



Visions of Sustainability

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Introduction

Humans are amidst a transition from the relatively stable Holocene to a new, uncertain epoch, the Anthropocene, in which planetary-scale changes are resulting from the wholesale conversion of the Earth into fleeting economic wealth. Humankind has only approached this scale of change two times in human history—during the Agricultural Revolution and the Industrial Revolution. These two revolutions transformed the way humans lived and gave them the power to alter the Earth. Unlike the Agricultural and Industrial Revolutions, however, the story of this third revolution is not fully written. The conclusion will depend on the decisions and actions that humans alive today make throughout their lives.

Sustainability discussions represent a proactive effort to influence the writing of this conclusion. At its core, sustainability is about improving the human condition—now and into the future—while adapting human activity to fit what nature can provide. On the surface, sustainability is an easy concept to grasp, but like peace, human rights, equality, and democracy, it is challenging to describe precisely, especially in a manner that inspires consensus. This is, in part, because sustainability, as an evolving set of aspirations and processes for achieving them, is an inescapably normative term that cuts across many disciplines. It involves values and subjective percep-

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tions about: the state of the planet; the merits and drawbacks of continued economic and human population growth; biodiversity protection; the promise of technology; social goals; ethics; risk; uncertainty; and the collective abilities of humans to dream, acquire, and process knowledge, make wise judgments, collaborate, manage, plan, govern, and change. There's an inherent paradox, too. A word that on first blush refers to maintaining some system property or properties in a constant state rests on staving off some forms of change while encouraging others. As such, sustainability calls for a deep, public conversation about the conditions for human flourishing.

The terms *sustain* and *sustenance* share the same Latin root, *sustinere* (held up from below). This suggests an implicit caution: If humans don't honor their profound dependence on nature and each other by learning how to correct erroneous or outmoded perceptions, harmonize diverse interests, identify critical conflicts, and adjudicate competing claims peacefully, the foundation for human flourishing just might collapse.

A Google search reveals hundreds of millions of hits for the terms *sustainability*, *sustainable society*, and *sustainable development*. The meteoric growth, careless usage, and potential for manipulation by special interests has led some to argue that sustainability has become a meaningless buzzword, or even "sustainababble." Others argue that this growth is indicative of a term with cachet, substance, and the capacity to be adapted to new understand-

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ing. Returning to the roots of sustainability and exploring its usage over time will unmask a term with meaning and profound significance for humankind.

Origins

Sustainability as a concept has its genesis in trepidation and hope. Trepidation stems from an ancient concern that in pursuing the good life, humans may have, mostly unwittingly but sometimes not, overstepped boundaries and set in motion serious and potentially irreversible harms. Hope emerges from a conviction that improving the human condition is realizable in this world. For some people, sustainability suggests empathy, restraint, and reflection properly posed as questions: What is the place of humans on this Earth? What are their responsibilities and obligations toward other humans—past, present, future—and nonhumans alike? As will be shown, exploring these questions and relating them to the many, evolving interpretations of sustainability can help humankind make sense of the past, claim the present, and plan for the future.

For thousands of years, people have been both fascinated and tormented by questions concerning the conditions necessary for human flourishing, for their future, and for their role in shaping it. Concern about breaching ecological carrying capacity limits and other conditions for human flourishing has been around for at least 25 centuries and shared across cultures. Emperor Ashoka (304-232 BCE) unified most of the Indian subcontinent through brutal conflict and subsequently became one of the most exemplary rulers in history. His most lasting influence, the rock and pillar Edicts of Ashoka, which are scattered around what is now India, Nepal, Pakistan, and Afghanistan, outlines reforms and policies for a just and humane society, wildlife conservation, respect for all life, and vegetarianism.¹ The Chinese philosopher Mencius (372-289 BCE) discussed the importance of adhering to particular harvesting practices, rates, and times to maintain high

yields (p. 19).² Plato (427-347 BCE), in *Critias*, discussed the ills of deforestation and its effect on erosion, biological diversity, and local climate change (pp. 271-275).³

Over 2,000 years later, in the 18th century, German Inspector General of Mines Hans Carl von Carlowitz coined the term *Nachhaltigkeit* (sustainability) when he decried the wasteful, short-termed exploitation of forests for silver mining and smelting and argued for a more circumspect approach to forestry, one which called for logging only as much wood as could grow back in the same period. These concerns were echoed more broadly and loudly by 19th century intellectual reformers such as John Stuart Mill, Thomas Malthus, and Harriet Martineau, who explicitly connected concern for the future to the welfare of humanity, the conservation of nature, and the Earth itself.⁴

The first formal effort to assess global human carrying capacity—or answer the question, How many people can the Earth support?—was produced in 1679 by Antoni van Leeuwenhoek, the Dutch inventor of the microscope (p. 16).⁵ Since van Leeuwenhoek's estimate of 13.4 billion people, there have been more than 65 estimates. These range from 0.5 billion to 1,000 billion. If medians are calculated using the upper and lower bounds (when authors offered ranges), the median of the low estimates is 7.7 billion and the median of the high estimates is 12 billion (pp. 212-216).⁵ Interestingly, the scatter among these estimates increases over time, suggesting that different assumptions and values govern the authors' calculations. The question, How many people can the Earth support? cannot be answered with ecological carrying capacity data alone. It can only be addressed meaningfully by outlining what kind of world people want and the conditions necessary to support its ongoing flourishing.

The contemporary notion of sustainability, at least in the United States, has its roots in two books from 1948: Fairfield Osborn's

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Our Plundered Planet and William Vogt's *Road to Survival*. Osborn and Vogt both wrote impassioned pleas for not exploiting the planet's resources faster than they can be regenerated. Presaging the now popular ecological footprint analysis, which reveals that humankind has surpassed the planet's biocapacity and is now living on borrowed ecological capital, Vogt argued, "By excessive breeding and abuse of the land mankind has backed itself into an ecological trap. By a lopsided use of applied science it has been living on promissory notes. Now, all over the world, the notes are falling due" (p. 284).⁶ Osborn asked, "Do we need another catastrophic warning from nature to stir us into further action, or can we not now accept the many evidences of approaching crisis and take steps to ward it off?" (p. 199).⁷

These books were followed by the pioneering international symposium, *Man's Role in Changing the Face of the Earth*, which explored the ecological and social consequences of human activities throughout history.⁸ Shortly after, Rachel Carson, in her book *Silent Spring* (1962), used the unintended side effects of reckless application of DDT in agriculture to raise the threat of unexamined materialism, scientism, and control of nature.⁹ In the process, she helped launch the environmental movement.

This idea of global overshoot was first explored analytically in 1972 with *The Limits to Growth: A Report for the Club of Rome's Project on The Predicament of Mankind*. The authors created a computer simulation model, World3, to explore how world population, industrial output, pollution, food production, and nonrenewable resource depletion interact over time to generate collapse or equilibrium states under various initial conditions. The few equilibrium scenarios required stabilizing population, reducing pollution and resource consumption, restoring farmland, and flattening industrial production.¹⁰ Despite being published in 30 languages and selling 30

million copies, the book drew substantial criticism from growth-oriented technological optimists and was dismissed by many as a doomsday prophecy. *The Limits to Growth*, however, can also be seen as a catalyst for the term sustainable society, which was introduced shortly after in Robert Stivers' *The Sustainable Society: Ethics and Economic Growth*¹¹ and in Dennis Pirages' edited collection, *The Sustainable Society: Implications for Limited Growth*.¹² Both books expanded on the theme of planetary limits to economic growth and explored the forms of social design and institutional change that are necessary to sustain meaningful improvements in quality of life.

Evolving Visions

The landmark 1972 United Nations (UN) Conference on the Human Environment in Stockholm resulted in a declaration that likely represents the first comprehensive statement on sustainability—without actually using the term. It focused on the foundational role of environmental quality in achieving a good life. Beginning with a broad conceptualization of the environment and peoples' relationship to it, the declaration states "[m]an is both creature and moulder of his environment, which gives him physical sustenance and affords him the opportunity for intellectual, moral, social, and spiritual growth." The declaration goes on to discuss the importance of "collaborating" with nature when working to promote equity, advance economic and social development, and improve quality of life for present and future generations.¹³ The World Conservation Strategy, commissioned by the UN Environment Programme, followed in 1980 and gave currency to the term *sustainable development* by stressing the interdependence of conservation and development. Emphasizing the primacy of Earth's living support systems for human survival and flourishing, it identified priority conservation issues and strategies for achieving these aims.¹⁴

The first significant shift in emphasis, from limits to growth as the foundation for human flourishing to unlimited economic growth, emerged with the World Commission on Environment and Development, which was tasked by the UN to identify long-term environmental strategies for achieving sustainable development by 2000. The commission's 1987 report, *Our Common Future*, the source of the iconic definition of sustainable development, asserted:

Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth (p. 8).¹⁵

Our Common Future engendered a return to the Enlightenment notion of progress, which conflates social and moral development with continued economic growth. The primacy of the Earth's living support systems was replaced with soft limits and technological substitution. In a related vein, John Elkington put forward the three pillars of the Triple Bottom Line—economic prosperity, environmental quality, and social justice—in an effort to embed sustainability considerations into business.¹⁶ While admirable, this effort falls into the same quandary as the *Our Common Future* definition by failing to establish clear priorities or guidelines for making decisions when conflicts and trade-offs among the three pillars exist.

Donella Meadows, a coauthor of *Limits to Growth*, made significant headway toward setting forth a sound, hierarchical relationship among economic, social, and environ-

mental goals. Using her characterization, a sustainable society:

would be interested in qualitative development, not physical expansion. It would use material growth as a considered tool, not as a perpetual mandate. It would be neither for nor against growth, rather it would begin to discriminate kinds of growth and purposes for growth. Before this society would decide on a specific growth proposal, it would ask what the growth is for, and who would benefit, and what it would cost, and how long it would last, and whether it could be accommodated by the sources and sinks of the planet (p. 10).¹⁷

Recently, there have been efforts to recover this rich, multiple criteria, and constraint-based vision of sustainability, which grounds improving the human condition (development) in the well-being of Earth's living support systems. Rockström et al.¹⁸ have worked to characterize nine planetary boundaries, which they assert constitute a safe operating space for humanity. Raworth¹⁹ has built on this work to create a complementary set of 11 social boundaries, which together form a “safe and just space for humanity.” The Norwegian philosopher Arne Naess, much like Emperor Ashoka, went even further by arguing that human decision making in the case of non-vital needs should also reflect respect for nonhuman life *for its own sake*.²⁰

While this collective set of sustainability visions generally covers the gamut, it is only a sampling of the diversity of sustainability definitions that have appeared in the literature. This diversity has helped to stimulate a creative tension that, over time, has tended to broaden and deepen the discussion and elucidate a few core goals and values.²¹ It has also generated a host of actions to model these visions. As Paul Hawken notes in *Blessed Unrest*, it's impossible to do justice to the great, quiescent underground movement of citizens who work daily to speak for the planet, other species, and our collective interdependence.²²

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Three inspired examples follow. Second Nature’s Climate Commitment is a movement by presidents to infuse sustainability across the curriculum while making their campuses climate neutral and building community resilience. The Living Building Challenge is a certification program for buildings that must, among other things, be built on previously developed sites, capture or recycle all of their water on site, produce more energy than they use relying on solar income, incorporate biophilia, use materials that are safe for all species over time, and celebrate design that creates transformative change. Mannahatta 2409 is a bold project and map-based web application that has been created to model, develop, and share designs for climate resilient rewilding and restoration of the island of Manhattan (NY), which has the biological diversity and resilience that Henry Hudson encountered in 1609.

A Framework for Exploring Sustainability

In searching for the good life, however, it appears that *Homo sapiens* have yet to fully take advantage of the warnings about planetary boundaries suggested long ago and the promise of global action for sustainability as outlined in Agenda 21 of the 1992 Rio Earth Summit²³ and reaffirmed in the subsequent “The Future We Want” Resolution of the Rio + 20 Earth Summit.²⁴ Examples of transgressing limits—such as coral bleaching, climate change, loss of cultural and biological diversity, fisheries collapse, growing disparities between rich and poor, and political insecurity—abound today (p. 2).²⁵ While the Millennium Development Goals have led to significant quality of life gains for some, spotty progress on addressing hunger, the number of people living in slums, maternal mortality, gender equality, and access to safe water and sanitation in rural areas highlight the challenge of improving quality of life for all.²⁶

When push comes to shove, there are only three general ways to secure a firm founda-

tion for human flourishing: 1.) increase human productive capacities; 2.) decrease human numbers, expectations, or both; and 3.) redefine the art and practice of giving and receiving sustenance (i.e., embrace planetary and social boundaries; improve manners; enhance equity; respect nonhuman life *for its own sake*; reduce corruption; upgrade institutions and public policies; incorporate full, life-cycle accounting; follow ecological design principles; etc.). Disagreement in sustainability visions lies in what combination of the three alternatives is favored and the practical strategies for advancing change.

An additional challenge complicates matters further. The failure to secure broad-scale, collective action on sustainability may have more to do with the human brain’s difficulty in keeping pace with a rapidly changing environment than a simple lack of information, understanding, concern, or consensus. The behaviors that have been selected, through biological and cultural evolution, have been for a world of relative stability, small human numbers, and tremendous resource abundance. Selection for a favorable biological or cultural adaptation is most successful when the past, present, and near future are relatively stable because the consequences of the adaptation are readily apparent and because they confer a clear advantage on the trait holders, which is maintained over time. As an example, when early human ancestors began eating meat, they likely made it possible to evolve larger brains, because growing brain tissue is metabolically very expensive. If the past, present, and near future are in great flux, there is no clear basis for demonstrating the relative benefit of a potential adaptations’ consequences.

Today, the environment that helped shape human behavior through biological and cultural evolution is itself changing rapidly and the specter of global unsustainability looms large. Science and technology now provide data and models to help piece together many of the coupled effects

of production and consumption (giving and receiving sustenance) before they happen.^{27,28} Technology also provides the communications infrastructure to share these insights widely, but the full force of this knowledge is only leveraging modest change. This may be because many of the consequences of present human actions are separated, in space and time, from those generating them—or not experienced viscerally by them. This undermines the potential of these very real consequences to directly influence the behavior of those causing them.²⁹ For example, those reaping the benefits of inefficient fossil fuel burning in the United States don't directly feel the impacts of rising seas on Pacific Island communities or the effects on future generations. Furthermore, when consequences are readily detectable, the relationship between cause and effect is frequently muddled. Even when causes are relatively clear, those in power frequently perceive other potential outcomes as more salient, not making it worth the effort for them to change. For example, addressing unjust and environmentally unsound production processes in China would likely result in higher prices for consumer goods.

The absence of significant forward movement toward broad sustainability objectives may have arisen, in part, because confusing, contrasting, and potentially conflicting goals and perspectives are deeply embedded in them. When trying to make sense of this situation and the diverse characterizations of sustainability, it is helpful to ask four questions:

1. *What are we trying to sustain*—environmental degradation, lifestyles of the wealthy, political stability, humans as a species, modern civilization, human rights and dignity, social equity, resilience, economic growth, population growth, technological progress, biological diversity, cultural diversity, nonrenewable resources, the ecosystem services on which human survival depends, happiness, the capacity to learn and continuously improve quality of life for all?

2. *For whom and with what rules of distribution*—some select group of humans, all humans, nonhumans to the extent that they are instrumentally useful to us, nonhumans for their own sake, all life?

3. *With what forms of decision making, governance, and metrics for measuring progress*—ad hoc, adaptive, or anticipatory planning; crisis management; representative democracy; socialism; participatory democracy; authoritarian dictatorship; expert-based, professional politicians; Gross Domestic Product; Genuine Progress Indicator; ecological footprint; Human Development Index, Happy Planet Index; etc.?

4. *For how long*—until the next annual report, for the next several years, for a generation, for future generations, for thousands of years, until the sun runs out of hydrogen fuel (≈ 5 billion years)?

Table 1 represents an attempt to portray the status quo plus two broad-brush visions of sustainability—nominal sustainability and robust sustainability—in terms of seven underlying perspectives on: nature and the environment; economic growth; population growth; technology; social goals and ethics; decision making and governance, planning horizon, and metrics for measuring progress; and behavior change.

Conclusion

The future is contingent. The value of discussing sustainability and exploring different visions lies in refocusing attention on improving the human condition and the requirements for achieving it on this planet. Characterizing sustainability visions in terms of seven key underlying perspectives can illuminate critical assumptions, subtle trade-offs, and conflicts. Other factors, such as the state of the planet knowledge, views on human nature, and human capacity for change, risk tolerance, and issues of the day also influence preferences for different visions. As an example, today's growing appreciation of planetary and social constraints is helping to differentiate the visions.^{18,19}

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Table 1. Visions of Sustainability in Terms of Seven Underlying Perspectives

	Status Quo	Nominal Sustainability	Robust Sustainability
Nature and the Environment	Humans are apart from and above nature (anthropocentrism). The environment is a limitless raw-material source and waste sink for humans to exploit as they see fit.	Humans are apart from and above nature. The environment, however, is not a limitless raw-material source and waste sink—some, albeit ill-defined, carrying capacity limits exist. Nature also contributes critical instrumental values that go beyond providing raw materials and a waste sink (i.e., aesthetic, spiritual, and other ecosystem support services).	Humans coevolved with, are a part of, and have innate affinity for nature (biophilia). Human flourishing rests on drawing sustenance from a finite planet with biospherical boundaries. Maintaining the conditions to support rich and flourishing biological diversity, which has value in itself, is a human responsibility.
Economic Growth	No inherent limits to continued economic growth exist. There are, however, externalities—changes in human welfare resulting from the unintended side effects of production and consumption that are not directly captured by the market. Quality of life is generally equated with standard of living; high consumption implies high quality of life.	Economic growth is complimentary to environmental protection and improving the human condition (quality of life). It is also required to achieve them. Full-cost accounting to internalize externalities can enhance opportunities to sustain economic growth.	Wealth ≠ Happiness. Economic growth can run counter to ecological well-being and social progress. Viable economic growth generates qualitative development and results from functioning safely within planetary boundaries, satisfying social goals and ethical concerns, and restoring the environment, especially over the near-term.
Population Growth	Population growth is not viewed as a significant concern. More minds to solve problems and continue to advance technology and economic growth are seen as benefits that outpace any negative effects associated with additional bodies.	Population growth must be slowed to match the pace of humans' capacity to compensate for adverse social and environmental side effects. Technological advances have the potential to extend carrying capacity, but can be outpaced by rapid population growth or excessive per capita consumption.	Population growth must be slowed and reversed so that ecological demands are well within what nature can provide safely and so that the requirement to improve the human condition can be met with available organizational and institutional capacities and resources.
Technology	No fundamental limits to human ingenuity and technological progress exist. Economic growth rests on unbridled technological progress, which creates advances that continually reduce the materials and energy requirements per unit of consumption and thereby improve quality of life.	Technological progress supports efficient production and consumption and the substitution of many ecosystem support services, which nature currently provides for free. This substitution, however, is not costless. Technological advances, especially when unquestioned, can also generate unintended, negative side effects with significant environmental and social	Some technologies are inherently anti-ecological and socially iniquitous. Substitution for ecosystem services is limited and often very expensive. The Precautionary Principle should be applied to technological choice, and production processes should be modeled on natural systems (biomimicry).
Social Goals and Ethics	Poverty reduction is a stated priority that is left to the market or private institutions. Poverty can only be overcome by sustained economic growth ("rising tide lifts all boats"). Great caution should be employed when considering the use of government policy to redirect markets to address social goals.	Improving quality of life is a stated priority. The capacity to broadly improve quality of life rests on sustained economic growth. Modest use of government policy is favored to redirect markets and behavior to reduce poverty and foster green production and consumption, address human rights, and enhance equality.	Improving quality of life for all by maintaining rich, cultural diversity, resolving conflicts nonviolently, and enhancing security are stated priorities. Markets and policy are used aggressively to address social goals. Excessive consumption by the wealthy must be reduced; consumption by the poorest must be expanded to meet basic needs.
Decision Making and Governance Planning Horizon Metric(s) for Measuring Progress	Ad hoc decision making by experts and professional politicians. Minimal government intervention. Planning horizon generally only reflects the next 1 to 5 years. Gross Domestic Progress (GDP)	Adaptive decision making by a combination of experts, professional politicians, and collaborative stakeholder processes. The need for modest government intervention is recognized. Planning horizon includes expressed concern for future generations. Modified GDP to reflect externalities, such as the Genuine Progress Indicator.	Anticipatory decision making fosters decentralized, participatory democracy. Government brokers sustainability. Planning reflects a multiple century time-scale and explicitly addresses the needs of future generations. Environmental, social, and economic indicators are used to regularly measure progress and make mid-course corrections.
Behavior Change	Markets are fully adequate to induce any necessary behavior change. People are utility maximizers with all pertinent information.	Not everything that matters can or should be incorporated into market-based decisions. Information is also not always adequate or accessible. All necessary behavior change, however, can be achieved with existing system structures—markets, political and social organizations, and institutions.	Transformative changes to system structures (markets, political and social organizations, and institutions) are necessary to induce unprecedented behavior changes. Science, policy, ethics, markets, finance, and social learning should be fully exploited to leverage requisite system structure changes.

Nominal sustainability, despite its wide appeal, may ultimately be like walking toward a northbound destination on a southbound train. One starts walking in the right direction, but multiple frames of reference exist and some matter more than others. As the train moves on, the desired destination grows further out of reach. Underlying perspectives may be mixed and matched to some extent, but, like a house of cards, they are also interconnected in subtle ways. In the final analysis, nominal sustainability likely represents a failure to fully and accurately assess the scope of the problems at hand and match them to appropriate, high-leverage solution strategies.

The expanding efforts to model robust sustainability serve as inspiring and, at times, ironic counterforces to the status quo and the widespread ignorance, denial, despair, and maladaptive behaviors it engenders in the face of failure to secure a safe and desirable operating space for humanity. While modest today, these efforts are a testament to the idea that having a relatively high certainty that one is on a viable path toward sustainability matters much more than thinking one is traveling in the correct general direction.

In the end, robust sustainability is premised on the belief that opportunities to secure a firm foundation for human flourishing can be enhanced as well as squandered. Getting on a path toward robust sustainability rests on a sober assessment of the state of the planet, reflection on humankind's highest aspirations, and a conscious, vigilant effort to transform knowledge and caring into action on a global scale. Unlike the Agricultural and Industrial Revolutions, which were slow-paced, largely unplanned, and oriented toward shaping nature to fit human needs, a sustainability revolution will need to re-shape human desires to fit what the planet can afford and support over time. It will need to happen on an extraordinarily short time scale, draw on the best anticipatory planning and science, demonstrate a renewed empathy for

and identification with all life, and muster groundbreaking global collaboration. All of these requirements rest on bringing into play our species-scale capacities for learning and innovation and deploying them for the common good. While the stakes are much higher today than thousands of years ago, generating the actions today to justify optimism for tomorrow is still likely the most vital challenge before humanity.

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