# 1NC

## OFF

#### The affirmative should defend the desirability of the hypothetical enactment of the resolution.

#### The United States should means the debate should center around the government normatively acting.

Jon M Ericson 3, Dean Emeritus of the College of Liberal Arts – California Polytechnic U., et al., The Debater’s Guide, Third Edition, p. 4

The Proposition of Policy: Urging Future Action In policy propositions, each topic contains certain key elements, although they have slightly different functions from comparable elements of value-oriented propositions. 1. An agent doing the acting ---“The United States” in “The United States should adopt a policy of free trade.” Like the object of evaluation in a proposition of value, the agent is the subject of the sentence. 2. The verb should—the first part of a verb phrase that urges action. 3. An action verb to follow should in the should-verb combination. For example, should adopt here means to put a program or policy into action through governmental means. 4. A specification of directions or a limitation of the action desired. The phrase free trade, for example, gives direction and limits to the topic, which would, for example, eliminate consideration of increasing tariffs, discussing diplomatic recognition, or discussing interstate commerce. Propositions of policy deal with future action. Nothing has yet occurred. The entire debate is about whether something ought to occur. What you agree to do, then, when you accept the affirmative side in such a debate is to offer sufficient and compelling reasons for an audience to perform the future action that you propose.

#### ‘Resolved’ means to enact a policy by law.

Words and Phrases 64. Permanent Edition.

Definition of the word “resolve,” given by Webster is “to express an opinion or determination by resolution or vote; as ‘it was resolved by the legislature;” It is of similar force to the word “enact,” which is defined by Bouvier as meaning “to establish by law”.

#### The “core” antitrust statutes are the Sherman Act, Clayton Act, and FTC Act

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U.S. antitrust law is defined by federal and state statutes, as interpreted by the courts. The core federal statutes are the Sherman Act,1 passed by Congress in 1890, and the Federal Trade Commission2 and Clayton Acts,3 both passed in 1914. The United States Department of Justice (“DOJ”) and the Federal Trade Commission (“FTC” or “Commission”) (together the “agencies”) share enforcement of most areas of federal antitrust law but with some differences in the scope of their authority. The FTC has sole authority to enforce Section 5 of FTC Act, which prohibits (1) unfair methods of competition and (2) unfair or deceptive acts or practices. The FTC almost always pursues claims for anticompetitive conduct as unfair methods of competition and reserves charges of unfair or deceptive acts or practices for consumer protection violations. Though the FTC's authority to challenge unfair methods of competition goes beyond conduct prohibited by the Sherman and Clayton Acts, in practice the FTC brings most unfair methods of competition cases under the same standards that courts apply to Sherman Act claims. The most prominent exception is the invitation to collude offense, which falls outside the scope of the Sherman Act (if the invitation is not accepted, there is no agreement). The FTC challenges invitations to collude as so-called “standalone” violations of Section 5.4 The DOJ has sole authority to pursue criminal violations of the antitrust laws. Most states have their own state antitrust and unfair competition statutes. State law follows federal law to some extent, though as discussed below, may differ from federal law in meaningful ways that vary state to state. State attorneys general and private parties can also typically file suit to enforce both federal and state antitrust law.

#### Vote negative for procedural fairness—debate is first and foremost a game revolving around wins and losses and getting the ballot. Debates are won by inches and not miles—this means that fairness must be a prerequisite to any other part of your decision calculus. Procedural fairness matters for our ability to play the game that we all spend so much of our lives on. Rigging debate in favor of one side by allowing them to skirt the topic makes the activity meaningless AND ruins pre-round and pre-tournament prep.

#### They tacitly agree with this argument—they adhere to speech times, cross-x, they don’t interrupt our speeches, they expect a win/loss at the end of the debate, etc.—all of which proves that their decision to sidestep the topic is done for a competitive advantage and nothing more.

#### Additionally, they make it impossible to decide “who did the better debating” because any argument you think they are winning can’t be separated from the fact they are winning it because of our inability to contest it.

#### Fairness is the only argument that your ballot can resolve because voting negative is a structural remedy for our impact BUT voting affirmative doesn’t solve any of the problems that they isolate.

#### This is not an argument about style or content but rather about form. They are allowed to read whatever arguments they want as long as they defend an instrumental implementation of a topical policy action. All of their criticisms of this interpretation are solved by reading it on the neg and switch side debate. Independently, they could read the same 1AC and just lose.

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#### Increased antitrust enforcement destroys Pentagon AI innovation – less R&D and smaller datasets prove

Foster, 20

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Fourth, we assume national security-relevant AI technologies will result, to some extent, from breakthroughs in general, commercially oriented AI innovation. Most private AI research is not defense-oriented, given the Pentagon’s relatively minor role as a customer.34 Nonetheless, many private sector AI advances are or will be convertible to military ends.35 Some of this innovation will be transferred directly from the commercial or lab setting to defense applications by the original innovators—that is, commercially oriented tech companies. One recent example is Project Maven. In other cases, defense-focused intermediaries will convert other companies’ AI advances into military applications.36 We assume future AI breakthroughs, whether originating in the private sector or at universities, could be converted into defense applications. Innovate: Would smaller AI companies be less innovative? In this section, we evaluate the relationship between scale and innovation. Given a greater number of smaller companies in the AI market, would they and the overall market be more or less innovative? We consider the relationship between firm size and access to data, a critical input for AI innovation. We also examine the relationships between company scale, R&D expenditures, and innovation. If innovation tracks R&D spending, a post-breakup AI sector could be less innovative. Anti-competitive tactics are another concern. Finally, we consider other inputs and factors affecting AI innovation, including business strategy, human capital, and access to computing power. We estimate that antitrust action will likely reduce the net amount and diversity of data held by firms that are broken up and could also reduce firms’ R&D budgets. However, the effect these losses will have on innovation remains unclear. Similarly, we expect firms’ computing resources to diminish with yet undetermined consequences; shared compute resources could perhaps more than compensate for any loss. Data Quantity Data is a core ingredient in AI development, especially for AI algorithms using machine learning approaches (such as neural networks). Currently, in order to build machine learning models that successfully identify patterns, AI researchers need large volumes of data.37 Models trained on larger datasets are more accurate,38 advantaging big firms with more data and users.39 Breaking up these companies would diffuse large datasets, potentially slowing or preventing AI advances that could benefit the Pentagon. Even though datasets amassed by commercial companies may not always have immediate use for the Defense Department, we expect that most of Big Tech’s data can directly or indirectly support innovation relevant to the Pentagon.40 However, policy mechanisms, such as a federal data pool or mandated datasharing, could increase smaller firms’ access to data and mitigate this concern. Similarly, firms could contract with one another to increase data access. Such actions could equalize the data playing field or even give small firms an advantage. In addition, standardized data pools might be better for building or training models than the current system of disorganized or siloed data at large firms. At the same time, these mitigating mechanisms could discourage investments to secure additional data, reducing overall data quantities.41 For example, a company might rely on a publicly supported database instead of building an innovative application to collect data by other means. 1. How much data do firms really need to innovate? All else being equal, smaller AI firms have less data. While the relationship between the quantity of data inputs and the quality of algorithmic outcomes is not linear, a correlation is usually evident. For example, recent experiments by researchers at Google found a logarithmic relationship between the amount of data fed into an image recognition model and the model’s performance.42 If more data means more innovation, a post-breakup AI sector could be less innovative overall. Antitrust action would likely reduce the amount of data held by large companies. This might hurt innovation, especially in application areas requiring exceptionally high amounts of data for acceptable performance.43 In short, the impact of antitrust action on data-driven innovation may hinge on the size of broken-up companies and their data holdings. Google Search or Amazon Web Services, for example, would be large corporations in their own right.44 AWS, one of Amazon’s larger divisions, achieved revenues similar to Raytheon’s company-wide revenues in 2018,45 demonstrating the possible size of spin-offs.46 Although data currently plays a central role in machine learning approaches to AI, some question its future significance in innovation.47 Less data-intensive machine learning approaches, such as few-shot learning and training on synthetic data, raise questions about the long-term relevance of data to AI.48 In the longer term, data may be less important to innovation than presently thought, in which case a lower threshold (smaller quantities of data) might not significantly undermine innovation. Similarly, reduced access to traditional data inputs may incentivize companies to invest in alternative data collection and training approaches, which could spur new innovation. 2. How well are larger firms able to use the large quantities of data they have? Data only matters for innovation insofar as it can be accessed and used. Large companies may struggle to fully utilize their large data holdings, potentially limiting harm to innovation in the case of antitrust enforcement. Larger companies can’t necessarily consolidate and access all of their data. Siloing and scattering occur when data is isolated within certain departments, inhibiting broader collaboration or cross-company use. Data curation—the management and integration of data—also affects its functionality. AI models are only as strong as their training data, and without adequate curation, training data usability diminishes.49 Training AI models also requires flexible data easily adjusted or re-configured to fit various training approaches. 90 percent of manufacturing lacks this flexible format.50 Siloing and scattering disproportionately affect larger companies.51 At Chinese AI giant Tencent, for example, executives report that siloed data prevents the company from using its WeChat app data to improve other products.52 A third of executives at large U.S. companies53 report that data siloing impedes data utilization efforts.54 While antitrust action would likely limit the quantity of data within companies, it might not limit the amount of accessible, useful data as sharply if much of that data was inaccessible to begin with. On the other hand, if large companies currently leverage their diverse data well, collaboration between companies or between government and industry could mitigate the winnowing effect of antitrust enforcement. In 1987, DARPA funded SEMATECH, a consortium bringing together leading U.S. semiconductor companies, in an attempt to improve domestic semiconductor competitiveness.55 SEMATECH significantly reduced the amount of R&D funding needed to produce “each new generation of chip miniaturization” and lowered miniaturization cycles from three years to two.56 Today, other consortiums like the National Alliance for Advanced Transportation Battery Cell Manufacture and the Department of Energy’s solar initiative, SunShot, are modeled on SEMATECH.57 AI may call for a similar approach; short of breaking up leading tech companies, antitrust policymakers may even consider mandated data sharing (whether through consortia or other means) as an effective antitrust remedy. Data Diversity Diverse data can also enhance innovation. Given the option, Fortune 1000 companies are more likely to diversify data sources than expand the quantity of data from existing sources.58 Of Fortune 1000 executives, 69 percent reported that data variety was the most important factor in their data success.59 Companies with more diverse data receive “faster intelligence” about products and market trends, which may enable them to better anticipate next-generation technologies.60 Consistent with this broader dynamic, we assume companies with greater data variety would be better positioned to build new technologies for the Pentagon and other government customers. However, not all corporate data will be a relevant input for Pentagon applications. Mission-specific applications, in particular, will likely rely to some degree on classified or otherwise unique data already held by the DOD. 1. Do larger firms have more diverse data? The sheer scale of large tech companies makes their data quite diverse; all else equal, smaller AI firms have less diverse data. Alphabet, for example, collects data from Google Search, Maps, YouTube, and Gmail. Antitrust action could reduce the diversity of data held by large tech companies as they fracture and focus on narrower markets. Even if the broken-up companies and their data stores remained large, this data would lose appreciable diversity. If more diverse data means more innovation, a postbreakup AI sector could be less innovative overall. However, if companies’ data did become more homogenous, adverse effects could be mitigated. Companies created in the wake of antitrust enforcement would collectively hold diverse data. Creating a centralized data pool might yield an even more diverse stockpile of data than what’s currently held by the likes of Google or Amazon. The NIH’s Data Commons offers one such example, with proposals circulating to create a similar global data commons for AI.61 Data sharing through contracts or centralized pools would, however, present an additional set of challenges, including privacy concerns and data security. 2. How well do larger firms leverage their diverse datasets? Large companies may struggle to fully utilize their diverse datasets, limiting both the innovation upside of diverse data and the innovation downside should antitrust enforcement result in more homogenous datasets. Siloing concerns apply equally to diverse datasets. Antitrust enforcement becomes far less of a threat to innovation if companies cannot currently leverage their diverse data. R&D Spending 1. What is the relationship between scale and R&D expenditure? If R&D spending drives innovation, firms that can spend more on R&D— presumably large ones—will generally hold an edge in innovation. A postbreakup AI sector could be less innovative as a result. Large tech companies do in fact spend more on R&D both in absolute and relative terms. According to PricewaterhouseCoopers, in absolute terms, Amazon and Alphabet were the world’s top two corporate R&D spenders in 2018, with Samsung, Intel, Microsoft and Apple in the top ten.62 In terms of relative R&D spending—the percentage of total firm expenses spent on R&D—large tech companies remained among the highest spenders, led by Facebook (33 percent) in fifth place globally.63 Alphabet and Microsoft, which each spent 20 percent, and Amazon (13 percent) ranked among the top thirty. The smallest firm (based on total operating expenses) of the top 100 global relative R&D spenders was NXP Semiconductors, a Dutch firm with $6.8 billion in operating expenses.64 Because larger firms tend to spend more on R&D, breaking them up would likely reduce their R&D spending. Increases in spending at smaller firms could counter this decline, but the amount and efficacy of that spending are uncertain—both at the individual firm level and in the aggregate across the post-breakup AI ecosystem.65 That said, broken-up firms would remain very large, with sizable R&D budgets to match. Imagine a break-up of Alphabet, whose operating expenses amounted to $110 billion last year; a spin-off company with one-fourth of Alphabet’s current R&D budget would still be larger than 77 of the 100 leading global relative R&D spenders. 2. What is the relationship between R&D expenditure and innovation? AI innovation is expensive.66 If R&D spending fuels innovation, larger, wealthier companies with more to spend on R&D will likely lead. However, the research is contradictory: some studies indicate larger R&D expenditures yield greater innovation, while others find the opposite. Existing research on R&D may not translate neatly to AI innovation; for example, little research considers differences between massive companies like today’s tech giants and very large corporations. Analysis of “small” firms’ R&D patterns may not apply to potential post-breakup tech companies, which would probably remain quite large. In addition, much of the existing literature is years or decades old, and may not pertain to the fast-evolving AI economy. Nevertheless, existing research can at least guide further work, consistent with the questions and research priorities we frame in this paper. Since the writings of economist Joseph Schumpeter in the mid-20th century, researchers have debated the relationship between innovation and R&D resources. Schumpeter argued that a strong correlation exists, noting that large firms have the resources to support risk-taking, more experienced and specialized staff, and cheaper access to capital.67 He believed these characteristics made larger firms optimal for economic growth and innovation.68 Significant research now contradicts Schumpeter’s work. Some studies show R&D productivity decreases with firm size,69 and smaller firms are “more profit/cost efficient in innovation,”70 generating more patents and more citations per dollar spent on R&D.71 Smaller firms are also “disproportionately responsible for significant innovations,”72 compared to larger firms that produce fewer innovations per dollar spent.73 Even among larger firms, innovation doesn’t neatly track with R&D budgets. For example, Apple ranked as the 2018 Global Innovation 1000 Study’s most innovative company, but spent a relatively modest 5.1 percent of overall sales on R&D— far from the highest percentage among companies in the index.74 However, other researchers back Schumpeter. Their work finds large firms are more R&D “intensive”75 and responsible for “higher quality” innovations.76 Some posit that “R&D spending and R&D productivity increase with scale,” as does “basic research, process innovation, and incremental innovation.”77 Large firms conduct almost six times more R&D, in aggregate, than small firms, and do so more productively.78 Collectively, large firms make up 87 percent of the “economic contribution of industrial R&D,” making them the disproportionate engines of innovation.79 Clearly, no consensus exists around how R&D spending influences innovation. Predicting how antitrust action on R&D resources might affect AI company innovation is therefore difficult. However, some researchers argue more specifically that large firms are more ideally suited for research that utilizes “economies of scale and scope, or requires large teams of specialists such as fundamental, science-based innovations and large-scale applications.”80 AI research, with its high degree of specialization, may fall into this category.81 If so, scale-reducing antitrust actions could prove damaging.

#### AI innovation is key to hegemony – even the perception we’re falling behind leads to next-gen war

Johnson, 19

(James, Assistant Professor, School of Law & Government, Dublin City University, Non-Resident Fellow, Modern War Institute at the United States Military Academy, West Point, PhD Politics & International Relations, University of Leicester, MA Asia-Pacific Studies, University of Leeds, "The end of military-techno Pax Americana? Washington’s strategic responses to Chinese AI-enabled military technology", Taylor & Francis, 10-21-2019, https://www.tandfonline.com/doi/full/10.1080/09512748.2019.1676299)\\JM

This article has made the following central arguments. First, while disagreement exists on the likely pace, trajectory, and scope of AI defense innovations, a consensus is building within the U.S. defense community intimating that the potential impact of AI-related technology on the future distribution of power and the military balance will likely be transformational, if not revolutionary. These assessments have in large part been framed in the context of the perceived challenges posed by revisionist and dissatisfied great military powers (i.e. China and Russia) to the current U.S.-led international order – rules, norms, governing institutions – and military-technological hegemony. Today, the United States has an unassailable first-mover advantage in a range of AI applications with direct (and in some cases singular) relevance in a military context.

Second, the rapid proliferation of AI-related military-technology exists concomitant with a growing sense that the United States has dropped the ball in the development of these disruptive technologies. Even the perception that America’s first-mover advantage in a range of dual-use enabling strategic technologies (i.e. semiconductors, 5G networks, and IoT’s) was at risk from rising (especially nuclear-armed) military powers such as China, the implications for international security and strategic stability could be severe. In response to a growing sense of alacrity within the U.S. defense community cognizant of this prospect, the Pentagon has authored several AI-related programs and initiatives designed to protect U.S. dominance on the future digitized battlefield (e.g. the Third Offset, Project Maven, the JAIC, and the DoD’s debut AI strategy). Further, broader U.S. national security concerns relating to Chinese efforts to catch up (and even surpass) the U.S. in several critical AI-related enabling technologies, has prompted Washington to take increasingly wide-ranging and draconian steps to counter this perceived national security threat.

Third, and related, in the development of AI evocations of the Cold War-era space race does not accurately capture the nature of the evolving global AI phenomena. Instead, compared to the bipolar features of the U.S.-Soviet struggle, this innovation arms race intimates more multipolar characteristics. Above all, the dual-use and commercial drivers of the advances in AI-related technology will likely narrow the technological gap separating great military powers (chiefly the U.S. and China) and other technically advanced small-medium powers. These rising powers will become critical influencers in shaping future security, economics, and global norms in dual-use AI.

In the case of military-use AI applications, however, several coalescing features of this emerging phenomena (i.e. hardware constraints, machine-learning algorithmic complexity, and the resources and know-how to deploy military-centric AI code), will likely constrain the proliferation and diffusion of AI with militaries’ advanced weapon systems for the foreseeable future. In turn, these constraints could further concentrate and consolidate the leadership in the development of these critical technological enablers amongst the current AI military superpowers (i.e. China and the United States), which could cement a bipolar balance of power and the prospect of resurgent bi-polar strategic competition.

Today, the United States has an unassailable first mover advantage in a range of AI applications with direct (and in some cases singular) relevance in a military context. However, as China approaches parity, and possibly surpasses the U.S. in several AI-related (and dual-use) domains, so the U.S. will increasingly view future technological incremental progress in emerging technologies – and especially unexpected technological breakthroughs or surprises – through a national security lens. Thus, responses to these perceived threats will be shaped and informed by broader U.S.-China geopolitical tensions (Waltz, 1979). These concerns resonated in the 2018 U.S. Nuclear Posture Review (NPR). The NPR emphasized that the coalescence of geopolitical tensions and emerging technology in the nuclear domain, in particular, how unanticipated technological breakthroughs in ‘new and existing innovations,’ might change the nature of the threats faced by the United States and the ‘capabilities needed to counter them.’ (NPR, 2018, p.14). In sum, against the backdrop of U.S.-China geopolitical tensions, and irrespective of whether China’s dual-use applications can be imminently converted into deployable military-use AI, U.S. perceptions of this possibility will be enough to justify draconian countermeasures.

Several future research questions outside the scope of this study would benefit from further study: How might rising powers and nonstate actors leverage AI technologies in ways that threaten the strategic environment of nuclear-armed great powers? How might the diffusion of dual-use AI to medium-small and nonstate actors affect great power strategic stability? As the distribution of military AI capabilities begins to diffuse to small and medium rising powers, independent of poles how might these states behave in the new multipolar order? Related, under what conditions can mastery of a particular technology such AI affect the global balance of power? Less dependent on the U.S. for their security, might rising power be more (or less) inclined to cooperate and form new regional bonds, or instead, grow to fear one another? And, how might the pace of this transition influence this outcome.

## Case

#### Presumption: Ballot can’t resolve anything about global algorithmic bias or data capitalism or “abolish antiblack anticompetitive debate practices”. They have not articulated a method

#### Inherency – McKittrick is ab reading archives which is already being done by people in Black Studies – the aff doesn’t do any archival work and the ballot doesn’t increase archival work

#### Competing rights claims collapse- only ethical option is to minimize unnecessary deaths

Greene 2010 – Joshua, Associate Professor of Social science in the Department of Psychology at Harvard University (The Secret Joke of Kant’s Soul published in Moral Psychology: Historical and Contemporary Readings, accessed: www.fed.cuhk.edu.hk/~lchang/material/Evolutionary/Developmental/Greene-KantSoul.pdf)

What turn-of-the-millennium science is telling us is that human moral judgment is not a pristine rational enterprise, that our moral judgments are driven by a hodgepodge of emotional dispositions, which themselves were shaped by a hodgepodge of evolutionary forces, both biological and cultural. Because of this, it is exceedingly unlikely that there is any rationally coherent normative moral theory that can accommodate our moral intuitions. Moreover, anyone who claims to have such a theory, or even part of one, almost certainly doesn't. Instead, what that person probably has is a moral rationalization. It seems then, that we have somehow crossed the infamous "is"-"ought" divide. How did this happen? Didn't Hume (Hume, 1978) and Moore (Moore, 1966) warn us against trying to derive an "ought" from and "is?" How did we go from descriptive scientific theories concerning moral psychology to skepticism about a whole class of normative moral theories? The answer is that we did not, as Hume and Moore anticipated, attempt to derive an "ought" from and "is." That is, our method has been inductive rather than deductive. We have inferred on the basis of the available evidence that the phenomenon of rationalist deontological philosophy is best explained as a rationalization of evolved emotional intuition (Harman, 1977). Missing the Deontological Point I suspect that rationalist deontologists will remain unmoved by the arguments presented here. Instead, I suspect, they will insist that I have simply misunderstood what Kant and like-minded deontologists are all about. Deontology, they will say, isn't about this intuition or that intuition. It's not defined by its normative differences with consequentialism. Rather, deontology is about taking humanity seriously. Above all else, it's about respect for persons. It's about treating others as fellow rational creatures rather than as mere objects, about acting for reasons rational beings can share. And so on (Korsgaard, 1996a; Korsgaard, 1996b). This is, no doubt, how many deontologists see deontology. But this insider's view, as I've suggested, may be misleading. The problem, more specifically, is that it defines deontology in terms of values that are not distinctively deontological, though they may appear to be from the inside. Consider the following analogy with religion. When one asks a religious person to explain the essence of his religion, one often gets an answer like this: "It's about love, really. It's about looking out for other people, looking beyond oneself. It's about community, being part of something larger than oneself." This sort of answer accurately captures the phenomenology of many people's religion, but it's nevertheless inadequate for distinguishing religion from other things. This is because many, if not most, non-religious people aspire to love deeply, look out for other people, avoid self-absorption, have a sense of a community, and be connected to things larger than themselves. In other words, secular humanists and atheists can assent to most of what many religious people think religion is all about. From a secular humanist's point of view, in contrast, what's distinctive about religion is its commitment to the existence of supernatural entities as well as formal religious institutions and doctrines. And they're right. These things really do distinguish religious from non-religious practices, though they may appear to be secondary to many people operating from within a religious point of view. In the same way, I believe that most of the standard deontological/Kantian self-characterizatons fail to distinguish deontology from other approaches to ethics. (See also Kagan (Kagan, 1997, pp. 70-78.) on the difficulty of defining deontology.) It seems to me that consequentialists, as much as anyone else, have respect for persons, are against treating people as mere objects, wish to act for reasons that rational creatures can share, etc. A consequentialist respects other persons, and refrains from treating them as mere objects, by counting every person's well-being in the decision-making process. Likewise, a consequentialist attempts to act according to reasons that rational creatures can share by acting according to principles that give equal weight to everyone's interests, i.e. that are impartial. This is not to say that consequentialists and deontologists don't differ. They do. It's just that the real differences may not be what deontologists often take them to be. What, then, distinguishes deontology from other kinds of moral thought? A good strategy for answering this question is to start with concrete disagreements between deontologists and others (such as consequentialists) and then work backward in search of deeper principles. This is what I've attempted to do with the trolley and footbridge cases, and other instances in which deontologists and consequentialists disagree. If you ask a deontologically-minded person why it's wrong to push someone in front of speeding trolley in order to save five others, you will get characteristically deontological answers. Some will be tautological: "Because it's murder!" Others will be more sophisticated: "The ends don't justify the means." "You have to respect people's rights." But, as we know, these answers don't really explain anything, because if you give the same people (on different occasions) the trolley case or the loop case (See above), they'll make the opposite judgment, even though their initial explanation concerning the footbridge case applies equally well to one or both of these cases. Talk about rights, respect for persons, and reasons we can share are natural attempts to explain, in "cognitive" terms, what we feel when we find ourselves having emotionally driven intuitions that are odds with the cold calculus of consequentialism. Although these explanations are inevitably incomplete, there seems to be "something deeply right" about them because they give voice to powerful moral emotions. But, as with many religious people's accounts of what's essential to religion, they don't really explain what's distinctive about the philosophy in question.

#### Extinction outweighs every other impact

Ord ’20 [Toby Ord, Senior Research Fellow in Philosophy at Oxford University & world-renowned risk-assessment expert who’s advised the World Health Organization, the World Bank, the World Economic Forum, the US National Intelligence Council and the UK Prime Minister’s Office. (3-3-2020, “The Precipice: Existential Risk and the Future of Humanity,” Hachette Book Group & Bloomsbury Publishing, <https://www.google.com/books/edition/The_Precipice/3aSiDwAAQBAJ?hl=en&gbpv=0>, Google Books]

UNDERSTANDING EXISTENTIAL RISK

Humanity’s future is ripe with possibility. We have achieved a rich understanding of the world we inhabit and a level of health and prosperity of which our ancestors could only dream. We have begun to explore the other worlds in the heavens above us, and to create virtual worlds completely beyond our ancestors’ comprehension. We know of almost no limits to what we might ultimately achieve.

Human extinction would foreclose our future. It would destroy our potential. It would eliminate all possibilities but one: a world ~~bereft~~ [lacking] of human flourishing. Extinction would bring about this failed world and lock it in forever—there would be no coming back.

The philosopher Nick Bostrom showed that extinction is not the only way this could happen: there are other catastrophic outcomes in which we lose not just the present, but all our potential for the future.

Consider a world in ruins: an immense catastrophe has triggered a global collapse of civilization, reducing humanity to a pre-agricultural state. During this catastrophe, the Earth’s environment was damaged so severely that it has become impossible for the survivors to ever reestablish civilization. Even if such a catastrophe did not cause our extinction, it would have a similar effect on our future. The vast realm of futures currently open to us would have collapsed to a narrow range of meager options. We would have a failed world with no way back.

Or consider a world in chains: in a future reminiscent of George Orwell’s Nineteen Eighty-Four, the entire world has become locked under the rule of an oppressive totalitarian regime, determined to perpetuate itself. Through powerful, technologically enabled indoctrination, surveillance and enforcement, it has become impossible for even a handful of dissidents to find each other, let alone stage an uprising. With everyone on Earth living under such rule, the regime is stable from threats, internal and external. If such a regime could be maintained indefinitely, then descent into this totalitarian future would also have much in common with extinction: just a narrow range of terrible futures remaining, and no way out.

[FIGURE 2.1 Omitted]

Following Bostrom, I shall call these “existential catastrophes,” defining them as follows: 3

An existential catastrophe is the destruction of humanity’s longterm potential.

An existential risk is a risk that threatens the destruction of humanity’s longterm potential.

These definitions capture the idea that the outcome of an existential catastrophe is both dismal and irrevocable. We will not just fail to fulfill our potential, but this very potential itself will be permanently lost. While I want to keep the official definitions succinct, there are several areas that warrant clarification.

First, I am understanding humanity’s longterm potential in terms of the set of all possible futures that remain open to us. 4 This is an expansive idea of possibility, including everything that humanity could eventually achieve, even if we have yet to invent the means of achieving it. 5 But it follows that while our choices can lock things in, closing off possibilities, they can’t open up new ones. So any reduction in humanity’s potential should be understood as permanent. The challenge of our time is to preserve our vast potential, and to protect it against the risk of future destruction. The ultimate purpose is to allow our descendants to fulfill our potential, realizing one of the best possible futures open to us.

While it may seem abstract at this scale, this is really a familiar idea that we encounter every day. Consider a child with high longterm potential: with futures open to her in which she leads a great life. It is important that her potential is preserved: that her best futures aren’t cut off due to accident, trauma or lack of education. It is important that her potential is protected: that we build in safeguards to make such a loss of potential extremely unlikely. And it is important that she ultimately fulfills her potential: that she ends up taking one of the best paths open to her. So too for humanity.

Existential risks threaten the destruction of humanity’s potential. This includes cases where this destruction is complete (such as extinction) and where it is nearly complete, such as a permanent collapse of civilization in which the possibility for some very minor types of flourishing remain, or where there remains some remote chance of recovery. 6 I leave the thresholds vague, but it should be understood that in any existential catastrophe the greater part of our potential is gone and very little remains.

Second, my focus on humanity in the definitions is not supposed to exclude considerations of the value of the environment, other animals, successors to Homo sapiens, or creatures elsewhere in the cosmos. It is not that I think only humans count. Instead, it is that humans are the only beings we know of that are responsive to moral reasons and moral argument—the beings who can examine the world and decide to do what is best. If we fail, that upward force, that capacity to push toward what is best or what is just, will vanish from the world.

Our potential is a matter of what humanity can achieve through the combined actions of each and every human. The value of our actions will stem in part from what we do to and for humans, but it will depend on the effects of our actions on non-humans too. If we somehow give rise to new kinds of moral agents in the future, the term “humanity” in my definition should be taken to include them.

My focus on humanity prevents threats to a single country or culture from counting as existential risks. There is a similar term that gets used this way—when people say that something is “an existential threat to this country.” Setting aside the fact that these claims are usually hyperbole, they are expressing a similar idea: that something threatens to permanently destroy the longterm potential of a country or culture.

Third, any notion of risk must involve some kind of probability. What kind is involved in existential risk? Understanding the probability in terms of objective long-run frequencies won’t work, as the existential catastrophes we are concerned with can only ever happen once, and will always be unprecedented until the moment it is too late. We can’t say the probability of an existential catastrophe is precisely zero just because it hasn’t happened yet.

Situations like these require an evidential sense of probability, which describes the appropriate degree of belief we should have on the basis of the available information. This is the familiar type of probability used in courtrooms, banks and betting shops. When I speak of the probability of an existential catastrophe, I will mean the credence humanity should have that it will occur, in light of our best evidence.9

There are many utterly terrible outcomes that do not count as existential catastrophes.

One way this could happen is if there were no single precipitous event, but a multitude of smaller failures. This is because I take on the usual sense of catastrophe as a single, decisive event, rather than any combination of events that is bad in sum. If we were to squander our future simply by continually treating each other badly, or by never getting around to doing anything great, this could be just as bad an outcome but wouldn’t have come about via a catastrophe.

Alternatively, there might be a single catastrophe, but one that leaves open some way for humanity to eventually recover. From our own vantage, looking out to the next few generations, this may appear equally bleak. But a thousand years hence it may be considered just one of several dark episodes in the human story. A true existential catastrophe must by its very nature be the decisive moment of human history—the point where we failed.

Even catastrophes large enough to bring about the global collapse of civilization may fall short of being existential catastrophes. While colloquially referred to as “the end of the world,” a global collapse of civilization need not be the end of the human story. It has the required severity, but may not be permanent or irrevocable.

In this book, I shall use the term civilization collapse quite literally, to refer to an outcome where humanity across the globe loses civilization (at least temporarily), being reduced to a pre-agricultural way of life. The term is often used loosely to refer merely to a massive breakdown of order, the loss of modern technology, or an end to our culture. But I am talking about a world without writing, cities, law, or any of the other trappings of civilization.

This would be a very severe disaster and extremely hard to trigger. For all the historical pressures on civilizations, never once has this happened— not even on the scale of a continent.10 The fact that Europe survived losing 25 to 50 percent of its population in the Black Death, while keeping civilization firmly intact, suggests that triggering the collapse of civilization would require more than 50 percent fatality in every region of the world.11

Even if civilization did collapse, it is likely that it could be reestablished. As we have seen, civilization has already been independently established at least seven times by isolated peoples.12 While one might think resource depletion could make this harder, it is more likely that it has become substantially easier. Most disasters short of human extinction would leave our domesticated animals and plants, as well as copious material resources in the ruins of our cities—it is much easier to re-forge iron from old railings than to smelt it from ore. Even expendable resources such as coal would be much easier to access, via abandoned reserves and mines, than they ever were in the eighteenth century. 13 Moreover, evidence that civilization is possible, and the tools and knowledge to help rebuild, would be scattered across the world.

There are, however, two close connections between the collapse of civilization and existential risk. First, a collapse would count as an existential catastrophe if it were unrecoverable. For example, it is conceivable that some form of extreme climate change or engineered plague might make the planet so inhospitable that humanity would be irrevocably reduced to scattered foragers.14 And second, a global collapse of civilization could increase the chance of extinction, by leaving us more vulnerable to subsequent catastrophe.

One way a collapse could lead to extinction is if the population of the largest remaining group fell below the minimum viable population—the level needed for a population to survive. There is no precise figure for this, as it is usually defined probabilistically and depends on many details of the situation: where the population is, what technology they have access to, the sort of catastrophe they have suffered. Estimates range from hundreds of people up to tens of thousands.15 If a catastrophe directly reduces human population to below these levels, it will be more useful to classify it as a direct extinction event, rather than an unrecoverable collapse. And I expect that this will be one of the more common pathways to extinction.

We rarely think seriously about risks to humanity’s entire potential. We encounter them mostly in action films, where our emotional reactions are dulled by their overuse as an easy way to heighten the drama.16 Or we see them in online lists of “ten ways the world could end,” aimed primarily to thrill and entertain. Since the end of the Cold War, we rarely encounter sober discussions by our leading thinkers on what extinction would mean for us, our cultures or humanity. 17 And so in casual contexts people are sometimes flippant about the prospect of human extinction.

But when a risk is made vivid and credible—when it is clear that billions of lives and all future generations are actually on the line—the importance of protecting humanity’s longterm potential is not, for most people, controversial. If we learned that a large asteroid was heading toward Earth, posing a greater than 10 percent chance of human extinction later this century, there would be little debate about whether to make serious efforts to build a deflection system, or to ignore the issue and run the risk. To the contrary, responding to the threat would immediately become one of the world’s top priorities. Thus our lack of concern about these threats is much more to do with not yet believing that there are such threats, than it is about seriously doubting the immensity of the stakes.

Yet it is important to spend a little while trying to understand more clearly the different sources of this importance. Such an understanding can buttress feeling and inspire action; it can bring to light new considerations; and it can aid in decisions about how to set our priorities.

#### Status quo market consolidation is goldilocks and ensures strong competition and consumer welfare—the plan ruins economic competitiveness

Portuese, 20

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Nevertheless, antitrust populism remains prevalent in both jurisdictions where smallness in the age of tech giants is preferred. If “antitrust law was born in a populist reaction to the developments during the Second Industrial Revolution” (Orbach, 2017, p. 18), antitrust populism is currently being revived as a result of disruptive changes brought about by the socalled ‘Fourth Industrial Revolution’. Industrial revolutions promote market concentration as new technological progress and organisational innovation emerge. The Fourth Revolution is no exception: with their network effects and data-intensive algorithms, the tech giants have built attractive digital platforms and have set up digital ecosystems whereby disruptive innovation has become crucial for the survival of digital market actors. They often evolve in zero-priced markets where services funded by advertisements facilitate capital gains out of third parties' use of big data. Worries about the curse of bigness in the ‘new Gilded Age’ of digital platforms (Wu, 2018a) and calls for socio-political goals to be pursued by contemporary antitrust enforcement have multiplied throughout jurisdictions, primarily in the EU and the US. The current “populist backlash” (Lianos, 2019, p. 113) also springs from a perceived ‘democratic deficit’ in technocratic antitrust where economic expertise in applying the consumer welfare standard dominates any politically motivated approach to antitrust. But are these calls for a return to antitrust populism with a New Brandeisian agenda adequately justified? 3 | ANTITRUST POPULISM DEBUNKED In the US, antitrust populism has attracted a bipartisan consensus: economic efficiency in general is discredited and consumer welfare is no longer regarded as the regulatory criterion for conducting antitrust analysis. Self-described as populists but ‘with a brain’ (Lynn & Longman, 2016), Neo-Brandeisians can be labelled as antitrust populists because of their intellectual lineage from the populist era prior and subsequent to the Sherman Act and their invocation of Brandeis's heritage (Wright, Dorsey, Klick, & Rybnicek, 2018, p. 294). They have gained tremendous media coverage, political influence, and popularity. Crane (2018, p. 118) mentions the “bewilderment of many observers” who are surprised by this sudden attack on the traditional role of antitrust from “both wings of the political spectrum, throwing into confusion a conventional understanding that pro-antitrust sentiment tacked left and antitrust laissez faire tacked right”. Left-leaning initiatives include the aggressive role of the Open Markets Institute14 led by Barry Lynn, Democratic presidential candidate Senator Elizabeth Warren, the Democrats' ‘A Better Deal’ economic platform,15 and the US House of Representative Antitrust Caucus, where reform bills have been introduced. Right-leaning examples include President Trump's assault on big media and tech giants, and the highly opportunistic challenge to the AT&T–Time Warner merger by the Department of Justice. Opinion editorials populate the US media with a mainstream view that corporate concentration has increased, that big firms have gained too much political power and have provided too few economic opportunities, and that breaking up corporate bigness or turning big companies into public utilities (Meyer, 2017) are suitable and desirable responses to be addressed by a new antitrust policy. In Europe, politicisation of antitrust laws has made important inroads at the highest political levels. EU Competition Commissioner Margrethe Vestager has departed from the approach of her predecessors (Joaquin Alumnia and Neelie Kroes) by pursuing an aggressive antitrust policy towards US big tech companies. Encouraged by the rise of anti-bigness sentiment, Vestager has reopened investigations against Google companies previously closed by Joaquin Alumnia. She fined Google companies record-breaking amounts for alleged abuses of market dominance. Whereas Neelie Kroes (2006) had argued that consumer welfare is and should remain the objective of EU competition policy, Commissioner Vestager (2016) vouched for more fairness in EU competition policy and for vague ‘citizens’ welfare’ and ‘public interest’ standards (Brotman, 2017) rather than the economics-based consumer welfare standard. 3.1 | Concentration and competition: A neutral relationship According to Neo-Brandeisians, digital companies have grown internally to such an extent that they have monopolised the markets or have grown externally by increasing numbers of mergers which have all resulted in increased corporate concentration. This market concentration could stifle innovation and could thus be detrimental to society at large (Stiglitz, 2019; Abdela & Steinbaum, 2018). If the evidence does indeed reveal increased corporate concentration and consolidation of business strategies (Grullon, Larkin, & Michaely, 2019; Philippon, 2018), this trend nevertheless remains modest (Shapiro, 2018) since an average of approximately 14 equally sized competitors are to be found in any given industry sector in the US (Sacher & Yun, 2019, p. 7). Likewise, as illustrated in Figure 1, the alleged market concentration in the US economy is evidenced by the increase in the sales shares of the 50 largest firms in each sector between 1997 and 2012, according to the French Ministry of Economic Affairs (DG Trésor) on the basis of US Census Bureau data. Thus, where market concentration is witnessed in the US, in a given sector more than 50 firms still compete against one another. Moreover, such concentration consists of increases of only a couple of percentage points in the sales of the 50 largest firms in each sector. Consequently, competition is still vibrant, and the weak pattern of market concentration demonstrates that larger firms are able to increase their sales more than smaller firms can – something surmised to occur through greater innovation, better access to finance, and larger consumer bases. In Europe, DG Trésor (2018, p. 1) finds that “concentration has remained stable overall”. More precisely, “the absence of concentration in Europe could reflect a lack of these highly-productive companies” since “concentration is the result of productivity gains (superstars)” (DG Trésor, 2018, p. 7). Against the populist “contention that big is bad, and that the growth of large firms with high market shares is increasing concentration and weakening competition, driving up profits, damaging innovation …” (OECD, 2018a, p. 4), “the evidence suggests that there has been a moderate increase in those broad measures of concentration that first raised the alarm, at least in the US and Japan, though not in European countries” (2018a, p. 3). In Europe, market concentration has indeed remained stable (Valletti, Koltay, Lorincz, & Zenger, 2017). Nevertheless, whether such market concentration is detrimental can still be questioned, on two grounds. First, market concentration can be said to have occurred only if the relevant market has been properly defined. Second, concentrated relevant markets may not pose a threat to innovation or a risk to consumer welfare, but, on the contrary, may be the result of a search for innovation and thus enhance consumer welfare. The corporate behemoths of today are not totally unmatched by the behemoths of yesterday (Hruska, 1992, p. 308). Already in the early twentieth century, Berle and Means (1933, p. 357) warned that “[t]he rise of the modern corporation has brought a concentration of economic power which can compete on equal terms with the modern state”. Also, size cannot equate to monopolisation because whereas size is assessed by objective metrics, monopolisation is analysed by subjective idiosyncratic characteristics, namely, the definition of the relevant market (Pleatsikas & Teece, 2001). Only once the relevant market has been appropriately defined can the degree of monopolisation be inferred (Hruska, 1992). For only when the relevant product market, the relevant geographic market, and the relevant temporal market have been defined can any conclusion of the overall relevant market be drawn together with the existence of monopolisation risks (Pleatsikas & Teece, 2001). Indeed, “without a market definition to focus on firms that are actually competitively relevant to one another, market share statistics are meaningless and certainly cannot be used to make inferences about the intensity or level of competition” (Wright et al., 2018, p. 316). As an illustration, in the Google Android decision16 the European Commission considered that the operating system of Android (Android OS) is a quasi-monopoly with 90 per cent market share. Android OS was not considered to be competing with Apple's operating system (IoS) since, according to the Commission, there is a relevant market for freely licensable operating systems (where Android dominated) and a separate licensable operating system (where IoS dominated). Should Android OS and IoS be considered to lie within the same relevant market of operating systems, Android could no longer be argued to be a monopoly; rather, a duopoly existed in which each corporation exerts considerable competitive constraints on the other (Portuese, 2019). Likewise, claims that Facebook enjoys a ‘monopoly’ (Srinivasan, 2019) on social media are exaggerated if the relevant social media market is more broadly assessed, and, most importantly, when attention markets attracting advertisers on social platforms are fully integrated into the analysis (Khan, 2018; Auer & Petit, 2019). Economic evidence reveals that increased market concentration can be the result of increased competition and enhanced innovation (Sacher & Yun, 2019, pp. 4–6). Concentration is indeed a rather neutral proxy for evaluating the competitive forces in a given market; the evidence for it, in line with the Schumpeterian intuition, is that firm size increase is positively related to innovation due to financial access and innovation behaviour (Alsharkas, 2014; Hirschey, Skiba, & Wintoki, 2012; Hruska, 1992). The economic evidence has long shown an ambiguous relationship between competition and innovation levels: a so-called U-inverted (concave) relationship reveals that perfect competition suppresses innovation and that a level of imperfect competition is required for the spirit of innovation to be unleashed via firm expansion (Cornett, Erhemjamts, & Tehranian, 2019; Kerber, 2017): high competition intensity increases the incentives for firms to innovate, and so market concentration increases (Aghion & Howitt, 1997; Aghion, Harris, & Vickers, 1997; Boone, 2001; Aghion, Bloom, Blundell, Griffith, & Howitt, 2005; Hashmi, 2013). Thus, market concentration may be the result of, not an impediment to, innovation incentivised by intensive market competition (Scherer, 1967; Blundell, Griffith, & Van Reenen, 1999; Tishler & Milstein, 2009). Wright et al. (2018, p. 318) conclude that “an increase in concentration alone might be the result of more competition, less competition, or the product of factors completely unrelated to competition in the economy”. When antitrust policy frowns upon (and prohibits) mergers between hitherto competing firms for the sake of preserving an ‘optimal’ market structure, the innovation factors underpinning the mergers may be overlooked. More importantly, the discovery process inherent in competition is impeded, as market competition is no longer “able to discover the best size of firms and thus the lowest cost at which production can be maintained” (Kirzner, 2000, p.13). The German antitrust authority has acknowledged that in innovationdriven markets (such as digital markets) the risk of over-enforcement is pointed out because the connection between concentration and innovation is not always clear and not all the influencing factors can be identified. Over-enforcement in such cases could reduce incentives for innovation and harm long-term innovation dynamics. (Bundeskartellamt, 2017, p. 32) Similarly, the US antitrust agencies, the Federal Trade Commission and the Department of Justice, have acknowledged that concentration is not systematically an effect of decreased levels of competition. Indeed, against the mainstream discourse, and given the lack of compelling evidence, they have seminally concluded, before the OECD, that: Concentration never tells the whole story about competition, and the proper delineation of the relevant market is critical if concentration is to tell any part of the story … Academics and journalists recently made claims of increasing concentration throughout the U.S. economy … [T]he U.S. Agencies find the claims of increasing concentration are unsupported by data for meaningful markets. (OECD, 2018b, pp. 2–3) Increased efficiency, better consumer service, and enhanced innovation potential are strong reasons for consolidation of the market. Such consolidation of an industry may also be the result of a tit-for-tat game with other firms, thereby increasing effective competition by smaller firms against bigger players (Demsetz, 1974, p. 167). Consequently, consolidation of an industry may be the prerequisite for incumbents to be effectively challenged. Scale-and-scope economies of mergers enable synergies with lower administrative costs and greater interoperability, especially in the age of digital platforms. These synergies can be pro- or anti-competitive; but mergers, and concentration more generally, can hardly be said to be detrimental to the economy as such (Lianos, 2019, pp. 1486–7; Haucap, 2017). Because they equate increased concentration with decreased competition, without providing evidence of consumer harm or reduced innovation, the arguments of antitrust populists in favour of more aggressive antitrust enforcement are flawed. Indeed, the “return to structural presumptions, such as a simple but per se ban on mergers that reduce the number of major firms to less than four” (Wu, 2018a, p. 129) is economically nonsensical (competition can be increased by a reduction in the number of firms) and legally impractical (how can we define markets so neatly as to be certain of the exact number of firms they contain?). Seen as “the priority for Neo-Brandeisian antitrust” (Wu, 2018a, p. 127), proposed changes to merger review rest on flawed assumptions and misconstrued proposals.

#### Decline causes global nuclear war—post 2008 world proves

Sundaram, 19

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KUALA LUMPUR and BERLIN, Feb 12 2019 (IPS) - Economic recovery efforts since the 2008-2009 global financial crisis have mainly depended on unconventional monetary policies. As fears rise of yet another international financial crisis, there are growing concerns about the increased possibility of large-scale military conflict. More worryingly, in the current political landscape, prolonged economic crisis, combined with rising economic inequality, chauvinistic ethno-populism as well as aggressive jingoist rhetoric, including threats, could easily spin out of control and ‘morph’ into military conflict, and worse, world war. Crisis responses limited The 2008-2009 global financial crisis almost ‘bankrupted’ governments and caused systemic collapse. Policymakers managed to pull the world economy from the brink, but soon switched from counter-cyclical fiscal efforts to unconventional monetary measures, primarily ‘quantitative easing’ and very low, if not negative real interest rates. But while these monetary interventions averted realization of the worst fears at the time by turning the US economy around, they did little to address underlying economic weaknesses, largely due to the ascendance of finance in recent decades at the expense of the real economy. Since then, despite promising to do so, policymakers have not seriously pursued, let alone achieved, such needed reforms. Instead, ostensible structural reformers have taken advantage of the crisis to pursue largely irrelevant efforts to further ‘casualize’ labour markets. This lack of structural reform has meant that the unprecedented liquidity central banks injected into economies has not been well allocated to stimulate resurgence of the real economy. From bust to bubble Instead, easy credit raised asset prices to levels even higher than those prevailing before 2008. US house prices are now 8% more than at the peak of the property bubble in 2006, while its price-to-earnings ratio in late 2018 was even higher than in 2008 and in 1929, when the Wall Street Crash precipitated the Great Depression. As monetary tightening checks asset price bubbles, another economic crisis — possibly more severe than the last, as the economy has become less responsive to such blunt monetary interventions — is considered likely. A decade of such unconventional monetary policies, with very low interest rates, has greatly depleted their ability to revive the economy. The implications beyond the economy of such developments and policy responses are already being seen. Prolonged economic distress has worsened public antipathy towards the culturally alien — not only abroad, but also within. Thus, another round of economic stress is deemed likely to foment unrest, conflict, even war as it is blamed on the foreign. International trade shrank by two-thirds within half a decade after the US passed the Smoot-Hawley Tariff Act in 1930, at the start of the Great Depression, ostensibly to protect American workers and farmers from foreign competition! Liberalization’s discontents Rising economic insecurity, inequalities and deprivation are expected to strengthen ethno-populist and jingoistic nationalist sentiments, and increase social tensions and turmoil, especially among the growing precariat and others who feel vulnerable or threatened. Thus, ethno-populist inspired chauvinistic nationalism may exacerbate tensions, leading to conflicts and tensions among countries, as in the 1930s. Opportunistic leaders have been blaming such misfortunes on outsiders and may seek to reverse policies associated with the perceived causes, such as ‘globalist’ economic liberalization. Policies which successfully check such problems may reduce social tensions, as well as the likelihood of social turmoil and conflict, including among countries. However, these may also inadvertently exacerbate problems. The recent spread of anti-globalization sentiment appears correlated to slow, if not negative per capita income growth and increased economic inequality. To be sure, globalization and liberalization are statistically associated with growing economic inequality and rising ethno-populism. Declining real incomes and growing economic insecurity have apparently strengthened ethno-populism and nationalistic chauvinism, threatening economic liberalization itself, both within and among countries. Insecurity, populism, conflict Thomas Piketty has argued that a sudden increase in income inequality is often followed by a great crisis. Although causality is difficult to prove, with wealth and income inequality now at historical highs, this should give cause for concern. Of course, other factors also contribute to or exacerbate civil and international tensions, with some due to policies intended for other purposes. Nevertheless, even if unintended, such developments could inadvertently catalyse future crises and conflicts. Publics often have good reason to be restless, if not angry, but the emotional appeals of ethno-populism and jingoistic nationalism are leading to chauvinistic policy measures which only make things worse. At the international level, despite the world’s unprecedented and still growing interconnectedness, multilateralism is increasingly being eschewed as the US increasingly resorts to unilateral, sovereigntist policies without bothering to even build coalitions with its usual allies. Avoiding Thucydides’ iceberg Thus, protracted economic distress, economic conflicts or another financial crisis could lead to military confrontation by the protagonists, even if unintended. Less than a decade after the Great Depression started, the Second World War had begun as the Axis powers challenged the earlier entrenched colonial powers. They patently ignored Thucydides’ warning, in chronicling the Peloponnesian wars over two millennia before, when the rise of Athens threatened the established dominance of Sparta! Anticipating and addressing such possibilities may well serve to help avoid otherwise imminent disasters by undertaking pre-emptive collective action, as difficult as that may be. The international community has no excuse for being like the owners and captain of the Titanic, conceitedly convinced that no iceberg could possibly sink the great ship.

#### Degrowth cancels space colonization.

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Second, there is some probability that climate change mitigation strategies will change the social order towards a degrowth philosophy. Degrowth is a vague socio-economic concept and social movement that, in general, calls for a contraction of the global and national economies by means of lower production and consumption rates, and, to some degree, to more profound changes to the “capitalist” system of economic production [67]. Degrowth or degrowth-like approaches are being actively considered as climate risk mitigation strategies [68, 69], and degrowth would almost certainly be a highly effective measure for mitigating climate change. After all, if we were to drastically reduce or even completely eliminate the (industrial) sources of greenhouse gases, the amount of greenhouse gases that are being emitted would accordingly drastically sink. From the long-term perspective of humankind’s survival, degrowth is problematic in at least two ways. First, there is a risk that the general contraction of economic activity would also slow or eliminate progress in the domain of energy, which would, in turn, reduce the probability of successful space colonization due to an absence of suitable energy sources. Second, and more fundamental: If degrowth were to become a dominant societal paradigm, it is uncertain whether the longterm survival of humankind by means of space colonization would be regarded a desirable goal. In a literal sense, establishing extraterrestrial colonies would mean growth; the size of the total human population would grow, and the area of space-time that humans occupy would grow. In a more philosophical sense, degrowth might even be antithetical to space colonization. Even though both degrowth and space colonization have a similar moral goal – increasing wellbeing – , the ends to that goal are very dierent. Within degrowth philosophy, the goal is, metaphorically speaking, not to “live beyond our means”: We should strive for “ecological balance”, and such a state should increase the average wellbeing. But the frame of reference is the status quo; Earth and humankind as we know it today. Space colonization, on the other hand, operates with a much larger frame of reference: All the future generations of humans (and other sentient beings) who could enjoy wellbeing if we succeed in colonizing space – and who will categorically be denied that wellbeing if we fail to colonize space [70]. The goal of space colonization as a moral project is not to live beyond our means, but to actively redene and expand what our means are through scientic and technological progress.

#### Solves inevitable extinction

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Space colonization is not only the subject of fiction but of serious science too. The late physicist Stephen Hawking argued that unless colonies were established in space the human race would become extinct. There are several natural phenomena beyond our control that could spell our obliteration. Over a long enough period of time our planet is vulnerable to catastrophic meteorite strikes, or getting exposed to the deadly radiation of a nearby supernova explosion. As our Sun burns its fuel it will start to expand and, in a few million years, will scorch Earth. We can also self-destruct by waging nuclear war, or by tilting our planet’s climate towards a runaway greenhouse effect. Space colonization is therefore the ultimate insurance policy of long-term human survival[4].

#### Decoupling [or dematerialization] makes growth sustainable—empirics, efficiency, substitution, consumption decline, innovation, financial oversight, and new reserves.

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What’s behind the broad and deep dematerialization of the American economy? Why are we now post-peak in our consumption of so many resources? In the next chapters I’ll present my explanation of the causes of dematerialization. First, though, I want to give a short explanation of what the causes are not. In particular, I want to show that the CRIB strategies born around Earth Day and promoted since then for reducing our planetary footprint—consume less, recycle, impose limits, and go back to the land—have not been important contributors to the dematerialization we’ve seen. Since Earth Day, we have demonstrably not consumed much less or gone back to the land in large numbers. We have recycled a lot, but this fact is irrelevant because recycling is a separate phenomenon from dematerialization. Much more relevant than recycling are the limits we’ve imposed in a couple of areas. The history of these limits is instructive because it helps us separate great ideas (limits on pollution and hunting animals) from truly terrible ones (limits on family size). All, Consuming The C part of the CRIB strategy—a plea for us to consume less for the planet’s sake—has largely fallen on deaf ears. To see this, let’s look at change in the real GDP of the United States. It grew by an average of 3.2 percent per year between the end of World War II and Earth Day. From 1971 to 2017, it grew by an annual average of 2.8 percent. Population growth also slowed down after the postwar baby boom, but it remained positive. America’s population increased by an average of 1.5 percent a year from 1946 to 1970, and by 1 percent annually from 1971 to 2016. So while we have slowed down some, we certainly haven’t come close to embracing degrowth in our population or consumption. But the American economy has changed significantly since Earth Day and has become relatively less oriented around making and building things. Services, ranging from haircuts to insurance policies to concerts, now make up a much larger share of the economy than they did in 1970. US personal consumption of services has risen from 30 percent of GDP in 1970 to 47 percent in 2017. So, has the decline in resource use come about because we don’t make or consume as many products as we used to? No. While it’s true that products have been declining in relative terms (in other words, as a percentage of total GDP) compared to services, our total consumption of products has still been increasing in absolute terms. So has our industrial production—the total amount of things made in America. What’s more, the United States has not recently shifted away from “heavy” manufacturing. We still make lots of vehicles, machinery, and other big-ticket items, just as we used to. But we don’t make them the same way we used to. We now make them using fewer resources. To see this, let’s add a line showing US industrial production to our graph from the previous chapter of GDP and total metal consumption. This updated chart makes clear that the country hasn’t stopped producing things. Instead, America’s manufacturers have learned to produce more things from less metal. So to summarize, growth of consumption has in some cases slowed down in recent years. But growth in resource use has done much more than slow down—it has reversed course and is now generally negative. We have not as a society embraced degrowth. Instead, we’ve done something far stranger and more profound: we’ve decoupled growth—in consumption, prosperity, and our economy—from resource use. Early in the Industrial Era, the French diplomat Alexis de Tocqueville published his 1835 book, Democracy in America. One of the first major investigations into the character of the then-young country, it remains one of the best.I De Tocqueville observed almost two centuries ago that the people of the United States liked their things: “In America, the passion for material well-being… is general.… Minds are universally preoccupied with meeting the body’s every need and attending to life’s little comforts.” What’s new is that providing for our needs and comforts now requires fewer materials, not more. Recycling: Big, and Beside the Point Recycling is big business: 47 percent, 33 percent, 68 percent, and 49 percent of all the tonnage of aluminum, copper, lead, and iron and steel (respectively) consumed in the United States in 2015 came from scrap metal rather than ore taken from the earth. Similarly, almost 65 percent of paper products came from recycled newspapers, pizza boxes, and so on rather than from felled trees. Yet recycling is irrelevant for dematerialization. Why? Because recycling is about where resource-producing factories get their inputs, while dematerialization is about what’s happened to total demand for their outputs. Paper mills, for example, get their raw material from two main sources: recycling centers and forests. American consumption of output from all paper mills combined has been declining since 1990, the year of peak paper in the United States. This decline is purely a matter of how much total demand there is for paper; it has no direct relationship to the amount of recycling taking place. But is there any indirect relationship? How much would our total consumption of resources such as paper or steel change without recycling? It’s impossible to answer with certainty, but my intuition is that if recycling didn’t exist, our total consumption of resources such as aluminum, copper, iron, and steel would be declining even more quickly. This seems counterintuitive; the conclusion is supported by a simple chain of reasoning. Recycling metals makes economic sense exactly because it’s cheaper to melt down and reuse scrap than it is to dig out and process ore. Without this scrap, a ton of metal would probably cost more, all other things being equal. And as a general rule, we use less of a thing when it costs more. So it seems most likely to me that we’d use less metal overall in a hypothetical zero-recycling economy than we do in our actual enthusiastic-about-scrap-metal-recycling economy. This does not mean that I think metal recycling is bad. I think it’s great, since it gives us cheaper metal products and reduces total greenhouse gas emissions (since it takes much less energy to obtain metal from scrap than from ore). But recycling, whatever its merits, is not part of the dematerialization story. It’s a different story. Back to the Land Is Bad for the Land The back-to-the-land movement is a fascinating chapter in the history of American environmentalism, but a largely insignificant one. There were simply never enough homesteaders and others who turned away from modern, technologically sophisticated life to make much of a difference. Which is a good thing for the environment. As Jeffrey Jacob documents in his book New Pioneers, the back-to-the-land movement in the United States began in the mid-1960s and continued into the next decade. According to one estimate, as many as 1 million North American back-to-the-landers were living on small farms by the end of the 1970s. This, though, was a weak current against the strong tide of urban growth; the number of American city dwellers increased by more than 17 million between 1970 and 1980. Going back to the land might have been widely discussed, but it was comparatively rarely practiced. We should be thankful for this because homesteading is not great for the environment, for two reasons. First, small-scale farming is less efficient in its use of resources than massive, industrialized, mechanized agriculture. To get the same harvest, homesteaders use more land, water, and fertilizer than do “factory farmers.” Farms of less than one hundred acres, for example, grow 15 percent less corn per acre than farms with more than a thousand acres. And bigger farms get better faster. Between 1982 and 2012 farms under one hundred acres grew their total factor productivity by 15 percent, whereas farms over a thousand acres grew theirs by 51 percent. So more homesteaders would have meant more land under cultivation, more water and fertilizer used, and so on. Second, rural life is less environmentally friendly than urban or suburban dwelling. City folk live in high-density, energy-efficient apartments and condos, travel only short distances for work and errands, and frequently use public transportation. None of these things is true of country living. As economist Edward Glaeser summarizes, “If you want to be good to the environment, stay away from it. Move to high-rise apartments surrounded by plenty of concrete.… Living in the country is not the right way to care for the Earth. The best thing that we can do for the planet is build more skyscrapers.” And if homesteaders decide not only to ignore Glaeser’s advice but also to leave modernity further behind and heat their homes with coal or wood, they do still more environmental harm. Coal home furnaces create lots of atmospheric pollution, much more than comes from other kinds of fuel. Poland, for example, today has 80 percent of all homes in Europe that burn coal, and thirty-three of the Continent’s fifty most polluted cities. And burning wood means chopping down trees. A lot of them. It’s almost certainly the case that the English turned to coal for home heating in the middle of the sixteenth century because they’d cut down such a huge percentage of their trees that the price of wood skyrocketed. So if we care about the environment, we should probably be glad that the back-to-the-land movement stalled out, and that industrial-scale, high-yield agriculture has become the norm. A comprehensive review published in Nature Sustainability in 2018 concluded, “The data… do not suggest that environmental costs are generally larger for [high-yield] farming systems.… If anything, positive associations—in which high-yield, land-efficient systems also have lower costs in other dimensions—appear more common.” Imposing Limits: The Worst Idea, and the Best One Of the four elements of the CRIB strategy, the drive to impose limits has by far the most checkered history. It yielded both the most harmful strategies, and the most helpful ones. The Population Implosion In 1979 the government of the People’s Republic of China announced its new family planning policy, which soon became known as the one-child policy. It was enacted despite the steady decline in the country’s birth rate throughout the 1970s. But after reading Limits to Growth, A Blueprint for Survival, and other books limning the looming dangers of unchecked population expansion, the missile scientist Song Jian came to believe that even faster birth rate reductions were required. He became the architect of the new policy, the main effect of which was to limit ethnic Han Chinese families to a single child. Exceptions to this restriction included giving some couples the right to a second child if their first was a girl, but the one-child policy soon became a central fact of Chinese family life. It is hard to see it in a positive light. After the policy was officially abandoned in late 2015, journalist Barbara Demick wrote its unflattering obituary: “Family planning became a powerful bureaucracy, with officials who terrorized parents. They beat and burned down the houses of people who violated the family-planning limits. They snatched over-quota baby girls from the arms of their mothers and gave them to orphanages, which in turn put them up for adoption, earning a three-thousand-dollar ‘donation’ for each baby.” The Chinese government maintains that approximately 400 million births were prevented by the one-child policy, but this is probably a large overestimate. As the economist Amartya Sen points out, “The additional contribution of coercion to reducing fertility in China is by no means clear, since compulsion was superimposed on a society that was already reducing its birth rate.” In their 2013 essay “How Will History Judge China’s One-Child Policy?” the demographers Wang Feng, Yong Cai, and Baochang Gu compared the policy unfavorably to two of their country’s great twentieth-century convulsions: the Cultural Revolution and the Great Leap Forward. They wrote, “While those grave mistakes both cost tens of millions of lives, the harms done were relatively short-lived and were corrected quickly afterward. The one-child policy, in contrast, will surpass them in impact by its role in creating a society with a seriously undermined family and kin structure, and a whole generation of future elderly and their children whose well-being will be seriously jeopardized.” History, in short, will judge this government-imposed limit on family size harshly.II Rational Restrictions Imposing limits on family size is a terrible idea for reasons both practical and moral. But it’s an excellent idea to impose limits on pollution, and on hunting some animals and selling products that come from their bodies. Such restrictions have yielded the great triumphs of the conservation and environmental movements in America and other countries. In 1970, the same year as the original Earth Day festival, the United States established the federal Environmental Protection Agency and made major amendments to 1963’s Clean Air Act. This was the start of a cascade of laws and regulations aimed at reducing pollution and other environmental harms. These have worked amazingly well. For example, atmospheric levels of sulfur dioxide in the United States have dropped to levels not seen since the first years of the twentieth century, and other kinds of air pollution have also dropped sharply. From 1980 to 2015, total emissions of six principal air pollutants decreased by 65 percent. As lead was banned from paint and gasoline, the concentration of that element in the blood of young children dropped by more than 80 percent between 1976 and 1999. Because lead retards brain development during youth, these declines are tremendously important. According to one study, American children in 1999 had IQs that were on average 2.2 to 4.7 points higher than they would have been had lead concentrations remained at their 1970 levels. More work certainly remains, but thanks to the limits imposed on pollutants, America’s soil, air, and water are all much cleaner than they were on Earth Day. The conservationists who grew concerned in the early years of the twentieth century about what hunting was doing to the populations of many animals were the predecessors of Earth Day’s environmentalists. Conservationists were spurred to action by the shocking extinction of the passenger pigeon. That such an abundant bird could be eradicated stunned many and spurred new laws restricting trade in animal products. The first of these was the Lacey Act, passed by Congress in 1900 and named for John Lacey, a Republican representative from Iowa. As he said during debate on the bill, “The wild pigeon, formerly in flocks of millions, has entirely disappeared from the face of the earth. We have given an awful exhibition of slaughter and destruction, which may serve as a warning to all mankind. Let us now give an example of wise conservation of what remains of the gifts of nature.” The Lacey Act and its successors imposed three kinds of limits on taking and consuming animals. First, hunting of some animals was fully banned. Protected species include the sea otter, which was protected by a 1911 international moratorium; the snowy egret, which was ruthlessly hunted for its gorgeous plumes until passage of the Weeks-McLean Law Act in 1913; and dolphins and manatees, which were sheltered by 1972’s Marine Mammal Protection Act. Second, many limits have been imposed on when and where animals can be hunted. Sport and food hunting are illegal in most national parks, for example, and duck, bear, deer, and many other animals have well-defined hunting seasons. Third, bans have been imposed on the commercial trade in many animal products. The most sweeping of these is probably the nationwide ban on the sale of hunted meat. You may see venison or bison meat at a butcher’s counter or on a menu in America, but it always comes from a ranch, not a hunt. These imposed limits have brought many iconic American animals back from the brink of extinction. North America now has more than half a million bison, for example, and over three thousand sea otters live off the coast of Northern California. Some previously threatened animals have come back so well that they’re now widely considered pests. People in many American neighborhoods today feel that there are too many white-tailed deer, Canada geese, and beaver. The story of dematerialization is not the story of following the CRIB strategies. Except for the excellent idea of imposing limits on polluting and pursuing animals, these strategies were ignored (we didn’t embrace degrowth and stop consuming), abandoned (we stopping going back to the land), irrelevant (dematerialization has nothing to do with recycling), or deeply misguided (China’s attempt to limit family size was a huge mistake). So how did we finally start getting more from less? How did we become post-peak in our use of so many resources? The next three chapters will take up this critical question. CHAPTER 7 What Causes Dematerialization? Markets and Marvels The triumph of the industrial arts will advance the cause of civilization more rapidly than its warmest advocates could have hoped. —Charles Babbage, The Exposition of 1851; or, Views of the Industry, the Science, and the Government of England, 1851 If CRIB strategies aren’t responsible for the large-scale dematerialization of the American economy that has taken place since Earth Day, then what is? How have we got more from less? I believe that four main forces are responsible, and that it’s helpful to think of them as two pairs. In this chapter we’ll look at the first pair, then take up the second in chapter 9. Capitalism and technological progress are the first pair of forces driving dematerialization. This statement will come as a surprise to many, and for good reason. After all, it’s exactly this combination that caused us to massively increase our resource consumption throughout the Industrial Era. As we saw in chapter 3, the ideas of William Jevons and Alfred Marshall point to the distressing conclusion that capitalism and tech progress always lead to more from more: more economic growth, but also more resource consumption. So what changed? How are capitalism and tech progress now getting us more from less? To get answers to these important questions, let’s start by looking at a few recent examples of dematerialization. Fertile Farms America has long been an agricultural juggernaut. In 1982, after more than a decade of steady expansion due in part to rising grain prices, total cropland in the country stood at approximately 380 million acres. Over the next ten years, however, almost all of this increase was reversed. So much acreage was abandoned by farmers and given back to nature that cropland in 1992 was almost back to where it had been almost twenty-five years before. This decline had several causes, including falling grain prices, a severe recession, over-indebted farmers, and increased international competition. A final factor, though, was the ability to get ever-more corn, wheat, soybeans, and other crops from the same acre of land, pound of fertilizer and pesticide, and gallon of water. The material productivity of agriculture in the United States has improved dramatically in recent decades, as we saw in chapter 5. Between 1982 and 2015 over 45 million acres—an amount of cropland equal in size to the state of Washington—was returned to nature. Over the same time potassium, phosphate, and nitrogen (the three main fertilizers) all saw declines in absolute use. Meanwhile, the total tonnage of crops produced in the country increased by more than 35 percent. As impressive as this is, it’s dwarfed by the productivity improvements of American dairy cows. In 1950 we got 117 billion pounds of milk from 22 million cows. In 2015 we got 209 billion pounds from just 9 million animals. The average milk cow’s productivity thus improved by over 330 percent during that time. Thin Cans Tin cans are actually made of steel coated with a thin layer of tin to improve corrosion resistance. They’ve been used since the nineteenth century to store food. Starting in the 1930s, they began also to be used to hold beer and soft drinks.I In 1959 Coors pioneered beer cans made of aluminum, which is much lighter and more corrosion resistant than steel. Royal Crown Cola followed suit for soda five years later. As Vaclav Smil relates, “A decade later steel cans were on the way out, and none of them have been used for beer since 1994 and for soft drinks since 1996.… At 85 g the first aluminum cans were surprisingly heavy; by 1972 the weight of a two-piece can dropped to just below 21 g, by 1988 it was less than 16 g, a decade later it averaged 13.6 g, and by 2011 it was reduced to 12.75 g.” Manufacturers accomplished these reductions by making aluminum cans’ walls thinner, and by making the sides and bottom from a single sheet of metal so that only one comparatively heavy seam was needed (to join the top to the rest of the can). Smil points out that if all beverage cans used in 2010 weighed what they did in 1980, they would have required an extra 580,000 tons of aluminum. And aluminum cans kept getting lighter. In 2012 Ball packaging introduced into the European market a 330 ml can that held 7.5 percent less than the US standard, yet at 9.5 g weighed 25 percent less. Gone Gizmos In 2014 Steve Cichon, a “writer, historian, and retired radio newsman in Buffalo, NY,” paid $3 for a large stack of front sections of the Buffalo News newspaper from the early months of 1991. On the back page of the Saturday, February 16, issue was an ad from the electronics retailer Radio Shack. Cichon noticed something striking about the ad: “There are 15 electronic gimzo type items on this page.… 13 of the 15 you now always have in your pocket.” The “gizmo type items” that had vanished into the iPhone Cichon kept in his pocket included a calculator, camcorder, clock radio, mobile telephone, and tape recorder. While the ad didn’t include a compass, camera, barometer, altimeter, accelerometer, or GPS device, these, too, have vanished into the iPhone and other smartphones, as have countless atlases and compact discs. The success of the iPhone was almost totally unanticipated. A November 2007 cover story in Forbes magazine touted that the Finnish mobile phone maker Nokia had over a billion customers around the world and asked, “Can anyone catch the cell phone king?” Yes. Apple sold more than a billion iPhones within a decade of its June 2007 launch and became the most valuable publicly traded company in history. Nokia, meanwhile, sold its mobile phone business to Microsoft in 2013 for $7.2 billion to get “more combined muscle to truly break through with consumers,” as the Finnish company’s CEO Stephen Elop said at the time of the deal. It didn’t work. Microsoft sold what remained of Nokia’s mobile phone business and brand to a subsidiary of the Taiwanese electronics manufacturer Foxconn for $350 million in May of 2016. Radio Shack filed for bankruptcy in 2015, and again in 2017. From Peak Oil to… Peak Oil In 2007 US coal consumption reached a new high of 1,128 million short tons, over 90 percent of which was burned to generate electricity. Total coal use had increased by more than 35 percent since 1990, and the US Energy Information Administration (the official energy statisticians of the US government) forecast further growth of up to 65 percent by 2030. Also in 2007 the US Government Accountability Office (GAO), a federal agency known as “the congressional watchdog,” published a report with an admirably explanatory title: “Crude Oil: Uncertainty about Future Oil Supply Makes It Important to Develop a Strategy for Addressing a Peak and Decline in Oil Production.” It took seriously the idea of “peak oil,” a phrase coined in 1956 by M. King Hubbert, a geologist working for Shell Oil. As originally conceived, peak oil referred to the maximum amount of oil that we could annually produce for all of humanity’s needs. The first oil wells pumped out the crude oil that was closest to the earth’s surface or otherwise easiest to access. As those wells dried up, we had to drill deeper ones, both on land and at sea. As the world’s economies kept growing, so did total demand for oil, which kept getting harder and harder to obtain. Peak oil captured the idea that despite our best efforts and ample incentive, we would come to a time after which we would only be able to extract less and less oil year after year from the earth. Most of the estimates summarized in the GAO report found that peak oil would occur no later than 2040. The report did not mention fracking, which in retrospect looks like a serious omission. Fracking is short for “hydraulic fracturing” and is a means of obtaining oil and natural gas from rock formations lying deep underground. It uses a high-pressure fluid to cause fractures in the rock, through which oil and gas can flow and be extracted. The United States and other countries have long been known to have huge reserves of hydrocarbons in deep rock formations, which are often called shales. Companies had been experimenting with fracking to get at them since the middle of the twentieth century, but had made little progress. In 2000 fracking accounted for just 2 percent of US oil production. That figure began to increase quickly right around the time of the GAO report. Not because of any single breakthrough, but instead because the suite of tools and techniques needed for profitable fracking had all improved enough. A gusher of shale oil and gas ensued. Thanks to fracking, US crude oil production almost doubled between 2007 and 2017, when it approached the benchmark of 10 million barrels per day. By September of 2018 America had surpassed Saudi Arabia to become the world’s largest producer of oil. American natural gas production, which had been essentially flat since the mid-1970s, jumped by nearly 43 percent between 2007 and 2017. As a result of the fracking boom the United States has experienced peak coal rather than peak oil. And the peak in coal is not in total annual supply, but instead in demand. Fracking made natural gas cheap enough that it became preferred over coal for much electricity generation. By 2017 total US coal consumption was down 36 percent from its 2007 high point. The phrase peak oil is still around, but, as is the case with coal, it usually no longer refers to supply. As a 2017 Bloomberg headline put it, “Remember Peak Oil? Demand May Top Out Before Supply Does.” Even though the extra supply from fracking has helped push down oil and gas prices, many observers now believe that energy from other sources—the sun, wind, and the nuclei of uranium atoms—is getting cheaper faster and becoming much more widely available. So much so that, as a 2018 article in Fortune about the future of oil hypothesized, “This wouldn’t be just another oil-price cycle, a familiar roller coaster in which every down is followed by an up. It would be the start of a decades-long decline of the Oil Age itself—an uncharted world in which… oil prices might be ‘lower forever.’ ” Analysts at Shell, the company from which the phrase peak oil originated, now estimate that global peak oil demand might come as soon as 2028. Taking Stock of Rolling Stock My friend Bo Cutter started his career in 1968 working for Northwest Industries, a conglomerate that owned the Chicago and North Western Railway. One of his first assignments was to help a team tasked with solving a problem that sounds odd to modern ears: figuring out where CNW’s railcars were. These cars are massive metal assemblies, each weighing thirty tons or more. In the late 1960s CNW owned thousands of them, representing a huge commitment of both material and money. Across the railroad industry, the rule of thumb then was that about 5 percent of a company’s railcars moved on any given day. This was not because the other 95 percent needed to rest. It was because their owners didn’t know where they were. CNW owned thousands of miles of track in places as far from Chicago as North Dakota and Wyoming. Its rolling stock (as locomotives and railcars are called) could also travel outside the company’s network on tracks owned by other railroads. So these assets could be almost anywhere in the country. When the railcars weren’t moving, they sat in freight yards. At the time Cutter started his job, freight yards didn’t keep up-to-date records of the idle rolling stock they contained because, in the days before widespread digital computers, sensors, and networks, there was no way to cost-effectively know or communicate the location of each car. So it was impossible for CNW or any other railroad to systematically track its most important inventory, even though doing so would be hugely beneficial to the company’s bottom line. For example, Cutter’s team knew that if they could increase the percentage of cars moving each day from 5 percent to 10 percent, they would need only half as many of them. Even a single percentage point increase in freight-car use would yield major financial benefits. When Cutter started his assignment, CNW and all other railroads employed spotters, who visited yards and watched trains pass, then telegraphed their findings to the head office. Other railroads passed on similar information to collect the demurrage charges they were owed for each CNW car on their tracks and in their yards. Cutter’s team improved on these methods by making them more systematic and efficient. They put in place a better baseline audit of where railcars were, employed more spotters, painted CNW cars differently so they were easier to see, and explored how to make more use of a new tool for businesses: the digital computer. That tool and its kin are now pervasive in the railroad industry. In the early 1990s, for example, companies started putting radio-frequency identification tags on each piece of rolling stock. These tags would be read by trackside sensors, thus automating the work of spotting. At present over 5 million messages about railcar status and location are generated and sent throughout the American railway system every day, and the country’s more than 450 railroads have nearly real-time visibility over all their rolling stock. The Rare Earth Scare In September of 2010 the Japanese government took into custody the captain of a Chinese fishing boat that had collided with Japanese patrol vessels near a group of uninhabited islands in the East China Sea claimed by both countries. China responded by imposing an embargo on shipments of rare earth elements (REE) to the Land of the Rising Sun. Even though Japan relented almost immediately and released the captain, a global panic began. This is because rare earths are “vitamins of chemistry,” as USGS scientist Daniel Cordier puts it. “They help everything perform better, and they have their own unique characteristics, particularly in terms of magnetism, temperature resistance, and resistance to corrosion.” By 2010 China produced well over 90 percent of the world’s REE. Its actions in the wake of the maritime incident convinced many that it could and would take unilateral action to control the flow of these important materials, and panicked buying soon followed (along with its close cousin rampant speculation). A bundle of REE that would have sold for less than $10,000 in early 2010 soared to more than $42,000 by April of 2011. In September of that year the US House of Representatives held a hearing called “China’s Monopoly on Rare Earths: Implications for US Foreign and Security Policy.” China didn’t attain its near monopoly because it possessed anything close to 90 percent of global reserves of REE. In fact, rare earths aren’t rare at all (one, cerium, is about as common in the earth’s crust as copper). However, they’re difficult to extract from ore. Obtaining them requires a great deal of acid and generates tons of salt and crushed rock as by-products. Most other countries didn’t want to bear the environmental burden of this heavy processing and so left the market to China. In the wake of the embargo, this seemed like a bad idea. As Representative Brad Sherman put it during the congressional hearing, “Chinese control over rare earth elements gives them one more argument as to why we should kowtow to China.” But there was never much kowtowing. By the time of the hearing, prices for REE were already in free fall. Why? What happened to the apparently tight Chinese stranglehold over REE? Several factors caused it to ease, including the availability of other supply sources and incomplete maintenance of the embargo. But as public affairs professor Eugene Gholz noted in a 2014 report on the “crisis,” many users of REE simply innovated their way out of the problem. “Companies such as Hitachi Metals [and its subsidiary in North Carolina] that make rare earth magnets found ways to make equivalent magnets using smaller amounts of rare earths in the alloys.… Meanwhile, some users remembered that they did not need the high performance of specialized rare earth magnets; they were merely using them because, at least until the 2010 episode, they were relatively inexpensive and convenient.” Overall, the companies using REE found many inexpensive and convenient alternatives. By the end of 2017 the same bundle of rare earths that had been trading above $42,000 in 2011 was available for about $1,000.What’s Going On? There is no shortage of examples of dematerialization. I chose the ones in this chapter because they illustrate a set of fundamental principles at the intersection of business, economics, innovation, and our impact on our planet. They are: We do want more all the time, but not more resources. Alfred Marshall was right, but William Jevons was wrong. Our wants and desires keep growing, evidently without end, and therefore so do our economies. But our use of the earth’s resources does not. We do want more beverage options, but we don’t want to keep using more aluminum in drink cans. We want to communicate and compute and listen to music, but we don’t want an arsenal of gadgets; we’re happy with a single smartphone. As our population increases, we want more food, but we don’t have any desire to consume more fertilizer or use more land for crops. Jevons was correct at the time he wrote that total British demand for coal was increasing even though steam engines were becoming much more efficient. He was right, in other words, that the price elasticity of demand for coal-supplied power was greater than one in the 1860s. But he was wrong to conclude that this would be permanent. Elasticities of demand can change over time for several reasons, the most fundamental of which is technological change. Coal provides a clear example of this. When fracking made natural gas much cheaper, total demand for coal in the United States went down even though its price decreased. With the help of innovation and new technologies, economic growth in America and other rich countries—growth in all of the wants and needs that we spend money on—has become decoupled from resource consumption. This is a recent development and a profound one. Materials cost money that companies locked in competition would rather not spend. The root of Jevons’s mistake is simple and boring: resources cost money. He realized this, of course. What he didn’t sufficiently realize was how strong the incentive is for a company in a contested market to reduce its spending on resources (or anything else) and so eke out a bit more profit. After all, a penny saved is a penny earned. Monopolists can just pass costs on to their customers, but companies with a lot of competitors can’t. So American farmers who battle with each other (and increasingly with tough rivals in other countries) are eager to cut their spending on land, water, and fertilizer. Beer and soda companies want to minimize their aluminum purchases. Producers of magnets and high-tech gear run away from REE as soon as prices start to spike. In the United States, the 1980 Staggers Act removed government subsidies for freight-hauling railroads, forcing them into competition and cost cutting and making them all the more eager to not have expensive railcars sit idle. Again and again, we see that competition spurs dematerialization. There are multiple paths to dematerialization. As profit-hungry companies seek to use fewer resources, they can go down four main paths. First, they can simply find ways to use less of a given material. This is what happened as beverage companies and the companies that supply them with cans teamed up to use less aluminum. It’s also the story with American farmers, who keep getting bigger harvests while using less land, water, and fertilizer. Magnet makers found ways to use fewer rare earth metals when it looked as if China might cut off their supply. Second, it often becomes possible to substitute one resource for another. Total US coal consumption started to decrease after 2007 because fracking made natural gas more attractive to electricity generators. If nuclear power becomes more popular in the United States (a topic we’ll take up in chapter 15), we could use both less coal and less gas and generate our electricity from a small amount of material indeed. A kilogram of uranium-235 fuel contains approximately 2–3 million times as much energy as the same mass of coal or oil. According to one estimate, the total amount of energy that humans consume each year could be supplied by just seven thousand tons of uranium fuel. Third, companies can use fewer molecules overall by making better use of the materials they already own. Improving CNW’s railcar utilization from 5 percent to 10 percent would mean that the company could cut its stock of these thirty-ton behemoths in half. Companies that own expensive physical assets tend to be fanatics about getting as much use as possible out of them, for clear and compelling financial reasons. For example, the world’s commercial airlines have improved their load factors—essentially the percentage of seats occupied on flights—from 56 percent in 1971 to more than 81 percent in 2018. Finally, some materials get replaced by nothing at all. When a telephone, camcorder, and tape recorder are separate devices, three total microphones are needed. When they all collapse into a smartphone, only one microphone is necessary. That smartphone also uses no audiotapes, videotapes, compact discs, or camera film. The iPhone and its descendants are among the world champions of dematerialization. They use vastly less metal, plastic, glass, and silicon than did the devices they have replaced and don’t need media such as paper, discs, tape, or film. If we use more renewable energy, we’ll be replacing coal, gas, oil, and uranium with photons from the sun (solar power) and the movement of air (wind power) and water (hydroelectric power) on the earth. All three of these types of power are also among dematerialization’s champions, since they use up essentially no resources once they’re up and running. I call these four paths to dematerialization slim, swap, optimize, and evaporate. They’re not mutually exclusive. Companies can and do pursue all four at the same time, and all four are going on all the time in ways both obvious and subtle. Innovation is hard to foresee. Neither the fracking revolution nor the world-changing impact of the iPhone’s introduction were well understood in advance. Both continued to be underestimated even after they occurred. The iPhone was introduced in June of 2007, with no shortage of fanfare from Apple and Steve Jobs. Yet several months later the cover of Forbes was still asking if anyone could catch Nokia. Innovation is not steady and predictable like the orbit of the Moon or the accumulation of interest on a certificate of deposit. It’s instead inherently jumpy, uneven, and random. It’s also combinatorial, as Erik Brynjolfsson and I discussed in our book The Second Machine Age. Most new technologies and other innovations, we argued, are combinations or recombinations of preexisting elements. The iPhone was “just” a cellular telephone plus a bunch of sensors plus a touch screen plus an operating system and population of programs, or apps. All these elements had been around for a while before 2007. It took the vision of Steve Jobs to see what they could become when combined. Fracking was the combination of multiple abilities: to “see” where hydrocarbons were to be found in rock formations deep underground; to pump down pressurized liquid to fracture the rock; to pump up the oil and gas once they were released by the fracturing; and so on. Again, none of these was new. Their effective combination was what changed the world’s energy situation. Erik and I described the set of innovations and technologies available at any time as building blocks that ingenious people could combine and recombine into useful new configurations. These new configurations then serve as more blocks that later innovators can use. Combinatorial innovation is exciting because it’s unpredictable. It’s not easy to foresee when or where powerful new combinations are going to appear, or who’s going to come up with them. But as the number of both building blocks and innovators increases, we should have confidence that more breakthroughs such as fracking and smartphones are ahead. Innovation is highly decentralized and largely uncoordinated, occurring as the result of interactions among complex and interlocking social, technological, and economic systems. So it’s going to keep surprising us. As the Second Machine Age progresses, dematerialization accelerates. Erik and I coined the phrase Second Machine Age to draw a contrast with the Industrial Era, which as we’ve seen transformed the planet by allowing us to overcome the limitations of muscle power. Our current time of great progress with all things related to computing is allowing us to overcome the limitations of our mental power and is transformative in a different way: it’s allowing us to reverse the Industrial Era’s bad habit of taking more and more from the earth every year. Computer-aided design tools help engineers at packaging companies design generations of aluminum cans that keep getting lighter. Fracking took off in part because oil and gas exploration companies learned how to build accurate computer models of the rock formations that lay deep underground—models that predicted where hydrocarbons were to be found. Smartphones took the place of many separate pieces of gear. Because they serve as GPS devices, they’ve also led us to print out many fewer maps and so contributed to our current trend of using less paper. It’s easy to look at generations of computer paper, from 1960s punch cards to the eleven-by-seventeen-inch fanfold paper of the 1980s, and conclude that the Second Machine Age has caused us to chop down ever more trees. The year of peak paper consumption in the United States, however, was 1990. As our devices have become more capable and interconnected, always on and always with us, we’ve sharply turned away from paper. Humanity as a whole probably hit peak paper in 2013. As these examples indicate, computers and their kin help us with all four paths to dematerialization. Hardware, software, and networks let us slim, swap, optimize, and evaporate. I contend that they’re the best tools we’ve ever invented for letting us tread more lightly on our planet. All of these principles are about the combination of technological progress and capitalism, which are the first of the two pairs of forces causing dematerialization. Technology: The Human Interface with the Material World One of my favorite definitions of technology comes from the philosopher Emmanuel Mesthene, who called it “the organization of knowledge for the achievement of practical purposes.” Sometimes that knowledge is crystallized into products such as hammers and iPhones, and sometimes it exists as techniques such as those for fracking or precision agriculture. Like knowledge itself, technologies accumulate. We haven’t forgotten about the lever, the plow, or the steam engine in the Second Machine Age, and we haven’t had to give them up to use cloud computing or drones. Like innovation itself, technologies are combinatorial; most of them are combinations or recombinations of existing things. This implies that the number of potentially powerful new technologies increases over time because the number of available building blocks does. These facts help me understand why we didn’t start to dematerialize sooner. It could simply be that we didn’t have the right technologies, or enough building blocks, to allow large-scale dematerialization. We had technologies that made it feasible and profitable for us to grow by taking more and more from the earth—more and more metals, fuels, water, fertilizers, and so on—but not ones that made it possible to profitably grow while taking less and less. In the Second Machine Age, that has changed. My other preferred definition of technology comes from the great science fiction author Ursula K. Le Guin, who wrote, “Technology is the active human interface with the material world. Its technology is how a society copes with physical reality: how people get and keep and cook food, how they clothe themselves, what their power sources are (animal? human? water? wind? electricity? other?), what they build with and what they build, their medicine—and so on and on. Perhaps very ethereal people aren’t interested in these mundane, bodily matters, but I’m fascinated by them.” So am I, because these “mundane matters” have twice reshaped the world—first during the Industrial Era, when technological progress allowed us to prosper by taking more from the planet, and now in the Second Machine Age, when we’ve finally figured out how to prosper while taking less. Capitalism: Means of Production Capitalism and religion are the two subjects that leave the fewest people on the sidelines. People have very firmly held opinions on both topics, and few change their minds no matter what evidence and arguments are presented to them. Yet despite this clear history of intransigence, many thinkers and writers have tried to bring others around to their point of view on both topics. Most have failed. I’m going to join this long sad parade by arguing in favor of capitalism. Before I do that, though, I want to define what I’m talking about. Even more than is the case with technology, clear definitions are important with capitalism because it’s such a triggering word. As the psychologist Jonathan Haidt has pointed out, some hear it as a synonym for liberation, others for exploitation. But let me put the dictionary before the thesaurus and offer a definition of what capitalism is before suggesting what it’s like. For our purposes, capitalism is a way to come up with goods and services and get them to people. Every society that doesn’t want its people to starve or die of exposure has to accomplish this task; capitalism is simply one approach to doing it. The important features of this approach are: Profit-seeking companies. Under capitalism, most goods and services are produced by for-profit companies rather than nonprofits, the government, or individuals. Companies can be owned by only a few people (such as the partners in a law firm) or a great many (publicly traded companies have shareholders all over the world) and are assumed to last over time; they don’t have a predefined end date. Free market entry and competition. Companies can go after one another’s markets and customers; there are few if any protected monopolies. It might not be legal to completely copy a rival’s patented product, but it’s perfectly legal to try to come up with something better. In economist-speak, markets are contested. Similarly, people can take their skills from one market to another; they’re not tied to a single geography or job. Strong property rights and contract enforcement. Patents are a form of intellectual property. They can be bought and sold just as other kinds of property—from land to houses to cars—can. Laws and courts ensure that none of these kinds of property can be stolen or destroyed, even by large, powerful entities such as billionaires, giant corporations, or the government. Similarly, if a small company and a big one sign a contract to work together, neither party gets to unilaterally walk away from the agreement without fear of getting sued. Absence of central planning, control, and price setting. The government does not decide what goods and services are needed by people, or which companies should be allowed to produce them. No central body decides if there is “enough” volume and variety in smartphones, caffeinated beverages, steel girders, and so on. The prices of these and most other goods and services are allowed to vary based on the balance of supply and demand, rather than being set in advance or adjusted by any central authority. Private ownership of most things. Smartphones, cups of coffee, steel girders, and most other products are owned by the people or companies that bought them. The companies that produced these things are also owned by people. Many shares of Apple, Starbucks, US Steel, and other public companies are held by mutual funds, pension funds, and hedge funds, but all these funds are themselves ultimately owned by people. Most houses, cars, land, gold, Bitcoin, and other assets are also owned by people rather than the government. Voluntary exchange. The phrase most closely associated with capitalism is voluntary exchange. People can’t be forced to buy specific products, take a certain job, or move across the country. Companies don’t have to sell themselves if they don’t want to. They also don’t have to make some products and not others, or stay within specific markets. The Waffle House chain doesn’t have any of its breakfast restaurants in my state of Massachusetts, but that’s not because lawmakers there are keeping it out. The legislature in Boston doesn’t have that power. I want to highlight a couple of things about this definition. First, capitalism is not without oversight. The government has clear roles to play in establishing laws and settling disputes (to say nothing of setting tax rates, controlling the money supply, and doing other things of critical economic importance). As we’ll see in the next two chapters, every sane advocate of capitalism also recognizes that while voluntary exchange and free market entry are great, they don’t create utopia. Some important “market failures” need to be corrected by government action. The second thing I want to point out is that all of today’s rich countries are capitalist, by this definition. This is not to say that all capitalist countries are alike. Denmark, South Korea, and the United States are very different places. They have dissimilar trade policies, tax systems, social safety nets, industrial structures, and so on. But they all have all of the things listed above; they are all inherently capitalist. Denmark’s economy is not planned and controlled out of Copenhagen, people in Korea own their own houses and furniture,III and contracts in America are generally respected and enforced. Today’s poorer countries, in sharp contrast, reliably do not have all of the things listed above. Their governments tend to run such things as airlines and telephone networks that are run by private companies in rich countries. It’s generally much harder to start a company in less affluent countries, so free market entry and competition are constrained. According to the World Bank, in 2017 it took less than six days to start a business in America, Denmark, Singapore, Australia, and Canada, and seventy days or more in Somalia, Brazil, and Cambodia. The world champion of entrepreneurial sclerosis was Venezuela (a country we’ll talk more about in the next chapter), at two hundred and thirty days. In poorer countries, it’s also often not clear who owns what. Things that are taken for granted in the rich world, such as unambiguous land registries and clear title to houses and other property, are problematic in many developing countries. The biggest difference between rich and poor countries might be whether laws are clearly and consistently enforced. Poorer countries don’t lack laws; they often have extensive legal codes. What’s in short supply is justice for all. Officials are corrupt; the elite get special treatment and rarely lose in court; police, regulators, and inspectors can expect bribes; and contested markets, property rights, and voluntary exchange suffer in countless other ways. It’s not that these abuses don’t occur in rich countries, but they occur much, much less often. I’ll make some more points about capitalism in the next chapter. To wrap up this one, I want to emphasize how well technological progress and capitalism work together. Overcoming the Limits A great way to see what happens when capitalism and tech progress combine is to look back at 1972’s The Limits to Growth, which we first came across in chapter 4. It’s a fascinating document for two reasons. First, it’s one of the most Malthusian books written since Malthus. It’s far gloomier than anything Jevons came up with. The team behind The Limits to Growth tried to model the future of the exponentially growing world economy and concluded, “We can thus say with some confidence that, under the assumption of no major change in the present system, population and industrial growth will certainly stop within the [twenty-first] century, at the latest. The system… collapses because of a resource crisis.” Second, The Limits to Growth provided an invaluable service by recording what the known global reserves of important resources were in 1972. “Known global reserves” are the deposits of a resource that can be profitably extracted given the prevailing knowledge and state of technology. The authors of The Limits to Growth included the known reserves of many resources to show how inadequate they were in the face of exponential growth of both output and resource consumption. The authors had little reason to suppose in the early 1970s that either kind of growth would stop on its own. As we saw in chapter 4, resource consumption went up in lockstep with overall economic output all throughout the twentieth century up to Earth Day. Few people expected that to change. The team behind The Limits to Growth certainly didn’t. The most generous estimate of future resource availability included in The Limits to Growth assumed that exponential consumption would continue, and that proven reserves were actually five times greater than commonly assumed. Under these conditions, the team’s computer models showed that the planet would run out of gold within twenty-nine years of 1972; silver within forty-two years; copper and petroleum within fifty; and aluminum within fifty-five. These weren’t accurate predictions. We still have gold and silver, and we still have large reserves of them. In fact, the reserves of both are actually much bigger than in 1972, despite almost half a century of additional consumption. Known global reserves of gold are almost 400 percent larger today than in 1972, and silver reserves are more than 200 percent larger. And it’s probably not too early to say that we’re not going to run out of copper, aluminum, and petroleum as quickly as estimated in The Limits to Growth. Known reserves of all are much larger than they were when the book was published. Known aluminum reserves are almost twenty-five times what they were in the early 1970s. How could these predictions about resource availability, which were taken seriously when they were released, have been so wrong? Because the Limits to Growth team pretty clearly underestimated both dematerialization and the endless search for new reserves. Capitalism and tech progress combine to drive both of these trends—the use of fewer resources and the hunt for more of them—and neither of these two drivers is about to become less powerful. So we’ll continue to innovate our way to greater dematerialization while we keep finding more reserves. The counterintuitive conclusion from this line of reasoning is that resource scarcity isn’t something we need to worry about. The earth is finite, so the total quantity of resources such as gold and petroleum is limited. But the earth is also very, very big—big enough to contain all we need of these and other resources, for as long as we’ll need them. The image of a thinly supplied Spaceship Earth hurtling through the cosmos with us aboard is compelling, but deeply misleading. Our planet has amply supplied us for our journey. Especially since we’re quickly slimming, swapping, optimizing, and evaporating our way to dematerialization. The Second Enlightenment Abraham Lincoln, the only US president to hold a patent,IV had a deep insight about capitalism. He wrote that the patent system “added the fuel of interest to the fire of genius in the discovery and production of new and useful things.” “The fire of genius” is a wonderful label for technological progress. “The fuel of interest” is equally good as a summary of capitalism. They interact in a self-reinforcing and ever-expanding cycle, and they’re now creating a dematerializing world. Innovators come up with new and useful technologies. They then partner with entrepreneurs or become entrepreneurs themselves as James Watt did. A new company is the result. Investors such as steam-engine backer Matthew Boulton often join in to provide the capital needed for growth in its early days. The start-up enters a market and takes on incumbents like the Newcomen steam engine. Customers like the new technology better and are free to choose it. Rivals can’t just copy the new technology because it’s protected by patents. So they either have to license it or come up with innovations themselves. The start-up grows and prospers and eventually becomes the new incumbent. Its success inspires the next round of innovators, entrepreneurs, and investors, who once again take aim at the incumbent by offering something better to their customers. Because of free market entry, the next innovators and start-ups can come from anywhere. And because innovation is such a distributed, dynamic, and unpredictable activity, it often comes from an unexpected place. It’s not necessary to plan this process. In fact, it’s a terrible idea to try to do so. Any central planner will miss many of the actual innovators or actively try to squelch them to protect the status quo of which the planners themselves are a part. This cycle of capitalist, technology-rich “creative destruction” was beautifully described in the middle of the twentieth century by the Austrian economist Joseph Schumpeter. But since the late nineteenth century and the work of Alfred Marshall and William Jevons, we’ve believed that this cycle would cause us to use up more and more of our planet’s resources. This was true throughout the Industrial Era, and especially in the years around Earth Day and the birth of the modern environmental movement. Environmentalists’ urgent cautions about resource use and planetary depletion were born out of an awareness of how powerfully technological progress and capitalism interacted. But then, for the reasons described in this chapter, that interaction changed. Tech progress and capitalism continued to reinforce each other, and to cause economies to get bigger and people to become more prosperous. But instead of also causing greater use of natural resources, they instead sparked dematerialization, something truly new under the sun. The fuel of interest in eliminating costs was added to the fire of the computer revolution, and the world began to dematerialize. The economic historian Joel Mokyr argues that the Industrial Era was made possible by the values of the Enlightenment. This intellectual movement began in the second half of the eighteenth century with many societies in the West embracing what Steven Pinker characterizes as four values: reason, science, humanism, and progress. According to Mokyr, the Enlightenment created a “culture of growth” that let both capitalism and technological progress flourish. I see an interesting inversion taking place now. If the Enlightenment led to the Industrial Era, then the Second Machine Age has led to a Second Enlightenment—a more literal one. We are now lightening our total consumption and treading more lightly on our planet. In America, the United Kingdom, and other rich countries, we are past “peak stuff” and are now using fewer total resources year after year. We’re accomplishing this because of the combination of technological progress and capitalism, which now let us get more from less.

#### Degrowth can’t stop warming—there’s lag between emissions and temperature rise.

Kolbert 17—(staff writer focusing on science news, member of the Bulletin of the Atomic Scientists' Science and Security Board). Kolbert, Elizabeth. 2017. “Can Carbon-Dioxide Removal Save the World?” The New Yorker. November 13, 2017. <https://www.newyorker.com/magazine/2017/11/20/can-carbon-dioxide-removal-save-the-world>.

Carbon dioxide was “discovered,” by a Scottish physician named Joseph Black, in 1754. A decade later, another Scotsman, James Watt, invented a more efficient steam engine, ushering in what is now called the age of industrialization but which future generations may dub the age of emissions. It is likely that by the end of the nineteenth century human activity had raised the average temperature of the earth by a tenth of a degree Celsius (or nearly two-tenths of a degree Fahrenheit). As the world warmed, it started to change, first gradually and then suddenly. By now, the globe is at least one degree Celsius (1.8 degrees Fahrenheit) warmer than it was in Black’s day, and the consequences are becoming ever more apparent. Heat waves are hotter, rainstorms more intense, and droughts drier. The wildfire season is growing longer, and fires, like the ones that recently ravaged Northern California, more numerous. Sea levels are rising, and the rate of rise is accelerating. Higher sea levels exacerbated the damage from Hurricanes Harvey, Irma, and Maria, and higher water temperatures probably also made the storms more ferocious. “Harvey is what climate change looks like,” Eric Holthaus, a meteorologist turned columnist, recently wrote. Meanwhile, still more warming is locked in. There’s so much inertia in the climate system, which is as vast as the earth itself, that the globe has yet to fully adjust to the hundreds of billions of tons of carbon dioxide that have been added to the atmosphere in the past few decades. It’s been calculated that to equilibrate to current CO2 levels the planet still needs to warm by half a degree. And every ten days another billion tons of carbon dioxide are released. Last month, the World Meteorological Organization announced that the concentration of carbon dioxide in the atmosphere jumped by a record amount in 2016. No one can say exactly how warm the world can get before disaster—the inundation of low-lying cities, say, or the collapse of crucial ecosystems, like coral reefs—becomes inevitable. Officially, the threshold is two degrees Celsius (3.6 degrees Fahrenheit) above preindustrial levels. Virtually every nation signed on to this figure at a round of climate negotiations held in Cancún in 2010. Meeting in Paris in 2015, world leaders decided that the two-degree threshold was too high; the stated aim of the climate accord is to hold “the increase in the global average temperature to well below 2°C” and to try to limit it to 1.5 °C. Since the planet has already warmed by one degree and, for all practical purposes, is committed to another half a degree, it would seem impossible to meet the latter goal and nearly impossible to meet the former. And it is nearly impossible, unless the world switches course and instead of just adding CO2 to the atmosphere also starts to remove it. The extent to which the world is counting on negative emissions is documented by the latest report of the Intergovernmental Panel on Climate Change, which was published the year before Paris. To peer into the future, the I.P.C.C. relies on computer models that represent the world’s energy and climate systems as a tangle of equations, and which can be programmed to play out different “scenarios.” Most of the scenarios involve temperature increases of two, three, or even four degrees Celsius—up to just over seven degrees Fahrenheit—by the end of this century. (In a recent paper in the Proceedings of the National Academy of Sciences, two climate scientists—Yangyang Xu, of Texas A. & M., and Veerabhadran Ramanathan, of the Scripps Institution of Oceanography—proposed that warming greater than three degrees Celsius be designated as “catastrophic” and warming greater than five degrees as “unknown??” The “unknown??” designation, they wrote, comes “with the understanding that changes of this magnitude, not experienced in the last 20+ million years, pose existential threats to a majority of the population.”) When the I.P.C.C. went looking for ways to hold the temperature increase under two degrees Celsius, it found the math punishing. Global emissions would have to fall rapidly and dramatically—pretty much down to zero by the middle of this century. (This would entail, among other things, replacing most of the world’s power plants, revamping its agricultural systems, and eliminating gasoline-powered vehicles, all within the next few decades.) Alternatively, humanity could, in effect, go into hock. It could allow CO2 levels temporarily to exceed the two-degree threshold—a situation that’s become known as “overshoot”—and then, via negative emissions, pull the excess CO2 out of the air. The I.P.C.C. considered more than a thousand possible scenarios. Of these, only a hundred and sixteen limit warming to below two degrees, and of these a hundred and eight involve negative emissions. In many below-two-degree scenarios, the quantity of negative emissions called for reaches the same order of magnitude as the “positive” emissions being produced today. “The volumes are outright crazy,” Oliver Geden, the head of the E.U. research division of the German Institute for International and Security Affairs, told me. Lackner said, “I think what the I.P.C.C. really is saying is ‘We tried lots and lots of scenarios, and, of the scenarios which stayed safe, virtually every one needed some magic touch of a negative emissions. If we didn’t do that, we ran into a brick wall.’ ”

#### BUT—growth solves via carbon capture.

Page 19—(BA in administration from University of Canberra, studied economics of climate change at Cambridge as a British Council Chevening Fellow, former energy advisor for the Australian Public Service). Page, Brad. 2019. “Why Carbon Capture Could Be the Game-Changer the World Needs.” World Economic Forum. March 22, 2019. <https://www.weforum.org/agenda/2019/03/why-carbon-capture-could-be-the-game-changer-the-world-needs/>. \*\*\*Added “degrees” for readability\*\*\*

The scale of the challenge is unprecedented. The world economy is set to double in the next 20 years, while we need to cut our emissions by more than half in that time and become net-zero by mid-century. Limiting global warming to 1.5 [degrees]˚C requires monumental action. We need to change the way we live, the way we work, the way we farm and eat, and the way we consume energy. Implementing this enormous shift will require substantial new investments in low-carbon technologies and efficiency. The IPCC SR 15 report finds that if the 1.5˚C goal is to be met, investments in low-carbon energy technology and energy efficiency will need to increase by roughly a factor of five by 2050 compared to 2015 levels. But the sad fact is the world is dangerously off-track. The current trajectory, as defined by the pledges and targets that governments have made under the Paris Agreement, would limit warming to about 3.0 [degrees]°C. Global CO2 concentration hit an all-time high in 2018. This is despite the record renewable generation capacity installed and operating globally, suggesting that renewables - while part of the solution - are not the complete solution. Indeed the IEA finds that of the 38 clean-energy technologies we need to meet our climate targets, only four are currently on track. Energy efficiency improvements have slowed down, and progress on key technologies like carbon capture and storage (CCS) remains stalled. Policymakers need to respond to these challenges with urgency, enabling policies that drive investment and clean-energy deployment in the short-term, while demonstrating sustained commitment to a low-carbon environment for success in the long-term. Growth: Decarbonisation can be a driver for prosperity But what sounds daunting might well be an unprecedented opportunity for economic growth. Former heads of governments and climate leaders agree: Decarbonisation is also the growth story of the 21st century. The New Climate Economy found that bold climate action can deliver $26 trillion in economic benefits through 2030 (compared with business-as-usual), while generating more than 65 million jobs and avoiding more than 700,000 premature deaths from air pollution in 2030. These findings should not go unnoticed, and governments should be looking for ways to capture this potential and translate it into actual economic growth. Technology neutrality: Let’s not discard any solutions We need ambition - but we also need cool heads. If we continue to perceive this challenge along the lines that have divided us for so long — as a tug-of-war, in effect — we will lose as a collective. One of the key technologies that is off-track in the IEA’s clean energy monitor is carbon capture and storage (CCS), a set of technologies that prevents carbon dioxide emissions from entering the atmosphere and safely stores them deep underground in dedicated geological storage. CCS first started to gain recognition in the 2000s as a means of capturing emissions from the dirtiest source of energy: coal-fired generation. This perception, that CCS is about delivering ‘clean coal’, coupled with the fact that its deployment globally has been slower than predicted has hung an albatross around its neck. The truth is that CCS has much wider applications. It remains the only technology that can deliver deep emissions reductions in hard-to-abate industrial sectors such as steel, fertiliser and cement. Decarbonising these sectors is not simply about electrifying them with zero-carbon power; most of these processes require either carbon in their chemistry or high heat input, neither of which electricity is able to provide. As global emissions continue to rise we are likely to overshoot our climate goals, and therefore carbon dioxide will need to be permanently removed from the atmosphere and used or stored. In fact, all four scenarios outlined in the IPCC SR15 report rely on carbon removal, with three of the four scenarios foreseeing significant amounts of carbon capture and storage. CCS can also have a role to play in generating power, as most emissions linked to energy infrastructure are already essentially locked-in. Coal-fired power plants, which account for one-third of energy-related CO2 emissions today, represent more than a third of cumulative locked-in emissions to 2040. Most of these plants are in Asia, where average coal plant is just 11 years old with decades left to operate. Looking ahead, more than 200 GW of coal capacity is under construction globally with 300 new plants to come online in the next few years in India and China alone. CCS is the only technology that can truly decarbonise these facilities. In OECD countries, renewable intermittency poses a real challenge to grid operators. Zero-emission electricity is central to our future but balancing services are likely to continue to be dominated by gas-fired plants for several decades yet. CCS is necessary. High cost is often touted as the reason behind CCS’ failure to scale up. Based on ‘micro’ measurements such as the levelised cost of electricity, power generation that incorporates CCS may appear more expensive compared to other sources. However, modelling by climate organizations such as the IPCC and the UK Committee on Climate Change repeatedly demonstrates that at a ‘macro’ system level - which surely should matter more from a societal point of view - achieving deep decarbonisation would be extremely difficult and costly, if not outright impossible, without CCS. At a micro level, while the cost of CCS could be more than $100 per tonne of CO2, it can also be as low as $20 a tonne for those applications where CO2 removal is an inherent part of the production process, such as in natural gas processing. Within that range, the IEA finds that as much as 450 million tonnes of CO2 can be captured and stored with a commercial incentive as low as $40 per tonne of CO2. Harnessing these low-cost opportunities could provide a solid foundation for scaling up CCS deployment. Technology innovation will also help. In the US, an emissions-free natural gas power plant began test operations in 2018, which has carbon capture built in as part of the combustion cycle aiming to compete with conventional combined cycle generation. If proven in practice, this could be a game-changer. Justice: Investing in a fair transition and new energy economy In the past, vast changes in the economy have led to socioeconomic displacements. A successful energy transition will seek to avoid such displacements through smart policies. Carbon capture can play an integral role in enabling a just transition for workers currently employed in the energy sector. It can also be a catalyst to new energy economies – particularly CCS with hydrogen. Decarbonised hydrogen production by steam methane reforming (SMR)/gasification coupling with CCS has been at scale in commercial practice for decades with industrial applications. Turning to policymakers: What’s next? Government support for climate investments: According to the IEA, 70% of global energy investments are expected to be driven by government decisions - and so how the energy transition will pan out depends on policymakers. Sufficient investment in CCS will not happen without strong and sustained government policy. A value on carbon: Climate policies needs to reflect the externalities created by pollution through placing a value on carbon, like the tax credits in the US or the carbon tax in Norway. A value on carbon creates a business case for investment in CCS. Policy confidence: CCS requires investment in long-lived capital assets, which will not happen without having confidence in predictable and stable policies. We may still have just enough time to save the world from the disastrous effects of climate change – but only if we enact those decarbonisation policies that will enable growth and a just transition. In a technology-neutral playing field, CCS will naturally take a central role as one of the key climate solutions.

#### Warming causes extinction

Dr. Yew-Kwang Ng 19, Winsemius Professor of Economics at Nanyang Technological University, Fellow of the Academy of Social Sciences in Australia and Member of Advisory Board at the Global Priorities Institute at Oxford University, PhD in Economics from Sydney University, “Keynote: Global Extinction and Animal Welfare: Two Priorities for Effective Altruism”, Global Policy, Volume 10, Number 2, May 2019, pp. 258–266

Catastrophic climate change Though by no means certain, CCC causing global extinction is possible due to interrelated factors of non-linearity, cascading effects, positive feedbacks, multiplicative factors, critical thresholds and tipping points (e.g. Barnosky and Hadly, 2016; Belaia et al., 2017; Buldyrev et al., 2010; Grainger, 2017; Hansen and Sato, 2012; IPCC 2014; Kareiva and Carranza, 2018; Osmond and Klausmeier, 2017; Rothman, 2017; Schuur et al., 2015; Sims and Finnoff, 2016; Van Aalst, 2006).7 A possibly imminent tipping point could be in the form of ‘an abrupt ice sheet collapse [that] could cause a rapid sea level rise’ (Baum et al., 2011, p. 399). There are many avenues for positive feedback in global warming, including: • the replacement of an ice sea by a liquid ocean surface from melting reduces the reflection and increases the absorption of sunlight, leading to faster warming; • the drying of forests from warming increases forest fires and the release of more carbon; and • higher ocean temperatures may lead to the release of methane trapped under the ocean floor, producing runaway global warming. Though there are also avenues for negative feedback, the scientific consensus is for an overall net positive feedback (Roe and Baker, 2007). Thus, the Global Challenges Foundation (2017, p. 25) concludes, ‘The world is currently completely unprepared to envisage, and even less deal with, the consequences of CCC’. The threat of sea-level rising from global warming is well known, but there are also other likely and more imminent threats to the survivability of mankind and other living things. For example, Sherwood and Huber (2010) emphasize the adaptability limit to climate change due to heat stress from high environmental wet-bulb temperature. They show that ‘even modest global warming could ... expose large fractions of the [world] population to unprecedented heat stress’ p. 9552 and that with substantial global warming, ‘the area of land rendered uninhabitable by heat stress would dwarf that affected by rising sea level’ p. 9555, making extinction much more likely and the relatively moderate damages estimated by most integrated assessment models unreliably low. While imminent extinction is very unlikely and may not come for a long time even under business as usual, the main point is that we cannot rule it out. Annan and Hargreaves (2011, pp. 434–435) may be right that there is ‘an upper 95 per cent probability limit for S [temperature increase] ... to lie close to 4°C, and certainly well below 6°C’. However, probabilities of 5 per cent, 0.5 per cent, 0.05 per cent or even 0.005 per cent of excessive warming and the resulting extinction probabilities cannot be ruled out and are unacceptable. Even if there is only a 1 per cent probability that there is a time bomb in the airplane, you probably want to change your flight. Extinction of the whole world is more important to avoid by literally a trillion times.

#### Technological growth is sustainable---EKC, larger yields, and renewables sources.

Rune Westergård 18. Entrepreneur, Engineer and Author, founder of the technical consulting company CITEC. 2018. “Real and Imagined Threats.” One Planet Is Enough. Springer International Publishing, pp. 71–80. CrossRef, doi:10.1007/978-3-319-60913-3\_7.

Threatening reports about our ability to create disasters and even exterminate ourselves are not a new idea. A standard example is the British national economist Thomas Malthus in the early 19th century, who predicted that population growth would come to a halt because of starvation. Malthus calculated that the available food in the world couldn’t feed more than one billion people. He extrapolated the development from a still picture of his own time and couldn’t fathom that food production would increase tremendously thanks to new knowledge and technology. Our present food production is sufficient for seven times as many. Malthus didn’t pay attention to the fact that we live in a continuously changing civilisation, and the same kind of miscalculations are still made today. There are people who have even achieved the status of media superstars by presenting various dystopias and catastrophe scenarios. As early as 1968, Professor Paul Erlichs at Stanford University published the bestseller The Population Bomb, where he predicted that an imminent population explosion would result in hundreds of millions of deaths by starvation in the 1970s and 80s. Basically, he made the same mistake as Malthus, i.e. he treated knowledge and technology as if they were static phenomena. The most widely read environment report in the world, State of the World, was a loud whistle-blower when it was first published in the early 1980s. The Swedish version, Tillståndet i världen, was published yearly from 1984 and some years into the 2000s by the Worldwatch Institute Norden; I still have some of the early issues left. This report contains many valuable observations and suggestions, but also several basic analytical mistakes. In other words, it acts as an eye-opener, but it suffers from being tainted by political ideology. Its main weakness is that it doesn’t take the intrinsic driving forces of progress into account. State of the World was translated into most major languages and is, as already mentioned, the world’s most widely read environmental report. It has affected us all, directly or indirectly, through school and media. Even if the Swedish version I refer to was written some years ago, it is still worthy of discussion, firstly because it maintains an appearance of scientific validity, and secondly because it has served as a trendsetter for the general ideology which has been adopted by many later books and reports on the subject at hand. It still lives on as an engraved pattern in our conception of the world. In the report we can, for instance, read the following: A world where human desires and needs are fulfilled without the destruction of natural systems demands an entirely new economic order, founded on the insight that a high consumption level, population growth, and poverty are the powers behind the devastation of the environment. The rich have to reduce their consumption of resources so that the poor can increase their standard of living. The global economy simply works against the attempts to reduce poverty and protect the environment. We stubbornly insist to regard economic growth as synonymous with development, even though it makes the poor even poorer. Even if we up to this point have mainly described the environment revolution in economic terms, it is, in its most fundamental meaning, a social revolution: to change our values. Massive threat scenarios are still presented, for instance in the British scientist Tim Jackson’s book Prosperity Without Growth from 2009, which is one of the most widely read and frequently quoted works in this area. Tim Jackson, who is an economist and professor in sustainable development, explains how we humans are indulging in a ruthless pursuit of new-fangled gadgets in a consumption society running at full speed towards its doom. He also claims that material things in themselves cannot help us to flourish; on the contrary, they may even restrain our welfare. In other words, we cannot build our hopes that the economy, technology or science can help us to escape from the trap of Anthropocene, which has brought us to the brink of an ecological disaster. There are hundreds on books on this theme, and they all agree that the general state of the world is pure misery; everything is getting worse, the resources are being depleted, and that man will soon have destroyed the entire planet. The apparent reason for this, of course, is due to the consumption culture and the present financial system—which exposes man as a greedy, ruthless and ultimately weak creature. This attitude may serve a purpose as an eye-opener. But it is not very credible, and it may even be counterproductive. Of course, we can see a lot of problems ahead of us; but to solve them, we need the correct diagnostics instead of dubious doomsday prophesies. Focus: The Problem Since the focus of attention is so profoundly fixated on the problems in the climate and environmental debate, the progress already made—and the opportunities at hand—are often overshadowed. The example below will help to illustrate this point: In the year 2014, the Nobel Prize in physics was awarded to three scientists who had invented blue light emitting diodes—a technology that has made high-bright and energy-efficient LED lighting possible. As lighting accounts for 20% of the world’s total electrical consumption, this invention has the potential to radically reduce energy consumption and greenhouse gas emissions. In an interview made by the major Swedish daily newspaper Dagens Nyheter, one of the prize winners, Hiroshi Amano, says the following about energy-efficient, inexpensive and high-bright LED lights: “They are now being used all over the world. Even children in the developing countries can use this lighting to read books and study in the evenings. This makes me very very happy”. Shortly after this announcement, the news headlines declared that LED lighting was a threat to the environment. This statement was based on a report showing that LED lighting could be hazardous to flies and moths, which in turn might disturb the eco system. This is a typical example of how progress pessimists and, not least the media, think and act. In this case, they focused on a potential problem associated with LED lighting, and ignored the tremendous possibilities that the new technology offered to dramatically reduce greenhouse gases and thus spare the eco system (not to mention all the other advantages). Books and reports of the kind mentioned above tell us repeatedly about disasters, threats, problems, collapses and famines. On the other hand, they are notoriously silent about the great improvements actually made—the reduction of extreme poverty (not only as a percentage but also in absolute numbers), longer lifespans, dramatic global progress in education and healthcare, etc. The lack of positive media coverage on the environment means that many people believe that too little is being done, which is quite understandable considering the one-sided nature of the information they are presented with. Alarmist reporting almost always reminds me of pirates: they are unreliable and half their vision is blocked by their eye patches. It is vital that the media not only one-sidedly focus on the misery without presenting the progress made and suggesting constructive courses of action. The quality of our decisions in all respects depends on our knowledge, insight and attitude. Real and Imagined Threats Many people are convinced that the climate and environmental problems are growing. It is certainly true that our planet has its limitations, but many of the predictions from alarmist literature have been proven false. In the 1980s, the forest dieback was a frequently discussed subject. To quote the well-known German news magazine Der Spiegel, an “ecological Hiroshima” was imminent. Most experts at the time claimed that a wide-spread forest death seemed unavoidable. Additionally, the general mood of impending doom was augmented by the threat of a nuclear disaster during the cold war. I remember the pessimistic discussions among friends and how frequently the gloomy reports appeared in Swedish and Finnish television. The future of humankind appeared to be depressingly bleak. But the forest dieback never happened. On the contrary, the forest area has been constantly expanding in Europe, even during the entire period when the forest was believed to be dying. Today, only two thirds of the yearly accretion in Europe are cut down, according to the Natural Resource Institute in Finland. There are different opinions as to why the large-scale forest dieback didn’t occur. One theory is that the researchers’ evidence and conclusions had been incomplete and too hasty; the forest was actually never in danger. Others suggest that the emission limitations implemented prevented the disaster. My point is that the environmental catastrophe did not happen. Some other environmental problems, exaggerated or not, that have concerned us during the last decades have also disappeared from the immediate agenda: overpopulation, DDT, the ozone hole, heavy metals, lead poisoning, soot particles, the waste mountain, and the acidification of our lakes. Unfortunately, some environmental problems, like soot particles and waste, still remain in some areas, especially in poorer countries, where there are other, even worse problems that have yet to be resolved. The conclusion is, however, that we and our society in most cases have handled threatening situations quite well. When alarming symptoms are noted, scientists and other experts are summoned, and we act according to their diagnoses. It is no big deal that the diagnoses are sometimes wrong, as long as the side effects are not too severe. The main thing is that we do our best to avoid disasters, and on the whole, humankind has succeeded rather well this far. As individuals, we react very differently to various kinds of threats. The closer and more tangible the threat is, the more violent are the reactions—while distant and invisible symptoms, like the depletion of the ozone layer, concern us less. In the latter cases, we have to trust the scientists’ and later the politicians’ reactions. Does this mean that disasters are avoided thanks to war headlines, threats, and anxiety? I don’t think that this is the most important explanation; rather, it is factual and science-based information that produces effective results. But if exaggerated threat scenarios and reports of misery are needed to inspire the necessary political opinion, acquire research funding and create behavioural changes, we will have to live with that. The most important thing to remember in this context is that the actions shouldn’t cause more harm than the original problem itself. The risk with exaggerated threat and misery reporting is that it may inspire an over-reaction based on misleading diagnoses, or the opposite—a paralysing feeling of helplessness. It is necessary to take threats against the climate and the environment seriously, but not to a degree where our ability to reason and act is blocked by fear or anxiety. Many environmental debaters claim that the fall of the Inca and Roman empires were caused by the same causes that are now threatening our present civilisation—a short-sighted over-exploitation and rape of nature. Easter Island is another popular example. However, in my opinion it is both worthless and irresponsible to judge the world situation of today by copying the outcome of earlier cultural endeavours in history. The inhabitants of the Inca empire and Easter Island didn’t have anything even remotely comparable with the organisations, technology, medicine or general knowledge of today. It would be like comparing a case of appendicitis in the past to a case today. In pre-modern times, it was a fatal condition. In this day and age, it is cured by a simple routine operation. Today, humankind is conscious of the climate changes and other ecological challenges. And we also have the knowledge and resources needed to act. Facts, Propaganda and Hidden Messages During all the years I have followed the development of technology and society, I have repeatedly observed how a mishmash of serious research, political propaganda, and the hidden agendas of individuals have been distributed more or less randomly by the media. There are of course many different kinds of alarmism— everything from well-founded research reports to exaggerated prophesies of doom. It is far from simple to separate the wheat from the chaff. The actions taken against ozone depletion, lead emissions and the toxic chemical, dioxin, are all examples of how research has shown the way to successful results. Today, greenhouse gas emissions top the list of issues deserving our gravest attention, as it is a global phenomenon—just as the depletion of the ozone layer once was. There are also a considerable number of local environmental problems, such as drought, air pollution, forest depletion and overfishing. All of these are real threats that have to be acted upon, even though they are not global. However, I am always disturbed when a single global environmental issue is bundled with an assortment of several local issues, rather like a simplified trademark advertisement for the negative consequences of civilisation. This makes the information abstract and inaccurate, ignoring the fact that different locales require different solutions. Fear and alarmism are natural reactions that once protected us when we were living at the mercy of nature—they are evolutionary relics from our life in the savanna. Today, the same properties can be significant drawbacks. The transition from a primitive, animal-like state to the society we have today must, on the whole, be counted as a great success. But many people regard the same world as over-exploited, depleted, unjust, war-ridden and balancing on the brink of destruction. How can people living in the same epoch have so entirely different views of the world? In the sustainability debate, there is one faction dealing with the natural resources and ecosystems, and another focusing on the redistribution of wealth. There is even a third faction discussing a minimalistic lifestyle; for example, downshifting, with less work and less material welfare. When all these ingredients are mixed without discretion, the result is an anxiety soup that many have choked on. In a situation like that, we cannot expect any constructive initiatives to materialise. Instead, it would be far better to explore, research and discuss each dimension separately. What Is the Real State of the Planet? It is easy to generalise and say that we over-exploit the planet’s resources and pollute the world with our waste. But how many care to examine these statements in detail and ask exactly which resources are over-exploited? • Are fish becoming extinct? It is true that overfishing occurs in many places, which is, of course, unsustainable. However, this is not an unavoidable threat to the world’s total food resources. Fortunately, there are several examples of fish stocks that have either recovered or started to replenish once the fishing effort has been eased. • Is the air being poisoned? Many are convinced that the air we breathe is becoming dirtier all the time. But that isn’t true, at least not in the Western world. From the year 1990, emissions of sulphur dioxide have been reduced by 80%, nitrogen oxides by 44%, volatile organic substances by 55%, and carbon monoxide by 62%. Despite these dramatic improvements, 64% of Europeans believe that pollution is increasing. • Are the forests dying? It is a general belief that the forests in the developed countries are dwindling. But that isn’t true; on the contrary, the wooded areas are expanding. However, the forests are decreasing in the poor countries, where forestry and farming are still major sources of income, as they once were in the industrialised countries. • Are we drowning in waste? There are many who believe that we are surrounded by constantly growing mountains of waste. In the developed countries, the truth is that increasing amounts of waste are being recycled and the landfills are decreasing. • Will there be enough phosphorus? Phosphorus is an important nutrient in farming, extracted from phosphate ore. Many scientists fear that the finite natural resource of phosphate ore will become depleted in the future, which may jeopardise the world’s food supply. But there are already working solutions for this problem, such as by reclaiming phosphorus through digestion residues and sewage sludge. There are also technological solutions for the chemical extraction of phosphorus from polluted water—the remediation of lakes and rainwater by removing phosphorus is already a common procedure. Here we achieve a win-win situation—phosphorus is collected while preventing the eutrophication of lakes. • Will there be enough energy to go around? A common statement is that the earth’s population is too large, and that we consume too much energy with respect to the climate. This is one of those issues where we have to think in terms of symptoms, diagnoses, and medication. The symptoms are there for all to see: climate change. On the other hand, the diagnosis that we consume too much energy is wrong. The correct diagnosis is that we are not using the right technology; i.e. energy efficient power production without harmful emissions. Consequently, the correct statement would be that we consume energy that is produced by technologies that are harmful to the climate. The difference in wording is important. As the first diagnosis is “too high energy consumption”, the remedy will be to use a different medication than a diagnosis based on “the wrong technology”. Alarmist reporting can inspire bad decisions if the statements aren’t systematically reviewed and evaluated. It can also be misguiding to express environmental threats in general terms. Actions must be based on precise specific symptoms with corresponding diagnoses. If the doctor discovers that the patient is lame and suffers from a high fever, it doesn’t help to predict imminent death. Maybe the lameness and the fever have different causes altogether! A successful cure would probably include two different diagnoses with separate medications. Several recent surveys of the general conception of the world have been made— one is Project Ignorance by Gapminder and Novus in Sweden. One of the questions asked was whether CO2 emissions per capita and year had increased or decreased in the world during the last 40 years. The surveyed group was large and representative in order to give a fairly accurate picture of the common opinion. No less than 90% believed that CO2 emissions had increased. The truth is that they haven’t increased at all. It is important that decision makers on all levels learn how to see the wood from the trees. Decisions based on false preconditions can halt technological development, and thus also the development of the economy, welfare, and a healthier environment. The flow of innovations in the climate and environmental areas is accelerating rapidly. This can be seen in the number of improvements that have occurred in recent years, which can be counted in the thousands. Such improvements have to be weighted on the same scale as the problems in this area. That is not to say the problems should be ignored—they need to be acted upon. But they should not be allowed to occupy our brains to the extent that our power to act is paralysed. Is the Notion of Sustainable Technology-Driven Growth Over-Optimistic? The development of a technological society has always been questioned. In the 19th century, critics claimed that the technological revolution would create poverty. In the 1970s, it was generally believed that the forest dieback would cause a disaster. In the 1980s, the acidification of lakes and throwaway mentality of society were regarded as manifestations of the devastating properties of growth and industrialisation. Today, many fear the environmental effects of air travel and the production of electronic devices. There are people who seriously wish to halt economic growth and wind back the clock to the society of the 1960s. They recall this time period as small-scaled and down-to-earth, stress-free and idyllic. But they tend to forget that the refrigerators of that time required 90% more electricity than today, and that our teeth were repaired with mercury fillings instead of plastic. There were no X-ray CT scanners and no medicines against ulcers. In addition, there were many more people living without electricity. There was also more widespread malnutrition, a higher infant mortality, and, in fact, more wars. Cars were fuelled by leaded petrol, and sulphur emissions were 90% higher than today. The acidification of lakes, as well as polluted streams and fields, were serious concerns. Since then, technological innovations have reduced sulphur emissions and removed the lead from car fuel. At any given point in history, there have been critics claiming that this was the time when we had reached the optimal point in the development of the modern society. But we hadn’t, not then and not now. And the more our countries are modernised, the greater our possibilities to care for animals and nature become. In the mid-1800s, the killing of large animals like sperm whales didn’t concern people to any significant degree, despite the cruel hunting methods using harpoons. The benefits of the whale fat, mainly used for lamp oil to facilitate reading in the evenings, overshadowed any empathic impulses. In the 1850s more than 70,000 people were employed by the American whaling industry. There were 900 ships in the world hunting whales, and during one of the most active years, 8000 whales were butchered, which provided more than 300,000 barrels of oil. The oil extracted from the head of the sperm whale, the so-called spermaceti oil, was especially sought-after. It was of very high quality and sold for 1.50 US dollars per litre in today’s monetary value. As a consequence, the number of sperm whales in the world rapidly dwindled. However, when oil drilling started in Pennsylvania in the year 1859, the price of whale oil began to fall. The fast transition to petroleum products for lighting and other applications is considered to have saved the last of the sperm whales. Thus, new technology can both contribute to the protection of threatened animal species and provide the wealth to make it affordable for us to even save predators. Imagine what would happen if we were able to bring back someone from the 19th century and tell them that today we move wolves though the air by helicopter in order to save the species and expand its habitat; our ancestor would probably rather go back to sleep than listen to such apparent stupidity. Pessimism Does not Support a Sustainable Development There is a lot of progress going on in the world today, but not without negative side effects. When improving the world and dealing with the side effects, an optimistic attitude provides us with a much better chance of success than a pessimistic view. The optimist carries a positive inner beacon to follow, while the pessimist is always looking for potential traps and drawbacks. As visions and conceptions of ideas often become self-fulfilling, it isn’t difficult to realise what’s most constructive. All decisions—big or small, conscious or not—are affected and guided by our inner beacon. When solving a problem, such as developing a new product for example, it is necessary to have a conception of a working solution in mind. As a product developer, it is of course necessary to review every minute step in the process and question the choices made. You have to ask yourself if there may be a better material or a smarter design. Strange as it seems, this continuous struggle in the mind of the developer may appear to be a kind of pessimism, as it is all about looking for weaknesses in the imagined solution. It is not dissimilar from the process a doctor follows when selecting a diagnosis and a remedy. You start with certain hypotheses, examine, exclude, test, question and verify until you are satisfied that you have made the correct diagnosis. Then the choice of medication becomes much simpler. It would be fatal if the doctor was pessimistic from the start and worked in the belief that it would be impossible to find a reason for the illness, or a working remedy. This could then be the conclusion that such a doctor would unconsciously try to verify. Would you like to have a doctor like that? The same is true for climate and environmental problems—we need optimists armed with critical thinking to solve them. There are also so-called climate change deniers, who believe that man hasn’t really affected the planet and its ecosystems to any significant degree. Some of them claim that the influence of the sun and other natural phenomena are so enormous that human activities have no bearing on global warming. Perhaps these deniers are so deeply pessimistic that they cannot imagine any possible solutions. For ages, man has harboured a certain distrust of his own species. Throughout history, various religions have emphasised human shortcomings and presented assorted consequential threats. During the last 30 years, such prophesies have increasingly often been introduced by environmental activists and some political groups, whose messages have been significantly supported by the media. The underlying conception of humanity isn’t flattering. The human race is considered to be fundamentally ruthless, greedy, short-sighted and evil. Threats against the climate and much other misery on earth are caused by human failure. However, if we take the time to study the progress that has been made by the human race throughout the ages, we actually get the opposite picture. Can it really be evil, greedy, and short-sighted beings who put their own lives at stake to treat people infected by Ebola or HIV in poor countries? Who are the ones that are continuously reducing the number of starving people on earth? Who are the ones that invent vaccines for the children of the world? Who are the ones that have developed a civilisation where an increasing number of people get educated, and who struggle to reduce the casualties of war? Why blame an entire species for atrocities that are actually committed by a mere fraction? Establishing a firm belief in humankind should be the first step on the road to sustainable development.

#### NETs link turns their impact.

Fred Krupp et al. 19. Nathaniel [Keohane](https://search-proquest-com.libproxy2.usc.edu/indexinglinkhandler/sng/au/Keohane,+Nathaniel/$N?accountid=14749), and Eric Pooley. \*President of Environmental Defense Fund, a United States-based nonprofit environmental advocacy group. \*\*Vice president for international climate at the Environmental Defense Fund. He used to be in academia at Yale University and served in the White House as special assistant to President Barack Obama. \*\*\*Senior Vice President, Strategy & Communications at the Environmental Defense Fund. 4-1-2019. "Less Than Zero: Can Carbon-Removal Technologies Curb Climate Change?" Foreign Affairs. https://search-proquest-com.libproxy2.usc.edu/docview/2186099162/594BA6C689D844ABPQ/13?accountid=14749/. accessed 4-16-2019//JDi

\*GHGs = greenhouse gases

\*NET = negative emissions technology

When it comes to generating support for climate policy, a warranted sense of alarm is only half the battle. And the other half-a shared belief that the problem is solvable-is lagging far behind. The newfound sense of urgency is at risk of being swamped by collective despair. A scant six percent of Americans, according to the Yale study, believe that the world "can and will" effectively address climate change. With carbon dioxide emissions from fossil fuels having risen by an estimated 2.7 percent in 2018 and atmospheric concentrations of carbon dioxide, which will determine the ultimate extent of warming, at their highest level in some three million years, such pessimism may seem justified-especially with a climate change denier in the White House. But it is not too late to solve the global climate crisis. A decade of extraordinary innovation has made the greening of the global economy not only feasible but also likely. The market now favors clean energy: in many U.S. states, it is cheaper to build new renewable energy plants than to run existing coal-fired power plants. By combining solar power with new, efficient batteries, Arizona and other sunny states will soon be able to provide electricity at a lower cost per megawatthour than new, efficient natural gas plants. Local, regional, and federal governments, as well as corporations, are making measurable progress on reducing carbon pollution. Since 2000, 21 countries have reduced their annual greenhouse gas emissions while growing their economies; China is expected to see emissions peak by 2025, five years earlier than it promised as part of the negotiations for the Paris climate agreement in 2015. At the UN climate talks held late last year in Poland, countries agreed on rules for how to report progress on meeting emission-reduction commitments, an important step in implementing the Paris accord. What's more, an entirely new arsenal is emerging in the fight against climate change: negative emission technologies, or nets. Nets are different from conventional approaches to climate mitigation in that they seek not to reduce the amount of greenhouse gases emitted into the atmosphere but to remove carbon dioxide that's already there. These technologies range from the old-fashioned practice of reforestation to high-tech machines that suck carbon out of the sky and store it underground. The window of opportunity to combat climate change has not closed-and with a push from policymakers, nets can keep it propped open for longer. THE HEAT IS ON How much time is left to avoid climate catastrophe? The truth is that it is impossible to answer the question with precision. Scientists know that human activity is warming the planet but still don't fully understand the sensitivity of the climate system to greenhouse gases. Nor do they fully comprehend the link between average global warming and local repercussions. So far, however, most effects of climate change have been faster and more severe than the climate models predicted. The downside risks are enormous; the most recent predictions, ever more dire. The Paris agreement aims to limit the increase in global average temperatures above preindustrial levels to well below two degrees Celsius, and ideally to no more than 1.5 degrees Celsius. Going above those levels of warming would mean more disastrous impacts. Global average temperatures have already risen by about one degree Celsius since 1880, with two-thirds of that increase occurring after 1975. An October 2018 special report by the un's Intergovernmental Panel on Climate Change, a body of leading scientists and policymakers from around the world, found that unless the world implements "rapid and far-reaching" changes to its energy and industrial systems, the earth is likely to reach temperatures of 1.5 degrees Celsius above preindustrial levels sometime between 2030 and 2052. Limiting warming to that level, the ipcc found, would require immediate and dramatic cuts in carbon dioxide: roughly a 45 percent reduction in the next dozen years. Even meeting the less ambitious target of two degrees would require deep cuts in emissions by 2030 and sustained aggressive action far beyond then. The ipcc report also warns that seemingly small global temperature increases can have enormous consequences. For example, the half-degree difference between 1.5 degrees Celsius and two degrees Celsius of total warming could consign twice as many people to water scarcity, put ten million more at risk from rising sea levels, and plunge several hundred million more people into poverty as lower yields of key crops drive hunger across much of the developing world. At two degrees of warming, nearly all of the planet's coral reefs are expected to be lost; at 1.5 degrees, ten to 30 percent could survive. The deeper message of the IPCC report is that there is no risk-free level of climate change. Targets such as 1.5 degrees Celsius or two degrees Celsius are important political markers, but they shouldn't fool anyone into thinking that nature works so precisely. Just as the risks are lower at 1.5 degrees Celsius than at two degrees Celsius, so are they lower at two degrees Celsius than at 2.5 degrees Celsius. Indeed, the latter difference would be far more destructive, since the damages mount exponentially as temperatures rise. To manage the enormous risks of climate change, global emissions of greenhouse gases need to be cut sharply, and as soon as possible. That will require transforming energy, land, transport, and industrial systems so they emit less carbon dioxide. It will also require reducing short-lived climate pollutants such as methane, which stay in the atmosphere for only a fraction of the time that carbon dioxide does but have a disproportionate effect on near-term warming. Yet even that will not be enough. To stabilize the total atmospheric concentration of carbon dioxide and other greenhouse gases [GHGs], the world will have to reach net negative emissions-that is, taking more greenhouse gases out of the atmosphere than are being pumped into it. Achieving that through emission reductions alone will be extremely difficult, since some emissions, such as of methane and nitrous oxide from agriculture, are nearly impossible to eliminate. Countering the emissions that are hardest to abate, and bring concentrations down to safer levels, requires technologies that actually remove carbon dioxide from the atmosphere. That's where nets come in-not as a substitute for aggressive efforts to reduce greenhouse gas emissions but as a complement. By deploying technology that removes existing carbon dioxide from the atmosphere, while accelerating cuts in emissions, the world can boost its chances of keeping warming below two degrees and reduce the risk of catastrophe. Scientists and activists have tended to regard these technologies as a fallback option, to be held in reserve in case other efforts fail. Many fear that jumping ahead to carbon dioxide removal will distract from the critical need to cut pollution. But the world no longer has the luxury of waiting for emission-reduction strategies to do the job alone. Far from being a Plan B, nets must be a critical part of Plan A. What's more, embracing nets sooner rather than later makes economic sense. Because the marginal costs of emission reductions rise as more emissions are cut, it will be cheaper to deploy nets at the same time as emission-reduction technologies rather than waiting to exhaust those options first. The wider the solution set, the lower the costs. And the lower the costs, the easier it is to raise ambitions and garner the necessary political support. THE FUTURE IS NOW Even though removing carbon dioxide from the atmosphere may sound like the stuff of science fiction, there are already nets that could be deployed at scale today, according to a seminal report released by the National Academies of Sciences, Engineering, and Medicine in October 2018. One category involves taking advantage of carbon sinks-the earth's forests and agricultural soils, which have soaked up more carbon dioxide since the Industrial Revolution than has been released from burning petroleum. To date, the growth of carbon sinks has been inadvertent: in the United States, for example, as agriculture shifted from the rocky soils of the Northeast to the fertile Midwest, forests reclaimed abandoned farmland, breathing in carbon dioxide in the process. But this natural process can be improved through better forest management-letting trees grow longer before they are harvested and helping degraded forests grow back more quickly. The large-scale planting of trees in suitable locations around the world could increase carbon sinks further, a process that must go hand in hand with efforts to curb tropical deforestation and thereby continue to contain the vast amounts of carbon already stored in the earth's rainforests. Farmland provides additional potential for negative emissions. Around the world, conventional agricultural practices have reduced the amount of carbon in soils, decreasing their fertility in the process. Smarter approaches can reverse the process. Small and large landholders alike could add agricultural waste to soil, maximize the time that the soil is covered by living plants or mulch, and reduce tilling, which releases carbon dioxide. All these steps would decrease the amount of carbon that is lost from soil and increase the amount of carbon that is stored in it. The most technologically sophisticated net available in the near term is known as "bioenergy with carbon capture and storage," or BECCS. It is also the riskiest. Broadly defined, beccs involves burning or fermenting biomass, such as trees or crops, to generate electricity or make liquid fuel; capturing the carbon dioxide produced in the process; and sequestering it underground. It is considered a negative emission technology, and not a zero emission technology, because growing the biomass used in the process removes carbon from the atmosphere. What makes BECCS so exciting is its potential to remove significantly more carbon from the atmosphere than other approaches do. But it also brings challenges. For one, it is expensive: electricity generated from beccs could cost twice as much as that generated with natural gas, because biomass is an inefficient fuel source and capturing and sequestering carbon dioxide is costly. The technology would also require careful monitoring to ensure that the carbon dioxide pumped underground stays there and clear rules for legal liability in the event of leaks. But the fact that private companies have been successfully injecting carbon dioxide into depleted oil and gas reservoirs for decades offers good evidence that permanent storage is possible on a large scale. More worrying are the additional climate risks that BECCS poses. If BECCS drives demand for biomass and more of the carbon that is stored in the forest ecosystem is released as a result, it could end up raising the level of carbon in the atmosphere rather than reducing it. Another concern is competition for land: converting farms or forests to grow energy crops, something that the large-scale use of BEccs might require, could drive up the cost of food, reduce agricultural production, and threaten scarce habitats. These problems could be mitigated by using only biomass waste, such as residues from logging and agriculture, but that would reduce the potential scale. Although BEccs deserves consideration as part of the arsenal, these risks mean that its contribution will likely end up being smaller than some proponents claim. Taking all these land-based nets together, and factoring in the considerable economic, practical, and behavioral hurdles to bringing them to scale, the National Academies report concludes that by midcentury, nets could remove as much as five billion tons of carbon dioxide from the atmosphere annually. Given the significant risks involved, that estimate is probably too bullish. Even if it were not, that's still only half of the ten billion tons of carbon dioxide that will likely need to be removed each year to zero out the remaining greenhouse gas emissions, even with aggressive cuts. CLOSING THE GAP Removing from the atmosphere the balance of the carbon dioxide necessary will require perfecting technologies currently in development. Two deserve particular mention; both are full of promise, although neither is ready for widespread use. The first is called "direct air capture"- essentially, sucking carbon from the sky. The technology is already being tested in Canada, Iceland, Italy, and Switzerland at pilot plants where massive arrays of fans direct a stream of air toward a special substance that binds with the passing carbon dioxide. The substance is then either heated or forced into a vacuum to release the carbon dioxide, which is compressed and either stored or used as feedstocks for chemicals, fuels, or cement. These technologies are real-albeit prohibitively expensive in their current form. As a recent study led by David Sandalow of Columbia University's Center on Global Energy Policy concludes, taking them to scale means solving a variety of technological challenges to bring down the costs. Above all, these processes are highly energy intensive, so scaling them would require enormous amounts of low-carbon electricity. (A direct-air-capture facility powered by coal-fired electricity, for example, would generate more new carbon dioxide than it would capture.) These obstacles are serious, but the surprising progress of the past decade suggests that they can be overcome in the next one. The second technology, enhanced carbon mineralization, is even further from being realized, but it is full of even more possibility. Geologists have long known that when rock from the earth's mantle (the layer of the earth between its crust and its core) is exposed to the air, it binds with carbon dioxide to form carbon-containing minerals. The massive tectonic collisions that formed the Appalachian Mountains around 460 million years ago, for example, exposed subsurface rock to weathering that resulted in the absorption of substantial amounts of carbon dioxide from the atmosphere. That took tens of millions of years; enhanced carbon mineralization seeks to fast-forward the process. Scientists are exploring two ways to do this. In one approach, rocks would be brought to the surface to bind with carbon from the air. Such natural weathering already occurs in mine tailings, the waste left over from certain mining operations. But mimicking this process on a large scale-by grinding up large quantities of rock containing reactive minerals and bringing it to the earth's surface-would be highly energy intensive and thus costly, roughly on par with direct air capture. Another potential approach is pumping the carbon dioxide underground to meet the rock. As the National Academies report explains, carbon-dioxide-rich fluids injected into basalt or peridotite formations (two kinds of igneous rock that make up much of the earth's mantle) react with the rock, converting the dissolved carbon dioxide into solid carbon-containing minerals. Pilot projects in Iceland and the United States have demonstrated that this is possible. There is also evidence for how this could work in the natural world. Peridotite usually lies deep inside the earth, but some rock formations around the globe contain pockets of it on the surface. For example, scientists are studying how the surface-level peridotite in Oman's rock formations reacts with the air and absorbs large amounts of carbon. In theory, this approach offers nearly unlimited scale, because suitable rock formations are widespread and readily accessible. It would also be cheap, because it takes advantage of chemical potential energy in the rock instead of costly energy sources. And since the carbon dioxide is converted to solid rock, the effect is permanent, and it carries few of the side effects that other nets could bring. GETTING TO LESS These technologies do not come cheap. The National Academy of Sciences recommends as much as $1 billion annually in U.S. government funding for research on nets. And indeed, such funding should be an urgent priority. But to make these technologies economically viable and scale them rapidly, policymakers will also have to tap into a much more powerful force: the profit motive. Putting a price on carbon emissions creates an economic incentive for entrepreneurs to find cheaper, faster ways to cut pollution. Valuing negative emissions-for example, through an emission-trading system that awards credits for carbon removal or a carbon tax that provides rebates for them-would create an incentive for them to join the hunt for nets. Forty-five countries, along with ten U.S. states, have put in place some mechanism to price carbon. But only a handful of them offer rewards for converting land into forest, managing existing forests better, or increasing the amount of carbon stored in agricultural soils, and none offers incentives for other nets. What's needed is a carbon pricing system that not only charges those who emit carbon but also pays those who remove it. Such a system would provide new revenue streams for landowners who restored forest cover to their land and for farmers and ranchers who increased the amount of carbon stored in their soils. It would also reward the inventors and entrepreneurs who developed new, better technologies to capture carbon from the air and the investors and businesses that took them to scale. Without these incentives, those players will stay on the sidelines. By spurring innovation in lower-cost nets, incentives would also ease the way politically for an ambitious pollution limit-which, ultimately, is necessary for ensuring that the world meets it climate goals. Simply put, humanity's best hope is to promise that the next crop of billionaires will be those who figure out low-cost ways to remove carbon from the sky. The biggest hurdle for such incentives is the lack of a global market for carbon credits. Hope on that front, however, is emerging from an unlikely place: aviation. Currently responsible for roughly two percent of global greenhouse gases, aviation's emissions are expected to triple or quadruple by midcentury in the absence of effective policies to limit them. But in 2016, faced with the prospect that the eu would start capping the emissions of flights landing in and taking off from member states, the un body that governs worldwide air travel, the International Civil Aviation Organization, agreed to cap emissions from international flights at 2020 levels. The airline industry supported the agreement, hoping to avoid the messy regulatory patchwork that might result if the eu went ahead and states beyond the eu followed suit with their own approaches. The resulting program, called the Carbon Offsetting and Reduction Scheme for International Aviation (corsia), requires all airlines to start reporting emissions this year, and it will begin enforcing a cap in 2021. Once in full swing, at least 100 countries are expected to participate, covering at least three-quarters of the forecast increase in international aviation emissions. Airlines flying between participating countries will have two ways to comply: they can lower their emissions (for example, by burning less fuel or switching to alternative fuels), or they can buy emission-reduction credits from companies. Because the technologies for reducing airline emissions at scale are still a long way off, the industry will mostly choose the second option, relying on carbon credits from reductions in other sectors. It is estimated that over the first 15 years of corsia, demand for these credits will reach between 2.5 billion and 3.0 billion tons-roughly equal to the annual greenhouse gas emissions from the U.S. power and manufacturing sectors. With this new option to sell emission-reduction credits to airlines, there is a good possibility that a pot of gold will await companies that cut or offset their carbon emissions. In short, corsia could catalyze a global carbon market that drives investment in low-carbon fuels and technologies-including nets. To realize its promise, corsia must be implemented properly, and there are powerful forces working to see that it is not. Some countries, including ones negotiating on behalf of their state-owned companies, are trying to rig the system by allowing credits from projects that do not produce legitimate carbon reductions, such as Brazil's effort to allow the sale of credits from huge hydroelectric dams in the Amazon that have already been built and paid for (and thus do not represent new reductions). Allowing such credits into the system could crowd out potential rewards for genuine reductions. But there are also powerful, sometimes unexpected allies who stand to gain from a global carbon market that works. For example, some airlines are motivated to act out of a fear that millennials, concerned about their carbon footprint, may eventually begin to shun air travel. The new regulations, by creating demand for emission reductions and spurring investment in nets to produce jet fuel, could be the industry's best hope of protecting its reputation-and a critical step toward a broader global carbon market that moves nets from promising pilot projects to a gamechanging reality. Skeptics say that nets are too speculative and a possibility only, perhaps, in the distant future. It is true that these innovations are not fully understood and that not all of them will pan out. But no group of scholars and practitioners, no matter how expert, can determine exactly which technologies should be deployed and when. It is impossible to predict what future innovations will look like, but that shouldn't stop the world from pursuing them, especially when the threat is so grave. The fact remains that many nets are ready to be deployed at scale today, and they might make the difference between limiting warming to two degrees and failing to do so. Ultimately, climate change will be stopped by creating economic incentives that unleash the innovation of the private sector-not by waiting for the perfect technology to arrive ready-made, maybe when it's already too late. No one is saying that achieving all of this will be easy, but the road to climate stability has never been that. Hard does not mean impossible, however, and the transformative power of human ingenuity offers an endless source of hope.

#### Alt causes transition wars---links especially hard to the thesis that people are hardwired.

Lee Harris 3. Analyst – Hoover Institution. 2003. “The Intellectual Origins of America-Bashing.” Hoover Instituion. Policy Review. http://www.hoover.org/publications/policyreview/3458371.html.

This is the immiserization thesis of Marx. And it is central to revolutionary Marxism, since if capitalism produces no widespread misery, then it also produces no fatal internal contradiction: If everyone is getting better off through capitalism, who will dream of struggling to overthrow it? Only genuine misery on the part of the workers would be sufficient to overturn the whole apparatus of the capitalist state, simply because, as Marx insisted, the capitalist class could not be realistically expected to relinquish control of the state apparatus and, with it, the monopoly of force. In this, Marx was absolutely correct. No capitalist society has ever willingly liquidated itself, and it is utopian to think that any ever will. Therefore, in order to achieve the goal of socialism, nothing short of a complete revolution would do; and this means, in point of fact, a full-fledged civil war not just within one society, but across the globe. Without this catastrophic upheaval, capitalism would remain completely in control of the social order and all socialist schemes would be reduced to pipe dreams.

#### Cap is the only ethical system supported by empirics.

The Economist 16. 10-1-2016. “Why they’re wrong.” Economist. <http://www.economist.com/news/leaders/21707926-globalisations-critics-say-it-benefits-only-elite-fact-less-open-world-would-hurt>.

The backlash against trade is just one symptom of a pervasive anxiety about the effects of open economies. Britain’s Brexit vote reflected concerns about the impact of unfettered migration on public services, jobs and culture. Big businesses are slammed for using foreign boltholes to dodge taxes. Such critiques contain some truth: more must be done to help those who lose out from openness. But there is a world of difference between improving globalisation and reversing it. The idea that globalisation is a scam that benefits only corporations and the rich could scarcely be more wrong. The real pro-poor policy Exhibit A is the vast improvement in global living standards in the decades after the second world war, which was underpinned by an explosion in world trade. Exports of goods rose from 8% of world GDP in 1950 to almost 20% a half-century later. Export-led growth and foreign investment have dragged hundreds of millions out of poverty in China, and transformed economies from Ireland to South Korea. Plainly, Western voters are not much comforted by this extraordinary transformation in the fortunes of emerging markets. But at home, too, the overall benefits of free trade are unarguable. Exporting firms are more productive and pay higher wages than those that serve only the domestic market. Half of America’s exports go to countries with which it has a free-trade deal, even though their economies account for less than a tenth of global GDP. Protectionism, by contrast, hurts consumers and does little for workers. The worst-off benefit far more from trade than the rich. A study of 40 countries found that the richest consumers would lose 28 [percent] of their purchasing power if cross-border trade ended; but those in the bottom tenth would lose 63 [percent]. The annual cost to American consumers of switching to non-Chinese tyres after Barack Obama slapped on anti-dumping tariffs in 2009 was around $1.1 billion, according to the Peterson Institute for International Economics. That amounts to over $900,000 for each of the 1,200 jobs that were “saved”. Openness delivers other benefits. Migrants improve not just their own lives but the economies of host countries: European immigrants who arrived in Britain since 2000 have been net contributors to the exchequer, adding more than £20 billion ($34 billion) to the public finances between 2001 and 2011. Foreign direct investment delivers competition, technology, management know-how and jobs, which is why China’s overly cautious moves to encourage FDI disappoint (see article). What have you done for me lately? None of this is to deny that globalisation has its flaws. Since the 1840s advocates of free trade have known that, though the great majority benefit, some lose out. Too little has been done to help these people. Perhaps a fifth of the 6m or so net job losses in American manufacturing between 1999 and 2011 stemmed from Chinese competition; many of those who lost jobs did not find new ones. With hindsight, politicians in Britain were too blithe about the pressures that migration from new EU member states in eastern Europe brought to bear on public services. And although there are no street protests about the speed and fickleness in the tides of short-term capital, its ebb and flow across borders have often proved damaging, not least in the euro zone’s debt-ridden countries. As our special report this week argues, more must be done to tackle these downsides. America spends a paltry 0.1% of its GDP, one-sixth of the rich-country average, on policies to retrain workers and help them find new jobs. In this context, it is lamentable that neither Mr Trump nor Mrs Clinton offers policies to help those whose jobs have been affected by trade or cheaper technology. On migration, it makes sense to follow the example of Denmark and link local-government revenues to the number of incomers, so that strains on schools, hospitals and housing can be eased. Many see the rules that bind signatories to trade pacts as an affront to democracy. But there are ways that shared rules can enhance national autonomy. Harmonising norms on how multinational firms are taxed would give countries greater command over their public finances. A co-ordinated approach to curbing volatile capital flows would restore mastery over national monetary policy. These are the sensible responses to the peddlers of protectionism and nativism. The worst answer would be for countries to turn their backs on globalisation. The case for openness remains much the same as it did when this newspaper was founded to support the repeal of the Corn Laws. There are more—and more varied—opportunities in open economies than in closed ones. And, in general, greater opportunity makes people better off. Since the 1840s, free-traders have believed that closed economies favour the powerful and hurt the labouring classes. They were right then. They are right now.

#### Transition fails—growth bias overwhelms, authoritarian fill-in, and 2008 proves.

Burch-Hansen 18—(Department of Business and Politics, Copenhagen Business School). Hubert Buch-Hansen. “The Prerequisites for a Degrowth Paradigm Shift: Insights from Critical Political Economy,” Ecological Economics, Volume 146, April 2018, pp. 157-163.

Political projects do not become hegemonic just because they embody good ideas. For a project to become hegemonic, (organic) intellectuals first need to develop the project and a constellation of social forces with sufficient power and resources to implement it then needs to find it appealing and struggle for it. In this context, it is worth noting that degrowth, as a social movement, has been gaining momentum for some time, not least in Southern Europe. Countless grassroots' initiatives (e.g., D'Alisa et al., 2013) are the most visible manifestations that degrowth is on the rise. Intellectuals – including founders of ecological economics such as Nicholas Georgescu-Roegen and Herman Daly, and more recently degrowth scholars such as Serge Latouche and Giorgos Kallis – have played a major role in developing and disseminating the ideas underpinning the project. A growing interest in degrowth in academia, as well as well-attended biennial international degrowth conferences, also indicate that an increasing number of people embrace such ideas. Still, the degrowth project is nowhere near enjoying the degree and type of support it needs if its policies are to be implemented through democratic processes. The number of political parties, labour unions, business associations and international organisations that have so far embraced degrowth is modest to say the least. Economic and political elites, including social democratic parties and most of the trade union movement, are united in the belief that economic growth is necessary and desirable. This consensus finds support in the prevailing type of economic theory and underpins the main contenders in the neoliberal project, such as centre-left and nationalist projects. In spite of the world's multidimensional crisis, a pro-growth discourse in other words continues to be hegemonic: it is widely considered a matter of common sense that continued economic growth is required. It is also noteworthy that economic and political elites, to a large extent, continue to support the neoliberal project, even in the face of its evident shortcomings. Indeed, the 2008 financial crisis did not result in the weakening of transnational financial capital that could have paved the way for a paradigm shift. Instead of coming to an end, neoliberal capitalism has arguably entered a more authoritarian phase (Bruff, 2014). The main reason the power of the pre-crisis coalition remains intact is that governments stepped in and saved the dominant fraction by means of massive bailouts. It is a foregone conclusion that this fraction and the wider coalition behind the neoliberal paradigm (transnational industrial capital, the middle classes and segments of organized labour) will consider the degrowth paradigm unattractive and that such social forces will vehemently oppose the implementation of degrowth policies (see also Rees, 2014: 97). While degrowth advocates envision a future in which market forces play a less prominent role than they do today, degrowth is not an anti-market project. As such, it can attract support from certain types of market actors. In particular, it is worth noting that social enterprises, such as cooperatives (Restakis, 2010), play a major role in the degrowth vision. Such enterprises are defined by being ‘organisations involved at least to some extent in the market, with a clear social, cultural and/or environmental purpose, rooted in and serving primarily the local community and ideally having a local and/or democratic ownership structure’ (Johanisova et al., 2013: 11). Social enterprises currently exist at the margins of a system, in which the dominant type of business entity is profit-oriented, shareholder-owned corporations. The further dissemination of social enterprises, which is crucial to the transitions to degrowth societies, is – in many cases – blocked or delayed as a result of the centrifugal forces of global competition (Wigger and Buch-Hansen, 2013). Overall, social enterprises thus (still) constitute a social force with modest power. Ougaard (2016: 467) notes that one of the major dividing lines in the contemporary transnational capitalist class is between capitalists who have a material interest in the carbon-based economy and capitalists who have a material interest in decarbonisation. The latter group, for instance, includes manufacturers of equipment for the production of renewable energy (ibid.: 467). As mentioned above, degrowth advocates have singled out renewable energy as one of the sectors that needs to grow in the future. As such, it seems likely that the owners of national and transnational companies operating in this sector would be more positively inclined towards the degrowth project than would capitalists with a stake in the carbon-based economy. Still, the prospect of the “green sector” emerging as a driving force behind degrowth currently appears meagre. Being under the control of transnational capital (Harris, 2010), such companies generally embrace the “green growth” discourse, which ‘is deeply embedded in neoliberal capitalism’ and indeed serves to adjust this form of capitalism ‘to crises arising from contradictions within itself’ (Wanner, 2015: 23). In addition to support from the social forces engendered by the production process, a political project ‘also needs the political ability to mobilize majorities in parliamentary democracies, and a sufficient measure of at least passive consent’ (van Apeldoorn and Overbeek, 2012: 5–6) if it is to become hegemonic. As mentioned, degrowth enjoys little support in parliaments, and certainly the pro-growth discourse is hegemonic among parties in government.5 With capital accumulation being the most important driving force in capitalist societies, political decision-makers are generally eager to create conditions conducive to production and the accumulation of capital (Lindblom, 1977: 172). Capitalist states and international organisations are thus “programmed” to facilitate capital accumulation, and do as such constitute a strategically selective terrain that works to the disadvantage of the degrowth project. The main advocates of the degrowth project are grassroots, small fractions of left-wing parties and labour unions as well as academics and other citizens who are concerned about social injustice and the environmentally unsustainable nature of societies in the rich parts of the world. The project is thus ideationally driven in the sense that support for it is not so much rooted in the material circumstances or short-term self-interests of specific groups or classes as it is rooted in the conviction that degrowth is necessary if current and future generations across the globe are to be able to lead a good life. While there is no shortage of enthusiasts and creative ideas in the degrowth movement, it has only modest resources compared to other political projects. To put it bluntly, the advocates of degrowth do not possess instruments that enable them to force political decision-makers to listen to – let alone comply with – their views. As such, they are in a weaker position than the labour union movement was in its heyday, and they are in a far weaker position than the owners and managers of large corporations are today (on the structural power of transnational corporations, see Gill and Law, 1989). 6. Consent It is also safe to say that degrowth enjoys no “passive consent” from the majority of the population. For the time being, degrowth remains unknown to most people. Yet, if it were to become generally known, most people would probably not find the vision of a smaller economic system appealing. This is not just a matter of degrowth being ‘a missile word that backfires’ because it triggers negative feelings in people when they first hear it (Drews and Antal, 2016). It is also a matter of the actual content of the degrowth project. Two issues in particular should be mentioned in this context. First, for many, the anti-capitalist sentiments embodied in the degrowth project will inevitably be a difficult pill to swallow. Today, the vast majority of people find it almost impossible to conceive of a world without capitalism. There is a ‘widespread sense that not only is capitalism the only viable political and economic system, but also that it is now impossible to even imagine a coherent alternative to it’ (Fisher, 2009: 2). As Jameson (2003) famously observed, it is, in a sense, easier to imagine the end of the world than it is to imagine the end of capitalism. However, not only is degrowth – like other anti-capitalist projects – up against the challenge that most people consider capitalism the only system that can function; it is also up against the additional challenge that it speaks against economic growth in a world where the desirability of growth is considered common sense. Second, degrowth is incompatible with the lifestyles to which many of us who live in rich countries have become accustomed. Economic growth in the Western world is, to no small extent, premised on the existence of consumer societies and an associated consumer culture most of us find it difficult to completely escape. In this culture, social status, happiness, well-being and identity are linked to consumption (Jackson, 2009). Indeed, it is widely considered a natural right to lead an environmentally unsustainable lifestyle – a lifestyle that includes car ownership, air travel, spacious accommodations, fashionable clothing, an omnivorous diet and all sorts of electronic gadgets. This Western norm of consumption has increasingly been exported to other parts of the world, the result being that never before have so many people taken part in consumption patterns that used to be reserved for elites (Koch, 2012). If degrowth were to be institutionalised, many citizens in the rich countries would have to adapt to a materially lower standard of living. That is, while the basic needs of the global population can be met in a non-growing economy, not all wants and preferences can be fulfilled (Koch et al., 2017). Undoubtedly, many people in the rich countries would experience various limitations on their consumption opportunities as a violent encroachment on their personal freedom. Indeed, whereas many recognize that contemporary consumer societies are environmentally unsustainable, fewer are prepared to actually change their own lifestyles to reverse/address this.

#### Decline causes nuke terror—defense ignores collapsed security infrastructure.

Rothkopf 9—(Visiting Scholar, Carnegie Endowment for International Peace, Testimony before the House Armed Services Committee). David Rothkopf. 3/11/9, http://carnegieendowment.org/files/0311\_testimony\_rothkopf.pdf

The Exacerbation of Critical Threats Associated with Proliferation of Weapons of Mass Destruction The proliferation of weapons of mass destruction remains the greatest threat to global security that we face. While there is no direct linkage between the economic crisis and the technical aspects of proliferation per se, the crisis could well lead to a recruitment bonanza for anti-U.S. non-state actors, greater tensions with hostile nations seeking to lash out at the U.S. as a means of distracting from economic despair at home, reduced resources for sufficient security to prevent proliferation, and the creation of more failed states which become homes to terrorists and criminal organizations that can play a role in WMD proliferation due to their lack of functioning institutional structures.

#### Extinction.

Roth 17—(Nickolas Roth & Matthew Bunn, research associate at the Belfer Center’s Project on Managing the Atom at Harvard University, professor of practice at the Harvard Kennedy School). 9/28/17, “The effects of a single terrorist nuclear bomb”, <https://thebulletin.org/2017/09/the-effects-of-a-single-terrorist-nuclear-bomb/>

And what standards of international order and law would still hold sway? The country attacked might well lash out militarily at whatever countries it thought might bear a portion of responsibility. (A terrifying description of the kinds of discussions that might occur appeared in Brian Jenkins’ book, Will Terrorists Go Nuclear?) With the nuclear threshold already crossed in this scenario—at least by terrorists—it is conceivable that some of the resulting conflicts might escalate to nuclear use. International politics could become more brutish and violent, with powerful states taking unilateral action, by force if necessary, in an effort to ensure their security. After 9/11, the United States led the invasions of two sovereign nations, in wars that have since cost hundreds of thousands of lives and trillions of dollars, while plunging a region into chaos. Would the reaction after a far more devastating nuclear attack be any less? In particular, the idea that each state can decide for itself how much security to provide for nuclear weapons and their essential ingredients would likely be seen as totally unacceptable following such an attack. Powerful states would likely demand that others surrender their nuclear material or accept foreign troops (or other imposed security measures) to guard it. That could well be the first step toward a more profound transformation of the international system. After such a catastrophe, major powers may feel compelled to more freely engage in preventive war, seizing territories they worry might otherwise be terrorist safe havens, and taking other steps they see as brutal but necessary to preserve their security. For this reason, foreign policy analyst Stephen Krasner has argued that “conventional rules of sovereignty would be abandoned overnight.” Confidence in both the national security institutions of the country attacked and international institutions such as the International Atomic Energy Agency and the United Nations, which had so manifestly failed to prevent the devastation, might erode. The effect on nuclear weapons policies is hard to predict: One can imagine new nuclear terror driving a new push for nuclear disarmament, but one could also imagine states feeling more certain than ever before that they needed nuclear weapons.

#### Growth causes transhumanism.

Fuller 17—(Auguste Comte Chair in Social Epistemology in the Department of Sociology at the University of Warwick). Fuller, Steve. 2017. “Transhumanism and the Future of Capitalism: The next Meaning of Life.” London School of Economics Business Review. January 30, 2017. https://blogs.lse.ac.uk/businessreview/2017/01/30/transhumanism-and-the-future-of-capitalism-the-next-meaning-of-life/.

Capitalism is not normally seen as an especially ‘humanistic’ ideology. Yet central to the legal innovations that enabled the rise of capitalism in the early modern West was a doctrine of the person as a being who is free to exchange goods and services. In the eighteenth century, this freedom was characterised as an ‘inalienable right’, which is to say, not transferable to another either by choice or under duress. Thus, a strong normative distinction between people and property was institutionalised, which had not existed in slave or feudal societies. The sting of the Marxist critique of capitalism comes from observing that this distinction is not upheld in practice. Instead a supposedly inalienable right of the person becomes a site for exploitation, as asymmetrical power relations in the marketplace reduces human labour to inhuman capital inputs. Transhumanism challenges the sense of humanity’s ontological stability shared by capitalists and socialists – which has rendered exploitation such a normatively charged issue in the modern era. To be sure, over the past 150 years the potential for exploitation has been mitigated by laws that circumscribe and regulate the role of work in life: While one may need to sell one’s labour to make a living, the buyer doesn’t have unconditional control over the seller’s life. In this context, welfare state legislation has operated as a safeguard against the realisation of Marx’s worst fears. However, whatever sense of humanism has been presumed by such policies is being gradually eroded by the information-based mode of production that characterises what Jean-Francois Lyotard originally called the ‘postmodern condition’. In particular, as computers mediate both the work and non-work aspects of life, many of the phenomenological markers that created distance between the ‘worlds’ of work and non-work are rapidly disappearing. An obvious case in point is the idea of ‘working from home’. People who operate this way typically shift back and forth between performing work and non-work activities on screen in an open-ended and relatively unstructured day. Meanwhile, all the data registered in these activities are gathered by information providers (e.g. Google, Facebook, Amazon), who then analyse and consolidate them for resale to private and public sector clients. Is this exploitation? The answer is not so clear. The information providers offer a platform that is free at the point of use, enabling users to produce and consume data indefinitely. Of course, such platforms are the source of both intense frustration and endless satisfaction for users, but the phenomenology of these experiences is not necessarily what one might expect of people in a state of ‘exploitation’. On the contrary, there is reason to think that people increasingly locate ‘meaning’ in their lives in some cyber-projection (‘avatar’) of themselves, notwithstanding the third-party ownership of the platform hosting the cyber-projection. Transhumanism is strongly implicated in this shift in the scope of one’s ‘personhood’. My own sense of identity may be tied to my having begun life as a member of Homo sapiens at a certain time and place. But that is largely a modern narrative convention, which is tied to what John Locke originally dubbed a ‘forensic’ sense of the person, which is enshrined in modern law – namely, the physical source of an action for whose effects the source is then accountable. Of course, there is scope for this individual to both extend and transfer his or her powers. Thus, the modern period has witnessed an expansion in the remit of corporate law and inheritance law. However, transhumanism takes the process of ‘extending’ and ‘transferring’ the powers of the person to a new level. On the one hand, in the case of extension, the person might incorporate genetically or prosthetically, with the intent of conferring new powers on the original physical individual, as opposed to simply merging the interests of that individual with those of other individuals in the sorts of business arrangements we normally call ‘corporations’. On the other hand, in the case of transfer, the person might do more than simply bequeath various assets to already existing individuals and institutions – say, in a will which comes into force upon one’s death. Rather, the person might in his or her own lifetime invest energy and income in support of virtual agents, ‘second lives’, with the effect of turning one’s physical self into a platform for launching the more meaningful cyber-selves. The state of humanity in such a state of transhumanised capitalism – ‘Capitalism 2.0’, if you will – is one of morphological freedom, as transhumanists themselves put it: It is the freedom not only to do what you want but also to be what you want. It is worth observing that this sense of freedom violates a key metaphysical assumption shared by liberals and socialists, namely, that humans are rough natural equals, not in the sense that everyone is naturally the same but that everyone has roughly the same mix of assets and liabilities, which in turn justifies a harmonious division of labour in society. The violation of this assumption implies that whatever problems of social justice relating to material inequality have emerged over the history of capitalism are potentially amplified by transhumanism, as the prospect of morphological freedom explodes stopgap liberal intuitions about the ‘natural equality’ of humans.

#### That solves extinction from disease, space col, and AI.

Sandberg 14—(Faculty of Philosophy, The Future of Humanity Institute & Oxford Martin School, University of Oxford). Sandberg, Anders. 2014. “Ethics of Brain Emulations.” Journal of Experimental & Theoretical Artificial Intelligence 26 (3): 439–57. https://doi.org/10.1080/0952813X.2014.895113.

On the other hand, there at least four major ways emulations might lower the risks of Earth originating intelligence going extinct: First, the existence of non-biological humans would ensure at least partial protection from some threats: there is no biological pandemic that can wipe out software. Of course, it is easy to imagine a digital disaster, for example an outbreak of computer viruses that wipe out the brain emulations. But that threat would not affect the biological humans. By splitting the human species into two, the joint risks are significantly reduced. Clearly, threats to the shared essential infrastructure remain, but the new system is more resilient. Second, brain emulations are ideally suited for colonising space and many other environments where biological humans require extensive life support. Avoiding carrying all eggs in one planetary basket is an obvious strategy for strongly reducing existential risk. Besides existing in a substrate-independent manner where they could be run on computers hardened for local conditions, emulations could be transmitted digitally across interplanetary distances. One of the largest obstacles of space colonisation is the enormous cost in time, energy and reaction mass needed for space travel: emulation technology would reduce this. Third, another set of species risks accrue from the emergence of machine superintelligence. It has been argued that successful artificial intelligence is potentially extremely dangerous because it would have radical potential for self-improvement, yet possibly deeply flawed goals or motivation systems. If intelligence is defined as the ability to achieve one’s goals in general environments, then superintelligent systems would be significantly better than humans at achieving their goals – even at the expense of human goals. Intelligence does not strongly prescribe the nature of goals (especially in systems that might have been given top-level goals by imperfect programmers). Brain emulations get around part of this risk by replacing the de novo machine intelligence with a copy of the relatively well-understood human intelligence. Instead of getting potentially very rapidly upgradeable software minds with non-human motivation systems, we get messy emulations that have human motivations. This slows the ‘hard takeoff’ into superintelligence, and allows existing, well-tested forms of control over behaviour – norms, police, economic incentives, political institutions – to act on the software. This is by no means a guarantee: emulations might prove to be far more upgradeable than we currently expect, motivations might shift from human norms, speed differences and socioeconomial factors may create turbulence, and the development of emulations might also create spin-off artificial intelligence. Fourth, emulations allow exploration of another part of the space of possible minds, which might encompass states of very high value (Bostrom, 2008).

# Not 1NC

## Case

#### Breaking up monopolies tubes the economy and ruins overall efficiencies. Firms like Apple and Amazon offers services for lower costs and dedicate higher investments to R&D --- that’s Portuese

#### Even small shifts ruin biz con AND overall growth.

Sarah Chaney Cambon 21, Reporter on The Wall Street Journal's Economics Team, BA in Business Journalism from the University of North Carolina-Chapel Hill, “Capital-Spending Surge Further Lifts Economic Recovery”, Wall Street Journal, 6/27/2021, https://www.wsj.com/articles/capital-spending-surge-further-lifts-economic-recovery-11624798800

Business investment is emerging as a powerful source of U.S. economic growth that will likely help sustain the recovery.

Companies are ramping up orders for computers, machinery and software as they grow more confident in the outlook.

Nonresidential fixed investment, a proxy for business spending, rose at a seasonally adjusted annual rate of 11.7% in the first quarter, led by growth in software and tech-equipment spending, according to the Commerce Department. Business investment also logged double-digit gains in the third and fourth quarters last year after falling during pandemic-related shutdowns. It is now higher than its pre-pandemic peak.

Orders for nondefense capital goods excluding aircraft, another measure for business investment, are near the highest levels for records tracing back to the 1990s, separate Commerce Department figures show.

“Business investment has really been an important engine powering the U.S. economic recovery,” said Robert Rosener, senior U.S. economist at Morgan Stanley. “In our outlook for the economy, it’s certainly one of the bright spots.”

Consumer spending, which accounts for about two-thirds of economic output, is driving the early stages of the recovery. Americans, flush with savings and government stimulus checks, are spending more on goods and services, which they shunned for much of the pandemic.

Robust capital investment will be key to ensuring that the recovery maintains strength after the spending boost from fiscal stimulus and business reopenings eventually fades, according to some economists.

Rising business investment helps fuel economic output. It also lifts worker productivity, or output per hour. That metric grew at a sluggish pace throughout the last economic expansion but is now showing signs of resurgence.

The recovery in business investment is shaping up to be much stronger than in the years following the 2007-09 recession. “The events especially in late ’08, early ’09 put a lot of businesses really close to the edge,” said Phil Suttle, founder of Suttle Economics. “I think a lot of them said, ‘We’ve just got to be really cautious for a long while.’”

Businesses appear to be less risk-averse now, he said.

After the financial crisis, businesses grew by adding workers, rather than investing in capital. Hiring was more attractive than capital spending because labor was abundant and relatively cheap. Now the supply of workers is tight. Companies are raising pay to lure employees. As a result, many firms have more incentive to grow by investing in capital.

Economists at Morgan Stanley predict that U.S. capital spending will rise to 116% of prerecession levels after three years. By comparison, investment took 10 years to reach those levels once the 2007-09 recession hit.

Company executives are increasingly confident in the economy’s trajectory. The Business Roundtable’s economic-outlook index—a composite of large companies’ plans for hiring and spending, as well as sales projections—increased by nine points in the second quarter to 116, just below 2018’s record high, according to a survey conducted between May 25 and June 9. In the second quarter, the share of companies planning to boost capital investment increased to 59% from 57% in the first.

“We’re seeing really strong reopening demand, and a lot of times capital investment follows that,” said Joe Song, senior U.S. economist at BofA Securities.

Mr. Song added that less uncertainty regarding trade tensions between the U.S. and China should further underpin business confidence and investment. “At the very least, businesses will understand the strategy that the Biden administration is trying to follow and will be able to plan around that,” he said.

#### Extinction is the only filter to evaluate impacts AND space solves terrestrial conflicts

Bates 17 – Jordan, analyst @ Futurist, “In Order to Ensure Our Survival, We Must Become a Multi-Planetary Species,” https://futurism.com/in-order-to-ensure-human-survival-we-must-become-a-multi-planetary-species

When viewed from this vantage point, it seems clear that if we care about fighting for issues that affect the community of sentient life, we must ask ourselves how to ensure that there is a community of sentient life to fight for. And if we believe that the flame of human consciousness is something rare and precious, we must ask ourselves how to ensure that the fire is not extinguished, as it were. One might also here note that colonizing Mars could be the key to solving many of our issues on Earth. Powerful, new technological solutions to previously intractable problems could be developed on Mars or in the process of colonizing it. It’s also possible that becoming multi-planetary will have a unifying/pacifying effect on humanity, helping those on Earth to see themselves as members of a single species that is now advancing out into the cosmos. Don’t get me wrong: I think it is tremendously important for us to address global poverty, the refugee crisis, human trafficking/slavery, industrial farming, various environmental crises, etc. But those issues won’t matter at all if all intelligent life in the biosphere is obliterated. It’s also important that we view those issues, and the present population of sentient beings on Earth, within the context of a timespan of potentially trillions of years, because that’s how long our evolutionary branch could, theoretically, persist. The existence of trillions or quadrillions of potential future intelligent life-forms hinges on our ability to avoid catastrophes that might obliterate intelligent life on Earth. Think of that for a moment: Trillions, quadrillions of potential human and post-human beings will never taste this existence unless we ensure the continuation of our evolutionary branch. We cannot fathom what these beings might become, or what untold wonders they might create, in this universe. If we value each of them even 0.00000000001% as much as we value each sentient being presently existing on Earth, we must admit that our top priority should be to ensure their existence, to ensure that the biological roadshow continues.

#### The magnitude differential is so big that you should literally ignore everything that’s not extinction

GPP 17 Global Priorities Project, Future of Humanity Institute at the University of Oxford, Ministry for Foreign Affairs of Finland, “Existential Risk: Diplomacy and Governance,” Global Priorities Project, 2017, <https://www.fhi.ox.ac.uk/wp-content/uploads/Existential-Risks-2017-01-23.pdf>

1.2. THE ETHICS OF EXISTENTIAL RISK

In his book Reasons and Persons, Oxford philosopher Derek Parfit advanced an influential argument about the importance of avoiding extinction:

I believe that if we destroy mankind, as we now can, this outcome will be much worse than most people think. Compare three outcomes:

(1) Peace.

(2) A nuclear war that kills 99% of the world’s existing population.

(3) A nuclear war that kills 100%.

(2) would be worse than (1), and (3) would be worse than (2). Which is the greater of these two differences? Most people believe that the greater difference is between (1) and (2). I believe that the difference between (2) and (3) is very much greater. ... The Earth will remain habitable for at least another billion years. Civilization began only a few thousand years ago. If we do not destroy mankind, these few thousand years may be only a tiny fraction of the whole of civilized human history. The difference between (2) and (3) may thus be the difference between this tiny fraction and all of the rest of this history. If we compare this possible history to a day, what has occurred so far is only a fraction of a second.65

In this argument, it seems that Parfit is assuming that the survivors of a nuclear war that kills 99% of the population would eventually be able to recover civilisation without long-term effect. As we have seen, this may not be a safe assumption – but for the purposes of this thought experiment, the point stands. What makes existential catastrophes especially bad is that they would “destroy the future,” as another Oxford philosopher, Nick Bostrom, puts it.66 This future could potentially be extremely long and full of flourishing, and would therefore have extremely large value. In standard risk analysis, when working out how to respond to risk, we work out the expected value of risk reduction, by weighing the probability that an action will prevent an adverse event against the severity of the event. Because the value of preventing existential catastrophe is so vast, even a tiny probability of prevention has huge expected value.67

Of course, there is persisting reasonable disagreement about ethics and there are a number of ways one might resist this conclusion.68 Therefore, it would be unjustified to be overconfident in Parfit and Bostrom’s argument.

In some areas, government policy does give significant weight to future generations. For example, in assessing the risks of nuclear waste storage, governments have considered timeframes of thousands, hundreds of thousands, and even a million years.69 Justifications for this policy usually appeal to principles of intergenerational equity according to which future generations ought to get as much protection as current generations.70 Similarly, widely accepted norms of sustainable development require development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs.71

However, when it comes to existential risk, it would seem that we fail to live up to principles of intergenerational equity. Existential catastrophe would not only give future generations less than the current generations; it would give them nothing. Indeed, reducing existential risk plausibly has a quite low cost for us in comparison with the huge expected value it has for future generations. In spite of this, relatively little is done to reduce existential risk. Unless we give up on norms of intergenerational equity, they give us a strong case for significantly increasing our efforts to reduce existential risks.

1.3. WHY EXISTENTIAL RISKS MAY BE SYSTEMATICALLY UNDERINVESTED IN, AND THE ROLE OF THE INTERNATIONAL COMMUNITY

In spite of the importance of existential risk reduction, it probably receives less attention than is warranted. As a result, concerted international cooperation is required if we are to receive adequate protection from existential risks.

1.3.1. Why existential risks are likely to be underinvested in

There are several reasons why existential risk reduction is likely to be underinvested in. Firstly, it is a global public good. Economic theory predicts that such goods tend to be underprovided. The benefits of existential risk reduction are widely and indivisibly dispersed around the globe from the countries responsible for taking action. Consequently, a country which reduces existential risk gains only a small portion of the benefits but bears the full brunt of the costs. Countries thus have strong incentives to free ride, receiving the benefits of risk reduction without contributing. As a result, too few do what is in the common interest.

Secondly, as already suggested above, existential risk reduction is an intergenerational public good: most of the benefits are enjoyed by future generations who have no say in the political process. For these goods, the problem is temporal free riding: the current generation enjoys the benefits of inaction while future generations bear the costs.

#### No defo impact.

Bailey 14—(science correspondent at Reason magazine). Ronald Bailey. Reason Magazine, August 1, 2014, “Predictions of a Man-Made Sixth Mass Extinction May Be Exaggerated”, <http://reason.com/archives/2014/08/01/predictions-of-a-man-made-sixth-mass-ext>.

Since most species live in forests, chiefly tropical forests, we should take a look at global forest cover trends. Happily, the deforestation rate is slowing. The Food and Agriculture Organization's State of the World's Forests 2012 report notes that the global rate of deforestation slowed from 0.2 percent per year between 1990 and 2000 to 0.14 percent between 2005 and 2010. Between 2000 and 2010, a total of 130 million hectares were cut, but 78 million hectares returned to forests. So globally, forests declined on average by 5.2 million hectares per year—at which rate, the report notes, "It will take 775 years to lose all of the world's forests." It adds, "This would seem to provide enough time for actions to slow or stop global deforestation." And indeed, researchers in 2006 found that more and more countries are passing through a "forest transition" in which their forest area starts expanding. Roger Sedjo, a forest ecologist at Resources for the Future, predicts that by 2050 most of the world's industrial wood will be grown on forest plantations covering only 5 to 10 percent of the extent of today's global forests. One dark blot on forest restoration trends is biofuel mandates in rich countries, which have spurred tropical countries to chop down forests to grow palm oil to produce biodiesel. By one estimate, 87 percent of the deforestation in Malaysia and 118 percent in Indonesia occurred as result of expanding palm oil plantations.

#### Renewables scale and solve—they ignore efficiency boosts from machine learning.

McAfee 19—(principal research scientist and codirector of the Initiative on the Digital Economy at MIT, PHD in business administration from Harvard, MS in mechanical engineering from MIT, unrelated to the crazy McAfee). McAfee, Andrew. 2019. More from Less: The Surprising Story of How We Learned to Prosper Using Fewer Resources—and What Happens Next. Scribner.

Energy. One of humanity’s most urgent tasks in the twenty-first century is to reduce greenhouse gas emissions. Two ways to do this are to become more efficient in using energy and, when generating it, to shift away from carbon-emitting fossil fuels. Digital tools will help greatly with both. Several groups have recently shown that they can combine machine learning and other techniques to increase the energy efficiency of data centers by as much as 30 percent. This large improvement matters for two reasons. First, data centers are heavy users of energy, accounting for about 1 percent of global electricity demand. So efficiencies in these facilities help. Second, and more important, these gains indicate how much the energy use of all our other complicated infrastructures—everything from electricity grids to chemical plants to steel mills—can be trimmed. All are a great deal less energy efficient than they could be. We have both ample opportunity and ample incentive now to improve them. Both wind and solar power are becoming much cheaper, so much so that in many parts of the world they’re now the most cost-effective options, even without government subsidies, for new electrical generators. These energy sources use virtually no resources once they’re up and running and generate no greenhouse gases; they’re among the world champions of dematerialization. In the decades to come they might well be joined by nuclear fusion, the astonishingly powerful process that takes place inside the sun and other stars. Harnessing fusion has been tantalizingly out of reach for more than half a century—the old joke is that it’s twenty years away and always will be. A big part of the problem is that it’s hard to control the fusion reaction inside any human-made vessel, but massive improvements in sensors and computing power are boosting hope that fusion power might truly be only a generation away.

#### Yes ROI for renewables.

Wetstone 19—(JD from Duke, BS in Biology from Florida State, former Chief Counsel for Environment at the US House of Representatives Committee on Energy and Commerce). Wetstone, Gregory. 2019. “Renewable Energy Is Booming. Here’s How to Keep It Going.” Fortune Magazine. July 2, 2019. https://fortune.com/2019/07/02/renewable-solar-wind-energy-investment/.

Renewable energy is one of the most attractive investment options for American companies today. Just ask Starbucks, which recently contracted for enough wind and solar power to supply 3,000 of its coffee shops with clean electricity. American businesses and global investors are increasingly turning to a low-carbon portfolio—a fact reflected in our new survey of the nation’s leading financial institutions, which found high near-term confidence for renewable energy growth over the next three years and a strong appetite for energy storage. When asked their reasons for this bullish outlook, survey respondents cited the low cost of renewable energy, expanded requirements that states derive a certain portion of their energy from renewable sources, increased demand from corporations, the potential for new carbon legislation, and a desire to benefit from sunsetting tax credits.

#### Peak oil is super wrong

McAfee 19—(principal research scientist and codirector of the Initiative on the Digital Economy at MIT, PHD in business administration from Harvard, MS in mechanical engineering from MIT, unrelated to the crazy McAfee). McAfee, Andrew. 2019. More from Less: The Surprising Story of How We Learned to Prosper Using Fewer Resources—and What Happens Next. Scribner.

From Peak Oil to… Peak Oil In 2007 US coal consumption reached a new high of 1,128 million short tons, over 90 percent of which was burned to generate electricity. Total coal use had increased by more than 35 percent since 1990, and the US Energy Information Administration (the official energy statisticians of the US government) forecast further growth of up to 65 percent by 2030. Also in 2007 the US Government Accountability Office (GAO), a federal agency known as “the congressional watchdog,” published a report with an admirably explanatory title: “Crude Oil: Uncertainty about Future Oil Supply Makes It Important to Develop a Strategy for Addressing a Peak and Decline in Oil Production.” It took seriously the idea of “peak oil,” a phrase coined in 1956 by M. King Hubbert, a geologist working for Shell Oil. As originally conceived, peak oil referred to the maximum amount of oil that we could annually produce for all of humanity’s needs. The first oil wells pumped out the crude oil that was closest to the earth’s surface or otherwise easiest to access. As those wells dried up, we had to drill deeper ones, both on land and at sea. As the world’s economies kept growing, so did total demand for oil, which kept getting harder and harder to obtain. Peak oil captured the idea that despite our best efforts and ample incentive, we would come to a time after which we would only be able to extract less and less oil year after year from the earth. Most of the estimates summarized in the GAO report found that peak oil would occur no later than 2040. The report did not mention fracking, which in retrospect looks like a serious omission. Fracking is short for “hydraulic fracturing” and is a means of obtaining oil and natural gas from rock formations lying deep underground. It uses a high-pressure fluid to cause fractures in the rock, through which oil and gas can flow and be extracted. The United States and other countries have long been known to have huge reserves of hydrocarbons in deep rock formations, which are often called shales. Companies had been experimenting with fracking to get at them since the middle of the twentieth century, but had made little progress. In 2000 fracking accounted for just 2 percent of US oil production. That figure began to increase quickly right around the time of the GAO report. Not because of any single breakthrough, but instead because the suite of tools and techniques needed for profitable fracking had all improved enough. A gusher of shale oil and gas ensued. Thanks to fracking, US crude oil production almost doubled between 2007 and 2017, when it approached the benchmark of 10 million barrels per day. By September of 2018 America had surpassed Saudi Arabia to become the world’s largest producer of oil. American natural gas production, which had been essentially flat since the mid-1970s, jumped by nearly 43 percent between 2007 and 2017. As a result of the fracking boom the United States has experienced peak coal rather than peak oil. And the peak in coal is not in total annual supply, but instead in demand. Fracking made natural gas cheap enough that it became preferred over coal for much electricity generation. By 2017 total US coal consumption was down 36 percent from its 2007 high point. The phrase peak oil is still around, but, as is the case with coal, it usually no longer refers to supply. As a 2017 Bloomberg headline put it, “Remember Peak Oil? Demand May Top Out Before Supply Does.” Even though the extra supply from fracking has helped push down oil and gas prices, many observers now believe that energy from other sources—the sun, wind, and the nuclei of uranium atoms—is getting cheaper faster and becoming much more widely available. So much so that, as a 2018 article in Fortune about the future of oil hypothesized, “This wouldn’t be just another oil-price cycle, a familiar roller coaster in which every down is followed by an up. It would be the start of a decades-long decline of the Oil Age itself—an uncharted world in which… oil prices might be ‘lower forever.’ ” Analysts at Shell, the company from which the phrase peak oil originated, now estimate that global peak oil demand might come as soon as 2028.

#### Desalination solves water.

Phillips 19—(environmental journalist, has written for Nature, the Guardian, the Daily Telegraph, the New Statesman, Businessweek and the EUobserver). Phillips, Leigh. 2019. “The Degrowth Delusion.” openDemocracy. August 30, 2019. <https://www.opendemocracy.net/en/oureconomy/degrowth-delusion/>.

And this uniquely human ability to transform our way of being is the key to understanding why both the economist and cleric Thomas Malthus and his latter-day epigones—from the Club of Rome's Limits to Growth report in the 1970s and Paul Ehrlich's Population Bomb bestseller (which predicted billions would be dying of starvation by the 1980s) to contemporary degrowth theorists and activists—have persistently been demonstrated to be wrong. The average human does not consume resources at a fixed rate, unlike the average specimen of other species. We are not like bacteria in a petrie dish. Through technological innovation and political change, we can, if we choose, produce the same value with fewer resources, both relatively and absolutely. And when we come up against natural limits, we can also innovate to overcome them. The entire history of our species is in essence a story of overcoming natural limits. The only truly insurmountable boundaries to what we can do are the laws of physics and logic (one day there may be teleportation, because it does not violate physical laws, but there can never be a perpetual motion machine, because it does). In his famous critique of Malthus's belief that population would eventually outstrip agricultural production, Friedrich Engels alighted upon the unique ingenuity of humanity: "[T]here still remains [an] element which, admittedly, never means anything to the economist – science – whose progress is as unlimited and at least as rapid as that of population. ... [S]cience advances in proportion to the knowledge bequeathed to it by the previous generation, and thus under the most ordinary conditions also in a geometrical progression. And what is impossible to science?" There is certainly a difference between the blithe free marketeer who declares that because innovation has always come along just in time to save us, and the socialist who says that in principle innovation can do this but there is no guarantee that it will. It may indeed be the case that the Malthusian doom-mongers have repeatedly been proven wrong, from the agricultural revolution of the 17th and 18th centuries to the Green Revolution of the 1940s and the demographic and public-health revolutions of the 1960s, but it does not follow therefore that this will always be the case. This is why socialists must take very seriously notions such as Planetary Boundaries developed by Johan Rockstrom, Will Steffen and their colleagues at the Stockholm Resilience Centre, so long as we view them as useful warnings of potential danger rather than permanent hard limits. For example, alongside maximum atmospheric concentration of greenhouse gases and minimum concentration of ozone, the Planetary Boundaries include the maximum use of freshwater. It is true that if exploitation of aquifers continues to increase at the current rate, all other things being equal, then we very much are at risk of water shortages. Free marketeers respond by saying that breakthroughs in desalination would eliminate this problem. And they are not wrong. But only if such technology is profitably brought to market. If desalination isn't profitable, or the pathway to commercialisation is too risky for investors, the problem won't be solved. The market is amoral and thus indifferent to the problem. To ensure that innovation does indeed resolve such challenges, there has to be a conscious, moral, non-market hand at the tiller: democratic economic planning at the global level. A democratically planned economy can continue to grow, but in a fundamentally different way to that of capitalist growth under which capitalists produce commodities willy-nilly with regulators later running to play catch-up when ecologically ruinous overproduction occurs. Long ahead of the problem appearing, we can slow down or hold tight or rearrange production until new efficiencies from technological innovation arrive that allow us to return to growth if it is necessary.