

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

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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 pos-

itive 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 non-renewable 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 (dollars in purchasing power parity)	Share of World Net Worth per Person (percent)	Share of World Population (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 per-

cent 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.