# Must Growth Doom the Planet?

*Ted Nordhaus*

Five billion years from now, the Sun will run out of hydrogen. Its core will collapse and its surface will expand to millions of times its present size. As Earth is engulfed in fiery apocalypse, all economic growth will come to an end, fulfilling, at last, the long-standing prophecy of many environmental scientists.

That endless economic growth on a finite planet is impossible has been a verity passed on from generation to generation of environmentalists as deep insight. Yet it is really little more than a tautology. Given its presuppositions—that growth is "endless" and the planet "finite"—the claim cannot be anything other than true.

*Growth: From Microorganisms to Megacities*
By Vaclav Smil
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Between now and the end, though, the claim, like most tautologies, is not terribly useful, telling us little about the planet's finitude or about the actual composition and trajectory of future growth. Forecasts of collapse due to population growth, overconsumption, resource exhaustion, and pollution, dating back to the Reverend Thomas Malthus in the eighteenth century, have consistently missed the mark. In fact, humans have increasingly thrived even as our demands upon the biosphere have grown well beyond anything that early proponents of limits to economic growth could have imagined.

But the fact that cornucopians have thus far gotten the better of the argument does not mean that future ecological collapse isn't possible. The human future ultimately hinges upon questions that neither camp can answer in advance. How much more will the human population grow? How much better and more efficient will our technologies become? How quickly will our economies continue to grow and how much additional consumption can the Earth sustain?

In this way, Malthusian claims are never wrong, only early. The Sun will expand to incinerate the Earth. Economic growth will come to an end. Q.E.D.

Many of his admirers will be surprised to learn that Vaclav Smil, the renegade environmental scientist and polymath, is something of a Malthusian. Smil has gained a following among conservatives, nuclear advocates, and promoters of various other Promethean solutions to environmental problems largely because he has long been a compelling skeptic of claims that renewable energy can rapidly displace fossil fuels. But Smil is an equal opportunity critic. His skepticism about green energy is more a reflection of his distaste for techno-optimism than it is particular to solar panels or wind turbines.

In his new book *Growth: From Microorganisms to Megacities*, Smil lays out the case for limiting economic growth, taking aim at nuclear energy, the Singularity, the growth assumptions of neoclassical economists, and just about every other school of techno-optimistic thought, alongside his familiar dismissals of various Green enthusiasms. The notion that technological innovation might allow for the "decoupling" of economic growth from ecological impacts, Smil tells us, "contradicts physical laws." He approvingly quotes the economist Kenneth Boulding that "anyone who believes in indefinite growth in anything physical, on a physically finite planet, is either mad or an economist." The circular economy, the idea that we might continuously recycle water, energy, and other key resources, requires "nothing less than abolishing entropy."

*Growth* has a valedictory quality to it. Smil pulls together research, ideas, and analyses developed over a long and celebrated career. As the subtitle suggests, Smil covers patterns of growth that characterize everything from single-celled organisms to those that describe the rise and fall of great civilizations. But mostly, long sections about the rates at which deciduous forests add biomass, the relationship between animals' life expectancy and body mass, and much else are a setup for what Smil wants to say about the future of human societies. The point about the trees and the amoebas is that human societies can no more escape the laws of thermodynamics than can anything else. The only way to assure the long-term survival of human civilization, Smil argues, is to establish limits to growth "on a planetary scale."

For Smil, it all comes back to flows of energy. Energy flows determine our ability to turn all other resources into the goods and services that humans consume. Our economy, our societies, our civilization, and our survival all depend upon the availability of energy sources, our ability to harness them, and the efficiency with

which we are able to convert them into the things we want and need.

Civilization began with the use of "extrasomatic" energy sources—those beyond our own bodies. First there was the mastery of fire and then the domestication of animals for travel and work. Human history since then "can be seen as a quest for ever higher reliance on extrasomatic energies," mainly powered by the sun, such as the flows of wind harnessed by sails and flows of water harnessed by mills. But most important for the emergence of "modern high-energy societies" were fossil fuels, energy from the sun stored over millions of years.

Because the availability of energy makes all terrestrial growth possible, determines its rate, and ultimately constrains it, growth of all sorts follows familiar patterns. *Growth* is full of charts showing the curving growth rates of crops, oil consumption, and much else. Smil tracks the increase in transportation speeds over time, the extension of human life expectancies, the ubiquity of cell phones, the cargo capacities of container ships and oil tankers, and the scale and distribution of megacities. Sometimes the growth curves look like S-curves—rising sharply and then leveling off—sometimes bell curves. Sometimes they go through periods of linear growth, sometimes exponential growth. Sometimes they slowly asymptote toward zero growth after a peak, sometimes they seemingly fall off a cliff.

The problem, Smil reminds us, is that without the benefit of hindsight, one never knows what sort of ride one is on until it's over. A period of exponential growth might level out into the S-shaped curve characteristic of logistic growth. A period of stagnation might be the top of one S-curve or the bottom of another. A series of S-curves, say the serial innovations that drove rising agricultural productivity through most of the last 10,000 years, over many millennia looks like linear growth. The apparent peak in global oil production in the 1970s that according to many marked the top of a bell curve turns out, with the benefit of hindsight, to have been the top of one S-curve and the bottom of another, kicked off by new technological innovations like horizontal drilling and hydraulic fracturing.

The fog of the present, our inability to view most present trends from a sufficient distance to understand what sort of growth trajectory they are on, makes all forecasts about growth, resource scarcity, and technological change inherently uncertain. But Smil's central point is nonetheless both obvious and too often ignored. All growth sooner or later comes to an end, and the faster the growth, the faster it will end. This basic insight is as true of solar panels as it is of population growth, and constrains the growth of pollution and environmental impacts no less than it does economies and consumption.

Smil is an intellectual of the old school. While the rest of us are surfing the Internet, Smil recently told *New York Magazine*'s David Wallace-Wells, he is reading about the history of the Sassanid empires. At his best, he is wide-ranging, interdisciplinary, and incisive. At his worst, he is dyspeptic, a man who imagines himself surrounded on all sides by charlatans and fools.

Smil, a Czech who has spent most of his career in Canada, has long documented how reliably energy experts have gotten the future of energy production and consumption wrong. Experts of various ideological stripes and technical disciplines have overestimated the growth of energy consumption in the developed world and underestimated it in the developing world. They have been too bullish about the growth of both renewable energy and nuclear power, while missing entirely the shale gas revolution.

Forecasts of this sort, Smil argues, often confuse preferences with predictions, and we would be much better served by being more transparent about the futures we want and less deterministic about those we might get. And yet, Smil is not terribly transparent about what sort of future he himself desires, beyond a vague gesture toward "intergenerational obligations arising from the need to maintain a habitable biosphere." In a 2018 interview with *Science*, he claimed to have no preferences at all: "I have never been wrong on these major energy and environmental issues, because I have nothing to sell."

In place of telling us what sort of future he'd like to see, Smil mostly tells us what he doesn't like. He bemoans the loss of the night sky outside his home in Manitoba and complains about Asian tourists at the Prado in Madrid obstructing his view of Velazquez's *Las Meninas*. These, by his own acknowledgement, are personal gripes "of a minor importance." But it's hard to shake the sense that what really offends Smil's Eastern European sensibilities is just the sheer obscenity of American consumption. Ordering a seven-ounce filet mignon in a Paris restaurant every now and again might be reasonable, Smil has suggested. Consuming a 36-ounce slab of beef at a Texas steakhouse is not. *Who does such things?*, Smil seems to ask.

But while there is ample reason to think that mass consumption at these levels is neither necessary nor desirable, it has never been clear why one must threaten social and ecological catastrophe to make a compelling case against it—nor, for that matter, how an alternative and less consumptive future works in which Smil gets to contemplate *Las Meninas* in peace and solitude and partake of the steak frite at L'Ami Jean but a billion Chinese do not.

Smil offers no particularly clear alternative as to how ten billion

people might live decent lives without economic growth. Instead, like so many other proponents of "degrowth" and steady-state economics, he mostly just throws up his hands. "Using regress as a [standard] of civilizational achievement, after a long-lasting addiction to progress," he writes, "creates an irreconcilable conflict or, more accurately, a challenge for which we have yet to find an effective solution (assuming that one exists)." His failure of imagination, in other words, is our problem, not his.

But the solution, such as it is, turns out to be right in front of us. Mainstream economic theory may posit that endless economic growth is desirable and possible, but what most macroeconomists actually fret about today is stagnation. The growth rate of developed economies has been falling for decades. This is due not to biophysical limits to consumption, but rather to the simple mathematical reality that the richer an economy becomes, the more wealth it needs to gain each year to maintain the same growth rate. Economic growth in wealthy post-industrial economies, in other words, appears to be inexorably slowing without the need for eco-austerity.

Each additional increment of growth in advanced economies also typically becomes less material-intensive, as sectors like manufacturing, mining, and refining account for a smaller share of total economic output, and knowledge and service sectors account for a larger share.

Population growth is slowing even faster than economic growth, as fertility rates typically fall as incomes and education rise—a dynamic that has been as robust a feature of global modernity as rising consumption. Japan, now 126 million people, could see its population fall by as much as half, to less than 60 million by 2100. The European Union, currently about 500 million, could shrink to as low as 300 million by 2100. Projections vary about when exactly global population will peak and begin to decline, but all major demographic forecasts project population growth trending in the same direction. Absent a radical change in the demography of a rapidly modernizing and urbanizing planet, global population is likely to peak and begin to decline late in this century or early in the next.

Taken together, declining fertility, slowing per capita economic growth, the changing composition of economic activity, and continuing improvements in technology and resource productivity are likely, toward the end of this century, to bring a peak and decline in the consumption of most important resources, and in impacts upon the environment. In fact, for absolute material demands upon the natural environment *not* to decline over the long term, one of these three robust trends would need to reverse itself. Global fertility trends would need to start rising

again. Long-term slowing of growth rates in industrialized economies would need to reverse. Or a broad swath of food, energy, and resource technologies would need to start to become less resource-efficient.

Smil, like a number of other environmental scholars, contests this notion. Instead, he argues that increases in resource productivity will not be put toward lower resource demands but toward more consumption and faster economic growth. Increasingly efficient steam engines in the nineteenth century famously did not result in a reduction in the use of coal but the opposite. One hundred fifty years of improving lighting efficiency hasn't resulted in lower use of energy for lighting but rather has inspired us to light up many more things. Much of the long-term improvement in the efficiency of internal combustion engines, Smil notes, has gone toward creating larger and more powerful vehicles. As long as there is pent up demand for more consumption, some portion of productivity gains will be put toward more consumption rather than less resource use.

But the claim that these "rebound" effects assure the endless growth of material consumption assumes that demand for them will never saturate. For that to be true, it must also be the case that the wealthier we get, the more material consumption we will demand, forever. Thirty-six-ounce steaks must become 72-ounce steaks, SUVs must become eighteen-wheelers, 2,000-square-foot split-level ranch homes must become 4,000-square-foot McMansions, and so on.

There is really not much evidence for that proposition. Despite our affinity for supersizing our homes, our automobiles, and our portions, the U.S. economy has nonetheless been following the same basic trajectory as all other developed economies: toward slower national and per capita income growth and consumption of material goods and services. Rockefeller University's Jesse Ausubel has studied one hundred key resources in the United States over the past century, such as cropland, water, electricity, nickel, and petroleum. Over a third of them are past peak consumption. Similarly, the United States and much of the European Union have seen falling greenhouse gas emissions over the last decade or more, even accounting for the outsourcing of industrial production to places like China.

Globally, by contrast, resource use and carbon emissions continue to rise, despite long-term and ongoing improvements in resource productivity. This is the reason that Smil characterizes claims that economic growth might decouple from material and energy inputs as "highly misleading." But the fact that overall demand for material goods and services has risen during the postwar period, when the global population has tripled and billions of people have

moved from deep agrarian poverty to urban and industrial living arrangements provides no strong basis for Smil's argument.

As both population and economic growth rates flatten out over the course of this century, it is likely that resource-productivity gains will overtake global economic growth rates, resulting in falling global demand for material resources over the long term. As a 2019 Breakthrough Institute report showed, global pasture land, the largest single human use of land, peaked in 2000 and continues to decline even as global beef production continues to rise. In a 2013 paper, Ausubel and colleagues argued that global cropland too appears close to peaking, even as global crop production continues to rise.

As with all growth curves, peak consumption of various material resources is not guaranteed to last. These trends could represent the top of a bell curve, the bottom of a new S-curve, or just a long plateau. But what they do demonstrate is that absolute decoupling of resources from economic growth is possible, even given a global economy today that still features robust population and income growth.

Smil's case for establishing limits to growth depends upon a further claim: that preserving economic growth while reducing environmental impacts can't happen soon enough to avoid surpassing key biophysical boundaries, which would lead to catastrophe for human societies. But Smil is too aware of the many failed proclamations of environmental scientists to make any strong or specific claim about what those biophysical limits might be. "Forecasting the state of modern civilization for generations or centuries to come remains an impossible exercise," he acknowledges.

Elsewhere—for example in his 2010 book *Energy Myths and Realities*—Smil has been less than catastrophic about global warming, the environmental risk most commonly thought to threaten the long-term survival of human societies. Nor does he worry that we will run out of resources. Instead, he invokes poorly defined challenges having to do with arable land, soil erosion, depleted aquifers, and crop productivity, combined with a changing climate. He is quite certain, though, that none of it can be sustained. "Pursuit of the highest possible economic growth rates, extending the culture of excessive consumption to additional billions of people, and treating the biosphere as a mere assembly of goods and services to be exploited (and used as a dumping ground) with impunity," he argues, "must change in radical ways."

In the end, Smil does offer a prediction of sorts, if not a very strong one. By the end of this century, he argues, human societies will need to impose limits upon economic growth in order to sustain human wellbeing for

the long term. But as prophecy, Smil's prediction is less provocative than it might first appear. By the end of this century, global population will likely be approaching zero growth anyway and a much more industrialized global economy will likely be struggling with the same headwinds to sustained rates of per capita growth that developed economies have been struggling with for decades.

In this regard, Smil's prognostication, should it come to pass, would follow a similar pattern to many other environmental laws and regulations. Environmental restrictions have often lagged, not led, the peaking of pollution and other environmental impacts. We "saved" the whales only after we had hunted many global populations to extirpation, and developed better substitutes for most of the resources we depended upon them for. Forests have returned across many parts of the United States, Europe, and Latin America after we no longer needed those lands to grow food. One 2005 study found that 76 percent of protected areas across Latin America and the Caribbean was under little threat of human development without protection, a dynamic that appears to be the case globally as well. We reached a global agreement to protect the ozone only after DuPont had developed a cheap substitute for chlorofluorocarbons.

In answer to modern environmentalism's tautology, Smil offers redundancy. Human societies will need to impose global limits to growth, he suggests, around the time that growth, or at least growing demands upon resources, will likely be coming to an end anyway.

Given how much damage two centuries of unprecedented growth and economic development have done to the biosphere, many imagine, understandably, that the end of growth might be a panacea for the natural world. But we should not be so quick to assume that a smaller and less affluent human population will necessarily bring lower demands upon natural resources.

History is replete with episodes where much smaller human populations accounted for environmental destruction at large scales. Early North Americans in the paleolithic era cleared most of the continent's forests and hunted mammoths and other megafauna into extinction. Across human history, roughly three-quarters of deforestation in temperate forests occurred before the Industrial Revolution, when the human population was less than a billion people, almost all of whom lived in deep poverty compared to today's industrial standards.

More recently, economic crises in relatively developed regions, such as Southeast Asia, the former Soviet Union, and Greece have led to serious environmental consequences, as economically struggling populations

turned to forests for firewood and to illegal hunting and fishing for food, to devastating effect.

For this reason, degrowth offers no guarantee that environmental impacts will decline. This is all the more so as calls for degrowth are frequently coupled with demands for a return to simpler, less technological, and non-synthetic systems for the provision of food and energy and for production of material goods and services. Less affluent economies more dependent upon production systems that use less technology would substantially increase the resource demands associated with consumption, and would erode or even entirely offset the benefits of lower levels of consumption.

Indeed, all over the world, poor populations dependent on low-productivity technologies often require surprisingly large per capita resource footprints to sustain their meager consumption. One 2012 study in *PNAS*, for instance, found that the average West African requires the same amount of land as the average Northern European to support a diet that is much poorer calorically and offers much less dietary protein.

By contrast, over the last two centuries, a virtuous cycle of rising energy and resource productivity has allowed for unprecedented levels of human wellbeing. With that has come a growing population—not because people are having more children but because life expectancies are much higher. Greater prosperity has brought rising material consumption—not mainly because of conspicuous consumption in the wealthiest societies, but rather the agrarian, energy, and demographic transitions that have allowed much of the global population to escape rural poverty and achieve something approaching modern living standards.

Growing demand for material goods and services by a growing and increasingly affluent global population has increased the pressure on natural resources. But it has also led to innovation that has raised resource productivity. In this way, rising resource productivity has allowed for both continuing economic growth and the increasing environmental efficiency of the global economy.

Reversing those dynamics will not necessarily result in lower resource usage, or lower environmental impacts. Lowering demand for resources could as easily result in less-productive resource use as in reduced pressure on resources. The combination of large post-growth human populations, economic stagnation, and increasingly abundant natural resources might drive human societies toward less-productive technological systems. The end of growth, in this way, may do more harm to the planet than good.

Whatever the flaws in his analysis, Smil is no dogmatist and, in the end, he recognizes the

challenges that an end to growth would bring. Smil dedicates much of the final chapter of *Growth* to Japan, a place that he has long traveled to and clearly loves, and that in many ways is a harbinger of the difficulties a post-growth future will bring.

The self-reinforcing dynamics that once drove Japan's rapid growth during the postwar era—a growing population, an expanding domestic market for goods and services, and cutting-edge, automated manufacturing—now are driving Japan's economy toward negative growth. The country's population is falling, its domestic market is stagnant, and its aging manufacturing capacity is faced with fierce competition for export markets.

The greater Tokyo megalopolis, which by some measures is the largest agglomeration of people in the history of the world, depends on rail systems that are aging and costly to maintain. So are the enormous waterworks that keep the city from regularly flooding. With most of the nation's nuclear plants shutting down after the Fukushima disaster, it is heavily dependent on imported coal, gas, and oil for its electricity, and whether Japan has the will and the wherewithal to build a new energy system, much less a clean one, is not clear.

As it spends down the economic surplus that built modern Japan, it is not clear how the country will maintain or rebuild these infrastructures and networks under conditions of steady-state or negative economic growth, nor how it will support an aging population that is increasingly dependent on savings and the social safety net. Insofar as Japan tells us something about the challenges that societies will face as growth comes to an end, it should give proponents of degrowth and steady-state economics some pause.

But "*in the long run*," as John Maynard Keynes famously observed, "we are all dead." In the present, there are close to a billion people still living in deep poverty, and billions more struggling to achieve the living standards of the developed world. For those populations, the question is not how growth will end but how it will be achieved. In a world in which degrowth is not desirable and endless exponential growth is not possible, it is understandable why politicians and the people who elect them remain so focused on growth anyway.

In this and other ways, the real choices we face lie between the two—between endless growth and steady-state economics. How will societies maintain some level of per capita economic growth, at least episodically, once population growth comes to an end? How will those societies maintain infrastructure without economic surplus? How will they maintain enough productivity growth to support aging populations, and how will they sustain resource productivity as demand for resources begins to decline?

Practically, the limits to growth that human societies are likely to face, and in places like Japan are already facing, will be social and economic, not biophysical. What is at stake is not the end of human societies but rather what will become of them as growth very slowly draws to an end. And what will become of the natural world as well—all of the biodiversity, beauty, and complexity that exists for reasons other than feeding us, clothing us, and otherwise meeting our material needs. Catastrophic narratives of social and economic collapse too often conflate the fate of human societies with that of the rest of creation. It is the latter that I worry about much more than the former, especially over the coming century, while billions of people continue the journey from agrarian poverty to modern living arrangements.

Addressing these challenges will require foresight and imagination, new institutions and continuing technological innovation, not limits to growth that will be redundant at best and coercive at worst. Fascinating as they may be, neither the second law of thermodynamics nor the growth rates of amoebas and microchips are likely to provide much guidance as to what we should do.

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