

# The Uninhabitable Earth

*Life After Warming*

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# Economic Collapse

**T**he murmuring mantra of global markets—which prevailed between the end of the Cold War and the onset of the Great Recession, promising something like their own eternal reign—is that economic growth will save us from anything and everything.

But in the aftermath of the 2008 crash, a number of historians and iconoclastic economists studying what they call “fossil capitalism” have started to suggest that the entire history of swift economic growth, which began somewhat suddenly in the eighteenth century, is not the result of innovation or the dynamics of free trade, but simply our discovery of fossil fuels and all their raw power—a onetime injection of that new “value” into a system that had previously been characterized by unending subsistence living. This is a minority view, among economists, and yet the précis version of the perspective is quite powerful. Before fossil fuels, nobody lived better than their parents or grandparents or ancestors from five hundred years before, except in the immediate aftermath of a great plague like the Black Death, which allowed the lucky survivors to gobble up the resources liberated by mass graves.

In the West especially, we tend to believe we’ve invented our way out of that endless zero-sum, scratch-and-claw resource scramble—both with particular innovations, like the steam engine and computer, and with the development of a dynamic capitalistic system to reward them. But scholars like Andreas Malm have a different perspective: we have been extracted from that muck only by a singular innovation, one engineered not by entrepreneurial human hands but in fact millions of years before the first ones ever dug at the earth—engineered by time and geologic weight, which many millennia ago pressed the fossils of Earth’s earlier carbon-based life forms (plants, small animals) into petroleum, like lemon under a press. Oil is the patrimony of the planet’s prehuman past: what stored energy the earth can produce when undisturbed for millennia. As soon as humans discovered that storehouse, they set about plundering it—so fast that, at various points over the last half century, oil forecasters have panicked about running out. In 1968, the labor historian Eric Hobsbawm wrote, “Whoever says Industrial Revolution, says cotton.” Today, he would probably substitute “fossil fuel.”

The timeline of growth is just about perfectly consistent with the burning of those fuels, though doctrinaire economists would argue there is much more to the equation of growth. Generations being as long as they are and historical memory as short, the West’s several centuries of relatively reliable and expanding prosperity have endowed economic growth with the reassuring aura of permanence: we expect it, on some continents, at least, and rage against our leaders and elites when it does not come. But planetary history is very long, and human history, though

a briefer interval, is long, too. And while the pace of technological change we call progress is today dizzying and may yet invent new ways of buffering us from the blows of climate change, it is also not hard to imagine those flush centuries, enjoyed by nations who colonized the rest of the planet to produce them, as an aberration. Earlier empires had boom years, too.

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You do not have to believe that economic growth is a mirage produced by fossil fumes to worry that climate change is a threat to it—in fact, this proposition forms the cornerstone around which an entire edifice of academic literature has been built over the last decade. The most exciting research on the economics of warming has come from Solomon Hsiang and Marshall Burke and Edward Miguel, who are not historians of fossil capitalism but who offer some very bleak analysis of their own: in a country that's already relatively warm, every degree Celsius of warming reduces growth, on average, by about one percentage point (an enormous number, considering we count growth in the low single digits as “strong”). This is the sterling work in the field. Compared to the trajectory of economic growth with no climate change, their average projection is for a 23 percent loss in per capita earning globally by the end of this century.

Tracing the shape of the probability curve is even scarier. There is a 51 percent chance, this research suggests, that climate change will reduce global output by more than 20 percent by 2100, compared with a world without warming, and a 12 percent chance that it lowers per capita GDP by 50 percent or more by then, unless emissions decline. By comparison, the Great Depression dropped global GDP by about 15 percent, it is estimated—the numbers weren't so good back then. The more recent Great Recession lowered it by about 2 percent, in a onetime shock; Hsiang and his colleagues estimate a one-in-eight chance of an ongoing and irreversible effect by 2100 that is twenty-five times worse. In 2018, a team led by Thomas Stoerk suggested that these estimates could be dramatic underestimates.

The scale of that economic devastation is hard to comprehend. Even within the postindustrial nations of the wealthy West, where economic indicators such as the unemployment rate and GDP growth circulate as though they contain the whole meaning of life in them, figures like these are a little bit hard to fathom; we've become so used to economic stability and reliable growth that the entire spectrum of conceivability stretches from contractions of about 15 percent, effects we study still in histories of the Depression, to growth about half as fast—about 7 percent, which the world as a whole last achieved during the global boom of the early 1960s. These are exceptional onetime peaks and troughs, extending for no more than a few years, and most of the time we measure economic fluctuations in ticks of decimal points—2.9 this year, 2.7 that. What climate change proposes is an economic setback of an entirely different category.

The breakdown by country is perhaps even more alarming. There are places that benefit, in the north, where warmer temperatures can improve agriculture and economic productivity: Canada, Russia, Scandinavia, Greenland. But in the mid-latitudes, the countries that produce the bulk of the world's economic activity—the United States, China—lose nearly half of their potential output. The warming near the equator is worse, with losses throughout Africa, from Mexico to Brazil,

and in India and Southeast Asia approaching 100 percent. India alone, one study proposed, would shoulder nearly a quarter of the economic suffering inflicted on the entire world by climate change. In 2018, the World Bank estimated that the current path of carbon emissions would sharply diminish the living conditions of 800 million living throughout South Asia. One hundred million, they say, will be dragged into extreme poverty by climate change just over the next decade. Perhaps “back into” is more appropriate: many of the most vulnerable are those populations that have just extracted themselves from deprivation and subsistence living, through developing-world growth powered by industrialization and fossil fuel.

And to help buffer or offset the impacts, we have no New Deal revival waiting around the corner, no Marshall Plan ready. The global halving of economic resources would be permanent, and, because permanent, we would soon not even know it as deprivation, only as a brutally cruel normal against which we might measure tiny burps of decimal-point growth as the breath of a new prosperity. We have gotten used to setbacks on our erratic march along the arc of economic history, but we know them as setbacks and expect elastic recoveries. What climate change has in store is not that kind of thing—not a Great Recession or a Great Depression but, in economic terms, a Great Dying.

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How could that come to be? The answer is partly in the preceding chapters—natural disaster, flooding, public health crises. All of these are not just tragedies but expensive ones, and beginning already to accumulate at an unprecedented rate. There is the cost to agriculture: more than three million Americans work on more than two million farms; if yields decline by 40 percent, margins will decline, too, in many cases disappearing entirely, the small farms and cooperatives and even empires of agribusinesses slipping underwater (to use the oddly apposite accountant’s metaphor) and drowning under debt all those who own and work those arid fields, many of them old enough to remember the same plains’ age of plenty. And then there is the real flooding: 2.4 million American homes and businesses, representing more than \$1 trillion in present-day value, will suffer chronic flooding by 2100, according to a 2018 study by the Union of Concerned Scientists. Fourteen percent of the real estate in Miami Beach could be flooded by just 2045. This is just within America, though it isn’t only South Florida; in fact, over the next few decades, the real-estate impact will be almost \$30 billion in New Jersey alone.

There is a direct heat cost to growth, as there is to health. Some of these effects we can see already—for instance, the warping of train tracks or the grounding of flights due to temperatures so high that they abolish the aerodynamics that allow planes to take off, which is now commonplace at heat-stricken airports like the one in Phoenix. (Every round-trip plane ticket from New York to London, keep in mind, costs the Arctic three more square meters of ice.) From Switzerland to Finland, heat waves have necessitated the closure of power plants when cooling liquids have become too hot to do their job. And in India, in 2012, 670 million lost power when the country’s grid was overwhelmed by farmers irrigating their fields without the help of the monsoon season, which never arrived. In all but the shiniest projects in all but the wealthiest parts of the world, the planet’s infrastructure was simply not built for climate change, which means the vulnerabilities are everywhere you look.

Other, less obvious effects are also visible—for instance, productivity. For the past few decades, economists have wondered why the computer revolution and the internet have not brought meaningful productivity gains to the industrialized world. Spreadsheets, database management software, email—these innovations alone would seem to promise huge gains in efficiency for any business or economy adopting them. But those gains simply haven't materialized; in fact, the economic period in which those innovations were introduced, along with literally thousands of similar computer-driven efficiencies, has been characterized, especially in the developed West, by wage and productivity stagnation and dampened economic growth. One speculative possibility: computers have made us more efficient and productive, but at the same time climate change has had the opposite effect, diminishing or wiping out entirely the impact of technology. How could this be? One theory is the negative cognitive effects of direct heat and air pollution, both of which are accumulating more research support by the day. And whether or not that theory explains the great stagnation of the last several decades, we do know that, globally, warmer temperatures do dampen worker productivity.

The claim seems both far-fetched and intuitive, since, on the one hand, you don't imagine a few ticks of temperature would turn entire economies into zombie markets, and since, on the other, you yourself have surely labored at work on a hot day with the air-conditioning out and understand how hard that can be. The bigger-picture perspective is harder to swallow, at least at first. It may sound like geographic determinism, but Hsiang, Burke, and Miguel have identified an optimal annual average temperature for economic productivity: 13 degrees Celsius, which just so happens to be the historical median for the United States and several other of the world's biggest economies. Today, the U.S. climate hovers around 13.4 degrees, which translates into less than 1 percent of GDP loss—though, like compound interest, the effects grow over time. Of course, as the country has warmed over the last decades, particular regions have seen their temperatures rise, some of them from suboptimal levels to something closer to an ideal setting, climate-wise. The greater San Francisco Bay Area, for instance, is sitting pretty right now, at exactly 13 degrees.

This is what it means to suggest that climate change is an enveloping crisis, one that touches every aspect of the way we live on the planet today. But the world's suffering will be distributed as unequally as its profits, with great divergences both between countries and within them. Already-hot countries like India and Pakistan will be hurt the most; within the United States, the costs will be shouldered largely in the South and Midwest, where some regions could lose up to 20 percent of county income.

Overall, though it will be hit hard by climate impacts, the United States is among the most well-positioned to endure—its wealth and geography are reasons that America has only begun to register effects of climate change that already plague warmer and poorer parts of the world. But in part because it has so much to lose, and in part because it so aggressively developed its very long coastlines, the U.S. is more vulnerable to climate impacts than any country in the world but India, and its economic illness won't be quarantined at the border. In a globalized world, there is what Zhengtao Zhang and others call an "economic ripple effect." They've also quantified it, and found that the impact grows along with warming. At one degree Celsius, with a decline in American GDP of 0.88 percent, global GDP would

fall by 0.12 percent, the American losses cascading through the world system. At two degrees, the economic ripple effect triples, though here, too, the effects play out differently in different parts of the world; compared to the impact of American losses at one degree, at two degrees the economic ripple effect in China would be 4.5 times larger. The radiating shock waves issuing out from other countries are smaller because their economies are smaller, but the waves will be coming from nearly every country in the world, like radio signals beamed out from a whole global forest of towers, each transmitting economic suffering.

For better or for worse, in the countries of the wealthy West we have settled on economic growth as the single best metric, however imperfect, of the health of our societies. Of course, using that metric, climate change registers—with its wildfires and droughts and famines, it registers seismically. The costs are astronomical already, with single hurricanes now delivering damage in the hundreds of billions of dollars. Should the planet warm 3.7 degrees, one assessment suggests, climate change damages could total \$551 trillion—nearly twice as much wealth as exists in the world today. We are on track for more warming still.

Over the last several decades, policy consensus has cautioned that the world would only tolerate responses to climate change if they were free—or, even better, if they could be presented as avenues of economic opportunity. That market logic was probably always shortsighted, but over the last several years, as the cost of adaptation in the form of green energy has fallen so dramatically, the equation has entirely flipped: we now know that it will be much, much more expensive to *not* act on climate than to take even the most aggressive action today. If you don't think of the price of a stock or government bond as an insurmountable barrier to the returns you'll receive, you probably shouldn't think of climate adaptation as expensive, either. In 2018, one paper calculated the global cost of a rapid energy transition, by 2030, to be negative \$26 trillion—in other words, rebuilding the energy infrastructure of the world would make us all that much money, compared to a static system, in only a dozen years.

Every day we do not act, those costs accumulate, and the numbers quickly compound. Hsiang, Burke, and Miguel draw their 50 percent figure from the very high end of what's possible—truly a worst-case scenario for economic growth under the sign of climate change. But in 2018, Burke and several other colleagues published a major paper exploring the growth consequences of some scenarios closer to our present predicament. In it, they considered one plausible but still quite optimistic scenario, in which the world meets its Paris Agreement commitments, limiting warming to between 2.5 and 3 degrees. This is probably about the best-case warming scenario we might reasonably expect; globally, relative to a world with no additional warming, it would cut per-capita economic output by the end of the century, Burke and his colleagues estimate, by between 15 and 25 percent. Hitting four degrees of warming, which lies on the low end of the range of warming implied by our current emissions trajectory, would cut into it by 30 percent or more. This is a trough twice as deep as the deprivations that scarred our grandparents in the 1930s, and which helped produce a wave of fascism, authoritarianism, and genocide. But you can only really call it a trough when you climb out of it and look back from a new peak, relieved. There may not be any such relief or reprieve from climate deprivation, and though, as in any collapse, there will be those few who find ways to benefit, the experience of most may be more like that of miners buried

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## Economic Collapse

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## “Systems”

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