CHAPTER 9

More-Sustainable Decisions Are Easier to Make and More Attractive

To a large degree, the patterns of unsustainable behavior described in Part I of this book have occurred because governments, corporations, individuals, and families have had no other choice or because sustainable options have been more expensive, less functional, or unpalatable. Even where more-sustainable approaches exist, they are often misunderstood or perceived as unattractive. Over the last two decades, the number and variety of attractive and publicly understood choices have grown. Governments, businesses, and individuals are making more-sustainable decisions because more and better choices exist.

More-sustainable decisions are increasingly understood as less expensive; more efficient; better for quality of life; and more consistent with individual, consumer, and public values. This is particularly true for decisions involving the use of energy, where rising energy costs, security concerns, and the availability of options for energy efficiency and renewable energy has made more-sustainable alternatives more appealing. In other cases, particularly with forest certification, the sustainable alternative is attractive in spite of the fact that it tends to command a price premium.

Fundamentally, sustainability is about creating choices that do not now exist and about making those alternatives attractive enough to be implemented. Changes that people want to make are more likely to happen at the necessary scale and speed than are changes that people resist or make reluctantly. The transitions from typewriters to personal computers, and from ordinary telephones to smartphones—both of which have happened in only a couple of decades—are examples of technological transitions that took place at the speed and scale needed for the transition to sustainability. Few if any of today's new practices are fully sustainable. Still, they are perhaps the most obvious and prominent way that progress toward sustainability has manifested itself over the past two decades. And they are in response to the growing public support described in the previous chapter.

Over the past two decades, the number, variety, and sophistication of specific and demonstrated sustainability practices have grown. These practices, beyond simply being available, often provide more attractive opportunities than are provided by many current practices. At the same time, many unsustainable business-as-usual practices are becoming more costly and present greater risks. The availability of new analytical frameworks and approaches, particularly ecosystem services, indus-

trial ecology, and environmental management systems, enable more-sustainable decisions to be made more easily.

Better Practices

A major reason for progress has been the development of specific sustainability practices that can be used in a variety of contexts and across a broad spectrum of quite ordinary, everyday decisions. Because sustainability requires a divergence from the path of business as usual, people want to know what those changes will be. The triple-bottom line of mutually reinforcing social, environmental, and economic goals is simply too abstract to provide guidelines for what one should do. Specific and previously demonstrated practices provide a reliable basis for departing from business as usual and enable interested businesses, governments, and individuals to move in a more-sustainable direction.

These refined and tested practices embrace a range of activities. They include certification and labeling programs, voluntary reporting and auditing standards, and specific sustainability practices.

Certification and Labeling Programs

Certification programs, which provide a set of sustainability-related standards, are typically run by nongovernmental organizations. If a particular entity—a business, for example—has met the appropriate standards or criteria, it is allowed to publicly display a sustainability certification. Labeling programs work in a similar way.

Over the past two decades, a great many third-party certification systems have developed for various economic sectors and activities. Three are highlighted in this chapter: green building (Leadership in Energy and Environmental Design, or LEED), sustainable forestry (Forest Stewardship Council and Sustainable Forestry Initiative), and the Energy Star labeling program run by EPA and the U.S. Department of Energy.

LEED

Perhaps the most visible nongovernmental certification program is the Leadership in Energy and Environmental Design process for green building, discussed in Chapter 4. Like many of the other building rating systems, LEED rates green building performance in six categories of building design, construction, and operation. LEED awards points for sustainable sites (such as where building projects preserve existing topography, retain existing vegetation, and reduce impervious surfaces), water efficiency (water collection and reuse, irrigation, and indoor water efficiency), energy and atmosphere (reduced energy consumption in buildings, such as by insulation and appliance efficiency), materials and resources (materials reuse and use of local materials), indoor environmental quality (reducing levels of volatile

organic compounds released from furniture and wall treatments), and innovation and design (such as the use of integrated photovoltaic technology).

Under LEED programs the "greenness" of a building is certified on a progressive scale, with the benchmarks of certified, silver, gold, and platinum. Due to the increasing popularity and rapid success of green-building rating systems, the green building industry now includes experienced builders and building officials equipped to manage development costs and anticipate misunderstandings about green building more efficiently. Experience also has produced more informed buyers of green building products.

Forest Certification

Two major certification programs exist for forestry in the United States: the Forest Stewardship Council (FSC), which operates around the world, and the American Forest and Paper Association's Sustainable Forestry Initiative (SFI). Each has certified millions of acres. Landowners obtain certification by meeting certain standards specified by one of these programs. The standards require protection of old growth, biodiversity, and water quality; specify sustainable harvest levels; require prompt reforestation; recognize the rights of indigenous peoples; minimize the use of chemicals; and allow clearcutting under certain circumstances. The two programs use somewhat different criteria. FSC emphasizes community relations, workers' rights, preservation of old growth, and traditional forestry concepts; SFI emphasizes organizational procedures and flexible performance guidelines.[1] In addition, SFI allows more use of tree plantations (areas where a single species is grown) than FSC and, unlike FSC, allows some use of genetically modified trees.[2]

Forested areas are not certified by FSC or SFI but by a third party, in order to ensure the independence and integrity of the process. By stimulating consumer demand, certification schemes persuade forest managers to adopt sustainable practices. In return, certified products receive a premium price. Although a consumer demanding more-sustainable products is the end customer, printers and homebuilders are influential intermediate customers. The Pinchot Institute for Conservation states that "independent, third party certification is one of the most significant developments in the field of forest management in the last two decades."[3] According to a 2010 status report on forest certification by Dovetail Partners, "the forest certification programs developed by the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI) have had a significant and positive impact on forest management in the United States" since 1990.[4]

In the aggregate, commitments from large buyers stimulate forest certification. Time Incorporated's 2007 commitment to use more paper certified by FSC coincided with certification on 11.4 million acres of forest.[5] The commitment of high profile paper buyers encourages forest product suppliers to certify their forests in the expectation that the demand for certified forest products will grow. To date,

however, no large homebuilder or lumber contractor has made a similar commitment to certified lumber sourcing.

In March 2011, 34 million acres of land in the United States were certified under the FSC program, and 56 million acres were certified under SFI.[6] Even though millions of acres are "dual certified," this still constitutes an important portion of the 651 million acres of forestland in the United States.[7]

While most of the certified land is in private hands, certification is also affecting state and federal forestlands. All of Washington State's forest trust lands are certified by SFI (2.1 million acres), and some are dual certified.[8] Minnesota has dual certification on 4.84 million acres of state-administered forestlands.[9] Three million acres of Wisconsin-owned land have dual certification.[10] In 2011, Michigan renewed both certifications on 3.9 million acres of state-owned forestland.[11] In Pennsylvania, 2.2 million acres of state forestland are certified by FSC.[12] Other states with recent significant state forest certifications under one or both major programs include Maryland,[13] New York,[14] Massachusetts,[15] and Ohio.[16] National forests administered by the U.S. Forest Service now meet many of the requirements of existing FSC and SFI certification standards. The Pinchot Institute for Conservation has concluded, however, that the "performance gaps" between the certification standards and national forest management would be difficult to close without changes in federal law and policy.[17]

The two major certification programs have also developed specialized certifications for particular areas. In 2004, the FSC created a separate certification for small, low-intensity forest operations with the aim of reducing certification costs and paperwork. The special certification program has proven successful in adapting to the needs of small-forest managers. In 2008, for example, 2.2 million acres of forest in Wisconsin, distributed among 41,000 parcels, earned FSC certification. A "group entity" actually holds the certificate and coordinates with individual landowners. In the Wisconsin example, and other similar programs, a state program acts as the group entity.[18] In other regions, nonprofit organizations and forest cooperatives act as the group entity.

Energy Star

Energy Star is a partnership between government and industry to promote energy efficiency. EPA created Energy Star in 1992 "as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions." In 2005, after more than a decade of existence as an administrative initiative, Congress formally authorized Energy Star.[19] Now administered jointly by EPA and the Department of Energy, Energy Star covers a variety of office and residential equipment as well as homes and commercial and industrial buildings.[20]

The widely recognized Energy Star label is placed on products that meet certain efficiency standards. Participation in Energy Star is voluntary, and products will not ordinarily be allowed to use the Energy Star Label unless they can deliver greater

energy savings than required by the energy efficiency standards established by Congress or the Department of Energy for those products. This typically requires appliances to be 10% to 25% more efficient than applicable minimum requirements.[21] Energy Star criteria also apply to appliances and equipment for which no standards have been set, including personal computers and computer monitors.

Energy Star has grown steadily in scope and effectiveness. In 2010 alone, adherence to Energy Star standards saved enough energy "to avoid greenhouse gas emissions equivalent to those from 33 million cars—all while saving nearly $18 billion on . . . utility bills."[22] Annual energy savings and reductions of greenhouse gas emissions are three times greater than they were in 2000.[23] Americans have purchased nearly 3.5 billion Energy Star-certified products since 2000, and almost 1.2 million homes have certification.[24] Energy Star also provides the basis for a substantial energy-efficiency rebate program. Funded through the American Recovery and Reinvestment Act of 2009,[25] the program provides $300 million worth of $50-to-$200 rebates to consumers who replace old appliances for new more-efficient household devices that have the Energy Star seal.[26]

Voluntary Reporting and Auditing Standards

The increase in corporate sustainability reporting described in Chapter 8 has been facilitated by the standardization of reporting and auditing. To be useful, these reports must be consistent and credible. For stakeholders the reports must cover a common group of core issues, although the reporting standards allow variation to cover topics of concern to a particular industry or geographic area.[27] While reporting standards have been an issue, a consensus is now emerging to use the Sustainability Reporting Guidelines issued by the Global Reporting Initiative (GRI) as the accepted standard for reporting. The project to develop the Global Reporting Initiative Guidelines originated with the Coalition for Environmentally Responsible Economies (CERES) and the Tellus Institute, which are American organizations, but the initiative is now a freestanding entity located in the Netherlands that also operates as a U.N. affiliate. In 2011, 80% of the largest companies, the G250 (the largest 250 countries in the world), applied the GRI guidelines to their reports, and 69% of the largest 100 firms in each of 34 countries studied did so as well; a separate calculation for the United States was not available.[28]

The GRI reporting guidelines are now in their third edition, and a fourth edition is planned for 2013. These guidelines are developed through an extensive process of consultation among a large group of stakeholders. The guidelines specify that all companies using them are to report on core environmental, economic, and social impacts but also allow for supplementary protocols for particular industry sectors as needed. In addition, GRI has indicated willingness to incorporate other reporting standards as needed for particular topics, as it has done with the reporting standards for climate change proposed by the World Resources Institute and the World Business Council for Sustainable Development. In sum, to be credible,

sustainability reporting today must either be done to GRI standards or convincingly explain why it is not.

A second credibility issue is whether the reports are consistently audited or otherwise checked to assure their accuracy. An Australian study concluded, unsurprisingly, that the companies with assurance review of their reports provided better environmental information.[29] There has also been substantial progress in developing auditing standards. Two sets of auditing standards for sustainability reports are now in place.[30] Auditing standards are different from reporting standards; they are instructions for auditors who are reviewing and evaluating a company's reporting.

How many companies undertake and report formal assurance either by auditing or some other means? Of the fourth-fifths of the Global 250 firms that report, 46% currently come with an assurance statement, as do 38% of the largest 100 companies in each country; these percentages reflect modest growth since 2005.[31] Major accounting firms do the bulk of this work (70% and 65% for the G250 and the largest 100 companies in each country, respectively) and in 2008, it was reported that most of the assurance is done in accord with auditing standards.[32] Reporting companies that do not use formal auditing practices typically substitute evaluations of other third-party commentators, including prominent nongovernmental organizations, as an alternative.[33] Taken together, formal assurance or third-party commentary is becoming an expected part of corporate sustainability reporting. As more and more companies issue assurance statements, their absence in the reports of others will be all the more glaring and impeaching.

Specific Sustainability Practices and Information Sharing Networks

There is a growing range of practices and programs that move a particular activity in a more-sustainable direction. These include, but are certainly not limited to, green infrastructure, green roofs, pollution prevention, and recycling. They generally have no certification program, although a builder may receive points for implementing some of these innovations in the course of seeking LEED certification. They do not embrace sustainability in the same broad sense as codes of conduct or sustainability programs. Rather, they are practices or sets of practices that can be employed to solve particular problems or as part of an overall project or program. For example, green infrastructure—permeable pavement, greater use of vegetated areas, and the like—has become more widely used by cities to cope with stormwater runoff.

Much of the information about best practices is distributed through networks that rely on conferences, newsletters, regular conference calls, and professional organizations to share information. The U.S. Green Building Council reports that its membership comprises 80 local chapters, 17,000 member companies and organizations, and more than 155,000 individuals certified with LEED professional credentials. Professional organizations for sustainability in education include the

Green Schools National Network and the American Association for Sustainability in Higher Education.

Attendance at the major conferences in the United States that focus on sustainability in higher education has increased steadily. Ball State University in Indiana has hosted the biannual Greening of the Campus conference since 1996; the number of attendees increased from an initial 150 in 1996 to 775 in 2009. Notably, the content of the conference has transitioned from a mix of the theoretical and inspirational to a more how-to focus.

Sustainability efforts are also growing in the practice of law. The American Bar Association, in partnership with EPA, has created the ABA-EPA Law Office Climate Challenge, a program to encourage law offices to conserve energy and resources, as well as reduce emissions of greenhouse gases and other pollutants.[34] The ABA Section on Environment, Energy, and Resources has also developed the Model Sustainability Policy and Implementation Guidelines for Law Organizations, in which a law organization commits to take steps over time toward sustainability.[35] Bar associations in Massachusetts,[36] California,[37] and Pennsylvania[38] have adopted lists of model sustainability practices. Oregon Lawyers for a Sustainable Future has published its own model sustainability policy for law offices, which is directed at reducing their environmental impact.[39]

The American Chemistry Council's Responsible Care Program encourages better environmental management, materials handling, and product stewardship of potentially harmful chemicals.[40] It has the potential to support and encourage environmental performance improvements by member companies, although the empirical results comparing the performance of program participants to the rest of the industry in 2000 were not encouraging.[41] The Council claims a 75% reduction in hazardous air pollutants since 1988, compared with an industrywide reduction of 38%, as well as recent reductions in sulphur dioxide emissions and water usage.[42]

Attractiveness of More-Sustainable Alternatives and Opportunities

Sustainable development increasingly provides new and more attractive opportunities that would not otherwise be available. A core premise of integrated decisionmaking—integrating environmental, economic, and social considerations into decisions—is that the resulting decisions are likely to produce more net benefits than would otherwise occur. Put differently, the environmental, social, and economic aspects of a decision are likely to be mutually reinforcing rather than contradictory or antagonistic. This premise is increasingly apparent to decisionmakers in a wide variety of contexts.

More-sustainable infrastructure, including mass transit systems, helps make many communities more attractive. Perhaps one of the oldest examples is the San Francisco cable cars, which not only reduce congestion and automobile emissions but also serve as a unique identifiable feature of San Francisco. (Other well-known

and highly used mass transit systems include the Chicago elevated train, the New York subway, and the Washington, D.C., Metrorail, to name but a few.) Portland, Oregon, and Seattle, Washington, are renowned for their bike paths, and Minneapolis was recently identified by *Bicycling* magazine as the most bike-friendly city in the country.[43] Boulder, Colorado, is known for its vast open spaces and parks. Chicago, the birthplace of the skyscraper, is becoming better known for its lush green roofs, urban forests, and parks.

As steps toward sustainability are taken in more places, awareness of the economic, environmental, health, quality-of-life, and other benefits of these efforts has spurred additional action. The market success of compact, walkable communities has encouraged localities and developers to pursue growth that promotes cleaner transportation choices. And ridership and development sparked by certain transportation projects has increased demand for these projects. Portland, Oregon's streetcar system, for example, was launched in 2001 and has spurred more than $3.5 billion of private investment along the line. Similarly, communities with significant wind and solar resources may be more aware of the opportunities to develop green industries; other local governments may rely on the corollary benefits of climate-change planning, such as lowering costs through gains in energy efficiency.

Brownfields redevelopment also provides a variety of benefits. Apart from cleaning up a property, or reusing it, brownfields redevelopment can create jobs. Most of these jobs are created in the predevelopment (cleanup or site preparation) stage, but a great many of them are created afterwards through the subsequent use of the property. According to the U.S. Conference of Mayors, between 1993 and 2010, 54 cities created nearly 97,150 permanent jobs at brownfields sites and another 64,730 jobs for the predevelopment and remediation of those sites.[44]

At brownfields sites, there are also many opportunities for sustainable reuse. Green technologies, for example, can reduce carbon emissions and produce other benefits.[45] Some sites, for example, have been transformed into urban greenways.[46] An intriguing new use of brownfields sites is "brightfields,"[47] locating renewable energy production equipment at urban sites.[48] In Brockton, Massachusetts, a 425-kilowatt solar array began operating in 2006 on the 3.7 acre site of a former gas works.

On sites where existing buildings are reused, employing green design and construction techniques in conjunction with overhauling the infrastructure may conserve energy and feature sustainable building materials and creative waste-reduction strategies.[49] Recognizing this, the new version of the popular LEED certification system for sustainable buildings awards points for building on a brownfields site and adds points for variables like building close to existing transportation systems.[50]

The drivers for change in building practices—human health, environmental quality, and economic needs—are not really disputed, and the growing number of green construction projects shows that green buildings perform better than their

conventional counterparts.[51] Studies report that green buildings often use 25% to 30% less energy than the national average.[52] Green building design and construction minimize the impacts of material needs and reduce construction and building waste. Green building practices result in reduced water consumption both indoors and outdoors, and contribute to improved water quality by incorporating storm-water control into building design.

Green building yields health and productivity benefits in both residential and nonresidential buildings. One report attributed green building with improving employee productivity at an estimated benefit of $6.4 billion in 2010.[53] Green building practices have also supported the notion that healthier spaces for education are also more productive spaces. A review of 30 green schools across the country, "based on a very substantial data set on productivity and test performance of healthier, more comfortable study and learning environments," concluded that "a 3-5% improvement in learning ability and test scores in green schools appears reasonable and conservative."[54]

Green building is also becoming more attractive because the upfront costs—real or imagined—of LEED certification are now much lower. One of the initial hurdles for green building was the perception that the costs of green building design and construction were prohibitively high.[55] Many of the increased building costs were found to be artificially inflated because green design principles were not incorporated early in the building concept.[56] In contrast to early estimates that green building methods would increase building costs as much as 25% over conventional building methods,[57] it has more recently been argued that LEED-certified buildings might increase upfront costs by only 2%.[58] The American Institute of Architects recently noted that "as the cost of green building continues to fall toward parity with traditional building practices, the old excuse of high cost begins to fall by the wayside."[59]

The economic benefits after the building is constructed are also considerable. For example, it is estimated that "an initial upfront investment of up to $100,000 to incorporate green building features into a $5 million project would result in a savings of a million dollars over the life of the building,"[60] and the upfront costs of green building investments are often recoverable within five years.[61] On a broader scale, the U.S. Department of Energy estimates that continued development, adoption, implementation, and compliance with green building standards will generate energy cost savings of more than $2.5 billion per year.[62] For the owners of a green building, the improvements also enhance property values.

Economic benefits have been a primary driver for other decisions as well. For a great many organizations—government at all levels, business and industry, colleges and universities, and even religious bodies—the opportunity to save money through reduced energy use has been an important driver for sustainability decisions. Between 1990 and 2009, IBM saved more than $370 million by reducing its energy use through efficiency and conservation.[63] According to Dow Chemical

Company, the $1 billion it has invested in energy efficiency between 1994 and 2010 has contributed to savings of $9.4 billion.[64]

Adoption of forest certification is motivated by the higher price of certified products. This market premium is most successful at encouraging sustainable practices where it can be captured primarily by the forest managers and directly enhances their bottom line.[65] The market premium available for certified paper is most accessible to northern forests, which are closest to pulp manufacturers. With less shipping cost and a more direct purchasing relationship, northern forest managers feel the benefit of certification.[66] Anecdotal evidence indicates that certified products are maintaining their market premium even in the economic downturn,[67] although weak demand and excess supply has weakened the market for paper and lumber.[68] Yet, in interviews with the Wisconsin Department of Natural Resources, paper and lumber industry executives felt that certified products buffered the impact of falling prices on their companies. Southern forests, by contrast, are already at a competitive disadvantage with higher shipping costs and lower-value wood products. Without efficient access to manufacturing, southern forest managers choose not to certify because the price premium does not translate into greater profits.[69]

At the state and local levels, the attractiveness of more-sustainable decisions includes not only economic returns but a variety of other factors. Many states believe, for example, that more-sustainable decisions will contribute to the preservation of a quality environment, the use of renewable or highly efficient energy resources, the maintenance of a healthy population, the presence of economic and social equity, and the maintenance of an engaged citizenry—all of which means that these states will have better futures. Many local sustainability efforts are being undertaken to address pressing environmental concerns, especially deterioration of air, water, or other resources necessary to the health or public life of the community.[70] Other local sustainability efforts address public health epidemics[71] as well as social and economic inequities,[72] or promote greater civic engagement in the process of monitoring the quality of life in local communities.[73]

Sustainability also provides a way for a decisionmaker to accomplish more than a single goal at one time. Because sustainable development means that one dollar of public expenditures will help achieve more than one purpose, it provides opportunities to improve the cost-effectiveness of government programs. The federal government's recent efforts under Executive Order 13514—which requires federal agencies to move toward sustainability by setting and achieving goals for reducing greenhouse gases, energy intensity, and potable water intensity—also provide opportunities that might not otherwise exist (especially cost savings through energy-use reduction) to enable federal agencies to spend their resources more efficiently and effectively. Much of the funding under recent federal legislation, including the American Recovery and Reinvestment Act, was premised on the view that energy efficiency and environmental protection can, if properly done, also provide opportunities for economic development and job creation.

Success stories—about economic development from the manufacture and use of wind turbines and solar collectors, growing demand for fuel-efficient cars, or the use of green infrastructure to comply with federal pollution-control requirements—all create interest in doing more of the same. Pennsylvania's mandatory recycling program is regarded as successful because it keeps 2 million tons of recyclable material out of landfills every year, supports thousands of businesses that employ more than 50,000 people, has saved more than a billion dollars in disposal costs, and has reduced greenhouse gas emissions.[74] Success stories are one of the most prominent features of sustainability because, by definition, they involve an improvement over business as usual. Success stories do not mean that an improvement in one place is necessarily replicable in another, but they provide abundant evidence that sustainability can and does lead to improvement.

Significantly, the voluntary nature of many of these practices makes them more attractive because it creates a context in which trial and error are more tolerable. LEED was initiated as a voluntary certification program that builders could market in private construction projects, not as a regulatory mandate.[75] In general, green building practices have been designed to overlay (rather than replace) the prescriptions of conventional building codes to add resource efficiency and environmental quality to existing safety requirements. The collaborative and voluntary nature of green building practices generally has avoided major litigation while encouraging private participation.

Growing Cost of, and Limits to, Business as Usual

There is growing evidence of the adverse effects of unsustainable development. These effects, based on national and global trends, include population growth, globalization, a growing gap between rich and poor, the loss of biodiversity, deterioration of ecosystems, and depletion of natural resources around the world. But the most obvious example is climate change, which is identified as a growing issue in many federal agency strategies as well as national defense and security strategies. Business-as-usual measures of success are also increasingly seen as inadequate. The movement to develop key indicators that would better measure national well-being (described in Chapter 5) was prompted by a recognition that GDP is not a complete measure of the nation's health and progress, and that we need a more well-rounded approach. This broader approach is likely to include the impacts of unsustainable development.

Business-as-usual approaches are becoming both more costly and more physically difficult. Rising, volatile gas prices and oil dependence are prompting more-sustainable transportation and land-use policies and also greater efforts for sustainable and reduced energy use in higher education. When gas prices spiked at more than $4 per gallon nationwide in 2008, the impact on the economy and on household budgets was pronounced. Purchases of more efficient vehicles, use

of alternatives to driving, and support for more-sustainable transportation policies all rose. Gas prices remain high as this book goes to press, as is awareness of the national security costs of dependence on unstable regimes for fossil fuel and potential limits to available oil supply. Because of growing global demand and the absence of sufficient global reserves that can be released to reduce price peaks, "[g]reat oil price swings are here to stay."[76] Higher and more volatile energy prices have made many operational sustainability efforts at colleges and universities more economical and have also sparked greater investments in education and research related to energy sustainability.

Climate change also makes business as usual less attractive. Higher temperatures as well as more severe and intense storms and droughts can pose serious risks to the availability of food and water, especially in developing countries, where the resulting social breakdown can lead to conflict. Similarly, the demand for fossil fuels from developing countries raises another set of security concerns, particularly the protection of supply lines, which can cause or contribute to war. Climate change is thus a major driver of corporate sustainability efforts. As Ira Feldman of Greentrack Strategies has explained:

> Understanding that "business as usual" is an untenable long-term strategy in the face of overwhelming scientific evidence, some businesses are responding to climate change by identifying the opportunities it presents, perhaps "one of the greatest investment, business and job creation opportunities of this generation . . . from carbon trading to renewable and cleaner energy generation and energy efficiency."[77]

A majority of states have recognized the need to reduce the use of fossil fuel and lower greenhouse gas emissions, whether based on concerns about climate change, energy security, or both. This is not to say that all states recognize that business as usual is becoming less attractive. A number of states with strong historical ties to fossil-fuel production, including Texas, Oklahoma, and Wyoming, have yet to enact climate action plans or take other significant steps to plan for greenhouse gas reductions.[78]

Coastal cities and states are recognizing the need to adapt to rising sea levels, warmer temperatures, and other changes. So is the National Park Service. Of the 150 glaciers that existed in Glacier National Park when it was created in 1850, only 26 remain, and these are likely to be gone by 2030.[79] (What will we call that park when it no longer has any glaciers?) Climate change adaptation is even considered serious enough to warrant inclusion in all federal agency strategies.

In the area of water use, improvements have resulted from a combination of scarcity and changes in water pricing that have created incentives for more efficiency. Some water scarcity is periodic (in the case of serious and protracted droughts), and some is due to more permanent shortages (in the case of metropolitan regions as varied as Atlanta and Las Vegas that are outgrowing their natural water supply). Growing urban areas face significant barriers in obtaining new water supplies, as well as legal barriers to new water projects. These legal barriers exist because of

the Endangered Species Act, the National Environmental Policy Act, and the Clean Water Act, all of which force consideration of alternatives. As a result, many cities have adopted significant water-efficiency requirements or incentives and invested in alternatives such as wastewater recycling and reuse. The U.S. Geological Survey suggests that "stricter water-quality standards for water discharges, mandated by the Clean Water Act, may have encouraged conservation, greater efficiency, and shifts to technologies that use less water."[80]

Recognition of specific problems with business as usual has prompted different decisions on other issues as well. Experience has shown that we cannot build our way out of congestion, since building or widening highways generates significant new traffic and often fails to provide long-term congestion relief. Moreover, the fiscal, physical, and environmental constraints on road building are becoming increasingly apparent. In Virginia, for example, it has been estimated that 418 lane miles would have to be built in the Washington, Hampton Roads, and Richmond urban areas each year just to maintain current congestion levels. The economic and social costs of traffic congestion and long commutes in rapidly growing areas have become so great that they have generated increased support for transportation alternatives and better links between transportation and land use. In Atlanta, for example, some major employers voiced a reluctance to locate or expand in the region due to severe congestion.

The costs of business as usual also prompted movement toward sustainability on lead poisoning. The phaseout of leaded gasoline and lead-based paint, the two principal sources of lead exposure, occurred in the United States and other countries in considerable measure because of product obsolescence and commercial decisions, facilitated and accelerated by regulatory and advocacy pressures. Similarly, much of the impetus for the international effort to prevent lead poisoning has been based on recognition of the costly problems that lead causes. Although the international effort was not based on mandatory action, the Rio Conference helped catalyze an international front against lead poisoning. Beginning with the 1993 session of the Commission on Sustainable Development—an oversight and review body created by the Rio Conference—the international community has recognized and reinforced the reduction and elimination of lead poisoning as a global priority.[81]

More and Better Tools

More-sustainable decisions are also easier to make because better tools exist to integrate social, economic, and environmental information, and to use that information in decisionmaking. Three key analytical tools are accounting for ecosystem services, industrial ecology, and environmental management systems.

Accounting for Ecosystem Services

Accounting for ecosystem services has emerged as the basis for many conservation and restoration efforts, including biodiversity conservation, watershed management, and water-quality protection. The premise for this accounting approach is that functioning ecosystems are essential to human well-being, and if ecosystems fail, we must build substitutes to ensure human survival.[82] Ecosystem services include air and water filtering, food production, and protection from severe weather events.[83] Ecosystem services also provide value by supporting particular cultural practices and cultural information.

Historically, many ecosystem services were not perceived as having financial value.[84] Not surprisingly, the Millennium Ecosystem Assessment reported that degradation of more than 60% of the ecosystems studied has outpaced their ability to recover.[85] Ecosystem services accounting seeks to capture the value of these previously ignored functions.[86] More specifically, as Gretchen Daily, director of the Center for Conservation Biology at Stanford University, explains, "the main aim in understanding and valuing natural capital and ecosystem services is to make better decisions, resulting in better actions relating to the use of land, water, and other elements of natural capital."[87] Initiatives are now underway to quantify the economic value of these services to humans and to use those values to protect and restore the environment. Many landowners, for instance, are now being paid for actions that recharge aquifers, store flood waters, or decrease the introduction of pollutants into waters, because those actions are now understood to have value. The market value of such agreements was $7 billion in 2007 and is expected to increase considerably in coming decades as demand for water increases and water becomes scarcer.[88]

Accounting for ecosystem services is now used in a variety of federal programs. The EPA has been integrating the valuation of ecosystem services into the assessment of natural resources damages under the Comprehensive Environmental Response, Compensation and Liability Act[89] and the Oil Pollution Act.[90] Ecosystem services have been targeted to assist in the implementation of a provision of the Food, Conservation, and Energy Act of 2008. That Act requires the government to encourage farmers, ranchowners, and landowners to use emerging markets for conservation activities by adopting guidelines "to measure the environmental services benefits" of those activities.[91] EPA's Ecosystem Services Research Program has focused on valuation techniques and capacity building for ecosystem services analysis,[92] and the Secretary of Agriculture has established the Office of Ecosystem Services and Markets to provide assistance in understanding the benefits of ecosystem services and to encourage the participation of farmers, ranchers, and forest landowners in ecosystem services markets.[93] The trend has pervaded state governments as well, as seen in the Oregon Legislature's announcement of a policy "to support the maintenance, enhancement, and restoration of ecosystem services

throughout Oregon, focusing on the protection of land, water, air, soil, and native flora and fauna."[94]

Industrial Ecology

Industrial ecology, a field that analyzes the flow of energy and materials through society, offers an alternative perspective to conventional economic analysis. It applies a systems approach to problem solving, which can assess how materials move through space and across time. The development of indicators for sustainability, and tools with which to quantify these metrics, has been one of the major steps toward enabling sustainable production of materials in the past 20 years.

Industrial ecology can evaluate the magnitude of environmental impacts that are often excluded from economic impact studies. The evolution of the subfield of materials flow analysis has highlighted the importance of "hidden flows"—the materials that are extracted or moved, but do not enter the economy, from activities such as mining. Often goods and services imported by one country cause such flows (or impacts) in the exporting country.[95] They are a measure, in other words, of the environmental impact of trade. The recently developed concept of "virtual water" provides another example of an impact not considered in standard economic studies. What makes water "virtual" is its use in production, but not in the final product. When Brazil ships soybeans to China, for example, the water use for growing occurs in Brazil. In that way, China meets part of its need for water, not by having the water exported to China, but rather by having water used in Brazil to produce food that is then shipped to China. Virtual water accounted for approximately 26% of the global water footprint between 1996 and 2005.[96] Virtual water helps us understand the "water footprint," not only of the production of soybeans and other products, but also of nations.

The largest contribution to industrial ecology has been the adoption of a life-cycle perspective to problem solving. In this approach, production systems are analyzed over the life span of a product (the so-called "cradle to grave" or "cradle to cradle" perspective) from raw material extraction, transformation, use, recycling, and disposal. After accounting for the flow of energy and materials of a production system, the environmental impact of that system can be assessed by identifying the emissions and pollutants resulting from the system.[97] These inputs and outputs (called the life-cycle inventory) to the end product are classified into different categories of environmental impact. Thus one can conduct a life cycle impact assessment (LCA) of a product; often these LCA categories of environmental impact include climate-change potential, acidification, eutrophication, resource depletion, ecotoxicity, and human health. The overall goal of life-cycle thinking is to promote efficient resource use and sustainable consumption practices.

"Industrial ecology thinking promises broadly to spur attention to opportunities for cost savings that would otherwise go unnoticed," according to Dan Esty, a Yale law professor who is now Commissioner of the Connecticut Department of

Energy and Environmental Protection, and Professor Michael Porter of Harvard Business School.[98] The information produced from an LCA can be used for product improvement and product comparison. An LCA can enable a manufacturer to improve a product or process by identifying an area with a heavy environmental burden. Often, these areas are targeted for improvements during, say, manufacture or supply-chain management, resulting in better energy efficiency or reduced waste. 3M has saved approximately $1.4 billion since 1974, when the company began focusing on pollution prevention in resource extraction and manufacturing. General Mills saves approximately $500,000 per year by using oat hulls for energy production in its biomass power plant rather than discarding the hulls to landfills.[99] This sort of recycling can involve multiple nearby facilities in a web of exchanges of byproducts, shared waste-management infrastructure, and similar environmental services in an industrial ecology practice known as industrial symbiosis.[100]

An LCA can also compare the environmental impact of different products, enabling a consumer to compare, for example, the environmental impacts from linoleum with those of ceramic/hardwood floors. The adoption of life-cycle thinking has permeated all sectors of the economy, both domestically and internationally, and has given rise to a host of consortiums dedicated to putting life cycle thinking into practice.[101]

Within the last decade, life-cycle analysis has also been incorporated into policymaking, particularly in the area of transportation fuels. In 2007, the state of California established the Low-Carbon Fuel Standard, a first-in-the-world greenhouse gas standard that mandates a "life-cycle carbon intensity" profile for all transportation fuels.[102] The law requires at least a 10% reduction in the greenhouse gas intensity of transportation fuels by 2020. Similar initiatives have been adopted by the European Union,[103] the United Kingdom,[104] and the Canadian province of British Columbia.[105] The Energy Independence and Security Act of 2007, which required that the amount of renewable liquid fuel used for transportation be increased from 9 billion gallons in 2008 to 36 billion gallons in 2022, also directed EPA to employ greenhouse gas performance standards based on life-cycle analysis to ensure that the new renewable fuels resulted in lower greenhouse gas emissions than the fossil fuels they were replacing.[106] Critics of renewable transportation fuels such as corn ethanol have argued that the net effect of these fuels, when land-use changes and other impacts are taken into account, is to increase greenhouse gas emissions rather than reduce them. In 2010, EPA finalized standards for a Low-Carbon Fuel Standard to ensure that the life-cycle greenhouse gas impacts of renewable fuels are significantly lower than those of fossil fuels.[107]

Green chemistry and green engineering are related to industrial ecology. These two fields, which have emerged in the last 20 years, are concerned with the discovery and development of materials and industrial processes that are "benign by design."[108] They focus on energy, water, and other resource inputs; worker and consumer health and safety; and waste generation through the entire product

life cycle. EPA is supporting the development of this emerging field though the Annual Presidential Green Chemistry Challenge Awards, established in 1998, and other efforts.

Environmental Management Systems

There has also been a growing use of management systems for sustainability. The International Standards Organization (ISO) has developed a series of standards that can be used to assist corporate sustainability efforts, including the ISO process for certifying a company's environmental management system,[109] which organizes and implements a company's environmental protection efforts. It includes internal policies and procedures designed and implemented to discover more of the company's total impact on the environment, and then to manage its operations as well as its decisions about products and processes to reduce these impacts and continuously improve environmental performance.

Companies can obtain certification of their environment management systems through ISO, and such certification has become increasingly popular.[110] To be certified, a facility must be checked and monitored to ensure that there really is a management system in place that meets the ISO standards and that the system is actually being implemented. Certification is typically done by third-party auditors who have themselves been approved by ISO, although a company may use its own employees if they have been trained and certified as auditors.

One limitation should be noted. These are management systems, not standards of environmental performance. As such, they articulate a commitment to internal processes and activities within the company, but they are not themselves a commitment to any specified level of environmental performance. Still, companies with environmental management systems generally have better environmental performance than other companies, and these systems offer some potential for moving a company toward sustainability.[111]

ISO has also developed a series of environmental standards, including guidelines for environmental auditing, environmental labeling (more commonly referred to as ecolabeling), product standards, and energy management. The standards do not mandate levels of pollution or performance; rather, they focus on evaluating the environmental or energy effects of particular products or activities, both within and outside manufacturing facilities.

Government agencies and businesses have also developed and deployed management systems to enable them to set sustainability goals, monitor progress toward those goals, and achieve them. The 2011 National Research Council report on sustainability at EPA, which recommended a management system that is based in many ways on those used in the private sector, provides an approach that other federal agencies could use to incorporate sustainability into their operations.[112]

These three tools—accounting for ecosystem services, industrial ecology, and environmental management systems—do not exhaust the range of new tools that have been developed. For example:

- The Natural Step (TNS), a nonprofit organization, has developed Toolkits for Sustainability to enable consumers to evaluate sustainable consumption at home, allow communities to plan for sustainable development, and encourage businesses to plan for sustainable wealth creation and sustainable production.[113]
- The United States played an active role in the development of the Strategic Approach to International Chemicals Management (SAICM), a global system for managing chemicals in commerce and designed specifically to address the lack of technical capacity in most countries for assessing and managing the hazards of chemicals. The SAICM provides a specific framework by which international efforts to manage chemicals can be strengthened.[114]
- EPA's Regional Vulnerability Assessment Program uses maps and online data to enable decisionmakers to gauge the extent to which specific actions will result in environmental improvements in specific places.[115]

Conclusion

Progress on sustainability has not occurred because there is now a better or more compelling definition of sustainability in general. Rather, it has come about in great measure because there are a growing number of specific programs, certification systems, checklists, and tools to enable businesses, individuals, and governments to move in a more-sustainable direction. These programs and tools provide decisionmakers with something focused and reliable that they can use with relative ease. At the same time, these more-sustainable programs and tools are increasingly attractive because the costs of business as usual are growing.

The availability of more attractive and sustainable alternatives reinforces, and is reinforced by, growing public support for more-sustainable practices. The existence of these alternatives provides something specific and attractive that can be supported, and growing support prompts the development and deployment of even more alternatives. As the economic and other costs of business as usual become clearer to more people, and as the ethical or religious implications of unsustainable development are better understood, it is likely that more and better alternatives will become available and be widely used.