## OFF

### 1NC---OFF

#### Interpretation: Appropriation is permanent and exclusive

Babcock 19 Professor of Law, Georgetown University Law Cente. Babcock, Hope M. "The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET." Syracuse L. Rev. 69 (2019): 191.

Article II is one of those succeeding provisions that curtails “the freedom of use outlined in Article [I] by declaring that outer space, including the [m]oon and other celestial bodies, is not subject to national appropriation.”147 It flatly prohibits national appropriation of any celestial body in outer space “by means of use or occupation, or by any other means.”148 However, “many types of ‘use’ or ‘exploitation’. . . are inconceivable without appropriation of some degree at least of any materials taken,” like ore or water.149 If this view of Article II’s prohibitory language is correct, then “it is not at all farfetched to say that the OST actually installs a blanket prohibition on many beneficial forms of development.”150 However, the OST only prohibits an appropriation that constitutes a “long-term use and permanent occupation, to the exclusion of all others.”151

#### Even if it seems like appropriation because they occupy space exclusively, orbital slots are temporary, forfeitable, and non-exclusive in international law

Blodger 16 {JD Candidate, 2016, University of Minnesota Law School; BA Hillsdale College, 2013. I would like to thank Professor Carbone and the MJLST editors and staff for their feedback, edits, and guidance throughout this process. "Reclassifying Geostationary Earth Orbit as Private Property: Why Natural Law and Utilitarian Theories of Property Demand Privatization." <https://scholarship.law.umn.edu/cgi/viewcontent.cgi?article=1006&context=mjlst>]

This does not preclude the extension of a countrys legal jurisdiction into the sea, but only precludes the state and private individuals from exercising an ownership interest in the sea.80 This limitation is expressed in the Outer Space Treaty.81 The non-appropriation principles of the treaty are based on the theory that space, like the sea, is a potential medium of transport, and that the occupation of one small part of the area will not foreclose anothers use of the remaining portions of space.82 The current GEO regulation regime also follows the exception proposed by Grotius, that a person may use a common area he occupies for as long as the occupation lasts, as shown by the fact that the ITU only grants temporary, forfeitable licenses to use areas of GEO.83 While these licenses do not confer a property right, they do purport to confer a right to use an area of space; and, even though the ITU likely has no authority to exclude others from operating in the same space, the mere presence of the satellite would deter and likely prevent others from attempting to occupy the same location.84 Thus, the Outer Space Treaty not only relies on Grotius theory as an initial basis for preventing private ownership, but also employs the exceptions Grotius identifies.

#### Occupation is de facto appropriation, not appropriation proper.

Matignon 19 [Louis de Gouyon Matignon, PhD in space law from Georgetown University, “ORBITAL SLOTS AND SPACE CONGESTION,” 06/03/19, *Space Legal Issues*, https://www.spacelegalissues.com/orbital-slots-and-space-congestion/, EA]

Near-Earth space is formed of different orbital layers. Terrestrial orbits are limited common resources and inherently repugnant to any appropriation: they are not property in the sense of law. Orbits and frequencies are res communis (a Latin term derived from Roman law that preceded today’s concepts of the commons and common heritage of mankind; it has relevance in international law and common law). It’s the first-come, first-served principle that applies to orbital positioning, which without any formal acquisition of sovereignty, records a promptness behaviour to which it grants an exclusive grabbing effect of the space concerned. Geostationary orbit is a limited but permanent resource: this de facto appropriation by the first-comers – the developed countries – of the orbit and the frequencies is protected by Space Law and the International Telecommunications Law. The challenge by developing countries of grabbing these resources is therefore unjustified on the basis of existing law. Denying new entrants geostationary-access or making access more difficult does not constitute appropriation; it simply results from the traditional system of distribution of access rights. The practice of developed States is based on free access and priority given to the first satellites placed in geostationary orbit.

#### Vote neg for predictable limits—including temporary occupation is a limits disaster—any aff about a single spaceship, satellite, or weapon would be T because they temporarily occupy space. Unlimited topics explode neg prep and draw unreciprocal lines of debate.

#### Fairness is a voter—it’s a gateway issue to the ballot.

#### Drop the debater to deter future abuse.

#### CI- Reasonability is arbitrary and we don’t know the brightline while prepping. Collapses since it uses an offense/defense paradigm to win it.

#### No RVIs- A] Illogical- you don’t win for being fair B] Encourages baiting theory which proliferates abuse C] Chills checking abuse for fear of the RVI D] Norming – we cant concede the ci which forces us to argue for bad norms

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#### Interpretation: Debaters must disclose affirmative frameworks, advocacy texts, and advantage areas thirty minutes before round if they haven’t read the affirmative before

#### Violation: They didn’t

#### Standards:

#### 1] Clash- Not disclosing incentivizes surprise tactics and poorly refined positions that rely on artificial and vague negative engagement to win debates. Their interpretation discourages third- and fourth-line testing by limiting the amount of time we have to prepare and forcing us to enter the debate with zero idea of what the affirmative is. Negatives are forced to rely on generics instead of smart contextual strategies destroying nuanced argumentation.

#### 2] Reciprocity – They get an infinite amount of time to frontline their aff to write the most efficient and effective answers to anything we could say against it while we get only four minutes in round. This gives them a tremendous advantage over us that makes it impossible to win substance.

#### 3] Shiftiness- Not knowing enough about the affirmative coming into round incentivizes 1ar shiftiness about what the aff is and what their framework/advocacy entails. That means even if we could read generics or find prep, they’d just find ways to recontextualize their obscure advocacy in the 1ar.

#### Reject 1AR theory- A] 7-6 time skew means it’s endlessly aff biased B] I don’t have a 3nr which allows for endless extrapolation C] 1AR theory is skewed to the aff because they have a 2ar judge psychology warrant.

#### Infinite abuse claims are wrong- A] Spikes solve-you can just preempt paradigms in the 1AC B] Functional limits- 1nc is only 7 minutes long

#### Condo is good proving a CP is bad doesn’t prove the plan is good, a logical policy maker can always choose not to act. Logic outweighs – it’s the basis of all rational arguments.

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#### [Actor] ought to submit a proposal for the appropriation of outer space by private entities to the National Aeronautics and Space Administration for a National Environmental Policy Act Environmental Impact Assessment providing necessary resources, staffing and otherwise, for prioritization of this Assessment. States ought to implement the least environmentally damaging alternative identified in the Environmental Impact Statement.

#### Counterplan competes and creates the the least environmentally damaging version of the aff.

**Haroun et al 21** [Fawaz Haroun, Shalom Ajibade, Philip Oladimeji, and John Kennedy Igbozurike, authors are all faculty of law for the University of Lagos in Nigeria. 03-19-2021, "Toward the Sustainability of Outer Space: Addressing the Issue of Space Debris," New Space, [https://www.liebertpub.com/doi/full/10.1089/space.2020.0047 accessed 2/16/22](https://www.liebertpub.com/doi/full/10.1089/space.2020.0047%20accessed%202/16/22)] Adam

The need for environmental impact assessment

The requirement of environmental impact assessment is contained in Principle 17 of the Rio Declaration. The principle provides:

Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

Before any activity is carried out that is likely to affect the environment, an assessment is to be carried out to know the exact nature of the effect it would have on the environment. The assessment allows the proper consideration of the environment while decisions are being made.[39](https://www.liebertpub.com/doi/full/10.1089/space.2020.0047#B39) EC Directive 85/337/EEC[40](https://www.liebertpub.com/doi/full/10.1089/space.2020.0047#B40) was the first international instrument to grant the principle recognition.

In the space context, any activity that is to be undertaken should necessarily require an environmental impact assessment, to know the exact effects of such an activity on outer space. After such assessments have been made, decisions should then be made in line with the assessments. In the case of the launching of spacecrafts into outer space, the trajectory of the spacecraft and the possible effects must be well considered. In addition, in a bid to prevent the increase of space debris, a disposal regime must be created for the spacecraft. Such a disposal regime shall allow the removal of the craft from outer space after it has served its purpose, or at least to have it moved to a safer part of outer space, to prevent the vicious increase of space debris.

#### Nasa uses existing NEPA guidelines in outer space – the counter plan extends that to private entities

**Nasa No Date** [Nasa and the National Environmental Policy Act, No Date, "NASA," Nasa, [https://www.nasa.gov/green/nepa/itm\_NEPAProgram.html accessed 2/16/22](https://www.nasa.gov/green/nepa/itm_NEPAProgram.html%20accessed%202/16/22)] Adam

NASA AND THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) requires all Federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and the reasonable alternatives to those actions. NASA follows the NEPA regulations promulgated by the Council on Environmental Quality (CEQ) and has developed agency-specific NEPA policies and regulations to ensure compliance with the NEPA statute, implementing regulations, and related Executive Orders.

NASA’s NEPA Program is managed by the Environmental Management Division, NASA Headquarters, and NASA NEPA Managers who oversee its implementation at the NASA Centers and component facilities. The program ensures that NASA is proactive in meeting its Federal stewardship responsibilities while ensuring mission success and lowering environmental liability. Early implementation of NEPA in the planning stages of NASA programs and projects can be critical to lowering the risk to mission schedules and costs, as well as risks to the environment.

The Agency stands behind its NEPA Program, ensuring that missions are implemented with the least possible impact to the environment. NASA knows that every mission, even exploration of other planets, starts with protecting our home, planet Earth.

**Extinction. EIA is key to preserve space resources, stop resource wars, and extra-terrestrial environmental damage.**

William R. **Kramer**, Hawaii Research Center for Futures Studies @ University of Hawaii, **'17**, In dreams begin responsibilities – environmental impact assessment and outer space development, ENVIRONMENTAL PRACTICE, VOL. 19, NO. 3, 128–138

**Benefits of extraterrestrial environmental impact assessment** Most publications regarding outer space resources maintain that those resources are nearly limitless, and many business models for exploitation do not imagine that resources on Mars, for example, will ever be exhausted (Lewis, 1996; Zubrin, 1996; Renstrom, 2016). Ever is a long time. While the statement may be figuratively true for some mineral ores that may last through an individual company’s project timeline, it is not necessarily true for long-term planning. **There will likely be competition for the rarest (most valuable) minerals**. Without some form of planning and regulation, they may be extracted in an inefficient and environmentally damaging manner and be **quickly depleted** (as exemplified by hydraulic mining for gold on Earth, which wasted much of the resource and resulted in extensive environmental damage) (Merchant, 1998).

How might resources be put to their highest and best use unless regulated? Both the Moon and Mars have water ice which will be **crucial for human survival**, but water also has lucrative industrial uses; it is potentially the raw material for manufacturing both rocket fuel and oxygen. **Conflicts over resource allocation** may be better addressed during an **assessment process** that seeks to balance highest and best use with discovery and first use. Who gains access to specific areas for mining becomes more problematic in that the Outer Space Treaty does not allow “ownership” of extraterrestrial territory; there is no guarantee that companies such as those listed previously will gain access to the most productive sites. The China National Space Administration is planning to place a crew on the Moon by 2024, so **competition for the best sites will be intense** (Kramer, 2015b; China Digital Times, 2012).

Space industries generally are not considering that their proposed actions may preclude alternative uses such as scientific research and human settlement. There will be a stream of not yet imagined uses that could be adversely affected or foreclosed. Many of the same conflicts between land use and human habitation experienced on Earth may emerge on extraterrestrial sites. On the Moon, for example, there are preferable sites for collecting solar energy. These “peaks of eternal light” are areas nearly always or constantly exposed to sunlight at the poles. They are very limited in both distribution and size (Elvis, Milligan, and Krolikowski, 2016). If a mining operation were to determine such areas suitable for their operations, or if mining created a constant plume of dust that would diminish the effectiveness of solar panels, how might such a situation be resolved?

Should potentially dangerous industries such as fuel manufacturing or storage be located near living areas? Would hydraulic fluid pipelines be closely monitored for leaks that may affect subsurface ice deposits mined for drinking water? How might vibrations from detonations affect unrelated structures or scientific instrumentation, such as telescopes? And how might a search for life, whether extinct or still living, be affected by human presence and our trail of bacteria and organic wastes? Humans’ biological pollution of Mars, for example, may greatly affect the results of any search for extraterrestrial life there (Kramer, 2009; McKay, 2009). Peter Doran of the Planetary Protection Subcommittee of the NASA Advisory Council offered, “The big issue with all missions to Mars is we don’t want to create a situation where we are impacting future life-detection science. Picture humans … walking around shedding microbes everywhere we go. Space suits as we know them do not take care of this problem (Mack, 2016).”

#### Adherence to NEPA solves global ecological sustainability

**Caldwell 98** (Lynton K. Caldwell, Professor Emeritus of Political Science & Public and Environmental Affairs at Indiana University, MA in History and Government from Harvard University, PhD in Political Science from the University of Chicago, “Beyond NEPA: Future Significance of the National Environmental Policy Act,” 22 Harv. Envtl. L. Rev. 203, Lexis)

\*\*\*note --- edited for gendered language & grammar, marked in brackets

A distinguishing feature of any society is its prevailing assumptions about its relationship to the Earth. The history of cultures--especially of religions--reveals a great number of cosmologies, the perceived relationships of people to their planetary environment. Today the **survival** of living species may depend first, upon the degree to which [hu]mankind's concept of its environmental situation corresponds to biophysical realities and second, upon what humans value, and how these values are expressed in relation to these realities. Archeology has recorded the failure of societies that have misconceived the requirements for environmental sustainability. During the earlier centuries of human history the impact of society on its environment was relatively light and local. If an environment, for whatever reason, became unsustainable, people could often move on to new lands, often displacing or destroying the original inhabitants. When degradation of the environment was slow or scarcely perceptible, the consequences of its decline often were not felt until they were irreversible. Where human numbers were small relative to space, migration permitted impaired environments to recover, at least partially. But many areas of the Earth have never recovered from the degradation of centuries-long misuse, and still more are headed toward impoverishment. In a world filled with people and settlements, the option of migration is increasingly unavailable. Recognition of narrowing environmental options has led in recent decades to conservation practices assisted by the growth of science, to the comparative measurement of environmental change, and to forecasts of the probable consequences of present trends. The conservation of natural resources movement has had a paradoxical effect upon human perceptions of environmental realities. While the conservation movement contributed both to the emergence of applied ecology and public environmental concern, many conservationists rejected environmentalism (often called preservationism) as uneconomical, unrealistic and anti-social. Economy and efficiency in the wise use of resources has been the essence of "conservation," which sees the environment as infinitely manageable--capable of sustained productivity under the guidance of experts knowledgeable of science. In this respect, conservationism [\*236] is fundamentally consistent with the Western worldview, especially that which prevailed during the era of U.S. Progressivism in the late nineteenth and early twentieth centuries. n82 Environmentalism emerged in the latter half of the twentieth century from a convergence of changing perceptions of the human condition in fields as diverse as ecology, public health, demography, climatology, cosmology, and ethics. When its true dimensions, assumptions, and expectations are understood, environmentalism is, as Robert Nisbet observed, revolutionary. n83 Its effect upon human society is comparable to the changed views of reality inherent in the Copernican cosmic revolution in the seventeenth century and the Darwinian evolution revolution in the nineteenth century. To some, this conclusion may seem to be an exaggerated estimate of the influence of environmentalism and its future prospects. Following initial successes of environmental protection efforts, there has been in many countries (including the United States) an anti-government reaction that has sometimes been violent. n84 It is doubtful that in the long run the "green backlash" will prevail. Its angry proponents are chiefly natural resources industries, land developers and speculators, libertarians, and their allies in public office. Still the counter-intuitive behavior of social systems makes any forecast of the future uncertain. Nevertheless there are ascertainable, measurable trends in today's world that strongly suggest the impending negative impact of powerful coercive environmental events upon human society in the twenty-first century. Adherence to principles like those expressed in NEPA may become more a matter of necessity than of voluntary choice. The way in which people and their governments respond to the prospect of these coercions will **shape the future of the world.** The timing of effective response is equally important. The longer the delay, the more [\*237] difficult the task and the greater the possibility of irremediable damage. Because the future of the world in the twenty-first century cannot be foreseen, we can only conjecture the true location of NEPA on the trajectory of history. I offer the following assessment of the significance of NEPA, fully realizing that, at least in the short run, the world is capable of unpredictable turns. NEPA is most fully understood as a national policy for henceforward into the future. "Environment" may be understood as a surrogate term for a concept more comprehensive than is usually appreciated. Our language tends to lag behind new insights. Among our most persistent and pervasive misconceptions is the artificial dichotomy of economy/ecology. Their true relationship might be suggested by the time-space concept in physics. The concepts of ecology and economy are not the same--they are distinguishable, but, paradoxically, also inseparable.n85 In mundane reality there are obvious conflicts within and between the "domains" of economy and the environment. Yet both these aspects of our world are in actuality inextricable--separable by cultural convention and for analytic purposes. In reality they should have a common inclusive name. Achievement of a national policy for the environment requires awareness of the ecology/economy interrelationship, of the direction toward which the world appears to be moving, and a growth of consensus on the kind of future that is desirable and sustainable. A national policy for the future of the environment cannot be achieved in isolation from other major societal issues. Issues of population, material growth, property rights and obligations, and basic social equities involve choices which many people would prefer not to make. But the world today is not a "new age of Aquarius," free from ultimate accountability to nature, if not to humanity. Regardless of what we may deny or resist, our society will in one way or another be compelled to accommodate its behaviors [\*238] to the inexorable workings of the world. But **apocalypse** need not be a preordained outcome for a society that marshals and moves its moral, material, intellectual, and organizational capabilities toward attainment of a preferred and sustainable future. IX. AN AGENDA FOR THE FUTURE The National Environmental Policy Act may be seen as a charter and agenda to guide this nation toward rational strategies for coping with the critical environmental problems that are present and growing. The United States has the material and intellectual capabilities for setting a[n] non-hegemonic **example for the world.** Whether it can generate a collective moral purpose to do so remains uncertain. As individuals, there is little that people can do to reverse destructive socio-ecological trends. Voluntary local initiatives may help where there is a sense of community purpose. But our fundamental environmental problems transcend manmade boundaries and require solutions commensurate with the problems, which are increasingly seen to be transnational, even global. The 1968 Biosphere Conference and the 1972 and 1992 U.N. conferences on the environment testify to an international recognition of [hu]mankind's environmental predicament. Yet in a world governed by nations, national action is necessary, not only for each nation, but for **international cooperation.** Action on any major social issue requires a **credible** collective purpose, catalytic **leadership,** and popular receptivity. There is strong evidence that the last of these--public support for environmental action--already exists. A goal-directed agenda is necessary to focus and activate social effort, for without such a codification of purpose, there can be no concerted action. Translation of social purpose into action is a function of leadership. To cope with the environmental predicament of [hu]mankind, leadership must be national and participatory, involving all sectors of society, but with an indispensable responsibility in government which is the affirming and coordinative institution for nationwide and international effort. For the United States, NEPA provides a comprehensive agenda for the environmental future. NEPA creates a foundation for a **unifying national effort** and **legitimizes** its goals and principles as [\*239] national policy. Beyond NEPA, specific, targeted action programs are needed to achieve its intent. NEPA may be regarded, in effect, as a constitution for the environment--principles to guide the nation toward an enhanced quality of life and an enduring environmental future.

### 1NC---OFF

## Case

### 1NC---TL

No uq

The aff only eliminates debris from terrorists not space terrorism itself means the aff cant solve

### 1NC---Spark

#### Newest research proves even worst-case nuclear winter is survivable – assumes secondary effects, fallout, arsenal sizes,

**Rodriguez 20** [Luisa Rodriguez is research fellow at the Forethought Foundation for Global Priorities Research. Previously, she researched nuclear war at Rethink Priorities and as a visiting researcher at the Future of Humanity Institute, "What is the likelihood that civilizational collapse would directly lead to human extinction (within decades)? - EA Forum", 24th Dec 2020, <https://forum.effectivealtruism.org/posts/GsjmufaebreiaivF7/what-is-the-likelihood-that-civilizational-collapse-would#Concrete_example__A_large_nuclear_war_that_causes_a_nuclear_winter//imp>]

Case 2: 90% population loss, infrastructure damage, and extreme climate change (e.g. nuclear war that caused nuclear winter) In a scenario in which a catastrophe causes the deaths of 90% of the population (800 million survivors), major infrastructure damage, and climate change — for example, a severe, global nuclear war that caused a nuclear winter — I believe the question of whether humans would be able to meet their basic needs becomes more difficult.[14] The questions I consider for this scenario are: What is the likelihood that survivors are able to continue to survive using traditional forms of agriculture, given a catastrophe that causes severe infrastructure damage and climate change? What is the likelihood that radiation causes extinction? What is the likelihood that humanity would survive in the event of conflict immediately following the catastrophe? What is the likelihood that survivors are able to continue to survive using traditional forms of agriculture? Time spent on this section: 2–3 hours Types of sources: Academic literature, non-academic reports, and expert interviews Expert judgment: Several experts, including ALLFED director David Denkenberger, have affirmed this conclusion — they do not expect humanity to dip below the minimum viable population even in relatively extreme sun-blocking scenarios. Literature review: The nature of all of the catastrophes we know of that would cause extreme global cooling (e.g. nuclear winter, asteroid impacts) **would have unevenly distributed impacts** — causing extreme global cooling in some parts of the world, but more moderate cooling in others. For example, in the case of a nuclear war between the US and Russia, nuclear winter models suggest that the most **severe climate effects would be limited** to the Northern Hemisphere, where temperatures would fall by 10–30 degrees C. But in the Southern Hemisphere, and especially at the equator, those effects would be much less severe: between 5–10 degrees Celsius. With heterogeneous impacts like this, it’s likely that agriculture would still be possible in some regions — especially in New Zealand and Australia, and possibly in South America and Central Africa.[15] To be clear, I’m describing a very grim scenario, in which basically everyone in the Northern Hemisphere — and in many parts of the Southern Hemisphere — would be unable to grow food using standard agricultural techniques. Given this, I expect there would be mass starvation and violent competition and conflict until a new equilibrium was reached, one where the remaining survivors didn’t exceed the Earth’s carrying capacity. While I expect this would be a truly terrible period of widespread suffering, I believe this equilibrium would be reached long before the population got anywhere near the minimum viable population. My best guess is the population would fall to hundreds of thousands to tens of millions, but not much lower. While I haven’t looked into this much, I feel fairly convinced that hundreds of thousands or **millions** of people **could survive** using traditional approaches to agriculture in parts of the world with more moderate climate effects (and basic mitigation strategies, like switching to crop types that are more resilient to temperature and precipitation fluctuations). And as with Case 1, at least some of the survivors in a Case 2 scenario would probably be able to survive the immediate aftermath of a catastrophe that caused civilizational collapse by exploiting food and other supplies in stores and larger stockpiles. This would give survivors some buffer time to learn additional skills required to survive once those supplies run out (e.g. fishing) or develop the techniques necessary to produce food using methods that don’t rely on climate factors like warm temperatures and regular precipitation. BOTEC: The longer the buffer time, the more likely humanity would be to subsequently survive. But there are a number of different considerations (relative to Case 1) that affect the calculus of just how long such a grace period would be in the context of a catastrophic event like a nuclear war that killed 90% of people and caused a nuclear winter. So I’ve done a similar exercise to the one above where I try to account for some of those differences. Note: As above, the following BOTEC relies on particularly poor sources, makes a bunch of dubious assumptions (discussed more below), and I’m not confident I’ve thought of all of the most important supplies. It should be considered very rough. TABLE5 See table note here.[16] Bottom line: I think it’s extremely likely that these supplies would last somewhere between around a year and a decade or more. I expect it would be closer to the lower end, given that competition and violence could lead to the depletion of supplies more quickly than if the population were reduced to a smaller number by the catastrophe directly. All this in mind, I think it is very likely that the survivors would be able to learn enough during the grace period to be able to feed and shelter themselves ~indefinitely. What is the likelihood that radiation causes extinction? Time spent on this section: 2–3 hours Types of sources: Academic papers, Wikipedia, and interviews with experts Literature review: In the aftermath of a nuclear war, radioactive fallout from the nuclear detonations would have long-lasting health impacts. In **the most extreme** nuclear war **scenario**s considered by academics (a nuclear war between the US and Russia and their allies, using 10,000 megatons (MT) of nuclear bombs), approximately 30% of the geographic area in the Northern Hemisphere would have enough fallout to be lethal to any adult in the area (Ehrlich et al., 1983). The current US and Russian nuclear arsenals don’t currently have that kind of megatonnage (they currently have closer to 2,500 MT). If we naively assume that radiation scales linearly, we might expect a modern day US-Russia nuclear war to contaminate up to 7.5% of the land area of the Northern Hemisphere. This may not sound like much, but consider that 95% of the world’s population lives on just 10% of its land area — meaning that 7.5% of land area could be home to millions or even billions of people. What’s more, tens to hundreds of millions more might be exposed to enough radiation to be more susceptible to cancer for the rest of their lives. On top of this, there are currently around 440 civilian nuclear power reactors scattered around the world, and likely tens or hundreds more military reactors. These have fail-safes and automatic shut down measures that are designed to ensure that all of the nuclear material in these reactors would be safely contained in the event of a global catastrophe that meant people stopped attending to them. Concretely, these fail safes make sure that water continues to be circulated around the nuclear fuel to ensure it doesn’t get so hot it causes a meltdown — i.e., an event where the nuclear core partially or completely melts, which might allow the nuclear fuel to breach its multiple layers of containment and leak out into the environment. If fuel did reach the environment, the radioactive fallout could spread across continents, creating exposure levels ranging from immediately fatal (in areas ranging from tens to thousands of square kilometers) to non-lethal but causing potential higher rates of cancer and infertility. But some of these fail-safes could plausibly fail during a catastrophe that caused infrastructure damage (or afterward, if any components of the fail system degraded). For example, some nuclear reactors rely on backup generators to power the pumps that keep water circulating in the core of the reactor. If those backup generators eventually all broke down, the reactor might melt down. I currently don’t have a good sense of how likely these failures would be. Newer nuclear reactors rely on more robust safety systems, with parts that wouldn’t break down as easily. And all nuclear reactor safety systems are designed to account for infrastructure damage caused by earthquakes and other physical shocks. But in a large-scale nuclear war, it seems very plausible that at least some nuclear reactors would melt down. My best guess is that this wouldn’t happen at a large scale, but even if it did, some areas would likely be far enough away from reactors to be spared the radioactive contamination. For example, Australia has just one nuclear reactor. Even if that reactor were to melt down, much of Australia would likely remain uncontaminated (Australia is just under 3 million square miles, and the Chernobyl meltdown is estimated to have contaminated under 60,000 square miles; and only a much smaller fraction of that area was sufficiently contaminated as to be lethal to humans). Bottom line: While radioactive fallout from nuclear detonations and power plant meltdowns would increase the death toll in the years following the collapse, I expect it **wouldn’t be** widespread enough to be immediately **fatal to everyone**, nor would it cause fertility rates or life expectancy to decrease enough to threaten extinction. And at the very least, **some** areas **are sufficiently far away as to be** relatively **safe** from radioactive fallout. What is the likelihood that humanity would survive in the event of conflict immediately following the catastrophe? Time spent on this section: 1–2 hours Types of sources: Academic literature, expert interviews, and speculation Historical base rate: In Case 2, it seems slightly more plausible to me that violence would lead to human extinction than in Case 1, but still fairly unlikely. I don’t think human extinction could be caused by a conflict fought with conventional weapons; **there would** just **be** **too many survivors (~800 million)** to be killed in conventional warfare (compare this to WWI and WWII, during which ~20 million and ~75 million people were killed, respectively). Weapons of mass destruction: My best guess is that the only way violence in the wake of a Case 2 civilizational collapse could directly lead to human extinction is if one group of **survivors** had access to and deployed weapons of mass destruction. This seems unlikely to me, first because it seems hard to imagine a group of survivors incapable of recovering critical infrastructure — and barely capable of meeting even their basic needs — would be able to successfully deploy weapons of mass destruction (though I’m not very confident about this). Second, it’s hard to imagine a scenario where the use of weapons of mass destruction kills millions of survivors, spread all over the world, without modern technologies like transportation. For example, with potentially many survivor groups, it seems hard to imagine how nuclear detonations would kill ~everyone despite the fact that the groups would likely be spread out all over the world, potentially in small bands that can’t each be individually targeted. Similarly, it’s hard to imagine how a pathogen could spread ~everywhere when survivors would likely have greatly reduced mobility (the latter isn’t obviously impossible, but it at least seems exceedingly difficult to me). There’s one counterargument I find somewhat persuasive, which is that it seems possible that all of the survivors might be confined to a relatively small area (for example, if only a small fraction of the Earth’s land area is habitable), making them more vulnerable to a single, large attack. If this were the case, it’s easier for me to imagine that the use of weapons of mass destruction could kill all of the remaining survivors. This would presumably mean the aggressors would be killing themselves, which makes it seem even less likely to me. But we’ve seen humans come dangerously close to threatening their own survival before, often because human aggressors aren’t always good at predicting how cascading effects could threaten their survival as well. A random example to make this concrete: If all of the survivors of a nuclear war were confined to Australia, which might be less impacted by a nuclear winter, one group might choose to use nuclear weapons against another group, not realizing that the radioactive fallout or further climate change could make Australia uninhabitable, even for them. Bottom line: I expect the survivors in Case 2 would not deploy weapons of mass destruction against their competitors, as it would likely pose a pretty big risk to the aggressor as well as the target. But I’m uncertain about this — humans have come close to making similarly self-destructive choices before. Thankfully, even if one group did use weapons of mass destruction against their competitors, I still think it’s very unlikely that their use would cause human extinction. This is because except in a few very specific and very strange scenarios, I expect the survivors would be too geographically distributed and disconnected to be wiped out by a single act of aggression. I therefore expect the result would be a much higher death toll, but not extinction. Concrete example: A large nuclear war that causes a nuclear winter So what, concretely, do I think would happen in the event of a catastrophe like a nuclear war that led to the death of 90% of the population, and caused severe infrastructure damage and significant global cooling? I expect that, in addition to the billions of people killed in the initial catastrophe, hundreds of millions or more would likely die in the famines and violent competition that followed. But my best guess is that hundreds of thousands to hundreds of millions of the survivors of the initial catastrophe would survive this violent period. I think it’s extremely likely these survivors would be able to support themselves using leftover food stocks and supplies, before eventually working out how to feed themselves through traditional agriculture and fishing and/or modified agriculture (using methods that don’t rely on climate factors like warm temperatures and regular precipitation). **All of the catastrophes** we know of **that would lead to extreme cooling** would only do so **for** 1–**10 years, and agriculture would become possible again once the climate began to return to normal**. At that point, it seems even more likely that the surviving humans would be able to meet their own basic needs by returning to traditional forms of agriculture. My key uncertainties are around whether I’m putting too much weight on the idea that humans would figure out how to subsist without traditional agriculture just because it’s technically possible, and whether conflict could lead to extinction through channels I haven’t foreseen. Another toy calculation suggests that these **uncertainties** probably **aren’t troubling enough to change my bottom line**. Note: I again assume each group’s fate is independent of the fates of other groups. I actually think this is a pretty reasonable assumption in this case. I expect that the **survivors** of a catastrophe like a severe nuclear war **would end up somewhat spread out** (at least across the Southern Hemisphere), as doing so would create less competition for resources within a smaller area (I discuss this more later). The farther apart the surviving groups are, the less likely they are to be affected by the same shocks (natural disasters, disease outbreaks, conflict). Additionally, in the event of a catastrophe like a nuclear war, transportation, communication, and other technologies that facilitate contact between geographically distributed groups would be enormously limited. This would further limit the extent to which each group’s fate ended up relating to another’s. There would be other sources of variation between groups that made their fates less correlated: Some groups might be made up mostly of farmers, while others will be made up of lawyers, some groups will tend toward cooperation, while others toward conflict, plus pure randomness (e.g. some groups might have a high proportion of survivors with genetic immunity to a particular disease). But there are also factors that point in the other direction — factors that suggest the surviving groups would be at least somewhat correlated. For example, nuclear winter climate conditions, while nonuniform, would nonetheless impact all surviving groups. Similarly, more severe natural disasters might affect large regions, meaning that at least all of the survivor groups at the regional level might end up experiencing very similar challenges to survival simultaneously. Likewise, there might be things about "human nature" that would be shared amongst all survivors. For example, it’s possible that all of the survivors, having witnessed the initial catastrophe, would have similar psychological experiences — like shock, stress, and social distrust, among others — that would make it more difficult to survive and cooperate. As above, the higher the true correlation between survivor groups, the more my toy calculations will cause me to underestimate the probability that all of the survivor groups would be wiped out. TABLE6 With 800 million survivors, the degree of pessimism you have to have about their ability to survive to end up believing that no groups would survive indefinitely is actually kind of extreme. The exact beliefs you’d have to have would depend on whether survivors were concentrated into a few big groups, or distributed in many smaller ones. Specifically: Even if you thought any given group of 100, 1,000, or 10,000 survivors had a 99% chance of being wiped out, it would still be virtually guaranteed that at least one group would survive. If you thought there was a 99% chance that any one of 800 groups of 100,000 people would be wiped out, there would still only be a 1 in 3,000 chance of extinction. The probability of extinction is higher (45%) if you believe that larger groups of 10 million would also have a 99% chance of being wiped out. But, again, to hold that view, you’d have to think that out of a group of 10 million people (again, bigger than the largest US city), not even a few hundred of those people would overcome the obstacles of the post-collapse environment (how to fish, how to farm despite global cooling, avoiding being killed by a hurricane or drought). I do not find this view very plausible. Similarly, the probability of extinction is very high indeed if you think that any given group of 100 million survivors has a 99% chance of being wiped out. Again, to believe extinction risk was that high, you’d have to think that there would be a 99% chance that none of the 100 million people would work out how to survive (for reference, only 14 countries have a population of 100 million or higher). Given all of this, my subjective judgment is that **it’s very unlikely that this scenario would more or less directly lead to human extinction.**

#### Claims that nuclear winter causes extinction are politically motivated & disputed by every credible scientist

**Scouras 19** [ James Scouras, Johns Hopkins University Applied Physics Laboratory, Nuclear War as a Global Catastrophic Risk, Journal of Benefit-Cost Analysis, 10(2), 274-295. doi:10.1017/bca.2019.16,  [https://sci-hub.tw/https://doi.org/10.1017/bca.2019.16](chrome-extension://iggoldplbhinbmldepiifdjfenfiompa/popup.html)//imp]

While it is clear that nuclear war is a global catastrophic risk, it is also clear that it is not an existential risk. Yet over the course of the nuclear age, a series of mechanisms have been proposed that, it has been erroneously argued, could lead to human extinction. The first concern arose among physicists on the Manhattan Project during a 1942 seminar at Berkeley some three years before the first test of an atomic weapon. Chaired by Robert Oppenheimer, it was attended by Edward Teller, Hans Bethe, Emil Konopinski, and other theoretical physicists (Rhodes, 1995). They considered the possibility that detonation of an atomic bomb could ignite a self-sustaining nitrogen fusion reaction that might propagate through earth’s atmosphere, thereby extinguishing all air-breathing life on earth. Konopinski, Cloyd Margin, and Teller eventually published the calculations that led to the conclusion that the nitrogen-nitrogen reaction was virtually impossible from atomic bomb explosions – calculations that had previously been used to justify going forward with Trinity, the first atomic bomb test (Konopinski et al., 1946). Of course, the Trinity test was conducted, as well as over 1000 subsequent atomic and thermonuclear tests, and we are fortunately still here. After the bomb was used, extinction fear focused on invisible and deadly fallout, unanticipated as a significant consequence of the bombings of Japan that would spread by global air currents to poison the entire planet. Public dread was reinforced by the depressing, but influential, 1957 novel On the Beach by Nevil Shute (1957) and the subsequent 1959 movie version (Kramer, 1959). The story describes survivors in Melbourne, Australia, one of a few remaining human outposts in the Southern Hemisphere, as fallout clouds approached to bring the final blow to humanity. In the 1970s, after fallout was better understood to be limited in space, time, and magnitude, depletion of the ozone layer, which would cause increased ultraviolet radiation to fry all humans who dared to venture outside, became the extinction mechanism of concern. Again, one popular book, The Fate of the Earth by Jonathan Schell (1982), which described the nuclear destruction of the ozone layer leaving the earth “a republic of insects and grass,” promoted this fear. Schell did at times try to cover all bases, however: “To say that human extinction is a certainty would, of course, be a misrepresentation – just as it would be a misrepresentation to say that extinction can be ruled out” (Schell, 1982). Finally, the current mechanism of concern for extinction is nuclear winter, the phenomenon by which dust and soot created primarily by the burning of cities would rise to the stratosphere and attenuate sunlight such that surface temperatures would decline dramatically, agriculture would fail, and humans and other animals would perish from famine. The public first learned of the possibility of nuclear winter in a Parade article by Sagan (1983), published a month or so before its scientific counterpart by Turco et al. (1983). While some nuclear disarmament advocates promote the idea that nuclear winter is an extinction threat, and the general public is probably confused to the extent it is not disinterested, **few scientists** seem to **consider it an extinction threat**. It is understandable that some of these extinction fears were created by ignorance or uncertainty and treated seriously by worst-case thinking, as seems appropriate for threats of extinction. But nuclear doom mongering also seems to be at play for some of these episodes. For some reason, portions of the public active in nuclear issues, as well as some scientists, appear to think that arguments for nuclear arms reductions or elimination will be more persuasive if nuclear war is believed to threaten extinction, rather than merely the horrific cataclysm that it would be in reality (Martin, 1982).4 To summarize, nuclear war is a global catastrophic risk. Such wars may cause billions of deaths and unfathomable suffering, as well as set civilization back centuries. Smaller nuclear wars pose regional catastrophic risks and also national risks in that the continued functioning of, for example, the United States as a constitutional republic is highly dubious after even a relatively limited nuclear attack. But what nuclear war is not is an existential risk to the human race. There is simply **no credible scenario** in which humans do not survive to repopulate the earth.

#### The threshold for survivability is low --- it only takes 100 people to repopulate the earth

Corey S. **Powell 18**, 8-13-2018, "How many humans would it take to keep our species alive? One scientist's surprising answer," NBC News, https://www.nbcnews.com/mach/science/how-many-humans-would-it-take-keep-our-species-alive-ncna900151//HM

In recent years, astronomers have found thousands of planets orbiting nearby stars, making the old science-fiction trope of off-world colonies seem a bit less absurd. But it was the 2016 discovery of a potentially habitable Earth-size planet around Proxima Centauri, the nearest star after the sun, that really got people thinking: Are we too vulnerable to asteroid strikes and other cataclysms to stick with our single planet? Could we safeguard our species by sending a space ark to a new home, a la "Battlestar Galactica" or the movie "Passengers?" Frédéric Marin is among those who are doing the hard thinking. The University of Strasbourg astrophysicist has been focusing not on the engineering issues of interstellar travel (which lie beyond current technology) but on the biology side of the question: How many crew members would be needed for an interstellar voyage that might last dozens of generations? In other words, **what is the minimum number of people required to** deliver and successfully plant a **self-sustain**ing **population** of Homo sapiens on another Earth? “I was reading a lot on the human psychological aspect of spaceflight, and I realized that all books I’ve read and all the movies I’ve seen that were dealing with multiple-generation ships were very naïve,” Marin says. “Since I have access to huge computing power and state-of-the-art simulation tools, I decided to solve this on my spare time.” So when he wasn’t busy simulating galaxies and black holes, Marin created a computer program that mimics the progress of a breeding population. Then he used the program, dubbed Heritage, to simulate the risks a spacefaring population would face, including the effects of inbreeding as well as of catastrophic events like a deadly pandemic or being hit by some celestial object. A paper about his research was published in February in the Journal of the British Interplanetary Society. The magic number The number Marin came up with is 98. Just 98 healthy people would be needed to operate the ship over many generations and to set up a healthy (non-inbred) population on another world, he estimates. That number holds even for his test case of a space ark mission lasting more than 6,000 years, although he allows for the population aboard the ark to grow over time — up to about 500, perhaps. The implications of this finding go far beyond the sorts of spaceships we might be able to build in another century or two. “Our results apply to any enclosed environment where emigration and immigration are not possible,” Marin says. “The same elements are essential for any self-sustaining colony, so our code can easily compute the survival rate of a group of humans after a local or global catastrophe as well.” So even if billions of humans were wiped out by some catastrophe, as long as a suitable group of 98 survived and were able to mate, Marin says, they could carry enough genetic diversity to propagate the species and rebuild the population. Rival calculation Marin acknowledges that 98 sounds like an awfully small number. But he insists it makes sense, even knowing that Cameron Smith, an anthropologist at Portland State University in Oregon, looked at the same basic problem in 2014 and came up with a minimum crew size of 14,000. “Genetic minimum viable population doesn’t deal with real-world concerns,” Smith says, adding that he based his calculation on the demographics of actual populations on Earth. Many hunter-gatherer societies survive in groups of about 100, but even isolated tribes always interact with and have offspring with neighboring groups. Even a population of 14,000 strikes Smith as a modest number if you’re counting on it to sustain our species. “Suppose a catastrophe comes along and it knocks out 70 percent of the population,” he says. “Now the demographic structure of the population has been so disrupted that you can no longer find appropriate mating partners. One little catastrophe and the whole thing could fall apart.” The settling of the South Pacific is an interesting case study, according to Smith. That’s because Polynesians populated the islands one by one, much as we might eventually populate other planets. Of course, the Polynesians had abundant open land for population growth and were followed by a stream of other migrants who could keep things going if they got wiped out.

#### Volcanoes prove

**Beckstead 15** [Nick Beckstead, Professor at Oxford University, Future of Humanity Institute, United Kingdom, “How much could refuges help us recover from a global catastrophe?,” Futures 72 (2015) 36–44 //wyo-tjc] [‘isolated peoples’ refers to populations unconnected from global society, such as Amazonian tribes]

A global catastrophe could disrupt global food production for two reasons. First, as noted a few times above, some global catastrophes—such as supervolcanic eruptions, nuclear wars, and asteroid collisions—might put enough dust in the atmosphere to interfere with photosynthesis and disrupt global food production. Second, an initial catastrophe could kill enough people and do enough damage to infrastructure to shut down global food production. Conceivably, stocking refuges with a very large food supply or method of making food—over and above what is necessary to survive the initial catastrophe—might help a small group to survive and recover if a global catastrophe disrupts global food production. A first issue is that a global food crisis **would not necessarily result in extinction**. **Extinction may even be extremely unlikely in such cases**. The closest historical precedent to these crises was the supervolcanic Toba eruption that took places about 74,000 years ago. Many eruptions of this kind have taken place in the last tens of millions of years, but they did not extinguish our pre-human ancestors (Shulman, 2012a). Humans may now be in many ways worse prepared for such a crisis, with a much larger percentage of the population without hunting and agricultural skills, but we have many advantages in terms of technology and coordination. **The 100+ isolated peoples would be relatively similar to pre-human ancestors who survived supervolcanic eruptions in the past,** though—as noted above—they may have a notable disadvantage in reestablishing an advanced industrial civilization. Second, in any of the global food crisis scenarios noted above, **there would be a substantial amount of remaining food reserves** in the form of grain stockpiles, livestock, fisheries, foods stored at retailers and private homes, and wild land animals that could be hunted (Shulman, 2012b). Therefore, if a refuge helps humanity survive a global food crisis, the mechanism could not be conceived of as ‘‘adding enough to the global food stock to help with survival.’’ More plausibly, there could be a scenario where there is not enough food for everyone to survive the global food crisis, but there would be enough food for some people to survive if they got a disproportionate share of the food. However, conflict (e.g., as in McCarthy’s postapocalyptic novel The Road) and/or egalitarian pressures could prevent a distribution that would allow at least some of the population to survive the crisis. Conceivably, if the refuge were sufficiently secret, isolated, and well-stocked, it might be the only place where these pressures could be abated, making the people in refuges the sole survivors of the global food crisis. While conceivable and perhaps plausible, refuges’ unique success in this kind of case is not automatic and perhaps unlikely. If some small, well-armed group seizes some grain elevators, refuses to share their bounty, and successfully defends what they have claimed, they could also survive the global food crisis. Alternatively, a single survivalist community might be isolated and well-defended enough to achieve the same purpose. This potential use case may deserve more detailed analysis. As noted above, even if some initial catastrophe failed to kill everyone, it could lead to a collapse of the modern world order. This type of scenario might accompany a global food crisis, or could arise independently in cases of an unprecedentedly bad pandemic or global war that decimates the population. Conceivably, such a collapse to lead to extinction or a failure to recover industrial civilization. In this kind of scenario, people in refuges are not the sole survivors of our hypothetical global catastrophe. Instead

#### Humanity would survive a nuclear war but industrial society wouldn’t

**Dartnell 15** [Lewis Dartnell. UK Space Agency research fellow at the University of Leicester, working in astrobiology and the search for microbial life on Mars. His latest book is The Knowledge: How to Rebuild Our World from Scratch. 04-13-15. "Could we reboot a modern civilisation without fossil fuels? – Lewis Dartnell." Aeon. <https://aeon.co/essays/could-we-reboot-a-modern-civilisation-without-fossil-fuels>]

Imagine that the world as we know it ends tomorrow. There’s a global catastrophe: a pandemic virus, an asteroid strike, or perhaps a nuclear holocaust. The vast majority of the human race perishes. Our civilisation collapses. The post-apocalyptic survivors find themselves in a devastated world of decaying, deserted cities and roving gangs of bandits looting and taking by force. Bad as things sound, that’s not the end for humanity. We bounce back. Sooner or later, peace and order emerge again, just as they have time and again through history. Stable communities take shape. They begin the agonising process of rebuilding their technological base from scratch. But here’s the question: how far could such a society rebuild? Is there any chance, for instance, that a post-apocalyptic society could reboot a technological civilisation? Let’s make the basis of this thought experiment a little more specific. Today, we have already consumed the most easily drainable crude oil and, particularly in Britain, much of the shallowest, most readily mined deposits of coal. Fossil fuels are central to the organisation of modern industrial society, just as they were central to its development. Those, by the way, are distinct roles: even if we could somehow do without fossil fuels now (which we can’t, quite), it’s a different question whether we could have got to where we are without ever having had them. So, would a society starting over on a planet stripped of its fossil fuel deposits have the chance to progress through its own Industrial Revolution? Or to phrase it another way, what might have happened if, for whatever reason, the Earth had never acquired its extensive underground deposits of coal and oil in the first place? Would our progress necessarily have halted in the 18th century, in a pre-industrial state? It’s easy to underestimate our current dependence on fossil fuels. In everyday life, their most visible use is the petrol or diesel pumped into the vehicles that fill our roads, and the coal and natural gas which fire the power stations that electrify our modern lives. But we also rely on a range of different industrial materials, and in most cases, high temperatures are required to transform the stuff we dig out of the ground or harvest from the landscape into something useful. You can’t smelt metal, make glass, roast the ingredients of concrete, or synthesise artificial fertiliser without a lot of heat. It is fossil fuels – coal, gas and oil – that provide most of this thermal energy. In fact, the problem is even worse than that. Many of the chemicals required in bulk to run the modern world, from pesticides to plastics, derive from the diverse organic compounds in crude oil. Given the dwindling reserves of crude oil left in the world, it could be argued that the most wasteful use for this limited resource is to simply burn it. We should be carefully preserving what’s left for the vital repertoire of valuable organic compounds it offers. But my topic here is not what we should do now. Presumably everybody knows that we must transition to a low-carbon economy one way or another. No, I want to answer a question whose interest is (let’s hope) more theoretical. Is the emergence of a technologically advanced civilisation necessarily contingent on the easy availability of ancient energy? Is it possible to build an industrialised civilisation without fossil fuels? And the answer to that question is: maybe – but it would be extremely difficult. Let’s see how. We’ll start with a natural thought. Many of our alternative energy technologies are already highly developed. Solar panels, for example, represent a good option today, and are appearing more and more on the roofs of houses and businesses. It’s tempting to think that a rebooted society could simply pick up where we leave off. Why couldn’t our civilisation 2.0 just start with renewables? Well, it could, in a very limited way. If you find yourself among the survivors in a post-apocalyptic world, you could scavenge enough working solar panels to keep your lifestyle electrified for a good long while. Without moving parts, photovoltaic cells require little maintenance and are remarkably resilient. They do deteriorate over time, though, from moisture penetrating the casing and from sunlight itself degrading the high-purity silicon layers. The electricity generated by a solar panel declines by about 1 per cent every year so, after a few generations, all our hand-me-down solar panels will have degraded to the point of uselessness. Then what? New ones would be fiendishly difficult to create from scratch. Solar panels are made from thin slices of extremely pure silicon, and although the raw material is common sand, it must be processed and refined using complex and precise techniques – the same technological capabilities, more or less, that we need for modern semiconductor electronics components. These techniques took a long time to develop, and would presumably take a long time to recover. So photovoltaic solar power would not be within the capability of a society early in the industrialisation process. Perhaps, though, we were on the right track by starting with electrical power. Most of our renewable-energy technologies produce electricity. In our own historical development, it so happens that the core phenomena of electricity were discovered in the first half of the 1800s, well after the early development of steam engines. Heavy industry was already committed to combustion-based machinery, and electricity has largely assumed a subsidiary role in the organisation of our economies ever since. But could that sequence have run the other way? Is there some developmental requirement that thermal energy must come first? On the face of it, it’s not beyond the bounds of possibility that a progressing society could construct electrical generators and couple them to simple windmills and waterwheels, later progressing to wind turbines and hydroelectric dams. In a world without fossil fuels, one might envisage an electrified civilisation that largely bypasses combustion engines, building its transport infrastructure around electric trains and trams for long-distance and urban transport. I say ‘largely’. We couldn’t get round it all together. When it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff. While the electric motor could perhaps replace the coal-burning steam engine for mechanical applications, society, as we’ve already seen, also relies upon thermal energy to drive the essential chemical and physical transformations it needs. How could an industrialising society produce crucial building materials such as iron and steel, brick, mortar, cement and glass without resorting to deposits of coal? You can of course create heat from electricity. We already use electric ovens and kilns. Modern arc furnaces are used for producing cast iron or recycling steel. The problem isn’t so much that electricity can’t be used to heat things, but that for meaningful industrial activity you’ve got to generate prodigious amounts of it, which is challenging using only renewable energy sources such as wind and water. An alternative is to generate high temperatures using solar power directly. Rather than relying on photovoltaic panels, concentrated solar thermal farms use giant mirrors to focus the sun’s rays onto a small spot. The heat concentrated in this way can be exploited to drive certain chemical or industrial processes, or else to raise steam and drive a generator. Even so, it is difficult (for example) to produce the very high temperatures inside an iron-smelting blast furnace using such a system. What’s more, it goes without saying that the effectiveness of concentrated solar power depends strongly on the local climate. No, when it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff. But that doesn’t mean the stuff we burn necessarily has to be fossil fuels. Let’s take a quick detour into the pre-history of modern industry. Long before the adoption of coal, charcoal was widely used for smelting metals. In many respects it is superior: charcoal burns hotter than coal and contains far fewer impurities. In fact, coal’s impurities were a major delaying factor on the Industrial Revolution. Released during combustion, they can taint the product being heated. During smelting, sulphur contaminants can soak into the molten iron, making the metal brittle and unsafe to use. It took a long time to work out how to treat coal to make it useful for many industrial applications. And, in the meantime, charcoal worked perfectly well. And then, well, we stopped using it. In retrospect, that’s a pity. When it comes from a sustainable source, charcoal burning is essentially carbon-neutral, because it doesn’t release any new carbon into the atmosphere – not that this would have been a consideration for the early industrialists. But charcoal-based industry didn’t die out altogether. In fact, it survived to flourish in Brazil. Because it has substantial iron deposits but few coalmines, Brazil is the largest charcoal producer in the world and the ninth biggest steel producer. We aren’t talking about a cottage industry here, and this makes Brazil a very encouraging example for our thought experiment. The trees used in Brazil’s charcoal industry are mainly fast-growing eucalyptus, cultivated specifically for the purpose. The traditional method for creating charcoal is to pile chopped staves of air-dried timber into a great dome-shaped mound and then cover it with turf or soil to restrict airflow as the wood smoulders. The Brazilian enterprise has scaled up this traditional craft to an industrial operation. Dried timber is stacked into squat, cylindrical kilns, built of brick or masonry and arranged in long lines so that they can be easily filled and unloaded in sequence. The largest sites can sport hundreds of such kilns. Once filled, their entrances are sealed and a fire is lit from the top. The skill in charcoal production is to allow just enough air into the interior of the kiln. There must be enough combustion heat to drive out moisture and volatiles and to pyrolyse the wood, but not so much that you are left with nothing but a pile of ashes. The kiln attendant monitors the state of the burn by carefully watching the smoke seeping out of the top, opening air holes or sealing with clay as necessary to regulate the process. Brazil shows how the raw materials of modern civilisation can be supplied without reliance on fossil fuels Good things come to those who wait, and this wood pyrolysis process can take up to a week of carefully controlled smouldering. The same basic method has been used for millennia. However, the ends to which the fuel is put are distinctly modern. Brazilian charcoal is trucked out of the forests to the country’s blast furnaces where it is used to transform ore into pig iron. This pig iron is the basic ingredient of modern mass-produced steel. The Brazilian product is exported to countries such as China and the US where it becomes cars and trucks, sinks, bathtubs, and kitchen appliances. Around two-thirds of Brazilian charcoal comes from sustainable plantations, and so this modern-day practice has been dubbed ‘green steel’. Sadly, the final third is supplied by the non-sustainable felling of primary forest. Even so, the Brazilian case does provide an example of how the raw materials of modern civilisation can be supplied without reliance on fossil fuels. Another, related option might be wood gasification. The use of wood to provide heat is as old as mankind, and yet simply burning timber only uses about a third of its energy. The rest is lost when gases and vapours released by the burning process blow away in the wind. Under the right conditions, even smoke is combustible. We don’t want to waste it. Better than simple burning, then, is to drive the thermal breakdown of the wood and collect the gases. You can see the basic principle at work for yourself just by lighting a match. The luminous flame isn’t actually touching the matchwood: it dances above, with a clear gap in between. The flame actually feeds on the hot gases given off as the wood breaks down in the heat, and the gases combust only once they mix with oxygen from the air. Matches are fascinating when you look at them closely. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this To release these gases in a controlled way, bake some timber in a closed container. Oxygen is restricted so that the wood doesn’t simply catch fire. Its complex molecules decompose through a process known as pyrolysis, and then the hot carbonised lumps of charcoal at the bottom of the container react with the breakdown products to produce flammable gases such as hydrogen and carbon monoxide. The resultant ‘producer gas’ is a versatile fuel: it can be stored or piped for use in heating or street lights, and is also suitable for use in complex machinery such as the internal combustion engine. More than a million gasifier-powered cars across the world kept civilian transport running during the oil shortages of the Second World War. In occupied Denmark, 95 per cent of all tractors, trucks and fishing boats were powered by wood-gas generators. The energy content of about 3 kg of wood (depending on its dryness and density) is equivalent to a litre of petrol, and the fuel consumption of a gasifier-powered car is given in miles per kilogram of wood rather than miles per gallon. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this. But you can do a lot more with wood gases than just keep your vehicle on the road. It turns out to be suitable for any of the manufacturing processes needing heat that we looked at before, such as kilns for lime, cement or bricks. Wood gas generator units could easily power agricultural or industrial equipment, or pumps. Sweden and Denmark are world leaders in their use of sustainable forests and agricultural waste for turning the steam turbines in power stations. And once the steam has been used in their ‘Combined Heat and Power’ (CHP) electricity plants, it is piped to the surrounding towns and industries to heat them, allowing such CHP stations to approach 90 per cent energy efficiency. Such plants suggest a marvellous vision of industry wholly weaned from its dependency on fossil fuel. Is that our solution, then? Could our rebooting society run on wood, supplemented with electricity from renewable sources? Maybe so, if the population was fairly small. But here’s the catch. These options all presuppose that our survivors are able to construct efficient steam turbines, CHP stations and internal combustion engines. We know how to do all that, of course – but in the event of a civilisational collapse, who is to say that the knowledge won’t be lost? And if it is, what are the chances that our descendants could reconstruct it? In our own history, the first successful application of steam engines was in pumping out coal mines. This was a setting in which fuel was already abundant, so it didn’t matter that the first, primitive designs were terribly inefficient. The increased output of coal from the mines was used to first smelt and then forge more iron. Iron components were used to construct further steam engines, which were in turn used to pump mines or drive the blast furnaces at iron foundries. And of course, steam engines were themselves employed at machine shops to construct yet more steam engines. It was only once steam engines were being built and operated that subsequent engineers were able to devise ways to increase their efficiency and shrink fuel demands. They found ways to reduce their size and weight, adapting them for applications in transport or factory machinery. In other words, there was a positive feedback loop at the very core of the industrial revolution: the production of coal, iron and steam engines were all mutually supportive. In a world without readily mined coal, would there ever be the opportunity to test profligate prototypes of steam engines, even if they could mature and become more efficient over time? How feasible is it that a society could attain a sufficient understanding of thermodynamics, metallurgy and mechanics to make the precisely interacting components of an internal combustion engine, without first cutting its teeth on much simpler external combustion engines – the separate boiler and cylinder-piston of steam engines? It took a lot of energy to develop our technologies to their present heights, and presumably it would take a lot of energy to do it again. Fossil fuels are out. That means our future society will need an awful lot of timber. An industrial revolution without coal would be, at a minimum, very difficult In a temperate climate such as the UK’s, an acre of broadleaf trees produces about four to five tonnes of biomass fuel every year. If you cultivated fast-growing kinds such as willow or miscanthus grass, you could quadruple that. The trick to maximising timber production is to employ coppicing – cultivating trees such as ash or willow that resprout from their own stump, becoming ready for harvest again in five to 15 years. This way you can ensure a sustained supply of timber and not face an energy crisis once you’ve deforested your surroundings. But here’s the thing: coppicing was already a well-developed technique in pre-industrial Britain. It couldn’t meet all of the energy requirements of the burgeoning society. The central problem is that woodland, even when it is well-managed, competes with other land uses, principally agriculture. The double-whammy of development is that, as a society’s population grows, it requires more farmland to provide enough food and also greater timber production for energy. The two needs compete for largely the same land areas. We know how this played out in our own past. From the mid-16th century, Britain responded to these factors by increasing the exploitation of its coal fields – essentially harvesting the energy of ancient forests beneath the ground without compromising its agricultural output. The same energy provided by one hectare of coppice for a year is provided by about five to 10 tonnes of coal, and it can be dug out of the ground an awful lot quicker than waiting for the woodland to regrow. It is this limitation in the supply of thermal energy that would pose the biggest problem to a society trying to industrialise without easy access to fossil fuels. This is true in our post-apocalyptic scenario, and it would be equally true in any counterfactual world that never developed fossil fuels for whatever reason. For a society to stand any chance of industrialising under such conditions, it would have to focus its efforts in certain, very favourable natural environments: not the coal-island of 18th-century Britain, but perhaps areas of Scandinavia or Canada that combine fast-flowing streams for hydroelectric power and large areas of forest that can be harvested sustainably for thermal energy. Even so, an industrial revolution without coal would be, at a minimum, very difficult. Today, use of fossil fuels is actually growing, which is worrying for a number of reasons too familiar to rehearse here. Steps towards a low-carbon economy are vital. But we should also recognise how pivotal those accumulated reservoirs of thermal energy were in getting us to where we are. Maybe we could have made it the hard way. A slow-burn progression through the stages of mechanisation, supported by a combination of renewable electricity and sustainably grown biomass, might be possible after all. Then again, it might not. We’d better hope we can secure the future of our own civilisation, because we might have scuppered the chances of any society to follow in our wake.

#### More evidence --- No resources left to re-industrialize

John **Jacobi 17**. Leads an environmentalist research institute and collective, citing Fred Hoyle, British astronomer, formulated the theory of stellar nucleosynthesis, coined the term “big bang,” recipient of the Gold Medal of the Royal Astronomical Society, professor at the Institute of Astronomy, Cambridge University. 05-27-17. “Industrial Civilization Could Not Be Rebuilt.” The Wild Will Project. <https://www.wildwill.net/blog/2017/05/27/industrial-civilization-not-rebuilt/>

A suggestion, for the sake of thought: If industrial civilization collapsed, it probably could not be rebuilt. Civilization would exist again, of course, but industry appears to be a one-time experiment. The astronomist Fred Hoyle, exaggerating slightly, writes: It has often been said that, if the human species fails to make a go of it here on Earth, some other species will take over the running. In the sense of developing high intelligence this is not correct. We have, or soon will have, exhausted the necessary physical prerequisites so far as this planet is concerned. With coal gone, oil gone, high-grade metallic ores gone, no species however competent can make the long climb from primitive conditions to high-level technology. This is a one-shot affair. If we fail, this planetary system fails so far as intelligence is concerned. The same will be true of other planetary systems. On each of them there will be one chance, and one chance only. Hoyle overstates all the limits we actually have to worry about, but there are enough to affirm his belief that industry is a “one-shot affair.” In other words, if industry collapsed then no matter how quickly scientific knowledge allows societies to progress, technical development will hit a wall because the builders will not have the needed materials. For example, much of the world’s land is not arable, and some of the land in use today is only productive because of industrial technics developed during the agricultural revolution in the 60s, technics heavily dependent on oil. Without the systems that sustain industrial agriculture much current farm land could not be farmed; agricultural civilizations cannot exist there, at least until the soil replenishes, if it replenishes. And some resources required for industrial progress, like coal, simply are not feasibly accessible anymore. Tainter writes: . . . major jumps in population, at around A.D. 1300, 1600, and in the late eighteenth century, each led to intensification in agriculture and industry. As the land in the late Middle Ages was increasingly deforested to provide fuel and agricultural space for a growing population, basic heating, cooking, and manufacturing needs could no longer be met by burning wood. A shift to reliance on coal began, gradually and with apparent reluctance. Coal was definitely a fuel source of secondary desirability, being more costly to obtain and distribute than wood, as well as being dirty and polluting. Coal was more restricted in its spatial distribution than wood, so that a whole new, costly distribution system had to be developed. Mining of coal from the ground was more costly than obtaining a quantity of wood equivalent in heating value, and became even more costly as the 54 most accessible reserves of this fuel were depleted. Mines had to be sunk ever deeper, until groundwater flooding became a serious problem. Today, most easily accessible natural coal reserves are completely depleted. Thus, societies in the wake of our imagined collapse would not be able to develop fast enough to reach the underground coal. As a result of these limits, rebuilding industry would take at least thousands of years — it took 10,000 years the first time around. By the time a civilization reached the point where it could do something about industrial scientific knowledge it probably would not have the knowledge anymore. It would have to develop its sciences and technologies on its own, resulting in patterns of development that would probably look similar to historical patterns. Technology today depends on levels of complexity that must proceed in chronological stages. Solar panels, for example, rely on transportation infrastructure, mining, and a regulated division of labor. And historically the process of developing into a global civilization includes numerous instances of technical regression. The natives of Tasmania, for example, went from a maritime society to one that didn’t fish, build boats, or make bows and arrows. Rebuilding civilization would also be a bad idea. Most, who are exploited by rather than benefit from industry, would probably not view a rebuilding project as desirable. Even today, though citizens of first-world nations live physically comfortable lives, their lives are sustained by the worse off lives of the rest of the world. “Civilization . . . has operated two ways,” Paine writes, “to make one part of society more affluent, and the other more wretched, than would have been the lot of either in a natural state.” Consider the case of two societies in New Zealand, the Maori and the Moriori. Both are now believed to have originated out of the same mainland society. Most stayed and became the Maori we know, and some who became the Moriori people settled on the Chatham Islands in the 16th century. Largely due to a chief named Nunuku-whenua, the Moriori had a strict tradition of solving inter-tribal conflict peacefully and advocating a variant of passive resistance; war, cannibalism, and killing were completely outlawed. They also renounced their parent society’s agricultural mode of subsistence, relying heavily on hunting and gathering, and they controlled their population growth by castrating some male infants, so their impact on the non-human environment around them was minimal. In the meantime, the Maori continued to live agriculturally and developed into a populated, complex, hierarchical, and violent society. Eventually an Australian seal-hunting ship informed the Maori of the Moriori’s existence, and the Maori sailed to the Chathams to explore: . . . over the course of the next few days, they killed hundreds of Moriori, cooked and ate many of the bodies, and enslaved all the others, killing most of them too over the next few years as it suited their whim. A Moriori survivor recalled, “[The Maori] commenced to kill us like sheep . . . [We] were terrified, fled to the bush, concealed ourselves in holes underground, and in any place to escape our enemies. It was of no avail; we were discovered and eaten – men, women, and children indiscriminately.” A Maori conqueror explains, “We took possession . . . in accordance with our customs and we caught all the people. Not one escaped. Some ran away from us, these we killed, and others we killed – but what of that? It was in accordance with our custom.” Furthermore, we can deduce from the ubiquitous slavery in all the so-called “great civilizations” like Rome or Egypt that any attempt to rebuild a similar civilization will involve slavery. And to rebuild industry, something similar to colonization and the Trans-Atlantic Slave Trade would probably have to occur once again. After all, global chattel slavery enabled the industrial revolution by financing it, extracting resources to be accumulated at sites of production, and exporting products through infrastructure that slavery helped sustain. So, if industrial society collapsed, who would be doing the rebuilding? Not anyone most people like. It is hard to get a man to willingly change his traditional way of life; even harder when his new life is going into mines. And though history demonstrates that acts like those of the Maori or slave traders are not beyond man’s will or ability, certainly most in industrial society today would not advocate going through the phases required to reach the industrial stage of development.

#### American and Polynesian migration prove survivors

Matheny 7 (Jason G., Candidate in Applied Economics at Johns Hopkins University, Research Associate at Oxford University, Ph.D., Master’s in Public Health from Johns Hopkins University and a M.B.A. from Duke University, “Reducing the Risk of Human Extinction”, Risk Analysis, Volume 27, Number 5, 2007, http://www.upmc-biosecurity.org/website/resources/publications/2007/2007-10-15-reducingrisk.html) OP

Perhaps more cost effective than building refuges in space would be building them on Earth. Elaborate bunkers exist for government leaders to occupy during a nuclear war (McCamley, 2007). And remote facilities are planned to protect crop seeds from “nuclear war, asteroid strikes, and climate change” (Hopkin, 2007). But I know of no self-sufficient, remote, permanently occupied refuge meant to protect humanity from a range of possible extinction events. Hanson (2007) argues that a refuge permanently housing as few as 100 people would significantly improve the chances of human survival during a range of global catastrophes. The Americas and Polynesia were originally populated by fewer than 100 founders (Hey, 2005; Murray-McIntosh et al., 1998). Although it would take thousands of years for 100 people to repopulate Earth, this would be a small setback compared to extinction.

#### So do mathematical models

**Carrington 2** [Damian Carrington, science reporter, New Scientist , ""Magic number" for space pioneers calculated | New Scientist", 15 February 2002 , <https://www.newscientist.com/article/dn1936-magic-number-for-space-pioneers-calculated//imp>]

**The “magic number”** of people **needed to create a viable population** for multi-generational space travel has been calculated by researchers. It **is** about the size of a small village – 160. But with some social engineering it might even be possible to halve this to **80**. Anthropologist John Moore from University of Florida tackled the problem as part of a combined effort with space scientists to determine how in future humans might successfully undertake century-long journeys out into space. In the past, attention has been focused on cryogenics, sperm banks and military-style modes of operation, says Moore, but “the ‘right stuff’ for a journey into space is the family – a million-year-old institution designed to assist reproduction.” Moore has previously studied small migrating populations of early humans and has developed simulation software – called Ethnopop – for analysing the viability of small groups.

#### Superintelligent AI is Inevitable by 2050 and causes extinction --- consensus of experts

**Elistratov 20** [Iaroslav Elistratov, Southeast Missouri State University, Helix, Volume 17, "Is AI Safety 'Rather Speculative Long-Termism?"", 2020, [https://www.semo.edu/writing/pdf/Helix-2020.pdf#page=20 //imp]](chrome-extension://iggoldplbhinbmldepiifdjfenfiompa/popup.html)

There is overwhelming evidence that the existential risks of AI are no longer ‘relatively small’. Nick Bostrom, a Swedish philosopher of AI, surveyed **the top 100 most cited AI researchers on the chances of artificial general intelligence** (**AGI**) – a machine that is capable of understanding or learning any intellectual task a human being can – being developed by 2045: the median estimate was for a one in two chance (rising to a nine in ten chance by 2075). Moreover, **they estimated the chance is about one in three** (31% probability) **that this development turns out to be** ‘bad’ or **‘extremely bad’ for humanity**. Another paper, which surveyed 352 AI researchers, showed that experts believe there is a 50% chance of AI outperforming humans in all tasks by 2061 (they give a 10% chance of it happening within 7 years) [8]. And some of the most authoritative people in the field echo that **the majority of AI researchers think that ‘we are likely to have a general-purpose AI around the middle of the century’**. Concerning the issue, Singer said: ‘I don’t know… I accept my lack of real knowledge on this, I’m just reporting what other people have said… From my reading, we’re still quite a long way off of the prospect of AI actually being smart enough to take us over. Somewhere in that 50 to 100 range, perhaps, which still gives us time to think about that issue…’ [10]. It is peculiar that Singer mentions the time window as a reassurance that we need not be concerned with AI. After all, he has claimed that temporal distance in and of itself should not have any moral weight. The most probable explanation is that Singer believes that the longer the time window, the higher the likelihood that humans can deal with the existential threat safely. Yet, this assumption seems to break down by its own logic: if we do not feel pressed to deal with the threat now, on account of the fact that we will have more time later, we will eventually run out of time. A broader problem is that **we are more likely to create an unsafe AI** rather than a safe one, because making a superhuman-level AI that is safe involves some additional challenges on top of the challenge of creating a general-purpose AI in the first place [11]. Once machines are capable of designing other machines like them, it will result in an explosion of intelligence that will push us **past the point of no return**, writes Nick Bostrom [12] So, the people in the field are unclear about what the future holds, but nevertheless, these same people think that the catastrophic risks are possible and that it is an important problem. Perhaps, then, AI Safety research is not that ‘speculative’ after all. Is it worth trying to reduce the AI risk? If we ‘reduce existential risk by mere one-millionth of one percentage point, it will be worth more than 100 times the value of saving a million human lives’ [13]. The expected value of any other good actions – like helping people here and now – will be trivial compared to even the slightest reduction in existential risk [14]. This rule, known as the ‘maxipok’ rule, should have particular force for consequentialists like Singer. One push back against this conclusion could be that we should not be concerned with events or incidents with a probability below a particular threshold (i.e., existential risks that are very unlikely to happen should be disregarded). This is best expressed in Singer’s own words: ‘The speculation that we will develop AI to such a point that it will become smarter than us and will, maybe, destroy us: firstly, it’s hard to know how likely this is; secondly, it’s hard to know how we – with our present state of knowledge – could prevent that… So, I think, we don’t know enough [about the risk of AI] to divert any funds from the existing charities’ [15]. There are problems with each of these statements. Regarding the first point, Singer seems to be asking ‘how likely must an existential risk be for us to start taking measures to reduce it?’ According to Singer himself: ‘If the [existential] risk were 1%, that would definitely be worth doing.’ [16] It is worth mentioning that there is likely to be an implicit assumption that the probability of existential risk is estimated by competent people in a relevant field. In the case of AI, some of the world’s leading experts in the field assign 18% probability that the development of AI turns out to be ‘extremely bad — existential catastrophe’ [17]. Thus, following Singer’s own line of reasoning, the existential risk of AI passes the risk threshold. What about the refutation that ‘we don’t know enough’ or that the future is too uncertain? Uncertainty is not a problem. The EA movement has always been about working with probabilities, which is a way of dealing with uncertainty. And AI scientists have shown that while the future is uncertain, **there is a high likelihood of catastrophic risk** in that uncertainty. To pivot from my argument for a moment, there could be a couple of additional objections to the conclusion I have just drawn – again, best expressed in Prof. Singer’s own words: ‘We should not take these estimates too seriously. The overall response rate was only 31%, and researchers working in AI have an incentive to boost the importance of their field by trumpeting its potential to produce momentous results’ [18]. Indeed, the concern is reasonable: researcher bias is a common problem. Yet even if we employ the most generous correction to the current probability of 18%, we would still have a risk percentage higher than the 1% threshold Singer employs. Let us go back to Singer’s second larger point that ‘it’s hard to know how we could prevent’ the undesirable outcome of an AGI. This argument seems paradoxical. The more we think about how to reduce the AI risks (e.g., value alignment, reward hacking, etc.), the more we find solutions to these problems (e.g., inverse reinforcement learning, generative adversarial networks, etc.). But these solutions are possible precisely because of AI Safety research. Hence to claim that: ‘We do not need to support AI Safety precisely for the reason that we do not know how to prevent it’ is putting the cart before the horse. The fact that we do not know how to prevent an AGI currently should be a reason in favor of AGI safety research not a reason against it. Prof. Singer noted that: ‘Negligence […] is culpable in judging the agent, how careful he was to find out what the likely consequence of his actions were’ [20]. In the case of AI – following this line of reasoning – by not paying due attention to the Safety research we all could be ‘the negligent agents.’ Are we culpable in the event of a catastrophe? The inevitability of AGI It seems likely that we are. According to experts, superhuman-level AI is inevitable [21]. Three assumptions support the conclusion they have reached: The first is a premise that information processing is the basis of intelligence. It seems clearly to be the case given that we have already built narrow intelligence into our machines: its strength could be weak and limited, but at this stage all we need to do is to accept that narrow AI systems – like IBM Watson, or AlphaGo – do, indeed, demonstrate some level of genuine intelligence. The second assumption leading to the inevitability of AGI is that we do not stand on a peak of intelligence. It is likely that the spectrum of intelligence extends much further than we currently conceive possible because many AI systems are already at superhuman-level of intelligence in their narrow tasks – it is sobering to think of: arithmetic; driving or chess (for example) humans will never be better than AI at these tasks. The challenge we face now is developing ‘flexibility’ of AI between tasks (or its generality), but not the creation of superhuman AI as such. Third, we will continue to improve our AI systems. Certainly, potential benefits of creating an AGI are huge: a more intelligent agent than we are may help us to solve (or drastically reduce) all the problems facing humanity today. In fact, the word ‘intelligence’ literally means: the ability to manipulate one’s environment to satisfy one’s objectives [22]. And, it seems, it is at the core of anything that we value – provided that we have problems we want to solve – from cancer to climate change; as long as there is a huge governmental and commercial interest; and given that the companies and governments (developing an AGI) are likely to be in a race against each other, it seems that we will not stop improving the technology. There is an argument to be made that it is probably impossible to put an end to AI research anyway: ‘As a practical matter AI research proceeds by people writing stuff on whiteboards and it’s very hard to pass legislation banning equations being written on the boards,’ explains Stuart Russell [23]. Ultimately, if intelligence is some form of information processing and if we get the appropriate algorithm right, it is likely that we develop a superhuman AGI. An argument of David Deutsch (not considering his views on AI) is relevant in that regard: anything that is compatible with the laws of nature is achievable given the requisite knowledge (i.e., the ‘momentous dichotomy’) [34].

#### Regardless of it’s terminal goal, it will wipe out humanity

**Bostrom et al 14** [Nick Bostrom is an Oxford University philosopher specializing in existential risks and the impact of future technology. He is the founding director of the Future of Humanity Institute at Oxford. Stephen Cass is a staff writer for IEEE Spectrum, and Eliza Strickland has read Bostrom’s book and spoken to him;also IEEE Spectrum Associate Editor, 12/4/14, Nick Bostrom, “Nick Bostrom Says We Should Trust Our Future Robot Overlords”, <http://spectrum.ieee.org/podcast/robotics/artificial-intelligence/nick-bostrom-says-we-should-trust-our-future-robot-overlord> //imp]

once we do make an AI with human-level intelligence, things could go bad in a hurry. Here’s what Bostrom said. Nick Bostrom: Well, at the moment, it’s computer scientists who are doing AI research, and to some extent neuroscientists and other folk. If and when machines begin to surpass humans in general intelligence, the research would increasingly be done by machines. And as they got better, they would also get better at doing the research to make themselves even better. Eliza Strickland: With this feedback loop, Bostrom says, an AI could go from human-level intelligence to superintelligence before we’re really prepared for it. Stephen Cass: Okay, so let’s suppose an AI does achieve superintelligence. Why would it seek to destroy its human creators? Eliza Strickland: Bostrom says it wouldn’t have any grudge against us—but the AI would have some goal, and we’d just be in its way. It would be similar to the way that humans cause animal extinctions, he said. Nick Bostrom: If we think about what we are doing to various animal species, it’s not so much that we hate them. For the most part, it’s just that we have other uses for their habitats, and they get wiped out as a side effect. Stephen Cass: So what motivates an AI? What would it be trying to accomplish? Eliza Strickland: It would have some goal that had been programmed into it by scientists. And Bostrom explains that even simple goals can have disastrous consequences. Nick Bostrom: Let’s suppose you were a superintelligence and your goal was to make as many paper clips as possible. Maybe someone wanted you to run a paper clip factory, and then you succeeded in becoming superintelligent, and now you have this goal of maximizing the number of paper clips in existence. So you would quickly realize that the existence of humans is an impediment. Maybe the humans will take it upon themselves to switch you off one day. You want to reduce that probability as much as possible, because if they switch you off, there will be fewer paper clips. So you would want to get rid of humans right away. Even if they wouldn’t pose a threat, you’d still realize that human bodies consist of atoms, and those atoms could be used to make some very nice paper clips. Eliza Strickland: Bostrom thinks that just about any goal we give an AI could come back to bite us. Even if we go with something like “make humans happy,” the machine could decide that the most effective way to meet this goal is to stick electrodes in the pleasure centers of all our brains. Stephen Cass: Isn’t that—spoiler alert!—basically the plot of the sci-fi movie I, Robot? Eliza Strickland: Oh, yeah. That was the Will Smith movie based on Isaac Asimov’s famous three laws of robotics, which are supposed to guarantee that a robot won’t hurt a human being. In the movie—and actually in most of Asimov’s robot stories—the laws don’t work quite as intended.

#### Cosmogenesis experiments will enable humans to create laboratory universes – it’s a matter of decades

**Merali 17** (Zeeya Merali is a freelance science writer and author of A Big Bang in a Little Room: The Quest to Create New Universes. Her work has appeared in Nature, Scientific American, Discover, Science, New Scientist, and on the BBC. She has also published two textbooks with National Geographic and has worked on NOVA's television series The Fabric of the Cosmos. She has a PhD in theoretical cosmology and lives in London. “The idea of creating a new universe in the lab is no joke,” 14 June, 2017. https://aeon.co/ideas/the-idea-of-creating-a-new-universe-in-the-lab-is-no-joke)

Fast-forward a quarter of a century, and the notion of universe-making – or ‘cosmogenesis’ as I dub it – **seems less comical than ever.** I’ve travelled the world talking to physicists who take the concept seriously, and who have even sketched out rough blueprints for how humanity might one day achieve it. Linde’s referees might have been right to be concerned, but they were asking the wrong questions. The issue is not who might be offended by cosmogenesis, but what would happen if it were truly possible. How would we handle the theological implications? What moral responsibilities would come with fallible humans taking on the role of cosmic creators? Theoretical physicists have grappled for years with related questions as part of their considerations of how our own Universe began. In the 1980s, the cosmologist Alex Vilenkin at Tufts University in Massachusetts came up with a mechanism through which the laws of quantum mechanics could have generated an inflating universe from a state in which there was no time, no space and no matter. There’s an established principle in quantum theory that pairs of particles can spontaneously, momentarily pop out of empty space. Vilenkin took this notion a step further, arguing that quantum rules could also enable a minuscule bubble of space itself to burst into being from nothing, with the impetus to then inflate to astronomical scales. Our cosmos could thus have been burped into being by the laws of physics alone. To Vilenkin, this result put an end to the question of what came before the Big Bang: nothing. Many cosmologists have made peace with the notion of a universe without a prime mover, divine or otherwise. At the other end of the philosophical spectrum, I met with Don Page, a physicist and evangelical Christian at the University of Alberta in Canada, noted for his early collaboration with Stephen Hawking on the nature of black holes. To Page, the salient point is that God created the Universe ex nihilo – from absolutely nothing. The kind of cosmogenesis envisioned by Linde, in contrast, would require physicists to cook up their cosmos in a highly technical laboratory, using a far more powerful cousin of the Large Hadron Collider near Geneva. It would also require a seed particle called a ‘monopole’ (which is hypothesized to exist by some models of physics, but has yet to be found). The idea goes that if we could impart enough energy to a monopole, it will start to inflate. Rather than growing in size within our Universe, the expanding monopole would bend spacetime within the accelerator to create a tiny wormhole tunnel leading to a separate region of space. From within our lab we would see only the mouth of the wormhole; it would appear to us as a mini black hole, so small as to be utterly harmless. But if we could travel into that wormhole, we would pass through a gateway into a rapidly expanding baby universe that we had created. (A video illustrating this process provides some further details.) We have no reason to believe that even the most advanced physics hackers could conjure a cosmos from nothing at all, Page argues. Linde’s concept of cosmogenesis, audacious as it might be, **is still fundamentally technological**. Page, therefore, sees little threat to his faith. On this first issue, then, cosmogenesis would not necessarily upset existing theological views. But flipping the problem around, I started to wonder: what are the implications of humans even considering the possibility of one day making a universe that could become inhabited by intelligent life? As I discuss in my book A Big Bang in a Little Room (2017), current theory suggests that, once we have created a new universe, we would have little ability to control its evolution or the potential suffering of any of its residents. Wouldn’t that make us irresponsible and reckless deities? I posed the question to Eduardo Guendelman, a physicist at Ben Gurion University in Israel, who was one of the architects of the cosmogenesis model back in the 1980s. Today, Guendelman is engaged in research that could bring baby-universe-making within practical grasp. I was surprised to find that the moral issues did not cause him any discomfort. Guendelman likens scientists pondering their responsibility over making a baby universe to parents deciding whether or not to have children, knowing they will inevitably introduce them to a life filled with pain as well as joy. Other physicists are more wary. Nobuyuki Sakai of Yamaguchi University in Japan, one of the theorists who proposed that a monopole could serve as the seed for a baby universe, admitted that cosmogenesis is a thorny issue that we should ‘worry’ about as a society in the future. But he absolved himself of any ethical concerns today. Although he is performing the calculations that could allow cosmogenesis, he notes that it will be **decades** before such an experiment might feasibly be realized.

#### Preventing infinite new universes outweighs

**Vinding 17** [Magnus Vinding, Co-founder of the Center for Reducing Suffering, "Suffering, Infinity, and Universe Anti-Natalism – Magnus Vinding", 2017/12/01, [https://magnusvinding.com/2017/12/01/suffering-infinity-and-universe-anti-natalism/ //imp]](chrome-extension://iggoldplbhinbmldepiifdjfenfiompa/popup.html)

It is therefore not unthinkable that this should be the main question of concern for consequentialists**:** how does this impact the creation of new universes? Or, similarly, that trying to impact future universe generation should be the [main cause](http://prioritizationresearch.com/) for aspiring effective altruists. And I would argue that the form this cause should take is universe [anti-natalism](https://en.wikipedia.org/wiki/Antinatalism): avoiding, or minimizing, the creation of new universes. There are countless ways to argue for this. As Brian Tomasik [notes](http://reducing-suffering.org/lab-universes-creating-infinite-suffering/), creating a new universe that in turn gives rise to infinitely many universes “would cause infinitely many additional instances of the Holocaust, infinitely many acts of torture, and worse. Creating lab universes would be very bad according to several ethical views.” Such universe creation would obviously be wrong from the stance of negative utilitarianism, as well as from similar [suffering-focused views](https://foundational-research.org/the-case-for-suffering-focused-ethics/). It would also be wrong according to what is known as [The Asymmetry](https://en.wikipedia.org/wiki/Asymmetry_(population_ethics)) in population ethics: that creating beings with bad lives is wrong, and something we have an obligation to not do, while failing to create happy lives is not wrong, and we have no obligation to bring such lives into being. A much weaker, and even less controversial, stance on procreative ethics could also be used: do not create lives with infinite amounts of [torture](http://www.simonknutsson.com/the-seriousness-of-suffering-supplement#Modern_and_future_torture). Indeed, [how](https://en.wikipedia.org/wiki/Theodicy), we must ask ourselves, could a benevolent being justify bringing so much [suffering](http://all-that-is-interesting.com/medieval-torture-devices) into being? What could possibly justify the Holocaust, let alone infinitely many of them? What would be our answer to the screams of “why” to the heavens from the torture victims? Universe anti-natalism should also be taken seriously by classical utilitarians, as a case can be made that the universe is likely to end up being net negative in terms of algo-hedonic tone. For instance, it may well be that most sentient life that will ever exist will find itself in a state of natural carnage, as civilizations may be rare even on planets where sentient life has emerged, and because even where civilizations have emerged, [it may be](https://www.amazon.com/Our-Final-Hour-Scientists-Warning/dp/0465068634) that they are [unlikely to be sustainable](https://en.wikipedia.org/wiki/Doomsday_argument), perhaps overwhelmingly so, implying that most sentient life might be expected to exist at the stage it has existed on for the entire [history of sentient life](https://www.youtube.com/watch?v=vEmWn0KGNxo) on Earth. A [stage](http://www.stafforini.com/txt/Horta%20-%20Debunking%20the%20idyllic%20view%20of%20natural%20processes.pdf) where sentient beings are born in great numbers only for the vast majority of them to die shortly thereafter, for instance due to starvation or by being eaten alive, which is most likely a net negative condition, even by [wishful](https://en.wikipedia.org/wiki/Wishful_thinking) classical utilitarian standards

#### Particle acceleration disasters cause galactic extinction- that outweighs

Milan M. **Cirkovic**, Anders **Sandberg, and** Nick **Bostrom**, **’10**, “Anthropic Shadow: Observation Selection Effects and Human Extinction Risks,” Risk Analysis, <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1539-6924.2010.01460.x>

An example par excellence of a Q = 0 event is a vacuum phase transition or a comparable quantum field collapse. Such an event would not only extinguish humanity but also completely and permanently destroy the terrestrial biosphere. Coleman and De Luccia first mentioned the possibility that such a disaster might be caused by the operation of high-energy particle colliders used in physics research.(40) This possibility has since been widely discussed,(10,41−46) and has motivated objections to the operation of high-energy particle colliders, including most recently the Large Hadron Collider.(46,47) Three specific threats are relevant: (1) triggering vacuum phase transition through creation of an expanding bubble of “new” vacuum state, (2) accidental production of charged strangelets, which could transform all Earth’s mass into strange matter, and (3) accidental production of a mini black hole falling into Earth’s center and subsequently destroying our planet. Although smacking of science fiction, this idea has been seriously considered even by high-level 1504 Cirkovi ´ c, Sandberg, and Bostrom ´ administrators of modern particle-accelerator laboratories.(48) This is not only an eschatological issue for humanity: a vacuum phase transition would also destroy the habitability of the universe for any other observers in our future light cone. Even if the chance of such a disaster is remote, its catastrophic impact would be so enormous that it deserves close scrutiny. Hut and Rees, in an important pioneering study of the problem of high-energy physics risks, suggested that concerns about particle colliders can be reasonably dismissed because high-energy particle collisions occurring in nature, such as those between cosmic-rays and the Earth’s atmosphere or the solid mass of the Moon, are still orders of magnitude higher than those achievable in human laboratories in the near future.(10) With plausible general assumptions on the scaling of the relevant reaction crosssections with energy, Hut and Rees concluded that the fact that the Earth (and the Moon) have survived cosmic-ray bombardment for about 4.5 Gyr implies that we are safe for the foreseeable future. For example, if the probability of a high-energy physics disaster in nature is 10−50 per year, then a doubling or even 10-fold increase of the risk through deliberate human activities is arguably trivial. The Hut-Rees argument should provide us no comfort, however, as it fails to correct for anthropic bias. A vacuum phase transition is an event for which Q = 0. Probability estimates based on observations of the Earth’s and Moon’s existence are thus completely unreliable. Moreover, the unreliability of these estimates applies to both naturally occurring and humaninduced vacuum phase transitions. (Hut and Rees also conclude, completely justifiably, that the number of potentially risky events in any conceivable human accelerator is much smaller than in the cosmicray interactions in nature.) Unfortunately, the same error is repeated in the recent Large Hadron Collider (LHC) safety study, where the duration of the solar system thus far is invoked as part of the arguments for accelerator safety.(46)

#### The military is developing isomer bombs---even just testing will destroy the Universe

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Recently the British science news journal "New Scientist" revealed that the American military **is pursuing** new types of exotic bombs - including a new class of isomeric gamma ray weapons. Unlike conventional atomic and hydrogen bombs, the new weapons would trigger the release of energy by absorbing radiation, and respond by re-emitting a far more powerful radiation. In this new category of gamma-ray weapons, a nuclear isomer absorbs x-rays and re-emits higher frequency gamma rays. The emitted gamma radiation has been reported to release 60 times the energy of the x-rays that trigger the effect. The discovery of this isomer triggering is fairly recent, and was first reported in a 1999 paper by an international group of scientists. Although this controversial development has remained fairly obscure, it has not been hidden from the public. Beyond the visible part of defense research is an immense underground of **secret projects** considered so sensitive that their **very existence is denied**. These so-called "black budget programs" are deliberately kept from the public eye and from most political leaders. CNN recently reported that in the United States the black budget projects for 2004 are being funded at a level of more than 20 billion dollars per year. In the summer of 2000 I contacted Nick Cook, the former aviation editor and aerospace consultant to Jane's Defence Weekly, the international military affairs journal. Cook had been investigating black budget super-secret research into exotic physics for advanced propulsion technologies. I had been monitoring electronic discussions between various American and Russian scientists theorizing about rectifying the quantum vacuum for advanced space drive. Several groups of scientists, partitioned into various research organizations, were exploring what NASA calls "Breakthrough Propulsion Physics" - exotic technologies for advanced space travel to traverse the vast distances between stars. Partly inspired by the pulp science fiction stories of their youth, and partly by recent reports of multiple radar tracking tapes of unidentified objects performing impossible maneuvers in the sky, these scientists were on a quest to uncover the most likely new physics for star travel. The NASA program was run by Marc Millis, financed under the Advanced Space Transportation Program Office (ASTP). Joe Firmage, then the 28-year-old Silicon Valley CEO of the three billion dollar Internet firm US Web, began to fund research in parallel with NASA. Firmage hired a NASA Ames nano-technology scientist, Creon Levit, to run the "International Space Sciences Organization", a move which apparently alarmed the management at NASA. The San Francisco based Hearst Examiner reported that NASA's Office of Inspector General assigned Special Agent Keith Tate to investigate whether any proprietary NASA technology might have been leaking into the private sector. Cook was intrigued when I pointed out the apparent connections between various private investors, defense contractors, NASA, INSCOM (American military intelligence), and the CIA. While researching exotic propulsion technologies Cook had heard rumors of a new kind of weapon, a **"sub-quantum atomic bomb"**, being whispered about in what he called the "dark halls" of defense research. Sub-quantum physics is a controversial re-interpretation of quantum theory, based on so-called pilot wave theories, where an information field controls quantum particles. The late Professor David Bohm showed that the predictions of ordinary quantum mechanics could be recast into a pilot wave information theory. Recently Anthony Valentini of the Perimeter Institute has suggested that ordinary quantum theory may be a special case of pilot wave theories, leaving open the possibility of new and exotic non-quantum technologies. Some French, Serbian and Ukrainian physicists have been working on new theories of extended electrons and solitons, so perhaps a sub-quantum bomb is not entirely out of the question. Even if the rumors of a sub-quantum bomb are pure fantasy, there is **no question** that mainstream physicists **seriously** contemplate a phase transition in the quantum vacuum as a **real possibility**. The quantum vacuum defies common sense, because empty space in quantum field theory is actually filled with virtual particles. These virtual particles appear and disappear far too quickly to be detected directly, but their existence has been confirmed by experiments that demonstrate their influence on ordinary matter. "Such research should be forbidden!" In the early 1970's Soviet physicists were concerned that the vacuum of our universe was only one possible state of empty space. The fundamental state of empty space is called the "true vacuum". Our universe was thought to reside in a "false vacuum", protected from the true vacuum by "the wall of our world". A change from one vacuum state to another is known as a **phase transition**. This is analogous to the transition between frozen and liquid water. Lev Okun, a Russian physicist and historian recalls Andrei Sakharov, the father of the Soviet hydrogen bomb, expressing his concern about research into the phase transitions of the vacuum. If the wall between vacuum states was to be breached, calculations showed that an **unstoppable expanding bubble** would continue to grow until it **destroyed our entire universe**! Sakharov declared that "Such research should be forbidden!" According to Okun, Sakharov feared that an **experiment** might accidentally **trigger a vacuum phase transition**.