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STATE OF THE WORLD

Innovations for a Sustainable Economy

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CHAPTER 1

Seeding the Sustainable Economy

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To critique the dominant economic system of the twentieth century would seem a fool's errand, given the unprecedented comfort, convenience, and opportunity delivered by the world economy over the past 100 years. Global economic output surged some 18-fold between 1900 and 2000 (and reached $66 trillion in 2006). Life expectancy leaped ahead—in the United States, from 47 to nearly 76 years—as killer diseases such as pneumonia and tuberculosis were largely tamed. And labor-saving machines from tractors to backhoes virtually eliminated toil in wealthy countries, while cars, aircraft, computers, and cell phones opened up stimulating work and lifestyle options. The wonders of the system appear self-evident.[1]

Yet for all its successes, other signals suggest that the conventional economic system is in serious trouble and in need of transformation. Consider the following side effects of modern economic activity that made headlines in the past 18 months:

- Atmospheric carbon dioxide levels are at their highest level in 650,000 years, the average temperature of Earth is "heading for levels not experienced for millions of years," and the Arctic Ocean could be ice-free during the summer as early as 2020.
- Nearly one in six species of European mammals is threatened with extinction, and all currently fished marine species could collapse by 2050.
- The number of oxygen-depleted dead zones in the world's oceans has increased from 149 to 200 in the past two years, threatening fish stocks.
- Urban air pollution causes 2 million premature deaths each year, mostly in developing countries.
- The decline of bees, bats, and other vital pollinators across North America is jeopardizing agricultural crops and ecosystems.
- The notion of an approaching peak in the world's production of oil, the most important primary source of energy, has gone from an alarming speculation to essentially conventional wisdom; the mainstream World Energy Council recently predicted that the peak would arrive within 15 years.[2]

These and other environmental consequences of the push for economic growth threaten the stability of the global economy. Add to this list the social impacts of modern economic life—2.5 billion people living on $2 a day or less and, among the wealthy, the rapid advance of obesity and related diseases—and the need to rethink the purpose and functioning of modern economies is clear.[3]

Even in business circles the sense that something is wrong with modern economies is palpable. An annual assessment of the most significant risks to the world's economies commissioned by the business-sponsored World Economic Forum found that many of the 23 diverse risks were nonexistent at the global level a quarter-century ago. These include environmental risks such as climate change and the strain on freshwater supplies; social risks, including the spread of new infectious diseases in developing countries and chronic diseases in industrial nations; and risks associated with innovations like nanotechnology. Beyond being new and serious, what is most striking is that half of the 23 are economic in nature or driven by the activities of modern economies. In other words, national economies, and the global economy of which they are a part, are becoming their own worst enemies.[4]

But if economies built according to the conventional model are increasingly self-destructive, a new kind of economy—a sustainable economy—is struggling to be born. Where the conventional economy depends largely on fossil fuels, is built around use-and-dispose materials practices, and tolerates extreme poverty even amid stunning wealth, the evolving sustainable economy seeks to operate within environmental boundaries and serve poor and rich alike.

The emergence of the sustainable economy is visible in a burst of creative experimentation involving design for remanufacture, "zero-waste" cities, environmental taxes, cap-and-trade carbon markets, car-sharing companies, maturing markets for solar and wind power, microfinance, socially responsible investment, land tenure rights for women, product take-back laws, and other innovations discussed in this book. Scaled up and replicated across the world, these and other experiments could form the basis of economies that meet the needs of all people at the least cost to the natural environment.

An Outdated Economic Blueprint

The world is very different, physically and philosophically, from the one that Adam Smith, David Ricardo, and other early economists knew—different in ways that make key features of conventional economics dysfunctional for the twenty-first century. Humanity's relationship to the natural world, the understanding of the sources of wealth and the purpose of economies, and the evolution of markets, governments, and individuals as economic actors—all these dimensions of economic activity have changed so much over the last 200 years that they signal the close of one economic era and the need for a new economic beginning.

In Smith and Ricardo's time, nature was perceived as a huge and seemingly inexhaustible resource: global population was roughly 1 billion—one seventh the size of today's—and extractive and production technologies were far less powerful and environmentally invasive. A society's environmental impact was relatively small and local, and resources like oceans, forests, and the atmosphere appeared to be essentially infinite.[5]

At the same time, humanity's perception of itself was changing, at least in the West. The discoveries of Enlightenment-era scientists

suggested that the universe operated according to an unchanging set of physical laws whose unmasking could help humans understand and take control of the physical world. Once the Swiss mathematician Daniel Bernoulli, for example, worked out key ideas of the physics of flight in 1738, it was only a matter of time before humans claimed the air for themselves. After eons of helpless suffering from the effects of plagues, famines, storms, and other wildcards of nature, this growing sense of human prowess—along with a seemingly inexhaustible resource endowment—encouraged the conviction that humanity's story could now be written largely independent of nature.[6]

This radically new worldview became entrenched within economics, and even late in the twentieth century most economic textbooks gave little attention to nature's capacity to absorb wastes or to the valuable economic role of "nature's services"—natural functions from crop pollination to climate regulation. One Nobel economist in the 1970s made the claim (since recanted) that "the world can, in effect, get along without natural resources." Even as growth in population and technological power in the last century raised concerns about resource scarcity, economists predicted confidently that price signals from free markets would prompt more-efficient production and consumption or that human effort would produce or discover substitutes. Nature would not be a roadblock to human progress.[7]

But the assumed independence of economic activity from nature, always illusory, is simply no longer credible. Global population has expanded more than sixfold since 1800 and the gross world product more than 58-fold since 1820 (the first year for which nineteenth-century data are available). As a result, humanity's impact on the planet—its "ecological footprint"—exceeds Earth's capacity to support the human race sustainably, according to the Global Footprint Network. (See Chapter 2.) For rich countries, the overshoot is especially high. Industrial economies today survive by dipping ever more deeply into reserves of forests, groundwater, atmospheric space, and other natural resources—practices that cannot continue indefinitely.[8]

The assumed independence of economic activity from nature, always illusory, is simply no longer credible.

These changing circumstances demand the upending of some fundamental economic notions. With the Industrial Revolution, for instance, factories, machines, financing, and other forms of created capital replaced land as the principal drivers of wealth production. Factories and funding remain important today, but resource scarcity has made "natural capital" an increasingly vital consideration in economic advance. Declines in oceanic fish catch, for example, are often caused by the growing scarcity of fish stocks (natural capital) rather than by a lack of fishing boats (created capital). (See Chapter 5.) Modern fishing practices now overpower nature's fish endowment: a 2006 study showed that the populations of 29 percent of oceanic species fished in 2003 had collapsed (meaning that catch had fallen to 10 percent or less of their peak abundance). Similar losses of natural capital are found at the regional level for forests, water, and other key resources.[9]

A second outdated tenet is that growth ought to be the primary goal of an economy. This remains the central operating assumption in finance ministries, stock markets, and shopping malls worldwide despite the clear threat to natural capital, because rapidly growing populations and the creation of consumer-

driven economies have made growth seem indispensable. But growth (making an economy bigger) is not always consistent with development (making it better): the nearly fivefold expansion of global economic output per person between 1900 and 2000 caused the greatest environmental degradation in human history and coincided with the stubborn persistence of mass poverty.[10]

Markets do little to provide public goods such as parks and mass transportation.

A third shaky axiom of conventional economic thinking is that markets are always superior to government spending and policies as economic tools. Markets are adept at generating vast quantities of private goods, but some of these—such as the dozens of redundant breakfast cereal choices—are of dubious social value. At the same time, markets do little to provide public goods such as parks and mass transportation. And although they help to allocate scarce resources "efficiently" across different products and modes of production, according to Tufts University economist Neva Goodwin, "the very definition of efficiency contains an acceptance of inequality." In economics, efficiency means allocating every resource to its highest value use, where value is defined mainly by purchasing power, so "a market works efficiently when the rich get a lot of what they want and the poor get just as much as they can pay for." Markets thus do little to ensure a just distribution of goods: those with the greatest wealth get the most, no matter that 40 percent of the global population lives in wrenching poverty.[11]

Finally, humans themselves differ sharply from the model of "economic man" held by early economists. The celebrated insight of Adam Smith was that the "invisible hand" leads self-interested individual actions to positive collective outcomes. This is a powerful idea, but it has overshadowed the equally important communitarian dimension of human societies—a dimension with deep roots in evolutionary history. People are motivated not only by self-interest but also by the desire to participate in a larger community, as with volunteer work or in response to local or national disasters. Recognizing the strong communitarian impulse of human beings, as sustainable economics does, offers a fuller and more realistic understanding of humans as economic actors.

Ballooning Liabilities

Conventional economies in the twentieth century churned out cornucopian prosperity and opportunity for people in dozens of countries. But as the century wore on, troubling numbers began to appear in environmental and societal balance sheets, suggesting that what is called "economic growth" entails significant losses—of species, healthy ecosystems, and a stable climate, for instance. Today, the alarming liabilities of modern economies threaten to undermine economic stability worldwide. Three issues—climate change, ecosystem degradation, and wealth inequality—illustrate the self-subversion of economies and economic activity today.

Climate change. The hidden story behind the headline-grabbing drama of climate change—melting glaciers, rising sea levels, and hundred-year storms—is the costs inflicted by global warming. The Intergovernmental Panel on Climate Change, the international scientific body charged with assessing the issue, reported in 2007 that the cost of curbing climate change through reductions in greenhouse gas emissions would run about 0.1 percent of gross world product annually. An independent review in 2006 conducted by Nicholas Stern, head of the

Government Economic Service in the United Kingdom, came to a more sobering conclusion: the cost of mitigation would be around 1 percent of gross world product. One percent in 2007 would have represented $650 billion, equivalent to the cost of the Viet Nam War (in 2007 dollars). This cost is steep, but it would be spread over many countries each year.[12]

Whatever the cost of action, it is a bargain compared with the cost of doing nothing. The Stern Report concluded that inaction on climate change could dampen global economic output by anywhere from 5 to 20 percent every year over the course of this century, the upper limit likely being closer to the final tally. It noted that heat waves like the one in 2003 in Europe, which killed 35,000 people and caused agricultural losses of $15 billion, will be commonplace in a few decades. And hurricane wind speeds in the United States, which are projected to increase 5–10 percent because of rising sea temperatures, would double annual hurricane damage costs. The report's low estimate reflects estimated market costs, while the 20 percent estimate sums market costs, nonmarket health and environmental costs, and an equity weighting factor that accounts for the fact that poor countries will bear a disproportionate burden of the total.[13]

The Stern Report's findings were largely echoed in a survey of climate research by the Global Development and Environment Institute (GDAE) at Tufts University, which noted that two major modeling efforts estimated annual climate damages by the end of this century at 8 percent or more of world output. Business as usual would lead to declining agricultural yields later in this century, as well as more immediate damage to water supplies, human health, and essential natural ecosystems. The Stern and GDAE assessments suggest that early preventive action is a prudent investment necessary to address what the Stern report calls "the greatest and widest-ranging market failure ever seen."[14]

Ecosystem degradation. In 2005, a comprehensive report entitled the Millennium Ecosystem Assessment documented the extent of global ecosystem destruction in the last half of the twentieth century. It concluded that human activity had changed the world's ecosystems, largely for the worse, more rapidly during those 50 years than during any period in recorded human history. Species extinction rates, on the rise since the Industrial Revolution, increased to at least 50–500 times the natural rate. Some 20 percent of the world's coral reefs were lost and another 20 percent were degraded. And more than half of the increase in atmospheric carbon dioxide levels, which stand some 36 percent above their 1750 levels, has occurred since 1959. The web of life weakened as ecosystems became less resilient and less stable.[15]

The report made an effort to measure the drag that ecosystem destruction has already had on economies. Citing World Bank data, it noted that in 2001 some 39 countries experienced a decline of 5 percent or more in wealth (measured as net savings) once unsustainable forest harvesting, depletion of nonrenewable mineral and energy sources, and damage from carbon emissions were taken into account. For 10 countries, the decline ranged from 25 to 60 percent. And these estimates were conservative because they ignored fisheries depletion, atmospheric pollution, degradation of freshwater sources, and loss of noncommercial forests, all of which carry their own economic costs.[16]

Comprehensive data on the economic value of ecosystem services are scarce, but the picture emerging from research over the last decade suggests that these services are of major, though often hidden, economic importance. A 1997 study conservatively

estimated the total global value of 17 ecosystem services to be at least as large as the combined annual output of the world's economies. A follow-up 2002 study estimated that current rates of habitat conversion cost the world's economies some $250 billion, year in and year out. And a 2006 set of case studies from Europe documents how biodiversity losses—of assets from crayfish to peatbogs to agricultural land—lead to the loss of ecosystem services, with clear economic costs. Plantation forests in Portugal, for example, have been associated with a fourfold increase in burnt area from forest fires between 1975 and 2003. Those losses totaled some 137 million euros in 2001, roughly 10 percent of the total economic value of the country's forests that year.[17]

Despite early indications of their enormous economic value, ecosystems continue to be lost. A lack of hard data regarding the actual value of the services of particular ecosystems hampers the incorporation of value into business and government decisionmaking. In addition, even when a value can be credibly estimated, it is often an externality—a cost or benefit accruing to society at large, rather than to the individuals or companies responsible—so there is little incentive for those actors to care for the species or ecosystem in question. And finally, the net value of converting an ecosystem may be artificially skewed by subsidies, tax breaks, and other government-sponsored incentives for the conversion. These market failures are common drivers of the huge environmental losses of the past half-century documented by the Millennium Ecosystem Assessment.[18]

Poverty amid affluence. Economic activity in the last century generated enough wealth, in principle, to have made extreme poverty obsolete. Global economic output increased more than 18-fold between 1900 and 2000 and nearly fivefold on a per person basis, dwarfing the total growth of the previous 19 centuries. Yet extreme deprivation became and remains the norm for a huge share of humanity: even now, as noted earlier, some 40 percent of people worldwide survive on $2 or less per day. One in every eight people in the world was chronically hungry in 2001–03, while one in five lacked access to clean water and two in five lacked adequate sanitation.[19]

Meanwhile, those at or near the economic pinnacle are fabulously wealthy. The gulf between the richest and poorest is now almost incomprehensible: the U.N. Development Programme reported in 2006 that the combined income of the world's 500 richest people was about the same as the income of the world's poorest 416 *million* people—imagine a tiny village somewhere in South America with as much wealth as the rest of the continent. While income inequality worldwide has lessened slightly since the Chinese economic surge began, China's course of development could not spread to Africa, South Asia, and other impoverished regions without catastrophic environmental ramifications.[20]

If inequality is measured in terms of net assets (a fuller measure of wealth than income), the skewing is even greater. (See Table 1–1, which uses household data to derive per capita wealth.) A 2006 United Nations University study found that in 2000 the richest 2 percent of adults globally owned more than half of the world's household assets—that is, financial assets such as investments, plus physical assets such as a home, minus debt—while the poorest 50 percent controlled only about 1 percent. The United States had the highest average net worth per household, at $143,857, while India had the lowest, at $6,500.[21]

Inequity can dampen development prospects. The World Bank's *World Development Report 2006* noted that when some

Table 1–1. Net Worth Per Person, by Country Income Group, 2000

Country Group	Net Worth per Person	Share of World Net Worth per Person	Share of World Population
	(dollars in purchasing power parity)	(percent)	(percent)
High-income OECD*	113,675	64	15
High-income non-OECD*	91,748	3	1
Upper middle-income	21,442	9	11
Lower middle-income	12,436	16	33
Low-income	5,485	8	40
World	26,421	100	100

**Organisation for Economic Co-operation and Development.*
Source: See endnote 21.

people lack access to markets for credit, land, or jobs, resources likely do not flow to where they can do the most good for an economy. A hard-working peasant might generate more wealth for the economy than a less talented shopkeeper, but the shopkeeper, being wealthier and better connected, is more likely to obtain credit or title to land. Multiply the example across many victims of economic discrimination and many input markets, and the losses of wealth to an economy could be sizable. And once these inequities are set, they tend to be reinforced by institutions and social arrangements that favor the interests of the wealthy, which can lock in inequality—and underperforming economies—for generations.[22]

Conceptual Reform in Economics: Seven Big Ideas

As understanding of humanity's interactions with nature evolved and economic liabilities expanded, reformist economists have developed "corrective lenses" to shed light on the blind spots of the conventional economic worldview. At least seven key areas of revisionist thinking—scale, growth versus development, prices, nature's contributions, the precautionary principle, the commons, and women—are influencing economic theory and helping to turn economic activity in more-sustainable directions. (See Box 1–1 on the connections between these ideas and the issues discussed in the rest of *State of the World 2008*.)

Adjust economic scale. The economy's scale is its physical size—the sheer volume of its energy and materials flows—relative to its host, the ecosystem. An analogy might be a baby growing in its mother's womb; it is a subsystem of the mother, totally contained by and dependent upon her. Birth marks the point at which the baby has reached the limit of the mother's ability to host it. Further growth in the womb makes both baby and mother worse off.

Similarly, the global economy depends completely on nature for raw materials, energy stocks, and indispensable services such as water and air purification, soil fertility, and waste absorption. When the economy reaches a certain size, further growth makes both system and subsystem worse off, not better. In the language of economists, growth has become "uneconomic." At the extreme, an economy that tries to grow beyond a size the biosphere can support will simply destroy it. So there must be a limit on the size of the economy; its physical growth cannot go on forever.[23]

Positive signs are beginning to emerge of concrete efforts to restrain the economy's physical size. In February 2007, for instance, the leaders of more than 90 international

Box 1–1. Conceptual Reform in Key Sectors

The conceptual reforms discussed in this chapter are reshaping economics in a variety of ways that are described throughout this book. The key idea of the global economy's scale, for instance, is integral to the new yardsticks used by economists and others to assess human well-being and sustainability (Chapter 2). Economic scale also comes up indirectly when considering how to boost resource efficiency, reform food production, build a low-carbon economy, and reform the global trading system (Chapters 3, 5, 6, 7, and 14). For example, huge livestock-raising and fish farming operations today create environmental and social problems unknown to earlier, small-scale efforts.

The role of prices in telling the ecological truth and nature's contributions to the economy are a key part of discussions on carbon markets, water, and biodiversity (Chapters 7, 8, and 9). The contrast between economic growth and true development is explored in chapters on new economic measures, consumption, and communities designed for sustainability (Chapters 2, 4, and 11). Is it really "progress," for instance, when cities are transformed into sprawling metropolises, family farms are turned into agribusinesses, and rainforests become monoculture tree plantations, as Chapter 2 asks?

The precautionary principle informs much of the discussion of ways to make production safe and sustainable (Chapter 3). And issues of resource ownership and the property rights regimes that are suitable for a sustainable economy are part of any discussion of "the commons" (Chapter 10).

The value of women's contributions to economies is increasingly acknowledged both in community-driven development programs and in the expanding field of microfinance (Chapters 12 and 13). Women-centered grassroots development can improve the health of children and mothers, for instance, and even overturn centuries-old practices like child marriage, in the process releasing untapped skills and energy for economic development.

corporations, including General Electric, Volvo, and Air France, called on governments to set uniform international goals for reductions in emissions of the greenhouse gases that cause climate change. The initiative addresses one key dimension of scale: greenhouse gas emissions, which are too large for the global ecosystem to handle. On the government side, the entry into force of the Kyoto Protocol in 2005 and the launch of the European cap-and-trade system that same year are part of a landmark attempt to commit the world to the goal of slowing the rate of greenhouse gas emissions.[24]

Meanwhile, many businesses are finding ways to "dematerialize" economic activity, which can also reduce an economy's physical size. The movie rental firm Netflix, for example, began to offer its movies online in 2007, reducing the need for packaging, stores, and trips to a rental store. Waste minimization is another strategy to shrink physical flows through an economy. The Interface carpet company in the United States has adopted a "Mission Zero" waste minimization goal, aiming "to eliminate any negative impact our company may have on the environment by the year 2020." The company reports clear progress: manufacturing waste sent to landfills has fallen by 70 percent since the mid-1990s, which the company says has saved some $336 million in disposal costs.[25]

Waste minimization can be promoted through governments as well. In New Zealand, for example, some 70 percent of local councils have declared a zero-waste-to-landfills goal for their communities. The town of Opotiki, the first in the nation to set such a goal, has diverted 90 percent of its waste away from landfills each year since 1999, according to Zero Waste New Zealand. Spurred by national waste minimization legislation and using tools like extended producer responsibility laws—which require compa-

nies to take back their worn products or packaging—most communities expect to meet their goals by 2020.[26]

Shift from growth to development. What's an economy for? The conventional answer has long been: to produce ever-greater quantities of goods and services. But as just discussed, this goal is untenable in this "full world," so the growth mandate is giving way in some quarters to a new focus on development. Development is ultimately about improving human well-being—meeting fundamental human needs for food and shelter, security, good health, strong relationships, and the opportunity to achieve individual potential. Much of conventional economic activity is indifferent to this well-being focus: the $1.2 trillion spent on the world's militaries in 2006, plus the billions spent on emergency room visits, police, security systems, hazardous-waste site cleanups, litigation, and other "defensive" measures, are all major contributions to economic growth, even though they may have contributed little or nothing to actually improving people's well-being. [27]

To be sure, improving well-being can involve growth: offering access to food and shelter for all, especially the desperately poor, will require economic expansion in some locales. And whether growth is involved or not, the poor need serious economic attention to advance their well-being. Initiatives from the Millennium Development Goals to grassroots campaigns led by End Poverty Now and other nongovernmental groups suggest a growing global consciousness around the need to help the poorest. And initiatives like microcredit seem to offer significant promise for the poor to increase their claim to a country's economic pie through provision of very small loans to the poor to build microbusinesses. The Microcredit Summit Campaign has involved tens of millions of families in microfinance and aims to extend its work to 175 million of the world's poorest families by 2015. While comprehensive studies on the impact of microcredit are yet to be done, initial research suggests that something valuable is being produced.[28]

The need to focus on well-being applies to wealthy people as well. A large body of research conducted over the past 30 years suggests that after a certain point, wealth does not generally increase happiness. (See Chapter 4.) Landmark studies done in the 1990s showed, for example, that self-reported levels of happiness in Japan were no greater in 1987 than in 1958, despite a five-fold increase in real income. Even in China, where real incomes grew by 2.5 times between 1994 and 2005, the share of people saying they were satisfied fell about 15 percentage points during this period, and the share saying they were dissatisfied rose by about as much. When economic growth no longer makes people any happier, it is beyond pointless—it is self-destructive.[29]

Efforts to advance human well-being within prosperous populations involve a wide range of initiatives, including campaigns for healthy eating, work leave for new parents, shortened workweeks, and encouragement of exercise. Promotion of cycling, for example, is on the rise, with recent initiatives in Australia, France, Taiwan, the United Kingdom, and the United States. Cycling and walking offer major health and environmental benefits, and they can be cost-effective: as the share of trips made by cycling, walking, and public transport rises, the share of the economy needed for transportation falls. While promoting cycling may seem quixotic, some European cities are inspiring models: in Amsterdam, for instance, some 27 percent of all urban trips are made by bike, compared with less than 1 percent in the United States.[30]

Some businesses are stepping up to the well-being challenge as well, by providing discounted gym memberships or by extending commuter subsidies to employees who bike or walk to work. The Sprint Corporation went a step further, designing exercise into its new headquarters. To encourage walking, its corporate campus was built with parking lots and food courts located far from offices, and with elevators deliberately designed to be slow—in order to encourage the use of stairs.[31]

Interest in ways to promote human well-being is widening among policymakers as well. Well-being is now a national policy goal in Australia, Canada, and the United Kingdom. And for the last 35 years, the Himalayan kingdom of Bhutan has made "gross national happiness," not economic growth per se, its official goal. (See Chapter 2.) Government policies there aim less at boosting raw gross domestic product (GDP) numbers than at raising educational levels and reducing poverty while preserving the country's environment and its cultural traditions.[32]

Make prices tell the ecological truth. Reformist economists have borrowed a principle from their conventional colleagues—"get the prices right"—and applied it to the effort to build sustainable economies. Environmental costs often go unrecognized by markets, as when costs created by carbon emissions are not included in the price of gasoline or electricity. These costs do not disappear, however, but are shouldered by bystanders, such as the poor in developing countries who pay to rebuild homes ruined by the storms or rising seas generated by climate change. Any economist will acknowledge that this sort of classic market failure sends distorted signals about the costs of economic activity and thus makes it difficult or impossible to achieve an efficient marketplace—the Holy Grail of conventional economics.

Governments are finding imaginative ways to include such costs, typically through taxes or fees. Ecotaxes, which in countries that belong to the Organisation for Economic Co-operation and Development provided 6–7 percent of tax revenues between 1994 and 2004, often involve shifting levies away from things valued by society, such as work, to undesirable things like pollution. Germany, for example, increased taxes on energy from 1999 through 2002 and reduced taxes on labor, resulting in lower emissions of carbon and the creation of 250,000 new jobs through 2003. Or consider feebates—a combination of fees and rebates—that subsidize the cleanest products or practices via a tax on the dirtiest ones. Sweden charged power plants a fee in the early 1990s for their emissions of nitrogen oxide—a principal cause of acid rain—and redistributed the revenues to the least polluting plants, providing a strong incentive for plants to reduce emissions. This led to a 34-percent reduction in the offending emissions in 1992 compared with 1990.[33]

Another example of a green tax is "congestion pricing" of automobiles entering urban centers. These charges are meant to raise the cost of driving, especially at peak hours, inducing people to shift to less-polluting public transportation. In Stockholm, a six-month congestion tax trial saw traffic levels fall an average 22 percent, personal injuries drop 5–10 percent, and ridership on public transportation increase some 4.5 percent. The trial was expensive, but the city estimates that if adopted permanently, the charge would produce 1.90 kronor of benefits for every krona invested, largely because of shorter travel times, increased road safety, and health and environmental benefits.[34]

Account for nature's contributions. Nature is a ready storehouse of the raw materials of civilization—food, fiber, fuel, minerals—and the collective annual value of these

goods is in the trillions. But the global ecosystem also provides many services that are the indispensable substrate of economies, including air and water purification, mitigation of droughts and floods, soil generation and soil fertility renewal, waste detoxification and breakdown, pollination, seed dispersal, nutrient cycling and movement, pest control, biodiversity maintenance, shoreline erosion protection, protection from solar ultraviolet rays, partial climate stabilization, and moderation of weather extremes.[35]

Far from being free, the value of ecosystem services is sobering. For instance, honeybees' work as pollinators is worth up to $19 billion a year in the United States alone. Farmers around the world spend $30–40 billion annually on pesticides to control crop pests, but the pests' natural enemies eliminate at least as large a share of the pest population—in fact, perhaps far more—and without them, expenditures on chemicals would be far higher.[36]

Fortunately, nature's contributions are increasingly being factored into economic decisionmaking through administrative and market mechanisms. In Costa Rica, landowners receive payments for preserving forests and their biodiversity, with the money coming from fuel taxes and the sale of "environmental credits" to businesses. In Mexico, water users pay into a fund that is used to protect upstream watersheds from exploitation, thereby helping to preserve water quality; nearly 1 million hectares are protected under the program. In the state of Victoria in Australia, landowners can bid competitively for government payments to conserve biodiversity and achieve other environmental benefits. (See Chapter 9.) These programs all assign prices to valuable natural services that have historically been taken as free—and therefore have been widely abused and degraded.[37]

Apply the precautionary principle. The precautionary principle is folk wisdom—Look before you leap, *Más vale prevenir que lamentar* (Better to prevent than lament)—embodied in public policy. It is commonly defined this way: "where an activity raises threats of serious or irreversible harm to the environment or human health, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically." Put more plainly, traditional risk analysts ask, How much environmental harm will be allowed? Precautionists prefer the question, How little harm is possible? If safe alternatives to a product or substance exist, they argue, why use a product with even a small, highly uncertain risk?[38]

In Mexico, water users pay into a fund that is used to protect upstream watersheds from exploitation.

The principle reflects an understanding that the modern economy is highly complex, globally integrated, and capable of deploying immense technological powers, all of which create an irreducible level of potentially dangerous uncertainty. Critics charge that the precautionary principle will stifle innovation, because unknown dangers by definition cannot be prevented. But precautionists note that a set of clues can help investigators determine if an innovation is likely to pose a danger. If a new product or technology is likely to generate irreversible consequences, harmful persistent wastes, or a large-scale impact, it becomes a candidate for serious investigation regarding its potential for harm.[39]

Today, precaution is increasingly embraced as public policy. The 1991 Maastricht Treaty that created the European Union established this as the guiding principle for environmental policy. In 1998, the Danish Environment Agency banned phthalates, a softener, from plastic toys because of its con-

nection to reproductive abnormalities in animals, even though no danger to humans had been documented. Similarly, in 1999 the Los Angeles School Board chose to ban chemical pesticides in favor of a safer alternative, integrated pest management. And in 2003 San Francisco led U.S. cities in adopting precaution as official policy.[40]

The precautionary principle may evolve further to cover cases where unforeseen problems arise even after new products or processes have been deemed safe. In those cases, another mechanism—the surety bond—could mitigate the damage or compensate victims. A company wishing to introduce a new product would be required to deposit an appropriate sum, keyed to the best estimate of potential future damages, in an interest-bearing escrow account. The money would circulate and support other economic activity, just as other deposited funds do, and would be returned (plus interest) when the firm could show that the damage had not occurred or was less severe than estimated.[41]

Revitalize commons management. Human societies have evolved a wide range of institutions for the long-term management of natural resources, but today it is not unusual to hear it argued—especially in discussions of the so-called tragedy of the commons (see Chapter 10)—that private property is the only workable arrangement or that central government control is necessary. But some resources (such as the atmosphere) arguably ought to belong to everyone or are difficult or impossible to privatize. In any case, privatization is no guarantee against mismanagement or abuse. And government controls, while workable in some instances, have been shown to be inferior to private or user-group-sponsored systems in others.[42]

The most difficult challenge is posed by resources that are accessible to all and whose use by one party reduces the availability to other parties. Global examples include the atmosphere and open-ocean fisheries; regional examples include aquifers and irrigation systems. Unless there are agreed-upon and enforceable rules to control access (property rights systems), such resources are vulnerable to rampant exploitation and overuse. In fact, this is precisely what often happens in open access systems, in which anyone can use the resource with no restrictions—the very scenario that can give rise to the tragedy of the commons. The global atmosphere is only one vivid example of this; anyone can use it as a free dumping place for greenhouse gas emissions.[43]

An often-overlooked alternative to private or government ownership is group property systems, which assign the rights to a group that can deny access to nonmembers. For centuries there has been common management of irrigation works, forests, and pastureland in Spain, Switzerland, Japan, and the Philippines, for instance. (See Chapter 10.) Now the practice is being revitalized in other situations. The European Union cap-and-trade scheme for controlling greenhouse gas emissions, for example, is based on the principles that the atmosphere is commonly held by all and that access to its carbon-absorption capacity should come at a price—ideally and ultimately, a price high enough to hold carbon emissions to sustainable rates. [44]

In *Capitalism 3.0*, Peter Barnes of the Tomales Bay Institute proposes that commons management systems be used as an alternative to government and private ownership of resources such as the atmosphere, the oceans, and great forests. Trusts would govern access to these commons, within sustainable limits, and would charge fees to those granted access. Revenues earned from the fees, in Barnes's vision, would be used to maintain the commons, with surpluses returned as dividends to the commons owners—all citizens. And because people would

have a financial stake in a healthy commons, they would follow with interest the trusts' management of them.[45]

Barnes and his colleagues at the Institute monitor commons management on a smaller scale in their "report to owners" entitled *Commons Rising*. For instance, they cite a 40,000-member food cooperative in Washington state that formed a trust to buy critical farmland and thus prevent its "development" as a housing tract. The trust is designed to manage the property as farmland for generations to come. Another example is efforts to resist the increasing "enclosure" of the information commons—attempts to privatize all intellectual property and thereby profit from it; responses such as the Creative Commons licensing scheme have sprung up to allow creative works to be shared and modified freely without charge.[46]

Value women. "Most poor people are women and most women are poor," noted a 1994 U.N. report, yet "almost all low-income women are economically active." This is still true, and it follows that ensuring economic opportunity and equality for women is likely to give economies a major shot in the arm. Gender bias in everything from asset ownership to wage rates to credit access dampens economic activity.[47]

Most fundamentally, women typically are not paid equally for equal work. Women's wages in manufacturing as a percentage of men's wages, for example, are 78 percent in Costa Rica, 66 percent in Egypt, 60 percent in Japan, and 91 percent in Sweden and Myanmar. Many countries have passed some version of an Equal Pay Act, but discrepancies between men and women persist: the United States, for instance, passed its Equal Pay Act in 1963, but women still earn only 77¢ for every dollar earned by men.[48]

Women also often lack access to land and credit. Women are responsible for 60–80 percent of the world's food production today, yet they own less than 15 percent of the land in developing countries. Creative solutions include the Grameen Bank's initiative to set eligibility rules for housing loans that require that titles to land and houses be in the name of wives as well as husbands. Thus in a divorce a wife is legally entitled to her share of the couple's assets.[49]

Beyond issues of formal discrimination, women could be better supported in the often-disproportionate roles they play in child care, elder care, volunteer work, and other unpaid labor, which account for a substantial share of all economic activity. The Canadian government, for example, estimates that unpaid work is worth 31–41 percent of GDP. Some governments in industrial countries—where the single breadwinner is no longer the norm and where paid and unpaid work are often closely intertwined—are examining how to take women's unpaid work into account in policy development. By providing liberal parental leave, giving workplaces incentives to offer day care, changing the tax structure to benefit those caring for aging parents, and other similar benefits, governments are working to support the social and economic value of women's unpaid work.[50]

Innovation Revolutionaries

Some analysts believe the innovations fueling sustainable economies are spawning the sixth major wave of industrial innovation since the start of the Industrial Revolution. (See Chapter 3.) From the steam engine in the first wave to biotechnology and information networks in the fifth, surges of innovation have accelerated the rates at which natural capital could be converted to human-made capital, thereby ushering in new eras of material prosperity throughout the industrial era. The sixth wave, which taps green chemistry, bio-

mimicry, industrial ecology, and other sustainability innovations, offers the promise of breakthroughs in using natural wealth efficiently, wisely, and equitably. And because it takes advantage of social and institutional innovations as well—not just technological ones—this new wave provides leadership roles for consumers and nongovernmental groups, businesses, and governments.[51]

Consider first the role of consumers. Using their market muscle, consumers are already helping to drive interest in green products of all kinds. Sales of Toyota's hybrid vehicles, for example, jumped from 18,000 in 1998 to 312,500 in 2006 and now number more than 1 million worldwide. Sales of compact fluorescent lightbulbs (CFLs) in the United States alone totaled 100 million in 2005. And purchases of organic foods worldwide jumped by 43 percent between 2002 and 2005, to $43 billion. Impressive as the growth in green products has been, sales constitute just a small share of the consumption of each product line—U.S. sales of CFLs accounted for only 5 percent of lightbulb sales in 2007, and organic agriculture is practiced on less than 1 percent of global agricultural land. Given that consumption accounts for a large share of the GDP of most economies—in the United States in 2006 it was 70 percent—consumers are barely tapping their power to swing economies in a sustainable direction. They need help.[52]

Using their market muscle, consumers are already helping to drive interest in green products of all kinds.

Businesses can provide assistance—and increase profitability—by meeting consumer demand for green products. Wal-Mart has taken a leadership role regarding CFLs, for example, setting a sales goal of 100 million bulbs in 2007, which would roughly double U.S. sales of these energy-efficient products. Other firms seem to be trying but are constrained by the pressures of corporate governance. British Petroleum has taken steps to remake itself as an energy company rather than an oil company. Its BP Alternative Energy business is set to invest $8 billion in solar, wind, and hydrogen power over the next decade. But BP cannot abandon its petroleum business wholesale in the near term without sacrificing the high returns that shareholders expect from today's lucrative oil market. Not surprisingly, its planned investment in BP Alternative Energy represents just 5 percent of its average annual capital investments.[53]

A key constituency with the power to reshape economies is investors, because capital invested today shapes industries for years and even decades to come. Socially responsible investments, project financing governed by the Equator Principles, and microfinance can help advance sustainability values. (See Chapter 13.) So can venture capital (VC) investments, the funds that seed many new, innovative businesses built on great ideas that can transform societies.

Venture capital has looked favorably on the "cleantech" sector—those businesses in the fields of energy, agriculture, water, and waste disposal that use innovative technologies or practices to deliver the services people want in a clean way. The field is booming: in 2006, VC cleantech investments in North America jumped 78 percent over 2005 levels to become the third-largest VC investment category, with 11 percent of all venture investments. Cleantech now gets more of these investments than the medical devices, telecommunications, and semiconductor sectors, and trails only software and biotech. Venture capital is growing in other regions as well, especially in China. There, clean-

tech VC investments increased some 147 percent between 2005 and 2006 and accounted for some 19 percent of all VC investment in the country.[54]

Perhaps the greatest boost to sustainability initiatives can be given by governments, which can shape markets and design non-market policies for sustainability. In Sweden, the government is using its regulatory and market-shaping powers to move the country rapidly away from fossil fuels. In 2006 a government commission recommended that by 2020 the use of oil in road transport be cut by 40–50 percent, that industry reduce its consumption of oil by 25–40 percent, and that heating oil use be eliminated entirely. While the commission envisioned many government/private initiatives to achieve these goals, government leadership is critical, through dozens of initiatives ranging from research on energy efficiency to promotion of affordable train service and tax incentives for biofuels production.[55]

At the municipal level, many cities are introducing bus rapid transit (BRT), an innovative system of expedited bus lanes and loading systems pioneered by the government of Curitiba, Brazil. Municipal governments have discovered in BRT a remarkably efficient mass transit option that is far cheaper than underground metro systems. As a result, BRT systems have been built in Quito, Bogotá, Jakarta, Beijing, Mexico City, and Guayaquil and are under development in dozens of other cities.[56]

BRT provides perhaps the best example of how good government is indispensable to achieving sustainability—and indeed ought to be in the forefront of the movement. Governments not only can launch initiatives such as BRT themselves, they can shape the rules for markets to ensure that the energy and creativity of business is harnessed for sustainable ends. And as the embodiment (ideally) of the collective will, values, and priorities of the societies that give them legitimacy, governments must step up and take on those necessary tasks that civil society and the private sector cannot or will not do adequately or competently—to look after the well-being of society as a whole.

With business, civil society, and government all showing serious interest in sustainability in dozens of countries worldwide, the chances of creating sustainable economies appear better than ever. As the vulnerabilities of conventional economies continue to be revealed, and as sustainability innovations proliferate and scale up, the prognosis is hopeful. Societies worldwide stand poised to rewrite the ongoing human drama of economics with a new chapter: the sustainable wealth of nations.

Chapter 1. Seeding the Sustainable Economy

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CHAPTER 2

A New Bottom Line for Progress

John Talberth

The way societies have defined and measured progress has had a profound influence on world history. Inspired by the idea of progress, humanity has eradicated infectious diseases, achieved explosive growth in agricultural productivity, more than doubled life expectancy, explored the origins of the universe, and vastly increased the amount and variety of information, goods, and services available for modern life. To be sure, progress has had its darker side. The evolution of weaponry from spears to atom bombs may be considered progress, but only in the most cynical sense. Likewise, transformation of vibrant cities to sprawl, family farms to agribusiness, and rainforest to monoculture tree plantations may only constitute progress for the minute fraction of humanity who have—often brutally—positioned themselves to benefit from mass exploitation of both human and natural capital.[1]

In the West, faith in the linear evolution of history framed how progress was viewed through the ages and remains a fundamental justification for today's progress mantra: economic globalization and consumerism. While this notion of progress is largely inconsistent with religious, moral, and economic frameworks common in Eastern and indigenous cultures, economists Rondo Cameron and Larry Neal point out that "nearly every nation in the world has now accepted the need to adjust its own economic policy and structure to the demands of the emerging global marketplace." Under economic globalization, progress is judged by how well nations implement policies to grow the scale and scope of market economic activity, improve efficiency of factors of production, remove regulatory barriers, and both specialize and integrate with the rest of the world. While gross domestic product (GDP) is the best-recognized measure of overall economic performance, many other metrics related to economic openness, productivity, tariffs, income, and privatization are equally influ-

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ential. This chapter describes the shortcomings of traditional metrics and provides an overview of new indicators designed to capture the environmental and social dimensions of progress.[2]

Economic Globalization and Genuine Progress: A Growing Disparity

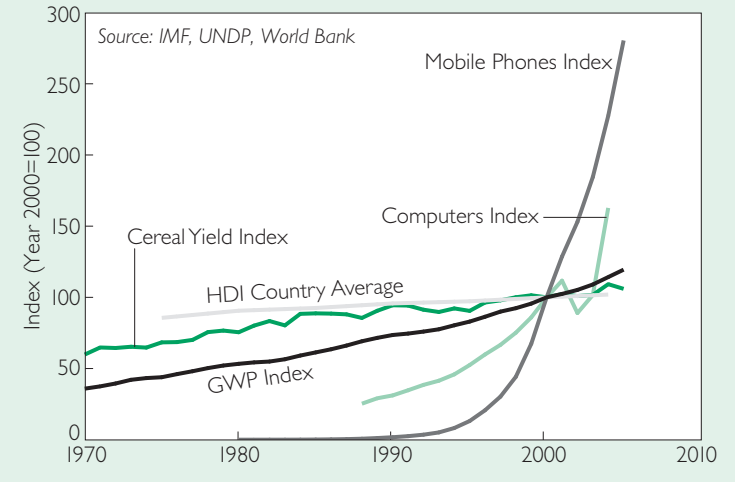
Undoubtedly, economic globalization has gone well by many standards. The era of globalization has been accompanied by significant improvements in key indicators such as the human development index, life expectancy, cereal yields, and dissemination of critical information technologies. (See Figure 2–1.) Nonetheless, there is widespread recognition that globalization indicators are increasingly irrelevant and out of touch with the great environmental and humanitarian disasters unfolding on the planet, that they mask gross inequities in the distribution of resources, and that they fail to register overall declines in well-being that stem from loss of community, culture, and environment.[3]

It is beyond dispute, for example, that GDP fails as a true measure of societal welfare. While it measures the economic value of consumption, GDP says nothing about overall quality of life. In 1906, economist Irving Fischer coined the term "psychic income" to describe the true benefit of all socioeconomic activity. Goods and services are valued not for themselves, Fischer argued, but in proportion to the psychic enjoyment derived from them. Higher levels of consumption may or may not have anything to do with a higher quality of life if such consumption is detrimental to personal health, to others, or to the environment.[4]

GDP gives no indication of sustainability because it fails to account for depletion of either human or natural capital. It is oblivious to the extinction of local economic systems and knowledge; to disappearing forests, wetlands, or farmland; to the depletion of oil, minerals, or groundwater; to the deaths, displacements, and destruction caused by war and natural disasters. (See Box 2–1.) And it fails to register costs of pollution and the nonmarket benefits associated with volunteer work, parenting, and ecosystem services provided by nature. GDP is also flawed because it counts war spending as improving welfare even though theoretically, at best, all such spending really does is keep existing welfare from deteriorating.[5]

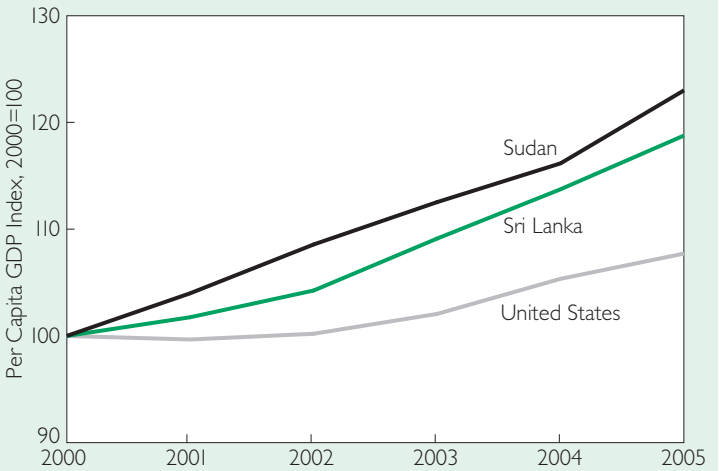
Per capita income and trade numbers are

Figure 2–1. World Indicator Trends, 1970–2005



Box 2–1. Gross Domestic Product: Blind to Economic, Social, and Environmental Crises

The most tragic humanitarian and natural disasters of the past five years have been largely unnoticed by GDP accounts. (See figure.) In Sudan, for example, the per capita GDP has risen 23 percent in this decade, yet 600,000 people were acutely at risk of famine from a prolonged drought in 2001. And more than 400,000 people were killed there and some 2.5 million displaced by alleged genocide in Darfur between 2003 and 2007. Similarly, in Sri Lanka the tsunami that killed at least 36,000 people and devastated coastal infrastructure in 2004 did not affect the steady rise in the nation's GDP. In the 2003 to 2005 period, the United States spent over $1.4 trillion on defense ($188 billion on the war in Iraq) and suffered great losses from Hurricane Katrina, yet the GDP there continued to rise. Income inequality in 2005 reached its highest level since 1928, with the top 300,000 Americans earning the same as the bottom 150 million.



also increasingly suspect macroeconomic indicators. Rising per capita income says nothing about the distribution of that income—it may drop for the majority, rise for a handful at the top, and still show an overall gain. Indeed, while per capita income soared by 9 percent in the United States in 2005, the increase all went to the wealthiest 10 percent of the population. The bottom 90 percent experienced a 0.6-percent decline. Similarly, a nation may have rapidly growing trade volumes but lose countless jobs that are exported to "more efficient" regions, become more vulnerable as its economy becomes more specialized, and lose a large degree of its economic self-determination as ownership and control over economic decisionmaking gets displaced to distant corporate offices.[6]

Traditional microeconomic indicators for businesses and institutions are becoming obsolete as well. A company's stock price might rise on news of successful downsizing, outsourcing, or mergers, but tens of thousands of people could be laid off despite obscene CEO salaries and an ever greater concentration of market power. In agriculture, global conglomerates have become very adept at improving the efficiency of food production when measured by output per dollar. At the same time, the amount of food per hectare has dropped relative to what used to be produced on smaller, supposedly less efficient farms—creating food deserts in some of the world's most productive agricultural regions.

And finally, at the personal level, measuring economic progress by the size of salaries, stock portfolios, or houses or by the number of SUVs, plasma televisions, computers, or

clothes someone owns fails to acknowledge the empty side of materialism. A rapidly emerging field called "hedonics" combines economics and psychology in an attempt to better understand what triggers "feelings of pleasure or pain, of interest and boredom, of joy and sorrow, and of satisfaction and dissatisfaction," as the authors of *Well-being: The Foundation of Hedonic Psychology* put it. An increasingly large and robust body of hedonics research confirms what people know intuitively: beyond a certain threshold, more material wealth is a poor substitute for community cohesion, healthy relationships, a sense of purpose, connection with nature, and other dimensions of human happiness. In his recent book *Deep Economy*, Bill McKibben provides an excellent overview of findings from this emerging field. One remarkable finding is that above an income of roughly $10,000 per person, the correlation between happiness and income no longer exists. (See also Chapter 4.)[7]

According to the World Bank, economic indicators serve three basic functions: they provide a measure of wealth, they help shape development policies, and they inform citizens on how their economies are being managed so that they can make appropriate political choices and thereby exert control over their governments. To accomplish all this, clearly some new indicators are needed.[8]

Sustainable Development: The New Bottom Line

In response to the grim realities of climate change, resource depletion, collapsing ecosystems, economic vulnerability, and other converging crises of the twenty-first century, a consensus is emerging among scientists, governments, and civil society about the need for a rapid but manageable transition to an economic system where progress is measured by improvements in well-being rather than by expansion of the scale and scope of market economic activity. We need to measure economic progress by how little we can consume and achieve a high quality of life rather than how fast we can add to the mountains of throwaway artifacts bursting the seams of landfills. We need to measure progress by how quickly we can build a renewable energy platform, meet basic human needs, discourage wasteful consumption, and invest in rather than deplete natural and cultural capital. We need an economic system that replaces brutal and wasteful competition between nations, businesses, and individuals with one that binds us together in cooperative frameworks for solving civilization's most urgent problems. We need an economic system that is firmly ensconced within Earth's ecological limits and guided by our spiritual and ethical traditions. We need an economic system that is diverse, adaptable, and resilient. All these objectives can be grouped under the rubric of sustainable development—the new bottom line for progress in the twenty-first century.

In 1987 the World Commission on Environment and Development defined sustainable development as meeting "the needs of the present without compromising the ability of future generations to meet their own needs." Since then, there has been a proliferation of frameworks giving substance to this basic definition by specifying goals, objectives, standards, and indicators of sustainable development for societies as a whole, for broad economic sectors, and for individual institutions. In *The Sustainability Revolution*, Andres Edwards suggests seven themes or objectives common to all frameworks: stewardship, respect for limits, interdependence, economic restructuring, fair distribution, intergenerational perspective, and nature as a model and teacher.[9]

Each framework is accompanied by a

unique blend of indicators for measuring progress or lack thereof in advancing these objectives. The remainder of this chapter considers a range of these new indicators, which can be subdivided into two broad categories and two broad types. The basic categories are macro-level indicators developed for economies as a whole and micro-level indicators for institutions or businesses. The two major types include aggregates or "headline indicators" (which attempt to combine individual indicators into a single numerical index) and specific, single-issue indicators. Given past misuses of single indices such as GDP, most sustainability practitioners recognize the need for a suite of indicators balanced across economic, environmental, and social domains.

A Macroeconomic View

Table 2–1 provides a sample of important macroeconomic indicators responsive to challenges of sustainable development in the twenty-first century. Each indicator is linked to one of five macroeconomic objectives common to popular sustainable development frameworks:

- promoting genuine progress based on multiple dimensions of human well-being,
- fostering a rapid transition to a renewable energy platform,
- equitable distribution of both resources and opportunity,
- protecting and restoring natural capital, and
- economic localization.

Since the late 1980s, researchers have been working to develop substitutes for GDP that address the costs and benefits of economic activity on environmental and social dimensions of well-being. Collectively, these indicators are known as "green" GDP accounting systems, the most comprehensive of which is the genuine progress indicator (GPI) and its variants.

The GPI is designed to measure sustainable welfare and thus replace GDP as a nation's most important yardstick of economic progress. It adjusts a nation's personal consumption expenditures upward to account for the benefits of nonmarket activities such as volunteering and parenting and downward to account for costs associated with income inequality, environmental degradation, and international debt. The GPI has been reviewed extensively in the scientific literature and found to offer the greatest potential for measuring national sustainable development performance.[10]

Redefining Progress has done a breakdown of GPI contributions and deductions for the United States in 2004. (See Table 2–2.) These calculations show the GPI at $4.4 trillion, compared with a GDP of nearly $10.8 trillion, implying that well over half of the economic activity in the United States that year was unsustainable and did not contribute to genuine progress.[11]

GPI accounts for the United States and many other countries show the gap between GPI and GDP widening since the mid- to late 1970s. Economists call this divergence the "threshold effect." It implies that after a particular threshold, environmental and social benefits of economic growth are more than offset by rising environmental and social costs. Before that point is reached, genuine progress generally rises with GDP.[12]

Despite its theoretical validity, the GPI and other green accounting systems have yet to be formally adopted by national governments as replacements for GDP—perhaps because the news they communicate is so sobering. In early 2007, the Chinese government abandoned its efforts to develop a green GDP; preliminary results of the project showed pollution-adjusted growth rates to be

Table 2–1. Sustainable Development Objectives and Macroeconomic Indicators

Economic Objective	Sample Indicators and Desired Direction of Effect	Description
Genuine human progress	Genuine progress indicator (+)	Aggregate index of sustainable economic welfare
	Happy planet index (+)	Aggregate index of well-being based on life satisfaction, life expectancy, and ecological footprint
	Well-being index (+)	Aggregate index of well-being based on health, wealth, knowledge, community, and equity
	Human development index (+)	Aggregate index of well-being based on income, life expectancy, and education
Renewable energy platform	Carbon footprint (–)	Provides spatial and intensity measures of life cycle carbon emissions
	Energy return on investment (+)	Ratio between energy a resource provides and the amount of energy required to produce it
	Energy intensity (–)	Energy used per unit of economic output
Social equity	Index of representational equity (–)	Measures consistency between ethnic composition of elected officials and that of the general population; zero indicates "perfect" consistency
	GINI coefficient (–)	Measures extent to which an income distribution deviates from an equitable distribution; zero indicating "perfect" equity
	Legal rights index (+)	Measures degree to which collateral and bankruptcy laws protect rights of borrowers and lenders, scale of 0 to 10.
	Access to improved water and sanitation (+)	Percent of population with access to improved water and sanitation services
Protect and restore natural capital	Ecological footprint (–)	Ecologically productive land and ocean area appropriated by consumption activities
	Genuine savings (+)	Net investment in human-built and natural capital stocks adjusted for environmental quality changes
	Environmental sustainability index (+)	Weighted average of 21 separate environmental sustainability indicators
Economic localization	Local employment and income multiplier effect (+)	Direct, indirect, and induced local economic activity generated by a given expenditure
	Ogive index of economic diversity (–)	Measures how well actual industrial structure matches an ideal structure; zero indicates "perfect" diversity
	Miles to market (–)	Average distance a group of products travels before final sale

nearly zero in some provinces. Nonetheless, there are dozens of encouraging pilot programs implemented by national governments and nongovernmental organizations (NGOs) to apply various green accounting systems.[13]

A recent global assessment found green accounting programs in place in at least 50 countries and identified at least 20 others that were planning to initiate such programs soon. Broader GPI applications that consider factors such as social equity or the value of nonmarket time uses are thus far relegated to academic institutions or NGOs such as Canada's Pembina Institute, which calculates an Alberta GPI and uses it to inform policy debates over economic diversification, trade, transportation, taxes, and many other economic, social, and environmental issues.[14]

Other macroeconomic indicators have been created to supplement GDP with information on overall well-being. One example is the happy planet index (HPI), first published by the New Economics Foundation and Friends of the Earth in 2006. The authors note that the HPI "measures the ecological efficiency with which, country by country, people achieve long and happy lives." The basic formula is to multiply a country's self-reported life satisfaction index (determined through surveys) by its average life expectancy and then divide by its ecological footprint. The first HPI assessment found Central America to be the region with the highest average score due to its relatively long life expectancy, high satisfaction scores, and an ecological footprint below its globally equitable share.[15]

Table 2–2. Genuine Progress Indicator Components and Values, United States, 2004

Component		Amount
		(billion dollars)
Contributions		
Weighted personal consumption expenditures (adjusted for inequality)	+	6,318.4
Value of housework and parenting	+	2,542.2
Value of higher education	+	828.0
Value of volunteer work	+	131.3
Services of consumer durables	+	743.7
Services of streets and highways	+	111.6
Net capital investment (positive in 2004, so included in contributions)	+	388.8
Total positive contributions to the GPI		$11,064.0
Deductions		
Cost of crime	–	$34.2
Loss of leisure time	–	401.9
Costs of unemployment and underemployment	–	177.0
Cost of consumer durable purchases	–	1089.9
Cost of commuting	–	522.6
Cost of household pollution abatement	–	21.3
Cost of auto accidents	–	175.2
Cost of water pollution	–	119.7
Cost of air pollution	–	40.0
Cost of noise pollution	–	18.2
Loss of wetlands	–	53.3
Loss of farmland	–	263.9
Loss of primary forest cover	–	50.6
Depletion of nonrenewable resources	–	1,761.3
Carbon emissions damage	–	1,182.8
Cost of ozone depletion	–	478.9
Net foreign borrowing (positive in 2004, so included in deductions)	–	254.0
Total negative deductions to the GPI		$6,644.8
Genuine progress indicator 2004		$4,419.2
Gross domestic product 2004		$10,760.0

Source: See endnote 11.

HPI data provide further corroboration of the threshold effect. Countries classified by the United Nations as medium human development fare better than either low or high development countries. An independent statistical analysis of HPI and per capita income values for 157 countries found the two rising together up to a threshold, then diverging after that. The HPI authors concluded that "well-being does not rely on high levels of consuming."[16]

As with the green GDP, well-being indices have yet to gain official prominence—with one notable exception. Since 1972 the government of Bhutan has been using the concept of gross national happiness (GNH) as a sustainable development framework. According to Prime Minster Lyonpo Jigmi Y Thinley, GHN is "based on the premise that true development of human society takes place when material and spiritual development occur side by side to complement and reinforce each other." The four pillars of GHN are equity, preservation of cultural values, conservation of the natural environment, and establishment of good governance. Recently, a major international conference in Bhutan was held to explore GHN in more depth, including ways to put it into operation as a replacement measure for GDP.[17]

On the second macroeconomic objective, the transition to renewable energy, there are dozens of useful metrics such as energy intensity (which measures conservation) or energy return on investment (which is critical for evaluating the feasibility of renewable energy investments). But the most ubiquitous measure in use is the carbon footprint, which is expressed in three basic ways: emissions in tons of carbon, the area of Earth's surface needed to sequester those emissions, and carbon intensity or emissions per unit of economic output. A zero carbon footprint is an often-stated policy goal. But measuring this is quite complex. For example, communities that want to assess their carbon footprints almost universally fail to consider carbon emissions associated with imports of either intermediate inputs or final consumer goods from other regions or land use activities like logging or urban growth that reduce carbon sequestration capacity.

Nonetheless, carbon footprint analysis is a useful way to monitor progress toward greater use of renewable energy as well as to identify firm policy targets. For example, to stabilize carbon dioxide concentrations in the atmosphere at 450 parts per million, various models suggest that global emissions must be reduced by 50 percent in 2050 and 80 percent by century's end. (See Chapter 6.) Combining this reduction target with various projections of growth in gross world product (GWP) allows calculation of the required carbon footprint of all economic processes needed to achieve this goal. Even under the most pessimistic GWP growth scenario of 1.1 percent a year, the required footprint reduction is on the order of 93 percent—from 2.88 ounces of carbon per dollar today to just 0.16 ounces by 2100.[18]

Social equity, another macroeconomic objective, has two key dimensions: equitable distribution of resources and equitable access to health care, education, economic opportunities, representation, cultural amenities, natural areas, and everything else considered essential to a good quality of life. Quantitative equity measures already inform policy debates over taxes, affordable housing, living wages, diversity, and location of public services, and their use is on the rise. One common way to measure social equity is to compare the distribution of resources or access with some ideal distribution described as fair or equitable. The index of representational equity (IRE) and the GINI coefficient are two permutations. The IRE compares

the ethnic or racial composition of elected officials, corporate management, or any other representative body with that of the general population of the relevant jurisdiction. It measures the degree of deviation, so values close to zero indicate more equitable representation if it is assumed that leaders should reflect the diversity of the populations they represent. The GINI coefficient measures the deviation between the actual income distribution of a given nation or community and a "fair" distribution, where different income brackets earn a proportional share of national income.[19]

Concerning the fourth objective, in *A Short History of Progress* Canadian novelist Ronald Wright succinctly notes: "If civilization is to survive, it must live on the interest, not the capital, of nature." Nature's interest is the flow of goods and services received from stocks of natural capital. These stocks include wild areas, healthy soils, genetic diversity, and the various atmospheric, terrestrial, and aquatic sinks for wastes inherited from the last generation. Natural capital yields goods such as foods, medicines, organic fertilizers, and raw materials for countless manufacturing processes as well as ecosystem services such as controlling floods, recycling wastes, building soils, and keeping atmospheric gases in balance free of charge. When natural capital is lost or degraded, the flow of goods and services is compromised or eliminated entirely, just as when decimation of human capital stocks destroys a community's ability to provide shelter, communications, water supply, or energy. As such, nondepletion of natural capital stocks and ecosystem service flows is a prerequisite for sustainability.[20]

The ecological footprint is perhaps the best known measure of natural capital depletion. Ecological footprint analysis (EFA) compares the surface area of Earth needed to sustain current consumption patterns and absorb wastes with what is available on a renewable basis. When the footprint exceeds biological capacity, the world is engaged in unsustainable ecological overshoot and depleting natural capital. The most recent accounts published by the Global Footprint Network find that "our footprint exceeds the world's ability to regenerate by about 25%," implying that we need 1.25 Earths to sustain present patterns of consumption. While there remain some theoretical and computational challenges to resolve, EFA has nonetheless gained status as one of the world's most ubiquitous and widely used sustainability metrics. According to the Secretariat of the U.N. Convention on Biological Diversity, EFA "provides a valuable form of ecological accounting that can be used to assess current ecological demand and supply, set policy targets, and monitor success in achieving them."[21]

Economic localization, the fifth objective, is the process by which a region, county, city, or even neighborhood frees itself from an overdependence on the global economy and invests in its own resources to produce a significant portion of the goods, services, food, and energy it consumes from its local endowment of financial, natural, and human capital. Localization is gaining new traction as a response to the looming crises over peak oil and climate change, since the global distribution system for goods is almost exclusively based on cheap fossil fuels. The World Bank acknowledges that localization "will be one of the most important new trends in the 21st century."[22]

Economic multipliers and measures of economic diversity such as the Ogive index are useful indicators of localization since they show how well a community is rebuilding its manufacturing base and creating linkages between multiple sectors. Another indicator of increasing importance and use is "miles to

market," which for an individual good or group of goods measures the distance traveled (including components) from source to market. The most popular variant is food miles—a concept that illustrates the wide-ranging benefits associated with locally grown foods, such as freshness, reduced carbon emissions, higher economic multiplier effects, and the absence of resource-intensive packaging, preservatives, and refrigeration.[23]

Five Microeconomic Objectives

Some of the most innovative sustainability initiatives are being undertaken at the institutional level by businesses, schools, and NGOs. To measure effectiveness, a wide range of micro-level metrics are being deployed and used as benchmarks of organizational success. Table 2–3 provides a small sample of these.

Increasingly, sustainability metrics are being reported side by side with more-traditional financial indicators to satisfy investor and stakeholder demand for accountability with respect to important environmental, social, and economic impacts. Accountability itself is a proven force for change. As Andrew Savitz and Karl Weber note in *The Triple Bottom Line*, such metrics have become a "key driver" of progress toward sustainable business.[24]

Like macro indicators, institutional sustainability metrics can be grouped by objectives common to popular sustainability frameworks:

- certification of products, operations, and supply chains;
- zero waste;
- eco-efficiency;
- workplace well-being; and
- community vitality.

Certification is a response to a pernicious effect of globalization: the disassociation between consumers and producers caused by supply chains that now span the globe. Consumers tend to know very little about the labor or environmental practices of corporations that produce goods they consume. This lack of accountability has contributed to a "race to the bottom" in which corporations choose locations that impose the least regulatory burden on their operations. Forced relocation of entire communities, sweatshops, contamination of water supplies, collapsing fisheries, and tropical deforestation are among the results.

The burgeoning new movement to independently certify goods as humanely and sustainably produced is a direct response to these practices. A key indicator is the degree to which institutions procure goods and services from certified sources. Some well-known companies are using certification to influence practices further down the supply chain. For example, Unilever's policy is to buy 100 percent of its fish from sustainable sources. To achieve this goal, the company helped design and now promotes Marine Stewardship Council certification by its suppliers. (See Chapter 5.)[25]

Other certification or sustainability rating systems evaluate a company's overall operations, not just the products or services they provide. The Global Reporting Initiative (GRI) has become the world's leading benchmark for measuring, monitoring, and reporting corporate sustainability efforts. Currently, the GRI includes 146 indicators drawn from economic, social, and environmental domains and 33 "aspects" within these domains, such as biodiversity, relations between labor and management, and investment and procurement practices.[26]

A conspicuous manifestation of unsustainable operations is a big waste stream in the form of air emissions, water pollutants, and refuse. Thus, a second key sustainability objec-

Table 2–3. Sustainable Development Objectives and Microeconomic Indicators

Economic Objective	Sample Indicators and Desired Direction of Effect	Description
Sustainability certification	Percent certified (+)	Percent of goods, services, and materials procured from certified sources
	Sustainability reporting compliance (+)	Degree of consistency with Global Reporting Initiative (GRI) or similar standards
	Pacific sustainability index score (+)	PSI score based on environmental, economic, and social criteria for relevant sector
Zero waste	Recycling rate (+)	Percent of waste stream recycled
	Emissions (–)	Air and water emissions including greenhouse gases total and per unit output
	Longevity (+)	Useful product life
Eco-efficiency	Recycled content (+)	Percent of materials used as inputs that are recycled
	Intensity (–)	Energy, water, and materials use per unit output
	Facility rating (+)	Level of LEED certification for buildings and facilities
Workplace well-being	Job satisfaction (+)	Average scores from employee satisfaction surveys
	Turnover rate (–)	Percent of employees voluntarily or involuntarily leaving organization each year by category
	Commuting (–)	Employee vehicle miles traveled
Community vitality	Local procurement (+)	Proportion of spending on goods and services provided by locally owned businesses
	Local economic impact (+)	Direct, indirect, and induced economic impact of local expenditures
	Community support (+)	Value of cash and in-kind goods and services donated for public benefit
	Living wage ratio (+)	Ratio of wage rate paid to living wage for relevant employment categories

tive is "zero waste." Recycling rates and emissions of air and water pollutants, including greenhouse gases (GHGs), are common indicators linked to zero waste strategies. Once adopted, regularly published, and used to set targets, such indicators often drive substantial changes in business practices.

One of the longest running zero waste initiatives is 3M's Pollution Prevention Pays program, based on the notion that waste is a sign of inefficiency and that its elimination should save money. For decades, 3M has monitored all aspects of the waste stream and urged its employees to develop innovative waste reduction programs. The company now reports cumulative reduction of over 2.2 billion pounds of pollutants. Emissions of volatile organic compounds have dropped from over 70,000 tons per year in 1988 to less than 6,000 tons today. 3M estimates it has saved at least $1 billion by reusing the waste stream and avoiding expen-

sive pollution mitigation measures.[27]

Carbon neutrality is another zero waste strategy, and offsets are one tool that companies are using to get there. (See Chapter 7.) For example, Green Mountain Coffee Roasters has monitored both its carbon emissions and the amount of offsets since 2003. In 2005, the company reported 9,823 tons of GHG emissions and an equal amount of offsets in the form of investments in wind and methane capture projects.[28]

Another important indicator related to zero waste is product longevity, often measured by useful product life. Products designed with longevity and upgradability in mind substantially reduce the flow of refuse to landfills. Additional longevity indicators listed in the Electronic Product Environmental Assessment Tool framework include availability of extended warranties, upgradability with common tools, modular design, and availability of replacement parts.[29]

Eco-efficiency, a third microeconomic objective, is about reducing the amount of water, energy, chemicals, and raw materials used per unit output. Eco-efficiency is motivated not only by environmental concerns but by the prospects of significant financial savings in the form of reduced energy and water bills, less money spent on raw materials, and fewer regulatory hurtles. Swiss-based ST Microelectronics cut electricity use by 28 percent and water use by 45 percent in 2003 and reported saving $133 million. DuPont committed to a policy of keeping energy use flat no matter how much production increased, which reportedly saved over $2 billion in the past decade. The company Advanced Micro Devices tracks "kilowatt hours per manufacturing index" and reports a 60-percent reduction from 2.17 in 1999 to 0.86 in 2005. One way to monitor eco-efficiency for facilities as a whole is the Leadership in Energy and Environmental Design's Green Building Rating System, which is used to certify home, schools, or commercial buildings as silver, gold, or platinum based on green design features that conserve electricity, water, and waste throughout the entire life cycle—from construction to demolition.[30]

The World Health Organization identifies meaningful and satisfying work, open decisionmaking, worker health and safety, and just compensation as key aspects of sustainable workplace environments. Workplace satisfaction, turnover rates, and health and safety factors such as commuting distances are common indicators of workplace well-being—another sustainable development objective—and ones that are driving change. The work satisfaction of full-time staff at Finland's Turku Polytechnic has been monitored since 2000. In a Web-based questionnaire, respondents are asked to assess on a scale of one to five their satisfaction with work, features of the job, the working community, their supervisor's performance, recognition of their knowledge and skills, and the organization's operations. The aggregate employee satisfaction score rose steadily from 3.30 to 3.78 between 2000 and 2004. Problem areas uncovered by the surveys included collaboration and communication, which motivated the school to publish a weekly electronic newsletter for personnel.[31]

In 2004 and 2005, Mountain Equipment Co-op (MEC) in Canada undertook comprehensive employee engagement surveys with Hewitt Associates. They asked for responses to such statements as "our people practices create a positive work environment for me" and monitored the percent of employees in agreement. MEC's overall Hewitt engagement score was quite low—48 percent in 2004—and as a result the firm undertook a wide range of improvement measures such as a continuing education assis-

tance, an upgraded maternity leave policy, extension of employee assistance programs, and increased accountability of senior staff. MEC's engagement score rose to 63 percent after the indicator was put in use.[32]

A final sustainability objective to consider is community vitality. Institutions committed to sustainable development universally recognize that they must contribute to the vitality of the communities in which they operate. While in-kind and cash donations are common, fundamental changes to business practices are increasingly important. One example is raising the share of goods and services procured from the local community rather than imported from afar. Local procurement can be a critical tool for regeneration of communities hard hit by globalization. For example, the London-based Overseas Development Institute is working with South African tourism companies and associations to promote local procurement as a way to fight poverty and other social ills plaguing rural villages.[33]

Paying living wages is another fundamental way for institutions to promote community vitality. Living wages take into account the cost of living at the local level and seek to provide a wage that fulfills the basic needs of workers and their families. Monitoring wages paid in relation to a living wage is a way to identify where adjustments need to be made. An exemplary example of this kind of monitoring is the international pharmaceutical corporation Novartis. The company works with local NGOs to identify a "basic needs basket" for a worker and family and to quantify the basket in local currencies. Using a methodology developed by Businesses for Social Responsibility, Novartis then calculates market-specific living wages and compares those with actual wages paid. By early 2006, the company had aligned the pay of all 93,000 employees with living wage levels.[34]

Fostering the New Bottom Line

How does the world move away from traditional measures such as GDP, trade volume, or factor efficiency? Encouraging the wider use of newer macroeconomic measures requires political pressure on international, national, and local governments. While there are many examples of alternative indicators used in research settings, clearly adaptation is slow and civil society leadership is key. As one step in the right direction, in November 2007 the European Commission, the Organisation for Economic Co-operation and Development, and several NGOs held a conference in Brussels entitled "Beyond GDP: Measuring Progress, True Wealth, and the Well-Being of Nations." Key objectives of the meeting included clarifying what indices are most appropriate to measure progress and how these can best be integrated into decisionmaking.[35]

Civil society can also participate in legal and administrative processes to enforce policies already in effect. For example, international finance agencies such as the World Bank are obliged to use benefit-cost analysis (BCA) to evaluate the feasibility of infrastructure development projects such as roads, oil pipelines, ports, and dams. As the Bank acknowledges, BCA "is a technique intended to improve the quality of public policy decisions. It uses as a metric a monetary measure of the aggregate change in individual well-being resulting from a policy decision." Typically, traditional economic measures like GDP are used as a proxy for well-being—a clearly erroneous practice—so there are opportunities to change such practices to be more in line with policy by using substitutes like the genuine progress indicator in these contexts.[36]

Market forces are already fostering greater

use of sustainable development indicators at the micro level. In their recent book *Green to Gold*, Daniel Esty and Andrew Winston of Yale University evaluated the stock performance of "Waveriders," a subset of companies they consider leaders in sustainability reporting and initiatives. They found that Waveriders "significantly outperformed the market" over the past 10 years, and they make a compelling case as to why maintaining credible sustainability metrics is a proven strategy for business success in the new century. Nonetheless, there is still a great deal that governments can do at all levels to tip the scales in favor of responsible Waverider-type companies.[37]

One obvious strategy is sustainable procurement policies. Given the immense resources under their control, governments at all levels can insist that companies they do business with do not just give lip service to sustainable development but demonstrate progress toward it through the GRI and other credible indicator systems. Another emerging strategy is the cultivation of markets for environmental goods and services through payments for ecosystem services and other market-based approaches. (See Chapter 9.) Governments can use their regulatory powers to create markets for flood control, pollination, biodiversity, water purification, and carbon sequestration services of healthy ecosystems by requiring offsets for urban development projects, power plants, or industrialized agriculture or forestry operations. Such markets would stimulate landholders to monitor both the stocks of natural capital under their care and the economic value of the ecosystem services those stocks generate. Taxes and subsidies are other important tools. For example, a simple carbon tax would automatically stimulate widespread use of carbon footprint analysis.

More direct approaches are legal requirements for simple disclosure. As documented in this chapter, the mere reporting of sustainability metrics like recycling rates, energy and water intensity, and living wage ratios is a key driver of change. Where sufficient public interest is present, it is reasonable to expect communities to insist on such disclosures as part of annual reports, tax returns, and permit applications. One prominent example of the impact of such practices is U.S. Superfund legislation, which requires companies to report annually on the amount of hazardous chemicals within each of their facilities. As Savitz and Weber note in *The Triple Bottom Line*, "companies suddenly faced with the simple disclosure requirement immediately began to take dramatic, unprecedented steps to redesign their processes to eliminate the need for these chemicals at all." The result was a 59-percent reduction in the amount of hazardous chemicals stored on-site by U.S. companies, the most dramatic voluntary environmental improvement in history—"all because of a simple disclosure requirement."[38]

Innovations like these need to be acknowledged and publicized, so that one good measure leads to another. No one indicator can capture all the components of sustainable development. Instead, governments should back a suite of creative indicator initiatives, giving the world a better and more holistic portrait of progress being made in the twenty-first century toward both happy people and a happy planet.

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Chapter 2. A New Bottom Line for Progress

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CHAPTER 3

Rethinking Production

L. Hunter Lovins

In 1999, executives at DuPont boldly pledged to reduce the company's greenhouse gas (GHG) emissions 65 percent below their 1990 levels by 2010 as part of a company-wide strategy to lighten its environmental impact. The plan, in part, was to diversify the product line—shedding divisions such as nylon and pharmaceuticals to focus on materials that reduce greenhouse gases, such as Tyvek house wraps for energy efficiency. The plan worked: by 2007 DuPont had cut emissions 72 percent below 1991 levels, reduced its global energy use 7 percent, and, in the process, saved itself $3 billion. DuPont now plans to go beyond mere efficiency improvements to make products that mimic nature, including plant-based chemicals like Bio-PDO that can replace petroleum in polymers, detergents, cosmetics, and antifreeze.[1]

DuPont's actions—and similar ones in dozens of other firms—reflect a recognition that the way goods and services are produced must be radically rethought in this sustainability century. Over the past 100 years, the way humans made and sold goods and services took a heavy toll. Now, smart companies recognize the need to move beyond business as usual to meet people's needs in sustainable ways.

Every year the world digs up, puts through various resource crunching processes, and then throws away over a half-trillion tons of stuff. Less than 1 percent of the materials is embodied in a product and still there six months after sale. All of the rest is waste. This pattern of production and the consumption it engenders now threaten every ecosystem on Earth. In March 2005, U.N. Secretary-General Kofi Annan observed that "the very basis for life on earth is declining at an alarming rate."[2]

By the time most human artifacts have been designed but before they have been built, 80–90 percent of their lifecycle eco-

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nomic and ecological costs have already become inevitable. For example, this book you are holding, the seat in which you are sitting, the airplane in which you may be flying, the terminal at which you will land, the vehicle in which you will continue your trip are all the result of myriad choices made by policymakers, designers, engineers, craftspeople, marketers, distributors, and so on. Each step represents opportunities to deliver the idea, the part, or the production process in ways that use more or fewer resources and result in a superior or suboptimal endresult. Thinking in a more holistic way and choosing more wisely at each step can reduce the impacts of these choices on the planet and its inhabitants.[3]

This is the foundation of Natural Capitalism, the framework of sustainability that describes how to meet needs in ways that achieve durable competitive advantage, solve most of the environmental and many of the social challenges facing the planet at a profit, and ensure a higher quality of life for all people. It is based on three principles:

- Buy the time that is urgently needed to deal with the growing challenges facing the planet by using all resources far more productively.
- Redesign how we make all products and provide services, using such approaches as biomimcry and cradle to cradle.
- Manage all institutions to be restorative of human and natural capital.[4]

The good news is that meeting human needs while using less stuff can be more profitable and can deliver a higher standard of living than continuing with current practices. Combined with efforts to lower consumption (see Chapter 4), practices that raise resource efficiency, circulate materials rather than dump them, and imitate nature offer a new model of prosperity for an environmentally degraded and poverty-stricken planet.

The Solid Foundation of Eco-efficiency

The ability to produce cheap goods and ship them around the planet derived in part from abundant supplies of cheap energy. Using this inexpensive oil, gas, and coal has polluted the planet and dangerously warmed the climate. In a carbon-constrained world, survival depends on finding ways to produce goods and services in dramatically more energy-efficient ways.

The concept of making things using fewer resources is far from new, but it remains the cornerstone in producing goods and services more sustainably. Critics such as William McDonough disparage eco-efficiency as simply doing less bad, but therefore still bad. Greater resource productivity alone will not deliver a sustainable society, but the criticism misses the significance of using as few resources as possible. The foundation of a building is far from sufficient to house a family, but without a solid underpinning no structure can long stand. Without eco-efficiency, no system of production can be said to be sustainable.[5]

More important, however, given the challenges facing the world, is the fact that using less stuff buys the critical time necessary to solve such daunting problems as climate change and to develop and implement production methods that meet humanity's needs in ways that do not cause more problems.

Eco-efficiency is the easiest component of the transition to sustainability to implement. It is increasingly profitable, and psychologically it is far more familiar to industrial engineers than are such concepts as biomimicry or the human dimensions of implementing the changes necessary. It is therefore a great place to start.

It is now cost-effective to increase the efficiency with which the world's resources are

used by at least fourfold—dubbed "Factor Four" in a 1997 book. The European Union has already adopted this as the basis for sustainable development policy and practice. Some countries like Australia have set this and even greater efficiency as a desirable national goal. The Environment Ministers of the Organisation for Economic Co-operation and Development, the government of Sweden, and various industrial and academic leaders in Europe, Japan, and elsewhere have gone even further, adopting Factor Ten improvements as their goal. The World Business Council for Sustainable Development (WBCSD) and the U.N. Environment Programme have called for Factor Twenty, which involves increasing efficiency 20-fold. There is growing evidence that even such ambitious goals are feasible and achievable in the marketplace. They may, in fact, offer even greater profits.[6]

One of the foremost proponents of eco-efficiency is the World Business Council for Sustainable Development, which introduced this term to the world right before the 1992 Earth Summit in Rio de Janeiro. WBCSD defines eco-efficiency as:

- reduction in the material intensity of goods or services,
- reduction in the energy intensity of goods or services,
- reduced dispersion of toxic materials,
- improved recyclability,
- maximum use of renewable resources,
- greater durability of products, and
- increased service intensity of goods and services.[7]

WBCSD is a CEO-led network of more than 200 companies promoting market-oriented sustainable development and greater resource productivity. It enables its members to share knowledge, experiences, and best practices on energy and climate, development, ecosystems, and the role of business in society. It maintains initiatives in sustainable value chains, capacity building, water, and energy use in buildings. WBCSD conducts sector-specific studies on how to reduce resource use in such areas as cement, electric utilities, mining and minerals, mobility, tires, and forestry. The group is led by an executive committee featuring leaders of such companies as Toyota, DuPont, Unilever, Lafarge, and Royal Dutch Shell.[8]

Member companies have implemented profitable resource productivity to lower their costs and reduce their environmental footprint. For example, AngloAmerican/ Mondi South Africa increased the production capacity of one of its pulp mills by 25 percent. This enabled it to accommodate a 40-percent increase in timber supply from more than 2,800 small growers, while increasing the efficiency of using waste wood to power the plant, decreasing the use of bleach chemicals, and reducing the use of coal from 562 to 234 tons per day—all while significantly cutting costs. The measures achieved reductions in:

- 2,177 tons of sulfur dioxide—a 50-percent reduction;
- 509 tons of nitrogen oxide (NO_X)—a 35-percent reduction;
- 297,121 tons of carbon dioxide (CO_2)—a 50-percent reduction; and
- total sulfur emissions—down approximately 60 percent.

Energy-efficient technologies also reduced water consumption and purchased energy. These enabled the pulp mill to use 44 percent less purchased energy in 2005 than in 2003. During 2005, one mill cut its energy and water costs by 27 percent.[9]

Increasingly, companies are implementing eco-efficiency to drive their innovation and enhance their competitiveness. STMicroelectronics (ST), a Swiss-based $8.7-billion semiconductor company, set a goal of zero net GHG emissions by 2010 while increasing

production 40-fold. ST's GHG emissions were traced to facility energy use (45 percent), industrial process (perfluorocarbon and sulfur hexafluoride) emissions (35 percent), and transportation (15 percent). The company undertook to reduce on-site emissions by investing in cogeneration (efficient combined heat and electricity production) and fuel cells (efficient electricity production).[10]

By 2010 cogeneration sources should supply 55 percent of ST's electricity, with another 15 percent coming from fuel switching to renewable energy. ST will reduce the need for energy supply through improved efficiency and implement various projects to sequester carbon. This commitment has improved profitability. During the 1990s its energy efficiency projects averaged a two-year payback—a nearly 71 percent after-tax rate of return.[11]

Making and delivering on this promise has also driven ST's corporate innovation and increased its market share, taking the company from the twelfth to the sixth largest microchip maker by 2004. By the time ST meets its commitment, it expects to have saved almost $1 billion.[12]

What is true in microchip manufacturing holds true in consumer retailing as well: things can be done more efficiently. In October 2005, Wal-Mart, the world's largest retailer, announced a corporate commitment to cut greenhouse gas emissions and reduce waste, pledging to be supplied 100 percent by renewable energy, to create zero waste, and to sell products that sustain resources and the environment.[13]

To achieve this, Wal-Mart is working with its 60,000 plus suppliers to help them learn how to produce "affordable sustainability, and become more sustainable businesses in their own right." The company began by reducing waste, announcing a goal of a 5-percent reduction in overall packaging by 2013. It estimated that the impact would be the equivalent of removing 213,000 trucks from the road and saving about 324,000 tons of coal and 77 million gallons of diesel fuel a year.[14]

Reducing packaging in the company's Kid Connection line of toys let Wal-Mart use 427 fewer containers to ship the same number of items, saving $2.4 million in shipping costs, 3,800 trees, and 1,300 barrels of oil annually. The company estimates that a similar effort globally could save nearly $11 billion. Wal-Mart's supply chain alone could save $3.4 billon.[15]

Companies are implementing eco-efficiency to drive their innovation and enhance their competitiveness.

Wal-Mart has pledged to implement an "Ethical Supplier Initiative" and is seeking more long-term and sustainable partnerships with the factories that supply its stores. One such program in a candy factory in Brazil that lacked a system for processing, recycling, and disposing of waste enabled the factory to install a waste management program, which in turn let the supplier generate $6,500 a year in new profits.[16]

Wal-Mart is working with suppliers to design more-efficient products to offer to its customers. A partnership with the Eco-magination program of General Electric (GE) will produce light-emitting diodes (LEDs). LED lights last longer, produce less heat, contain no mercury, and use significantly less energy than other bulbs. Lighting accounts for about one third of Wal-Mart's electricity use. Since 2004 Wal-Mart has invested about $17 million in developing LED lighting systems for its own refrigerator cases in more than 500 stores. It projects that this will save about $3.8 million a year and reduce the

company's CO_2 emissions by 65 million pounds. Wal-Mart's purchase will be sufficiently large that it will bring GE's production costs for LED lighting down to levels competitive with ordinary lamps.[17]

The company is also taking a closer look at how some of the products on its shelves are made, in line with WBCSD's emphasis on reducing the dispersion of toxic chemicals as one component of eco-efficiency. At the March 2007 quarterly meeting of senior management and major suppliers of Wal-Mart, CEO Lee Scott indicated that the company would begin phasing phthalates out of the plastics used in children's toys. By July, Wal-Mart announced that it would no longer ship infants' toys containing these endrocrine-disrupting compounds.[18]

A number of frameworks aim to help companies use resources more efficiently. Lean manufacturing arose from the Toyota Production System and was popularized in the 1996 book *Lean Thinking* by James Womack and Dan Jones. It emphasizes reduction in process variability as a way to identify and eliminate inefficiencies that reduce quality. Waste is eliminated as a byproduct of enhancing the smoothness of the process. Similarly, the Six Sigma system trademarked by Motorola and fanatically implemented by hundreds of companies seeks to cut waste by eliminating any variability in the production of items.[19]

These two systems are valuable approaches, but management needs to understand their limits. Manufacturers have found that both have the drawback of inhibiting creativity. The mental model that seeks to eliminate any defect or deviation from a given standard is inimical to the sort of intellectual curiosity, tolerance for ambiguity, spirit of experimentation, and appetite for risk that characterizes great invention. Many companies now insulate their creative staff from the salutary discipline of Six Sigma. But once the invention is conceived, lean manufacturing enables a company to deliver exceptional quality, squeeze out waste, and scale up production to efficiently deliver a predictable product.

Lean manufacturing, as implemented by Toyota, features an almost manic dedication to reducing the "seven wastes" as a way to enhance customer satisfaction. It identifies any part of an operation that does not contribute to customer satisfaction as waste, specifically targeting product design, supplier networks, and factory management. It seeks to eliminate the production of more items than are demanded by the customer, the movement of people or machines, any idle time of people or machines, the movement of material or product, inefficient processing (see Box 3–1), excess inventory of input or product, and the need to rework or throw out anything.[20]

As lean manufacturing caught on in the United States, it was logical that it would be combined with clean production, which is what the U.S. Environmental Protection Agency, the Chicago Manufacturing Center (CMC), and others did.

CMC sponsored the GreenPlants Sustainable Leadership Program to help a group of Chicago area manufacturers implement lean, clean, more-sustainable production, in order to enhance the competitiveness of manufacturing companies threatened by foreign companies. Working with Natural Capitalism Solutions, the program helps local manufacturers implement more-sustainable production techniques as the basis for retaining globally competitive manufacturers in the Chicago area. The 84 CMC clients surveyed in fiscal 2004 reported that they hired 194 people for newly created jobs, saved 527 jobs, and did not lay off anyone due to improvements.[21]

PortionPac Chemical Corporation is using

Box 3–1. The Robot Versus the Hair Dryer

A *Wall Street Journal* article exploring why Toyota was outcompeting Detroit and its suppliers stated that the Japanese manufacturer was able to "produce vehicles with one-third the defects of mass-produced cars using half the factory space, half the capital, and half the engineering time. Elements of lean production, such as 'just-in-time' shipments of supplies, are familiar to most U.S. manufacturers. But adapting the whole Toyota system, and the cultural changes that go with it, has proven difficult for many American companies."

The article tells one of the classic Toyota stories of an engineer making wasteful reliance on expensive high technology look silly. Painting processes are one of the auto industry's more polluting activities.

> *Armed with a $12 dryer from a discount store, Mr. Oba proved to engineers from Michigan's Summit Polymers Inc. that their $280,000 investment in sleek robots and a paint oven to bake the dashboard vents they produce actually was undermining quality and pushing up costs. The fancy equipment took up to 90 minutes to dry the paint and in the bargain caused quality flaws because parts gathered dust as they crept along a conveyor.*
>
> *Mr. Oba's hair dryer did the job in less than three minutes. Chastened, Summit's engineers replaced their paint system with some $150 spray guns and a few light bulbs for drying and integrated the painting into the final assembly process. Family-owned Summit cut its defect rate to less than 60 per million parts from 3,000 per million.*

Source: See endnote 20.

CMC's program to develop sustainable cleaning systems. The cleaning industry has traditionally wasted energy in manufacturing, shipping, and disposing of cleaning formulations that were 90 percent water; these were shipped in steel pails and multigallon drums that were then discarded. Many cleaning formulations being used were extremely hazardous, and few janitors understood how to apply the solutions correctly. To address these problems, PortionPac Chemical Corporation was founded in 1964 to eliminate the water and instead ship small plastic packets of concentrated, portion-controlled solutions. PortionPac helped Boeing reduce costs and simplify its cleaning process by reducing a thousand different brands of cleaning products to just 10, with PortionPac products as 3 of those 10.[22]

PortionPac has gained market share because of its sustainability campaign. It has also shifted its business model to sell customers the service of a cleaner facility, in addition to selling chemicals that others can use. In 1999, the company helped schools in Tacoma, Washington, save 627,000 hours of labor, including moving drums around, and $102,000 in chemical purchases by implementing this system. Now more than 7,000 schools have signed on to PortionPac's set cost fee, which includes the cleaning products the schools need plus proper education on how to clean, proper mixing, and safe usage. PortionPac works with correctional facilities, schools, hotels, hospitals, and industrial plants to limit the number of products and ensure proper usage.[23]

The company has also helped such clients as Cornell University earn Leadership in Environmental and Energy Design (LEED) certification from the U.S. Green Building Council by using PortionPac's Green Seal–certified products. Dale Walters, General Manager of Facilities Operations at Cornell, notes that "over time, Cornell saved costs by using the right amount of product and going from twenty cleaning products to four. It also reduced safety risks involved with handling chemicals. When we sought to

create LEED certified buildings, we worked with PortionPac to establish a green housekeeping strategy." Walters reports that "PortionPac products reduced chemical waste through both the proper use of cleaning chemicals and the sheer reduction of packaging (small packets versus large jugs or plastic containers). PortionPac products are a main component of our sustainable cleaning strategy." By helping organizations find better ways to motivate their janitors and clean their facilities, while reducing the use of chemicals, PortionPac is winning contracts and expanding its business.[24]

Cradle to Cradle: Extending a Product's Life

"Cradle to cradle" is a concept introduced by Walter Stahel more than 25 years ago in Europe. In 1976, as Director of a project on product life extension at Battelle research laboratories in Geneva, Stahel embarked on a program to return products to useful lives. He analyzed cars and buildings on microeconomic and macroeconomic bases and concluded that every extension of product life saved enormous amounts of resources in contrast with turning virgin material into a new product, and it also substituted the use of people for the expenditure of energy.[25]

Stahel found that 75 percent of industrial energy use was due to the mining or production of such basic materials as steel and cement, while only about 25 percent was used to make the materials into finished goods like machines or buildings. The converse relationship held for human labor: three times as much labor was used to convert materials into higher value-added products as in the original mining. He suggested that increasing the kinds of businesses that recondition old equipment as opposed to those that convert virgin resources into new goods would substitute labor for energy. And he pointed out that such work could be conducted in small workshops around the country where the products that needed rebuilding were located—something like car repair shops that are located in every village. This sort of job creation would address both unemployment and resource waste.[26]

In the early 1990s Walter Stahel, by then widely recognized in Europe as a founder of the new sustainability movement, proposed that sustainability rests on five pillars, each of which is essential for the survival of humans on Earth. None of these pillars is a higher priority, he observed, or subject to tradeoffs. Stahel's pillars roughly mirror the history of the sustainability movement.

The first pillar is the conservation of nature as the underpinning of a prosperous economy. This involves the need to preserve intact ecosystems as the basis of all life-support systems. It applies to such planetary systems as a stable climate or the ability of the oceans to support life, as well as to local carrying capacities and the ability of regions to assimilate waste. The second pillar is the need to preserve individual health and safety that may be jeopardized by economic activities. This seeks to limit toxicity and pollution by such things as heavy metals and endocrine disruptors.

The first two pillars form the domain of the original environmental movement. They are characterized by command-and-control legislation and by minimalist compliance by industry. They tend to be dominated by technical experts and agency bureaucrats. This approach to protecting the environment costs money and created the belief that environmental protection, actually the basis of durable prosperity, is incompatible with economic success.

The third pillar adds resource productivity, innovation, and entrepreneurship to the sustainability approach. It assumes a Factor

Ten increase in efficiency as the way to forestall such threats as climate change and the loss of ecosystems. This is the approach of eco-efficiency in industrial as well as developing countries.

Stahel argues that implementing the first three pillars is the basis of a sustainable economy. But, he says, "a sustainable economy is only part of the objective to reach a sustainable society. A distinct border-line exists therefore after these first three pillars, which separates techno-economic issues from societal ones. The coming 'Quest for a Sustainable Society' must be much broader and include social and cultural issues."[27]

Thus the fourth pillar adds social ecology to the mix. This is the first element of the human dimension of sustainability and includes, in Stahel's words, "peace and human rights, dignity and democracy, employment and social integration, security and safety, the constructive integration of female and male attitudes. Key words here are: the commons, 'prisoners' dilemma', sharing and caring, barter economy."[28]

The fifth pillar Stahel calls cultural ecology. This encompasses how different cultures view the concept of sustainability and how to achieve it. It includes attitudes toward risk-taking and a sense of national heritage. For example, American engineers may see a good business case for eliminating waste, but the Japanese have an almost visceral distaste for waste. It offends them. The fifth pillar includes the critical aspects of corporate culture, whereby, for example, in 1995 DuPont called for 100-percent yield rather than zero waste. This pillar also considers the human part of the equation, such as whether people should be retrained rather than fired.

The First Industrial Revolution, the forerunner of modern manufacturing, arose at a time in history when there were relatively few skilled people to run the new machines that were revolutionizing production. There was an apparent abundance of nature and its services. Profit-maximizing capitalists "economized on their scarce resource" (people) and substituted the use of natural resources and ecosystem services (the ability to spew pollution into the air that everyone breathes and pour wastes into rivers) to drive profits. From this the modern world was born. This transformation enabled a Lancashire weaver to spin 200 times as much fabric on the new machines as his predecessor did on a spinning wheel.[29]

The Holy Grail of prosperity was believed to be labor productivity, and indeed still today people believe that increasing labor productivity will increase well-being—as if the goal of the economy is one person doing all the work and everyone else out of work. But in today's world of relative scarcity, the tables are turned. About 10,000 more people arrive on Earth every hour, and every major ecosystem is in peril. Greater use of ecosystem services impoverishes everyone, and people need work. Yet the whole mental model of how to run the economy is based on the 200-year-old perception of the basis of prosperity: penalize the use of people, subsidize the use of resources, and increase labor productivity.[30]

Stahel describes how in 1993, as U.S. companies faced hard times, the corporate world made heroes of such restructurers as Al Dunlap and Jack Welch. Dunlap, in the name of "creating shareholder value" gained the nickname Chainsaw Al: in 20 months as CEO of Scott Paper, he devastated the 115-year-old company by terminating 11,000 people—35 percent of the labor force—including 71 percent of the staff at corporate headquarters. He, of course, made enormous personal gain. His counterpart at GE, dubbed Neutron Jack Welch, cut GE employment from 380,000 to 208,000.[31]

The logic of capitalism, the greatest known

system in human history for the creation of wealth, has not changed. But the relative scarcities have. In today's world, the recipe for prosperity is to encourage, as Stahel has outlined, the use of people and to penalize the use of resources.

Stahel describes how, also in the early 1990s, Honda used its workers to maintain and repair its own machines rather than suffer layoffs that would damage worker morale and lead to work stoppages. Increasingly, European and Japanese policymakers are considering the approach of tax shifting: eliminating taxes on employment and income, things people want more of, and replacing them with taxes on pollution and depletion of resources, things the world wants less of.[32]

Stahel cautions that of the five pillars, social and cultural ecology are the weakest underpinnings. To the extent that the social fabric breaks down, the other pillars soon collapse. The current focus on eco-efficiency, clean production, green products, and the use of technology to implement sustainability are necessary, but it is equally important to consider the human dimension, including such issues as meaningful employment, sustainable development, and enabling people to achieve their full potential.

Sustainability, Stahel notes, has little application in the short term. Its value is as a vision. He tells the story of the three stonecutters who are asked what they are doing. One says that he is putting in his eight hours. The second replies that he is cutting this limestone into blocks. The third answers that he is building a cathedral. Sustainability, says Stahel, is the cathedral we are all creating.[33]

Following Nature's Lead

Biomimicry, the conscious emulation of life's genius, is an even more profound approach to making manufacturing sustainable. Janine Benyus, author of the groundbreaking book *Biomimicry*, asks the simple question, How would nature do business? She points out that nature delivers a wide array of products and services, but very differently from the way humans do. Nature, for example, runs on sunlight, not high flows of fossil energy. It manufactures everything at room temperature, next to something that is alive. It makes very dangerous substances, as anyone who has been in proximity to a rattlesnake knows well, but nothing like nuclear waste, which remains deadly for millennia. It creates no waste, using the output of all processes as the input to some other process. Nature shops locally and creates beauty. Buckminster Fuller once pointed out that "When I am working on a problem I never think about beauty. I only think about how to solve the problem. But when I have finished, if the solution is not beautiful, I know it is wrong."[34]

The discipline of biomimicry takes nature's best ideas as a mentor and then imitates these designs and processes to solve human problems. Dozens of leading industrial companies—from Interface Carpets and AT&T to 3M, Hughes Aircraft, Arup Engineers, DuPont, General Electric, Herman Miller, Nike, Royal Dutch Shell, Patagonia, SC Johnson, and many more—use the principles of biomimicry to drive innovation, design superior products, and implement production processes that cost less and work better. (See Box 3–2.)[35]

Biomimicry invites innovators to turn to the natural world for inspiration, then evaluate the resulting design for adaptiveness in the manufacturing process, the packaging, all the way through to shipping, distribution, and take-back decisions. It ensures that the energy used, production methods chosen, chemical processing, and distribution are part of a whole system that reduces materials use, is clean and benign by design, and eliminates

Box 3–2. Biomimicry and Carpets

Industrialist Ray Anderson, chair of the billion-dollar-a-year carpet company Interface, tells the story of the creation of his product Entropy. David Oakey, the head product designer of Interface, sent his design team into the forest with the instruction to find out how nature would design floor covering. "And don't come back," he instructed, "with leaf designs—that's not what I mean. Come back with nature's design principles."

So the team spent a day in the forest, studying the forest floor and streambeds until they finally realized that it is total chaos there: no two things are alike, no two sticks, no two stones, no two anything....Yet there is a pleasant orderliness in this chaos.

They returned to the studio and designed a carpet tile such that no two tiles have the same face design. All are similar but all are different. Interface introduced the product into marketplace as Entropy, and in 18 months the design was at the top of best-seller list. This was faster than any other product in the company's history. How different is that from the prevailing industrial paradigm of every mass-produced item? A typical industrial product must be cookie-cutter the same.

The advantages of Entropy were astonishing: almost no waste and off quality in production. The designers could not find defects in the deliberate imperfection of having no two tiles alike. Installers could put the carpet in quickly without having to take time to get the pile net all running uniformly. They could take tiles from the box as they came and lay them randomly, the more random the better—like a floor of leaves. The user can replace individual damaged tiles without the "sore thumb effect" that comes with precision perfection and uniformity and can rotate tiles just like tires on cars in order to extend useful life. Moreover, dye lots now merged indistinguishably, which means sellers do not have to maintain an inventory of individual dye lots waiting to be used.

Yet one wonders: could there be more to explain the success of entropy? Perhaps there is.

A speaker on an environment lecture circuit begins every speech by having her audience close their eyes and picture that ideal comfort zone of peace and repose, of solitude, creativity, security—that perfect place of comfort. She then asks, how many of you were somewhere indoors? Almost no one ever raises their hand. This quality has a name, biophilia—humans gravitate to nature for the perfect comfort zone.

And somehow, subliminally, Entropy seems to bring the outdoors indoors. That is its real appeal.

Entropy is made with recycled content in a climate-neutral factory; 82 of Interface's products are now designed on the principle of no two alike. These represent 52 percent of Interface's sales. Using principles like waste minimization and biomimicry has enabled Interface to bring the company's CO_2 emissions to roughly 10 percent of their 1996 levels.

Source: See endnote 35.

the costs that last century's technologies imposed on society and the living world.[36]

EcoCover Limited of New Zealand used the concept that in nature there is no waste—the output of all processes is food for some other process—to develop an organically certified, biodegradable mulch mat to substitute for black plastic sheeting used in agriculture to prevent moisture loss and weed growth. Using shredded waste paper that would otherwise have gone to landfill, bound together with fish waste, the material is produced by previously unemployed people.[37]

The product uses waste to improve soil productivity, conserve soil moisture, and cut water use. It cuts the use of chemical fertilizers, pesticides, and herbicides that contaminate soil and groundwater. It reduces weeds; increases plant growth, quality, and yield; and keeps paper and fish waste out of landfills. The cover is left in the soil as improved organic and nutrient content. This is not recycling. It is "upcycling" waste back into productive soil.[38]

The humble abalone sits in the Pacific Ocean and in seawater and creates an inner lining immediately next to its body that is twice as strong as the best ceramics that humans can make using very high temperature kilns. The overlapping brick-like structure of the seashell makes it very hard to crack, protecting the abalone from sea otters and the like. Dr. Jeffrey Brinker's research group at Sandia Labs found out that the iridescent mother-of-pearl lining of the abalone self-assembles at the molecular level when the animal excretes a protein that causes sea water to deposit out the building blocks of the abalone's beautiful shell.[39]

The researchers mimicked the manufacturing process of the mollusk to create mineral/polymer layered structures that are optically clear but almost unbreakable. This evaporation-induced, low-temperature process enables the liquid building blocks to self-assemble and harden into complex "nano-laminate" structures. The bio-composite materials can be used as coatings to toughen windshields, airplane bodies, or anything that needs to be lightweight but fracture-resistant.[40]

Companies are using biomimicry to match not only the form of natural products but also the function of larger ecosystems. In July 2007, Toyota Motor Corporation announced plans to increase the sustainability of its production operations. The Tsutsumi Prius production plant will add a 2-megawatt solar electric array. It will also paint some of its exterior walls and other surfaces with a photo-catalytic paint that breaks down airborne NO_X and sulfur oxides. This will do as much to clean the air as surrounding the plant with 2,000 poplar trees would have.[41]

The plant's impressive biomimicry program is coupled with a strong foundation of eco-efficiency. The plant is installing innovative assembly-line technology and further streamlining current production systems such as the Global Body Line and Set Parts System to greatly improve both productivity and energy efficiency. By 2009, the plant is expected to achieve an annual CO_2 reduction effect of 35 percent.[42]

The practice of using nature as model, measure, and mentor lies at the heart of the change in the industrial mental model that will be essential if humans are to survive. Nature runs a very rigorous, 3.8-billion-year-old testing laboratory in which products that do not work are recalled by the manufacturer. As Janine Benyus says: "Failures are fossils, and what surrounds us is the secret to survival."[43]

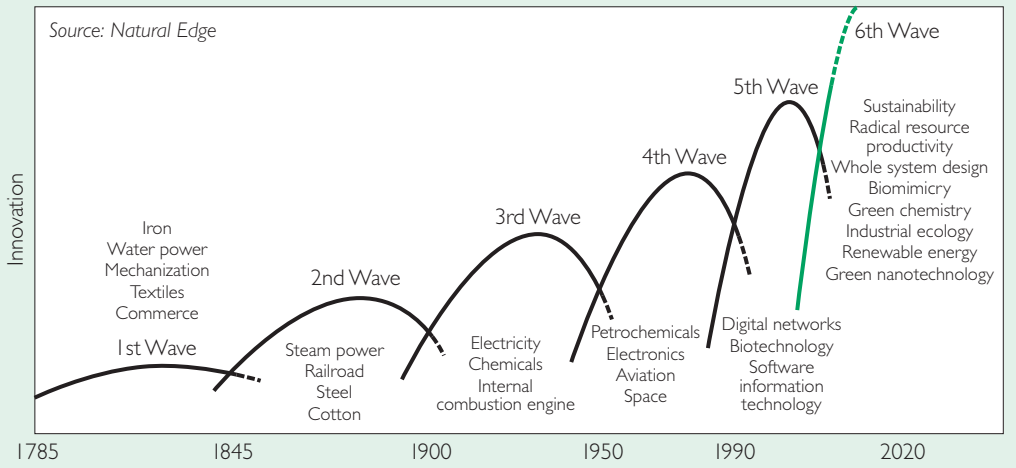
The First Industrial Revolution was based on brute force manufacturing processes that inefficiently heat, beat, and treat massive amounts of raw materials to produce a throwaway society. The next Industrial Revolution will rise upon the elegant emulation of life's genius, a survival strategy for the human race, and a path to a sustainable future. "The more our world looks and functions like the natural world," Benyus notes, "the more likely we are to endure on this home that is ours, but not ours alone."[44]

Riding the New Wave of Innovation

Business success in a time of technological transformation demands innovation. Since the First Industrial Revolution, there have been at least six waves of innovation (see Figure 3–1), each shifting the technologies that underpin economic prosperity. In the late 1700s textiles, iron mongering, water-power, and mechanization enabled modern commerce to develop.[45]

The second wave saw the introduction of steam power, trains, and steel. In the 1900s, electricity, chemicals, and cars began to dominate. By the middle of the twentieth century

Figure 3–1. Waves of Innovation



it was petrochemicals and the space race, along with electronics. The most recent wave of innovation brought computers and ushered in the digital or information age. As the Industrial Revolution plays out and economies move beyond iPods, older industries will suffer dislocations unless they join the increasing number of companies implementing the array of sustainable technologies that are making up the next wave of innovation.[46]

Perhaps the tipping point in corporate movement to greener production came when General Electric announced Eco-magination. As part of the initiative, GE board chairman Jeffrey Immelt promised to double the company's investment in environmental technologies to $1.5 billion by 2010. He also announced that GE would reduce the company's greenhouse gas emissions 1 percent by 2012; without action, emissions would have risen 40 percent. Immelt stated: "We believe we can help improve the environment and make money doing it."[47]

Critics charged that GE was greenwashing, simply labeling some of its existing products as green and changing very little. Hypocrisy, however, is often the first step to real change. A little less than a year after the campaign's launch, Immelt announced that his green-badged products had doubled in sales over the prior two years, with back orders for $50 billion more, blowing away his initial prediction of $12 billion in sales by 2010. Over the same time frame, the rest of GE products had increased in sales only 20 percent. GE also announced that it had reduced its GHG emissions by 4 percent in 2006, dwarfing its 2012 target of 1 percent.[48]

Companies that increase resource productivity and implement sustainable production strategies such as biomimicry and cradle to cradle, especially in the context of a broader whole-system corporate sustainability strategy, improve every aspect of shareholder value. What constitutes shareholder value? What enhances it?

Traditionally, the "bottom line" measured whether a company was profitable. More recently, a company's profits and stock value had to increase over the next quarter or the firm was considered unworthy of investment. This highly questionable metric is so incom-

patible with management of an enterprise for long-term value that even the Financial Accounting Standards Board has undertaken to rewrite financial reporting to encourage alternatives to such short-sighted behavior. (See also Chapter 2.)[49]

Sustainability advocates have urged companies to manage a "triple bottom line": achieve profit but also protect people and the planet. While this is a tempting formulation, it has had the effect of bolting concern for the environment and social well-being onto companies as cost centers that reduce the traditional measure of profit. A much more useful approach is that of the "integrated bottom line." This recognizes that profit is a valid metric, but only one of many that give a company enduring value.[50]

Other aspects of shareholder value include enhanced financial performance from energy and materials cost savings in industrial processes, facilities design and management, fleet management, and operations. Reduced risk is another key point to consider, tied to insurance access and cost containment, legal compliance, reduced exposure to increased carbon regulations and price, and reduced shareholder activism. Finally, core business value is enhanced through:

- sector performance leadership;
- greater access to capital;
- first-mover advantage;
- improved corporate governance;
- the ability to drive innovation and retain competitive advantage;
- enhanced reputation and brand development;
- increased market share and product differentiation;
- ability to attract and retain the best talent;
- increased employee productivity and health;
- improved communication, creativity, and morale in the workplace;
- improved value chain management; and
- better stakeholder relations.

The validity of this management approach is borne out by a recent report from Goldman Sachs, which found that companies that are leaders in environmental, social, and good governance policies have outperformed the MSCI world index of stocks by 25 percent since 2005. Seventy-two percent of the companies on the list outperformed their industry peers.[51]

It is daunting to realize that achieving a sustainable society will require changing how we manufacture and deliver all our products and services. But the evidence increasingly shows that companies taking a leadership role in using resources more efficiently, in redesigning how they make products, and in managing their operations to enhance people and intact ecosystems have found a better way to make a bigger profit. Solving the challenges of implementing a transition to a sustainable society can unleash the biggest economic boom since the space race. There has never been a greater opportunity for entrepreneurs to do well by doing good and for communities to enhance energy security, improve the quality of life, and enable people to join the transition to a more sustainable future.

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CHAPTER 4

The Challenge of Sustainable Lifestyles

Tim Jackson

In a small apartment in the sprawling suburbs of Mumbai, the financial capital of India, 35-year-old George Varkey wakes at dawn to the sound of his newborn baby's uneven breathing. Already the apartment is hot and humid, the air stirred rather than cooled by small electric fans. His wife, Binnie, is preparing breakfast. His elderly parents, four-year-old son, and younger brother are all still in bed. George is keen to be ready early. Today a news team from the BBC in London is coming to visit.[1]

George's apartment has three rooms and a tiny kitchen. The modern apartment block has running water and electric power. There is a small fridge in the kitchen and a TV in every other room. The family's latest acquisition is a DVD player. Outside is George's Suzuki sedan, essential to his small advertising business. He takes home 55,000 rupees (a little under $1,200) a month. Together with his brother's earnings as a mechanic and his wife's part-time nursing, the family lives reasonably well on just over 1 million rupees ($24,000) a year, well above the average household income in India of $3,000 a year.[2]

George and his family are part of a rapidly growing consumer market—India's "bird of gold." In the last two decades, household income has roughly doubled. In the next two decades, average incomes are expected to triple. By 2025 India will be the fifth largest consumer market in the world, surpassing even Germany in terms of overall spending. On a per capita basis, however, India will still be poor. Each person will still spend on average less than 50,000 rupees, a little over $1,000, a year. Yet in only 20 years the share of the population classified as "deprived" will be more than halved—from 54 percent today to 22 percent by 2025. And this is in spite of the fact that by then India will nearly have passed China to become the most populous nation on Earth.[3]

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Someone who might benefit from this economic "miracle" is 26-year-old Vidya Shedge, another participant in the BBC program. Vidya lives with 10 members of her family in a single room in the considerably poorer outskirts of Mumbai. There is no running water, no fridge, and no DVD player. But they do now have electricity—enough to burn three incandescent lightbulbs and a couple of fans during the hottest part of the day. Vidya's ambition is to save enough from her 7,500 rupees ($160) a month job in a bank to afford a car. She, too, is looking forward to her visit from the BBC. They want to talk to her about "carbon footprints."

Perhaps surprisingly, both George and Vidya already know something about climate change. They understand that human activities are responsible for global warming. George has even discussed what his household can do to reduce their carbon emissions. Every room in the apartment has energy-efficient lightbulbs. A little more surprisingly, and in spite of believing that the industrial world must lead the way, both George and Vidya are relatively optimistic that something can be done to halt climate change.

A recent international survey confirms these counterintuitive findings. In June 2007 the HSBC Bank published a Climate Confidence Index. People in India showed the highest level of concern about climate change—60 percent of respondents placed it at the top of their list of concerns—the highest commitment to change (alongside Brazil), and the highest level of optimism that society will solve this problem. Skepticism and intransigence, it seems, are mainly the domain of industrial nations. The United States and the United Kingdom scored lowest on commitment. France and the United Kingdom scored lowest on optimism. India's optimism in finding solutions is driven in particular by the younger age groups. A whole new generation of Indians see hope in the future.[4]

Justifying that hope will not be easy. For George's family, life has clearly improved since his parents' generation. And yet his standard of living—measured in conventional terms—is modest at best. Vidya's family has a massive hill to climb. Eleven people living in one small room with a combined income of $16 a day is a level of poverty long consigned to history in the West. So how is it going to be possible for George, Vidya, 1 billion other Indians, and great numbers of Chinese (not to mention people in Africa, Latin America, and the rest of Southeast Asia) to achieve the standard of living taken for granted in the United States—and still "solve the problem" of climate change?

How can a world of finite resources and fragile environmental constraints possibly support the expectations of 9 billion people in 2050 to live the lifestyle exemplified for so long by the affluent West? That is the challenge that guides and frames this chapter.[5]

The Math of Sustainability

Broadly speaking, the impact of human society on the environment is determined by the number of people on the planet and the way in which they live. The math of the relationship between lifestyle and environment is pretty straightforward. It was set out several decades ago by Paul Ehrlich of Stanford University and has been explored in detail in many other places since. In essence, the lesson is simple. Reducing the overall impact that people have on the environment can happen in only a limited number of ways: changing lifestyles, improving the efficiency of technology, or reducing the number of people on the planet.[6]

The question of population is clearly critical. Population is one of the factors that "scales" humanity's impact on the planet.

Another is the expectations and aspirations of the increasing population. This chapter focuses primarily on the latter. But a simple example based on George and Vidya's carbon footprints helps illustrate the relationship.

In George's household, the carbon footprint is around 2.7 tons of carbon dioxide (tCO_2) per person. In Vidya's, it is less than a fifth of this, under 0.5 tCO_2 per person. (The average carbon footprint in India is 1 tCO_2 per person.) The difference is mainly due to the different level and pattern of consumption in the two households, since the efficiency of technology providing goods and services is pretty much the same. Basically, George's household enjoys a much higher standard of living in conventional terms. If India's 1 billion people all lived as George does now, that country would have moved from fifth place in the list of carbon emitters in 2004 to third, below only the United States and China. (See Table 4–1.) Their personal carbon footprints would still be low by western standards, however.[7]

Table 4–1. Population and Carbon Dioxide Emissions, Selected Countries, 2004

Country or Region	Population	CO_2 Emissions	Emissions per Person
	(million)	(million tons)	(tons of CO_2)
United States	294	5,815	19.8
China	1,303	4,762	3.7
Russia	144	1,553	10.8
Japan	128	1,271	10.0
India	1,080	1,103	1.0
Germany	83	839	10.2
United Kingdom	60	542	9.1
France	62	386	6.2
Bangladesh	139	35	0.3
European Union (15 countries)	386	3,317	8.6
World	6,352	26,930	4.2

Source: See endnote 7.

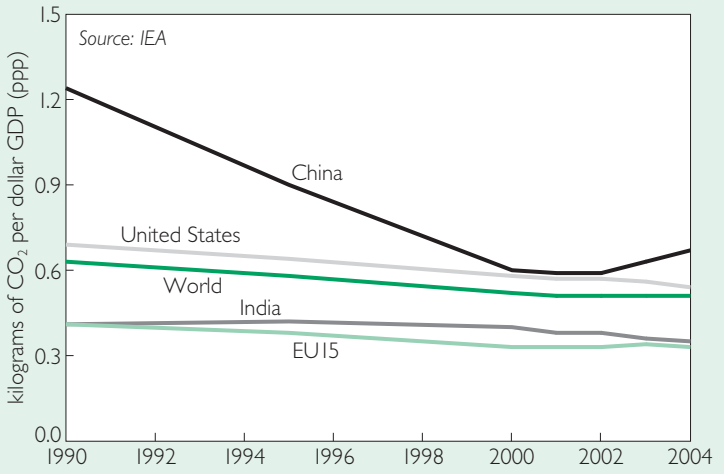
The technological efficiency of providing goods and services is higher in the European Union (EU) and the United States than it is in India. All other things being equal, then, this should lower the carbon footprint in industrial nations. So huge regional disparities in per capita footprint are almost entirely due to the pattern and level of consumption—to differences in lifestyle.

Clearly, western nations have been the key driver of climate change so far. Between 1950 and 2000, the United States was responsible for 212 gigatons of carbon dioxide, whereas India was responsible for less than 10 percent as much. So it is clear that the richest people on the planet are appropriating more than their fair share of "environmental space." Yet this lifestyle is increasingly what the rest of the world aspires to.[8]

Much is made of efficiency improvements. And some relative improvements in the carbon intensity of growth are evident in some countries. (See Figure 4–1.) But these gains are slow at best, and in China they have been reversed in recent years. This is one reason that China's carbon dioxide emissions recently surpassed those of the United States. Across the world as a whole, greenhouse gas emissions grew by 80 percent between 1970 and 2004 and could double again by 2030.[9]

In summary, any gains in technological efficiency are simply being swamped by the sheer scale of rising aspirations and an increasing population. If everyone in the world lived the way Americans do, annual global CO_2 emissions would be 125 gigatons—almost five times the current level—by the middle of the century. In stark contrast, the Intergovernmental Panel on Climate Change has esti-

Figure 4–1. Carbon Intensity of GDP, 1990–2004



mated that the world needs to reduce global emissions by as much as 80 percent over 1990 levels by 2050 if "dangerous anthropogenic climate change" is to be averted. This would mean getting global emissions below 5 gigatons and reducing the average carbon footprint to well under 1 ton per person, lower than it now is on average in India.[10]

This challenge clearly calls for an examination of assumptions about the way people live. What is it that drives and frames people's aspirations for the "good life"? What lies behind the runaway aspirations that seem so unstoppable in the West and are rapidly becoming the object of desire in every other nation?

The "Science of Desire"

In the conventional economic view, consumption is the route to human well-being. The more people have, the better off they are deemed to be. Increasing consumption leads to improved well-being, it is claimed.

This view goes a long way toward explaining why the pursuit of the gross domestic product (GDP) has become one of the principal policy objectives in almost every country. Rising GDP symbolizes a robust and thriving economy, more spending power, richer and fuller lives, increased family security, greater choice, and more public spending. The rise of India's "bird of gold," its consumer class, is heralded in financial markets with huge delight. China's vigorous economy has led to an equally striking sense of market optimism.[11]

Economics has remained almost willfully silent, however, on the question of why people value particular goods and services at all. The "utilitarian" model has become so widely accepted that most modern economic textbooks barely even discuss its origins or question its authenticity. The most that economists can say about people's desires is what they infer from patterns of expenditure. If the demand for a particular automobile or household appliance or electronic device is high, it seems clear that consumers, in general, prefer that brand over others. Their reasons for this remain opaque within economics.[12]

Fortunately, other areas of research—such as consumer psychology, marketing, and "motivation research"—have developed a somewhat richer body of knowledge. This "science of desire" has mainly been dedicated to helping producers, retailers, marketers, and advertisers design and sell products that consumers will buy. Little of the research concerns itself explicitly with the environmental or social impacts of consumption.

Indeed, some of it is downright antithetical to sustainability. But its insights are extremely valuable for a proper understanding of consumer motivation.[13]

For a start, it is immediately clear that consumption goes way beyond just satisfying physical or physiological needs for food, shelter, and so on. Material goods are deeply implicated in individuals' psychological and social lives. People create and maintain identities using material things. "Identity," claim consumer researchers Yiannis Gabriel and Tim Lang, "is the Rome to which all theories of consumption lead." People narrate the story of their lives through stuff. They cement relationships to others with consumer artefacts. They use consumption practices to show their allegiance to certain social groups and to distinguish themselves from others.[14]

It may seem strange at first to find that simple stuff can have such power over emotional and social lives. And yet this ability of human beings to imbue raw stuff with symbolic meaning has been identified by anthropologists in every society for which records exist. Matter matters to people. And not just in material ways. The symbolic role of mere stuff is borne out in countless familiar examples: a wedding dress, a child's first teddy bear, a rose-covered cottage by the sea. The "evocative power" of material things facilitates a range of complex, deeply ingrained "social conversations" about status, identity, social cohesion, and the pursuit of personal and cultural meaning.[15]

Material possessions bring hope in times of trouble and offer the prospect of a better world in the future. In a secular society, consumerism even offers some substitute for religious consolation. Recent psychological experiments have shown that when people become more aware of their own mortality, they strive to enhance their self-esteem and protect their cultural worldview. In a consumer society, this striving has materialistic outcomes. It is almost as though people are trying to hold their existential anxiety at bay by shopping.[16]

At a recent Consumer Forum organized for the Sustainable Consumption Roundtable in the United Kingdom, people were asked to talk about their hopes and fears for the next decade or so. They spoke about their desire to do well for their children and grandchildren. There was a strong wish to live in safe, sociable communities. People expressed spontaneous concern about others, about poverty in the developing world, and—without being told the interests of the sponsors—about the environment: climate change, resource scarcity, recycling. Shot through these expressions of concern, however, like a light relief, were recurrent, persistently materialist themes: big houses, fast cars, and holidays in the sun. Getting on and getting away pervades narratives of lifestyle success.[17]

This deep reliance on material goods for social functioning is not unique to the western world. George and Vidya also say they want to see a good future for their children. They want to do well and be seen to do well among their peers. Just below the surface, these aspirations are cashed out in broadly western terms. Vidya's overriding ambition is to afford a car. For the first time in their lives, George and Binnie are planning a holiday outside India. Getting on and getting away means as much there as it does in London, Paris, New York, and Sydney.[18]

Very similar values and views are clearly discernible in China, Latin America, and even parts of Africa. The consumer society is now in effect a global society—one in which, to be sure, there are still "islands of prosperity, oceans of poverty," as Indian ecologist Madhav Gadjil puts it. But one in which the evocative power of material goods

increasingly creates the social world and provides the dominant arbiter of personal and societal progress.[19]

The Paradox of Well-being

In the conventional view, the recipe for progress is simple: the more people consume, the happier they will be. A close look at what motivates consumers uncovers a whole range of factors—family, friendship, health, peer approval, community, purpose—known to have a strong correlation with reported happiness. In other words, people really do consume in the belief that it will deliver friends, community, purpose, and so on. But there is a paradox at work here that at one level is tragic. People have a good grasp of the things that make them happy but a poor grasp of how to achieve these things. The assumption that more and more consumption will deliver more and more well-being turns out to be wrong.[20]

Using data collected in the World Values Survey, Ronald Inglehart and Hans-Dieter Klingemann examined the hypothesis that happiness (or life satisfaction) is linked to income growth. The good news is that the equation just about works for George and Vidya. There is an increasing trend in life satisfaction at lower levels of income. (See Figure 4–2.) The bad news is that the relationship will begin to diminish as their incomes rise further. Across most industrial countries there is at best only a weak correlation between increased income and reported happiness. And in countries with average incomes in excess of $15,000, there is virtually no correlation between increased income and improved life satisfaction.[21]

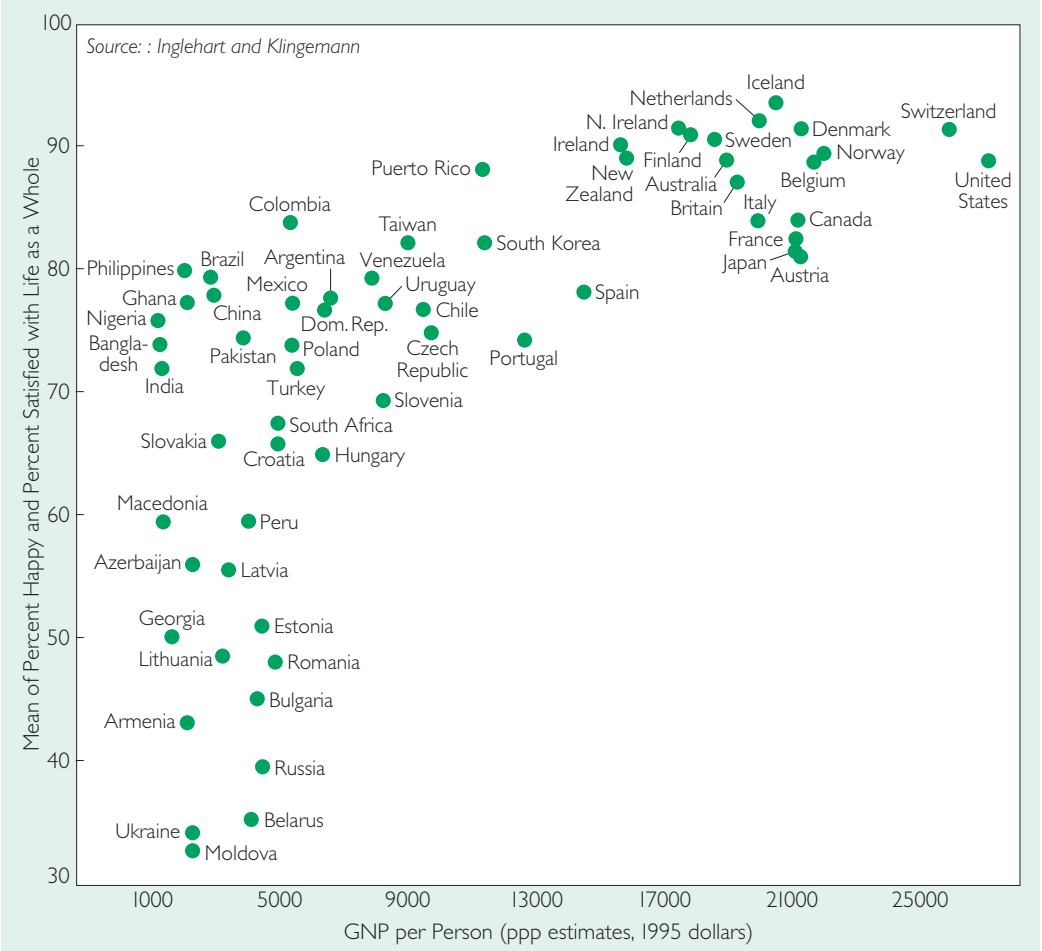
The same paradox is found within individual nations over time. Real income per head has tripled in the United States since 1950, but the percentage of people reporting themselves to be very happy has barely increased at all—in fact, it has declined since the mid-1970s. In Japan, there has been little change in life satisfaction over several decades. In the United Kingdom, the percentage reporting themselves very happy dropped from 52 in 1957 to 36 today.[22]

Some key aspects of people's well-being, far from improving, appear to have declined in western nations. Rates of depression have been doubling every decade in North America. Fifteen percent of Americans age 35 have already experienced a major depression. Forty years ago, the figure was only 2 percent. One third of people in the United States now experience serious mental illness at some point in their lives, and almost half of these will suffer from a severe, disabling depression. During any single year, about 6 percent of the population will suffer from clinical depression; suicide is now the third most common cause of death among young adults in North America.[23]

Teasing out the underlying causes of this unhappiness is not particularly easy. But there are two fairly compelling sets of data suggesting that consumerism itself is partly to blame. The first set suggests a negative correlation between materialistic attitudes and subjective well-being. Philosopher Alain de Boton has shown how an unequal society leads to high levels of "status anxiety" in its citizens. Psychologist Tim Kasser and his colleagues have shown how people with more materialistic attitudes—people who define and measure their own worth through money and material possessions—report lower levels of happiness. Striving for self-esteem through material wealth appears to be a kind of "zero-sum game" in which the constant need for betterment and approval only serves to entrench people in an almost neurotic spiral of consumption.[24]

A second, equally compelling set of evidence relates rising unhappiness to the undermining of certain key institutions. Subjective

Figure 4–2. Subjective Well-being and Per Capita Income, 2000



well-being depends critically on family stability, friendship, and strength of community. But these aspects of life have suffered in the consumer society. Family breakdown, for example, has increased by almost 400 percent in the United Kingdom since 1950. The percentage of Americans reporting their marriages as "very happy" declined significantly over just 20 years during the latter part of the last century. People's trust and sense of community have fallen dramatically over the last 50 years. In the middle of the twentieth century, more than half of all Americans believed that people were "moral and honest." By 2000 the proportion had fallen to little over a quarter. Participation in social and community activities declined markedly over the same period.[25]

In other words, there appears to be a correlation between rising consumption and the erosion of things that make people happy—particularly social relationships. This correlation does not necessarily mean, of course,

that one thing "causes" the other. But in practice, as described later, there are some pretty compelling reasons to take seriously the idea that the structures and institutions that are needed to maintain growth simultaneously erode social relationships. As economist Richard Layard describes it: consumption growth has "brought some increase in happiness, even in rich countries. But this extra happiness has been cancelled out by greater misery coming from less harmonious social relationships."[26]

One tragic result of this elusive search for happiness is that industrial societies are closing off options for other people, both now and in the future, to lead fulfilling lives—without even being able to show reward for it in the here and now.

Live Better by Consuming Less?

The paradox of well-being begs the question, Why do people continue to consume? Why not earn less, spend less, and have more time for families and friends? Couldn't people live better—and more equitably—this way and at the same time reduce humanity's impact on the environment?

This idea has provided the motivation for numerous initiatives aimed at living more simply. "Voluntary simplicity" is at one level an entire philosophy for life. It draws extensively on the teachings of Mahatma Gandhi, who encouraged people to "live simply, that others might simply live." In 1936, a student of Gandhi's described voluntary simplicity in terms of an "avoidance of exterior clutter" and the "deliberate organisation of life for a purpose." Former Stanford scientist Duane Elgin picked up this theme of a way of life that is "outwardly simple, yet inwardly rich" as the basis for revisioning human progress. More recently, psychologist Mihály Csíkszentmihályi has offered a scientific basis for the hypothesis that people's lives can be more satisfying when they are engaged in activities that are both purposive and materially light.[27]

Sociologist Amitai Etzioni has identified three kinds of people pursue simplicity. "Downshifters" are those who, having achieved a given level of wealth, make a conscious choice to reduce their income; they then moderate their lifestyle so they can spend more time with family or pursuing community or personal interests. "Strong simplifiers" are those who give up highly paid, high-status jobs altogether and accept radically simpler lifestyles. The most radical contingent are the "dedicated, holistic simplifiers," who embrace radical change and adjust their entire lives around an ethical vision of simplicity, sometimes motivated by spiritual or religious ideals.[28]

Some of these initiatives, such as the Findhorn community in northern Scotland, emerged initially as spiritual communities, attempting to create space in which to reclaim the contemplative dimension of living that used to be captured by religious institutions. Findhorn's character as an eco-village developed more recently, building on principles of justice and respect for nature. Another modern example is Plum Village, the "mindfulness" community established by an exiled Vietnamese monk, Thich Nhat Hahn, in the Dordogne area of France, which now provides a retreat for at least 2,000 people. At one level these initiatives are modern equivalents of more traditional religious communities like those of the Amish in North America or Buddhist monasteries in Thailand, which every young male is expected to spend some time in before going out into professional life.[29]

Not all networks have this explicit spiritual character, however. The Simplicity Forum, for example, launched in North America in 2001 is a loose secular network of "simplicity leaders" who are committed to "achieving and

honoring simple, just and sustainable ways of life." Downshifting Downunder is an even more recent initiative, started following an international conference on downshifting in Sydney in 2005; its aim is to "catalyze and coordinate a downshifting movement in Australia that will significantly impact sustainability and social capital."[30]

The downshifting movement now has a surprising allegiance across a number of industrial economies. A recent survey in Australia found that 23 percent of respondents had engaged in some form of downshifting in the preceding five years. A staggering 83 percent felt that Australians are too materialistic. An earlier study in the United States found that 28 percent of those surveyed had taken some steps to simplify and 62 percent expressed a willingness to do so. Very similar results have been found in Europe.[31]

Research on the success of these initiatives is quite limited, but existing studies show that simplifiers really have less materialistic values and show greater respect for the environment and for others. More important, simplifiers appear to show a small but significant increase in subjective well-being. Consuming less, voluntarily, can improve well-being—completely contrary to the conventional model.[32]

The backlash against consumerism bears witness to an emerging counterculture that recognizes the limits of the consumer society and is looking for something beyond it. Buy Nothing Day every November—dedicated to persuading people to resist consumerism—is now an international phenomenon. In 2006 there were initiatives on the streets in almost 30 countries and in scores of cities, including, for the first time, a demonstration on the streets of Mumbai.[33]

Equally striking is the rise of the Transition Towns concept—towns and cities that have declared unilateral action against the twin threats of peak oil and climate change. Launched in September 2006 in the small town of Totnes in southwest England, the U.K. network expanded to over 20 towns and cities in only a year. In the United States, 400 cities have signed the U.S. Mayors Climate Protection Agreement, which pledges to meet the Kyoto Protocol targets on reducing CO_2 emissions, in spite of the federal government's refusal to ratify the protocol.[34]

It is important not to get too carried away with this evidence. Simple living communities remain marginal. The religious basis for them does not appeal to everyone, and the secular versions seem less resistant to the incursions of consumerism. Downshifting Downunder generated a flurry of activity in Australia for six months or so, for instance, but barely functions as a working network only two years later. Some of these initiatives depend heavily on individuals having sufficient personal assets to provide the economic security needed to pursue a simpler lifestyle. Finally, it is clear that forced or involuntary simplicity is quite another story. Subjective well-being plummeted in the "transition economies" (former Soviet states) during the 1990s.[35]

As the evidence on global consumerism makes abundantly clear, mainstream consumer values show little sign of slowing down the pace of material and environmental profligacy. Existing attempts to live better by consuming less remain marginal at best. So the question remains, Why do people continue to consume, knowing the social and environmental consequences, even beyond the point at which it adds to their satisfaction?

Competing for Status—and for Survival

Is the urge to consume somehow "natural," hardwired through evolution? Certainly, the desire for comfort, a decent home, good

relationships with friends and family, doing well in the community, and perhaps broadening horizons through experience appear to be very widespread. The emerging field of evolutionary psychology suggests that human desires do indeed have their roots in ancestral origins.[36]

Genetic succession depends on two critical factors: surviving long enough to reach reproductive age and finding a mate. So human nature is conditioned by the need to get the material, social, and sexual resources required for these tasks. In particular, argues evolutionary psychology, people are predisposed to "position" themselves constantly in relation to the opposite sex and against their sexual competitors. As a (male) reviewer of one book on evolutionary psychology noted with some glee: "Animals and plants invented sex to fend off parasitic infection. Now look where it has got us. Men want BMWs, power and money in order to pair-bond with women who are blonde, youthful and narrow-waisted."[37]

To make matters worse, this fundamental element of sexual competition never abates. People adapt to any given level of satisfaction and continually expand their aspirations. This response may be conditioned by the fact that everyone else is engaged in the same unending struggle. There is an evolutionary advantage in never being satisfied. But the result is that people find themselves condemned to run faster and faster, like the Red Queen in Lewis Carroll's novel *Through the Looking Glass*, just to maintain their position in the race.[38]

The idea that consumerism may have something to do with sex has a clear resonance with common wisdom. Advertisers and media executives are extraordinarily creative in using sex and sexual imagery to sell their products. In a recent study of people's behavior in three completely different cultures, researchers found that consumer motivations are almost inextricably entwined in the language and imagery of sexual desire. The fact that material things play a role in creating and maintaining desire is central here. As a respondent in the study remarked: "No one's gonna spot you across the other side of a crowded room and say: 'Wow! Nice personality!'"[39]

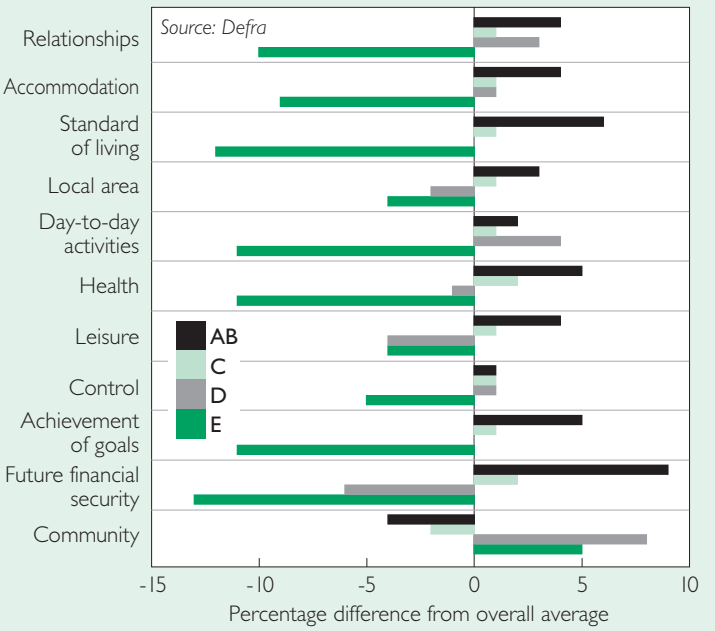
Survival itself is mediated by social status. This is most graphically illustrated by the plight of India's 170 million Dalits. Literally translated, Dalits means "the broken people," and life at the bottom of India's caste system is tough. Infant mortality and undernourishment are high; literacy, access to health care, and life expectancy are all significantly lower than the national average. Workers in the stone trade—almost exclusively Dalits—can have a life expectancy as low as 30 years, compared with a national average of 62.[40]

This effect is by no means confined to poorer countries. Recent evidence has shown how closely health and well-being are related to social status in industrial countries. A fascinating example of this was revealed by the U.K. government's research on life satisfaction across different "life domains." (See Figure 4–3.) Poorer people reported lower life satisfaction in almost all domains. One notable exception was higher satisfaction with their community. People employed in higher-status jobs pay a price, it seems, in terms of social relationships. Being poor may have some limited advantages in this one area. On the whole, however, inequality favors the rich. Though it might undermine social relationships, reduce overall well-being, and even corrupt values in pathological ways, the evidence suggests that being better off really does pay in terms of individual well-being.[41]

The problem for society is threefold. First, at the aggregate level, this intense status competition leads to less happy societies. Unequal

societies systematically report higher levels of "distress" than more equal ones. Second, this mechanism for achieving happiness appears to have no endpoint. There is no getting off the "hedonic treadmill" of rising income and increasing consumption. Third, the environmental and resource implications of this unproductive "race to the top" are quite simply unsustainable. Taken together with the vast inequalities—the "oceans of poverty"—that still persist across the world, these three problems represent an enormous challenge to consumerism. But they also begin to point toward the importance of social structure in determining whether or not society is sustainable.[42]

Figure 4–3. Domain Satisfaction by Social Group, England



Key (examples of occupations in each social group)
AB: doctor, lawyer, accountant, teacher, nurse, police officer
C: junior manager, student, clerical worker, foreperson, plumber
D: manual worker, shop worker, apprentice
E: casual laborer, unemployed

The "Iron Cage" of Consumerism

Left to their own devices, it seems, there is not much hope that people will spontaneously behave sustainably. As evolutionary biologist Richard Dawkins has concluded, sustainability just "doesn't come naturally" to humankind. But it is a mistake to assume that evolutionary motivations are all selfish. Evolution does not preclude moral, social, and altruistic behaviors. Social behaviors evolved in humans precisely because they offer selective advantages to the species. An important lesson from evolutionary psychology is that the balance between selfish and cooperative behaviors depends critically on the kind of society they occur in.[43]

Social behavior can exist—to some extent—in all societies. In very competitive societies, self-serving behavior tends to be more successful than cooperation. But in a society characterized by cooperation, altruistic behaviors tend to be favored over selfish ones. In other words, the balance between altruism and selfishness is not hardwired in people at all. It depends critically on social conditions: rules, regulations, cultural norms and expectations, government itself, and the

set of institutions that frame and constrain the social world.[44]

So there are some searching questions to ask about the balance of the institutions that characterize modern society. Do they promote competition or cooperation? Do they reward self-serving behavior or people who sacrifice their own gain to serve others? What signals do government, schools, the media, and religious and community institutions send out to people? Which behaviors are supported by public investment and infrastructure and which are discouraged?

Increasingly, it seems, the institutions of consumer society encourage individualism and competition and discourage social behavior. Examples are legion: private transport is encouraged through incentives over public transport; motorists are given priority over pedestrians; energy supply is subsidized and protected, while demand management is often chaotic and expensive; waste disposal is cheap, economically and behaviorally, while recycling demands time and effort. These kinds of asymmetry represent an "infrastructure of consumption" that sends all the wrong signals, penalizing pro-environmental behavior, making it all but impossible even for highly motivated people to act sustainably without personal sacrifice.[45]

Increasingly, it seems, the institutions of consumer society encourage individualism and competition and discourage social behavior.

Equally important are the subtle but damaging signals sent by government, regulatory frameworks, financial institutions, the media, and education systems. Salaries in business are higher than those in the public sector, particularly at the top; nurses and those in the caring professions are consistently poorly paid; private investment capital is written down at high discount rates, making long-term costs invisible; success is counted in terms of material status; children are becoming a "shopping generation"—hooked on brand, celebrity, and status.[46]

At one level, the task facing sustainability is as old as the hills: balancing individual freedoms against the social good. This relies crucially on being able to make prudent choices, at the individual and the social level, between the present and the future. Rampant individualistic behavior that seeks short-term gratification ends up undermining well-being not just for the individual but for society as a whole. So the task for sustainability—indeed, for any society—is to devise mechanisms that prevent this "undermining of well-being" and preserve the balance between present desires and future needs.

Oxford economic historian Avner Offer addresses exactly this task in *The Challenge of Affluence*. Unaided, argues Offer, individual choices tend to be irredeemably myopic. People favor today too much over tomorrow, in ways that—to an economist—are entirely inexplicable under any rational rate of discounting of the future. Offer's unique contribution is to suggest that this fallibility has (or in the past had) a social solution. And that solution is precisely what affluence is in the process of eroding.[47]

To avoid trading away long-term well-being for the sake of momentary pleasures, society has evolved a whole set of "commitment devices": social and institutional "mechanisms" that constrain people's choices in ways that moderate the balance of choice away from the present and in favor of the future. Savings accounts, marriage, norms for social behavior, government itself in some sense—all these can be regarded as examples of mechanisms that make it a little easier for people to curtail their evolutionary appetites

for immediate arousal and protect their own future interests. And, indeed, the interests of affected others.

The "challenge" Offer addresses is that affluence is eroding and undermining these commitment devices. The increase in family breakdown and the decline in trust have already been noted. Parenthood has been placed under increased financial and social pressure in industrial countries. And in terms of economic commitment, it is telling that savings rates fell worldwide in the second half of the last century, declining by 5–10 percentage points across the United States and Europe. Meanwhile, consumer debt has soared, rising from $1 trillion to $2.5 trillion in the United States alone between 1995 and 2007. The role of government itself has been increasingly "hollowed out" as politicians on both left and right sought to bolster economic output and free up the "invisible hand" of the market.[48]

The drivers behind these trends are complex, but a key responsibility, argues Offer, lies with the relentless stream of novelty inherent in consumption growth. Evidence seems to bear this out. "Accelerating the rate of innovation is a top priority for technology managers," notes the U.S.-based Industrial Research Institute. The rate of innovation is driven in turn by the structural reliance of businesses and the economy on growing consumption. Novelty keeps people buying more stuff. Buying more stuff keeps the economy going. The continuing expansion of the market into new areas and the continuing allegiance of consumers appear to be vital to this process—even as they erode commitment devices and undermine well-being.[49]

The end result is a society "locked in" to consumption growth by forces outside the control of individuals. Lured by humanity's evolutionary roots, bombarded with persuasion, and seduced by novelty: consumers are like children in a candy store, knowing that sugar is bad to eat, but unable to resist the temptation. This is a system in which no one is free. People are trapped by their own desires. Companies are driven by the need to create value for shareholders, to maximize profits. Nature and structure combine to lock people firmly into the "iron cage" of consumerism.[50]

Living Well—and Within Limits

Put simply, sustainability is about living well, within certain limits. For this to happen, across a global population approaching 7 billion and expected to reach 9 billion by 2050, people's patterns of consumption have to change.[51]

Achieving this is a colossal task. But it is not an impossible one. A proper understanding of the relationship between individual desires and the social good is vital here. As noted earlier, consuming comes naturally to humankind. Restraint does not. Change requires a supportive social environment. People are torn constantly between self-enhancement and self-transcendence. There is little individuals can do to shift their underlying nature. But the balance between self-serving and social behaviors is malleable at the social level. In one social context, selfishness will imprison us, impoverish people's lives, and may ultimately destroy the living environment. In another, the common good will prevails and people's lives will be richer, more satisfying, and more fulfilling.

There is clear evidence of an appetite for change. During an 18-month project, the Sustainable Consumption Roundtable in the United Kingdom identified a strong desire for collective action. *I Will If You Will*—the title of the Roundtable report—was a common

theme emerging from a range of social research. This effect is not confined to the United Kingdom. The evidence on downshifting and simplicity, reactions against consumerism, the high levels of commitment to change (even in developing countries) found in the HSBC survey, a rising interest in alternatives to consumerism: all these are real, demonstrable effects. But good intentions are not enough, and they will continue to be undermined unless physical infrastructure, institutions, and social structures change.[52]

Who is capable of influencing these wider structures? Ultimately, of course, all sections of society must take responsibility for change. Government, business, and consumers all have some role to play; the media, community groups, religious institutions, and traditional wisdom are all essential influences on the social environment. But without strong leadership from government, change will be impossible. Individuals are too exposed to social signals and status competition. Businesses operate in competitive markets. A transition from self-interest to social behaviors requires changes in underlying structures—changes that strengthen commitment and encourage social behavior. Government is the principal agent in protecting the social good. A new vision of governance that embraces this role is critical.

Two or three key tasks are vital here. In the first place, policies need to support an infrastructure of sustainability: access to reliable public transport, recycling facilities, energy efficiency services, maintenance and repair, re-engineering and reuse. Systematic biases against these facilities have to be dismantled and policies to encourage them brought into place.[53]

The second key task lies in establishing fiscal and institutional frameworks that send consistent signals to businesses and consumers about sustainable consumption. A core example of this is the role of a "social cost of carbon" in providing incentives for investments in low-carbon technologies and behaviors. The Stern Review on the economics of climate change suggests that this cost might be as high as $85 per ton of CO_2. There is no doubt that internalizing this cost in market prices and investment decisions would have a major influence on reducing carbon emissions. The review also cast doubt on prevailing discounting practices, suggesting that zero or even negative discount rates might be appropriate when looking at projects with long-term impacts on the environment.[54]

But the role of government is not confined to fiscal frameworks. The way energy industries are regulated, for instance, has a profound effect on the incentives for demand management and energy service companies. Product policy can have a significant influence on access to durable, efficient products that minimize environmental harm. Recent EU legislation, for example, has already led to progressive improvements in the efficiency of energy-consuming appliances. Australia pledged early in 2007 to outlaw incandescent lightbulbs before 2010. The 27 EU nations have now followed that example. Surveying evidence of policy successes, the Sustainable Consumption Roundtable found that progressive standards, clearly signaled to manufacturers in advance, are a particularly effective instrument for moving toward more-sustainable consumption.[55]

The influence of government on social norms and expectations is, at first sight, less obvious. Policymakers are uncomfortable with the idea that they have a role in influencing people's values. But the truth is that governments intervene constantly in the social context. Myriad different signals are sent out, for example, by the way education is structured, by the importance accorded to economic indicators, by guidelines for public

sector performance, by public procurement policies, by the impact of planning guidelines on public and social spaces, by the influence of wage policy on the work-life balance, by the impact of employment policy on economic mobility (and hence on family structure and stability), by the effect of trading standards on consumer behavior, by the degree of regulation of advertising and the media, and by the support offered to community initiatives and faith groups. In all these arenas, policy shapes and helps create the social world.

As this chapter suggests, the drift of these influences over the last few decades has been away from encouraging commitment and in favor of encouraging consumption. But there are some striking counterexamples: places where strenuous efforts have been made to rein in consumerism and focus more specifically on well-being. Several nations, including the United Kingdom, Canada, and China, have begun to develop "well-being accounts"—new ways of measuring national progress alongside or in place of the GDP. (See Chapter 2.) In late 2007, the Organisation for Economic Co-operation and Development, the European Commission, and several nongovernmental groups cohosted a major international conference, "Beyond GDP," designed to look at more effective measures of social progress.[56]

A crucial arena for action lies in advertising, particularly ads directed at children. Global advertising expenditures now amount to $605 billion (with the United States alone accounting for $292 billion). The figure is growing at the rate of 5–6 percent a year, with online advertising growing faster than any other sector, at between 30 percent and 40 percent a year. The impact of this, particularly on children, is pernicious. Marketing pressure has been linked explicitly to rising childhood obesity.[57]

At an international conference in 2006, the World Health Organization stopped short of banning advertising to children, but Scandinavian nations have taken a more proactive stance. In Sweden, TV advertising to children under 12 is banned. Norway, too, has restrictions on children's advertising, and the Consumer Ombudsman has an educational role in Norwegian schools. Recent advertising guidelines in Norway include a ban on advertising cars as "green," "clean," or "environmentally friendly." Although a Norwegian plan to develop anti-consumption adverts failed to attract funding in the United Nations, the nongovernmental group Adbusters, based in Vancouver, Canada, remains a focus of resistance to commercial advertising. Perhaps most striking of all, São Paulo, Brazil, the fourth largest city in the world, has recently become the first city outside socialist economies to ban outdoor advertising.[58]

Australia pledged early in 2007 to outlaw incandescent lightbulbs before 2010.

Religious leadership has declined substantially in industrial countries. But traditional wisdom is still an important influence on the debate about living well. In less secular societies, religion plays a number of roles. It warns against material excess; it provides a social and spiritual context for self-transcendence, altruism, and other-regarding behavior; and it offers a space for contemplation in which to make sense of people's lives in deeper and more meaningful ways than those provided by the fleeting consolations of consumerism.

One thing is clear: if a part of the function of consumerism is to deliver hope—as indicated earlier—then countering consumerism means building new avenues of hope that are less reliant on material goods. In countries

where religious institutions are still strong, this task is much easier. In Southeast Asia, for example, in response to the economic crisis of the mid-1990s, the King of Thailand revived the traditional concept of the Sufficiency Economy, built on Buddhist principles, and provided a much-needed frame of reference to help countless microenterprises in rural villages survive the economic shocks of the recession and build a sustainable future in its aftermath. In the mountain Kingdom of Bhutan, progress is being reconceived in part as a spiritual endeavor. In many Islamic nations, the framework for moral restraint is already in place. From a western perspective, this framework is often seen as oppressive of individual freedoms, particularly for women. But Islam—and other religious traditions—are important sources of understanding the limits of relying on human nature to protect the public good.[59]

In the final analysis, the consumer society offers neither a durable sense of meaning in people's lives nor any consolation for losses. The erosion of religious participation in the West offers one more example of crumbling commitment devices. The examples in this chapter bear testament to the desire for change and the visionary courage of individuals, communities, and a handful of political leaders prepared to initiate that change. Millions of people have already discovered that treading more lightly allows them to breathe more easily. And it offers a new creative space for social change—a place where family, friendship, community, and a renewed sense of meaning and purpose are possible.

A sustainable world is not an impoverished world but one that is prosperous in different ways. The challenge for the twenty-first century is to create that world.

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Chapter 4. The Challenge of Sustainable Lifestyles

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Chapter 5. Meat and Seafood: The Global Diet's Most Costly Ingredients

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