CHAPTER 10

A Look Ahead: Eco-Quality for Environmental Sustainability

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About This Chapter

As we move forward into the twenty-first century, managing for quality is breaking new ground. Product developers need to design products and services that meet the newest concern from its customers—the need for sustainable and ecologically friendly products. As a society and as businesses, we need to not merely maintain the status quo but to break through self-imposed constraints and fundamentally shift to a new landscape—a new zone of quality—and to design processes and products for ecological quality from the start. This chapter focuses on what we believe is the next addition to the management of quality. We call it "eco-quality."

High Points of This Chapter

1. *Understanding Climate Change.* Increasing atmospheric carbon dioxide (CO_2) levels have been linked to climate change and a variety of environmental problems. Such phenomena as melting ice caps, freshwater shortages, and species extinctions are

implicated as examples of breaks in the "quality dikes" created by humans in the course of technological advancement.

2. *Societal responsibility.* Once-separate societies have begun to band together ideologically on environmental issues, taking visible, concerted action to shore up the quality dikes. In particular, legislation, agreements, treaties, and accords are being put into place to incentivize and set limits as to what is appropriate and inappropriate activity.
3. *Corporate responsibility.* Industries are beginning to invest in programs and initiatives to address—and reduce—the environmental impact associated with all life cycle stages of products and processes. Organizations have a responsibility to shareholders and the community to prepare for changes, including understanding their carbon profile and having a plan in place to reduce it. Five life cycle stages are identified as part of a cradle-to-grave assessment to arrive at a comprehensive carbon profile.
4. The concept of eco-quality and the methods to attain it are new and being tested. We focus on four tools being tested here.

Quality and Sustainability: An Introduction

Organizations large and small that have gained success in the past and want to thrive in the future are being challenged to find—and capitalize upon—opportunities to meet their own strategic goals while also meeting societal needs. More and more organizations are being encouraged to look at the entire landscape unfolding before them, from a perspective of a balanced array of outcomes characterized by the new "triple bottom line" of people, planet, and profits (Savitz and Weber 2006). As we go forward into the twenty-first century, organizations cannot focus only on profits and their bottom line; they also must take into consideration people and our planet. Quality Management has always taken people into consideration; now as we go forward a third dimension has been added that encompasses environmental sustainability and stewardship.

Quality and environmental sustainability are becoming increasingly interdependent. Organizations of all sizes are looking at ways to increase efficiencies and productivity without compromising the integrity of the environment. As a result, as we see it, there is a paradigm shift evolving within the quality management arena as quality and environmental sustainability are merging toward a partnership. This partnership makes perfect sense; the performance excellence we strive for in a business environment extends to the larger, natural environmental that provides the context in which businesses operate.

This partnership accelerated with the creation of the ISO (International Organization for Standardization) 14000 Environmental Management System, a companion system to ISO 9000 (Chapter 16). With increased environmental awareness, organizations are looking for innovative ways to reach their strategic goals while keeping within societal, environmental constraints. The worldwide issues of global warming and sustainability are on the minds of many millions of people throughout the world, and the widespread adoption of ISO 14000 reflects this. According to the most recent report at the time of printing this handbook, there were over 14,000 sites worldwide certified to ISO14000. Of these, the majority were in the following countries:

- Japan (2600)
- Germany (1600)

- UK (1200)
- Sweden (650)
- Taiwan (500)
- United States (590)
- Netherlands (475)
- Korea (460)
- Switzerland (400)
- France (360)

This partnership between quality management and environmental sustainability will bring positive change for both business and the environment.

A number of years ago Dr. Joseph Juran coined the phrase "life behind the quality dikes." (Juran 1969). These quality dikes, as explained by Dr. Juran, are a way of securing benefits while living dangerously. These benefits are the results of technological advances, and we are kept safe from harmful byproducts of technology by these quality dikes. Dr. Juran went on to say that there are minor breaks in these quality dikes—occasional failures of goods and services. As he stated, these failures are annoying as well as costly. More significant failures also can be cited, such as the Chernobyl and Bhopal disasters. These are extreme examples, but they pale in comparison with the potential impending tsunami of the effects of global warming.

If this approaching tsunami plays out as many believe it will, it will spring more than just a few leaks in the dikes, posing instead a much more significant threat to our environment. This situation has slowly been gaining momentum for several years with much discussion regarding the effects of greenhouse gases (GHG), in particular CO_2, on temperature and climate. Carbon dioxide, which is generated from various sources both man-made and natural, has physical and correlative properties that make it a prime suspect in global temperature fluctuations. Unlike the events at Chernobyl and Bhopal, which originated in point sources with effects confined to a general geographic area, global warming is, by definition, more far reaching—it is worldwide. Although technology-induced catastrophes such as Chernobyl and Bhopal are plainly different in many regards from the global warming issue, they have something very much in common in that technology and people have the capacity to create change, for better and for worse.

Global Warming

Global warming is one of those topics that tend to divide people into two separate schools of thought. On one hand, there are those who believe that global temperature fluctuations reflect normal, common-cause variation, or perhaps represent part of a natural environmental or physical cycle the earth is now experiencing, and has experienced in our distant past. The other school of thought contends that humans are causing the earth's temperature to increase as a result of our technologies, specifically through the increase GHG. These gases are emitted primarily through natural sources and human (technological) activities, and they contribute to the "greenhouse effect"; GHGs include water vapor, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and carbon dioxide. Significantly, the U.S. Environmental Protection Agency issued in early 2009 a proposed finding that GHGs contribute to air pollution that may endanger public health or welfare.

Of these major contributors, CO_2 is judged to have the most far reaching and consequential effects on our environment. Atmospheric CO_2 levels are at record highs, and links have been suggested with rising sea levels, water shortages around the world, depletion of fisheries, extinction of species, and numerous other phenomena. For example, polar ice caps have been melting, with the Arctic sea ice minimum dropping 7.5 percent per decade between 1979 and 2006 (NASA 2009). Large areas of the world's regions are expected to suffer a substantial decrease in fresh water by midcentury (U.N. Environment Programme 2009). Atlantic cod stocks have collapsed from a likely combination of overfishing, natural and human environmental impacts, including temperature shifts (Cascorbi and Stevens 2004) and recovery has been minimal. Estimates of species extinction over the next several decades have been placed at over 30 percent, potentially threatening over a million species (Thomas et al. 2004).

As developing economies step onto the global stage, they are expected to contribute to CO_2 emissions at alarming rates. China, considered to be the "world's factory," has about 1.35 billion people and is only 30 percent mobilized and working in factories. China surpassed the United States in carbon dioxide emissions in 2006 (Aufhammer and Carson 2008), and the country's share of global emissions is projected to rise from 18 percent in 2005 to 33 percent in 2030 (Garnaut 2008, Table 3.2). To understand in more detail from where CO_2 is originating, see the pie charts depicting worldwide CO_2 emissions by region and sector (Figure 10.1a, b), and by sector within the United States (Figure 10.2).

Whether the earth is simply experiencing another environmental cycle or humans directly are contributing to an increase in the earth's temperature perhaps is a moot point. If there is something society can be doing to mitigate potentially damaging effects to the environment, then we as citizens of this planet have a responsibility to our children and future generations to take action to preserve and to sustain our environment.

Although formal steps are being taken, many believe that international cooperation is not keeping pace with the world's ever-growing interdependence and threats to the environment.

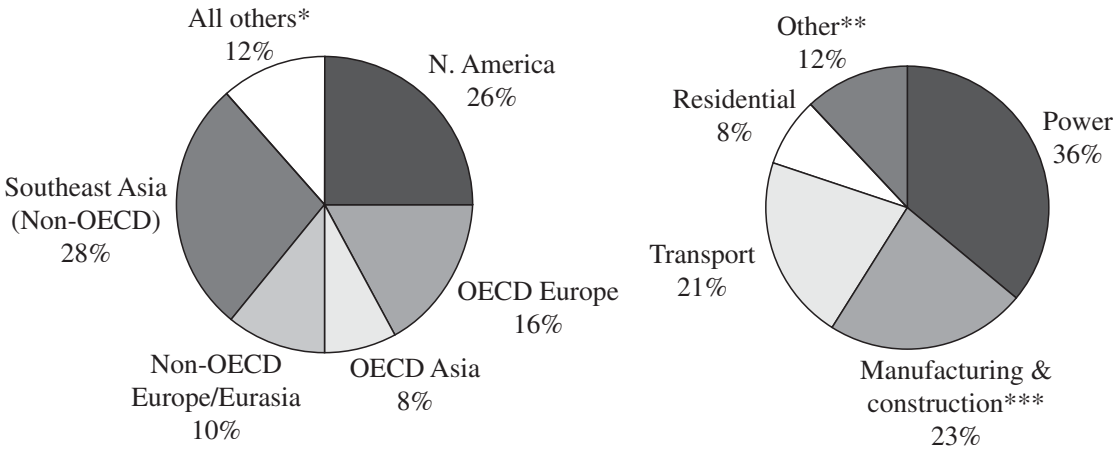

Figure 10.1 Worldwide CO_2 emissions by (a) region and (b) sector. *All others include Africa, the Middle East, and Central and South America. OECD: Organization for Economic Co-Operation and Development. **Other includes commercial and public services. ***Manufacturing and Construction includes other energy industries (e.g., oil refineries, coal mining, oil and gas extraction, and other energy-producing industries. [*Intergovernmental panel on climate change (IPCC, 2005).*]

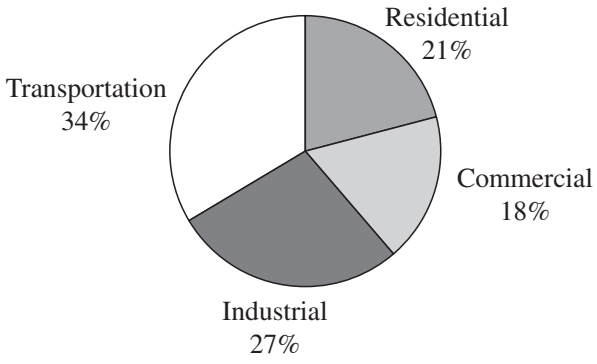

Figure 10.2 Energy-related carbon dioxide emissions by end-use sector, 2007. (*Energy Information Association, 2008.*)

We have not inherited the Earth from our fathers. We are borrowing it from our children.

—Native American saying

Societal Responsibility

Social interactions among people in their everyday lives have expanded through technological advances and the capacity to impact others across distances. Historically, "society," in the sense of the general public, was defined functionally by the physical constraints of distance. An extended family was the only "society" of concern to an individual in prehistoric days, with subsequent expansion to tribes, villages, cities, cultures, and civilizations. To be sure, society in the sense of humanity always existed, but it had little practical impact to an individual that neither intermingled with nor directly depended on others that lived more than the next valley away. Societies were small, and so were perceived responsibilities.

Two factors—technology and the sheer number of people—have worked together to facilitate the mingling and the interdependence of people. Technologies as simple as the wheel and as complex as the Internet allow people and ideas to move vast distances with relative ease. Populations once limited to local impact now are sufficiently large to affect many others; fishing in international waters is one example; shipping heavy metal-laden electronic components to other continents for recycling is another.

Once-separate societies have begun to band together ideologically on environmental issues. Although no universal consensus exists on many aspects of the environmental impact of various human activities, governments, grass-roots organizations, and other assemblages are more vocally conversing and taking visible, concerted action to shore up the quality dikes Dr. Juran so astutely saw decades ago. These efforts appear certain to result in widespread sea changes in legislation controlling aspects of quality we have long taken for granted. Legislation is necessary, perhaps, to achieve emerging societal goals, but is control alone sufficient?

Consider what legislation, agreements, treaties, and accords are intended to do. Although they may incentivize, they act as constraints by setting out limits as to appropriate and inappropriate activity. This is the essence of control—to maintain performance within certain boundaries. Through continuous, incremental innovation and the elimination of sporadic,

special causes of poor performance against environmental standards, the dikes gradually will be strengthened.

What else can be done? A good control plan eventually makes itself unnecessary. Once all the leaks have been plugged and the walls of the dikes strengthened, the dikes themselves become the limitation to quality improvement. In the same fashion, we need to think beyond mere control, to instead break through the self-imposed constraints and fundamentally shift to a new landscape—a new zone of quality—and to design processes and products for ecological quality from the start. This is eco-quality.

Corporate Responsibility

What is the role of corporations in this context of ecoquality? The global marketplace increasingly is focused on the environment, and customer needs now include social responsibility. As a part of this, organizations are beginning to invest in programs and initiatives to address—and reduce—the environmental impact associated with all life cycle stages of their products and processes. For example, U.S. Fortune 500 corporations and their global counterparts are beginning to recognize the importance of understanding and improving the environmental impact of internal technologies and business practices. With the belief that corporate sustainability (including environmental dimensions) creates long-term shareholder value, Dow Jones established the Sustainability Indexes in 1999, providing the first tracking of financial performance of leading sustainability-driven organizations worldwide.

Another international program is the Carbon Disclosure Project (CDP). The CDP is a nonprofit organization with the mission to provide information to investors and stakeholders regarding the opportunities and risks to commercial operations presented by climate change. The CDP is a special project of the Rockefeller Philanthropy Advisors, an organization formed to help donors create thoughtful, effective philanthropy throughout the world having U.S. IRS 501(c)(3) charitable status, with the sole purpose of providing a coordinating secretariat for the participating investors. The CDP seeks to create long-lasting relationships between shareholders and corporations regarding the implications for shareholder value and commercial operations presented by climate change. The primary goal of the CDP is to facilitate a dialogue, supported by quality information, from which a rational response to climate change will emerge.

CDP Risks and Opportunities

A major objective of the CDP is to identify strategic risks and opportunities and their implications for businesses. The following is an example of risk-related questions from a questionnaire sent from the CDP to their clients (Carbon Disclosure Project 2008).

- Regulatory—What is your company's exposure to regulatory risks related to climate change?
- Physical—What is your company's exposure to physical risks from climate change?
- General—What is your company's exposure to risks in general as a result of climate change?
- Management—Has your company taken or planned action to manage the general and regulatory risks and/or adapt to the physical risks identified?
- Financial and business implications—How do you assess the current and/or future financial effects of the risks identified and how those risks might affect your business?

These questions reflect a concerted effort by industry to capture the risks and associated opportunities that present themselves via climate change, or global warming, as we have come to know it. As governments move toward stricter regulations of CO_2 levels, they will be demanding evidence that organizations have sustainable practices in place. Additionally, carbon quotas, caps, and similar legislation are in various stages of planning and implementation worldwide. Organizations have shareholder and community responsibility to prepare for upcoming changes, including understanding their carbon profile and having a plan in place to reduce it if at all possible.

Many global organizations have been proactive for a number of years promoting the design of new products for sustainability; two are highlighted below.

Spain's Telefónica Environmental Footprint

Corporate responsibility is exemplified in the Spanish company, Telefónica. In 2008, Telefónica implemented an Operational Control Standard across the entire Telefónica Group, with the objective of introducing best practices of environmental management to its fixed and mobile telephony operations, thereby minimizing Telefónica's environmental footprint.

As a leader in global telecom, Telefónica strives continuously to minimize the impact of its activities on the environment. It has an Environmental Management System and an Operational Control Standard that reflects best practice in the environmental management field. They developed the Standard by identifying the environmental concerns surrounding the activities and processes involved in rolling out our networks and then framing good environmental management practices specifically for each network. They felt that impact control would help minimize the company's footprint as and when the Standard is put into practice in the countries where they do business. The environmental concerns identified in Telefónica's operations are

- Energy use
- Waste (particularly electrical and electronic equipment and batteries)
- Radio wave emissions
- Environmental and visual impact
- Noise

Another globally recognized organization is Volvo**.** The Volvo Environment Prize is awarded for "Outstanding innovations or scientific discoveries which in broad terms fall within the environmental field." The Volvo Environment Prize is awarded by an independent foundation, which was instituted in 1988. Laureates represent all fields of environmental and sustainability studies and initiatives.

Product and Process Life Cycle Analysis

Earlier we introduced the concept of product or process life cycle stages. Here, we will develop this concept more fully. The life cycle is important because it is necessary to analyze all aspects of products and supporting processes from the cradle to the grave to arrive at a comprehensive carbon profile. This can only be achieved through a collaborative effort between commercial operations and supply and distribution chains. After a baseline carbon profile is established, the objective is to institute best practices that support the environmental sustainability of products and processes that support the end products. Although this is straightforward in theory, currently there is no single centralized or standardized set of data

for the life cycle activities and processes to be included in quantifying product or process CO_2 emissions.

However, we can start by identifying five major phases of the life cycle of a product with its supporting processes that could be evaluated and analyzed. We can determine the probable range of CO_2 emissions generated by these various stages throughout the life cycle of the product and its supporting processes. The five basic life cycle stages of a typical commercial operation are as follows:

1. Product/process design (identification of supply-chain members)
2. Manufacturing process
3. Production operations
4. Supply-chain system
5. Final disposal (end of life)

Understandably, the initial focus of an organization in establishing its carbon profile is primarily focused on manufacturing and production and supply-chain activities that are under the most direct control. With maturity, however, design and end-of-life contributions should be considered more fully and addressed. Ultimately, the creation and development of an environmental sustainability process will benefit an organization's customers, shareholders, and society at large.

In support of meeting the responsibility corporations have to shareholders and society in terms of environmental sustainability, we recommend the following activities:

- Develop a data set for the life-cycle activities and processes to be included in estimating CO_2 emissions.
- Encourage active collaboration to foster industry partnerships to further expand the environmental sustainability of products and deliver continuous improvement.
- Continue to evaluate and analyze CO_2 emissions and other environmental metrics of commercial operations to ensure that we are not just shifting the environmental burden.
- Educate manufacturers and consumers from all industries regarding the relative environmental impacts of their products and supporting processes.

Origins of Quality and the Environment

As we move further into the twenty-first century, the quality movement is breaking new ground. As stated previously, we need to think beyond merely controlling hazards (building and maintaining quality dikes), to instead break through constraints and fundamentally improve the environmental dimension of existing processes and products. Additionally, we need to acknowledge the new customer need of social responsibility, and design future processes and products for ecological quality from the start. Eco-Quality embodies these concepts.

Quality and its relationship to the environment is not new. In 1969, Dr. Juran stated his concerns about the effect of poor quality, and the technology that developed it, on the environment. Technology in this context was the means by which organizations met customer needs and how people interact with the physical, chemical, and biological world. As society makes technological advances, there must be means of controlling them so that the advances provide benefit rather than harm. In his analogy of quality dikes (Chapter 2, Quality's Impact on Society and the National Culture), Dr. Juran viewed quality as protecting mankind from the surging water of technological advances. On occasion there are leaks in the dike, and we must repair them before they go further out of control.

In stating his concerns about the environment and how it relates to quality management, Dr. Juran was well ahead of his time, nearly 30 years ago. Dr. Juran's concern for natural resources and the sustainability of the environment was based on a sincere desire to bring a better quality of life to not just his children and grandchildren but all of humanity. Dr. Juran intuitively made the connection between quality and environmental sustainability but did not give it a name. In recognition of his contribution, the Juran Institute refers to this as Eco-Quality.

Eco-Quality Defined

Eco-Quality is not a replacement for designing a product and service that must be "fit for purpose." It is an extension on what fit for purpose will mean in the future. We believe that customers, of their own volition and through pressure from society and lobbyists, will create a new landscape for *Quality and Performance Excellence*, a new zone of quality that incorporates the dimension of *Environmental Sustainability* in partnership with the *Management of Quality*. We now have the knowledge and experience to combine quality design, control and improvement tools with best practices for environmental sustainability. Eco-Quality is intended to enable clients across industries to respond to demands from customers, regulatory agencies and shareholders for accountability in producing products and services fit for ecological use, focusing on understanding carbon profiles and reducing them to appropriate levels.

Eco-Quality and Performance Excellence

An effective performance excellence program in the future will include fulfillment of customer Eco-Quality needs. This is in alignment with the Juran Trilogy, encompassing the distinct processes of quality design, quality control, and quality improvement. Starting with a complete needs assessment of a client's products and supporting processes, a best fit methodology per the Trilogy is determined. The program core is quality improvement of processes, accomplished via a detailed accounting of carbon emissions and sources. The outcome is a baseline carbon footprint, with corresponding recommendations to improve process efficiency, eliminate waste associated with CO_2, and control emissions over the long term through continuous improvement methods. The triple bottom line of people, planet, and profits goes from red to green by listening to the mounting voice of the customer, reducing negative impact to the environment, and providing a return on investment through improved efficiencies and cost reduction.

Methods and Tools for Eco-Quality

A number of methods and tools are being used to move toward eco-friendly, eco-quality products.

ISO 14000 Environmental Management System

The ISO 14000 standard requires that organizations establish an *environmental management* system (Chapter 16, Using International Standards to Ensure Organization Compliance). It is applicable to any business, regardless of size, location, or industry. The purpose of the standard is to reduce a business' environmental footprint and to decrease pollution and waste that a business produces. The most recent version of ISO 14001 was released in 2004 by the *International Organization for Standardization* (ISO).

The ISO 14000 environmental management standards exist to help organizations minimize how their operations negatively affect the environment. In structure it is similar to *ISO 9000 quality management* and both can be implemented side by side. In order for an organization to be awarded an ISO 14001 certificate, they must be externally audited by an audit body that has been accredited by an accreditation body.

An effective Environmental Management System meeting the requirements of ISO 14001:2004 is a management tool enabling an organization of any size or type to do the following:

- Identify and control the environmental impact of its activities, products, or services.
- Improve its environmental performance continually.
- Implement a systematic approach to setting environmental objectives and targets, to achieving these, and to demonstrating that they have been accomplished.

Life Cycle Assessments

This is a "cradle-to-grave" analysis of the environmental impacts of a product or service caused or necessitated by its existence, from birth to death. Not limited to greenhouse gases (see carbon footprint, below), it encompasses many forms of damage such as ozone depletion, desertification, and resource depletion. The objective of a life cycle analysis is to encourage informed and appropriate choices by providing fair comparison of products and services in terms of negative environmental impact.

The ISO 14000 environmental management standards define four phases of a life cycle assessment:

1. Goal and scope—description of the objectives, functional unit, system boundaries, method of assessment, and impact categories included in the assessment
2. Life cycle inventory—detailed listing of inputs and outputs (e.g., materials, energy, water, chemicals, emissions, radiation) in terms of elementary flow to and from processes and the environment; relies heavily on software for data collection and modeling
3. Life cycle impact assessment—characterization of potential impacts, normalization to a common unit of measure, and weighting of impact categories
4. Interpretation—sensitivity and overall analysis and conclusions regarding major contributing factors; assessment relative to the goal and scope

Life cycle assessments can be used as a comparative tool, for example, to compare plastic versus glass versus aluminum beverage containers for environmental impact, with the results used for marketing purposes, or new product design. A recent study reports life cycle assessments being used predominantly to support business strategy (18 percent) and R&D (18 percent) as inputs to product or process design (15 percent), for educational purposes (13 percent), and for labeling or product declarations (11 percent) (Cooper and Fava 2006).

Carbon Footprinting

A carbon footprint (or profile) is the combined total of all greenhouse gas emissions caused directly and indirectly by an individual, event, organization, or product (The Carbon Trust 2009). This is frequently reported as being "CO_2 equivalent" with carbon dioxide used as a convenient, common currency; a carbon footprint therefore need not be strictly confined to CO_2 alone. This is an expansive definition and includes many sources over which an individual or organization has varying degrees of control. From a practical perspective, it is useful to classify the CO_2 equivalents according to the degree of control. Common categories are

- Emissions from activities, products, and services under direct control
- Emissions from activities, products, and services under indirect control
- Emissions from electricity usage

Understanding an organization's carbon footprint is important for two reasons, already alluded to. First, customers, suppliers, shareholders, government agencies, and other third parties increasingly request this information from businesses. For example, organizations engaged in carbon neutrality "cap and trade" or those developing green marketing messages will need comprehensive, accurate, and verifiable reporting of GHG emissions, especially as this may become part of the public record. Second, from the adage "you cannot manage what you do not measure," measuring a carbon footprint is a necessary step toward reducing and controlling it, ultimately achieving gains in the triple bottom line.

Energy Audits

An energy audit is an inspection and analysis of the energy flow through a building, process, or system, one that is carried out to improve energy efficiency and reduce overall consumption. Although energy audits are not new (efficiency has long been an issue in corporate accounting offices), the "pollution" factor is gaining in prominence as an impetus. Because a large proportion of energy typically comes from carbon-based fossil fuels, carbon dioxide is a natural by-product of energy use, and energy use therefore is a major contributor to a carbon footprint.

An energy audit consists of the following types of information:

- Building information—type of building (e.g., office, school), prior modifications, current conservation measures, occupancy profile
- Building characteristics—gross floor space, ceiling height, exterior wall area, number and placement of doors, insulation type and thickness, glass area, heating and cooling methods
- Electricity usage—metering method, demand patterns (including peak, average, and minimum), energy cost, service cost
- Nonelectricity energy usage—other sources such as natural gas, liquefied petroleum, kerosene, coal, wood, steam
- HVAC system—heating, ventilation, and air conditioning units, sensors and controls; air flow and pressure
- Hot water—energy source, temperature at origin and point of use, distance from heater to point of use, insulation, recirculation
- Lighting—area, lighting type (incandescent, fluorescent, mercury vapor, high-pressure sodium, metal halide), wattage, output, operating hours, controls

Based on the audit results, opportunities are identified to eliminate energy waste, and reduce CO_2 emissions and operating costs. Many governments now sponsor programs to encourage "green building" and provide information to assist in energy audits, e.g., as part of the EPA's Energy Star program.

The End Game

Just as no single factor is implicated in climate change, no single player is driving the ball on social change; it is a collective effort. As organizations forge ahead and put together plans to meet the needs their customers, it is easy to dismiss the once-solitary voices calling for change. This would be a mistake. Compelling expectations originate from multiple sources and perspectives:

- Customers—sensitive to the environmental impact of products and services they purchase

- Shareholders—demanding accountability, transparency, and favorable return on investment
- Legislators—pursuing legal incentives and constraints
- Scientific community—seeking evidence-based action
- Suppliers and distributors—looking forward and back to manage their "cradle-to-grave" chain

Ignoring these factors will not make them go away; instead, a real possibility exists that organizations failing to heed these influences will sooner go away. We are all faced with this environmental challenge in one way or another.

The future belongs to those who are planning for it today.

—African proverb

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