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#### CP Text: States, except the United States, should ban the appropriation of outer space for asteroid mining by private entities. The United States should fund the appropriation of outer space for the mining of rare earth metals from asteroids by private entities.

#### The PIC is key to beat China and protect against Chinese REM gatekeeping

Stavridis 21 [(James, retired US Navy admiral, chief international diplomacy and national security analyst for NBC News, senior fellow at JHU Applied Physics Library, PhD in Law and Diplomacy from Tufts) “U.S. Needs a Strong Defense Against China’s Rare-Earth Weapon,” Bloomberg Opinion, March 4, 2021, https://www.bloomberg.com/opinion/articles/2021-03-04/u-s-needs-a-strong-defense-against-china-s-rare-earth-weapon] TDI

You could be forgiven if you are confused about what’s going on with rare-earth elements. On the one hand, news reports indicate that China may increase production quotas of the minerals this quarter as a goodwill gesture to the Joe Biden administration. But other sources say that China may ultimately ban the export of the rare earths altogether on “security concerns.” What’s really going on here?

There are 17 elements considered rare earths — lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium and yttrium — and while many aren’t actually rare in terms of global deposits, extracting them is difficult and expensive. They are used across high-tech manufacturing, including smartphones, fighter aircraft and components in virtually all advanced electronics. Of particular note, they are essential to many of the clean-energy technologies expected to come online in this decade.

I began to focus on rare-earth elements when I commanded the North Atlantic Treaty Organization’s presence in Afghanistan, known as the International Security Assistance Force. While Afghans live in an extremely poor country, studies have assessed that they sit atop $1 trillion to $3 trillion in a wide variety of minerals, including rare earths. Some estimates put the rare-earth levels alone at 1.4 million metric tons.

But every time I tried to visit a mining facility, the answer I got from my security team was, “It’s too dangerous right now, admiral.” Unfortunately, despite a great deal of effort by the U.S. and NATO, those security challenges remain, deterring the large foreign-capital investments necessary to harvest the lodes. Which brings us back to Beijing.

China controls roughly 80% of the rare-earths market, between what it mines itself and processes in raw material from elsewhere. If it decided to wield the weapon of restricting the supply — something it has repeatedly threatened to do — it would create a significant challenge for manufacturers and a geopolitical predicament for the industrialized world.

It could happen. In 2010, Beijing threatened to cut off exports to Japan over the disputed Senkaku Islands. Two years ago, Beijing was reportedly considering restrictions on exports to the U.S. generally, as well as against specific companies (such as defense giant Lockheed Martin Corp.) that it deemed in violation of its policies against selling advanced weapons to Taiwan.

President Donald Trump’s administration issued an executive order to spur the production of rare earths domestically, and created an Energy Resource Governance Initiative to promote international mining. The European Union and Japan, among others, are also aggressively seeking newer sources of rare earths.

Given this tension, it was superficially surprising that China announced it would boost its mining quotas in the first quarter of 2021 by nearly 30%, reflecting a continuation in strong (and rising) demand. But the increase occurs under a shadow of uncertainty, as the Chinese Communist Party is undertaking a “review” of its policies concerning future sales of rare earths. In all probability, the tactics of the increase are temporary, and fit within a larger strategy.

China will go to great lengths to maintain overall control of the global rare-earths supply. This fits neatly within the geo-economic approach of the One Belt, One Road initiative, which seeks to use a variety of carrots and sticks — economic, trade, diplomatic and security — to create zones of influence globally. In terms of rare earths, the strategy seems to be allowing carefully calibrated access to the elements at a level that makes it economically less attractive for competitors to undertake costly exploration and mining operations. This is similar to the oil-market strategy used by Russia and the Organization of Petroleum Exporting Countries for decades.

Some free-market advocates believe that China will not take aggressive action choking off supply because that could precipitate retaliation or accelerate the search for alternate sources in global markets. What seems more likely is a series of targeted shutdowns directed against specific entities such as U.S. defense companies, Japanese consumer electronics makers, or European industrial concerns that have offended Beijing.

The path to rare-earth independence for the U.S. must include: Ensuring supply chains of rare earths necessary for national security; promoting the exploitation of the elements domestically (and removing barriers to responsibly doing so); mandating that defense contractors and other critical-infrastructure entities wean themselves off Chinese rare earths; sponsoring research and development to find alternative materials, especially for clean energy technology; and creating a substantial stockpile of the elements in case of a Chinese boycott.

This is a bipartisan agenda. The Trump administration’s strategic assessment of what needs to be done (which goes beyond just 17 rare earths to include a total of 35 critical minerals) is thoughtful, and should serve as a basis for the Biden administration and Congress.

#### REM access key to military primacy and tech advancement – alternatives fail

Trigaux 12 (David, University Honors Program University of South Florida St. Petersburg) “The US, China and Rare Earth Metals: The Future Of Green Technology, Military Tech, and a Potential Achilles‟ Heel to American Hegemony,” USF St. Petersberg, May 2, 2012, https://digital.stpetersburg.usf.edu/cgi/viewcontent.cgi?article=1132&context=honorstheses] TDI

The implications of a rare earth shortage aren’t strictly related to the environment, and energy dependence, but have distinct military implications as well that could threaten the position of the United States world’s strongest military. The United States place in the world was assured by powerful and decisive deployments in World War One and World War Two. Our military expansion was built upon a large, powerful industrial base that created more, better weapons of war for our soldiers. During the World Wars, a well-organized draft that sent millions of men into battle in a short amount of time proved decisive, but as the war ended, and soldiers drafted into service returned to civilian life, the U.S. technological superiority over its opponents provided it with sustained dominance over its enemies, even as the numerical size of the army declined. New technologies, such as the use of the airplane in combat, rocket launched missiles, radar systems, and later, GPS, precision guided missiles, missile defense systems, high tech tanks, lasers, and other technologies now make the difference between victory and defeat.

The United States military now serves many important functions, deterring threats across the world. The United States projects its power internationally, through a network of bases and allied nations. Thus, the United States is a powerful player in all regions of the world, and often serves as a buffer against conflict in these regions. US military presence serves as a buffer against Chinese military modernization in Eastern Asia, against an increasingly nationalist Russia in Europe, and smaller regional actors, such as Venezuela in South America and Iran in the Middle East. The U.S. Navy is deployed all over the world, as the guarantor of international maritime trade routes. The US Navy leads action against challenges to its maritime sovereignty on the other side of the globe, such as current action against Somali piracy. Presence in regions across the world prevents escalation of potential crisis. These could result in either a larger power fighting a smaller nation or nations (Russia and Georgia, Taiwan and China), religious opponents (Israel and Iran), or traditional foes (Ethiopia and Eretria, Venezuela and Colombia, India and Pakistan). US projection is also key deterring emerging threats such as terrorism and nuclear proliferation. While not direct challenges to US primacy, both terrorism and nuclear proliferation can kill thousands.

The US Air Force has a commanding lead over the rest of the world, in terms of both numbers and capabilities. American ground forces have few peers, and are unmatched in their ability to deploy to anywhere in the world at an equally unmatched pace.

The only perceived challenge to the United States militarily comes from the People’s Republic of China.76 While the United States outspends all other nations in the world put together in terms of military spending, China follows as a close second, and has begun an extensive modernization program to boot.77 The Chinese military however, is several decades behind the United States in air power and nuclear capabilities.78 To compensate, China has begun the construction of access-denial technology, preventing the US from exercising its dominance in China’s sphere of influence.79 Chinese modernization efforts have a serious long-term advantage over the United States; access to rare earth metals, and a large concentration of rare earth chemists doing research.80 This advantage, coupled with the U.S. losing access to rare earth metals, will even the odds much quicker than policymakers had previously anticipated. 81

The largest example is US airpower. With every successive generation of military aircraft, the U.S. Air Force becomes more and more dependent on Rare Earth Metals.82 As planes get faster and faster, they have to get lighter and lighter, while adding weight from extra computers and other features on board.83 To lighten the weight of the plane, scandium is used to produce lightweight aluminum alloys for the body of the plane. Rare Earth metals are also useful in fighter jet engines, and fuel cells.84 For example, rare earths are required to producing miniaturized fins, and samarium is required to build the motors for the F-35 fighter jet.85 F-35 jets are the next generation fighter jet that works together to form the dual plane combination that cements U.S. dominance in air power over the Russian PAK FA.86

Rare earth shortages don’t just affect air power, also compromising the navigation system of Abrams Tanks, which need samarium cobalt magnets. The Abrams Tank is the primary offensive mechanized vehicle in the U.S. arsenal. The Aegis Spy 1 Radar also uses samarium.87 Many naval ships require neodymium. Hell Fire missiles, satellites, night vision goggles, avionics, and precision guided munitions all require rare earth metals. 88

American military superiority is based on technological advancement that outstrips the rest of the world. Command and control technology allows the U.S. to fight multiple wars at once and maintain readiness for other issues, as well as have overwhelming force against rising challengers. This technology helps the U.S. know who, where, and what is going to attack them, and respond effectively, regardless of the source of the threat.

Rare Earth Elements make this technological superiority possible.

To make matters worse, the defense industrial base is often a single market industry, dependent on government contracts for its business. If China tightens the export quotas further, major US defense contractors will be in trouble.89 Every sector of the defense industrial base is dependent on rare earth metals. Without rare earths, these contractors can’t build anything, which collapses the industry.90

Rare Earth shortages are actually already affecting our military, with shortages of lanthanum, cerium, europium and gadolinium happening in the status quo. This prevents us not only from building the next generation of high tech weaponry, but also from constructing more of the weapons and munitions that are needed in the status quo. As current weapon systems age and they can’t be replaced, the US primacy will be undermined. Of special concern is that U.S. domestic mining doesn’t produce “heavy” rare earth metals that are needed for many advanced components of military technologies. Given the nature of many military applications, substitutions aren’t possible. 91

#### Primacy and allied commitments solve arms races and great power war – unipolarity is sustainable, and prevents power vacuums and global escalation

Brands 18 [(Hal, Henry Kissinger Distinguished Professor at Johns Hopkins University's School of Advanced International Studies and a senior fellow at the Center for Strategic and Budgetary Assessments) "American Grand Strategy in the Age of Trump," Page 129-133]

Since World War II, the United States has had a military second to none. Since the Cold War, America has committed to having overwhelming military primacy. The idea, as George W. Bush declared in 2002, that America must possess “strengths beyond challenge” has featured in every major U.S. strategy document for a quarter century; it has also been reflected in concrete terms.6

From the early 1990s, for example, the United States consistently accounted for around 35 to 45 percent of world defense spending and maintained peerless global power-projection capabilities.7 Perhaps more important, U.S. primacy was also unrivaled in key overseas strategic regions—Europe, East Asia, the Middle East. From thrashing Saddam Hussein’s million-man Iraqi military during Operation Desert Storm, to deploying—with impunity—two carrier strike groups off Taiwan during the China-Taiwan crisis of 1995– 96, Washington has been able to project military power superior to anything a regional rival could employ even on its own geopolitical doorstep.

This military dominance has constituted the hard-power backbone of an ambitious global strategy. After the Cold War, U.S. policymakers committed to averting a return to the unstable multipolarity of earlier eras, and to perpetuating the more favorable unipolar order. They committed to building on the successes of the postwar era by further advancing liberal political values and an open international economy, and to suppressing international scourges such as rogue states, nuclear proliferation, and catastrophic terrorism. And because they recognized that military force remained the ultima ratio regum, they understood the centrality of military preponderance.

Washington would need the military power necessary to underwrite worldwide alliance commitments. It would have to preserve substantial overmatch versus any potential great-power rival. It must be able to answer the sharpest challenges to the international system, such as Saddam’s invasion of Kuwait in 1990 or jihadist extremism after 9/11. Finally, because prevailing global norms generally reflect hard-power realities, America would need the superiority to assure that its own values remained ascendant. It was impolitic to say that U.S. strategy and the international order required “strengths beyond challenge,” but it was not at all inaccurate.

American primacy, moreover, was eminently affordable. At the height of the Cold War, the United States spent over 12 percent of GDP on defense. Since the mid-1990s, the number has usually been between 3 and 4 percent.8 In a historically favorable international environment, Washington could enjoy primacy—and its geopolitical fruits—on the cheap.

Yet U.S. strategy also heeded, at least until recently, the fact that there was a limit to how cheaply that primacy could be had. The American military did shrink significantly during the 1990s, but U.S. officials understood that if Washington cut back too far, its primacy would erode to a point where it ceased to deliver its geopolitical benefits. Alliances would lose credibility; the stability of key regions would be eroded; rivals would be emboldened; international crises would go unaddressed. American primacy was thus like a reasonably priced insurance policy. It required nontrivial expenditures, but protected against far costlier outcomes.9 Washington paid its insurance premiums for two decades after the Cold War. But more recently American primacy and strategic solvency have been imperiled.

THE DARKENING HORIZON For most of the post–Cold War era, the international system was— by historical standards—remarkably benign. Dangers existed, and as the terrorist attacks of September 11, 2001, demonstrated, they could manifest with horrific effect. But for two decades after the Soviet collapse, the world was characterized by remarkably low levels of great-power competition, high levels of security in key theaters such as Europe and East Asia, and the comparative weakness of those “rogue” actors—Iran, Iraq, North Korea, al-Qaeda—who most aggressively challenged American power. During the 1990s, some observers even spoke of a “strategic pause,” the idea being that the end of the Cold War had afforded the United States a respite from normal levels of geopolitical danger and competition. Now, however, the strategic horizon is darkening, due to four factors.

First, great-power military competition is back. The world’s two leading authoritarian powers—China and Russia—are seeking regional hegemony, contesting global norms such as nonaggression and freedom of navigation, and developing the military punch to underwrite these ambitions. Notwithstanding severe economic and demographic problems, Russia has conducted a major military modernization emphasizing nuclear weapons, high-end conventional capabilities, and rapid-deployment and special operations forces— and utilized many of these capabilities in conflicts in Ukraine and Syria.10 China, meanwhile, has carried out a buildup of historic proportions, with constant-dollar defense outlays rising from US$26 billion in 1995 to US$226 billion in 2016.11 Ominously, these expenditures have funded development of power-projection and antiaccess/area denial (A2/AD) tools necessary to threaten China’s neighbors and complicate U.S. intervention on their behalf. Washington has grown accustomed to having a generational military lead; Russian and Chinese modernization efforts are now creating a far more competitive environment.

#### Counterplan solves scenario 1 – climate solutions rely on REMs

Arrobas et al 17 [(Daniele La Porta Arrobas is a senior mining specialist with the World Bank based in Washington DC and has degrees in Geoscience and Environmental Management, Kirsten Hund is a senior mining specialist with the Energy and Extractives Global Practice of the World Bank and holds a Master’s in IR from the University of Groningen in the Netherlands, Michael Stephen McCormick, Jagabanta Ningthoujam has an MA in international economics and international development from JHU and a BS in MechE from Natl University of Singapore, John Drexhage also works at the Intl Institute for Sustainable Development) “The Growing Role of Minerals and Metals for a Low Carbon Future,” World Bank, June 30, 2017, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/207371500386458722/the-growing-role-of-minerals-and-metals-for-a-low-carbon-future] TDI

* Full report - https://documents1.worldbank.org/curated/en/207371500386458722/pdf/117581-WP-P159838-PUBLIC-ClimateSmartMiningJuly.pdf

Climate and greenhouse gas (GHG) scenarios have typically paid scant attention to the metal implications necessary to realize a low/zero carbon future. The 2015 Paris Agreement on Climate Change indicates a global resolve to embark on development patterns that would significantly be less GHG intensive. One might assume that nonrenewable resource development and use will also need to decline in a carbon-constrained future. This report tests that assumption, identifies those commodities implicated in such a scenario and explores ramifications for relevant resource-rich developing countries. Using wind, solar, and energy storage batteries as proxies, the study examines which metals will likely rise in demand to be able to deliver on a carbon-constrained future. Metals which could see a growing market include aluminum (including its key constituent, bauxite), cobalt, copper, iron ore, lead, lithium, nickel, manganese, the platinum group of metals, rare earth metals including cadmium, molybdenum, neodymium, and indium—silver, steel, titanium and zinc. The report then maps production and reserve levels of relevant metals globally, focusing on implications for resource-rich developing countries. It concludes by identifying critical research gaps and suggestions for future work.

# Case

## Framing

#### The ROB is to vote for the better debater.

**Moral uncertainty means preventing extinction should be our highest priority.  
Bostrom 12** [Nick Bostrom. Faculty of Philosophy & Oxford Martin School University of Oxford. “Existential Risk Prevention as Global Priority.” Global Policy (2012)]  
These reflections on **moral uncertainty suggest** an alternative, complementary way of looking at existential risk; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate.¶ **Our present understanding of axiology might** well **be confused. We may not** nowknow — at least not in concrete detail — what outcomes would count as a big win for humanity; we might not even yet **be able to imagine the best ends** of our journey. **If we are** indeedprofoundly **uncertain** about our ultimate aims,then we should recognize that **there is a great** option **value in preserving** — and ideally improving — **our ability to recognize value and** to **steer the future accordingly. Ensuring** that **there will be a future** version of **humanity** with great powers and a propensity to use them wisely **is** plausibly **the best way** available to us **to increase the probability that the future will contain** a lot of **value.** To do this, we must prevent any existential catastrophe.

## Cap

#### Growth is sustainable and inevitable – unparalleled data proves tech solves, but transition doesn’t.

Bailey ’16 (Ronald; 12/16/16; B.A. in Philosophy and B.A. Economics from the University of Virginia, member of the Society of Environmental Journalists and the American Society for Bioethics and Humanities, citing a compilation of interdisciplinary research; Reason, “Is Economic Growth Environmentally Sustainable?” <http://reason.com/archives/2016/12/16/is-economic-growth-environmentally-sust1)>

Is economic growth environmentally sustainable? No, say a group of prominent ecological economists led by the Australian hydrologist James Ward. In a new PLoS ONE article—"Is Decoupling GDP Growth from Environmental Impact Possible?"—they offer an analysis inspired by the 1972 neo-Malthusian classic The Limits to Growth. They even suggest that The Limits to Growth's projections with regard to population, food production, pollution, and the depletion of nonrenewable resources are still on track. In other words, they think we're still heading for a collapse. I think **they're wrong**. But they're wrong in an instructive way. The authors describe two types of "decoupling," relative and absolute. Relative decoupling means that economic growth increases faster than rates of growth in material and energy **consumption** and **environmental impact**. Between 1990 and 2012, for example, China's **GDP rose 20-fold** while its energy use increased by a factor of four and its material use by a factor of five. Basically this entails increases in efficiency that result in using fewer resources to produce more value. Absolute decoupling is what happens when continued economic growth actually **lessens resource use** and impacts on the natural environment, that is, creating more value while using less stuff. Essentially humanity becomes richer while withdrawing from nature. To demonstrate that continued economic growth is unsustainable, the authors recycle the hoary I=PAT model devised in 1972 by the Stanford entomologist and population alarmist Paul Ehrlich and the Harvard environmental policy professor (and chief Obama science adviser) John Holdren. Human Impact on the environment is supposed to equal to Population x Affluence/consumption x Technology. All of these are presumed to intensify and worsen humanity's impact on the natural world. In Ward and company's updated version of I=PAT, the sustainability of economic growth largely depends on Technology trends. Absolute decoupling from resource consumption or pollutant emissions requires technological intensity of use and emissions to decrease by at least the same annual percentage as the economy is growing. For example, if the economy is growing at three percent per year, technological intensity must reduce 20-fold over 100 years to maintain steady levels of resource consumption or emissions. If technological intensity is faster then resource use and emissions will decline over time, which would result in greater wealth creation with ever lessening resource consumption and environmental spillovers. Once they've set up their I=PAT analysis, Ward and his colleagues assert that "for non-substitutable resources such as land, water, raw materials and energy, we argue that whilst efficiency gains may be possible, there are minimum requirements for these resources that are ultimately governed by physical realities." Among the "physical realities" they mention are limits on plant photosynthesis, the conversion efficiencies of plants into meat, the amount of water needed to grow crops, that all supposedly determine the amount of agricultural land required to feed humanity. They also cite "the upper limits to energy and material efficiencies govern minimum resource throughput required for economic production." To illustrate the operation of their version of the I=PAT equation, they apply it to a recent study that projected it would be possible for Australia's economy to grow 7-fold while simultaneously reducing resource and energy use and lowering environmental pressures through 2050. They **crank the notion** that there are nonsubstitutable physical limits on material and energy resources through their equations until 2100, and they find that eventually consumption of both rise at the same rate as economic growth. QED: Economic growth is unsustainable. Or as they report, "Permanent decoupling (absolute or relative) is impossible for essential, non-substitutable resources because the efficiency gains are ultimately governed by physical limits." **Malthus wins again!** Or does he? GDP growth—increases in the monetary value of all finished goods and services—is a crude measure for improvements in human well-being. Nevertheless, rising incomes (GDP per capita) correlate with lots of good things that nearly everybody wants, including access to more and better **food**, longer and **healthier lives**, more educational **opportunities**, and greater scope for life choices. Ward and his colleagues are clearly right that there is only so much physical stuff on the Earth, but even they know that wealth is not created simply by using more stuff. Where they go wrong (as so many Malthusians do) is by implicitly assuming that there are limits to human creativity. Interestingly, Ward and his colleagues, like Malthus before them, focus on the supposed limits to **agricultural productivity**. For example, they cite the limits to photosynthesis, which will limit the amount of food that humanity can produce. But as they acknowledge, human population may not continue to increase. In fact, **global fertility rates** have been **decelerating** for many decades now, and demographer Wolfgang Lutz calculates that world population will peak after the middle of this century and begin falling. Since the number of mouths to feed will stabilize and people can eat only so much, it is unlikely that the **biophysical limits** of agriculture on Earth will be exceeded. But it gets even better. Agricultural **productivity is improving**. Consider the biophysical limit on photosynthesis cited by the study. In fact, researchers are already making progress on installing more efficient C-4 photosynthesis into rice and wheat, which would **boost yields by** as much as **50 percent**. British researchers just announced that they had figured out how to boost photosynthetic efficiency to create a super-wheat would increase yields by 20 percent. In a 2015 article for the Breakthrough Journal, "The Return of Nature: How Technology Liberates the Environment," Jesse H. Ausubel of Rockefeller University reviews how humanity is **already decoupling** in many ways from the natural world. "A series of 'decouplings' is occurring, so that our economy no longer advances in tandem with exploitation of land, forests, water, and minerals," he writes. "American use of almost everything except information **seems to be peaking**." He notes that agricultural applications of fertilizer and water in the U.S. peaked in the 1980s while yields continued to increase. Thanks to increasing agricultural productivity, humanity is already at **"peak farmland"**; as a result, "an area the size of India or of the United States east of the Mississippi could be released globally from agriculture over the next 50 years or so." Ward is worried about biophysical limits on water use. But as Ausubel notes, U.S. **water use has peaked** and has declined **below the level of 1970**. What about meat? Ausubel notes the **greater efficiency** with which chickens and cultivated fish turn grains and plant matter into meat. In any event, the future of farming is not fields but factories. Innovators are already seeking to replace the entire dairy industry with milk, yogurt, and cheeses made by genetically modified bacteria grown in tanks. Others are figuring how to culture meat in vat. Ausubel also notes that many countries have already been through or are about to enter the "forest transition," in which forests begin to expand. Roger Sedjo, a forest economist at Resources of the Future, has projected that by the middle of this century most of world's **industrial wood** will be produced from planted forests covering a remarkably small land area, perhaps **only 5 to 10 percent** of the extent of today's global forest. Shrinking farms and ranches and expanding forests will do a lot toward turning around the alarming global reduction in wildlife. How about unsubstitutable stuff? Are we running out of that? Ausubel notes that the U.S. has apparently already achieved **absolute decoupling**—call it peak stuff—for a lot of materials, including plastics, paper, timber, phosphate, aluminum, steel, and copper. And he reports relative decoupling for **53** other **commodities**, all of which are likely heading toward absolute decoupling. Additive manufacturing is also known as 3-D printing, in which machines build up new items one layer at a time. The Advanced Manufacturing Office suggested that additive manufacturing can reduce material needs and costs by up to **90 percent**. And instead of the replacement of worn-out items, their material can **simply be recycled** through a printer to return it to good-as-new condition using only 2 to 25 percent of the energy required to make new parts. 3-D printing on demand will also eliminate storage and inventory costs, and will significantly cut transportation costs. Nanomanufacturing—building atom-by-atom—will likely engender a **fourth industrial revolution** by spurring exponential economic growth while reducing human demands for material resources. Ward and company project that Australians will be using 250 percent more energy by 2100. Is there an upper limit to energy production that implies unsustainability? In their analysis, the ecological economists apparently assume that energy supplies are limited. Why this is not clear, unless their model **implicitly assumes** a growing **consumption** of fossil fuels (and even then, the world is not close to running out of those). But there is a source of energy that, for all practical purposes, is limitless and has few deleterious environmental effects: **nuclear power**. If demand for primary energy were to double by 2050, a back-of-the-envelope calculation finds that the **entire world's energy needs** could be supplied by 6,000 conventional nuclear power plants. The deployment of fast reactors would supply "renewable" energy for thousands of years. The development of thorium reactors could also supply **thousands of years** of energy. And both could do so without harming the environment. (Waste heat at that scale would not be much of a problem.) Such power sources are in any relevant sense "decoupled" from the natural world, since their fuel cycles produce **little pollution**. Recall that GDP measures the monetary value of all finished goods and services. Finished goods will become a shrinking part of the world's economy as more people gain access to food, clothing, housing, transportation, and so forth. Already, services account for 80 percent of U.S. GDP and 80 percent of civilian employment. Instead of stuff, people will want to spend time creating and enjoying themselves. As technological progress enables economic growth, people will consume more pixels and less petroleum, more massages and less mortar, more handicrafts and less hardwood. Ultimately, Ward and his colleagues make the **same mistake as Malthus** and the Limits to Growth folks: They **extrapolate trends** without taking adequate account of human **ingenuity**. Will it be possible to grow the economy 7-fold over this century while reducing resource consumption and restoring the natural world? Yes.

#### Our ev is just better – prefer data over buzzwords.

Newman ’17 (Peter; 7/27/17; Curtin University Sustainability Policy Institute, conducting a twenty-year statistical analysis based on third-party meta studies; EDP Sciences, “The rise and rise of renewable cities,” <https://www.rees-journal.org/articles/rees/pdf/2017/01/rees170008s.pdf)>

Abstract. The **decoupling of fossil fuels** from growth in economic activity has been **proceeding rapidly** for most of the 21st century and is analyzed globally in terms of structures and technologies for energy efficiency and for switching to renewable energy in the world’s cities. This is leading to the **decline of coal** and oil. The evidence suggests that the changes are **based on demand** for the structures and technologies that are emerging, facilitating a **disruptive process**. The rise of renewable cities can therefore be expected to accelerate. 1 Introduction The rise of renewable cities began in the 1990s but has accelerated in the 21st century [1,2]. As shown below, both coal and oil have begun to fall in the nations of the world driven mostly by their cities as this is where **growth and change** is happening [3]. The question raised by this paper is whether the rise will continue and even accelerate. The theory behind whether the rise in renewable cities is likely to continue or accelerate is partly left to economists who project the future based on the past [4] and more recently by those who see disruptive innovation as causing the future and thus leading to much accelerated change [5,6]. Disruptive innovation is caused by demand rather than supply. The costs of supply need to be competitive but may not be the cheapest option when people discover they want it for many reasons and this changes the whole system that the market is based around. An example often given by Christensen [5] is how small floppy discs outcompeted the larger discs which were cheaper per unit of memory storage but were not as convenient to carry; the system changed in response by developing the portable lap top computer. Disruptive innovations can surprise businesses who focus just on supply costs and they can go bankrupt whilst their product is still the cheapest and the whole structural system around them changes in response to the new demand. This is known as the “Kodak effect” due to the way Kodak chose not to develop their digital cameras as they saw them as too expensive. This paper seeks to find evidence of whether the renewable city is being driven by disruptive innovations based on demand, as well as competitive costs of supply, leading to a whole system change. If it is so, then the rise in renewable cities is likely to continue and even accelerate based on demand for the structures and products of the renewable city at a surprising rate. The decoupling of economic growth and fossil fuels In 2017, the International Energy Agency confirmed that economic growth has been **decoupling from** greenhouse **emissions** and fossil fuels since the start of the 21st century and that this was now leading to the first **drop in fossil fuel consumption** and subsequent emissions [7]. How this relates to the rise of the renewable city is the focus of this paper. The mechanisms are first understood by looking at a range of national data as set out in Figure 1. Denmark decoupled relatively from the 1990s but absolutely over the last 17 years and is typical of many European nations and cities. The US and Australia have been slower but have now decoupled relatively from the 2000s and absolutely over the past 5–9 years. China decoupled relatively from 2005 and absolutely over the past few years with coal whilst **oil has plateaued**. India has started relative decoupling in the past decade and may change to an absolute decline in fossil fuels as it is investing strongly in renewables and urban electric rail [11]. These trends suggest a global process the rise of the renewable city as outlined by Droege [1,2]; this appears to be occurring much faster than expected and invites the question as to whether it will accelerate [3]. 3 Mechanisms for the rise of the renewable city The mechanisms behind the decoupling of wealth and fossil fuels and the resulting rise of renewable cities are likely to be based around **structural energy** efficiencies and **growth** in renewables. Whether they are disruptive, demand driven changes, will be examined with coal and oil. 3.1 The fall of coal 3.1.1 Structural built environment energy efficiencies In the period from 2000 to 2013 the Organization for Economic Cooperation and Development improved energy efficiency by a steady 0.6% per year but in 2013/14 it improved 1.5% and in 2014/15 it improved 1.8% [12]. This rapid growth seems to be more **structural** in its base as appliances and buildings are becoming **significantly more efficient** as shown by the Intergovernmental Panel on Climate Change [13]. This does appear to be a demand driven process involving digital smart systems in appliances and in construction and management of buildings leading to declines in electricity consumption [14]. 3.1.2 Renewable fuel growth Bloomberg New Energy Finance (BNEF) has made projections of the growth in renewables based on the relative costs of fuels. They suggest that from 2015 to 2040 renewables will become the **dominant power source** in the world; wind and solar will account for **64% of** the **new** generating **capacity**, and globally there will be 60% zerocarbon power, replacing coal and gas, which will decline from 57% to 31% [15]. The predictions are made based on trends and on declining costs for renewables relative to fossil fuels. The **biggest growth** is predicted to be roof top solar which will drop in cost by 60%. However, it may be driven at an **even faster rate** if it has demand driven characteristics. Carbon tracker researchers have suggested that the changes may be even more radical than BNEF are predicting as they appear to be following more rapidly than any previous predictions and are indicating elements of disruptive innovation [16,17]. The question is therefore whether there is any new evidence of the changes being disruptive with adoption of renewables proceeding more rapidly than supply cost projections. There is evidence from Australia of a **remarkably rapid adoption** of roof top solar at a time when little investment in power was happening in the aftermath of abandoning the Australian carbon-pricing scheme [18]. Perth in particular showed this as the city grew rapidly in wealth over the past decade and 25% of households invested in roof-top solar photovoltaics (PV). This happened well beyond what would have been predicted based just on supply costs and household solar is now the largest power station in the grid [18]. Battery storage is now following the same trends [19] and analysis in Perth shows solar-storage systems enable over **90% gridfree** electricity as well as producing more renewable energy to feed into the grid and generate income [18]. The technology of PV and batteries seems to fit into a niche for ordinary single residential householders [20]; recent demonstrations are showing similar heavy demand in medium density shared households that integrate PV and batteries using Citizen Utilities and blockchain software to enable peer to peer trading [21]. The signs are there that demand is driving the electricity system toward a rapid decline in coal even faster than supply costs would indicate. This may involve more gas in some cities like in the US where this is significantly cheaper but the attractions of roof-top solar and batteries are more than likely going to outcompete gas when the **market enables it to work** as it is in Australia with simple financing, permitting and installation [22,23]. 3.2 The fall of oil 3.2.1 Structural transport energy efficiencies Oil is embedded in the structure of cities through 50 years of automobile dependence in the practice of town planning; however this is changing as an unpredicted peak in car use per capita has occurred across the world’s developed cities and even into emerging cities [24]. This is driven by: – increases in density that have led to exponential declines in car use [24]; – rapid growth in transit across all the world’s cities as traffic congestion has led to faster rail options that bypass the traffic [25]; – similar trends in walking and cycling driven by health considerations and the demand for better networks [26,27]. These trends are all demand driven. Vehicle efficiency has also been slowly increasing despite an increase in vehicle size washing out some of this improvement [28]. 3.2.2 Electric mobility Electric vehicles are growing globally at **over 40% per year** and are expected to reach at least 25% of the vehicle fleet by 2040 [29]. Most of this growth is in China which is likely to mean cheaper exports. The demand for electric vehicles is high whether they are personal cars, buses, trains or electric bikes and certainly with cars this is happening well before the **supply cost** is competitive though the daily costs of operation are significantly lower and this is a strong demand factor for most consumers; some are therefore predicting even higher adoption rates [30]. There is another demand-based trend that will impact on the shift to **electric mobility**. The trend in electricity to become more **based on renewables** means that growth in solar-powered EVs are likely to be driven by demand similar to roof top solar. EVs are already being used to fit cleverly into home PV and battery systems with the high potential for “vehicle to grid (V2G)” transfers of power to enable extra storage options in the grid. Electric transit is also beginning to be switched to renewable power as demand for clean transport grows across cities [24] and new ways of financing this demand are being found [31]. 4 Will the demand for renewable cities rise and rise? The rise of the renewable city has been quite dramatic and this paper suggests that it will continue to rise due to demand which **facilitates disruptive innovation** in replacing both coal and oil. Such demand is seen in the improved electricity systems that are emerging as a result of the demand for roof top solar and in the demand for re-urbanized cities where electric mobility can better service the needs of the community. There are two other demand factors that are likely to continue to drive the need for a **renewable city** the knowledge economy and the digital economy The knowledge economy is based around creative interactions where people work together in dense urban centers as these are where the innovative, face-to-face synergies occur between people [32]. Old central business districts and new suburban centers have been transformed back into functional walking cities and those which have done this best have attracted the most capital and young talent to work there [33]. The six most walkable cities in the US have 38% higher GDP. In Boston 70% of the knowledge economy workers live in walkable locations [24]. Transit systems and walking are the most spatially efficient forms of transport as well as being the most free of carbon. If one km of a lane of road was considered as a unit of travel then car traffic can fit about 800 people per hour down that lane in a suburban street, a freeway up to 2500, a busway around 5000, a light rail between 10,000 and 20,000 and a heavy rail up to 50,000 [24]. These striking differences in spatial efficiency are translating into competitive advantage based on the need to bring people together in centers. There is a strong demand for such cities because they represent the places where the new knowledge economy will most likely emerge and provide new opportunities. The data is also strong that there is demand for **low carbon buildings** in these new regenerating urban centers [34]. Indeed, cities are competing for residents and workers through the provision of new sustainability oriented precincts and neighborhoods; the data shows that sustainability features in buildings are a close third behind **affordability and location** [3,32,35]. As with many economic changes, there is another cultural dimension to this change that perhaps explains the rapidity of the changes observed above as well as the demographic complexion of the change. Young people (especially those involved in knowledge economy jobs) are moving to reduce their car use and switch to alternative transport faster than any other group. This has been recognized by a few commentators and has been related to the use of social media devices in the digital economy. On transit or walking (and even to an extent while biking) young people are already connected by their smart technology phones and tablets. They are hardly usable while driving a car. The report by Davis et al. [34] shows that the mobile phone is a far more important device than a car for younger people. This is a cultural revolution that partly underlies the rail revolution as well as the re-urbanization of cities. It is essentially a smart city phenomenon. Thus, the structural expression of this change is that younger people are moving to live in the walking city or transit city as these locations more readily enable them to express the kind of urban experience and culture that they aspire to as well as save precious time. This is the demand that enables peak car, the rail revival and city center renewal to continue. This can explain why cities like Washington, D.C. and Portland are demonstrating the decoupling of GDP from car use per capita (Fig. 2). 5 Conclusion The evidence gathered in this paper has shown that there is a **new trend**: the rise of the renewable city which has emerged this century from the **decoupling of fossil fuels** and economic **growth**. The fall of coal and the fall of oil are both caused by structural **energy efficiency gains** (smart technology and smart buildings for coal; smart, dense transit-oriented cities that reduce car dependence for oil) and by switching to renewable fuels (coal is being replaced by wind and solar especially roof-top PV; oil is being replaced by electric mobility). This appears to be led by demand in cities as well as somewhat competitive supply costs. The rise and rise of the renewable city is thus to be expected as demand is likely to continue to rise for the urban living advantages associated with renewable city technologies and structures.

### Sustainable

#### It’s sustainable.

Radelet ’16 (Steven; February 2016; Ph.D. and M.P.P. from Harvard University, B.A. from Central Michigan University, Distinguished Professor of the Practice of Development, and is Director of the Global Human Development Program at Georgetown University, former Professor of Government and Economics at Harvard University, former economic advisor to President Sirleaf of Liberia; Foreign Affairs, “Prosperity Rising,” https://www.foreignaffairs.com/articles/2015-12-14/prosperity-rising)

Since the early 1990s, daily life in poor countries has been changing profoundly for the better: **one billion people** have escaped extreme poverty, average **incomes have doubled**, infant death **rates have plummeted**, millions more girls have enrolled in school, **chronic hunger** has been cut almost in half, deaths from malaria and other diseases have declined dramatically, **democracy has spread** far and wide, and the incidence of war—even with Syria and other conflicts—has fallen by half. This unprecedented progress goes way beyond China and India and has touched hundreds of millions of people in dozens of developing countries across the globe, from Mongolia to Mozambique, Bangladesh to Brazil. Yet few people are aware of these achievements, even though, in aggregate, they rank among the **most important in human history**. In 2013, the Swedish survey organization Novus Group International asked Americans how they thought the share of the world’s population living in extreme poverty had changed over the last two decades. Sixty-six percent of respondents said that they thought it had doubled, and another 29 percent said that it hadn’t changed. Only five percent knew (or guessed) the truth: that the share of people living in extreme **poverty had fallen by half**. Perhaps that ignorance explains why Washington has done so little to take advantage of these promising trends, giving only tepid support to nascent democracies, making limited investments in economic development and in new health and agricultural technologies, and failing to take the lead in building more **effective international institutions**. Whatever the reason, many developing countries are now responding to what they perceive as the United States’ indifference by looking elsewhere—especially toward China—for deeper engagement and advice on how to keep growing. At the same time, climate change, the slowdown in global growth, and rising tensions in the Middle East and beyond have begun to **threaten further progress**. As a result, the United States now risks missing out on a **historic chance** to strengthen its global leadership and help create a safer, more prosperous, and more democratic world—just at the moment when it could help the most. ONE GIANT LEAP Global poverty is falling faster today than at any time in human history. In 1993, about two billion people were trapped in extreme poverty (defined by the World Bank as living on less than $1.90 per day); by 2012, that number had dropped to less than one billion. The industrialization of China is a big part of the story, of course, but even excluding that country, the number of extreme poor has fallen by more than 400 million. Since the 1980s, **more than 60 countries** have reduced the number of their citizens who are impoverished, even as their overall populations have grown. This decline in poverty has gone hand in hand with much **faster economic growth**. Between 1977 and 1994, the growth in per capita GDP across the developing countries averaged zero; since 1995, that figure has shot up to three percent. Again, the change is widespread: between 1977 and 1994, only 21 developing countries (out of 109 with populations greater than one million) exceeded two percent annual per capita growth, but between 1995 and 2013, 71 such countries did so. And going backward has become much less common: in the earlier period, more than 50 developing countries recorded negative growth, but in the later one, just ten did. The **improvements in health** have been even bigger. In 1960, 22 percent of children in developing countries died before their fifth birthday, but by 2013, only five percent did. Diarrhea killed five million children a year in 1990 but claimed fewer than one million in 2014. **Half as many people** now **die** from malaria as did in 2000, and deaths from tuberculosis and AIDS have both dropped by a third. The share of people living with chronic hunger has fallen by almost half since the mid-1990s. **Life expectancy** at birth in developing countries has **lengthened by** nearly **one-third**, from 50 years in 1960 to 65 years today. These improvements in health have left no country untouched, even the worst-governed ones. Consider this: the rate of child death has declined in every single country (at least those where data are available) since 1980. Meanwhile, far more children are enrolling in and completing school. In the late 1980s, only 72 percent of all primary-school-age children attended school; now, the figure exceeds 87 percent. Girls in developing countries have enjoyed the biggest gains. In 1980, only half of them finished primary school, whereas four out of five do so today. These leaps in education are beginning to translate into better-skilled workers. Then there is the shift to democracy. Prior to the 1980s, most developing countries were run by left- or right-wing dictators. Coups and countercoups, violence and assassinations, human rights abuses—all formed part of regular political life. But starting in the 1980s, dictators began to fall, a process that accelerated after the Cold War. In 1983, only 17 of 109 developing countries qualified as democracies, based on data from Freedom House and the Center for Systemic Peace; by 2013, the number had **more than tripled**, to 56 (and that’s not counting the many more developing countries with populations of less than one million). As those numbers suggest, power today is far more likely to be transferred through the ballot box than through violence, and elections in most countries have become fairer and more transparent. Twenty years ago, few Indonesians could have imagined that a furniture maker from central Java would beat one of Suharto’s relatives in a free and fair election, as Joko Widodo did in 2014. Nor would many have predicted that Nigeria, then still under military rule, would in 2015 mark its first peaceful transfer of power between parties, or that Myanmar (also called Burma) would hold its most successful democratic election the same year. Across the developing world, individual freedoms and rights are honored to a much greater degree, human rights **abuses are rarer**, and legislative bodies have more power. Yes, many of these new democracies have problems. And yes, the march toward democracy has slowed since 2005—and even reversed in some countries, such as Thailand and Venezuela. But in many more—from Brazil to Mongolia to Senegal—democracy has deepened. Never before in history have so many **developing countries been so democratic**. As states have become wealthier and more democratic, **conflict and violence** within them have declined. Those who think otherwise should remember that as recently as the 1980s and early 1990s, much of the world was aflame, from Central America to Southeast Asia to West Africa. There were half as many civil wars in the last decade as there were in the 1980s, and the number of people killed in armed conflicts has **fallen by three-quarters**. Three major forces sparked this great surge in development progress. First, the end of the Cold War brought an end to the superpowers’ support for some of the world’s nastiest dictators and reduced the frequency of conflict. As ideas about economic and political governance began to change, developing countries introduced more market-based economic systems and more democracy. Second, globalization created vast new opportunities for economic growth. Increased flows of trade, investment, information, and technology created more jobs and improved living standards. Third, new and more effective leaders—in politics, business, religion, and civil society—began to forge deep change. Where courageous figures, such as Nelson Mandela in South Africa, stepped forward, countries progressed; where old-style dictators, such as Robert Mugabe in Zimbabwe, remained in power, countries languished. This **incredibly wide-ranging progress** should not obscure the considerable work that remains: progress has not reached everyone, everywhere. One billion people still live in extreme poverty, six million children die every year from preventable diseases, too few girls get the education they deserve, and too many people suffer under dictatorships. Countries such as Haiti, North Korea, Uzbekistan, and Zimbabwe lag far behind. But the fact remains that an **enormous transformation** is under way—one that has already substantially improved the lives of hundreds of millions of people. WIN-WIN The United States should welcome and encourage this progress. For starters, broad-based development **enhances global security**. It is not true that poverty necessarily breeds terrorism, as some argue—after all, most poor people are not terrorists, and many terrorists are not poor. But it is true that poor states tend to be weak states unable to prevent **terrorist and criminal networks** from operating on their soil. Sustained development strengthens government institutions and reduces the need for outside intervention. As former U.S. Secretary of Defense Robert Gates put it, “Development is a lot cheaper than sending soldiers.” Development also builds states’ capacities to fight pandemic disease. Guinea, Liberia, and Sierra Leone were overwhelmed by Ebola in 2014 largely because they all had weak health systems. The same was true in many of the countries hit hardest by the HIV/AIDS epidemic decades ago. As poor countries grow wealthier, however, they become better equipped to **fight diseases** that can spread quickly beyond their borders. A more prosperous developing world also benefits the U.S. economy. The spread of economic growth creates **new markets** for American businesses not just in China but also in Brazil, Indonesia, South Africa, and beyond. Developing countries are buying more and more aircraft, automobiles, semiconductors, medical equipment, pharmaceuticals, consultancy services, and entertainment. Although the growth in trade with developing countries has slowed during the last year, their economies will no doubt remain major market opportunities for U.S. companies. In 1990, such states accounted for one-third of the global economy; today, their share is half, and they purchase more than half of U.S. exports. In 2011, Walmart spent $2.4 billion to acquire a controlling share of a holding company that operates more than 350 retail stores in South Africa and 11 other African countries, signaling a level of interest in African consumers that would have been unimaginable two decades ago. To be sure, emerging markets also create competition for U.S. businesses and hardship for American workers who lose their jobs as a result. But they also create many new jobs, as American firms expand abroad and as companies in the developing world send more capital to the West. Moreover, developing countries are increasingly coming up with their own **innovations** and **technologies**, in medicine, agriculture, energy, and more. The United States should respond to this growing competition not with protectionism but by strengthening its own capacities: rebuilding its **infrastructure, improving** its **educational** system, and investing in new technologies. Finally, development helps spread and deepen the values that Americans hold dear: openness, economic opportunity, democracy, and freedom. These values tend to go hand in hand with growing prosperity: as incomes rise, citizens demand greater freedoms. History suggests that even governments that do not welcome these ideas eventually embrace them or are replaced by those that do. And as more developing countries achieve progress under market-based economic systems and democracy, other countries seek to **emulate the model**. The United States and Europe have a strong self-interest in encouraging this process, since it will enhance global stability and add to the number of like-minded partners that can help address future challenges. SUSTAINING THE SURGE What makes all this progress especially impressive is that it has continued despite a number of major shocks that in an earlier age could well have stopped it: the outbreak of the HIV/AIDS pandemic in the 1980s, the Asian financial crisis in 1997–98, the 9/11 attacks, the global food crisis of 2007–8, and the global financial crisis of 2008. In each case, pundits predicted that the disaster of the day would set back progress. Yet in each case, the gains continued. There are good reasons to believe they can continue well into the future. The forces that sparked these **changes were fundamental**, not transitory. Governments have learned from their mistakes and gotten much better at managing inevitable downturns. Global integration has made critical technologies available to more and more people. **State institutions** have become more effective, with improved (if imperfect) legal systems, clearer property rights, and greater respect for individual liberties. Democratic rules and norms governing the transfer of political power, free speech, and accountability have become more deeply entrenched. Civil society groups are more active. These deep-seated changes have put enormous additional gains well within reach. If **economic growth proceeds** along the lines of most projections over the next two decades, some 700 million more people will escape extreme poverty. Per capita incomes in poor countries will double again, **millions of** childhood **deaths** will be avoided, **tens of millions** of children will get the education they deserve, hunger will decline, and basic rights and freedoms will spread further. At least, that’s what should happen—but none of these future gains is guaranteed. Growth has slowed markedly since 2008 in emerging economies such as Brazil and China and throughout the developing world. Russia, Thailand, and Venezuela have turned less democratic, and South Africa and Turkey seem to be headed in that direction as well. The Middle East has seen the return of conflict and **authoritarian rule**. China’s aggressive actions in the South China Sea could **spark a major conflict** that could kill tens of thousands of people and devastate the region’s economies. Outbreaks of SARS and the H1N1 and Ebola viruses underscore humanity’s vulnerability to disease, and many doctors worry that growing resistance to antibiotics could reverse some of the hard-fought gains in health. Meanwhile, global population is on track to exceed nine billion by 2050, and the combination of more people, higher incomes, and warmer climates will place enormous strains on the world’s supplies of fresh water, food, and energy. Although there are ample grounds for pessimism, the doomsayers continue to **underestimate humanity’s growing ability** to cooperate in the face of new challenges. In the eighteenth century, when Thomas Malthus looked at population growth and foresaw catastrophic famine, he failed to appreciate the advances in agriculture, health, and governance that human ingenuity could create. The same was true for those that predicted a population disaster in Asia in the 1960s and 1970s. Today, the problems facing developing countries are plain to see, while the new ideas and innovations that will overcome them are harder to picture. Continued progress isn’t automatic or guaranteed. But with smart choices, it is within reach. LEADING BY EXAMPLE Most of the key choices will be made in developing countries themselves. Sustaining progress will require leaders there to reduce their countries’ dependence on natural resources, make their economies more inclusive, invest more in health and education, expand opportunities for women, and strengthen democracy and the rule of law. Yet the future of development will also **depend on the** actions of the **world’s leading countries**, since poorer countries can prosper only in a strong global system. The United States must do its part by regaining its economic leadership through major investments in infrastructure, education, and technological advances in health, agriculture, and alternative fuels. It must act to fix its long-term budget problems by improving the solvency of Social Security, Medicare, and Medicaid and strengthen the financial system through better regulation. The country must also do a much better job of leading by **example on democracy**. Deep political polarization, the lack of substantive debate, the unwillingness to compromise, misguided foreign policy adventurism, and the Great Recession have made liberal democracy look unattractive and ineffective. That malaise matters, because many developing countries are now engaged in a battle of ideas over which economic and political model they should follow. On the one side stands the model that has prevailed in the West since World War II: market capitalism coupled with **liberal democracy**. On the other is the model practiced by China, Vietnam, Ethiopia, and, increasingly, Russia, among others: state capitalism coupled with authoritarian rule. And there’s yet one more option, with a smaller but more dangerous following: religious fundamentalism, as promulgated by Iran and Saudi Arabia and groups such as the Islamic State (or ISIS) and Boko Haram in Nigeria. As the Western countries struggle and China continues to rise, authoritarian capitalism is becoming more appealing. Consider Beijing’s ties to Africa. China purchased $26 billion in imports from the continent in 2013; the United States purchased $9 billion. Chinese investment in Africa has been growing by 50 percent per year since 2000, whereas U.S. investment is growing by 14 percent per year. Make no mistake: many Africans still prefer to follow the American model and view China with suspicion. But those attitudes are beginning to shift, and Beijing’s apparent ability to get things done will only enhance China’s appeal, especially if Washington seems to talk big but deliver little. THE NEXT SURGE FORWARD Aside from the broader task of getting their own houses in order, the United States and other Western powers should also assert leadership in several specific areas to **keep the progress going**. The first is climate change, which presents one of the greatest threats to poverty reduction. Most of the world’s poor countries had little to do with creating the problem, yet they will bear the brunt of the damage. Rising sea levels, changing rainfall patterns, higher temperatures, and dwindling water supplies will derail progress, will undermine global food production, and could engender major conflict. Developing countries have an important role to play in curbing emissions, but they will not switch to low-carbon fuels and other clean technologies if their developed-world counterparts do not. Washington has taken important first steps to reduce power-plant emissions and raise automotive fuel-efficiency standards, but there is a very long way to go. Second, leading countries—especially the United States—should invest more in **technological innovation**. Much of the credit for recent improvements in living standards goes to vaccines, medicines, high-yielding seed varieties, cell phones, and the Internet. These new technologies (alongside old ones such as electricity and paved roads) have not yet reached everywhere, so simply making them more widely available would do wonders. But sustaining progress for the next several decades will also require **significant investments** in new vaccines, more powerful drugs, drought- and heat-resistant seeds, desalination techniques, and clean energy.

### Climate

#### Capitalism solves environmental crisis - industrial development, technological advances, and any alternative fails

Zitelmann 20 [(Dr. Rainer, a historian and sociologist. He is also a world-renowned author, successful businessman and real estate investor. Zitelmann has written a total of 24 books and has a doctorate in political science and sociology) “‘System Change Not Climate Change’: Capitalism And Environmental Destruction” Forbes, 7/13/2020] BC

The Price Of Growth—Destruction Of The Environment?

But isn’t there a price for this growth: environment devastation? Of course, nobody would deny that industrialization causes environmental problems. But the assertion that growth automatically leads to ever accelerating environmental degradation is simply false. Yale University’s Environmental Performance Index (EPI) uses 16 indicators to rank countries on environmental health, air quality, water, biodiversity, natural resources and pollution. These indicators have been selected to reflect both the current baseline and the dynamics of national ecosystems. One of the Index’s most striking findings is that there is a strong correlation between a state’s wealth and its environmental performance. Most developed capitalist countries achieve high environmental standards. Those countries with the worst EPI scores, such as Ethiopia, Mali, Mauritania, Chad and Niger, are all poor. They have both low investment capacity for infrastructure, including water and sanitation, and tend to have weak environmental regulatory authorities.

Contrary to prevailing perceptions, industrial development and technological advances have contributed significantly to relieving the burden on the environment. Both Indur Goklany in his book The Improving State of the World and Steven Pinker in chapter ten (“The Environment”) of his book Enlightenment Now demonstrate that we are not only living longer, healthier lives in unprecedented prosperity, but we are also doing so on a comparatively clean planet.

Researchers have confirmed that economic freedom—in other words, more capitalism—leads to higher, not lower, environmental quality.

Every year, the Heritage Foundation compiles its Index of Economic Freedom, which analyzes individual levels of economic freedom, and thus capitalism, in countries around the world. The Heritage Foundation’s researchers also measure the correlation between each country’s environmental performance and its economic freedom. The results couldn’t be clearer: the world’s most economically free countries achieve the highest environmental performance rankings with an average score of 76.1, followed by the countries that are “mostly free,” which score an average of 69.5. In stark contrast, the economically “repressed” and “mostly unfree” countries all score less than 50 for environmental performance.

Is Government The Best Solution To Environmental Problems?

Anti-capitalists frequently claim that central government is the best solution to environmental problems. And there is no doubt that state regulations to safeguard the environment are important. But state regulations, cited by anti-capitalists as a panacea for environmental issues, often achieve the opposite of what they were intended to do. Hardly any other country in the world touts its green credentials as much as Germany. According to even the most conservative estimates, Germany’s so-called “energy transition” is set to cost a total of almost €500 billion by 2025.

But the results of this massive investment is sobering, as an analysis by McKinsey reveals, “Germany is set to miss several key energy transition targets for the year 2020, and the country’s high power supply security is at risk unless new generation capacity and grid infrastructure are built in time for the coal and nuclear exit and electrification of transportation networks is accelerated.”

For decades, environmentalists in Germany focused on shutting down nuclear power plants. However, the phasing out of nuclear power has left Germany in a poor position in terms of CO2 emissions compared to other countries. It is not without good reason that Germany’s energy policy has been described as the dumbest in the world.

The latest generation of nuclear power plants are much safer than their predecessors. Despite what environmentalists might claim, impartial calculations have confirmed that it is impossible to meet the world’s energy needs from solar and wind power alone. Enlightened environmentalists are therefore now calling for nuclear power to be rightfully included in the fight against climate change. And yet, this is precisely what is being prevented in Germany by politicians—not capitalism. This example, just one of many, shows that government environmental policy is often ineffective. In some instances, it even achieves the opposite of what it was originally intended to, i.e. it exacerbates existing environmental problems.

It is also wrong to think that capitalism necessarily leads to ever greater waste of limited natural resources. Just take the smartphone for example, one of the most environmentally friendly of capitalism’s many achievements. With just one small device, a whole plethora of devices that used to consume resources in the past, such as the telephone, camera, calculator, navigation system, dictation machine, alarm clock, flashlight and many others, have been replaced. Smartphones also help to reduce the consumption of paper as many people choose not to take notes on paper and, for example, use their iPhone instead of a calendar to enter appointments.

Those who call for “system change” instead of “climate change” do not usually say which system they would prefer. All they are really sure of is that any new system should not be based on free market economics and that the state should play the decisive role. The simple fact is that socialism has failed in every country every time it has been tried—and socialism has damaged the environment more than any capitalist system. Murray Feshbach documents examples of the environmental destruction wrought by socialism in his book Ecological Disaster. Cleaning Up the Hidden Legacy of the Soviet Regime. As the book progresses through chapters such as “A Nuclear Plague,” “Dying Lakes, Rivers, and Inland Seas” and “Pollution of the Air and Land,” it becomes clear that this non-capitalist system was responsible for the greatest environmental destruction in history. Anti-capitalists may well reply that they do not want a system like the Soviet Union. And yet, they cannot name a single real-world system—at any time in the history of mankind—that provides better environmental solutions than capitalism.

#### It’s key to CCS – link-turns every impact.

Graciela ‘16 (/16 – Professor of Economics and of Statistics at Columbia University and Visiting Professor at Stanford University, and was the architect of the Kyoto Protocol carbon market (being interviewed by Marcus Rolle, freelance journalist specializing in environmental issues and global affairs, “Reversing Climate Change: Interview with Graciela Chichilnisky,” http://www.globalpolicyjournal.com/blog/01/09/2016/reversing-climate-change-interview-graciela-chichilnisky)//cmr

GC: Green capitalism is a new economic system that values the natural resources on which human survival depends. It fosters a harmonious relationship with our planet, its resources and the many species it harbors. It is a new type of market economics that addresses both equity and efficiency. Using carbon negative technology™ it helps reduce carbon in the atmosphere while fostering economic development in rich and developing nations, for example in the U S., EU, China and India. How does this work? In a nutshell Green Capitalism requires the creation of global limits or property rights nation by nation for the use of the atmosphere, the bodies of water and the planet’s biodiversity, and the creation of new markets to trade these rights from which new economic values and a new concept of economic progress emerges updating GDP as is now generally agreed is needed. Green Capitalism is needed now to help avert climate change and achieve the goals of the 2015 UN Paris Agreement, which are very ambitious and universally supported but have no way to be realized within the Agreement itself. The Carbon Market and its CDM play critical roles in the foundation of Green Capitalism, creating values to redefine GDP. These are needed to remain within the world’s “CO2 budget” and avoid catastrophic climate change. As I see it, the building blocks for Green Capitalism are then as follows; (1) Global limits nation by nation in the use of the planet’s atmosphere, its water bodies and biodiversity - these are global public goods. (2) New global markets to trade these limits, based on equity and efficiency. These markets are relatives of the Carbon Market and the SO2 market. The new market create new measures of economic values and update the concept of GDP. (3) Efficient use of Carbon Negative Technologies to avert catastrophic climate change by providing a smooth transition to clean energy and ensuring economic prosperity in rich and poor nations. These building blocks have immediate practical implications in reversing climate change and can assist the ambitious aims of Paris COP21 become a reality. MR: What is the greatest advantage of the new generation technologies that can capture CO2 from the air? GC: These technologies build carbon negative power plants, such as Global Thermostat, that clean the atmosphere of CO2 while producing electricity. Global Thermostat is a firm that is commercializing a technology that takes CO2 out of air and uses mostly low cost residual heat rather than electricity to drive the capture process, making the entire process of capturing CO2 from the atmosphere very inexpensive. There is enough residua heat in a coal power plant that it can be used to capture twice as much CO2 as the plant emits, thus transforming the power plant into a “carbon sink.” For example, a 400 MW coal plant that emits 1 million tons of CO2 per year can become a carbon sink absorbing a net amount of 1 million tons of CO2 instead. Carbon capture from air can be done anywhere and at any time, and so inexpensively that the CO2 can be sold for industrial or commercial uses such as plastics, food and beverages, greenhouses, bio-fertilizers, building materials and even enhanced oil recovery, all examples of large global markets and profitable opportunities. Carbon capture is powered mostly by low (85°C) residual heat that is inexpensive, and any source will do. In particular, renewable (solar) technology can power the process of carbon capture. This can help advance solar technology and make it more cost-efficient. This means more energy, more jobs, and it also means economic growth in developing nations, all of this while cleaning the CO2 in the atmosphere. Carbon negative technologies can literally transform the world economy. MR: One final question. You distinguish between long-run and short-run strategies in the effort to reverse climate change. Would carbon negative technologies be part of a short-run strategy? GC: Long-run strategies are quite different from strategies for the short-run. Often long-run strategies do not work in the short run and different policies and economic incentives are needed. In the long run the best climate change policy is to replace fossil fuel sources of energy that by themselves cause 45% of the global emissions, and to plant trees to restore if possible the natural sources and sinks of CO2. But the fossil fuel power plant infrastructure is about 87% of the power plant infrastructure and about $45-55 trillion globally. This infrastructure cannot be replaced quickly, certainly not in the short time period in which we need to take action to avert catastrophic climate change. The issue is that CO2 once emitted remains hundreds of years in the atmosphere and we have emitted so much that unless we actually remove the CO2 that is already there, we cannot remain long within the carbon budget, which is the concentration of CO2 beyond which we fear catastrophic climate change. In the short run, therefore, we face significant time pressure. The IPCC indicates in its 2014 5th Assessment Report that we must actually remove the carbon that is already in the atmosphere and do so in massive quantities, this century (p. 191 of 5th Assessment Report). This is what I called a carbon negative approach, which works for the short run. Renewable energy is the long run solution. Renewable energy is too slow for a short run resolution since replacing a $45-55 trillion power plant infrastructure with renewable plants could take decades. We need action sooner than that. For the short run we need carbon negative technologies that capture more carbon than what is emitted. Trees do that and they must be conserved to help preserve biodiversity. Biochar does that. But trees and other natural sinks are too slow for what we need today. Therefore, negative carbon is needed now as part of a blueprint for transformation. It must be part of the blueprint for Sustainable Development and its short term manifestation that I call Green Capitalism, while in the long run renewable sources of energy suffice, including Wind, Biofuels, Nuclear, Geothermal, and Hydroelectric energy. These are in limited supply and cannot replace fossil fuels. Global energy today is roughly divided as follows: 87% is fossil, namely natural gas, coal, oil; 10% is nuclear, geothermal, and hydroelectric, and less than 1% is solar power — photovoltaic and solar thermal. Nuclear fuel is scarce and nuclear technology is generally considered dangerous as tragically experienced by the Fukushima Daichi nuclear disaster in Japan, and it seems unrealistic to seek a solution in the nuclear direction. Only solar energy can be a long term solution: Less than 1% of the solar energy we receive on earth can be transformed into 10 times the fossil fuel energy used in the world today. Yet we need a short-term strategy that accelerates long run renewable energy, or we will defeat long-term goals. In the short term as the IPCC validates, we need carbon negative technology, carbon removals. The short run is the next 20 or 30 years. There is no time in this period of time to transform the entire fossil infrastructure — it costs $45-55 trillion (IEA) to replace and it is slow to build. We need to directly reduce carbon in the atmosphere now. We cannot use traditional methods to remove CO2 from smokestacks (called often Carbon Capture and Sequestration, CSS) because they are not carbon negative as is required. CSS works but does not suffice because it only captures what power plants currently emit. Any level of emissions adds to the stable and high concentration we have today and CO2 remains in the atmosphere for years. We need to remove the CO2 that is already in the atmosphere, namely air capture of CO2 also called carbon removals. The solution is to combine air capture of CO2 with storage of CO2 into stable materials such as biochar, cement, polymers, and carbon fibers that replace a number of other construction materials such as metals. The most recent BMW automobile model uses only carbon fibers rather than metals. It is also possible to combine CO2 to produce renewable gasoline, namely gasoline produced from air and water. CO2 can be separated from air and hydrogen separated from water, and their combination is a well-known industrial process to produce gasoline. Is this therefore too expensive? There are new technologies using algae that make synthetic fuel commercially feasible at competitive rates. Other policies would involve combining air capture with solar thermal electricity using the residual solar thermal heat to drive the carbon capture process. This can make a solar plant more productive and efficient so it can out-compete coal as a source of energy. In summary, the blueprint offered here is a private/public approach, based on new industrial technology and financial markets, self-funded and using profitable greenmarkets, with securities that utilize carbon credits as the “underlying” asset, based on the KP CDM, as well as new markets for biodiversity and water providing abundant clean energy to stave off impending and actual energy crisis in developing nations, fostering mutually beneficial cooperation for industrial and developing nations. The blueprint proposed provides the two sides of the coin, equity and efficiency, and can assign a critical role for women as stewards for human survival and sustainable development. My vision is a carbon negative economy that represents green capitalism in resolving the Global Climate negotiations and the North–South Divide. Carbon negative power plants and capture of CO2 from air and ensure a clean atmosphere together innovation and more jobs and exports: the more you produce and create jobs the cleaner becomes the atmosphere. In practice, Green Capitalism means economic growth that is harmonious with the Earth resources.

## Space Col

#### Colonization impossible –

#### B. Time and energy requirements.

**Stross 07**, Charles: technical author, freelance journalist, and author of The Web Architect’s Handbook [“The High Frontier, Redux,” http://www.antipope.org/charlie/blog-static/2007/06/the\_high\_frontier\_redux.html]

Historically, crossing oceans and setting up farmsteads on new lands conveniently stripped of indigenous inhabitants by disease has been a cost-effective proposition. But the scale factor involved in space travel is strongly counter-intuitive. Here's a handy metaphor: let's approximate one astronomical unit — the distance between the Earth and the sun, roughly 150 million kilometres, or 600 times the distance from the Earth to the Moon — to one centimetre. Got that? 1AU = 1cm. (You may want to get hold of a ruler to follow through with this one.) The solar system is conveniently small. Neptune, the outermost planet in our solar system, orbits the sun at a distance of almost exactly 30AU, or 30 centimetres — one foot (in imperial units). Giant Jupiter is 5.46 AU out from the sun, almost exactly two inches (in old money). We've sent space probes to Jupiter; they take two and a half years to get there if we send them on a straight Hohmann transfer orbit, but we can get there a bit faster using some fancy orbital mechanics. Neptune is still a stretch — only one spacecraft, Voyager 2, has made it out there so far. Its journey time was 12 years, and it wasn't stopping. (It's now on its way out into interstellar space, having passed the heliopause some years ago.) The Kuiper belt, domain of icy wandering dwarf planets like Pluto and Eris, extends perhaps another 30AU, before merging into the much more tenuous Hills cloud and Oort cloud, domain of loosely coupled longzperiod comets. Now for the first scale shock: using our handy metaphor the Kuiper belt is perhaps a metre in diameter. The Oort cloud, in contrast, is as much as 50,000 AU in radius — its outer edge lies half a kilometre away. Got that? Our planetary solar system is 30 centimetres, roughly a foot, in radius. But to get to the edge of the Oort cloud, you have to go half a kilometre, roughly a third of a mile. Next on our tour is Proxima Centauri, our nearest star. (There might be a brown dwarf or two lurking unseen in the icy depths beyond the Oort cloud, but if we've spotted one, I'm unaware of it.) Proxima Centauri is 4.22 light years away.A light year is 63.2 x 103 AU, or 9.46 x 1012 Km. So Proxima Centauri, at 267,000 AU, is just under two and a third kilometres, or two miles (in old money) away from us. But Proxima Centauri is a poor choice, if we're looking for habitable real estate. While exoplanets are apparently common as muck, terrestrial planets are harder to find; Gliese 581c, the first such to be detected (and it looks like a pretty weird one, at that), is roughly 20.4 light years away, or using our metaphor, about ten miles. Try to get a handle on this: it takes us 2-5 years to travel two inches. But the proponents of interstellar travel are talking about journeys of ten miles. That's the first point I want to get across: that if the distances involved in interplanetary travel are enormous, and the travel times fit to rival the first Australian settlers, then the distances and times involved in interstellar travel are mind-numbing. This is not to say that interstellar travel is impossible; quite the contrary. But to do so effectively you need either (a) outrageous amounts of cheap energy, or (b) highly efficient robot probes, or (c) a magic wand. And in the absence of (c) you're not going to get any news back from the other end in less than decades. Even if (a) is achievable, or by means of (b) we can send self-replicating factories and have them turn distant solar systems into hives of industry, and more speculatively find some way to transmit human beings there, they are going to have zero net economic impact on our circumstances (except insofar as sending them out costs us money). What do I mean by outrageous amounts of cheap energy? Let's postulate that in the future, it will be possible to wave a magic wand and construct a camping kit that encapsulates all the necessary technologies and information to rebuild a human civilization capable of eventually sending out interstellar colonization missions — a bunch of self-replicating, self-repairing robotic hardware, and a downloadable copy of the sum total of human knowledge to date. Let's also be generous and throw in a closed-circuit life support system capable of keeping a human occupant alive indefinitely, for many years at a stretch, with zero failures and losses, and capable where necessary of providing medical intervention. Let's throw in a willing astronaut (the fool!) and stick them inside this assembly. It's going to be pretty boring in there, but I think we can conceive of our minimal manned interstellar mission as being about the size and mass of a Mercury capsule. And I'm going to nail a target to the barn door and call it 2000kg in total. (Of course we can cut corners, but I've already invoked self-replicating robotic factories and closed-cycle life support systems, and those are close enough to magic wands as it is. I'm going to deliberately ignore more speculative technologies such as starwisps, mind transfer, or AIs sufficiently powerful to operate autonomously — although I used them shamelessly in my novel Accelerando. What I'm trying to do here is come up with a useful metaphor for the energy budget realistically required for interstellar flight.) Incidentally, a probe massing 1-2 tons with an astronaut on top is a bit implausible, but a 1-2 ton probe could conceivably carry enough robotic instrumentation to do useful research, plus a laser powerful enough to punch a signal home, and maybe even that shrink-wrapped military/industrial complex in a tin can that would allow it to build something useful at the other end. Anything much smaller, though, isn't going to be able to transmit its findings to us — at least, not without some breakthroughs in communication technology that haven't shown up so far. Now, let's say we want to deliver our canned monkey to Proxima Centauri within its own lifetime. We're sending them on a one-way trip, so a 42 year flight time isn't unreasonable. (Their job is to supervise the machinery as it unpacks itself and begins to brew up a bunch of new colonists using an artificial uterus. Okay?) This means they need to achieve a mean cruise speed of 10% of the speed of light. They then need to decelerate at the other end. At 10% of c relativistic effects are minor — there's going to be time dilation, but it'll be on the order of hours or days over the duration of the 42-year voyage. So we need to accelerate our astronaut to 30,000,000 metres per second, and decelerate them at the other end. Cheating and using Newton's laws of motion, the kinetic energy acquired by acceleration is 9 x 1017 Joules, so we can call it 2 x 1018 Joules in round numbers for the entire trip. NB: This assumes that the propulsion system in use is 100% efficient at converting energy into momentum, that there are no losses from friction with the interstellar medium, and that the propulsion source is external — that is, there's no need to take reaction mass along en route. So this is a lower bound on the energy cost of transporting our Mercury-capsule sized expedition to Proxia Centauri in less than a lifetime. To put this figure in perspective, the total conversion of one kilogram of mass into energy yields 9 x 1016 Joules. (Which one of my sources informs me, is about equivalent to 21.6 megatons in thermonuclear explosive yield). So we require the equivalent energy output to 400 megatons of nuclear armageddon in order to move a capsule of about the gross weight of a fully loaded Volvo V70 automobile to Proxima Centauri in less than a human lifetime. That's the same as the yield of the entire US Minuteman III ICBM force. For a less explosive reference point, our entire planetary economy runs on roughly 4 terawatts of electricity (4 x 1012 watts). So it would take our total planetary electricity production for a period of half a million seconds — roughly 5 days — to supply the necessary va-va-voom.

#### D. Launch costs.

**Laubscher 07**, Bryan: Los Alamos National Laboratory project leader [“Where Can We Afford to Go with Rockets?” http://blog.spaceelevator.com/archives/2007/07/]

Using the value of $10,000/kg, the cost of moving one kilogram of payload from the surface of Earth to the vicinity of Mars is $34,000. The cost to the lunar surface is greater. I claim that this is good to at least a factor of two barring a glacial bureaucracy that would drive the cost higher than $68,000/kg. I do not foresee the lower limit of $17,000 per kilogram being realized but most people would agree it is a lower limit. NASA’s Space Exploration Initiative called for a Mars rocket with a mass of 1000 metric tons which corresponds to $340 billion launch cost to Mars! The innovative Mars Direct plans called for a Mars spacecraft of 87 tons implying $2.9 billion launch cost to Mars! These costs do not include research, development, fabrication, construction or test flights. Also, these costs are not rigorous since these ships were to be constructed and launched from LEO so the mass may include their fuel to Mars – my source did not break down the mass. If the fuel to Mars is included, then the launch costs change to $100 billion and $853 million, respectively. In either case, the magnitude of these numbers is useful to realize what we are looking at in terms of launch costs. A manned outpost or colony would require many, many tons of shelter, equipment, food, water etc. to be sent to Mars over a long period of time. If the plan is to “live off the land”, initial missions will still require tremendous amounts of logistical support. The moon requires even more in-situ support since it lacks the inherent resources and advantages of Mars. Of course many fewer resources are required for the 3-day trip to the moon versus the many months travel time to Mars. Conclusion My question is: How much exploration, especially manned exploration, of the moon and Mars will we be doing at $34,000 per kilogram? My guess is that we’ll do pretty much what we’ve done over the last 35 years since the last Apollo mission.