5 Environmental and Corporate Challenges

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Learning Objectives

After reading this chapter, you should be able to:

1. Describe global warming, suspected causes of global warming, and the environmental challenges of air and water pollution and ozone depletion.
2. Compare and contrast environmental management systems and the ISO 14001 standards and describe how both foster organizational efficiency, reduce waste, and reduce environmental impact.
3. Explain how processes such as cradle-to-cradle design, biomimicry, and net zero construction provide tools to innovate, mitigate risk, gain organizational efficiency, reduce waste, and reduce environmental impact.

Pretest Questions

1. The major energy companies such as ExxonMobil and Shell claim that global warming is not a concern. T/F
2. An environmental management system is part of every company's strategic plan. T/F
3. Cradle-to-cradle is a process mapping tool that helps identify waste. T/F

Answers can be found at the end of the chapter.

Introduction

In 2006, environmentalist and author Bill McKibben published a book titled *The End of Nature*, which received significant attention from management scholars. McKibben does not argue that the end of nature equals the end of the world; rather, he argues that the ecosystem may be experiencing the end of the "self-healing" period. McKibben argues that as humans have developed products like the pesticide DDT—which killed 40% of the birds in the United States—their footprint has been so large and so ominous that the only way for the natural world to persist is for humans to manage it. He says people can no longer wait for nature to heal itself; nor can we ignore the significant environmental problems we collectively face. McKibben's book was another urgent warning about the impact humans have on the ecosystem and the precarious future we face if we do not change.

This chapter clarifies that no employee, corporation, citizen, or government stands outside of nature, the ecosystem, and the environment. It argues that the impact of human activity on water, air, the protective ozone layer, and global warming are not reversible. It then examines new conceptualizations that allow corporations to see the environmental impact of their operations, and work to mitigate damage. It introduces new conceptual tools such as environmental management systems (EMSs), ISO 14001, cradle-to-cradle, and the ideal of net zero construction as ways corporations can turn the tide of environmental degradation. Essentially, it discusses the need for humans to manage the earth's ecosystems, with the corporation playing a significant role.

This chapter fits neatly with Chapter 6, which discusses the emerging efforts of governments and other advocacy groups to regulate and reduce environmental impact. In this discussion we begin to see that government and self-regulation can have a positive impact on the environment—a key goal of social responsibility.

5.1 Environmental Issues

This chapter uses the term *environment* to refer to the natural ecosystems that include air, water, land, and the life forms in, on, around, and dependent on them. One problem with environmental issues is that they manifest themselves on varying scales for different living organisms. For example, suppose Jim fails to maintain his car's engine. It will become less

efficient, use more gas, emit more pollution, and cost more to run each month. Perhaps the global impact from Jim's car is negligible. However, if Jim's car is one of 100,000 cars in the community that have similar problems, then air pollution in his area might worsen. Over time, residents' health might be affected, and there may be impacts on wildlife, water quality, and tourism. Less efficient engines mean more fuel will be consumed, which in turn means that fewer fossil fuels are available in aggregate. More pollution impacts the neighborhood's plant growth. If these behaviors are practiced by communities around the world, the ozone layer will be depleted and there will be an increase in global temperatures due to the greenhouse effect. Thus, one individual's behavior, negligible on a personal level, has a potential cumulative effect when multiplied by the rest of the planet's population.

The same issues apply to corporations, which have both the disadvantage and advantage of size. The disadvantage relates to how negative corporate actions are more likely to have a larger, more measurable, and more significant impact on the environment. On the other hand, responsible corporate behavior can also make a significant difference in the community and the larger ecosystem. This section covers the primary environmental issues, which include global warming, climate change, water pollution, and air pollution.

Global Warming and Climate Change

One view of environmental health suggests that the world's climate is changing, and even major oil companies agree that carbon dioxide emission is the primary cause. The Royal Dutch Shell (2016) website says: "Our lives depend on energy wherever we live. But in order to prosper while tackling climate change, society needs to provide much more energy for a growing global population while finding ways to emit much less CO2 [carbon dioxide]" (para. 1).

Carbon dioxide released by burning fossil fuels is one of the major likely causes of the buildup of gases that caused the **greenhouse effect** and led to global warming. The greenhouse effect occurs when carbon dioxide and other gases trap the earth's heat and keep it from dissipating.

While politicians and others argue about the *cause* of the change, there is less debate that the planet *is* heating up—a phenomenon known as **global warming**. Global warming refers to the fact that the earth has warmed between 0.6 and 0.9°C over the last century, or about 1.8°F. The Intergovernmental Panel on Climate Change claims the increase is most likely due to human-generated greenhouse gases (Intergovernmental Panel on Climate Change, 2016).

One of the deadliest types of pollution, and the other major source of greenhouse gases contributing to global warming, is *black carbon*. Black carbon is partially combusted black smoke created by diesel engine and wildfires, and it is full of particulate matter (pollution). The majority of people in developing nations create black carbon because they, for a variety of reasons, rely on inefficient fuel sources to heat their living spaces and cook their food (Dons et al., 2011). For example, in China the vast majority of low-income workers use large charcoal bricks to provide heat and as a cooking source. In much of India and Africa, people burn charcoal or use dangerous kerosene stoves. As a result, many of the cities in these places are too smoggy to see the sky (in fact, some athletes refused to participate in the 2008 Beijing Olympics due to pollution concerns). The smoke, and the effect of the smoke on health, is overwhelmingly negative for humans and the planet (Dons et al., 2011).

Another possible cause of global warming comes from deforestation. Half of all the original forests on earth have been cut, burned, and turned into farmland (Malhi et al., 2008). Burning forests releases carbon into the atmosphere in the form of smoke. It also eliminates the forest as one of the atmosphere's natural air filters. Deforestation efforts have multiple short-term economic benefits that can be difficult for developing nations to resist. Trees are cut to burn as fuel (sometimes to make the charcoal that creates black carbon) or lumber. But instead of adopting a reforestation program, land is cleared as pasture for livestock or for plantations and farms. Cutting trees without growing them back causes erosion, a loss of biodiversity, and increased atmospheric carbon dioxide (Angelsen & Kaimowitz, 1999; Malhi et al., 2008).

Sometimes deforested areas are cleared to raise cattle and produce beef. This is another probable source of increased atmospheric carbon dioxide and global warming. Methane, which is a by-product of digestion from animals such as cows, is a significant greenhouse gas. The average cow produces from 100 to 250 pounds (70 to 120 kg) of methane gas every year. According to the Food and Agriculture Organization of the United Nations, methane produced by cows contributes to almost 18% of all greenhouse gases (Time for Change, n.d.).

With these and other sources of carbon continuing unchecked in parts of the world, some predict the earth will warm by as much as 6.4°C, or 11.5°F, by the year 2100. The World Bank (2016) says developing nations will be hardest hit because populations in those countries have less resiliency to cope with the multitude of changes that such an increase will herald.

Some political organizations that oppose environmental regulations concede that the climate is changing, but they argue it is not necessarily because of human activity. Despite this, U.S. government agencies, governments of many coastal cities, the United Nations, the World Bank, and the vast majority of scientists, including those from energy companies, believe that the major cause of climate change is human activity. This relates to CSR because more executives now consider climate change to be a corporate risk and use CSR budgets and initiatives to measure and address climate-related activities. Some climate-related risks relate to pollution, waste, and water supplies and use.

Water Pollution and the Scarcity of Clean Water

In the late 1990s, just prior to the terrorist attacks of September, 11, 2001, the National Security Study Group made two dire predictions. The first was that the United States was vulnerable to a large-scale terrorist attack. The second prediction, which went largely unnoticed, stated that future geopolitical conflicts would not be fought over land, riches, or oil, but rather fresh water supplies and rights (U.S. Commission on National Security, 1999).

While water covers the vast majority of the world, fresh water that can be used for drinking and to irrigate crops is becoming increasingly scarce. Only about 1.5% of the water on earth is fresh, and much of that is locked in icy glaciers in the North and South Poles (U.S. Environmental Protection Agency [EPA], 2016d). In other regions of the world, fresh drinkable (potable) water is becoming increasingly difficult to find because of both organic and chemical pollution. It is estimated that over 500 people die every day in India from water pollution–related illnesses (United Nations Children's Emergency Fund, 2013). China reports that 90% of the water in its cities is polluted, leaving half a billion Chinese with no access to safe drinking water ("China Announces," 2015). However, the problem of safe drinking water and

polluted water supplies is not limited to just developing countries. In the United States about 45% of all streams and lakes are polluted. Consider the 2016 crisis in the city of Flint, Michigan, where numerous citizens became sick due to the local municipality's failure to ensure safe drinking water supplies for the city (CNN Library, 2016).

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Pollution is compromising clean water sources throughout the world.

The Organisation for Economic Co-operation and Development (OECD) predicts that by 2030, 780 million people will lack access to safe drinking water (OECD, 2012). Such numbers represent almost half of the world's population. The same report says that corporations and factories now use three times more water than they did 50 years ago. Certainly, human and economic development remain curtailed when clean water is scarce or unavailable, as mortality rates, illness, and disease (as well as malnutrition and death) result. Also, many industrial processes and agricultural activities rely on water for viability; less water means less viable crops and a more fragile food supply.

Pollution affects more than just municipal and freshwater sources; oceans are also affected by pollution. The UN estimates that 87% of all marine fisheries in the world are overfished. The Nature Conservancy estimates that at the current rate, 70% of all coral reefs in the world will be gone in the next 50 years. The effect of global warming is also being felt in the delicate ocean ecosystem. Seawater is absorbing carbon dioxide, which then becomes acid, and acid-sensitive species are dying out (Food and Agriculture Organization, 2012). It is not just the water's pollution that causes concern. As polar ice caps melt, there is an increase in sea levels, too. Oceans are rising, making life difficult in coastal areas such as New Orleans and the Netherlands, where people live at or below the current sea level. Rising oceans also threaten entire countries, such as the island nation of Kiribati (McGrath, 2015).

Water pollution poses threats to individual countries and communities, but it also threatens global safety, health, and business (some businesses use water as an input, such as beverage industries, while others use water to clean facilities or cool equipment, such as electronic component manufacturers). Thus, water pollution and continued access to clean water and sanitation are CSR issues that overlap with strategy and public health. Whether firms are motivated to focus on water use and pollution out of concerns for safety, CSR, community engagement, or sustainability (or another reason), the topic overlaps with CSR and sustainability at many levels.

Air Pollution

Like other sources of pollution, air pollution stems from both natural and human-made activities. Exposure to polluted air indoors or outdoors can cause serious health problems. All populations, but particularly children, pregnant women, and the elderly, can develop diseases from being exposed to air pollution. Daily and prolonged exposure to air pollution also

reduces people's ability to be active and exercise, and it increases their susceptibility to infection (National Institute of Environment Health Sciences, n.d.).

All nations deal with air pollution, though some cities have geographic features to help—for example, some nations have mountains that trap bad air, while others may be on the coast where prevailing winds push polluted air away. In the United States, the Centers for Disease Control and Prevention (CDC) claims that air pollution has generally been declining since about 1990. This is largely due to pollution controls on cars and stricter regulations for factories. Still, the CDC (2016) cautions that air pollution can account for increased cancer rates, birth defects, and even heart disease. This data relates to CSR in two ways: It reinforces the value of past CSR efforts (and past legislation regarding factory emissions) and also suggests that firm managers need to continue to monitor emissions and other possible contributions to pollution.

Ozone Depletion

The **ozone** is a thin layer of gas that floats in the stratosphere between 9 and 28 miles above the planet. Although mildly poisonous to humans, it is critical to life on earth because it absorbs ultraviolet light from the sun. Excessive ultraviolet light causes skin cancer, damages the eyes, and reduces our ability to resist disease. Historically, chlorofluorocarbons, or CFCs, formerly used in refrigerants, solvents, and propellants, were impacting the upper atmosphere and depleting the ozone layer over the earth. In 1987 world leaders negotiated the Montreal Protocol, a multinational treaty that banned CFCs and other ozone-depleting chemicals from being manufactured and sold. Countries have until 2030 to phase out all CFCs. Still, the existing and prior damage to the ozone remains. Scientists believe it will take until the middle of the 22nd century for the ozone layer to completely recover (United Nations Environment Programme [UNEP], 2014).

Regarding air pollution, data indicates that worldwide, the combination of government regulation and corporate care (self-regulation) helps reduce pollution. For example, in 2014 the UN under-secretary-general and United Nations Environment Programme (UNEP) executive director Achim Steiner announced progress had been made in terms of the ozone layer's recovery. (UNEP, 2014). The Montreal Protocol is the world's most successful environmental treaty. It provided significant protections for the stratospheric ozone layer that kept unhealthy levels of ultraviolet radiation from reaching the earth's surface. But Steiner also says, "The challenges we face are still huge. The success of the Montreal Protocol should encourage further action not only on the protection and recovery of the ozone layer but also on climate" (as cited in UNEP, 2014, p. 1).

The topics of air pollution, ozone layer damage, and water pollution (including a discussion of carbon dioxide and methane) relate to CSR because businesses and communities rely on access to water for basic operations. Ensuring the viability of people and communities, as well as ensuring continued access to basic services, is thus both a CSR and a strategic issue.

5.2 Finding Solutions

Solutions to environmental issues require considering and cooperating with stakeholders, and achieving CSR and sustainability comes with challenges. For example, in the past 10 years, the state of California has considered building a high-speed rail system between Los Angeles and San Francisco. Such a system would reduce the congested traffic on the freeway between the two giant cities and also make each trip between the cities have less of a carbon footprint. However, farmers from the San Joaquin and Hanford parts of California took a *not-in-my-backyard (NIMBY)* approach to the issue, which is when local residents oppose a project that will likely hurt their community. Residents oppose the rail system on the grounds that it will take too much farmland out of production and pollute their neighborhoods (California High Speed Rail Authority, 2012). As with many large projects developed for greater efficiency, a negative impact on some can have a positive impact on many.

For these and myriad other reasons, environmental issues remain complicated. The changing and improved science and the debates around causes, complications, and impacts of different types of pollution cause disagreement in governments, consumers, regulatory bodies, and between corporate stakeholders. The questions of scale associated with environmental issues add another complicated dimension to their consideration. These include: Can a single country make a difference if leaders and businesses within that country change their behavior? Can a single corporation or single industry impact a global environment? Can individual behaviors make any difference at all?

Recall how business leader Ray Anderson of Interface Carpet (described in Chapter 1), suggested that *only* individual action can make a significant difference. As CEO of his company, he realized that he needed to take local action in order to make global impact.

CSR and Sustainability in Action: Interface Carpet, Part 2

When Ray Anderson reinvented himself, his company, and his industry, the carpet business was one of the most polluting industries on the planet. Most carpet was made using chemicals created from petroleum. Old carpet was dumped in landfills. The industry was known for its high impact on the environment. But Anderson saw a different way to conduct business. He said:

> Distancing ourselves from the wellhead requires that we reimagine the antiquated, linear, take-make-waste industrial system of which we are all a part; it requires us instead, to become part of a thoughtful, cooperative, cyclical system that mimics nature in the way that we design, source, manufacture, sell, install—and eventually reclaim and recycle—our products. This ambitious undertaking requires new technology, new inputs, and new thinking. (as cited in Anderson & White, 2009, p. i)

(continued)

CSR and Sustainability in Action: Interface Carpet, Part 2 (continued)

Interface adopted a sustainable design approach that opened the company to innovation and creativity and made it more profitable. Interface's accomplishments since 1994 are impressive. In terms of waste and pollution, Interface has taken the following steps:

- Cut greenhouse gas emissions by 94 percent
- Cut fossil fuel consumption by 60 percent
- Cut waste by 80 percent
- Cut water use by 80 percent
- Invented and patented new machines, materials, and manufacturing processes
- Increased sales by 66 percent, doubled earnings, and raised profit margins. (Interface, 2016, para. 3)

The creation of an Interface European plant has been even more impressive. A recent press release reports, "As of January, the plant is operating with 100% renewable energy, using virtually zero water in manufacturing processes and has attained zero waste to landfill" (Interface, 2016).

Interface Carpet's environmental achievements does not mean it was always easy for Anderson or his company. Interface spent some years "in the red" (meaning it was financially unprofitable) and faced years of change and internal organizational issues. The Interface story showcases how being a green company comes with challenges as well as distinct benefits. In most years, the bottom line grew and the company's profile changed for the better. The company is now recognized as an environmental leader.

The journey of Interface Carpet, Ray Anderson, and similar companies was even more impressive because of the era in which it took place. When Ray Anderson started his environmental journey in the early 1990s, the tools were not in place to do what he wanted. By his own admission, Anderson spent a great deal of time inventing and creating processes. He discovered that all around him, new tools were emerging from companies and organizations facing the same challenge.

Today most companies can identify, understand, and manage their environmental footprint by using an EMS to track the impact an organization has on natural systems. An EMS offers a basis for understanding waste and pollution generation, as well as for finding ways to increase efficiency and be intelligent about resource flows. The sections that follow discuss the benefits of an EMS and examine the ISO 14001 EMS standards. These standards form the foundation of the life cycle assessment detailed in Chapter 6. An extension of such tools is the net zero ideal, which refers to the goal of eliminating all wasted energy and materials.

Environmental Management Systems

An **environmental management system (EMS)** is the set of systems and routines that firms use to identify and manage waste and pollution and to understand how natural resources are used and allocated. With an EMS, a corporation does not just manage the manufacture of product or service; it systematically manages its total environmental impact, including waste, carbon footprint, transportation costs, and product disposal. An EMS can range from informal and simplistic to formal and extremely complex. A system can be managed in-house or assigned to an outside vendor. In some firms, staff members may already be managing purchasing activities, maintenance work, or other key functions with an eye toward stewarding resources, but they may not call the system they use for this work a formal EMS. Thus, in some firms, formalizing the process simply requires giving current activities a name and more structure. In other firms, starting an EMS requires building new systems and structures.

The U.S. Environmental Protection Agency (EPA) offers a clear definition and a set of processes to develop an EMS for businesses of any size, including local, state, and federal agencies.

An EMS provides a systematic way of managing an organization's environmental impact in a manner that can be regularly reported and tracked. Sometimes an EMS results in an extensive document that reflects analysis and results from an external third-party organization—such a document serves as a benchmark to make improvements and reduce waste.

Other times the EMS is done internally, and results may or may not be made public, depending on what company managers want. A good EMS becomes both a tool and a process, not just a means to publishing a one-time report. A good EMS assigns accountability and gives responsibility to specific people for specific outcomes. It sets a framework for training in goal achievement. It gives consistency and order to operations and goals and describes how they will build on each other year after year. An EMS encourages contractors and suppliers to establish their own EMS and to integrate better with the focal organization (Florida & Davison, 2001).

Some organizations interested in implementing an EMS struggle with getting buy-in from management, unions, and/or employees. People often resist change, even when the changes seem well intentioned and focused on reducing environmental impact and increasing operational efficiency. Outdated thinking suggests that spending money to mitigate environmental impact increases an organization's costs without providing sufficient compensatory financial or other benefit. Yet with the EMS and other new tools available to organizations, evidence increasingly suggests that reducing a firm's environmental footprint also increases its bottom line. Pioneers like Ray Anderson are examples of business leaders who grew business by making the corporation a steward of the environment.

EPA studies indicate that organizations in which managers take the environmental management process seriously incur significant benefits above and beyond any costs incurred in launching and refining an EMS. While internally managing an EMS takes time and requires training (and sometimes hiring an external consultant), the potential benefits are significant. According to the EPA (2016a), such benefits include:

- Improved environmental performance
- Enhanced compliance [reduces costs due to fewer/lower fees]

- Pollution prevention
- Resource conservation
- New customers/markets
- Increased efficiency/reduced costs
- Enhanced employee morale
- Enhanced image with public, regulators, lenders, investors
- Employee awareness of environmental issues and responsibilities

Overall, the vast majority of organizations committed to an EMS say it is an outstanding management tool because it allows managers to take both a broad focus and a strategic and tactical view of the organization on a regular basis.

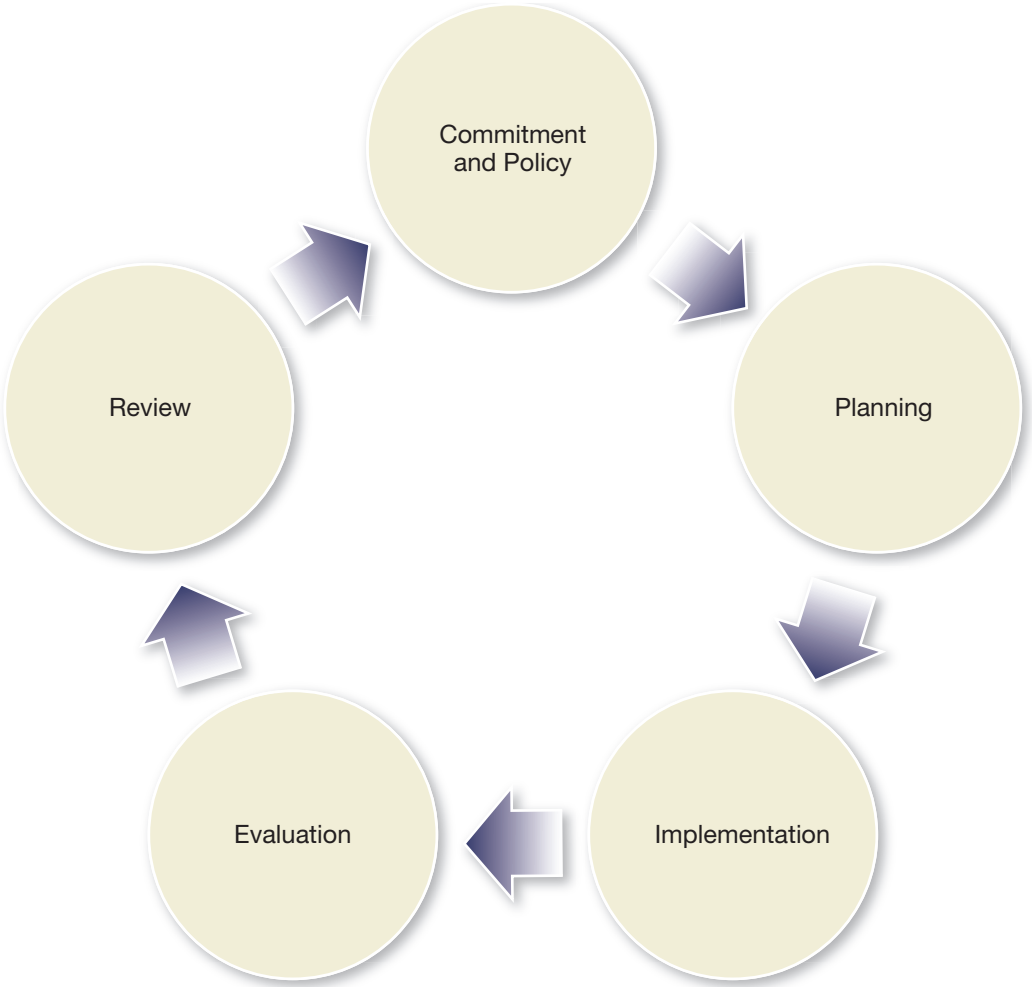
The ISO 14001 EMS Standards

A more specific EMS process designed for businesses is the **ISO 14001** protocols and standards (International Organization for Standardization [ISO], n.d.a), which relate to EMS analyses. The ISO 14001, established in 1996 and updated in 2015, uses a "plan, do, check, act" process to encourage continuous improvement. Deploying an EMS using these standards is consistent with systems theory because it takes a holistic approach. It is also consistent with the Shingo model because it follows the ideas of continuous improvement. It also aligns with the sustainable business practices detailed in previous chapters.

The ISO 14001 process is outlined in Figure 5.1. Its approach suggests that if all stakeholders, including top management, fail to commit to environmental improvement, then success will not be as pervasive. Once stakeholders are committed, planning begins. The ISO 14001 protocols show the specifics of planning are important because they identify, prioritize, and assign measurement tasks to each environmental issue within the corporation. As corporations follow the ISO 14001 processes, they find that the necessary costs—including training, equipment, and new personnel—become evident as they move from planning to implementation. Stakeholders need more commitment when the process requires financial resources. Over time, and as the new system works, new communication networks can emerge because people tend to discuss what the process reveals. The benefits of less waste and less effort become evident as people share successes and setbacks. Through the evaluation process, the company becomes more reflective and makes improvements. In the review phase, management reviews the results and starts the process again to achieve continuous improvement.

The ISO 14001 standards may seem daunting for many companies, as they require being committed to reducing environmental impact and systematically measuring results. However, firms that comply with the standards and become certified often receive priority as service providers. Also, early certification efforts can save money over time, given that compliant firms avoid fines and expensive delays as they catch up with regulations. While the ISO 14001 and EMSs are now widely used, many companies in the United States and Europe do not formally adopt conventional environmental management standards to evaluate their environmental footprint. One reason the statistic seems low is because many firms adopt informal systems but do not pay consultants or officially report findings using the ISO standards in CSR and sustainability reports.

Figure 5.1 Key elements in ISO 14001 deployment



*Source: Adapted from "Learn About Environmental Management Systems," by U.S. Environmental Protection Agency, 2016b (**https://www.epa.gov/ems/learn-about-environmental-management-systems#costs**).*

The EMS and ISO 14001 are tools for continuous improvement, so a one-time adoption does less to advance a company than a long-term commitment to using the standards and processes. Both tools also assume that the problem of environmental damage is permanent and without a final answer. Rather, environmental management occurs through ongoing and continuous resolution that damage can be mitigated but never eliminated. Still, there are many compelling environmental success stories of companies from various industries implementing the EMS and ISO 14001.

For example, Walmart (among many other companies) has published extensive accounts of savings that resulted from deploying EMS tools at headquarters and beyond. The implications suggest that EMSs are useful across industry boundaries; they offer a valuable tool that employees and leaders can use to monitor and advance operational impacts.

CSR and Sustainability in Action: Wisconsin Energy Corporation

The Wisconsin Energy Corporation (WEC) began to use an EMS in 2002. Doing so led to significant changes at one of its power plants, the Pleasant Prairie power plant, which took an innovative approach to address the side effects of fuel use and creation. Under normal operations, the coal-burning power plant emits a significant amount of air and landfill pollution. The plant burned virgin coal to create energy, resulting in *fly ash*, which is similar to the soot that is left over in a fireplace. Using the EMS, WEC engineers looked at old landfills and noticed that the ash they were dumping was much darker in the new fills. The darker ash contained unburned coal, which represented a significant amount of waste and inefficiency. The first step the engineers took was to reburn much of the landfill coal and fly ash mixture, which extracted the energy and saved on the purchase of new coal. This created new and more concentrated fly ash that had cement-like characteristics and became a valuable component of concrete. The WEC found that it could sell this concentrated fly ash to cement manufacturers and eliminate the landfill altogether. In a year's time, this step saved over $12 million in landfill costs, plus reduced the amount of virgin coal purchases by $3 million (Wisconsin Energy, 2013).

Net Zero Construction

Another way some corporations can address environmental issues is to use net zero construction. These standards have broad implications for all industries. Note that an estimated 40% of the total fossil fuel consumption in the United States and European Union (EU) go toward heating and cooling large buildings (UNEP, 2009). This poses a significant cost to businesses and creates a tremendous amount of greenhouse gas. The *net zero consumption principle* proposes that carbon emissions and energy bills can be significantly (and sometimes entirely) reduced, and dependency on fossil fuels eliminated, if people construct buildings that conserve and reduce energy usage. Thus, the term **net zero** refers to the fact that buildings designed and built with such goals could potentially require no net inputs of energy other than solar and geothermal (naturally occurring sources of energy). In some cases such buildings can even generate a net *gain* of energy; the energy surplus can then be stored or sold to energy companies (Baden, Fairey, Waide, de T'serclaes, & Lausten, 2006).

A zero energy building (alternately referred to as a zero net energy building, net zero energy building, or net zero building) consumes an average of no net energy from government or private sources or from any source other than the building itself. Thus, the net zero model means the total amount of energy used by the building each year is roughly equal to the amount of renewable energy the building creates.

Depending on the activities of a net zero building's tenants, such buildings may have periods of the day that require excessive heating or cooling, but on an annual basis they produce as much (or more) energy as the tenants consume. Consequently, they do not increase the amount of greenhouse gas in the atmosphere. According to the U.S. Department of Energy

(DOE), most net zero energy buildings get half or more of their energy from local power suppliers, but they return the same amount at other times (DOE, 2015).

In the United States and Europe, net zero or near net zero is now a requirement for new government buildings. Advocates see this requirement as a cost savings move that also allows participating agencies to advocate a reduced carbon footprint and market themselves as examples of low-emitting firms with quality CSR and sustainability programs. The net zero movement has also migrated to the housing market and changed the way homes are built in the United States. While some contractors find it difficult to change old habits, many find a market demand for energy efficient homes that are either net zero or close to net zero (Torcellini, Pless, Deru, & Crawley, 2006).

The Green Acres housing development in New Paltz, New York, located 80 miles north of New York City, is considered to be the first net zero housing development in the United States. The homes are built of insulated concrete forms with spray foam insulated rafters and triple-pane casement windows (all of these choices eliminate heating or cooling losses). To make the homes even more energy efficient, they are also heated and cooled by a *geothermal system* (meaning that the heat source comes from the earth). Greenhill Contracting began construction on Green Acres in the summer of 2008, and after a year of occupancy the solar panels of the first occupied home in Green Acres generated 1,490 *kilowatt hours* (kWh, a measure of how energy is bought and sold) more energy than the home consumed. The second occupied home has also achieved zero net energy use. The development serves as an example to consumers and other contracting firms of how buildings can be constructed with sustainability and cost savings over the structure's life.

5.3 Cradle-to-Cradle Design and Analysis

As issues related to the environment become increasingly important to stakeholders, these individuals search for methods, processes, and frameworks to guide their action. The design philosophy known as "cradle-to-cradle design thinking" exemplifies one such framework. **Cradle-to-cradle** design asks adherents to model business and industry on natural processes so that the outputs from one process become the inputs for another and no resources are wasted. Consider, for example, how the leaves that fall from a tree become the compost that fuel the tree's growth. (This book expands on this concept in Chapter 6, which discusses how corporations use cradle-to-cradle design to reduce environmental footprints.)

The term *cradle-to-cradle* (sometimes called Cradle2Cradle) is a registered trademark of McDonough Braungart Design Chemistry and embodies the same philosophy as *regenerative design*. Walter R. Stahel originally developed the basic principles in the 1970s, but in 2002 Michael Braungart and William McDonough published a book called *Cradle to Cradle: Remaking the Way We Make Things*. This book has become an important work in the design industry, and many companies and organizations around the world implement its tenets as part of their CSR and sustainability journey (McDonough & Braungart, 2002).

The core principle of cradle-to-cradle plays on the common phrase "cradle-to-grave" (more on this in Chapter 6). The cradle-to-cradle model suggests that any product or design should be considerate of life and future generations and should minimize waste. Waste represents a

form of death, but recycling and creatively reusing products keeps resources alive for many generations. Cradle-to-cradle design represents an advanced systems theory model because it compels people to look holistically at an entire life cycle, from the inputs, throughputs, and outputs of the product, business, or system.

The Cradle-to-Cradle Process

The cradle-to-cradle process involves four basic steps. The first involves looking at material health and identifying the composition of the materials used in the manufacturing process. This forces the designer to ask if he or she is using hazardous materials, pigments, or compounds that might persist in the environment and cause harm. It also forces the designer to consider the upstream source of products and whether that source is sustainably raised, harvested, extracted, or otherwise procured.

The second step is to look at material reutilization and ask how much of the material used to make a product can be recovered or recycled at the end of the product's life. Again, the cradle-to-cradle process suggests that *every* product should be recyclable and convertible into a new product. There are increasing examples of this practice in current industry, such as manufacturing recyclable cars or outdoor deck material created from recycled milk bottles.

The third step involves assessing the amount and source of energy required for production. In this step, for example, designers consider using at least 50% renewable energy to make any part or subassembly for the product.

The final step in this process involves considering any actual waste created, such as water pollution, wasted paper, water used in manufacture, scrap material or clippings, or air pollution. In this step, designers and manufacturers look at the social implications of waste and the ways people use and discard products, to ensure social responsibility once the products leave the factories (Sacks, 2009).

Biomimicry

The cradle-to-cradle design is part of a family of ideas that suggest nature and evolution can inspire human effort and innovation. Over time, natural environments have adapted in ways that provide "answers" to human problems, but answers that humans have historically overlooked.

When designers and engineers (and others in manufacturing and procurement) deliberately turn to nature for examples of how to address design problems, the results are sometimes referred to as **biomimicry**. Biomimicry is when products imitate nature. Examples of this practice include Ford Motor Company designers who studied how geckos stick to walls and ceilings to invent and test nontoxic adhesion alternatives. The following are additional products that reflect ways in which nature can inspire industry:

- Deformable glass, which mimics the strength found in seashells through something called hierarchical ordering.
- Biodegradable adhesives, which are based on waterproof adhesives from mussels.

- Self-cleaning paint, which is inspired from the waxy bumps found in lotus leaves that carry water and dirt away from the plant.
- *Anti-fouling* (prevents growth of organisms)and *wicking* (pulls moisture away) surfaces, which uses ridges like that of a pitcher plant to get water and have slick leaves.
- Antibacterial surfaces, which are inspired by shark scales.
- Products such as packaging foam, bricks, and leather grown from bacteria, which use little energy (Terrapin Bright Green, 2016).

The biomimicry movement has grown nationally and internationally. Biomimicry has its own institute, a research community, and many advocates, including leaders and designers in large companies. One of the foremost practitioners is Amory Lovins, an American physicist, writer, environmental scientist, and chair/chief scientist of the Rocky Mountain Institute, which uses principles of biomimicry (and other scientific principles) to advance its mission to support the efficient and restorative use of resources. Everyone associated with the institute works toward a vision of sustainability (Rocky Mountain Institute, 2016).

Kyodo/AP

An example of how biomimicry can contribute to innovation is found in the Sharp Corporation's use of butterfly wing movement to design an electric fan propeller.

These examples of biomimicry reveal how CSR and sustainability goals can help companies innovate. For some, biomimicry represents an advanced way to approach innovation. For others, it offers an exciting way to fully "walk the talk" in terms of learning from nature, improving because of nature, and honoring nature while running a business.

Apply Your Knowledge: Solutions to Environmental Issues

Select a community with which you or your group are familiar. Then do the following:

List the three most significant environmental issues facing the community. For example, the city might be outgrowing its water source or experience temperature inversions during the winter caused by air pollution.

Then, list how each of these issues impacts your health. For example, are you exposed to cancer-causing chemicals, and does the community have a higher-than-average cancer rate? Is air pollution a problem that leads to a higher-than-average rate of lung disease?

Review the list and detail the major causes of these problems. Are these caused by factories? Traffic?

Provide several significant steps that could be taken at a corporate level to reduce the impact of the environmental problem.

Think of several significant personal steps that could be taken to reduce the impact of the environmental problem.

Chapter Summary

This chapter discussed how there are renewed interest and benefits in connecting to and restoring the natural environment, rather than depleting it. In other words, many corporations use business principles and the motivation to save money in the long term to enact behaviors that restore or cause less damage to nature.

Corporations in which leaders and employees use some or all of the environmental innovations described in this chapter work to be sustainable over time in all incarnations of the definition. Such firms have the potential to be profitable over the longer term, making them less susceptible to negative market forces than companies whose leaders eschew such practices. Leaders who focus on CSR and sustainability, and turn that focus into sustained actions, have a competitive advantage because they are likely to be more innovative, cost-effective, and spend less money on waste disposal.

However, the question of how to build a sustainable business that has a restorative impact on the environment remains. As mentioned, EMSs, net zero construction, and biomimicry offer tools for understanding why protecting the natural environment is important and how people can tackle environmental initiatives. In his book *The Web of Life*, author Fritjof Capra discusses the cultural context in which the scientific revolution of environmentalism is unfolding. Capra (1996) argues we are discovering that we cannot understand the major problems of our time in isolation, because these problems are interconnected and interdependent. For example, he argues that population growth is tied to poverty and that the extinction of plant and animal species is linked to developing country growth and indebtedness. Specifically, he states:

> Ultimately these problems must be seen as just different facets of one single crisis, which is largely a crisis of perception. It derives from the fact that most of us, and especially our large social institutions, subscribe to the concepts of an outdated worldview, a perception of reality inadequate for dealing with our overpopulated, globally interconnected world. (Capra, 1996)

This chapter suggested that leaders and individuals can do more than simply *consider* nature; people and firms can use specific frameworks and principles to preserve, protect, and even restore the natural world in which we all work, play, build, and consume. Such exemplars can inspire others to do the same, and their work (and mistakes) helps firms and industries find competitive advantage without creating environmental damage.

Posttest

1. In the late 1990s the National Security Study Group predicted that which of the following resources would be a cause of future conflict?
   a. trees
   b. oil
   c. land
   d. water

2. As a result of advances in stakeholder and environmental management as discussed in the chapter, ozone depletion has been _____.
   a. increasing
   b. completely eliminated
   c. slowed but not reversed
   d. moderately reversed
3. Net zero buildings have _____.
   a. higher energy bills
   b. lower energy bills
   c. no significant energy bill
   d. no Internet signals
4. EMS, as used in this chapter, stands for _____.
   a. emergency management system
   b. environmental mapping system
   c. environmental management system
   d. emergency mapping system
5. The major known advantage of biomimicry products is _____.
   a. increased efficiency and likely biodegradability
   b. decreased shipping costs
   c. decreased development and production costs
   d. increased availability of materials
6. Cradle-to-cradle product analysis starts with raw materials and _____.
   a. creates a cost–benefit analysis
   b. examines the life cycle of the product, including recycling
   c. looks just at noise and waste
   d. looks just at energy consumption

Answers: 1(d); 2(d); 3(c); 4(c); 5(a); 6(b)

Critical-Thinking Questions

1. How has or how might global warming impact you or your community? How will it impact various economic sectors, such as tourism? Agriculture? Transportation?
2. Do you think corporations can really be restorative to the natural environment? Are the innovations described in this chapter short-term fads or do they have "staying power?" Why or why not?
3. Perform a quick EMS of your classroom, educational institution, or work environment. What recommendations do you have for its carbon footprint?
4. How might our lives be different if most buildings were constructed according to green building codes?

5. Research and select a product that mimics nature. How does it reduce waste and reduce the impact on the natural environment? How can the design or concept of this product be applied to other products or industries?
6. What are three things you could do in your life right now to reduce your impact on the natural environment?

Additional Resources

The island country of Kiribati faces a large migration due to climate change:
http://www.bbc.com/news/world-asia-pacific-34967633

BBC environment correspondent Matt McGrath assesses why a 2°C increase in global average temperatures is seen as the gateway to dangerous warming:
http://www.bbc.com/news/science-environment-34920941

Learn more about the International Organization for Standardization's standards:
http://www.iso.org/iso/home.htm

A video on the ISO 14001 can be found here:
https://www.youtube.com/embed/_hs54V3x1VQ?fs=1&autoplay=1&rel=0

Video-based information on Interface Carpet, CSR, and developing countries:
https://www.youtube.com/watch?v=Tu6wzHp7aEk

Review the Sustainable Development Goals 2030 at the website found here:
https://sustainabledevelopment.un.org/post2015/transformingourworld

Review the findings of the Intergovernmental Panel on Climate Change here:
http://www.ipcc.ch/

Answers and Rejoinders to Chapter Pretest

1. **False.** These major oil companies agree that global warming and carbon emissions are a major global issue.
2. **False.** Not every company has an environmental management system, but they are growing in popularity.
3. **True.** The cradle-to-cradle process asks producers to consider the inputs and the outputs that go into making a product and ensure that nothing is wasted and everything can be recycled or reused.

Rejoinders to Posttest

1. Due to the increasing scarcity of fresh water and the pollution of available sources, the National Security Study Group predicted that access and rights to drinkable water would be a major cause of future geopolitical conflict.
2. The Montreal Protocol is considered a success because it has moderately reversed ozone layer depletion.

3. Net zero buildings might pay for energy at times, but they may also contribute energy to the grid at other times.
4. EMS stands for "environmental management system," which should be a part of every large corporation's planning.
5. Most biomimicry products are biodegradable and can be recycled back into the environment. They were also inspired by nature.
6. Cradle-to-cradle product analysis involves examining the life cycle of a product, which includes recycling.

Key Terms

biomimicry The creation of artificial products that mimic natural products and have a less negative impact on the environment.

cradle-to-cradle The study of a product's or process's life cycle that follows it from birth to disposal and attempts to use the outputs of one system to become inputs for another.

environmental management system (EMS) A system used to study the impact of corporate activity on the environment and identify ways to reduce negative impacts; can be formal or informal.

global warming The slow warming of the earth's surface temperature, likely caused by the greenhouse effect.

greenhouse effect The effect of carbon dioxide and other gases that cause heat to be trapped in the earth's atmosphere, similar to a greenhouse that traps heat.

ISO 14001 An International Organization for Standardization process to identify and measure a company's environmental impact.

net zero A building construction method that allows a building to generate as much energy as it uses (or more).

ozone A natural gas that forms a protective layer around the earth that screens harmful light and radiation.