

Beyond Sustainababble

Robert Engelman

We live today in an age of *sustainababble*, a cacophonous profusion of uses of the word *sustainable* to mean anything from environmentally better to cool. The original adjective—meaning capable of being maintained in existence without interruption or diminution—goes back to the ancient Romans. Its use in the environmental field exploded with the 1987 release of *Our Common Future*, the report of the World Commission on Environment and Development. Sustainable development, Norwegian Prime Minister Gro Harlem Brundtland and the other commissioners declared, “meets the needs of the present without compromising the ability of future generations to meet their own needs.”¹

For many years after the release of the Brundtland Commission’s report, environmental analysts debated the value of such complex terms as *sustainable*, *sustainability*, and *sustainable development*. By the turn of the millennium, however, the terms gained a life of their own—with no assurance that this was based on the Commission’s definition. Through increasingly frequent vernacular use, it seemed, the word *sustainable* became a synonym for the equally vague and unquantifiable adjective *green*, suggesting some undefined environmental value, as in *green growth* or *green jobs*.

Today the term *sustainable* more typically lends itself to the corporate behavior often called *greenwashing*. Phrases like sustainable design, sustainable cars, even sustainable underwear litter the media. One airline assures passengers that “the cardboard we use is taken from a sustainable source,” while another informs them that its new in-flight “sustainability effort” saved enough aluminum in 2011 “to build three new airplanes.” Neither use sheds any light on whether the airlines’ overall operations—or commercial aviation itself—can long be sustained on today’s scale.²

The United Kingdom was said to be aiming for “the first sustainable Olympics” in 2012, perhaps implying an infinitely long future for the quadrennial event no matter what else happens to humanity and the planet.

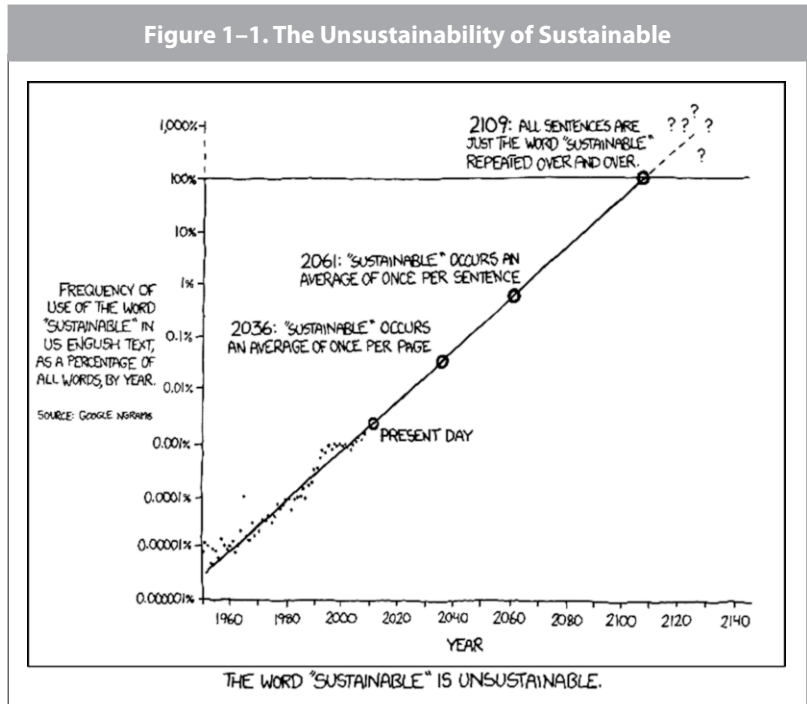
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(If environmental impact is indeed the operable standard, the Olympics games in classical Greece or even during the twentieth century were far more sustainable than today's.) The upward trend line of the use of this increasingly meaningless word led one cartoonist to suggest that in 100 years sustainable will be the only word uttered by anyone speaking American English. (See Figure 1-1.)³

By some metrics this might be considered success. To find *sustainable* in such common use indicates that a key environmental concept now enjoys general currency in popular culture. But sustainababble has a high cost. Through overuse, the words *sustainable* and *sustainability* lose meaning and impact. Worse, frequent and inappropriate use lulls us into dreamy belief that all of us—and everything we do, everything we buy, everything we use—are now able to go on forever, world without end, amen. This is hardly the case.

The question of whether civilization can continue on its current path without undermining prospects for future well-being is at the core of the world's current environmental predicament. In the wake of failed international environmental and climate summits, when national governments take no actions commensurate with the risk of catastrophic environmental change, are there ways humanity might still alter current behaviors to make



them sustainable? Is sustainability still possible? If humanity fails to achieve sustainability, when—and how—will unsustainable trends end? And how will we live through and beyond such endings? Whatever words we use, we need to ask these tough questions. If we fail to do so, we risk self-destruction.

This year's *State of the World* aims to expand and deepen discussion of the overused and misunderstood adjective *sustainable*, which in recent years has morphed from its original meaning into something like “a little better for the environment than the alternative.” Simply doing “better” environmentally will not stop the unraveling of ecological relationships we depend on for food and health. Improving our act will not stabilize the atmosphere. It will not slow the falling of aquifers or the rising of oceans. Nor will it return Arctic ice, among Earth's most visible natural features from space, to its pre-industrial extent.

In order to alter these trends, vastly larger changes are needed than we have seen so far. It is essential that we take stock, soberly and in scientifically measurable ways, of where we are headed. We desperately need—and are running out of time—to learn how to shift direction toward safety for ourselves, our descendants, and the other species that are our only known companions in the universe. And while we take on these hard tasks, we also need to prepare the social sphere for a future that may well offer hardships and challenges unlike any that human beings have previously experienced. While it is a subset of the biosphere, the social sphere is shaped as well by human capacities with few known limits. We can take at least some hope in that.

Birth of a Concept

Respect for sustainability may go back far in human cultures. North America's Iroquois expressed concern for the consequences of their decisionmaking down to the seventh generation from their own. A proverb often attributed to Native American indigenous cultures states, “We have not inherited the earth from our fathers, we are borrowing it from our children.” In modern times, the idea of sustainability took root in the writings of naturalist and three-term U.S. Representative George Perkins Marsh in the 1860s and 1870s. Humans were increasingly competing with, and often outcompeting, natural forces in altering the earth itself, Marsh and later writers documented. This is dangerous in the long run, they argued, even if demographically and economically stimulating in the short run.⁴

“What we do will affect not only the present but future generations,” President Theodore Roosevelt declared in 1901 in his first Message to Congress, which called for conservation of the nation's natural resources. The value of conserving natural resources for future use—and the dangers of failing to do so—even made it into political cartoons in the decades that followed. (See Figure 1–2.) The U.S. National Environmental Policy Act of 1969 echoed

Figure 1–2. 1936 Cartoon by Jay N. “Ding” Darling



MOTHER NATURE SPENT A MILLION YEARS PUTTING UP PRESERVES FOR US—NOW LOOK AT 'EM!



RS. AND THE WORLD SPENDS THE REST OF HISTORY FIGHTING FOR WHAT'S LEFT OF SUSTAINING RESOURCES!



Roosevelt's words, affirming that "it is the continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."⁵

Two important points emerge from the definition of *sustainable development* found in *Our Common Future*, which is still the most commonly cited reference for sustainability and sustainable development. The first is that any environmental trend line can at least in theory be analyzed quantitatively through the lens of its likely impact on the ability of future generations to meet their needs. While we cannot predict the precise impacts of trends and the responses of future humans, this definition offers the basis for metrics of sustainability that can improve with time as knowledge and experience accumulate. The two key questions are, What's going on? And can it keep going on in this way, on this scale, at this pace, without reducing the likelihood that future generations will live as prosperously and comfortably as ours has? For sustainability to have any meaning, it must be tied to clear and rigorous definitions, metrics, and mileage markers.

The second point is the imperative of development itself. Environmental sustainability and economic development, however, are quite different objectives that need to be understood separately before they are linked. In the Chairman's Foreword to *Our Common Future*, Gro Harlem Brundtland defined development as "what we all do in attempting to improve our lot." It is no slight to either low- or high-income people to note that as 7.1 billion people "do what we all do . . . to improve our lot," we push more dangerously into environmentally unsustainable territory. We might imagine optimistically that through reforming the global economy we will find ways to "grow green" enough to meet everyone's needs without threatening the future. But we will be better served by thinking rigorously about biophysical boundaries, how to keep within them, and how—under these unforgiving realities—we can best ensure that all human beings have fair and equitable access to nourishing food, energy, and other prerequisites of a decent life. It will almost certainly take more cooperation and more sharing than we can imagine in a world currently driven by competition and individual accumulation of wealth.⁶

What right, we might then ask, do present generations have to improve their lot at the cost of making it harder or even impossible for all future generations to do the same? Philosophically, that's a fair question—especially from the viewpoint of the future generations—but it is not taken seriously. Perhaps if "improving our lot" could somehow be capped at modest levels of resource consumption, a fairer distribution of wealth for all would allow development that would take nothing away from future generations. That may mean doing without a personal car or living in homes that are unimaginably

small by today's standards or being a bit colder inside during the winter and hotter during the summer. With a large enough human population, however, even modest per capita consumption may be environmentally unsustainable. (See Box 1–1.)⁷

Gro Brundtland, however, made the practical observation that societies are unlikely to enact policies and programs that favor the future (or nonhuman life) at the expense of people living in the present, especially the poorer among us. Ethically, too, it would be problematic for environmentalists, few of us poor ourselves, to argue that prosperity for those in poverty should take a back seat to protection of the development prospects of future generations. Unless, perhaps, we are willing to take vows of poverty.⁸

While sustainability advocates may work to enfranchise future generations and other species, we have little choice but to give priority to the needs of human beings alive today while trying to preserve conditions that allow future generations to meet their needs. It is worth recognizing, however, that there is no guarantee that this tension is resolvable and the goal achievable.

If Development Isn't Sustainable, Is It Development?

The world is large, yet human beings are many, and our use of the planet's atmosphere, crust, forests, fisheries, waters, and resources is now a force like that of nature. On the other hand, we are a smart and adaptive species, to say the least. Which perhaps helps explain why so many important economic and environmental trends seem headed in conflicting and even opposite directions. Are things looking up or down?

On the development side, the world has already met one of the Millennium Development Goals set for 2015 by the world's governments in 2000: by 2010 the proportion of people lacking access to safe water was cut in half from 1990 levels. And the last decade has witnessed so dramatic a reduction in global poverty, central to a second development goal, that the London-based Overseas Development Institute urged foreign assistance agencies to redirect their aid strategies over the next 13 years to a dwindling number of the lowest-income nations, mostly in sub-Saharan Africa. By some measures, it can be argued that economic prosperity is on the rise and basic needs in most parts of the world are increasingly being met.⁹

On the environment side, indicators of progress are numerous. They include rising public awareness of problems such as climate change, rainforest loss, and declining biological diversity. Dozens of governments on both sides of the development divide are taking steps to reduce their countries' greenhouse gas emissions—or at least the growth of those emissions. The use of renewable energy is growing more rapidly than that of fossil fuels (although from a much smaller base). Such trends do not themselves lead

Box 1–1. Toward a Sustainable Number of Us

To link environmental and social sustainability, think population. When we consider what levels of human activity are environmentally sustainable and then, for the sake of equity, calculate an equal allocation of such activity for all, we are forced to ask how many people are in the system.

Suppose for example, we conclude that 4.9 billion tons of carbon dioxide (CO₂) per year and its global-warming equivalent in other greenhouse gases—one tenth of the 49 billion tons emitted in 2010—would be the most that humanity could emit annually to avoid further increases in the atmospheric concentrations of these gases. We then need to divide this number by the 7.1 billion human beings currently alive to derive an “atmosphere-sustainable” per capita emission level. No one responsible for emissions greater than the resulting 690 kilograms annually could claim that his or her lifestyle is atmosphere-sustainable. To do so would be to claim a greater right than others to use the atmosphere as a dump.

One 1998 study used then-current population and emission levels and a somewhat different calculation of global emissions level that would lead to safe atmospheric stability. The conclusion: Botswana’s 1995 per capita emission of 1.54 tons of CO₂ (based in this case on commercial energy and cement consumption only) was mathematically climate-sustainable at that time. Although population-based calculations are not always so informative with every resource or system (sustaining biodiversity, for example), similar calculations could work to propose sustainable per capita consumption of water, wood products, fish, and potentially even food.

Once we master such calculations, we begin to understand their implications: As population rises, so does the bar of per capita sustainable behavior. That is, the more of us there are, the less of a share of any fixed resource, such as

the atmosphere, is available for each of us to sustainably and equitably transform or consume in a closed system. All else being equal, the smaller the population in any such system, the more likely sustainability can be achieved and the more generous the sustainable consumption level can be for each person. With a large enough population there is no guarantee that even very low levels of equitable per capita greenhouse emissions or resource consumption are environmentally sustainable. If Ecological Footprint calculations are even roughly accurate, humanity is currently consuming the ecological capacity of 1.5 Earths. That suggests that no more than 4.7 billion people could live within the planet’s ecological boundaries without substantially reducing average individual consumption.

Absent catastrophe, sustainable population anything like this size will take many decades to reach through declines in human fertility that reflect parents’ intentions. There is good reason to believe, however, that a population peak below 9 billion might occur before mid-century if societies succeed in offering near-universal access to family planning services for all who want them along with near-universal secondary education for everyone. Also helpful would be greatly increased autonomy for women and girls and the elimination of fertility-boosting programs such as birth dividends and per child tax credits.

In the meantime, while population remains in the range of 7 billion, individual levels of greenhouse gas emissions and natural resource consumption will have to come way, way down to even begin to approach environmental sustainability. Consumption levels that would bring those of us in high-consuming countries into a sustainable relation with the planet and an equitable relation with all who live on it would undoubtedly be small fractions of what we take for granted today.

Source: See endnote 7.

directly in any measurable way to true sustainability (fossil fuel use is climbing fast as China and India industrialize, for example), but they may help create conditions for it. One important trend, however, is both measurable and sustainable by strict definition: thanks to a 1987 international treaty, the global use of ozone-depleting substances has declined to the point where the atmosphere's sun-screening ozone layer is considered likely to repair itself, after sizable human-caused damage, by the end of this century.¹⁰

It is not clear, however, that any of these development and environmental trends demonstrate that truly sustainable development is occurring. Safe water may be reaching more people, but potentially at the expense of maintaining stable supplies of renewable freshwater in rivers or underground aquifers for future generations. Reducing the proportion of people in poverty is especially encouraging, but what if the instruments of development—intense application of fossil fuels to industrial growth, for example—contribute significantly to increasing proportions of people in poverty in the future?

Moreover, economic development itself is running into constraints in many countries, as population and consumption growth inflate demand for food, energy, and natural resources beyond what supply—or at least the simple economics of price or the logistics of distribution—can provide. The price of resources has climbed for most of the last 10 years after sliding during the previous several decades. Results of rising prices for food, fossil fuels, minerals, and necessities that rely on nonrenewable resources for their production include food riots like those of 2008 and crippling power blackouts like the one in India that affected nearly a tenth of the world's population in 2012.¹¹

Yet even as economic growth seems to be bumping into its own limiting constraints in much of the world, the most important environmental trends are discouraging and in many cases alarming. Human-caused climate change, in particular, shows no signs of slowing or beginning any soft landing toward sustainability, with global emissions of greenhouse gases continuing to climb in the upper range of past projections. The rise is slowed, on occasion and in some countries, mostly by recession or happenstance shifts in fossil-fuel economics (such as the recent ascendance of shale gas production in the United States) rather than any strategic intention or policy.

Despite all international efforts to rein in emissions of fossil-fuel-based carbon dioxide, for example, these emissions are today larger than ever and may be increasing at an accelerating pace. (See Figure 1–3.) A brief downward blip in 2009 was unrelated to coordinated government action but stemmed from global economic decline. The global increase in fossil-fuel-based CO₂ was estimated at 3 percent in 2011 compared with 2010—nearly three times the pace of population growth—despite a still sluggish global

economy and absolute emissions reductions in the United States that year. This trend leads some scientists to suggest it may be too late to stop future warming in a safe temperature range for humanity.¹²

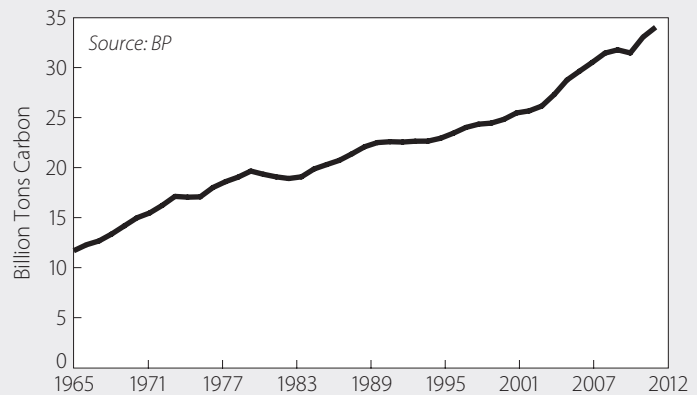
Demographic and economic growth drives growth in greenhouse gas emissions and natural resource use. Aspirations over the past few decades that economic growth can be “decoupled” from energy and natural resource use, thus allowing the growth to continue indefinitely, have proved overly optimistic. An earlier trend

toward energy decoupling reversed course during the global economic downturn that began in late 2007. This was partly because governments of industrial countries attempted to stimulate their sluggish economies through energy-intensive public works programs, but it was mostly due to massive industrialization in the emerging economies of China and India. Until the combined power of population and economic growth is reversed or a strong climate pact transforms the global economy, there seems to be little prospect for either true sustainability or truly sustainable development through ever-greater efficiency and decoupling.¹³

This logic is especially worrisome because we have already dug ourselves so deeply into unsustainability, based on the assessment of many scientists, that we are now passing critical environmental thresholds or “tipping points.” We are starting to feel the weight of what was once balanced on Earth’s seesaw now sliding down upon us. In 2009, a group of 30 scientists identified nine planetary boundaries where sustainability could be roughly measured and monitored. Human beings had already, by their calculation, crashed through two such boundaries and part of a third: in greenhouse gas loading of the atmosphere, in nitrogen pollution, and in the loss of biological diversity.¹⁴

Three years later, in the run-up to the U.N. Rio+20 Conference on sustainable development, another group of scientists, led by Anthony D. Barnofsky of the University of California, Berkeley, warned that based on land use and other indicators of human domination of natural systems, the planet may already be poised to undergo an imminent, human-induced state shift. That phrase refers to an abrupt and irreversible shift from an existing state to a new one. In this case, the shift would compare in magnitude (though not in

Figure 1–3. Fossil-Fuel-Based Carbon Dioxide Emissions, 1965–2011



comfort) to the rapid transition that ended the last Ice Age and ushered in the more temperate climate in which human civilization evolved.¹⁵

What the scientists found in physical and biological systems, U.N. Environment Programme analysts found in political ones. Rooting among the 90 most important international environmental commitments made by governments, the analysts could identify significant progress only in four, including halting further damage to the ozone layer and improving access to safe water.¹⁶

Other signs are positive, however, as noted earlier. The rapid growth of renewable energy, growing acceptance that human activities are warming the world, new efforts among many corporations to improve their environmental behavior and reputations (although sometimes this is more sustainable than real), the seriousness with which Mexico and China are trying to rein in their greenhouse gas emissions, a recent slowdown in deforestation in Brazil—all these trends signal the possibility of shifts in unsustainable trends in the near future.¹⁷

But absent far more progress, the basic trends themselves remain clearly, measurably unsustainable: the shrinking of aquifers around the world as farmers are called on to produce more food while competing with other water users, the global declines of fisheries and of all biodiversity, the accelerating emergence of new infectious diseases over the last few decades, and—of course—the relentless march of warmer temperatures, higher oceans, and ever-more-intense downpours and droughts. People who survive in leadership roles at some point develop realistic strategies for likely eventualities. And it now seems pretty obvious that the time has arrived to prepare for the consequences of unsustainability, even while we refuse to give up the effort, however quixotic, to shift to true sustainability on some reasonable schedule.

Predicament and Possibility

Why has it proved so hard to conform human behavior to the needs of a life-supporting future? A major reason is simply the unprecedented scale that humanity has reached in the twenty-first century: We are 7.1 billion sizable individual organisms, each requiring thousands of kilocalories of food energy and several liters of water per day. The vast majority of us are unwilling to share our private living space with wild plants and animals. We like to live in a temperature range far narrower than that of the outdoors, and we like to be mobile. As we carve out land to grow our food, we fully convert it from wild nature to humanized territory.

In all these needs and wants, we are helped by the fact that much of the stored energy that living things gained from the sun over hundreds of millions of years has been unleashed for our enjoyment—to fuel our globe-spanning travel, to control the climates of our homes and workplaces, to al-

low many of us to enjoy pleasures and comforts unknown even to monarchs in the past. Our political and economic institutions evolved before anyone imagined the need to restrain human behavior out of concern for the future. An estimated 2.8 trillion tons of carbon dioxide emissions sleep in fossil fuel reserves—more than enough to guarantee climate catastrophe from a CO₂-saturated atmosphere—that companies and governments would gladly sell tomorrow for immediate combustion if they could bring the buried carbon to the surface and get the right price for it.¹⁸

With exceptions in a few countries, growing human populations are eating more meat, using more carbon-based energy, shouldering aside more natural landscapes, and tapping into more renewable and nonrenewable commodities than ever before in history. The momentum of a still-young global population all but guarantees demographic growth for decades to come. The momentum of the world's transportation networks, infrastructure, and built environment all but guarantees that shifts toward low-carbon energy will take decades. Individual aspirations for wealth and comfort all but guarantee increasing per capita global consumption, at least to the extent the world economy will support it. But ever-greater energy investments are needed to tap fossil fuels and other critical nonrenewable resources, raising the likelihood that these will become increasingly expensive with time.

Our predicament at least presents us with opportunity. In the words of poet W. H. Auden, “We must love one another or die.” In order to survive, we may find ourselves dragged kicking and screaming into ways of relating to each other and the world around us that humanity has been aspiring to achieve since the emergence of the great ethical and spiritual traditions many centuries ago.¹⁹

Asking the Difficult Questions

In asking “Is Sustainability Still Possible?” we realized several other questions would also need to be grappled with in this report. The first section, The Sustainability Metric, explores what a rigorous definition of sustainability would entail, helping to make this critical concept measurable and hence meaningful. Though such measurement is often challenging to design and agree on, much less carry out, the objective would be to continually improve on it, for scientific measurement has always improved over time.

The first step toward survival is to define *environmentally sustainable* and to use this definition to measure and monitor whether current trends are heading toward or away from trajectories that could continue indefinitely without threatening future life. The second is to use these sustainability metrics to develop practical measures, whether politically feasible at the moment or not, that can bend the curve of current trends toward sustainability.

To help with measurement, we should look without blinking at what is unsustainable—at practices and patterns that, if we don't stop them, will stop us. The rarely voiced reality of environmental unsustainability is that we may have not just less prosperous and comfortable lives in the future but shorter and fewer lives altogether. If it proves too challenging to feed the projected 2050 world population of more than 9 billion people, for example, it is quite possible we will not have to—for the worst of reasons. The same can be said of “business-as-usual” greenhouse gas emission scenarios: by the time global thermometers register a hike of 4 degrees Celsius, business-as-usual will have ended a long time ago.²⁰

Raising the specter of rising death rates and civilizational collapse underlines the need for rigor in assessing what true sustainability is and how to measure if we are heading there. In doing so we must accept that true sustainability may not arrive for decades or even centuries, yet we'll need to be vigilant about making progress toward it now and at each point along the way. The objective will then be to build popular support, make such measures feasible, and eventually transform them into effective policies and programs worldwide.

The second section of the book, *Getting to True Sustainability*, explores the implications of the gaps that remain between present realities and a truly sustainable future. What would it take—what actions, policies, institutional

and behavioral changes, and reductions in the scale of human activity—to arrive at a truly sustainable society? In a world far more preoccupied with present economic and security conditions than with its own future capacity to support life, how can those who care about these issues help move societies in the right direction? How can we spur a sufficiently rapid transition toward a world in which humanity and the nature that supports it can thrive indefinitely?

Equipped with clearer definitions of true sustainability and clearer indicators of where we stand in relation to it, we can begin to “get real”—that is, more practical and ambitious—about making our actions and behaviors truly sustainable. Straight-

forward objectives of where we need to be can help us separate marginal action, political showmanship, and feel-good aspirations from measurable progress. The danger of rigorous definition and measurement is, of course, the psychological impact of the awareness of how distant the goal of true



Andrea O'Connell

sustainability is. The momentum and weight of that distance can be overwhelming and debilitating. But the fool's gold that sustainability offers is poor medicine; far better to know where we stand—and to stop standing in a space in which we will not survive.

Are there really policy options for forging toward true sustainability? There are at least some good candidates, and attention to the sustainability metric will help us identify which ones are worth making a priority—whether relating to climate change, population growth, nitrogen runoff, or biodiversity loss. Detailed and productive policy proposals can emerge when we focus more on sustainability metrics and how to manage them to produce equitable outcomes. It will take time; as current environmental politics makes clear, not much is achievable with today's governments. Those who care about these issues need to think like eighteenth- and nineteenth-century abolitionists, who worked tirelessly on their cause for generations before legal slavery disappeared from the world. While time is in most ways the scarcest resource of all, achieving true sustainability will need a political movement that grows and gains power over time to make its influence decisive.

Centuries of human experience amid hardship do nonetheless suggest the possibility that we will muddle through whatever lies before us on the home planet. We have no way of knowing what inventions will arise to revolutionize our lives and maybe minimize our impacts. Perhaps ocean currents or cold fusion will offer supplies of energy that are safe, climate-neutral, and effectively inexhaustible. There is no basis for smug certainty that we face catastrophe. Yet based on what we have done and are doing ever-more intensively to the atmosphere, oceans, soils, forests, fisheries, and life itself, it takes an almost religious conviction to be confident that such sunny outcomes will unfold all over the environmental stage.

History also shows that even human resilience can have its downside. By adapting so well to past environmental losses (the extinction of large mammals in the Pleistocene, for example), we humans have been able to keep expanding our population, leading to ever-wider ripples and denser layers of long-term unsustainability. Unless scientists are way off track in their understanding of the biophysical world, we would be wise today to look to dramatic and rapid “demand contraction”—call it degrowth or simply an adaptive response to an overused planet—to shift toward a truly environmentally sustainable world that meets human needs. We need to understand the boundaries we face—and then craft ways to fairly share the burden of living within them so that the poor bear the least and the wealthy the most. That's only fair.

The stakes by their nature are higher the younger someone is—and highest still for those who are not yet but will be born. We are talking about the survival of human civilization as we know it, and possibly of the species itself. “There is . . . no certainty that adaptation to a 4°C world is pos-

sible,” a recent World Bank report conceded, referring to a global average temperature increase of 7.2 degrees Fahrenheit from pre-industrial times that is considered likely by 2100 without policy change. And so the book’s third section—Open in Case of Emergency—takes on a topic that most discussions of sustainability leave unsaid: whether and how to prepare for the possibility of a catastrophic global environmental disruption. We could define this as a sharp break with the past that reverses the long advance of human creature comforts, health, and life expectancy—and from which recovery might take centuries.²¹

In many parts of the world, the emergency has already arrived. There are places where violence is routine—and routinely unpunished—and where creature comforts are as distant as personal safety. Sustainability is a meaningless concept in such places, but scholars of sustainability could profitably study how people survive there. How do they adapt and stay resilient in the face of their struggles? How did cultures and societies survive during and after one of the worst civilizational reversals in history, the fourteenth-century Black Death, which may have cut European population by half?

It is through just such an exploration that the environmental movement enters fully into the social sphere, after a long history in which the objective was to protect nature from human influence. We are living in the Anthropocene now, the era in which humans are the main force shaping the future of life. And it is too late to wall off nature from human influence. Even if we could somehow cork all the world’s tailpipes and smokestacks, quench all fires, and cap all other greenhouse gas emission sources, Earth will keep warming for decades and the oceans will rise for centuries to come. We need to focus on adapting to a dramatically changing climate and environment while simultaneously pressing ever harder to head off further change. If we fail to constrain the ways we are changing the planet, the planet will eventually overwhelm all our efforts to adapt.²²

Such speculation may sound pessimistic, but neither fear of pessimism nor a dogged determination to remain optimistic are reasons for understating our predicament. Optimism and pessimism are equal distractions from what we need in our current circumstance: realism, a commitment to nature and to each other, and a determination not to waste more time. There seems little point in determining your gut feeling about the future when you can put your shoulder to the wheel to make sure the world will keep sustaining life. “Feeling that you have to maintain hope can wear you out,” eco-philosopher Joanna Macy said in a recent interview with the wisdom of her 81 years. “Just be present. . . . When you’re worrying about whether you’re hopeful or hopeless or pessimistic or optimistic, who cares? The main thing is that you are showing up, that you’re here, and that you’re finding ever more capacity to love this world, because it will not be healed without that.”²³

that we pass only at peril to our future. Among these are the two systems just mentioned—climate and biodiversity—but also key mineral cycles and changes in land, oceans, and air. Marking these boundaries and our position relative to them sometimes requires subjective judgment, yet the process nonetheless contributes to better metrics. The concepts of planetary boundaries and of the Ecological Footprint, discussed here by Jennie Moore and William E. Rees, offer among the most influential sustainability metrics yet devised, and their implications are daunting.

Renewable freshwater especially lends itself to sustainability quantification. Hydrologists have carefully measured much of Earth's water cycle. We will never run out of water, but some societies drive themselves into scarcity by using so much water that precipitation fails to maintain levels in rivers, lakes, and aquifers. Sandra Postel explores these metrics—and finds hope for future sustainability in the fact that so much freshwater is wasted through inefficient use. Covering 71 percent of Earth's surface, salt water offers wide scope for sustainability metrics. As Antonia Sohns and Larry Crowder note, unsustainable human behaviors of many kinds ultimately leave their mark on the seas—in acidification, rising temperatures, declining oxygen content, the onset of red tides, and the ongoing decline of fisheries. More challenging is the task of connecting each of these trends and others with the metrics of the human activities that lead to them, but that too is part of our task.

On renewable energy, Shakuntala Makhijani and Alexander Ochs approach quantification from a different perspective, measuring the potential to expand access to “sustainable energy” to the point that this all-important sector no longer adds to the atmospheric burden of greenhouse gases. Eric Zencey develops metrics for energy-related principles such as Energy Return on Energy Invested (EROI), which like unforgiving physical laws may limit how much energy humanity can mobilize and for how long. Gary Gardner takes up EROI as well, in addressing quantification of natural resources that perhaps can only be used sustainably with perfect recycling—which of course excludes fossil fuels and other resources consumed entirely by use.

Kate Raworth tackles another kind of sustainability, that of the social sphere. She takes inspiration from the planetary boundaries work to explore metrics that might help us understand when our treatment of our fellow human beings exceeds the bounds of what is needed for long-term societal survival. Social sustainability may be the hardest type to submit to measurement, but without enduring societies, a supportive natural environment will matter to few human beings. The question of how we live together on a crowded planet that unravels even as we work to hold its strands in place may call forth the most important sustainability metric of all.

—Robert Engelman