giant leap for capitalism. Only three countries have ever launched human beings into orbit. This past weekend, SpaceX became the first private company ever to do so, when it sent its Crew Dragon capsule into space aboard its Falcon 9 rocket and docked with the International Space Station. This was accomplished by a company Elon Musk started in 2002 in a California strip mall warehouse with just a dozen employees and a mariachi band. At a time when our nation is debating the merits of socialism, SpaceX has given us an **incredible testament to the power of American free enterprise.** While the left is advocating unprecedented government intervention in almost every sector of the U.S. economy, from health care to energy, **today Americans are celebrating the successful privatization of space travel.** If you want to see the difference between what government and private enterprise can do, consider: It took a private company to give us the first space vehicle with touch-screen controls instead of antiquated knobs and buttons. It took a private company to give us a capsule that can fly entirely autonomously from launch to landing — including docking — without any participation by its human crew. It also took a private company to invent a reusable rocket that can not only take off but land as well. When the Apollo 11 crew reached the moon on July 20, 1969, Neil Armstrong declared “the Eagle has landed.” On Saturday, SpaceX was able to declare that the Falcon had landed when its rocket settled down on a barge in the Atlantic Ocean — ready to be used again. That last development will save the taxpayers incredible amounts of money. The cost to NASA for launching a man into space on the space shuttle orbiter was **$170 million per seat, compared with just $60 million** to $67 million on the Dragon capsule. The cost for the space shuttle to send a kilogram of cargo into to space was $54,500; with the Falcon rocket, the cost is just $2,720 — **a decrease of 95 percent.** And while the space shuttle cost $27.4 billion to develop, the Crew Dragon was designed and built for just $1.7 **billion — making it the lowest-cost spacecraft developed in six decades.** SpaceX did it in six years — far faster than the time it took to develop the space shuttle. ***The private sector does it better, cheaper, faster and more efficiently than government***. **Why? Competition.** Today, SpaceX has to compete with a constellation of private companies — including legacy aerospace firms such as Orbital ATK and United Launch Alliance and innovative start-ups such as Blue Origin (which is designing a Mars lander and whose owner, Jeff Bezos, also owns The Post) and Virgin Orbit (which is developing rockets than can launch satellites into space from the underside of a 747, avoiding the kinds of weather that delayed the Dragon launch). In the race to put the first privately launched man into orbit, upstart SpaceX had to beat aerospace behemoth Boeing and its Starliner capsule to the punch. It did so — for more than $1 billion less than its competitor. **That spirit of competition and innovation will revolutionize space travel in the years ahead.** Indeed, Musk has his sights set far beyond Earth orbit. Already, SpaceX is working on a much larger version of the Falcon 9 reusable rocket called Super Heavy that will carry a deep-space capsule named Starship capable of carrying up to 100 people to the moon and eventually to Mars. Musk’s goal — the reason he founded SpaceX — is to colonize Mars and make humanity a multiplanetary species. He has set a goal of founding a million-person city on Mars by 2050 complete with iron foundries and pizza joints. Can it be done? Who knows. But this much is certain: **Private-sector innovation is opening the door to a new era of space exploration**. Wouldn’t it be ironic if, just as capitalism is allowing us to explore the farthest reaches of our solar system, Americans decided to embrace socialism back here on Earth?

#### Eliminating property rights scares investors away and spills over to other space activities. Freeland 05

Steven Freeland (BCom, LLB, LLM, University of New South Wales; Senior Lecturer in International Law, University of Western Sydney, Australia; and a member of the Paris-based International Institute of Space Law). “Up, Up and … Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space.” Chicago Journal of International Law: Vol. 6: No. 1, Article 4. 2005. JDN. <https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1269&context=cjil>

V. THE NEED FOR CELESTIAL PROPERTY RIGHTS? ¶ The fundamental principle of "non-appropriation" upon which the international law of outer space is based stems from the desire of the international community to ensure that outer space remains an area beyond the jurisdiction of any state(s). Similar ideals emerge from UNCLOS (in relation to the High Seas) as well as the Antarctic Treaty, 42 although in the case of the latter treaty, it was finalised after a number of claims of sovereignty had already been made by various States and therefore was structured to "postpone" rather than prejudice or renounce those previously asserted claims.43 In the case of outer space, its exploitation and use is expressed in Article I of the Outer Space Treaty to be "the province of all mankind," a term whose meaning is not entirely clear but has been interpreted by most commentators as evincing the desire to ensure that any State is free to engage in space activities without reference to any sovereign claims of other States. This freedom is reinforced by other parts of the same Article and is repeated in the Moon Agreement (which also applies to "other celestial bodies within the solar system, other than the earth")." Even though both the scope for space activities and the number of private participants have expanded significantly since these treaties were finalised, it has still been suggested that the nonappropriation principle constitutes "**an absolute barrier** in the realization of every kind of space activity., 4 ' **The amount of capital expenditure required to research, scope, trial, and implement a new space activity is significant.** To bring this activity to the point where it can represent a viable "stand alone" commercial venture **takes many years and almost limitless funding.** From the perspective of a private enterprise contemplating such an activity, it would quite obviously be an important element in its decision to devote resources to this activity that it is able to secure the highest degree of legal rights in order to protect its investment. **Security** of patent and other intellectual property rights, for example, are vital prerequisites for private enterprise research activity on the ISS, and these rights are specifically addressed by the ISS Agreement between the partners to the project and were applicable to the experiments undertaken by Mark Shuttleworth when he was onboard the ISS.46

#### Asteroid mining can happen with private sector innovation and is key to solve a laundry list of impacts--climate change, economic decline and asteroid collisions. Taylor 19

Chris Taylor [journalist, was senior news writer for Time.com, San Francisco bureau chief for Time magazine], 19 - ("How asteroid mining will save the Earth — and mint trillionaires," Mashable, 2019, accessed 12-13-2021, https://mashable.com/feature/asteroid-mining-space-economy)//ML

How much, exactly? We’re only just beginning to guess. [Asterank](http://www.asterank.com/), a service that keeps track of some 6,000 asteroids in NASA’s database, prices out the estimated mineral content in each one in the current world market. More than 500 are listed as “>$100 trillion.” The estimated profit on just the top 10 asteroids judged “most cost effective” — that is, the easiest to reach and to mine, subtracting rocket fuel and other operating costs, is around $1.5 trillion.¶ Is it ours for the taking? Well, here’s the thing — we’re taking it already, and have been doing so since we started mining metals thousands of years ago. Asteroid strikes are the only reason rare metals exist in the Earth’s crust; the native ones were all sucked into our planet’s merciless iron core millions of years ago. Why not go to the source?¶ As a side project, space mining can grab water from the rocks and comets — water which, with a little processing makes rocket fuel. Which in turn makes even more currently unimaginable space operations possible, including ones that could give the planet all the energy it needs to avert climate catastrophe. Cislunar space — the bit around us and the moon, the local neighborhood, basically — is about to get very interesting.¶ It’s hard, even for the most asteroid-minded visionaries, to truly believe the full scope of this future space economy right now. Just as hard as it would have been in 1945, when an engineer named Vannevar Bush first proposed [a vast library of shared knowledge that people the world over would access via personal computers](https://en.wikipedia.org/wiki/Memex), to see that mushroom into a global network of streaming movies and grandmas posting photos and trolls and spies who move the needle on presidential elections. ¶ No technology’s pioneer can predict its second-order effects.¶ The space vision thing is particularly difficult in 2019. Not only do we have plenty of urgent problems with democracy and justice to keep us occupied, but the only two companies on the planet to have gone public with asteroid-mining business plans, startups that seemed to be going strong and had launched satellites already, were just bought by larger companies that are, shall we say, less comfortable executing on long-term visions.¶ Planetary Resources was founded in 2012 in a blaze of publicity. Its funding came from, among others, Larry Page, Eric Schmidt, Ross Perot, and the country of Luxembourg. It had inked an orbital launch deal with Virgin Galactic. And it was sold last October to a blockchain software company. (To 21st century readers, this paragraph would look like I’m playing tech world mad libs.)¶ In January, the other company, Deep Space Industries, also partly funded by Luxembourg (way to get in the space race, Luxembourg!), was sold to Bradford Space, owned by a U.S. investment group called the American Industrial Acquisition Corporation. Maybe these new overlords plan on continuing their acquisitions' asteroid mining endeavors rather than stripping the companies for parts. Both companies have been notably silent on the subject. “The asteroid mining bubble has burst,” [declared The Space Review](http://www.thespacereview.com/article/3633/1), one of the few online publications to even pay attention.¶ That’s also to be expected. After all, anyone trying to build Google in 1945 would go bankrupt. Just as the internet needed a half-dozen major leaps forward in computing before it could even exist, space industry needs its launch infrastructure.¶ Currently, the world’s richest person and its most well-known entrepreneur, Jeff Bezos and Elon Musk, respectively, are working on the relatively cheap reusable rockets asteroid pioneers will need. (As I was writing this, Bezos announced in an email blast that one of his New Shepherd rockets had flown to space and back five times like it was nothing, delivering 38 payloads for various customers while remaining entirely intact.) ¶ Meanwhile, quietly, Earth’s scientists are laying the groundwork of research the space economy needs. Japan’s Hayabusa 2 spacecraft has been in orbit around asteroid Ryugu for the last year and a half, learning everything it can. (Ryugu, worth $30 billion according to Asterank, is the website's #1 most cost-effective target.) The craft dropped [tiny hopping robot rovers](https://www.space.com/41941-hayabusa2-asteroid-rovers-hopping-tech.html) and a [small bomb](https://www.space.com/japan-hayabusa2-asteroid-bomb-video.html) on its target; pictures of the small crater that resulted were released afterwards.¶ Officially, the mission is to help us figure out how the solar system formed. Unofficially, it will help us understand whether all those useful metals clump together at the heart of an asteroid, as some theorize. If so, it’s game on for asteroid prospectors. If not, we can still get at the metals with other techniques, such as optical mining (which basically involves sticking an asteroid in a bag and drilling with sunlight; sounds nuts to us, but [NASA has proved it in the lab](https://www.nasa.gov/directorates/spacetech/niac/2017_Phase_I_Phase_II/Sustainable_Human_Exploration/)). It’ll just take more time.¶ Effectively, we’ve just made our first mark at the base of the first space mineshaft. And there’s more to come in 2020 when Hayabusa 2 returns to Earth bearing samples. If its buckets of sand contain a modicum of gold dust, tiny chunks of platinum or pebbles of compressed carbon — aka diamonds — then the Duchy of Luxembourg won’t be the only deep-pocketed investor to sit up and take notice.¶ The possibility of private missions to asteroids, with or without a human crew, is almost here. The next step in the process that takes us from here to where you are? Tell us an inspiring story about it, one that makes people believe, and start to imagine themselves mining in space. How would you explain the world-changing nature of the internet to 1945? How would you persuade them that there was gold to be mined in Vannevar Bush’s idea? You’d let the new economy and its benefits play out in the form of a novel.¶ As Hayabusa dropped a bomb on Ryugu, Daniel Suarez was making the exact same asteroid the target of his fiction. Suarez is a tech consultant and developer turned New York Times bestselling author. His novels thus far have been techno-thrillers: his debut, [Daemon](https://www.amazon.com/dp/B003QP4NPE/ref=dp-kindle-redirect?_encoding=UTF8&btkr=1), a novel of Silicon Valley’s worst nightmare, AI run rampant, made more than a million dollars.¶ So it was a telling shift in cultural mood that Suarez’s latest thriller is also a very in-depth description of — and thinly-disguised advocacy for — asteroid mining. In [Delta-v](https://www.amazon.com/Delta-v-Daniel-Suarez-ebook/dp/B07FLX8V84/ref=sr_1_1?crid=UMNUUSR3NCBX&keywords=delta-v&qid=1556930756&s=digital-text&sprefix=delta-v%2Cdigital-text%2C204&sr=1-1), published in April, a billionaire in the 2030s named Nathan Joyce recruits a team of adventurers who know nothing about space — a world-renowned cave-diver, a world-renowned mountaineer — for the first crewed asteroid mission.¶ Elon Musk fans might expect this to be Joyce’s tale, but he soon fades into the background. The asteroid-nauts are the true heroes of Delta-v. Not only are they offered a massive payday — $6 million each for four years’ work — they also have agency in key decisions in the distant enterprise. Suarez deliberately based them on present-day heroes. The mission is essential, Joyce declares, to save Earth from its major problems. First of all, the fictional billionaire wheels in a fictional Nobel economist to demonstrate the actual truth that the entire global economy is sitting on a [mountain of debt](https://www.washingtonpost.com/opinions/the-247-trillion-global-debt-bomb/2018/07/15/64c5bbaa-86c2-11e8-8f6c-46cb43e3f306_story.html?noredirect=on&utm_term=.5fb3ff1155d9). It has to keep growing or it will implode, so we might as well take the majority of the industrial growth off-world where it can’t do any more harm to the biosphere.¶ Secondly, there’s the climate change fix. Suarez sees asteroid mining as the only way we’re going to build [solar power satellites](https://en.wikipedia.org/wiki/Space-based_solar_power). Which, as you probably know, is a form of uninterrupted solar power collection that is theoretically more effective, inch for inch, than any solar panels on Earth at high noon, but operating 24/7. (In space, basically, it’s always double high noon). ¶ The power collected is beamed back to large receptors on Earth with large, low-power microwaves, which researchers think will be harmless enough to let humans and animals pass through the beam. A space solar power array like [the one China is said to be working on](https://www.forbes.com/sites/scottsnowden/2019/03/12/solar-power-stations-in-space-could-supply-the-world-with-limitless-energy/#2d3f78a54386) could reliably supply 2,000 gigawatts — or over 1,000 times more power than the largest solar farm currently in existence. ¶ “We're looking at a 20-year window to completely replace human civilization's power infrastructure,” Suarez told me, citing the report of the Intergovernmental Panel on Climate Change on the coming catastrophe. Solar satellite technology “has existed since the 1970s. What we were missing is millions of tons of construction materials in orbit. Asteroid mining can place it there.”¶ The Earth-centric early 21st century can’t really wrap its brain around this, but the idea is not to bring all that building material and precious metals down into our gravity well. Far better to create a whole new commodities exchange in space. You mine the useful stuff of asteroids both near to Earth and far, thousands of them taking less energy to reach than the moon. That’s something else we’re still grasping, how relatively easy it is to ship stuff in zero-G environments. ¶ Robot craft can move 10-meter boulders like they’re nothing. You bring it all back to sell to companies that will refine and synthesize it in orbit for a myriad of purposes. Big pharma, to take one controversial industry, would [benefit by taking its manufacturing off-world](https://medium.com/fitch-blog/why-is-big-pharma-interested-in-the-space-economy-c078ac1bf67c). The molecular structure of many chemicals grows better in microgravity.¶ The expectation is that a lot of these space businesses — and all the orbital infrastructure designed to support them — will be automated, controlled remotely via telepresence, and monitored by AI. But Suarez is adamant that thousands if not millions of actual human workers will thrive in the space economy, even as robots take their jobs in old industries back on Earth.¶ “Our initial expansion into space will most likely be unsettled and experimental. Human beings excel in such environments,” he says. “Humans can improvise and figure things out as we go. Robots must be purpose-built, and it's going to take time and experience for us to design and build them.”¶ Which is another way startups back on Earth will get rich in the new economy: designing and building those robots, the nearest thing to selling picks and shovels to prospectors in the space gold rush. Thousands of humans in space at any one time will also require the design and construction of stations that spin to create artificial gravity. Again, this isn’t a great stretch: Using centrifugal force to simulate gravity in space was first proposed by scientists in the 19th century. NASA has had workable designs for spinning cislunar habitats called [O’Neill cylinders](https://en.wikipedia.org/wiki/O%27Neill_cylinder) since the 1970s. We just haven’t funded them. ¶ But the trillionaires clearly will.¶ In short, Suarez has carefully laid out a vision of the orbital economy that offers something for everyone in our divided society. For Green New Deal Millennials, there’s the prospect of removing our reliance on fossil fuels at a stroke and literally lifting dirty industries off the face of the planet. For libertarians and other rugged individualists, there’s a whole new frontier to be developed, largely beyond the reach of government. ¶ For those who worry about asteroids that could wipe out civilization — though luckily, [this isn't likely to happen any time soon](https://mashable.com/article/armageddon-asteroid-threat) — here is a way for humanity to get proficient in moving them out of the way, fast. Indeed, the National Space Society has offered [a proposal](https://space.nss.org/technologies-for-asteroid-capture-into-earth-orbit/) to capture the asteroid Aphosis (which is set to miss Earth in the year 2029, but [not by a very comfortable margin](https://www.space.com/asteroid-apophis-2029-flyby-planetary-defense.html)), keep it in orbit, and turn it into 150 small solar-power satellites, as a proof of concept. ¶ For the woke folks who care about the bloody history of diamond production, there’s the likelihood that space mining would wipe out Earth’s entire diamond industry. “They will be found in quantities unattainable on Earth,” claims Suarez, with good reason. We are starting to discover that there is more crystalized carbon in the cosmos than we ever suspected. Astronomers have identified one [distant planet made entirely of diamond](https://www.nationalgeographic.com/science/phenomena/2014/06/24/diamond-the-size-of-earth/); there may be more, but they are, ironically, hard to see. ¶ We don’t have diamond planets in our solar system (and we can’t do interstellar missions), but we do have diamond-studded asteroids. Mine them for long enough and you will wear diamonds on the soles of your shoes.¶ For investors and entrepreneurs, there is the thrill of racing to be the first member of the four-comma club. ([Neil deGrasse Tyson believes that the first trillionaire will be an asteroid mining mogul](https://www.nbcnews.com/science/space/neil-degrasse-tyson-says-space-ventures-will-spawn-first-trillionaire-n352271); Suarez isn’t sure whether they’ll be the first, but he suspects that asteroid mining “will mint more trillionaires than any industry in history.”) ¶ For the regular guy or gal with a 401K, there’ll be a fast-rising stock market — inflated not by financial shenanigans this time, but an actual increase in what the world counts as wealth.¶ For workers, there is the promise of sharing in the untold riches, both legally and otherwise. It would be hard to stop miners attaining mineral wealth beyond their paycheck, under the table, when your bosses are millions of miles away. Then there’s the likelihood of rapid advancement in this new economy, where the miners fast gain the knowledge necessary to become moguls.¶ “After several tours in space working for others, perhaps on six-month or year-long contracts, it's likely that some workers will partner to set up their own businesses there,” says Suarez. “Either serving the needs of increasing numbers of workers and businesses in space, marketing services to Earth, or launching asteroid mining startups themselves.” All in all, it’s starting to sound a damn sight more beneficial to the human race than the internet economy is. Not a moment too soon. I’ve written encouragingly about asteroid mining several times before, each time touting the massive potential wealth that seems likely to be made. And each time there’s been a sense of disquiet among my readers, a sense that we’re taking our rapacious capitalist ways and exploiting space.¶ Whereas the truth is, this is exactly the version of capitalism humanity has needed all along: the kind where there is no ecosystem to destroy, no marginalized group to make miserable. A safe, dead space where capitalism’s most enthusiastic pioneers can go nuts to their hearts’ content, so long as they clean up their space junk. ¶ ([Space junk](https://mashable.com/category/space-junk) is a real problem in orbital space because it has thousands of vulnerable satellites clustered closely together around our little blue rock. The vast emptiness of cislunar space, not so much.)¶ And because they’re up there making all the wealth on their commodities market, we down here on Earth can certainly afford to focus less on growing our stock market. Maybe even, whisper it low, we can afford a fully functioning social safety net, plus free healthcare and free education for everyone on the planet.¶ It’s also clearly the area where we should have focused space exploration all along. If we settle on Mars, we may disturb as-yet-undiscovered native bacteria — and as the character Nathan Joyce shouts at a group of “Mars-obsessed” entrepreneurs in Delta-V, Mars is basically filled with toxic sand and is thus looking increasingly impossible to colonize. (Sorry, Mark Watney from The Martian, those potatoes would probably kill you.)

#### Warming causes extinction.

Bill **McKibben 19**, Schumann Distinguished Scholar at Middlebury College; fellow of the American Academy of Arts and Sciences; holds honorary degrees from 18 colleges and universities; Foreign Policy named him to their inaugural list of the world’s 100 most important global thinkers. "This Is How **Human Extinction** Could Play Out." Rolling Stone. 4-9-2019. https://www.rollingstone.com/politics/politics-features/bill-mckibben-falter-climate-change-817310/

Oh, it could get **very bad**. In 2015, a study in the Journal of Mathematical Biology pointed out that if the world’s **oceans** kept warming, by 2100 they might become hot enough to “**stop oxygen production** by **phyto-plankton** by disrupting the process of photosynthesis.” Given that **two-thirds** of the **Earth’s oxygen** comes from phytoplankton, that would “likely result in the **mass mortality of animals and humans**.”A year later, above the Arctic Circle, in Siberia, a heat wave thawed a reindeer carcass that had been trapped in the permafrost. The exposed body released anthrax into nearby water and soil, infecting two thousand reindeer grazing nearby, and they in turn infected some humans; a twelve-year-old boy died. As it turns out, **permafrost** is a “very good preserver of **microbes** and **viruses**, because it is cold, there is no oxygen, and it is dark” — scientists have managed to revive an eight-million-year-old bacterium they found beneath the surface of a glacier. Researchers believe there are fragments of the **Spanish flu virus**, **smallpox**, and **bubonic plague** buried in Siberia and Alaska. Or consider this: as ice sheets melt, they take weight off land, and that can **trigger earthquakes** — seismic activity is already increasing in Greenland and Alaska. Meanwhile, the added weight of the new seawater starts to bend the Earth’s crust. “That will give you a **massive increase in volcanic activity**. It’ll activate faults to create earthquakes, submarine landslides, tsunamis, the whole lot,” explained the director of University College London’s Hazard Centre. Such a landslide happened in Scandinavia about eight thousand years ago, as the last Ice Age retreated and a Kentucky-size section of Norway’s continental shelf gave way, “plummeting down to the abyssal plain and creating a series of **titanic waves** that roared forth with a vengeance,” **wiping all signs of life** from coastal Norway to Greenland and “drowning the Wales-sized landmass that once connected Britain to the Netherlands, Denmark, and Germany.” When the waves hit the Shetlands, they were sixty-five feet high. There’s even this: if we keep raising carbon dioxide levels, we may not be able to think straight anymore. At a thousand parts per million (which is within the realm of possibility for 2100), human cognitive ability falls 21 percent. “The largest effects were seen for Crisis Response, Information Usage, and Strategy,” a Harvard study reported, which is too bad, as those skills are what we seem to need most. I could, in other words, do my best to scare you silly. I’m not opposed on principle — changing something as fundamental as the composition of the atmosphere, and hence the heat balance of the planet, is certain to trigger all manner of horror, and we shouldn’t shy away from it. The dramatic uncertainty that lies ahead may be the most frightening development of all; the physical world is going from backdrop to foreground. (It’s like the contrast between politics in the old days, when you could forget about Washington for weeks at a time, and politics in the Trump era, when the president is always jumping out from behind a tree to yell at you.) But let’s try to occupy ourselves with the most likely scenarios, because they are more than disturbing enough. Long before we get to tidal waves or smallpox, long before we choke to death or stop thinking clearly, we will need to concentrate on the most mundane and basic facts: everyone needs to eat every day, and an awful lot of us live near the ocean. FOOD SUPPLY first. We’ve had an amazing run since the end of World War II, with crop yields growing fast enough to keep ahead of a fast-rising population. It’s come at great human cost — displaced peasant farmers fill many of the planet’s vast slums — but in terms of sheer volume, the Green Revolution’s fertilizers, pesticides, and machinery managed to push output sharply upward. That climb, however, now seems to be running into the brute facts of heat and drought. There are studies to demonstrate the dire effects of warming on coffee, cacao, chickpeas, and champagne, but it is cereals that we really need to worry about, given that they supply most of the planet’s calories: corn, wheat, and rice all evolved as crops in the climate of the last ten thousand years, and though plant breeders can change them, there are limits to those changes. You can move a person from Hanoi to Edmonton, and she might decide to open a Vietnamese restaurant. But if you move a rice plant, it will die. A 2017 study in Australia, home to some of the world’s highest-tech farming, found that “**wheat productivity** has **flatlined** as a **direct result of climate change**.” After tripling between 1900 and 1990, wheat yields had stagnated since, as temperatures increased a degree and rainfall declined by nearly a third. “The chance of that just being variable climate without the underlying factor [of climate change] is less than one in a hundred billion,” the researchers said, and it meant that despite all the expensive new technology farmers kept introducing, “they have succeeded only in standing still, not in moving forward.” Assuming the same trends continued, yields would actually start to decline inside of two decades, they reported. In June 2018, researchers found that a two-degree Celsius rise in temperature — which, recall, is what the Paris accords are now aiming for — could cut U.S. corn yields by 18 percent. A four-degree increase — which is where our current trajectory will take us — would cut the crop almost in half. The United States is the world’s largest producer of corn, which in turn is the planet’s most widely grown crop. **Corn is vulnerable** because even a week of high temperatures at the key moment can **keep it from fertilizing**. (“You only get one chance to pollinate a quadrillion kernels of corn,” the head of a commodity consulting firm explained.) But even the hardiest crops are susceptible. Sorghum, for instance, which is a staple for half a billion humans, is particularly hardy in dry conditions because it has big, fibrous roots that reach far down into the earth. Even it has limits, though, and they are being reached. Thirty years of data from the American Midwest show that heat waves affect the “vapor pressure deficit,” the difference between the water vapor in the sorghum leaf’s interior and that in the surrounding air. Hotter weather means the sorghum releases more moisture into the atmosphere. Warm the planet’s temperature by two degrees Celsius — which is, again, now the world’s goal — and sorghum yields drop 17 percent. Warm it five degrees Celsius (nine degrees Fahrenheit), and yields drop almost 60 percent. It’s hard to imagine a topic duller than sorghum yields. It’s the precise opposite of clickbait. But **people have to eat**; in the human game, the single most important question is probably “What’s for dinner?” And when the answer is “Not much,” things **deteriorate fast**. In 2010 a severe heat wave hit Russia, and it wrecked the grain harvest, which led the Kremlin to ban exports. The global **price of wheat spiked**, and that helped **trigger the Arab Spring** — Egypt at the time was the largest wheat importer on the planet. That experience set academics and insurers to work gaming out what the next **food shock** might look like. In 2017 one team imagined a vigorous El Niño, with the attendant floods and droughts — for a season, in their scenario, corn and soy yields declined by 10 percent, and wheat and rice by 7 percent. The result was chaos: “quadrupled commodity prices, civil unrest, significant negative humanitarian consequences . . . **Food riots** break out in urban areas across the Middle East, North Africa, and Latin America. The euro weakens and the main European stock markets lose ten percent.” At about the same time, a team of British researchers released a study demonstrating that even if you can grow plenty of food, the transportation system that distributes it runs through just fourteen major choke-points, and those are vulnerable to — you guessed it — massive disruption from climate change. For instance, U.S. rivers and canals carry a third of the world’s corn and soy, and they’ve been frequently shut down or crimped by flooding and drought in recent years. Brazil accounts for 17 percent of the world’s grain exports, but heavy rainfall in 2017 stranded three thousand trucks. “It’s the glide path to a perfect storm,” said one of the report’s authors. Five weeks after that, another report raised an even deeper question. What if you can figure out how to grow plenty of food, and you can figure out how to guarantee its distribution, but the food itself has lost much of its value? The paper, in the journal Environmental Research, said that rising carbon dioxide levels, by speeding plant growth, seem to have reduced the amount of protein in basic staple crops, a finding so startling that, for many years, agronomists had overlooked hints that it was happening. But it seems to be true: when researchers grow grain at the carbon dioxide levels we expect for later this century, they find that minerals such as calcium and iron drop by 8 percent, and protein by about the same amount. In the developing world, where people rely on plants for their protein, that means huge reductions in nutrition: India alone could lose 5 percent of the protein in its total diet, putting 53 million people at new risk for protein deficiency. The loss of zinc, essential for maternal and infant health, could endanger 138 million people around the world. In 2018, rice researchers found “significantly less protein” when they grew eighteen varieties of rice in high–carbon dioxide test plots. “The idea that food became less nutritious was a surprise,” said one researcher. “It’s not intuitive. But I think we should continue to expect surprises. We are completely altering the biophysical conditions that underpin our food system.” And not just ours. People don’t depend on goldenrod, for instance, but bees do. When scientists looked at samples of goldenrod in the Smithsonian that dated back to 1842, they found that the protein content of its pollen had “declined by a third since the industrial revolution — and the change closely tracks with the rise in carbon dioxide.” Bees help crops, obviously, so that’s scary news. But in August 2018, a massive new study found something just as frightening: crop pests were thriving in the new heat. “It gets better and better for them,” said one University of Colorado researcher. Even if we hit the UN target of limiting temperature rise to two degrees Celsius, pests should cut wheat yields by 46 percent, corn by 31 percent, and rice by 19 percent. “Warmer temperatures accelerate the metabolism of insect pests like aphids and corn borers at a predictable rate,” the researchers found. “That makes them hungrier[,] and warmer temperatures also speed up their reproduction.” Even fossilized plants from fifty million years ago make the point: “**Plant damage** from insects **correlated** with rising and falling **temperatures**, reaching a maximum during the warmest periods.”

#### An asteroid collision would ensure extinction – would fundamentally alter the biosphere, don’t underestimate its risk. Hudson 19

Wesley Hudson ’19, news reporter for Express, “Asteroid alert: NASA warning as kilometre long space rock set to skim Earth at 25,000mph”, 8/28/19, Express, https://www.express.co.uk/news/science/1170826/asteroid-news-NASA-latest-space-rock-asteroid-1998-HL1-earth-danger-apocalypse

AN ASTEROID almost a kilometre wide is currently barreling through space at more than 25,000mph and is due to skim the earth towards the end of October. NASA’s Jet Propulsion Laboratory (JPL) claim the space rock will shoot past the earth within a “close” proximity of the planet in the early hours of October 26. The asteroid, dubbed 1998 HL1, is a so-called Near-Earth Object (NEO) flying on a Close Approach Trajectory. NASA expects the 1998 HL1 to come flying by dangerously close around 1.21am BST (17.21pm PDT). The daunting moment will mark anther journey around the sun for the asteroid since it was discovered in 1998. The asteroid will be travelling at a staggering speed of over 25,000mph as it barrels past the Earth. The JPL predict the asteroid could be between 440m and 990m wide. At its largest an asteroid of this size is bigger than the tallest building in the world, the Burj Khalifa in Dubai. Even at it’s smallest, 1998 HL1 is still bigger than The Shard. Since it was discovered, 1998 HL1 has been seen up to 408 times. An NEO is an asteroid or comet which is on an orbital path intersecting that of the Earth's. This asteroid will miss the Earth by almost four million miles. If it were to strike the Earth, an asteroid of this size would cause catastrophic damage. The extinction of the dinosaurs in the Cretaceous-Tertiary event 65million years ago is famously believed to have been caused by a massive asteroid impact. The Chicxulub Crater in Mexico is the most commonly accepted point of impact, with the responsible body thought to be around 10km in diameter. A car-sized asteroid is estimated to hit the Earth roughly once a year. The majority of asteroids on track for the planet are usually burnt up as they enter the Earth's atmosphere. NASA administrator Jim Bridenstine has previously warned a potential asteroid collision is **more likely** then people realise. He said: "We have to make sure that people understand that this is not about Hollywood, it's not about the movies. "This is about ultimately protecting the only planet we know, right now, to host life - and that is the planet Earth.” NASA is currently in the process of developing the Double Asteroid Redirection Test (DART). DART will test if it is possible to redirect asteroids that are threatening to impact with Earth. SpaceX chief Elon Musk had previously tweeted fears of a deadly collision that Earth was not prepared for. Mr Musk tweeted: “**A big rock will hit Earth eventually & we currently have no defence**.”

#### Don’t write our impacts off as low probability – asteroid collision is complex and the existence of space keyholes exponentially increases the risk of collision. Vereš ’19

Peter Vereš ’19, Harvard-Smithsonian Center for Astrophysics, “Chapter 6 Vision of Perfect Observation Capabilities”, 2019, Planetary Defense, Space and Society, https://dl1.cuni.cz/pluginfile.php/634091/mod\_resource/content/1/Planetary%20Defence.pdf

Often, uncertain orbits are a source of elevated impact risks of some NEOs with the Earth. The impact probability of an asteroid with Earth is a **complex problem**. First, the orbits of Earth and the asteroid should be close enough or even intersect; second, the Earth and asteroid should meet at the intersection at the same time. If these conditions are met, then one can assess how close the asteroid flies around the Earth at a given time, or whether it will hit the Earth. One must remember that **each asteroid orbit comes with uncertainties** and therefore, instead of a single accurate solution where the asteroid will hit the Earth or miss it, there is always a realm of possible solutions within the orbit uncertainties. The tangent plane to the asteroid’s trajectory at the time of impact, or close approach, is called a b-plane. At a given time of a predicted impact, all possible closest distances to the Earth of possible orbits create an area on the tangent plane. If the area contains the Earth, then the impact probability for that epoch is non-zero and in a simple approximation can be denoted as a ratio of an area of Earth cross section and the entire area with possible orbits going through the b-plane. It happens that a newly discovered NEO with a short arc that is coming very close to the Earth has a non-zero impact probability, because its orbit is highly uncertain and the area on the b-plane is very large. Typically, further observations improve the orbit, and the impact risk for a given epoch falls to zero. Some objects, however, have orbits with low orbital uncertainty, but still have non-zero impact probability, such as Bennu. The non-zero impact probability is computed for a given time in the future, but even if the orbit is known very well today, **small perturbations** from planets and non-gravitational forces **increase the uncertainty** for future impacts. That is why NASA’s Sentry is providing predictions only for the next 100 years. A close flyby of a spacecraft around an asteroid may improve the asteroid’s orbit significantly, however, it does not fully mitigate its impact in the future, due to the presence of keyholes (Chodas 1999)—small areas in space near Earth. Keyholes are specific for asteroids flying very close to the Earth and are rather small, from a few to hundreds of kilometers across. If the keyhole is hit during the NEO flyby, the orbit of the NEO becomes resonant with Earth and the NEO will return to Earth regularly, **increasing its impact probability**. Thus, in case of a very near Earth flyby, **the orbit needs to be known with such precision** (~km) **that keyhole avoidance is confirmed**. NASA has even created the NEO Deflection App,1 where the public can try to change the orbit of a hypothesized NEO on direct impact trajectory. For Earth impact monitoring, the accuracy of orbits and orbital uncertainties is crucial and deserves more attention. The future of orbit determination and uncertainty mitigation will depend more and more on sophisticated software that will be able to handle orbital computation in detail; assess uncertainties and errors of measurements; coordinate a list of objects that are crucial for follow-up or orbit improvement, or even automatically point the telescopes in a network to observe those asteroids; measure their positions; and submit the data to MPC. This automated process is more or less implanted by several surveys (CSS, LCOGT) and agencies (ESA, MPC).