

Sustainability



The book explores the integral role of facility managers in Environmental Stewardship and Sustainability to apply sustainable practices to both built and natural environments, develop and direct programs aligned with organizational sustainability goals, and integrate sustainability into decision-making processes with supporting environmental impact data.



IFMA Facility Management Learning System

Book 2

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Environmental Stewardship and Sustainability

✦ Introduction

Role of facility managers as related to *Environmental Stewardship and Sustainability* competency

Fulfilling the environmental stewardship and sustainability competency requires a facility manager to:

- Apply sustainable facility management practices to both the built and natural environments.
- Develop and direct programs to support the organization's commitment to sustainability.
- Ensure that sustainability is included as a factor in organization decision making and support those decisions with data related to impact on the environment and the facility and its occupants.

Overview of *Environmental Stewardship and Sustainability* competency

Exhibit 2-1 highlights the content covered in each of the following chapters. Facility managers who have a special interest in this subject are encouraged to consider the Sustainability Facility Professional certification offered by IFMA.

Exhibit 2-1: Overview of *Environmental Stewardship and Sustainability* Competency (continued on next page)

Chapter	Content
1. Sustainable Facility Management	• Definition of sustainability • Eight focus areas for sustainable facility management • Five principles of sustainability • Benefits of sustainable facility management and the risks of unsustainable practices • Facility managers' role in promoting and implementing sustainability • The model of the Triple Bottom Line as a decision-making tool
2. Aligning Organizational Strategy with Sustainability	• Integrating sustainability with the organization's strategic plan • Using stakeholder interests to build support for a sustainable strategy • Process for developing a sustainability strategy • Process for implementing strategies through sustainable policies



**Exhibit 2-1: Overview of *Environmental Stewardship and Sustainability*
Competency (concluded)**

Chapter	Content
3. Measuring and Reporting Sustainability	• Measuring greenhouse gas emissions and the carbon footprint • International standards and reporting frameworks for sustainability • Certification systems to recognize organizational achievements in sustainable building and facility operations and maintenance • Internal measures
4. Focus Areas for Sustainable Facility Management (Input)	Program goals and tactics for: • Energy • Water use • Materials and resources
5. Focus Areas for Sustainable Facility Management (Process)	Program goals and tactics for: • Workplace management • Indoor environmental quality • Quality of services
6. Focus Areas for Sustainable Facility Management (Output)	Program goals and tactics for: • Waste • Site impact



Chapter 1: Sustainable Facility Management

After completing this chapter, students will be able to:

- Define sustainability.
 - List the key drivers for sustainability.
 - State the importance of sustainability to the organization.
 - List how sustainability impacts the facility manager.
 - List the benefits and risks of starting a sustainability initiative.
 - List IFMA's eight major categories of sustainability.
 - Define the Triple Bottom Line and its intersections.
 - State the organizational impact of the Triple Bottom Line.
-

✦ Topic 1: Sustainability and Facility Management

Sustainability defined

In 1987 the United Nations sponsored the World Commission on Environment and Development, also known as the Brundtland Commission, to conduct a study of the world's resources. The commission's report defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." In other words, sustainable practices seek to accommodate human needs without diminishing the productivity or health of natural systems.

Sustainability for organizations is more important today than it has ever been. The current historical period has been referred to in textbooks as "the age of accountability." Businesses used to have the luxury of deciding whether to participate in practices such as sustainability; today it is no longer a choice but a requirement. An organization today is judged not just on the basis of the quality of the goods and services it produces but also on the care it shows people (both inside and outside the organization) and the environment. These responsibilities are both ethical and legal; organizations must conduct their strategic activities while ensuring compliance with all applicable laws and regulations.

Developing a long-range view

Sustainability is marked by a concern for the effects of a decision over the entire life cycle of a product or practice. The impact of an action must be judged by all the actions that preceded it and all the actions that will follow



it. For example, from a sustainability viewpoint, the purchasing of paper towels for a facility restroom includes the past (the source of the paper, how renewable that resource is, the impact on the environment from the manufacturing process, the distance and method of transportation to the facility), the present (how it is used or conserved in the facility) and the future (how it will be disposed of and the effects of its decomposition). Sustainable development as a concept forces organizations to shift their focus from the short term to the long term.

Including the built and natural environments

Sustainability is also about the interaction between the natural environment and the built environment.

- The built environment includes all buildings and living spaces that are created or modified by people. In addition to the buildings and spaces themselves, it also includes infrastructure elements such as waste management, transportation and utility transmission systems put in place to serve the built space.
- The natural environment—resources such as forests, trees, rivers and streams—affects the human and financial health of the organization and its community. The natural environment helps to clean the air, cool buildings and provide relaxation. If the natural environment is not healthy, organizations and others in the community do not receive the original benefits or services of the natural environment and must instead spend time and money to clean up pollution.

Facility managers must be aware of the potential effects of these two environments on each other and act to minimize negative effects and take advantage of positive ones.

Why sustainable facility management?

Many global drivers are pushing sustainability to the forefront of business, government and social conversations throughout the world. These drivers include:

- Awareness of the finite nature of resources available to support a steadily growing world population.
- Increasing use by governments of incentives and penalties to change corporate and individual behavior.
- Speed and breadth of information that have placed every organization under a microscope of public opinion about what constitutes acceptable corporate behavior.



As business leaders step up the corporate response to the sustainability agenda, facility managers will increasingly be asked to deliver support service that is broader and deeper than ever before—often with the continuing demand for cost reduction. Facility management today is regarded as a vital function, a service that is in support of both the people who deliver the core business and the boardroom aspirations for corporate social responsibility. Sustainable facility management is an opportunity for organizations to fulfill these responsibilities. As sustainability takes hold in the organization, the facility manager's contribution will be substantial. Many organizations will look to their facility managers for leadership and guidance in this area.

Did You Know?

Data presented in a study by the Commission for Environmental Cooperation (CEC) illustrates the negative impact facilities can have on the environment. The CEC gathered data on current building practices from countries around the world. This study is reinforced and built upon by the United Nations Environment Programme (UNEP) summary article for decision makers.

Together these two documents show a rather bleak outlook on current facility consumption levels.

Facilities are responsible for 40 percent of global energy use, 33 percent of global greenhouse gas emissions, 68 percent of the total electricity consumption and 38 percent of total carbon dioxide emissions.

Five principles of sustainability

In leading the organization's commitment to sustainability, the facility manager can rely on five principles to shape the facility's sustainable response:

- **Reduce consumption.** Facility managers often need to encourage a change in the behavior and expectations of occupants and owners. It may also be necessary to change some of the operating processes and parameters, including decreasing cycle time.
- **Change sources.** Paying attention to details and investigating alternatives can help reduce waste and contribute to savings, especially related to transportation costs.



- **Reduce pollution.** An organization puts out many forms of pollution: air, water and noise pollution and solid waste. And each of these forms can be reduced through different techniques.
- **Illustrate good corporate citizenship.** Corporate citizenship refers to organizational behaviors in relation to, for example, neighboring property occupiers, the local neighborhood or city and so on. It involves considering impact on the community when making decisions.
- **Demonstrate ethical behavior.** Many organizations have an ethics policy that communicates the expected standards for management, employees and suppliers. This ethics policy should incorporate expectations about sustainable behavior in regards to the environment and society.

Benefits of sustainable facility practices

There are direct and indirect benefits from sustainable facility management.

Direct benefits include:

- Identifying supply chain risks early.
- Reduced demand for resources.
- Increased innovation.
- Improved employee productivity.

A commitment to sustainable practices can benefit an organization also indirectly by:

- Contributing to the organization's competitive edge.
- Enhancing the organization's image.
- Increasing employee satisfaction and assisting in employee recruitment, especially among younger workers.

Risks of nonsustainable practices

Failing to pursue sustainability as an organization also has risks such as:

- Economic and possibly criminal liability for pollution.
- Ethical, legal, and social problems posed by supply chain partners whose operations and labor relations are not sustainable.
- Poor image that can deter customers, investors or strategic partners.
- Noncompliance with emerging regulations that will result in significant fines and nonmonetary sanctions.

Eight areas for sustainability

IFMA has grouped sustainability initiatives into eight major areas: energy, water, materials and resources, workplace management, indoor environmental quality, quality of services, waste and site impact. These areas are discussed in more detail in Chapter 3. Exhibit 2-2 lists concerns in each area.



Exhibit 2-2: IFMA's Eight Major Categories of Sustainability

Energy	
How energy is consumed by the facility's core building systems and occupants	How the facility can optimize its energy performance
How energy is priced and purchased	How the facility can improve the efficiency of equipment and appliances
Water	
How the facility uses its water, including water withdrawals	How the facility can recycle and reuse water
Materials and Resources	
How the facility uses finite resources	How the facility makes purchases
How the facility manages recyclable materials	
Workplace Management	
How the space the facility has can be used more flexibly	How to create workspaces that are productive
How to encourage and support working virtually	How to decrease the facilities' impact on the environment
Indoor Environmental Quality	
How indoor air quality affects workers	How the facility can improve in a targeted area
How the facility contributes to occupant comfort	How the facility can manage hazardous materials
Quality of Services	
How the facility designs mail services, manages documents and provides meeting services	How the facility maintains its exteriors, site features (windows, walls, roofing) and grounds (paved and unpaved areas, exterior facility amenities)
How the facility maintains landscape and amenities	
Waste	
How the facility collects and disposes of waste	How the facility can create or better use a recycling program
How the facility can reduce the amount of waste it generates	How the facility disposes of hazardous waste
Site Impact	
How the facility manages stormwater	How the facility reduces its contribution to the heat island effect
How the facility reduces its light pollution	How the facility encourages sustainable transportation options



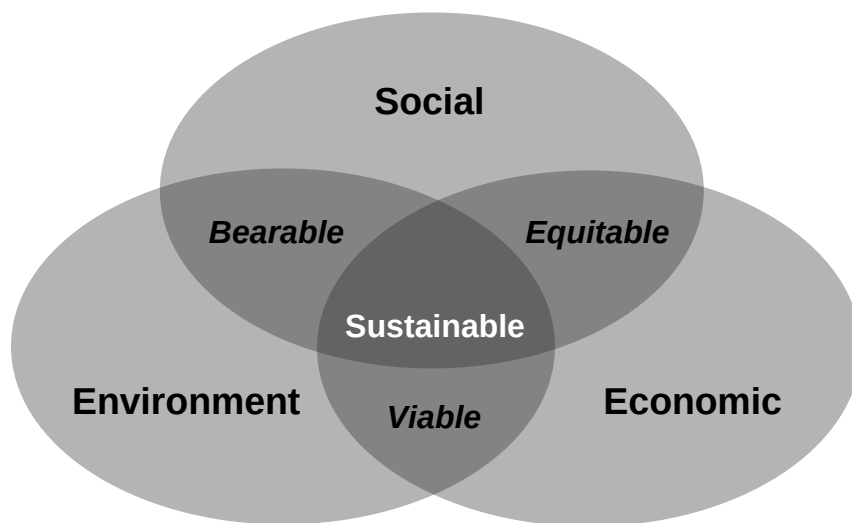
✦ Topic 2: Triple Bottom Line

What is the Triple Bottom Line?

Sustainability depends on finding and maintaining harmony between the built environment, the natural environment and the society. To create and preserve that harmony, organizations and individuals strive to achieve a balance between the social, environmental and economic aspects of sustainability. An organization's social bottom line is affected by how the facility impacts employees, suppliers and the community at large. Its environmental bottom line depends on its ability to avoid harming the environment and to preserve scarce resources for future generations—from sourcing raw materials to production processes, shipping and administration. The organization's economic bottom line will benefit according to the value created by the organization after deducting the cost of all inputs.

The Triple Bottom Line model in Exhibit 2-3 shows the way in which these three aspects are connected. Actions to achieve benefits in one category cannot be initiated without examining the impacts of the decision on the other categories and even the same category. For example, replacing a working incandescent lamp with a compact fluorescent will save energy, but it will also create waste that must be disposed of, and some of that waste includes toxic heavy metals. Making the decision to save energy by replacing the lamp has a positive impact on the economic aspect of the Triple Bottom Line, but it also has a negative impact on the environmental aspect.

Exhibit 2-3: The Triple Bottom Line



Facility managers and the Triple Bottom Line

Think about sustainability as the common ground shared by stakeholders—the place where “doing good” and “doing well” are synonymous. Andrew Savitz, in his book *The Triple Bottom Line*, refers to this intersection as the sustainability “sweet spot,” where the pursuit of profits seamlessly blends with the pursuit of the common good.

The activities of facility management touch on all three of the aspects of the Triple Bottom Line. Many of the environmental indicators for sustainability are under the direct control of the facility manager—e.g., energy usage, waste generation. Facility managers can use the Triple Bottom Line to generate ideas for policies and programs and to structure their reporting on the facility’s sustainability strategy.

From a social perspective, the Triple Bottom Line focuses the facility manager’s attention on areas such as community involvement and occupant well-being. This translates into goals such as:

- Monitoring all vendors for fair labor practices (i.e., child labor, exploitation) and environmentally sound business practices.
- Practicing fair labor relations (e.g., paying fair wages, requiring normal working hours).
- Creating a safe, comfortable and productive work environment for the people of the organization.
- Contributing to the community in a positive way (i.e., sponsorships, donations of time or money) and avoiding exploiting or harming the community.

From an environmental perspective, the Triple Bottom Line focuses facility managers on avoiding harm to the environment and preserving scarce resources for future generations. This translates into goals such as:

- Managing the consumption of energy and resources.
- Reducing waste.
- Recycling and reusing.
- Decreasing the organization’s carbon footprint.
- Decreasing or eliminating hazardous waste.
- Create building processes that abolish toxic material to support a healthy environment.

From an economic perspective, the Triple Bottom Line focuses facility managers on the value of sustainable actions to the organization’s economic well-being. This perspective commits facility managers to ensure that sustainable decisions:

- Lower operating cost.
- Increase asset value.
- Deliver a high return on investment (ROI).



- Deliver increased efficiency.
- Provide long-term savings.

This may involve taking advantage of incentives, grants and tax rebates for sustainable strategies.

Achieving balance

Each of the three aspects of sustainability (social, environment, economic) are about making choices. Before an organization decides to go down one path, it should weigh the impact of that decision against the other aspects of the Triple Bottom Line. The goal is to make a decision that is:

- **Bearable.** This is the balance between the environmental and social aspects of the Triple Bottom Line. The organization asks whether an action producing a positive effect from the environmental perspective is causing negative effects on the productivity of occupants. The solution must have a better-than-neutral effect on the occupants; it must be improving things in some way. For example, if the set temperature point is too high and the occupants are not comfortable, then the occupants are no longer productive and the negative impact on productivity may outweigh the energy savings on heat or air conditioning.
- **Viable.** This is the balance between the environmental and economic aspects of the Triple Bottom Line. A viable action ensures the long-term survival of both the environment and the organization. For example, if the organization implements a recycling program for facility fluorescent lamps, the program will be viable only if the facility can ensure that collection can be done without sacrificing significant amounts of space or requiring significant additional labor; that it can be done safely, without breakage that would expose the environment and occupants to toxic metals; and that a disposal site is available that can handle the waste in a sustainable manner.
- **Equitable.** This is the balance between the social and economic aspects of the Triple Bottom Line. When determining if something is equitable, the organization must ask if the social benefits will outweigh the cost of the initiative. For example, adding daylighting for occupants has economic costs for reconfiguring workstations, adding sun shades to windows and adding skylights. Are these costs equitable when weighed against the potential benefits to be reaped by the organization through increased user productivity, reduced emissions and reduced operating costs?

Sustainability is not achieved by pitting one aspect of the Triple Bottom Line against another; it looks to maximize all three.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. Sustainability as a concept forces organizations to shift their focus from the _____ to the _____.

2. List the three global drivers for sustainability.

3. List the direct and indirect benefits of becoming a sustainability-conscious organization.

Direct benefits: _____

Indirect benefits: _____

4. List the five principles of sustainability that a facility manager should focus on.

5. List IFMA's eight major categories of sustainability.



6. List two examples of facility manager goals for each aspect of the Triple Bottom Line.

Social: _____

Economic: _____

Environment: _____

7. List the three balances (intersections) of the Triple Bottom Line.



Progress check answers

1. Short term, long term (p. 2-4)
2. Depleting world resources, incentives and penalties, speed and breadth of communication (p. 2-4)
3. Direct benefits include identifying supply chain risks early, reduced demand for resources, increased innovation and improved employee productivity. Indirect benefits include a greater competitive edge, an enhanced company image and increased employee satisfaction and success in employee recruitment. (p. 2-6)
4. Reduce consumption, change sources, reduce pollution, illustrate good corporate citizenship, demonstrate ethical behavior. (p. 2-5)
5. Energy, water, materials and resources, workplace management, indoor environmental quality, quality of services, waste, site impact (p. 2-6)
6. Social: Monitoring vendors for fair labor and environmental practices; practicing fair labor relations; creating a safe, comfortable and productive work environment; contributing to the community
Environmental: Managing energy consumption, reducing waste, increasing recycling and reuse, decreasing carbon footprint, decreasing or eliminating hazardous waste
Economic: Increased ROI, lower operating costs, increased asset value, increased efficiency, long-term savings (p. 2-9)
7. Bearable, viable, equitable (p. 2-10)



Chapter 2: Aligning Organization Strategy with Sustainability

After completing this chapter, students will be able to:

- Describe the role that sustainability policies play in implementing sustainability strategies.
 - Detail sustainability policy development.
 - Describe the key aspects of a sustainable or “green” lease.
 - State how the strategic planning model can be applied to sustainability.
 - List the strategies to keep leadership engaged in and committed to a sustainability initiative.
 - Define stakeholder and provide examples of stakeholders’ interests in sustainable facility management.
 - List the steps in developing and implementing sustainability projects.
 - Describe financial decision-making tools used to support sustainability projects.
-

✦ Topic 1: Sustainability Policies

Definition

A sustainability policy is a high-level working document that serves two purposes:

- Focusing the organization on sustainable issues that most directly relate to its vision and strategy, and
- Ensuring that decision makers throughout the organization will consider appropriate sustainable goals in matters large and small, throughout the organization, including facility management.

If no sustainability policies currently exist, any new sustainability program should include policy development. Once in place, the sustainability policy can drive and shape subsequent sustainability initiatives.

Parts of a sustainability policy

A sustainability policy should be clear and straightforward. The main parts of a sustainability policy include:

- **Sustainability vision.** A sustainability vision has a global point of view: How is the world enriched or diminished by what is done? What are the major impacts on society? How does the overall business strategy reflect those impacts? What does our sustainable organization look like when fully successful? Typically it is a one- or two-sentence, well-crafted statement that provides employees and stakeholders with a set of broadly stated principles



against which the efforts can be measured. A sustainability vision should show how to incorporate an emphasis on environmental, social and economic prosperity into every decision made throughout the organization and to think about how this would take hold at the operating level.

- **Scope.** Scope, or key issues, can be determined by completing a matrix like the one shown in Exhibit 2-4. The matrix lists issues under the Triple Bottom Line aspects and then indicates their relationship to and influence on the organization's sustainable strategy.

Exhibit 2-4: Sample Topic Matrix

Sustainable Issues		Sustainable Elements					
		Energy	Waste	Water	Purchasing	Travel	Community
SOCIAL	Lifestyle	IH	IH	IL	IH	IH	DH
	Safety & Health	IL	DH	DH	DH	IH	DL
	Comfort	IL	DH	DL	IH	IH	DL
	Awareness	DH	DH	DH	DH	DH	DH
	Knowledge	DH	DL	DH	DL	IL	DH
	Public Service	DH	DH	DH	IL	IL	DH
	Community	DH	DH	DH	IH	IL	DH
		Energy	Waste	Water	Purchasing	Travel	Community
ENVIRONMENTAL	Emissions	DH	DH	DH	DH	DH	IL
	Biodiversity	IL	DL	DH	DH	IL	DL
	Landfills	IL	DH	IL	DH	IL	DL
	R&D	DH	DL	DH	DH	IL	IL
	Awareness	DH	DH	DL	DH	DH	DH
	Legislation	DH	DH	DH	DH	IL	IH
		Energy	Waste	Water	Purchasing	Travel	Community
ECONOMIC	Supply Chain	DH	DH	DH	DH	DH	IL
	Capital Costs	DH	DH	DH	DH	IL	DH
	Productivity	IL	IL	IL	DH	DH	DH
	R&D	DH	DH	DL	DH	IL	IL
	Brand Recognition	DH	DH	DH	DH	DH	DH
	Liability	DH	DH	DH	DH	IL	DH
	Rentention	IH	IH	IL	IH	IL	DH
	Legislation	DH	DH	DH	DH	IL	IL

DH—direct relation/high influence

DL—direct relation/low influence

IH—indirect relation/high influence

IL—indirect relation/low influence



- **Performance metrics.** Performance metrics determine the standards by which to measure the success of the policy.
- **Goals.** The goals are what should be accomplished with the sustainability policy.
- **Procedures and strategies.** Procedures and strategies are defined in terms of the social, economic and environmental aspects of a policy. Responsibilities should be assigned for specific strategies.
- **Time period.** Time period refers to both the timeline by which to achieve all aspects of the sustainability policy and timelines for various milestones within the policy.
- **Responsible party.** The sustainability policy should have accountability at the highest level within the organization.

10 steps to creating a sustainability policy

There are ten steps to creating a sustainability policy, as shown in Exhibit 2-5.

Exhibit 2-5: 10 Steps to Creating a Sustainability Policy



1: Identify stakeholders.

Recognize, prioritize and understand those individuals who are the key stakeholders in the organization. The policy is more likely to be received favorably if the stakeholders are adequately engaged.



2: Confirm organizational strategy.

Agree on a policy that is aligned with the organization's wider corporate strategy because the sustainability objectives should enhance those of the overall organization and support the organization's objectives.

3: Agree that sustainability policy meets strategy and expectation.

Gain consensus from the stakeholders on what the sustainability policy is aiming to achieve. Identify the specific links between the sustainability policy and the organization's overall strategic goals.

4: Get a high-level sponsor.

Prepare a business case for the policy and present it to a senior executive who has a desire for sustainability. Having the support of a high-level executive may be beneficial when it is time to present the policy to top-level management.

5: Agree on policy boundaries.

When trying to determine what the policy is, it helps to know what it is not. Defining the scope and extent of the policy with the main stakeholders helps define those boundaries. Having a well-defined policy makes prioritizing objectives easier, allowing for more efficient use of the available resources.

6: Provide adequate resources.

Assign enough resources and make sure they are the right resources to be able to properly execute the action plan. A sustainability policy's success is strongly linked to a cost-effective implementation. The implementation process should not necessarily demand a capital increase.

7: Set SMART targets.

SMART as a monitoring technique involves analyzing proposed targets and measuring media from five different perspectives:

- **S = Specific.** The goal should identify a specific action or event that will take place. This perspective answers the questions "Who?" and "What?"
- **M = Measurable.** Include in the specific goal statement the measurements to be used to determine that the results or outcomes have been achieved. This perspective answers the question "How?"
- **A = Achievable.** Goals should challenge people to do their best, but they need to also be achievable. This perspective answers the question "Is it attainable?"



- **R = Relevant.** Goals need to pertain directly to the performance challenge being managed. This perspective answers the questions “Is it relevant?” and “Is it realistic?”
- **T = Time-bound.** A goal should be grounded within a time frame—enough time to complete the goal, but not too much time, which can affect project performance. This perspective answers the question “When?”

8: Engage staff.

Since the facility management staff is often responsible for carrying out the sustainability policy, it is important to engage staff in a two-way conversation about the policy.

9: Communicate success.

Providing timely feedback regarding the sustainability policy’s strengths and weaknesses allows stakeholders to identify with what is going on with the timeline and progression of the implementation process. This also helps everyone involved understand external aspects of the policy and process that affect sustainability on a more global scale.

10: Review and provide feedback.

To make sure everyone involved is allowed to voice opinions, establish a two-way feedback channel. The provided data can be analyzed by the stakeholders and then that information can be turned into well-defined action points.

Rules to live by

Policy development is a strategic function; therefore, it often starts at a high level. Facility managers are in a good position to steer policy development because of their influence and the importance of facilities to the value of the organization. Here are some rules that can help keep the goals focused:

- Seek out the buy-in of senior management. Any issues that arise will escalate to upper management, and having at least one or two champions keeps the cause moving in the right direction.
- Be sure to use the organization’s best practices when creating a policy to maintain consistency throughout the organization.
- Make sure to educate occupants and build momentum from their excitement for the program.
- Don’t forget to promote the results of the program to build and maintain momentum. Sharing success information is an excellent way to promote both the policy and the organization within the community as well as within the organization itself.



Example: A sustainable leasing policy

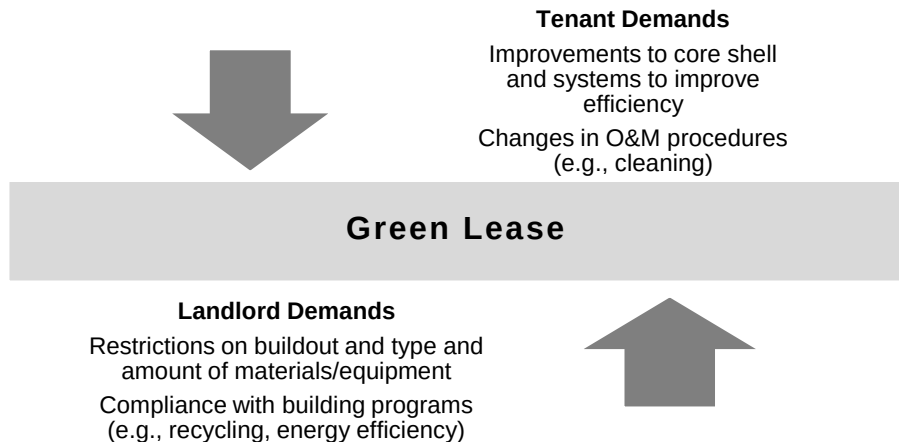
A good example of a sustainability policy is a practice called “green leasing.” Green leasing is the process of integrating sustainability elements into lease negotiations. This could include efficient building design, energy and water efficiencies, equipment, appliances, waste minimization and other sustainability objectives.

A sustainable leasing policy provides guidance to facility managers acting as lessors or lessees on ways to increase the energy-efficient operation of a building, improve the property’s indoor environmental quality, or decrease the amount of materials used and discarded in the buildout process.

Green leases are marked by:

- **Lease structures that provide mutual incentives.** Conventional leases may be structured in such a way that economic benefits from tenant efficiency accrue to the landlord rather than the tenant (typically found in gross leases, in which tenants do not pay operating costs) or do not provide any incentive to landlords to make capital improvements (typically, net leases in which tenants pay operating costs and receive direct benefit of improved efficiency). A green lease should be structured so that both parties receive incentives for sustainable choices.
- **Transparency.** Regular, complete and candid sharing of information about building performance is necessary in a green lease, especially if tenants expect to be rewarded for increased efficiency or if the lease terms include stipulations about building performance.
- **Alignment of interests and compromise.** The tenant and the landlord will each expect concessions, as illustrated in Exhibit 2-6. The success of the lease will depend on the degree of collaboration the tenant and landlord can achieve.

Exhibit 2-6: Tenant-Landlord Perspectives in a Green Lease



Both parties can implement their desires in writing:

- Tenants can develop RFPs (requests for proposal) to be used by leasing agents to identify suitable properties. These RFPs can incorporate a checklist of sustainable characteristics that the tenant is seeking.
- Landlords can create a green lease contract that executes sustainable lease terms. The work letter can clearly set forth requirements and restrictions on buildout—e.g., the types of materials and lighting that must be used or the manner of disposal for current space materials.

Benefits of a sustainability policy

Sustainability policies offer hard and soft benefits. Hard benefits are very popular with the decision makers, as they are quantifiable and can usually be expressed in terms of monetary units. Soft benefits are harder to quantify but can be expressed in terms of monetary values.

Examples of hard benefits include:

- Cost-efficient manufacturing processes or other processes that directly affect cost reduction.
- Money-saving measures such as reducing the amount and/or cost of business travel.
- Profit-making activities such as selling surplus energy to the grid.

Examples of soft benefits include:

- Improved employee morale.
- Increased occupant health, comfort and productivity.
- Reduced pollution and landfill waste.
- Increased competitive advantage.
- Increased brand strength.

The key to measuring soft benefits is to identify the right person, metric and tool for the job. For example, when looking for an individual within the organization to assist with estimating the impact that employee satisfaction and personnel training have on productivity, try the HR director. His or her knowledge and experience can help translate the increase in productivity into a monetary benefit.

Selling the benefits

How should these benefits be sold to the stakeholders within the organization? Hard benefits are easy to sell as they are tangible and their ROI can be easily explained. For this reason, hard benefits have traditionally been the center of any discussion about the economic feasibility of a project.



Soft benefits, despite being more difficult to measure, have a value and impact that is being increasingly recognized by upper management. The way to sell soft benefits to stakeholders may need to be more creative and certainly more proactive than that needed for hard benefits.

A well-presented soft benefit business case, one that has a basis in solid experience and examples from projects that may be similar to those being presented, can be as solid as a business case presented with financial and technical data. When focusing on a creative approach to selling the soft benefits, don't try to measure those things that are impossible to measure.

Also, be clear with the stakeholders that soft benefits can be as tangible as hard benefits. As with the example of the HR director, an improvement in the environment of the occupants in the building can be assumed to improve staff morale, thereby increasing performance and reducing the amount of staff turnover. Do not be afraid of making assumptions. That being said, make sure to define what the assumptions are and to describe how those assumptions were reached.

Keep in mind that there may be just one chance at selling the business case to the stakeholders. Since the concept of soft benefits may be unfamiliar, it may be necessary to open some eyes, detail some explanations and do some hand-holding to get the audience through the case. Communicating both the hard and soft benefits clearly and effectively will impact the minds of the decision makers both now and with future projects. Again, be clear on the assumptions made within the business case and be prepared to back up those assumptions with examples from the real world. Finally, be clear and concise in the summaries. Include the full cost, the resulting benefits and the potential risks involved.

✦ Topic 2: Sustainable Plan Development

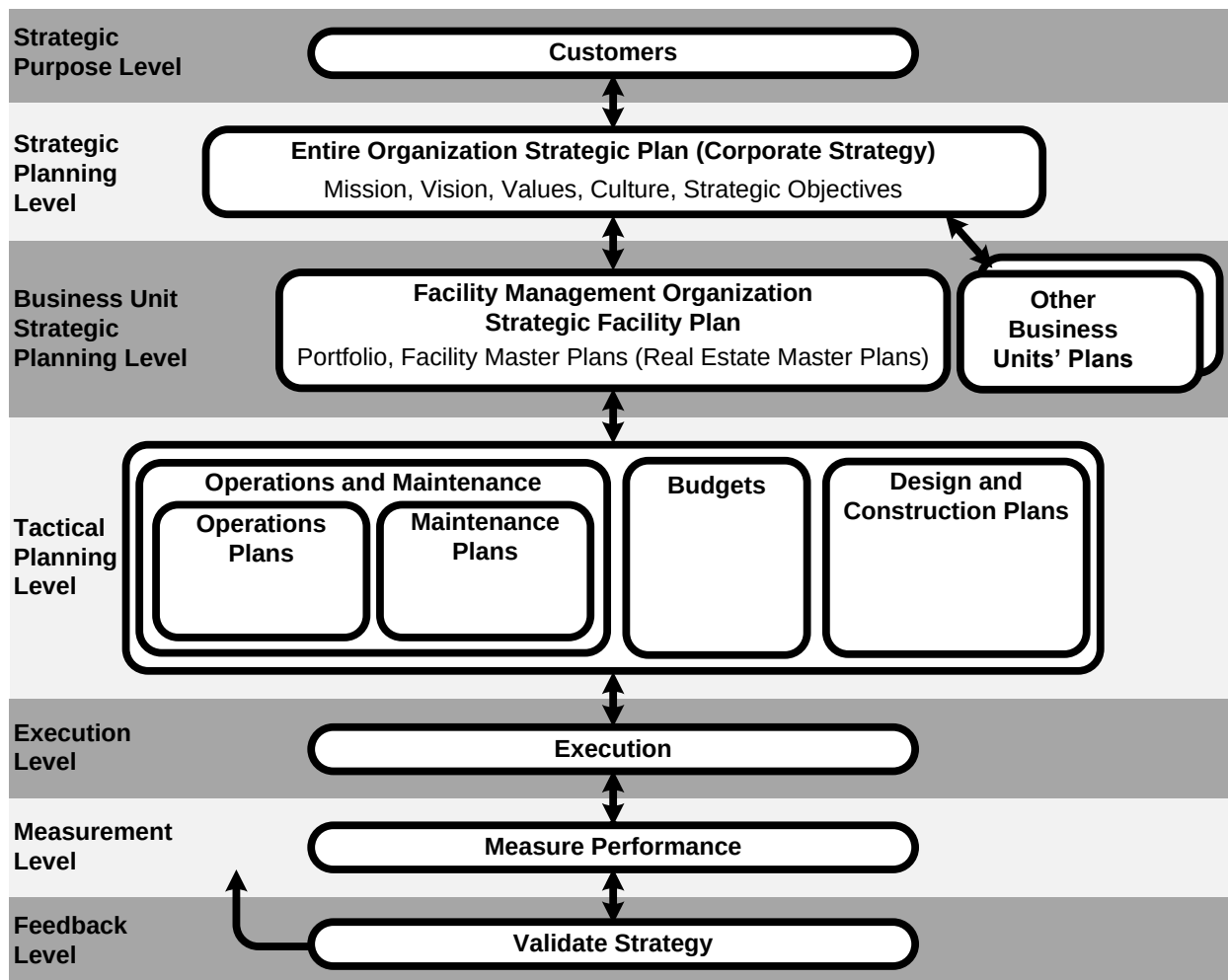
Strategic planning and sustainability

The strategic planning process is discussed in detail in the *Leadership and Strategy* competency. Briefly, strategic planning turns the organization's missions and values into policy goals, the policy goals into strategic objectives, and the objectives into action plans. The strategy influences the business plans of the organization's units, including facility management. These units must examine the ways in which they are affected by the organization's strategic objectives or contribute to achieving those goals. The units then set their own specific objectives and plan programs and initiatives to achieve those objectives within their resources. Unit plans are then implemented, their results



measured and the strategy validated or corrected as needed. This process is illustrated in Exhibit 2-7.

Exhibit 2-7: Strategic Planning Overview Model



If the organization has committed to the principles of sustainability, that commitment will be articulated as sustainable goals—for example, implementing “green” policies, providing a living wage for all employees, decreasing impact on its community. Unit managers must then develop their own approaches to helping the organization accomplish these goals. For example, IT will revise computer purchasing guidelines and network design policies to relieve pressure on finite resources such as materials and energy. Human resources may implement a wage survey and economic analysis of the living wage proposal. Facility management may propose facility transportation initiatives to help ease traffic congestion.



The facility manager owns sustainable goals like “reducing the facility’s carbon footprint” or “decreasing water consumption.” Organizational success in sustainability is directly tied to sustainable planning by the facility management function.

Aligning facility sustainability plans with the organizational strategy

The end goal of the facilities management strategic plan is to enable the organization to accomplish its sustainability objectives.

There are benefits in aligning FM plans to organizational strategy:

- The logic behind the FM plan is transparent (obvious) in how it supports the entire organization’s requirements.
- The requirements (staff, resources, access to decision makers and so forth) to execute the FM strategic plan are seen as appropriate.
- The facility’s success measures are linked to satisfying the entire organization’s requirements.
- The methods proposed (outsourcing, upgrading technology, subleasing and so forth) to execute the FM plan support the entire organization’s goals, and objectives are seen as appropriate.

Assessing the organization’s position on sustainability

Before starting the facility strategic planning process, however, the facility manager must take the organization’s sustainability “pulse” by considering:

- **What the company/organization says**—its vision statement, strategic goals in annual reports, the measures it applies to assess the strategy’s success, corporate social responsibility (CSR) reports, sustainability reports, policies.
- **How the organization operates**—whether its decisions and actions demonstrate the influence of sustainable principles.
- **The nature of the business within the facility** and whether/how it could be made more sustainable.
- **How sustainability applies to the industry**—is the organization leading or lagging its competition in this field?

If the organization is committed to sustainability, the facility manager must be prepared to champion the cause and lead the effort. Strategies for approaching a sustainability initiative from the champion role are to:

- Form a cross-functional committee.
- Create smaller project teams for each project.
- Hold an official program launch.
- Use internal formal communication channels to keep people informed.



If the organization is not currently committed to sustainability, the facility manager can try to change that position by playing the role of insurgent and/or by influencing those with formal and informal authority.

An insurgent is a self-appointed leader who has the passion and personal power to start up a program without formal authorization or sponsorship. Insurgents may need more creative strategies to get things done. Some strategies include:

- Reaching out to those who can contribute to the effort or are concerned about the specific sustainability issue. Exhibit 2-8 lists internal and external groups that could support a facility manager's efforts to promote sustainability.
- Working on the low-cost/no-cost initiatives first to gain momentum.
- Sharing success stories informally.
- Creating informal discussion groups.
- Inviting sustainability guest speakers to team meetings.
- Networking with other facilities that are making progress in sustainability.

Exhibit 2-8: Groups Affected by Sustainability Initiatives (continued on next page)

Group	How Impacted
Internal Groups	
Facility management	Sustainability could impact day-to-day responsibilities and how the facility manager completes them. This group will feel the greatest impact of a sustainability initiative.
Real estate	Sustainability could impact how real estate searches for, bids on and strategizes about the purchasing or leasing of new properties.
Legal	Sustainability could impact contracts with suppliers, contractors and other vendors to include language around sustainability requirements.
Human resources (HR)	Sustainability could impact how HR positions the organization to new employees, benefits provided and services offered to existing employees.
Finance/accounting	Sustainability could impact how this group accounts for the usage of items as well as the depreciation of assets, grants applied for, rebates given and tax incentives.
Information technology	Sustainability could impact the information that is going to be tracked and the systems and infrastructure needed to support sustainability initiatives such as telecommuting or videoconferencing.
Marketing/sales	Sustainability could impact the image of the organization as a whole, which in turn impacts any marketing materials and any sales messaging.
Senior management	Sustainability could impact senior management's strategic planning and goal setting for the future.



Exhibit 2-8: Groups Affected by Sustainability Initiatives (concluded)

Group	How Impacted
External Groups	
Landlord	Sustainability could impact how the organization attracts tenants and the requirements landlords have of those tenants.
Tenants	Sustainability could impact how the organization selects a location and what amenities the organization requires.
Service providers/suppliers	Sustainability could impact whether or not the organization gets a contract. It may also affect reporting requirements.
Governing authorities	Sustainability could impact laws around greenhouse gas emissions, carbon footprint and the monitoring and tracking of hazardous waste.
Utility providers	Sustainability could impact the demand for utilities. Depending on the type of utility, it may also affect any rebates the provider may offer.
Neighboring businesses	Sustainability could impact neighboring businesses, who may feel more motivated to pursue their own sustainability efforts.
Community	Sustainability could impact people living near the facility and in the entire community. The facility's actions may affect their experiences and daily activities in positive and negative ways.
Workplace	Sustainability could impact the very way that work gets done and even transform it.

Supporting stakeholders' interests in sustainability

The facility manager must also be prepared to educate management about the sustainable interests of their stakeholders. An organization's internal and external stakeholders could include:

- Management and investors/shareholders, if the organization is publicly held.
- Business units within the organization, such as facility management.
- Clients and customers.
- Organization members (e.g., employees).
- Community members (e.g., neighbors, local organizations).
- Regulators (e.g., local government planning agencies, safety monitoring agencies).

Because of the benefits and risks associated with an organization's position on sustainability that were discussed in Chapter 1, stakeholders may urge the organization to include sustainability in its values and strategic plan. The facility manager must be ready to discuss with management the implications of neglecting any of these perspectives. For example, the organization may be sacrificing the trust of regulators if it does not collect and report required data completely, accurately and in a timely fashion. Tenants may be concerned that the building's operating and maintenance strategy is at odds with their own



Developing a strategy for sustainable facility management

commitment to sustainability. Fidelity to shareholder interests can be questioned if management does not act responsibly to decrease energy costs and increase asset value.

The goal of strategic planning is to develop business-driven schemes and convert them into plans of action. A sustainability strategic plan outlines the sustainability direction of an organization, including the broad, long-term, significant plans, methods and actions by which the organization will operate.

Development of the sustainability plan involves the following phases:

- Phase 1: Understanding (preparing a plan, identifying sustainable objectives)
- Phase 2: Analysis (evaluating initiatives/ideas)
- Phase 3: Planning (formulating and validating the plan)
- Phase 4: Acting (presenting the plan)

Once this process has been completed, the output will be an enterprise-wide sustainability plan that will identify the various initiatives and projects that the organization can undertake. This sustainability plan can serve the organization for many years and allows for the continuous improvement of the organization's Triple Bottom Line.

Each phase is described below.

Understanding

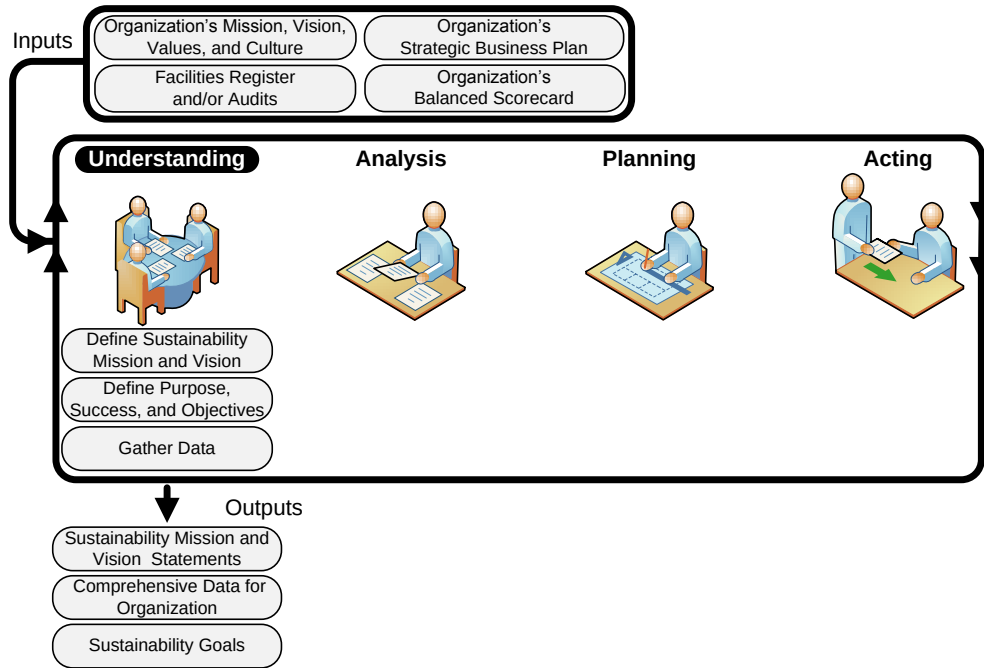
The first step of developing a sustainability plan is to gather all pertinent people and information. There are four key tasks to engage in when preparing to develop a plan:

- **Get a management sponsor.** A sponsor will continuously work to emphasize the importance of developing a sustainability plan. This person should ultimately be the individual who will provide assistance when it is time to present the plan to the appropriate level of management for approval and funding.
- **Form a cross-functional team.** Team members can be chosen from the groups listed in Exhibit 2-8.
- **Define the criteria for ideas.** Basic guidelines must be established to help the team determine the criteria to be used for financial justification of sustainable initiatives—for example, return on investment or payback period.
- **Generate potential cost-saving ideas.** One of the best places to discover opportunities for cost saving is within the operating budget. The cross-functional team and the stakeholders should look at each line item of the operating budget and determine how the organization could reduce each cost.



The inputs, processes and outputs for this phase are shown in Exhibit 2-9.

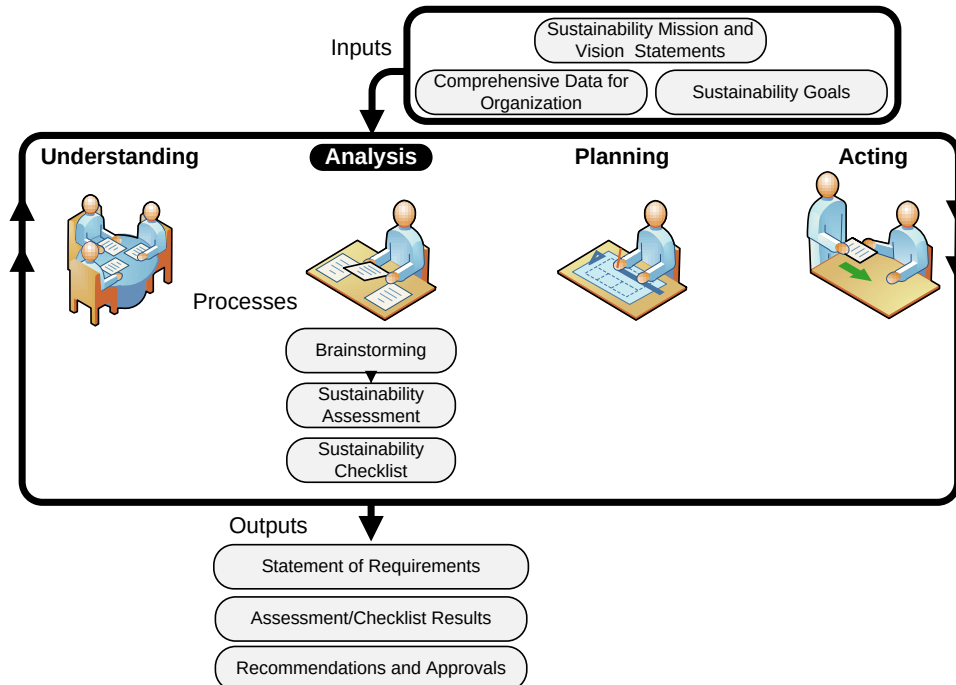
Exhibit 2-9: Strategy Life-Cycle Model (Understanding Phase)



Analysis

Exhibit 2-10 shows the inputs, processes and outputs for the Analysis phase.

Exhibit 2-10: Strategy Life-Cycle Model (Analysis Phase)



Regardless of the size of a facility or whether it is owned or leased, program implementation begins with evaluating and measuring the current situation. The first and most logical areas to approach include:

- Utility consumption.
- Waste production.
- Indoor environment quality.
- Site characteristics.
- Material and resource use.
- Supply chain.

The team will also assess high-level user requirements, weigh the strengths and weaknesses of the organization, rank and prioritize objectives, and generate one or more potential strategies. Potential strategies are usually tested for feasibility and best use of funds.

Frequently, organizations begin their sustainability program implementation by conducting a sustainability audit or assessment to identify opportunities.

A sustainability audit is the method for recording important facility characteristics, including utility use and waste stream as well as other quantitative attributes. A sustainability audit also includes an evaluation of the policy, practices and procedures that relate and contribute to sustainable facility management. This includes interviews with appropriate stakeholders within the organization. An important part of the sustainability audit is to establish which measurement and monitoring processes are in place within the facility.

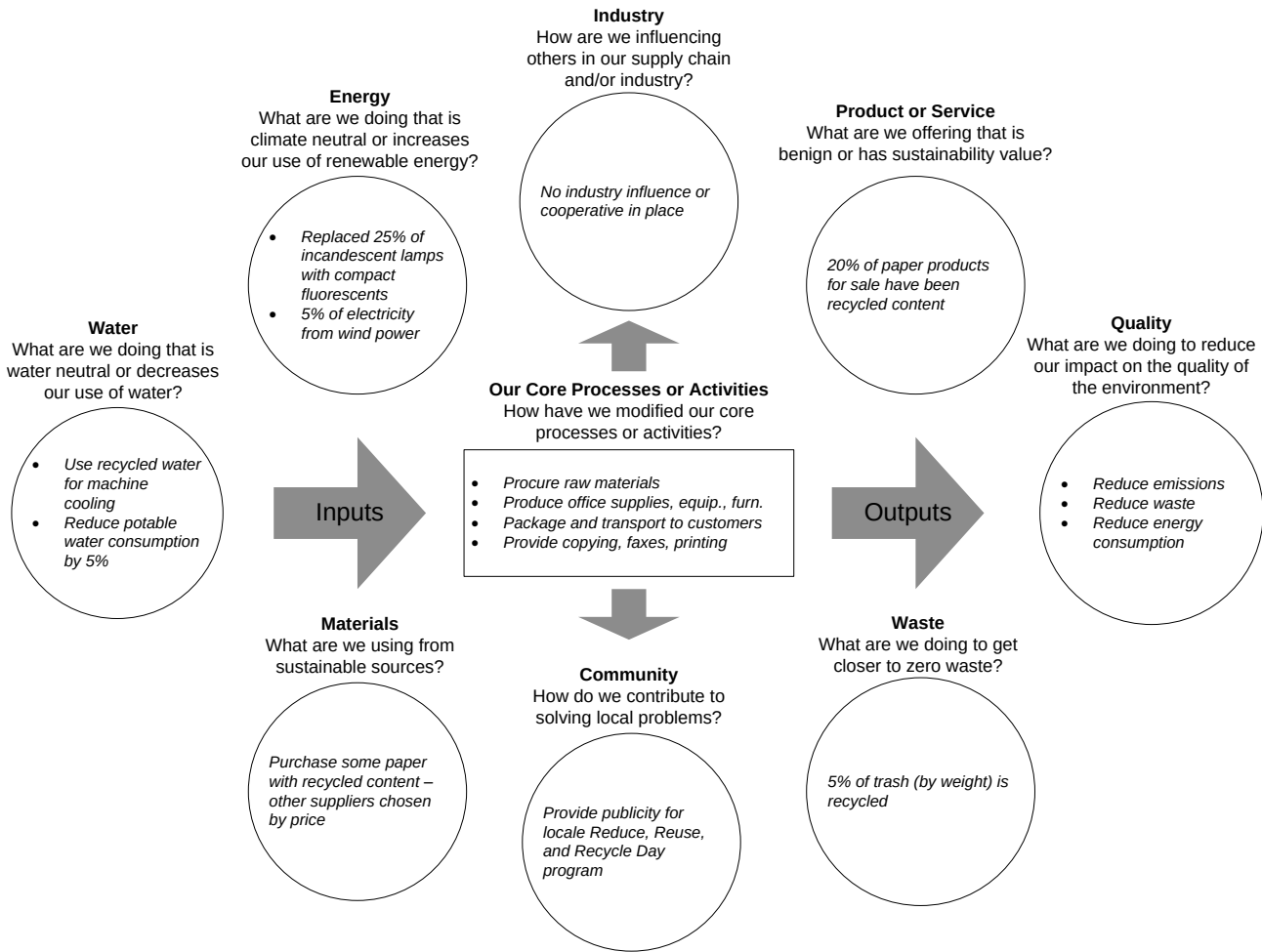
A sustainability audit looks at opportunities for improving the organization's sustainability from different perspectives. It describes the organization's core processes, the activities that are necessary to conducting them (inputs) and the necessary outcomes of these processes (outputs). Exhibit 2-11 on the next page illustrates a sample audit process for an office supplies company.

Opportunities are then analyzed according to the cost and effort required for implementations and the potential savings or impact on sustainable goals.

The result of this analysis may include a set of strategic user requirements, a gap analysis indicating the difference between the current versus the desired services and organizational assets, a set of viable strategies from which decision makers can select, and a recommended strategy. The facility manager will build a business case to support the recommended strategy.



Exhibit 2-11: Sustainability Assessment for Office Supplies Company



Source: Adapted from “FM Sustainability: Creating Your Action Plan” (online course).
Houston, Texas: International Facility Management Association (IFMA).

A business case provides the reasoning for initiating the project and demonstrates how the project supports the organization’s strategy and goals as well as how it will drive results. (Business cases are discussed in detail in the competency on *Finance and Business*.) Sustainability is often treated like any other business initiative. If a sustainability initiative doesn’t have a positive impact on the bottom line, then it is not likely to be accepted by the organization. Facility managers can use the Triple Bottom Line to analyze and show the impact of a plan.

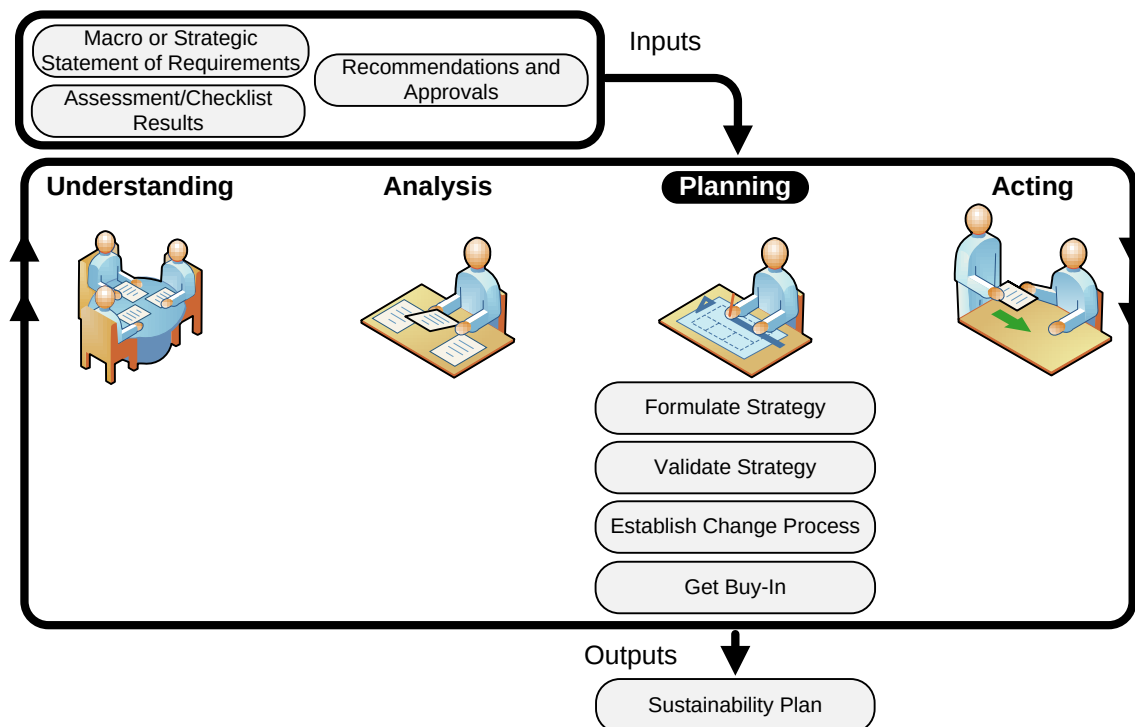
Planning

Planning involves evaluating the business cases and developing a preliminary sustainability plan. The plan should include sufficient details, including budget and schedules, to support decision making. This plan is



then circulated within the team. This plan should be the cumulative: If the team believes that the first 10 ideas should be implemented, a summary listing should be created showing the costs and savings up to that point along with the net savings and the combined payback. Exhibit 2-12 illustrates the inputs, processes and outputs associated with the planning phase.

Exhibit 2-12: Strategy Life-Cycle Model (Planning Phase)



Acting

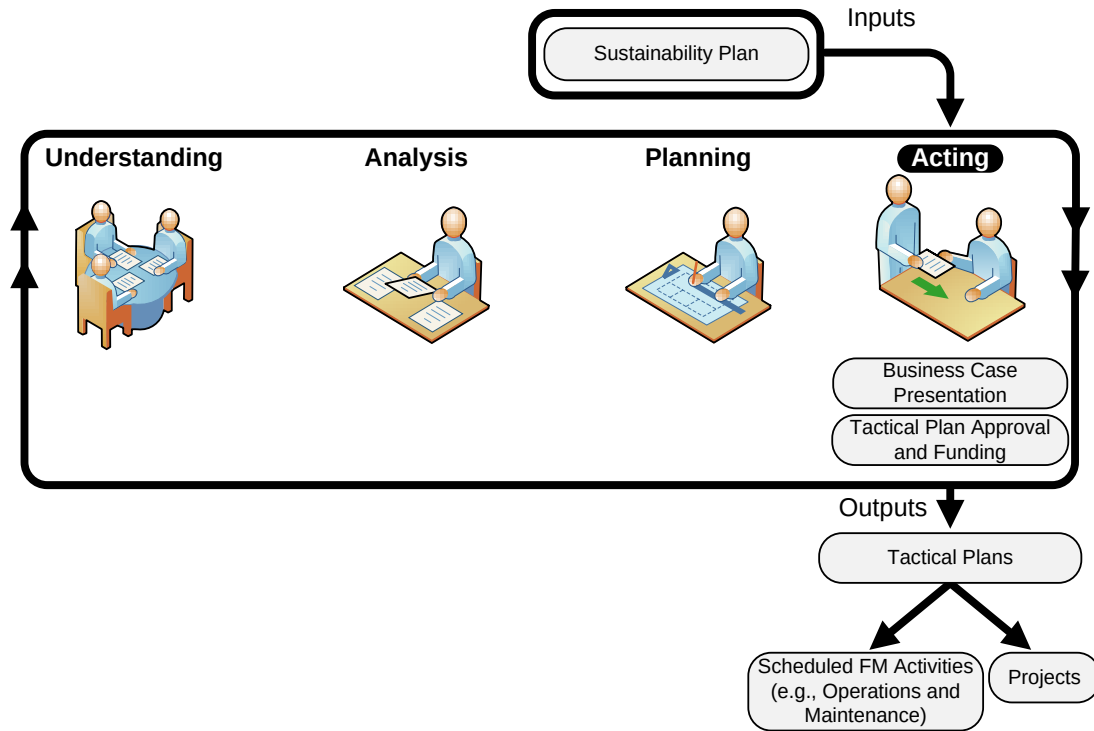
The final phase of developing a sustainability plan is to present the plan to management. The presenter, identified by the team, should have updated and finalized presentation materials and any accompanying materials that would be helpful to explain concepts and support analysis. Resource materials can be very influential when proposing the plan.

Exhibit 2-13 on the next page shows an overview of the Acting phase.

Once a management decision has been received, the facility manager can begin the process of implementing specific initiatives—being careful to collect appropriate data that can evaluate the plan’s effectiveness and support possible modification.



Exhibit 2-13: Strategy Life-Cycle Model (Acting Phase)



✦ Topic 3: Sustainability Projects

Sustainability projects are the outputs of the organization’s sustainability planning process. Projects usually have designated leaders and cross-functional teams. The facility manager usually facilitates the development of the project and ensures the integrity of the facility is protected.

The steps to establishing a sustainability project are as follows:

1. Make a commitment.
2. Assess the current performance. This may involve gathering data from sources such as building automation systems and invoice records. This data may be benchmarked against performance of comparable facilities.
3. Set the facility goals in one or all of the eight categories of sustainability. An example from the site impact category might be to “reduce pollution and land development impacts from conventional automobile use for commuting trips.”
4. Create an action plan. A SWOT analysis can provide more information about strengths and opportunities that the facility can leverage and about weaknesses and threats that must be addressed.



5. Implement the action plan and define roles and responsibilities. Available budget and resources are allocated to provide the most impact on sustainable goals—balancing cost, feasibility, potential outcomes and schedules. Communicating the plan and engaging occupants will be critical to the plan’s success.
6. Measure and report performance against goals.
7. Evaluate progress.
8. Recognize achievements and summarize lessons learned.

The tasks involved in developing and leading sustainability projects require skills similar to those covered in the competencies on *Project Management* and *Leadership and Strategy*.

✦ Topic 4: Financial Decision-Making Tools

Financial tools that are commonly used as the basis for decision making with regard to sustainability initiatives include simple payback period, ROI, net present value (NPV), life-cycle cost analysis (LCCA), and total cost of ownership (TCO).

Simple payback period

The simple payback period (SPP) is the period of time required for the return on an investment to “repay” the sum of the original investment. It is the most widely used metric in capital budgeting. As the name states, the calculation is simple; as a result, placing too much weight on the payback period can often cause an organization to miss an opportunity. While simple payback period may be a quick and easy calculation, it is important to note that it does not take the impact of any cash flows that are received after the payback period into consideration or recognize the time value of money. A simple payback period is only as accurate as the costs and benefits that are used to calculate it.

There are two ways to calculate the simple payback period: one with equal annual savings and one with unequal annual savings.

Payback with equal annual savings

If the annual cash flows are equal, then the payback period is calculated by dividing the initial investment by the annual savings:

$$\text{Payback period (in years)} = \frac{\text{Initial investment cost}}{\text{Annual operating savings}}$$



Suppose the facility manager installed a new piece of more efficient equipment that cost US\$15,000 and this piece of equipment is expected to save the organization US\$6,000 a year. The simple payback period would be 2.5 years:

$$\frac{\text{US\$15,000}}{\text{US\$6,000}} = 2.5 \text{ years}$$

Payback with unequal annual savings

If the annual cash flow differs from year to year, the payback period is determined when the accrued cash savings equal the initial investment costs. Then the calculation is done by year; the simple payback period is when the cumulative cash flow balance equals zero.

Exhibit 2-14 shows an example of the same original investment of US\$15,000 and different cost savings each year.

Exhibit 2-14: Payback with Unequal Annual Savings

Year	Annual Cash Flow	Cumulative Cash Balance
0 (today)	(15,000)	(15,000)
1	5,000	(10,000)
2	2,000	(8,000)
3	3,000	(5,000)
4	2,000	(3,000)
5	3,000	0

Return on investment (ROI)

Return on investment is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (annual savings) of an investment is divided by the cost of the investment; the result is expressed as a percentage or a ratio:

$$\text{ROI} = \frac{\text{Annual savings}}{\text{Cost of an investment}}$$

Let's return to the example that was used for simple payback period. The ROI on that investment would be:

$$\frac{\text{US \$6,000}}{\text{US \$15,000}} = 40 \text{ percent}$$



Net present value

One way to determine if a project is worth pursuing is by calculating its net present value (NPV). NPV is the difference between the present value of cash inflows generated by the asset and the amount of the initial investment. It is one of the financial tools used to determine if a project is a “go.” The formula for NPV is as follows:

$$\text{Net present value} = \text{Present value of future cash flows} - \text{Net investment}$$

If the NPV is greater than zero, then the project has a positive economic benefit. If the NPV equals zero, then the project is neutral and requires further evaluation. If the NPV is less than zero, then the project has a net cash outlay (expense).

A negative NPV does not necessarily mean that the investment is not worth making. NPV is often used to determine the cash value of the best alternative, and the best alternative may be the alternative with the least negative cash flow.

Facility managers interested in sustainability prefer to use net present value because it is more rigorous than simple payback period and ROI. The rigor comes from the fact that NPV considers the time value of money and evaluates cash flows over time. The premise behind the time value of money is that money that one has now is worth more than money one will receive in the future. Because money can earn interest or be invested, it is worth more if it is available immediately. Facility managers proposing sustainability projects will be expected to justify their funding requests and show that the recommended projects will bring more value to the organization than will investing the money elsewhere.

When calculating NPV, the future cash flows are discounted back to their present value. The rate used to discount future cash flows to the present value is called the discount rate. The discount rate is the rate of return that could be earned on an investment with similar risk.

Let's compare two projects and determine their NPV (see Exhibit 2-15).

- Project A—The cost is US\$15,000, the annual savings are US\$2,000 over four years, and the discount rate is nine percent.
- Project B—The cost is US\$17,000, the annual savings are US\$5,500 over four years, and the discount rate is nine percent.

In this example, the preferred project to invest in is Project B.



Exhibit 2-15: Net Present Value

	Cost	PV*	Net Cash
Project A	US\$15,000	US\$2,000 x 3.2397* = US\$6,479	(US\$8,521)
Project B	US\$17,000	US\$5,500 x 3.2397* = US\$17,818	US\$818

Present value of US\$1 at compound interest

Period	5%	6%	7%	8%	9%	10%
1	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091
2	0.9070	0.8900	0.8734	0.8573	0.8417	0.8265
3	0.8639	0.8396	0.8163	0.7938	0.7722	0.7513
4	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830
5	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209

* The sum of the first four entries in the 9% interest column

Life-cycle cost analysis (LCCA)

Life-cycle cost analysis (LCCA) is the process of determining all costs incident to the planning, design, construction, operation and maintenance, and disposition of a structure over time. The terms “whole-life costing” and “cradle-to-grave” are synonymous with life-cycle cost analysis.

LCCA is often used to compare alternatives that meet the same need but have different initial and operating costs. LCCA is recommended to guide decisions related to high-performance building envelope, energy-efficient lighting, mechanical system selection, HVAC selection and stormwater management.

It is critical to address life-cycle costs before the project budget is fixed and to ensure at the goal-setting stage that it is clear that decision making is based on life-cycle costing. If only first-cost economics dictate decision making, then very different types of choices may be made.

Life-cycle costing is a complex process. The first step that is recommended is to calculate the simple payback period. If that calculation determines that it requires more than five years to recoup costs, then a life-cycle cost analysis may be required in order to make a sound recommendation.

Life-cycle cost analysis steps

The LCCA process can be broken down into eight simple steps. Exhibit 2-16 reviews each step in the process.



Exhibit 2-16: LCAA Steps

Step	Description
1: Identify project purpose and alternatives.	Identify the main purpose of the analysis and determine which alternatives are going to be considered. The alternatives must be comparable and must fill a common need. Ideally there should be at least three alternatives. For example, LCCA would not be used to compare an HVAC system with a new lighting system. However, LCCA could be used to decide whether to purchase standard equipment or high-efficiency equipment.
2: Determine the baseline.	Select the baseline alternative. This is the alternative that the others are going to be compared against.
3: Determine the activity time.	Determine the relevant time frame for the project costs. This must be determined for each alternative and usually equals its useful life (or the life of the equipment). • Activity time includes project start date and when project costs will occur. • Project costs include project management, design, construction, energy use, maintenance, disposal and any finance costs.
4: Determine the study period.	The time or study period is the period over which ownership and operations expenses are to be evaluated. Study length often reflects the intended life or use of an item. In facility evaluations, the allowable depreciation period is often used. The same period must be used for all alternatives to have an equitable comparison.
5: Identify and estimate the costs.	Identify the elements that are going to be included in the calculation. This includes documentation of the items that are to be excluded from the calculation. A monetary value must be calculated for each of the costs associated with each of the alternatives in the LCCA. This includes both first (i.e., initial) and future costs, which are defined below.
6: Complete the life-cycle cost calculation.	When all of the information for steps 1 through 5 has been collected, then the actual LCC can be calculated for each alternative. The life-cycle cost is calculated using the discounted present value of all project costs for all alternatives over the project life. The specifics of this calculation are covered below.
7: Consider any nonmonetary benefits and costs.	Next we consider any nonmonetary costs and benefits associated with the project. These would be items to which there is no objective way of assigning a monetary value. Examples include the lack of noise from a newer system or the satisfaction of employees.
8: Compare and select the best alternative.	When the prior steps have been completed for all alternatives, then the comparison of alternatives can begin. On the surface, the alternative with the lowest LCCA would be the best choice.

Initial and future costs

An LCCA includes both initial costs, also referred to as first costs, and the future costs. Initial costs are all costs incurred prior to occupation of the facility or prior to possessing the item. Initial costs are usually a known entity,



so they involve less estimating. Future costs are all costs incurred after occupation of the facility or after taking possession of the item. Calculating future costs is a little more complex as there are many unknown factors and multiple assumptions that must be documented.

Exhibit 2-17 lists examples of costs or expenses in these two categories.

Exhibit 2-17: Initial and Future Costs

Initial Costs	
• Purchase • Land acquisition • Construction • Design or engineering studies	• Equipment • Installation labor • Project management (in-house and external) • Loan down payment
Future Costs	
• Energy and resources <i>The estimated expenses for energy and resources are based on consumption, current rates and price projections.</i> • Operation, maintenance and repairs <i>These are costs associated with operating and maintaining the facility or piece of equipment. It is important to include the annual costs and other costs that are expected to occur at some point during the study period.</i> • Replacement <i>The same source must be used to calculate replacement costs as was used to calculate initial investment costs.</i> • Residual value (resale/salvage, disposal) <i>Salvage value is the value the piece of equipment or building is worth to someone else. When calculating salvage value for equipment, it is important to consider the money and time it would cost to get the equipment out of the building.</i>	• Finance charges and taxes <i>Finance costs include both the loan payment and any interest charged. Depending on the type of loan, the finance charges and taxes may be embedded within the statement. It may take some digging to find the correct amount.</i> • Nonmonetary costs <i>The items that fall into this category, such as safety, do not have a monetary value. Nonmonetary costs include items such as improved air quality and increased natural lighting. Even though they do not have a monetary value, these costs should be documented. When it comes time to make the final decision and all things are equal, it is the nonmonetary costs that will have the largest impact.</i>

Determining a discount rate

Once all of the costs have been researched and the appropriate figures gathered, the next step before the actual life-cycle cost can be calculated is to determine the appropriate discount rate.



A discount rate is a rate at which future cash flows are discounted because of the time value of money. There are two types of discount rates: real and nominal. The difference is that the real discount rate excludes the rate of inflation while the nominal discount rate includes it. Many organizations believe that inflation affects most expenses in a similar manner. Therefore, most facility managers choose to eliminate some of the complexity and use the real discount rate.

Calculating present value

To combine the initial and future expenses, the present value of the expenses must be calculated. Present value is the method used to compare costs; all cash flows are converted to their present value or the value of past and future dollars corresponding to today's value.

The present value calculation uses the discount rate and the time a cost was or will be incurred to establish the present value of the cost in the base year of the study period. In addition to time, the discount rate also dictates the present value of future costs. When using the real discount rate for present value calculations, the costs must also be expressed in like terms.

In the case of initial costs, it is assumed that they already occur in the base year. Therefore, it is unnecessary to calculate their present value. Their amounts will be used as they stand when the life-cycle cost is calculated.

The situation is different with future costs. These occur sometime in the future; therefore, their present value must be calculated. Future costs are broken down into two categories: one-time and recurring. Recurring costs are those that occur every year over the study period. One-time costs are those that do not occur every year over the study period. Replacement costs are often considered one-time costs.

To determine the present value of future one-time costs, the following formula is used:

$$PV = \frac{A_t \times 1}{(1 + d)^t}$$

Where:

- PV = Present value.
- A_t = Amount of one-time cost at time t.
- d = Real discount rate.
- t = Time (expressed in number of years).



To determine the present value of future recurring costs, this formula is used:

$$PV = \frac{A_0 \times (1 + d)^t - 1}{d \times (1 + d)^t}$$

Where:

- PV = Present value.
- A_0 = Amount of recurring cost.
- d = Real discount rate.
- t = Time (expressed in number of years).

Once all of the information that goes behind each of the factors has been assembled, the following formula is used to complete the life-cycle cost calculation:

$$\text{Life-cycle cost} = IC + PV \text{ of FC} - PV \text{ of RV}$$

Where:

- Life-cycle cost = Total life-cycle cost in present value terms.
- IC = Initial costs.
- PV of FC = Present value of the future costs (excluding the residual value).
- PV of RV = Present value of the residual value less any disposal costs.

Total cost of ownership (TCO)

When an organization decides to purchase a major asset, it has committed to a stream of costs over its lifetime. When this stream of costs is added up, it comprises the total cost of ownership (TCO). *Getting Started*, part of the IFMA Foundation Sustainability “How-To Guide” Series, provides a more complete picture, stating that the total cost of ownership “includes the cost to design, build, operate and maintain, and dispose of a facility over its service life.” TCO, similar to life-cycle costing, shows that there can be a large difference between the price of something and its long-term cost. The largest difference between the total cost of ownership and life-cycle costing is the inclusion of nonmonetary costs; life-cycle costing includes both monetary and nonmonetary costs in the final decision.



TCO analysis is used to support acquisition and planning decisions for a wide range of assets that bring significant maintenance or operating costs across a long usable life. Total cost of ownership is used to support decisions involving computing systems, vehicles, buildings, laboratory equipment, medical equipment, factory machines and private aircraft.

Financially, TCO analysis is used for:

- Budgeting and planning.
- Prioritizing capital acquisition proposals.
- Lease vs. buy decisions.

Good TCO analysis brings out the hidden or non-obvious ownership costs that might otherwise be overlooked in making purchase decisions or planning budgets. As with any decision-making tool, TCO has some advantages and disadvantages. Exhibit 2-18 shows that TCO is a good tool to guide decision making as long as its disadvantages are considered and accounted for.

Exhibit 2-18: Advantages and Disadvantages of TCO

Advantages	Disadvantages
• Brings out hidden costs of ownership • Points out potential cost issues before they become a problem • Finds additional cost savings • Points out avoided costs	• Does not take into consideration business benefits not related to costs • Assumes benefits are the same for all decision options • Assumes the choice is solely made on price • Does not factor in nonfinancial benefits

Summary

CEOs and CFOs may openly embrace and even champion sustainability efforts, but the reality is that these individuals speak the language of finance and the bottom line. As a result, the facility manager's understanding of the decision-making tools covered in this section is critical to the success of any sustainability initiative. Exhibit 2-19 on the next page details the tools and how they are used by organizations and, more specifically, by facility managers to make decisions on sustainability initiatives. The "difficulty" rating of low, medium or high refers to the amount of information, time and resources needed to complete the calculation.



Exhibit 2-19: Decision-Making Tools

Decision-Making Tool	Difficulty	Definition	How Tool Is Used to Make Decisions
Simple payback period	Low	Calculated by dividing initial cost of a project by annual expected savings.	• Evaluate a project's economic feasibility. • Determine how quickly the initial costs will be recovered. • Decide if the facility manager should spend additional time and resources to research and implement the initiative. • Uncover if additional synergies can be gained in other areas as a result of this improvement.
Return on investment	Low	A measure of how efficiently management employs financial resources; annual return divided by average annual investment.	Generate one number that is then easily compared with the ROI from other projects.
Net present value	High	Difference between the present value of cash inflows generated by the asset and the amount of the initial investment	Forecast value delivered by alternate investment options over time.
Life-cycle cost analysis	High	Process of determining all costs incident to the planning, design, construction, operation and maintenance, and disposition of a structure over time. Reflects the total cost of ownership over the life of the asset, not just capital investment and operating costs. Analyzes all life cycle costs of a system or a component.	Compare two or more projects that are different with regard to size (monetary requirements) and timing. Make decisions based on an "equal" discounted cost value.
Total cost of ownership	High	Financial management strategy that accounts for the complete life cycle (cradle-to-grave) measurement and management of a physical asset's useful life. Includes both direct costs that are specifically related to the item or asset and indirect costs shared by several grouped assets.	Decide whether to service, refurbish or replace certain elements.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. A sustainability policy provides guidance on sustainable FM practices in _____ so that the present and future decisions of an organization can be made for the good of the company, the community and the environment.

- ☐ a. social, environmental and economic areas
☐ b. health and safety standards
☐ c. occupant health and productivity
☐ d. reduced pollution and landfill waste

2. What are the main parts of a sustainability policy?

3. Why is it important to identify the key stakeholders in an organization?

- ☐ a. They can act as contributors or potential barriers.
☐ b. They provide a link to the sustainability policy.
☐ c. They can develop the business case.
☐ d. They are the link to the community.

4. List three examples of hard benefits of sustainability policies.

5. List three characteristics of green leases.

6. What are the four phases for developing a sustainability plan?



7. Which of the following tasks should occur during the first phase of sustainability plan development?
- () a. Assign members to assist with developing business cases.
 - () b. Develop cash flow.
 - () c. Review preliminary businesses cases.
 - () d. Define what criteria will be used to consider and evaluate ideas.

8. List the steps to establishing a sustainability project.

9. How is simple payback period with equal annual savings calculated?

10. How is return on investment calculated?

11. Define life-cycle cost analysis.

12. How is the life-cycle cost analysis tool used to make decisions?

13. Define total cost of ownership.



Progress check answers

1. a (p. 2-15)
2. Sustainability vision, scope, performance metrics, goals, procedures and strategies, time period, responsible party (p. 2-14)
3. a (p. 2-16)
4. Cost-efficient manufacturing processes or other processes that directly affect cost reduction, money-saving measures such as reducing the amount and/or cost of business travel, profit-making activities such as selling surplus energy to the grid (p. 2-20)
5. Characteristics of green leases include mutual incentives for sustainable behavior, transparency and communication of performance results, and alignment of interests and compromise. (p. 2-19)
6. Understanding, analysis, planning, acting. (p. 2-26)
7. d (p. 2-26)
8. Make a commitment, assess the current performance, set the facility goals, create an action plan, implement the action plan, measure and report performance against goals, evaluate progress, recognize achievements and summarize lessons learned. (p. 2-31)
9. Simple payback period with equal annual savings is calculated by dividing the initial investment cost by the annual operating savings. (p. 2-32)
10. Return on investment (ROI) is annual savings divided by the cost of the investment. (p. 2-33)
11. Life-cycle cost analysis is the process of determining all costs incident to the planning, design, construction, operation and maintenance, and disposition of a structure over time. (p. 2-35)
12. LCCA is often used to compare alternatives that meet the same need but have different initial and operating costs. (p. 2-35)
13. The total cost of ownership (TCO) “includes the cost to design, build, operate and maintain, and dispose of an asset over its service life.” (p. 2-39)



Chapter 3: Measuring and Reporting Sustainability

After completing this chapter, students will be able to:

- Define carbon footprint and measurement tools for greenhouse gas emissions.
 - Characterize the purposes of ISO standards and the Global Reporting Initiative reporting framework.
 - Describe the purpose and contents of energy performance statements.
 - Provide examples of sustainable building certification systems.
 - Explain how the sustainability balanced scorecard and ENERGY STAR's Portfolio Manager can be used to measure the facility's sustainability performance.
-

✦ Topic 1: Metrics

Metrics are critical to successful facility management and even more so when analyzing sustainability initiatives:

- Metrics can provide a starting point for developing a business case to gain management support for a sustainability initiative. They provide part of the story about how much money the facility spends, for example, on water, electricity or heating.
- Only by establishing a baseline can facility managers assess the effectiveness of a sustainability initiative and report to management on the value of their investment in the initiative.
- If a facility manager has access to benchmark data as a point of comparison, the facility manager can more easily identify problem areas that merit attention and investment.
- As metrics accumulate, they become a self-benchmark for the facility—a way of measuring current performance against historical data. In some cases, these comparisons can point out problems in building systems, such as leaks or malfunctioning sensors.

Metrics may be objective, such as kilowatts of electricity used or cubic feet of gas. They may also be checklists of sustainability requirements the facility fulfills. Metrics and benchmarks should be carefully chosen. They must measure the right aspects of a problem in a reliable and reproducible manner. As much as possible, they should not be subject to other factors that may change. If they are, then the inconsistencies must be able to be resolved through normalization methods. For example, measuring per-occupant energy



consumption for a building with volatile occupancy rates will not yield meaningful results.

Obtaining meaningful and accurate measurements of sustainable impact is technically challenging. However, international organizations have proposed standard approaches to measuring such disparate performances as decreasing greenhouse gas emissions and improving indoor environmental quality. The rest of this chapter considers tools to measure greenhouse gas emissions, sustainability performance standards, metrics for standardized sustainability reporting, benchmarking and systems for certifying sustainable buildings.

✦ Topic 2: Measuring Greenhouse Gas Emissions

As this competency illustrates, sustainable facility management depends on developing common terminology and establishing and communicating best practices. It also depends on developing and using globally recognized metrics so that progress, or lack of it, can be identified, documented and, in some cases, reported—to government agencies and/or sustainability certification bodies, such as the Building Research Establishment Environmental Assessment Method (BREEAM).

One of the more common ways to illustrate the effects of sustainable and non-sustainable energy practices is by measuring greenhouse gas emissions, since these emissions, associated with the use of carbon fuels, contribute directly to global warming. The primary greenhouse gases are carbon dioxide, methane, nitrous oxide and ozone. Of these gases, carbon dioxide has the highest global warming potential.

Carbon footprint

The carbon footprint is a very powerful tool in understanding an organization's impact on climate change. According to www.eoearth.org, a carbon footprint is the “measure of the amount of greenhouse gases produced by human activities.” The carbon footprint of an organization is measured annually as the total of CO₂ output measured in tons.

The total carbon footprint of an organization is made up of two parts:

- The primary footprint is the measure of the direct emissions of CO₂. These come from the burning of fossil fuels for energy consumption and transportation. The organization has direct control over these.
- The secondary footprint is the measure of the indirect emissions of CO₂. These come from the whole life cycle of a product, cradle to grave.



Generally, the organization does not have direct control over these emissions, which are often referred to as the supply chain carbon footprint.

Measuring GHG and CO₂ emissions

The challenge in measuring the facility's greenhouse gas and carbon dioxide emissions is not only to gather data about energy consumption but to capture data for all sources of energy, both direct and indirect, and to convert that into carbon dioxide equivalent. Because of the variety of organizations involved in reporting, a number of protocols and tools have been developed to assist organizations in calculating their GHG emissions and carbon footprint.

One example is the Common Carbon Metric, which was developed by the United Nations Environmental Programme-Sustainable Building and Climate Initiative (UNEP-SBCI). It measures:

- **Energy intensity.** A facility's energy intensity is calculated as kWh per square meter or occupant per year. This result is then multiplied by the official GHG emission coefficients published for each fuel type.
- **Carbon intensity.** Carbon intensity is calculated as kgCO₂e per square meter or occupant per year. For conversion factors, users are directed to the Greenhouse Gas GHG Protocol, which offers standards for reporting and calculation tools for different sectors. The GHG Protocol is published by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).

Another example is the U.S. Environmental Protection Agency's ENERGY STAR Portfolio Manager program, which includes tools to calculate a building's total GHG footprint from direct and indirect energy use. For on-site direct use, Portfolio Manager applies fuel-specific factors for heating value, carbon content and carbon oxidation to the facility's consumption data. Indirect emissions capture energy used or lost in the transmission process. These are calculated using data submitted by generators to the U.S. EPA's eGRID database. Facility managers enter consumption data (from bills and meters) for each fuel type, and the tool applies the appropriate conversion factors to yield data on CO₂, CH₄, N₂O and carbon dioxide equivalents (CO₂e). For purchased electricity, the tool designates the facility's electrical grid and the applicable conversion factor.

Portfolio Manager also allows organizations to compute and deduct Green Power purchases (renewable energy certificates) and electricity generated on site with renewable energy sources, such as solar. Renewable energy certificates (RECs) are discussed in Chapter 4.



✦ Topic 3: Defining Sustainable Practices

Standards and frameworks

As the sustainability movement has matured, different organizations have attempted to define what constitutes sustainable practices in order to provide guidance to organizations engaged in sustainable transformation. Two prominent groups involved in this movement are the International Organization for Standardization (ISO) and the Global Reporting Initiative (GRI). ISO's work is termed "standards": methods that have been determined to be "best practices" and are clearly defined in the standard. The GRI refers to its work as a sustainability reporting framework—a less rigid and defined set of "good practices" that provide the outline of a sustainability reporting program.

ISO

ISO is the world's largest developer and publisher of international standards. ISO is a nongovernmental organization made up of a network of the national standards institutes of 163 countries. It forms a bridge between the public and private sectors and enables a consensus to be reached on solutions that meet both the requirements of businesses and the broader needs of society.

ISO standards are voluntary and not enforced. However, many countries or organizations may adopt certain standards as regulations. The following ISO standards are related to sustainability initiatives.

- ISO 14001 establishes the requirements for an environmental management system that can be used by an organization to measure and document the organization's environmental impact.
- ISO 15392 identifies and establishes general principles for sustainability in building construction.
- ISO 21930 provides principles and requirements for Type III environmental declarations of building products.
- ISO 26000 is intended to assist in contributing to sustainable development and encourage organizations to go beyond legal compliance and promote a common understanding of social responsibility. ISO 26000 provides guidance on:
 - Concepts, terms and definitions related to social responsibility.
 - The background, trends and characteristics of social responsibility.
 - Principles and practices relating to social responsibility.
 - The core subjects and issues of social responsibility.
 - Integrating, implementing and promoting socially responsible behavior throughout the organization and, through its policies and practices, within its sphere of influence.
 - Identifying and engaging with stakeholders.
 - Communicating commitments, performance and other information related to social responsibility.



Global Reporting Initiative (GRI)

Twenty-plus years ago, corporate sustainability reports usually consisted of environmental statements created by chemical companies trying to clean up their images. Today, organizations issue these reports for many reasons, including:

- Image management and message impact.
- Benchmarking performance on specific issues.
- Promoting transparency and accountability.
- Complying with government requirements and mandates.

Sustainability reporting is fast becoming an essential part of management practice for successful organizations of all sizes worldwide. Providing a comprehensive sustainability report communicating past and current sustainability initiatives may be required by investors and is often sought after by vested stakeholders. The audience may be different for each organization, and portions of the content may differ for each audience.

To increase the transparency, consistency and quality of these reports, the Global Reporting Initiative (GRI), a network of organizations, developed a reporting framework that defines what to report (the organizational profile and key areas for sustainable management) and how to measure and report it (meaningful metrics for areas as diverse as energy or water consumption and occupant productivity).

For reporting purposes, GRI has described performance indicators in three categories that correspond to the Triple Bottom Line:

- Economic: flow of capital among stakeholders and economic impacts of the organization throughout society
- Environmental: materials, energy, water, biodiversity, emissions and waste, products and services, compliance, and transport
- Social: employment practices and labor relations, occupational health and safety, training and education, diversity and equal treatment, human rights issues (e.g., child labor), society (e.g., community involvement, competitive practices), product responsibility (e.g., labeling, customer privacy)

Exhibit 2-20 provides examples of GRI performance indicators in these areas.



Exhibit 2-20: GRI Performance Indicators

Performance Indicator	Reported Data
EN3: Direct energy consumption by primary energy source Note: Direct or primary energy sources include coal, natural gas and products distilled from petroleum. Direct primary renewable energy sources include biofuels, ethanol and hydrogen.	Nonrenewable and renewable primary energy sources used Direct energy sources produced and sold Total energy consumption (direct energy purchased and produced minus direct energy sold) Total direct energy consumption from renewable and nonrenewable energy sources
EN4: Indirect energy consumption by primary source Note: Indirect, intermediate or secondary energy has been converted from primary energy to another, more usable form, such as electricity, heat or steam.	Amount of intermediate energy purchased and consumed from nonrenewable and renewable energy sources (solar, wind, geothermal, hydro, biomass intermediate, hydrogen intermediate) Amount of primary fuels consumed to produce intermediate energy (This data reflects energy loss experienced in the process of conversion and distribution of intermediate energy, such as electricity. Source energy may be several times greater than site energy—energy that enters the facility.) Total amount of intermediate energy consumed and primary energy consumed in its production
EN8: Total water withdrawal by source Note: Withdrawal equals consumption. This metric helps indicate the scale of potential impacts and risks associated with the facility's water use.	Total volume of water withdrawn from any water source, either directly or through intermediaries such as water utilities (includes abstraction of cooling water) Total volume of water withdrawn in cubic meters per year (m ³ /year) from surface water (includes wetlands, rivers, lakes and oceans), groundwater, rainwater, wastewater from another organization, and municipal or other water utilities
EN2: Percentage of materials used that are recycled input materials	Total weight or volume of materials used (from EN1) Total weight or volume of recycled input materials (list any estimation methods) Percentage of recycled input materials used
LA7: Rates of injury, occupational diseases, lost days, and absenteeism and total number of work-related fatalities by region	Injury rate (IR), including fatalities Fatalities as absolute number Occupational diseases rate (ODR) Lost day rate (LDR) Absentee rate (AR)
EN 29: Significant environmental impacts of transporting products and other goods and materials used for the organization's operations and for transporting members of the workforce	Significant environmental impacts of the modes of transportation used (e.g., energy use, emissions) Significant environmental impacts of transportation used for logistical purposes and for transportation of members of the organization's workforce How the environmental impacts of transportation are mitigated



✦ Topic 4: Certifying Sustainability Achievements

Energy performance statements

Energy performance statements focus on one aspect of a building's sustainability—energy consumption. Some governments have required that buildings measure and report their energy efficiency to the public to support decisions about purchasing, selling or leasing facility space. These statements are often reported as benchmarks, comparing the facility's energy use against that of comparable structures.

Two examples of energy performance statements are the Statement of Energy Performance and the Energy Performance Certificate. Both of these statements of energy performance use a metric that will be described briefly first—energy use/utilization intensity (EUI).

Energy use intensity

EUI is usually measured in the following manner:

$$\text{EUI} = \frac{\text{Annual building energy use (kBtus or MJ)}}{\text{Building area (square foot or meter)}}$$

EUI can also be expressed per occupant or as a ratio of energy cost to organization revenue.

Energy use can include site and source energy. Site energy refers to the amount of energy entering the facility, either as direct or primary energy (e.g., natural gas) or as indirect or secondary energy (e.g., electricity). Facility managers can identify site energy through utility bills. Source energy includes energy required to store and transport primary fuels and to generate, transmit and distribute secondary energy. Source energy is determined by applying multipliers to the site amount. Source energy multipliers for electricity vary but can be three times the site energy. Multipliers can be obtained from providers.

FM should use and interpret EUIs cautiously. Depending on how energy use and area are defined, the resulting ratio may not give a very accurate picture of a facility's energy efficiency. For example, if a calculation includes only site energy, it can make a facility seem more efficient than another facility that is using site and source energy. If the area includes space that is not conditioned, the EUI will be artificially low. Using maximum occupancy levels when there are high vacancy rates can also produce deceptive EUIs.



Statement of Energy Performance

The Statement of Energy Performance (SEP) can be completed for any building in a facility manager's ENERGY STAR portfolio. (ENERGY STAR is a tool created by the U.S. Environmental Protection Agency and is described later in this chapter.) An SEP contains the following useful information:

- Actual site energy use annualized to a 12-month period.
- EUI by site and source.
- Emissions in tonnes of CO₂e per year.
- Comparisons of site and source EUI with national averages.
- Confirmation that indoor environmental quality has not been sacrificed for energy efficiency (e.g., acceptable ventilation and thermal conditions).

Energy Performance Certificate

EU Directive 2002/91/EC on the energy performance of buildings defined standards and requirements for a process that could result in better-informed purchasers and lessees who could use a building's energy performance as a decision factor when reviewing potential properties. The system could also encourage property owners to focus on improving the energy efficiency of their properties, since it would now be a critical success factor.

The directive has been transposed into national laws, which can vary significantly. The U.K. law covers both residential and commercial properties. An Energy Performance Certificate (EPC) is required whenever a building is constructed, sold or leased. There are some exceptions, such as places of worship, temporary buildings or buildings with very little energy use, such as a car park. EPCs can be prepared for entire buildings or for areas within the building. If a building has a shared heating/cooling system, a facility manager can base energy performance for an area on the building's EUI or can compare the space with a comparable one in the facility.

An EPC rates a building on a 100-point scale, with a score of 92 to 100 qualifying as an A rating. The rating derives from a comparison of the building's actual performance with its potential performance based on equipment and type. The certificate also includes recommendations for improving the structure's energy performance.

Building certification systems

Various building certification systems have been developed to help organizations document their sustainability accomplishments and achieve recognition of their efforts. The goal of a sustainable building certification system is to ensure that the constructed building meets the owner's operational requirements while minimizing the impact of the building on the environment throughout its life, providing a healthy and productive environment for occupants, and reducing building energy and water use. The system provides



an objective standard for certifying that a building is environmentally friendly or sustainable. Applicants' success in meeting these standards is determined by licensed, trained assessors.

It is important to note that building rating systems provide goals and metrics to use in designing and implementing the organization's sustainability strategy. They provide legitimacy and context to justify the organization's strategy; many organizations use parts of these systems to develop their programs and sell them to management and stakeholders.

A number of building rating systems are in use today around the world. These systems are fairly similar in the subjects they address, but they can be quite different in their main focus and how they are implemented as well as other important ways. The differences stand out when comparing the requirements of sustainable building evaluation systems developed for different building types, regions, countries or points in a building's life cycle. Exhibit 2-21 summarizes information about seven major systems.

Exhibit 2-21: Sustainability Building Rating Systems (continued on next page)

Building Rating System	Country of Origin	Key Points
BREEAM	United Kingdom	• Oldest building assessment system • Evaluates building management, energy use, health and well-being, pollution, transportation, land use and ecology, materials, water
LEED	United States	• Developed by the U.S. Green Building Council • Offers rating systems for commercial interiors, homes, core and shell, health care, new construction, retail, schools, and existing buildings operations and maintenance
CASBEE	Japan	• Key concept is building environmental efficiency (BEE) • Four assessment tools corresponding to life cycle: pre-design, new construction, existing buildings, renovation
Green Globes®	Canada	• Offers an effective, practical and affordable way to advance the overall environmental performance and sustainability of commercial buildings • Operated by Green Building Institute in U.S.
Green Star	Australia	• Developed to promote common language and standard measurements, integrated whole building design and awareness of life-cycle impacts • Includes categories on management and innovation



Exhibit 2-21: Sustainability Building Rating Systems (concluded)

Building Rating System	Country of Origin	Key Points
Green Mark	Singapore	- A benchmarking scheme that incorporates internationally recognized best practices in environmental performance and design - Emphasizes impact on both the environment and occupant
Three Star System	China	Government standard focusing on land savings and outdoor environment, efficiency (energy, water, materials), indoor environmental quality, and operations and management

✦ Topic 5: Managing Performance through Measurement

Even if organizations do not report the results of their sustainability programs, it is essential that they plan to measure their efforts regularly and consistently. This allows decision makers and facility managers to adjust strategies to improve performance and to allocate resources to actions proven to show results. Various tools can be used to help facility managers measure and assess the facility's sustainability performance, including ENERGY STAR Portfolio Manager and the sustainability balanced scorecard.

ENERGY STAR Portfolio Manager

ENERGY STAR Portfolio Manager is not a whole-building rating system but a well-respected performance management tool that analyzes a building's water consumption, carbon footprint and investment priorities. (Portfolio Manager's use in calculating the organization's carbon footprint and in generating a Statement of Energy Performance was discussed earlier in this chapter.)

Facility managers enter data on building resource use into Portfolio Manager. They can then establish baselines and then track levels over time. Analysis of these data and trends suggests areas for improvement and prioritizes opportunities for investment, which helps align the organization's sustainability plan with its overall strategic plan. It also helps monitor the effect of changes and identifies possible issues with policies and systems.

Sustainability balanced scorecard

The balanced scorecard is a strategic planning and management system used extensively in business and industry, government and nonprofit organizations to align business activities to the vision and strategy of the organization, improve internal and external communications and monitor organization



performance against strategic goals. Its approach to strategic planning is distinctive in that it analyzes organizational choices and performance from different perspectives: financial, process, customer and learning and growth. The balanced scorecard is discussed in *Leadership and Strategy*.

The sustainability balanced scorecard is based on the traditional balanced scorecard but adds a focus on objectives and initiatives directed at achieving sustainability goals and applies the perspectives of the Triple Bottom Line (i.e., social, economic and environmental). The process of creating a sustainability balanced scorecard helps ensure that FM's sustainability program is:

- Aligned with the organization's strategy and values. For example, FM may choose to focus on energy efficiency to help the organization meet its financial goals and on water efficiency so that it can be a better corporate citizen in its community.
- Aligned with the needs of different stakeholders. An initiative aimed at lowering electrical load must be considered from the financial perspective (e.g., ROI), the process perspective (e.g., impact on Operations), the customer perspective (e.g., the effect on customers' and occupants' abilities to satisfy their own goals) and the growth and learning perspective (e.g., new knowledge and skills that will be developed as a result of this action).
- Prioritized by impact. Specific initiatives should be chosen because of the potential environmental impact they promise compared to the required investment. An inexpensive initiative that produces little environmental impact is not desirable.
- Assessed from all three perspectives of the Triple Bottom Line. Each initiative should be considered from the perspective of financial stakeholders, occupants and customers, and the environment. For example, a lighting retrofit project must consider the organization's budget, occupants' need for adequate lighting and the waste created by changing fixtures.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. How is carbon intensity described in the Common Carbon Metric?

Match each ISO standard with its description.

- | | |
|--------------------|---|
| 2. _____ ISO 14001 | a. Provides the principles and requirements for Type III environmental declarations of building products. |
| 3. _____ ISO 15392 | |
| 4. _____ ISO 21930 | b. Assists in contributing to sustainable development; intended to encourage a facility manager to go beyond legal compliance and to promote a common understanding of social responsibility. |
| 5. _____ ISO 26000 | c. Establishes the requirements for an environmental management system that can be used by an organization to measure and document the organization's environmental impact. |
| | d. Identifies and establishes general principles for sustainability in building construction. |
6. Which of the following statements about the Global Reporting Initiative (GRI) is correct? (*Select all that apply.*)
- () a. The GRI is a globally recognized building certification system.
- () b. One of its purposes is to improve the quality of sustainability reporting.
- () c. GRI assessments focus only on environmental performance.
- () d. GRI provides guidance on how to report results of sustainable policies.
7. Which of the following statements about Energy Performance Certificates (EPCs) is correct? (*Select all that apply.*)
- () a. EPCs are mandatory in the U.K. whenever a building is constructed, sold or leased.
- () b. The score is based on incremental improvement in the building's energy use.
- () c. EPCs compare a building's actual energy performance with its potential performance.
- () d. Facilities applying for EPCs receive ratings as acceptable or not acceptable.



8. What is the goal of sustainable building rating systems?

9. ENERGY STAR Portfolio Manager allows facility managers to:

- ☐ a. automate their core building systems to save energy.
- ☐ b. test different energy saving scenarios for their facilities.
- ☐ c. collect and analyze data on energy use for facility structures.
- ☐ d. perform sustainability audits of their facilities.

10. A sustainability initiative should be prioritized according to _____
and _____.



Progress check answers

1. The Common Carbon Metric measures energy intensity, calculated as kWh per square meter or occupant per year, and carbon intensity, calculated as kgCO₂e per square meter or occupant per year. (p. 2-47)
2. c (p. 2-48)
3. d (p. 2-48)
4. a (p. 2-48)
5. b (p. 2-48)
6. b and d (p. 2-49)
7. a and c (p. 2-52)
8. To ensure that the constructed building meets the owner's operational requirements while minimizing the impact of the building on the environment throughout its life, providing a healthy and productive environment for occupants, and reducing building energy use (p. 2-52)
9. c (p. 2-54)
10. The return on investment and the environmental benefit (p. 2-55)



Chapter 4: Focus Areas for Sustainable Facility Management (Input)

After completing this chapter, students will be able to:

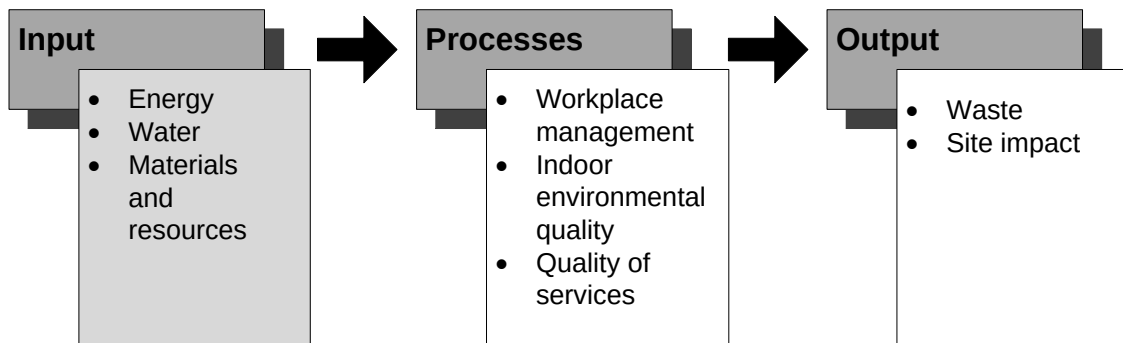
- Describe and illustrate the goals of sustainable energy use.
 - Describe measures facility managers can take to decrease the facility's energy consumption.
 - Distinguish between renewable and nonrenewable energy alternatives.
 - Describe tools and strategies to help facility managers improve the sustainability of facility energy purchasing practices, including metering and submetering.
 - Describe ways in which facility managers can optimize facility energy use through, for example, commissioning, energy audits, and building automation systems.
 - Describe the process of carbon trading and the role of carbon offsets and renewable energy credits.
 - Summarize key goals in increasing the sustainability of a facility's water consumption.
 - Trace the flow of water into, through and out of a facility, and describe the issues related to each part of that path.
 - Describe ways to increase the efficiency of facility fixtures and fittings, boilers and cooling towers.
 - List key elements in water-conserving landscaping.
 - Describe ways in which water may be reused and harvested to decrease water withdrawals.
 - Describe sustainable goals for facility management of materials and resources.
 - Describe a sustainable procurement process.
 - Explain how a facility's sustainable performance can be affected by its supply chain partners.
 - Explain the significance of sustainable product certification labels and programs.
 - List sources to verify product sustainability claims.
-

Sustainable facility management practices are often complex and are evolving quickly, so this competency cannot be a complete survey of sustainable facility operations and maintenance practices. Instead, the following chapters focus on goals related to each of the eight areas of sustainable facility management and describe briefly some initiatives aimed at those goals. These areas are shown in Exhibit 2-22.



Chapter 4 will focus on input categories, Chapter 5 on process categories and Chapter 6 on output categories.

Exhibit 2-22: Major Categories of Sustainable Facility Management



✦ Topic 1: Energy

Program goals In terms of energy use, the goals of sustainable facility management are fairly simple.

- **Use less.** Reducing energy consumption by decreasing demand and increasing efficiency satisfies two considerations for sustainability: to reduce the use of finite resources, such as fossil fuels, and to reduce pollution, including greenhouse gas emissions and other air and water pollutants.

Increasing the efficient or productive use of energy is the foundation for increasing a facility's sustainable energy use. A report prepared by the National Association of Energy Service Companies noted that:

Many people think first of renewable energy technologies, such as photovoltaics, when they think about green buildings, but energy efficiency is the technical and economic foundation of a green building project. On the technical side, no renewable energy technology is inexpensive or reliable enough to offset inefficient end uses, so a building's energy use must be minimized to make optimal use of renewable energy.

Increasing efficiency without decreasing demand, however, does not necessarily result in using less energy. The quest for efficiency must be carried on simultaneously with a continuous search for energy uses that can be reduced or eliminated.



- **Use more energy derived from renewable sources.** This addresses the sustainability goal of reducing pressure on finite resources by changing the source of energy from finite fossil fuels to renewable energy sources. Initiatives aimed at this goal include:
 - Purchasing more energy from renewable sources. In both regulated and deregulated markets, facility managers can look for ways to increase the amount of facility energy derived from renewables. Nonrenewable energy use can be offset by purchasing credits.
 - Generating energy on site (e.g., with solar-powered systems) and replacing facility equipment powered by fossil fuels with models that are powered by alternative sources of energy.
- **Use energy in a more socially and environmentally responsible manner.** Being a sustainable organization entails recognizing the potential of the facility's actions to improve or degrade the well-being of its communities. Decreasing carbon emissions and other pollutants contributes to the health of the general population and protects communities from the possible climatic effects of global warming. By managing when the facility uses electrical power, for example, a sustainable facility not only saves money but removes pressure from its immediate and widespread communities—by decreasing the need for additional generating plants (whose construction will necessitate increased energy rates) and lowering the risk of brownouts and blackouts caused by excessive demand on the power grid.

From a design standpoint, the ultimate objective is the development of net-zero energy buildings, also known as zero net energy buildings (ZNE). These high-performance buildings are grid-integrated and capable of generating as much energy as they consume, using cutting-edge technologies and on-site generation systems such as solar power and geothermal energy. The U.S. Department of Energy has developed a goal of market-ready commercial net-zero energy buildings by 2025 and residential net-zero energy buildings by 2020 through the Building Technologies Program. Meeting this type of goal will not only require constructing new buildings with new technologies, but operating and maintaining them with the skills and core competencies of the facility manager in mind.

Use less energy

Using less energy generally involves:

- Upgrading the building envelope to decrease infiltration, heat loss and solar gain.
- Improving the efficiency of core systems.
- Optimizing energy use.
- Decreasing the plug-in load.



Upgrading the building envelope

Upgrading the building envelope reduces energy demand and increases system efficiency. Temperatures can be maintained more easily, allowing systems to operate less frequently. Building envelope improvements can also result in reduced heating and cooling loads, which lead in turn to lower energy bills and the possibility of eventually downsizing system components during the replacement cycle.

Upgrades to building envelopes that affect energy performance focus on increasing insulation and reducing infiltration and solar heat gain. Sustainable activities include the following.

- **Insulation.** Walls and roof areas should be insulated to a level consistent with the local climate. Insulation value should be a decision factor when replacing existing doors and windows.
- **Inspection.** Regular inspections of the building exterior should be implemented, particularly those areas around doors and windows, the roof and subroof structure, any openings in the envelope made for vents or pipes, and junction areas between the foundation and walls, the walls and roof and conjoined exterior panels. Maintenance of the envelope to prevent infiltration has the additional benefit of preventing moisture from entering and accumulating inside the facility, damaging structures and potentially elevating mold levels in facility air.
- **Decreasing solar gain.** Solar radiation adds directly to cooling needs. Facility managers can use low-E windows, window films and internal and external shading devices. Trees are also effective defenses against solar gain through facility windows.

Improving the efficiency of core systems

The term “core building systems” refers to installed equipment that is integral to providing common building services:

- Heating, ventilation and air conditioning (HVAC) systems, including:
 - Control systems (thermostats, sensors, building automation systems).
 - Boilers to heat water and/or generate steam.
 - Heating equipment, such as furnaces, and other heating devices, such as radiant heating and solar heating systems.
 - Cooling system equipment, such as chillers, cooling towers.
 - Ventilation equipment, including ductwork, fans, fan coils, air-handling units to condition and circulate air, exhausts, variable air flow mixing boxes.
 - Other devices, such as variable speed drives, humidity control equipment, heat storage reservoirs, heat recovery units.



- Lighting, both interior and exterior.
- Electrical systems.
- Transport systems, including lifts, escalators, moving walkways.
- Plumbing, including:
 - Domestic and process water heating and cooling.
 - Pumping and distribution throughout the facility.

(Other building systems—safety/fire suppression and communication/computer systems—are discussed under Topic 3, “Quality of Services.”)

HVAC systems

There are opportunities to improve the efficiency of a building’s heating, cooling and ventilation during design, scheduled replacement/retrofits, and operations and maintenance activities. Facility managers can upgrade entire systems or components to increase efficiency as part of a projected replacement schedule. In some cases, savings may justify replacing inefficient equipment earlier than scheduled. If an organization has been implementing numerous changes to increase the facility’s energy efficiency, system replacement provides a good opportunity to size the facility’s equipment to the new load. Capacity can also be matched more closely to actual occupancy rates.

Efficiency can be improved in each component of the HVAC system as well. Notable technologies include:

- **Variable speed drives.** These electronic devices can be added to motors, allowing the motor to save energy by adjusting its speed to current load requirements. For example, reducing a fan’s speed by 20 percent saves 50 percent of its energy consumption.
- **Demand-controlled ventilation.** Demand-controlled ventilation can save energy by reducing the volume of air delivered to a space that must be heated or cooled. The capability can be added by integrating CO₂ sensors and controls with HVAC equipment. The amount of unconditioned outside air drawn into a building depends on the concentration of carbon dioxide in occupied areas of the facility.
- **Heat exchange technology.** Devices capture waste heat and use it to preheat water or fresh air. The heat exchange principle is also used in desiccant cooling/heat enthalpy wheels.



- **Economizers.** Air-side economizers control dampers to mix cooler outside air with return air, decreasing energy needs for cooling. Water-side economizers use the same principle for cooling towers.

It is easy to overlook one of the most obvious and effective ways to increase system efficiency: ensuring that pipes and ducts are properly insulated.

Operation and maintenance activities can also increase HVAC efficiency. Equipment can be sequenced for greater efficiency. Temperature settings can be adjusted, and unnecessary simultaneous heating and cooling can be identified and avoided. Proper maintenance (planned predictive/preventive maintenance as well as unplanned corrective or emergency maintenance) can help the facility achieve—or at least approach—efficiency levels promised by manufacturers. Automatic water conditioning systems can decrease formation of scale and sediment.

Lighting

Facility lighting is a common target for efforts to improve energy efficiency, both because of the energy directly consumed by lighting fixtures and the increased cooling demand that lighting creates. ENERGY STAR reports that decreasing the lighting load by one watt per square foot in a 100,000-square-foot building would result in a chiller capacity reduction of 23 tons.

At the same time, occupant needs must be considered when modifying facility lighting. An upgrade is not sustainable if increased energy efficiency results in the failure to meet the organization's other needs. For example, an organization managing a resort complex may want to decrease its electric bill, but it also wants its housekeeping staff to be able to see what needs to be cleaned and its guests to be able to climb stairs safely or use a parking area at night. It wants all occupants to be able to see critical and informational signage. It also needs to support an image that will attract guests.

Sustainable lighting strategies include:

- Incorporating daylight as much as possible.
- Using more efficient sources of artificial light, such as compact fluorescents and LEDs.
- Using more efficient fixtures with electronic rather than mechanical ballasts.
- Combining task lighting with ambient lighting.
- Installing more controls to allow some lights to be turned off.



- Using occupancy sensors to turn lights off automatically.
- Automating lighting control in building automation system.

Energy consumed by lighting can also be decreased through improved maintenance practices, such as keeping lamps and reflectors free of dust and replacing lamps on a schedule, rather than waiting for them to burn out. This saves energy—and maintenance time—because lamps become less efficient as they approach the end of their useful lives.

Electrical

Activities aimed at improving the sustainability of the facility electrical system include:

- Establishing a preventive maintenance program, inspecting system components for odors, discoloration, deformation and heat, and manually operating all switches to prevent corrosion. Infrared thermography can be used to detect overheating in inaccessible areas.
- Implementing a predictive maintenance program.
- Correcting low power factor by adding capacitors on problematic loads. This is referred to as power factor correction. The capacitors store reactive power (measured in kVARs) created by induction motors and release energy in opposition to create a more balanced load. Facilities with power load issues may require the advice of electrical system experts.
- Checking electrical system design and capacity when the facility expands.

Transport

Lifts can be made more efficient by:

- Switching from hydraulic to traction or magnetic drives.
- Using controls to manage lift routes according to occupant needs.
- Using LEDs for cabin lighting.

Plumbing

Facilities may be using potable water provided through a municipal system, well water or water reclaimed from other facility processes. The different sources of water—with different temperatures and chemistries—may affect how it can be used more sustainably.

Opportunities to improve the sustainability of facility water heating include:

- Installing solar thermal systems that can meet at least part of the facility's demand for heated water.
- Installing more efficient water heaters.



- Installing multiple smaller heaters rather than one large heater that will consume more energy.
- Ensuring that circulating pumps for domestic hot water are not operating when the buildings is unoccupied.
- Ensuring appropriate insulation of tanks and pipes.
- Reducing hot water temperatures to 140 to 160°F (or 60 to 71°C), when code-compliant. ENERGY STAR recommends 120°F for laundries.
- Taking advantage of newer technologies if appropriate, such as tankless water heaters or heaters that use heat transfer technologies.
- Reducing wasteful use of heated water by installing low flow showerheads, single temperature fittings and automatic shutoff valves (which will reduce waste through leaks).

Optimizing energy use

Facility managers can approach optimizing building systems through the use of commissioning, energy audits, energy contracting and building automation systems.

Commissioning

Commissioning is a planned and integrated systematic process of verifying and documenting that all building systems perform interactively according to the design intent and the owner's operational needs. Ideally, the process should begin with the design phase and last at least one year after the construction phase and into the occupancy phase, and it should include training of operations and maintenance staff.

Commissioning is a labor intensive process, but research has shown that its economic benefits often provide a good return on investments of time and money. Research into the benefits of commissioning by the U.S.-based Lawrence Berkeley National Laboratory collated and analyzed data from 224 buildings. Analysis showed that commissioning projects produced 15 percent median whole-building energy savings and had a median payback period of 0.7 years. In the study period, the 224 buildings discovered over 7,000 problems in the course of building commissioning.

Post-occupancy inspections are called recommissioning. Systems' current performance is measured against initial benchmarks, and repairs or changes are made to meet the original building goals. The reinspection should be exhaustive and revisit all systems (including not only HVAC systems but building controls, lighting controls and irrigation systems) and the building envelope.



Existing buildings that were never commissioned after construction may implement commissioning as well, in a process called retrocommissioning. Data is gathered from various sources—e.g., complaints, maintenance reports, utility bills, original documentation—and analyzed to identify performance gaps. These gaps can then be prioritized and addressed.

Continuous commissioning is an ongoing process to resolve operating problems, improve comfort, optimize energy use and identify retrofits. Tools can include building automation system reports and alerts, monthly energy invoices, building information, O&M records and reports of problems. Continuous commissioning offers the important benefit of identifying problems more quickly, before their effects can cause significant energy loss or wasted consumption or impair occupant comfort.

Energy site audits

In energy audits, building practices are compared to norms that are generally accepted markers of efficient operation. Audits can be performed by utilities or contractors, but facilities can also perform their own audits. Facility managers may draw on inventories that are part of ratings systems, such as ENERGY STAR, or the energy sections of facility rating systems, such as LEED or the Sustainability Tracking, Assessment and Rating System (STARS) for higher education facilities.

Energy audits promote sustainability, of course, only when they produce actual change. Facility managers can improve the efficacy of audits by establishing energy use levels, ideally by building system or area, before the audit and then measuring and documenting changes to energy efficiency after initiatives have been implemented.

Building automation systems (BAS)

Building automation systems (BAS) have helped facilities achieve the goal of being “smart.” In a smart facility, certain processes—such as shutdowns of power, lighting or irrigation schedules, adjustments to temperature setpoints, or demand response energy arrangements—can be conducted automatically, rather than manually, with improvements in efficiency. The systems also allow:

- Real-time monitoring and control of the entire system from a central or remote location.
- Issuance of alarms when conditions exceed predetermined limits.



- Performance of diagnostics.
- Documentation of performance and logging of errors. This enables analysis of performance for better problem solving and earlier identification of performance issues. It also allows facility managers to measure gains made by initiatives to provide feedback to management or to support applications for sustainable facility certification.

Building automation systems are discussed in the competency on *Technology*.

Energy performance contracting

Energy performance contracting (EPC) refers to a risk-based contractual agreement between a customer and an energy service company (ESCO) in which the ESCO promises to deliver specified energy performance in return for an agreed fee. The ESCO delivers all services and systems in a turnkey arrangement. In general, ESCOs improve a facility's energy consumption primarily by improving energy (and water) efficiency. A smaller part of ESCO business is to install engine/turbine generators, develop on-site renewable energy generation and consult on energy management, including billing and procurement of resources. The goal for an EPC project is to generate enough savings in facility energy costs to pay the full fees plus any charges the customer incurs to finance the project.

Decreasing the plug-in load

Advances in efficient use of energy have also been made in the various electronic devices and equipment (the plug-in load) used throughout a facility. Facility managers can improve the use of energy-efficient electronics and appliances by:

- **Purchasing energy-efficient electronics and appliances.** Energy efficiency ratings are available for electronics (e.g., computer components, servers, televisions), appliances (e.g., food service equipment, cleaning equipment) and lighting. ENERGY STAR is used in many countries. EnergySaving Recommended labels are used in the U.K. to rate the efficiency of appliances and electronics. In Europe, Ecolabel combines efficiency with other sustainability issues. TCO Certification, also in Europe, combines energy efficiency with ergonomics for computer and office equipment.
- **Avoiding standby power loss.** Standby power waste occurs when an appliance or electronic device is not in use but continues to consume



electricity. Facility managers can decrease this wasted energy consumption by:

- Ensuring power management settings are activated on facility computers.
- Installing energy-reducing devices, such as occupancy sensors for vending machines.
- Supplying occupants with smart power strips that can facilitate powering down groups of equipment and can automatically power down idle equipment after a set time.

Use renewable sources

Renewable energy sources include solar (thermal or photovoltaic), wind, hydro, tidal, wave, geothermal, biomass, biogas (or digester gas, the production of gas from the anaerobic breakdown of organic matter). Electricity is considered a secondary source of energy, produced by converting primary fuels into a more desirable or usable form. The goal is to use electricity generated as much as possible by renewable sources, rather than coal or natural gas.

When sustainable facilities are producing their own electricity on site, it is critical that they have some way to make the best use of excess electricity. There will be times, particularly with solar and wind, when the facility will generate more or less than it needs. If the facility can sell excess back into the grid, it avoids the considerable expense of storage batteries. It can also essentially “bank” excess electricity for those periods when the system is not generating power (e.g., cloudy or windless days). If the practice is allowed locally, a utility agrees to “buy back” net excess generation—electricity generated on site that is in excess of the facility’s need. The amount is determined by net metering, which may involve a single meter that can run backward, creating a credit. Alternatively, a utility may require a separate meter to measure on-site generation.

Solar

There are two approaches to capturing solar energy: photovoltaic (PV) and thermal. PV systems generate electricity, while low-temperature solar thermal collectors produce heat for space, process and water heating. (High-temperature concentrating solar thermal electric, or concentrating solar power, has been used by energy producers but is generally used on site only for special process applications. These systems use mirrors to produce extremely hot water that is used to operate electricity-producing turbines.) Both approaches have been proven effective for facilities. The type chosen usually depends on how energy is used by the facility. Facilities using a great deal of



hot water (e.g., residential halls, hotels) can benefit from thermal systems; facilities that need to power lights and electronics can benefit from photovoltaic systems.

Facility managers should consider a variety of factors when deciding about integrating solar power into the facility's energy use:

- Amount of sun (As systems become more efficient, requirements for certain hours of sunlight are being lowered.)
- In photovoltaic systems, the cost of electricity produced from other sources
- In thermal systems, characteristics of the facility's use of heated water (The most economic uses are in facilities that have a continuous need for heated water.)
- Government or utility rebates
- Potential to sell generated power back to the grid

Biomass

On-site generation of electricity and heat from biomass is practical when a facility has ample access to sources of biomass that do not require significant transportation.

The fuel can be burned to produce heat directly or fermented to produce gas that can then be used as a fuel. Excess heat can be used to run turbines and generate electricity, which the facility may be able to sell back to the electrical grid.

Geothermal

Geothermal systems have been installed in both residential and commercial buildings to capitalize on the difference between air and subsurface temperatures. In Iceland, for example, hot water is piped from below the surface for district heating and other purposes, such as heating sidewalks. Horizontal or vertical pipes that are filled with water (or antifreeze/water mixture in cold climates) are installed below ground or use wells or surface water, such as ponds. The fluid is piped into the building and uses heat transfer principles to both heat and cool interiors. Geothermal systems require a certain amount of space (more for horizontal systems) and the right type of soils.

Wind

Wind turbines produce few emissions, and excess electricity may be sold back into the grid in some locations. Their economic use on a large scale may be limited by high construction and battery storage costs, availability of transmission lines from installations and permitting processes. For a facility with access to adequate and fairly reliable wind speeds, however, small-scale



wind generation may be a viable option. For example, small wind turbines mounted atop parking lot lighting poles can supplement purchased electricity.

Micro hydro

Most people are familiar with large dams that generate enormous amounts of power, but some industrial plants have been able to capitalize on their locations to build small dams or “run of the river.” In this type of hydro project, water from a river is diverted into a channel or pipe where it spins turbines that produce electricity. Like wind energy, hydro power releases few emissions and excess electricity may be sold back into the grid. Unlike wind energy, it is predictable. Hydro’s potential is highly dependent on location, and projects require significant capital investment as well as environmental review and permitting.

Use energy more intelligently

A sustainable use of energy requires knowing how it is priced, how it is used within the facility, and how energy surpluses can be used to generate income and to decrease the facility’s carbon footprint.

Did You Know?

Facility managers will see two principal measurements of electrical usage on facility electricity bills: kilowatt (kW) and kilowatt hour (kWh). Kilowatt use quantifies how much electricity has been consumed. Kilowatt hours describe the rate at which electricity is being consumed, or demand. A common illustration of the difference between these terms involves ten 100-watt lamps. If ten lamps are illuminated for one hour during the course of a day, they will have consumed a total of one kW of electricity—10 lamps times 100 watts (1,000 watts) divided by 1,000 to convert from watts to kilowatts. If those ten lamps are all operated at the same time, they are consuming electricity at the rate of one kilowatt per hour, or one kWh.

Understanding electrical energy pricing factors

Electrical prices are uniquely affected by when power is used and how much is used in a given time period. High consumption and demand place a burden on transmission lines, which can carry only so much voltage, and cause disruptions in power supply, either complete loss or a drop in power supplied.

The peak component of electricity pricing reflects the realities of supply and demand. At those times when customers are more likely to use power, the kWh will cost more. Peak times typically occur during the workweek, during the workday and during the cooling season.



In addition, utilities may add demand charges, which are determined by a facility's maximum use during some period set by the electricity provider. For example, a demand charge may be set according to a facility's highest average kW as measured in 15-minute intervals throughout the day. This demand rate will be applied, and will not be lowered, for a certain time period, even if actual demand decreases.

If a facility manager can lower facility consumption and demand of electricity—for example, by improving the efficiency of core building systems and lowering cooling load, or by changing operating procedures to avoid or lower peak demand—the facility manager can decrease energy costs for the facility and deliver benefits to the environment (lower use of fossil fuels, fewer environmental effects from new power plants and transmission lines) and to society (less climate change, less disruption in electricity transmission, fewer increases in rates due to the need for expanded electricity infrastructure, fewer property and aesthetic issues associated with new transmission lines).

Monitoring and managing energy use

To manage electrical consumption and demand more sustainably, a facility manager must:

- Know the pattern of electrical consumption in the facility and how that pattern relates to pricing thresholds (e.g., peak and price step thresholds, peak times).
- Be able to manage energy consumption patterns.

A “smart” meter can track facility energy use both in terms of how much energy is being used and when it is being used. The meter can also communicate in a two-way manner with energy providers, so that providers know when actual demand is exceeding or falling below anticipated demand.

Submetering involves installing separate meters for defined facility areas. The areas may be tenant spaces, pieces of equipment or areas with energy demand that the facility manager wants to track separately.

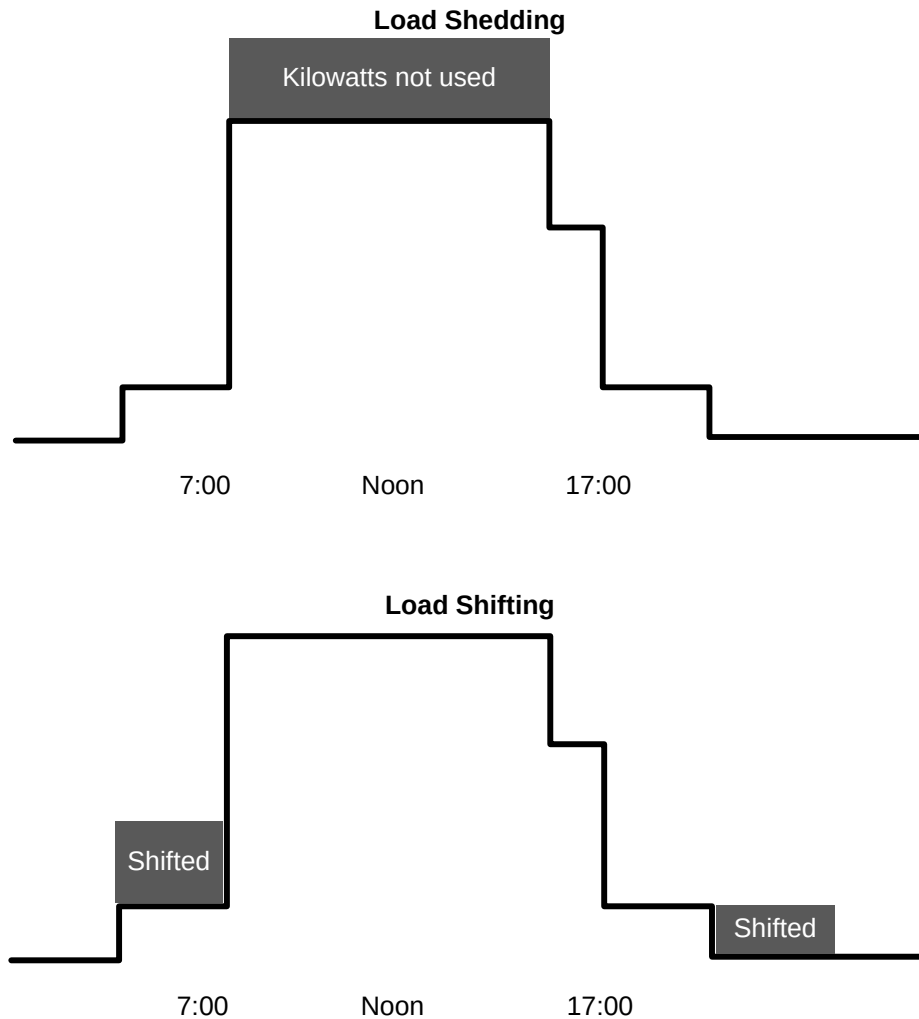
By installing smart meters and submeters for each major area or process, the facility manager can map facility consumption and demand in small time intervals (e.g., 15 minutes). Software applications can then be used to analyze this data and describe a load profile for the facility and specific areas. The facility manager can study this data for opportunities to manage energy use more sustainably.

One of the management tactics might be load shedding or load shifting (Exhibit 2-23). Load shedding reduces peaks in consumption levels by, for example, optimizing the HVAC system (raising cooling set points) or turning off certain



banks of lights. Load shifting involves rescheduling certain operations to lower peak demand and shift operations that are not time-sensitive to periods of the day (or week) when peak rates are lower. For example, a building may make ice at night, when the rates are low, and store it to use in cooling the building later during that time of day when temperatures—and electrical rates—are highest.

Exhibit 2-23: Load Shedding and Load Shifting



Demand response Demand response is a contractual arrangement between facilities and power companies in which facilities agree to reduce or shift their consumption during peak demand periods in return for defined financial incentives. The demand response contract specifies how much demand must be reduced and for how long. Analysts have noted that demand response arrangements reduce not only demand but also overall consumption—with reductions of four to eleven percent in overall electric consumption.



Changing occupant behaviors

Because technology may not be a complete or feasible solution in some situations, facility managers need to involve participants. Facility managers can:

- **Identify and remove obstacles to the desired occupant behavior.** Obstacles may be technological—e.g., occupants may not have access to necessary controls to turn off lights, computers may need to be left on at night for IT reasons. Inconvenience and discomfort may be factors as well.
- **Educate occupants about the issue and their role.** Providing educational information and feedback about the impact of the facility’s sustainability efforts can motivate increased occupant involvement. Information may be distributed via newsletters or e-mails or on a facility Web site. Some large facilities have implemented “energy dashboards” that provide occupants real-time access to the facility’s energy performance.
- **Fit solutions to the environment and provide support solutions for occupants.** A solution may be technological in some cases—e.g., a hotel room card key that places a room in occupied/unoccupied energy mode when the key is placed in a receptacle by the room door—and operational in others—e.g., an after-hours sweep by security who turn off lights in locked offices. Before choosing and implementing the solution, the facility manager should gather occupant feedback and buy-in. For any technological solution, the facility manager should enlist IT support and implement a help line or desk.

Exhibit 2-24 lists some ideas for influencing occupant behavior through organization and policy, technological support and feedback.

Exhibit 2-24: Changing Occupant Energy Consumption (continued on next page)

Organizational Ideas
• Implement “summer dress” policies to support a higher summer setpoint in buildings. • Enlist a local “champion” who can interact more directly with occupants about tactics for lowering energy use. • Include energy consumption as an item in regular department meetings. • Implement a policy that all tenant, organization or occupant equipment must be certified as energy-efficient or must be removed.
Technological Support
• Make it easier for occupants to turn off lights (e.g., subdivide large lighting banks into smaller areas that can be controlled separately, simplify switches and/or color-code switches to identify lighting banks). • Install passive systems that use occupancy or motion sensors. • Ensure that power management options have been set on all computers. • Insert a prompt before the computer shutdown sequence starts to remind occupants to turn off power strips and lights—or use smart power strips.



Exhibit 2-24: Changing Occupant Energy Consumption (concluded)

Feedback
• Create a Web or intranet-accessible “dashboard” to show occupants the impact they are having on energy use through their behavior. • Reward lowered use or compliance with policies by providing a free group lunch. • Put energy message signage at the point of use and change the message regularly so that it doesn’t become invisible. • Meter areas to provide tenants and floors specific feedback on consumption. • Provide reports from energy audits.

Implementing a carbon trading policy

Carbon trading is a market-based system that brings carbon credit buyers and sellers together. Businesses emitting carbon dioxide can purchase carbon credits, or offsets, to offset their emissions. A carbon offset is a measurable reduction of GHG emissions from an activity or project in one location that is used to compensate for emissions occurring elsewhere. They are sold as metric tons of carbon dioxide equivalents or tCO₂e.

Offsets can be produced by:

- Reducing emissions through increased efficiency or destruction of GHG. Methane gas has 21 times the global warming potential of CO₂, so removing methane from the atmosphere—by, for example, capturing and using or burning off methane released from landfills, manure and coal mines—benefits the environment.
- Sequestration of carbon biologically (in plants) or geologically (storing of CO₂ in rock formations)

Facility managers can support their organizations’ efforts to meet carbon caps, avoid carbon taxes and/or participate in carbon trading (i.e., purchase or sell carbon offsets in a carbon trading market) by:

- Ensuring that facility consumption data is available, complete and accurate.
- Focusing on facility projects that decrease carbon emissions—by decreasing consumption of fossil fuels and increasing the use of renewables.
- Ensuring documentation of projects that will be used to support carbon offsets. Facility managers may also be involved in helping to validate carbon offsets the organization purchases.



Did You Know?

In response to increases in GHG emissions and its commercial sector's large share of emissions (37 percent), the Tokyo Metropolitan Government has implemented a mandatory cap-and-trade scheme that requires covered organizations to reduce carbon dioxide emissions from 2010 to 2014 by an average of six percent compared to baseline emissions. The required decrease will climb to 17 percent in the next five-year period. After the first year, emissions exceeding the mandatory levels may be traded or banked. Three types of offsets are permitted:

- Emissions reductions from small and midsize facilities within the area
- Renewable energy certificates
- Emissions reductions for large facilities outside the area

Japan is in the process of implementing national and regional cap-and-trade markets.

Renewable energy credits (RECs)

RECs—or green tags or certificates, as they are termed in Europe—are similar in intent to carbon offsets (to reduce carbon emissions) and can be seen as complementary. Rather than representing removed or sequestered carbon, RECs represent electrical energy generated by renewable sources of energy. As such, they are a good way to capture reduction in Scope II emissions (indirect emissions, such as those from the generation of electricity). They can be used to meet voluntary renewable energy targets as well as compliance requirements.

These certificates can be bought and sold—by utilities, marketers or third parties—like shares in a company. They entitle purchasers to claim that they have produced an equivalent amount of renewable energy, although they have not actually produced the energy. Like carbon offsets, the REC scheme also allows producers to monetize the environmental value of excess energy produced on site from renewable sources.

Facility managers should make certain that they are purchasing RECs from reputable sources. In the U.S., sustainable energy products are certified by the Center for Resource Solutions in San Francisco (Green-e). The EU validates its own energy certificates through the Renewable Energy Guarantees of Origin (REGO) programs, which are operated within member states (e.g., Ofgem in the U.K.).



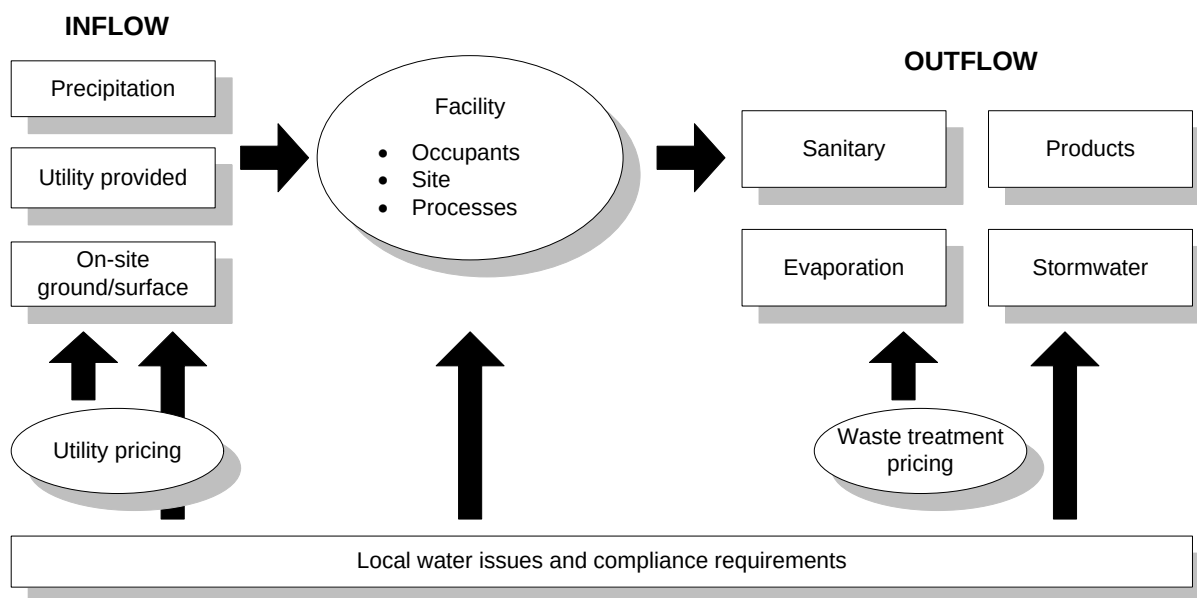
✧ Topic 2: Water

- Program goals** To improve the sustainability of facility use of this finite resource, facility managers must:
- Understand how the facility uses water.
 - Reduce the amount of water the facility withdraws from local sources.
 - Recycle facility water where possible.
 - Capture and use stormwater for certain facility purposes, subject to local laws and regulations.

Understand water use Facility managers should understand how water enters the facility, is used throughout the facility (including the volume of water used for different purposes) and leaves the facility. In addition, they should be aware of general issues surrounding water use in the facility's community and regulations and guidelines with which facilities must comply.

The diagram in Exhibit 2-25 illustrates how water flow into and out of the facility and external factors that influence water use.

Exhibit 2-25: Facility Water Flow Diagram



A facility manager should be aware of where and how much water is used within the facility as well as seasonal patterns of use (for example, during cooling season) and local laws and regulations that may affect water withdrawals.



Uses can include:

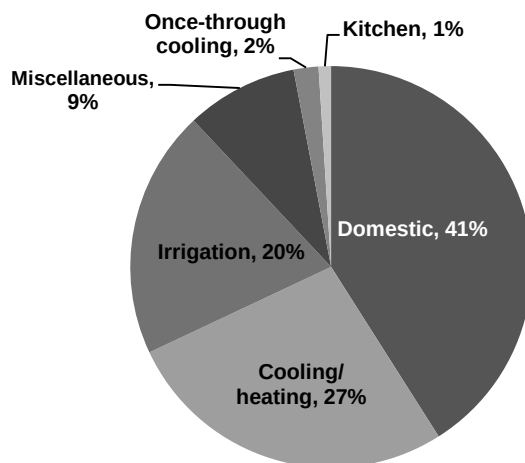
- Occupant use for drinking water, sanitation.
- Facility processes, such as manufacturing, food service, laundry, recreation.
- Core building systems, such as boilers and chillers.
- Site use for landscaping and exterior maintenance, including testing sprinkler systems.
- Product purchasing (indirect use of water through product life cycle).

Submeters may be used throughout a facility to establish baselines of water use. Sometimes, simple observation and mechanical measurement against time can be used to establish baselines. This data can support planning for and evaluation of water conservation initiatives and can be used to identify potential leaks—through, for example, a spike in water consumption in a particular area.

Establish water use benchmarks

Establishing a benchmark for facility water use—and ideally water use by specific systems within the facility—is a useful first step for identifying opportunities and setting priorities. By tracking information from submeters and invoices, facility managers can establish how water use is distributed among the facility’s primary water-consuming activities. Exhibit 2-26 shows how water is used in a typical U.S. office building, but the situation for facilities can be unique depending on the type of processes conducted in the facility, local regulations, geographic location and building age. For example, facilities in arid regions or communities affected by extended droughts may have already reduced the portion of water spent on irrigation—perhaps voluntarily but also because of economic and compliance pressures.

Exhibit 2-26: Typical U.S. Office Building Water Use



Source: U.S. Department of Energy, 2009.



Understand water pricing

Facility managers should also be familiar with their utility pricing structure. Some jurisdictions charge for sewer only. However, those charges will be calculated based on the facility's water use. In this case facility managers have an extra incentive to conserve water and also to track its use. Water that is used for irrigation and does not enter the waste water system is subtracted from the facility's total volume.

Some utilities charge a flat rate for access, but an increasing number are adopting pricing structures designed to encourage water conservation. An inclined-block price structure ties rate to the amount of consumption. When consumption exceeds a certain point, the facility's rate jumps to the next tier. An inverse pricing system, declining-block pricing, uses the incentive of lower rates if customers decrease water use.

Some utilities may tie rates to season, to reflect the impact of seasonal droughts, or to particularly high one-time withdrawals of water from the system.

Local governments may also restrict the amount of water that may be withdrawn from bodies of water and define the condition (e.g., chemical content, temperature) in which it must be returned to its source.

Reduce use

One of the simplest and most productive areas for water conservation inside the facility is plumbing fixtures and appliances. The following initiatives aimed at improving efficiency of fixtures and appliances can be implemented with a minimum of outlay:

- **Test and adjust building water pressure if needed.** Excessive pressure increases overall water consumption and can compound the number of leaks. Increased pressure also means that more water will be lost if a leak occurs.
- **Lower fixture flow.** Lower fixture flow by installing aerators on faucets and upgrading to low-flow faucets and showerheads and, where appropriate, to infrared sensor model faucets. Replacing older toilets can yield water savings of 77 percent. Replacements can be part of repair or renovation projects and can earn rebates in some areas.
- **Implement an aggressive maintenance program and leak reporting system.** Timely detection and fixing of leaks and routine checking and cleaning of parts vulnerable to clogging or corrosion are standard FM practices but also sustainable facility management practices. It may be helpful to enlist occupants and custodial staff in these efforts by implementing a leak reporting system. The key is to make reporting easy to do on the spot and to follow up with carefully tracked repairs.



Did You Know?

Increased water use means increased energy use. The U.S. EPA reports that letting a water faucet run for five minutes is about equivalent to running a 60-watt lamp continuously for 14 hours.

- **Use water-efficient appliances and equipment.** When replacing equipment such as washing machines or dishwashers, facility managers should consider both energy efficiency and water efficiency. Systems for labeling appliances according to their water use efficiency are evolving in the same manner that energy efficiency labels have.

There are other opportunities to save water as well. Facility managers can practice water-conserving landscaping and exterior maintenance. Waterless cleaning of surfaces and walks should be used when possible. Landscapes should be designed to require little irrigation—for example, by using native plantings rather than exotic ornamentals. Irrigation systems can also be designed to conserve water—by using drip systems, for example, and by integrating controllers, timers or sensors to deliver only the amount of water needed when it is needed.

Operations and maintenance on boiler systems and cooling towers can be improved as well. Sustainable operations find an alternative to the use of single-pass or once-through cooling systems that use water once and then discharge it into wastewater. Sustainable maintenance practices can prevent leaks, reduce corrosion and manage treatment of system water so that intake of fresh water can be decreased.

Recycle

Depending on local codes and regulations, graywater from facility processes and operations can be collected, stored, filtered and redistributed for other purposes.

In the first step, graywater is collected from the facility and directed into a containment system. Collection methods can be simple or complex and costly, depending on the facility and the collection site. In general, the graywater collection system operates in parallel with black water collection. This means additional plumbing that, in an existing facility, can be impractical. When collection plumbing can be simply installed at a single, accessible point and graywater can be directly removed to the collection device, the system may be



more practical. This may apply to facility cooling processes (where condensate can be recycled and reused as supply water) or laundry or food processing centers.

Graywater collected from some sources may be directed immediately back into the facility, without filtering or treatment—often to flush toilets. Other sources of graywater may require more treatment before the water can be reused. For example, water can be directed to settling tanks in which suspended solids are allowed to fall out and sink to the bottom of the tank. The solids can be pumped out later. Skimmers can be used to remove surface materials. Pumping the graywater through a sand filter may capture additional pollutants.

Graywater used for irrigation is generally delivered via subsurface distribution systems rather than through above-ground watering. This is because of the potential for bacterial/viral contamination of surfaces.

Capture rainwater for use

In a rainwater harvesting system, precipitation is collected from facility rooftops and hardscapes (such as parking areas) via gutters, downspouts, curbing and conduits. It can be directed into storage containers for later use, or it can be immediately redistributed for reuse in the facility. Excess runoff can be directed into the stormwater system.

Harvested rainwater can be used in landscape irrigation and facility water features, such as fountains or ponds. It can also be redirected back into the facility for use in cooling systems, flushing toilets, or cleaning exteriors and hardscapes.

Before implementing rainwater harvesting, however, a facility manager must consider to what degree the practice will affect water supplies needed to replenish surface water bodies and support dependent local animal and plant communities. Diverting rainwater to support water-intensive landscaping, facility amenities or equipment is not sustainable. Local covenants may restrict harvesting systems, and local jurisdictions may even consider the practice an appropriation of water rights. This may add to the expense and complexity of implementing rainwater harvesting.

In industrialized areas, facility managers must also consider the increased possibility that precipitation may contain heavy metals or that runoff may come into contact with contaminants in the facility (e.g., manufacturing materials stored uncovered and above ground). Harvesting and reusing this water could result in contaminating facility soils and facilitating entry of heavy metals into groundwater.



✦ Topic 3: Materials and Resources

Program goals In line with the general goals of sustainability, sustainable use of materials and resources implies:

- Using less materials and resources to avoid depleting finite resources.
- Using materials made from sustainable sources and/or recycled content.
- Purchasing in a sustainable manner.
- Avoiding the use of materials that contribute to pollution or pose hazards to occupants' health or safety.

The best way to accomplish these goals is to develop a sustainable procurement policy and ensure that it is followed.

Sustainable procurement

Purchasing is the specific buying activity or the placing of orders under the umbrella of a procured goods or service contract. Procurement is the systematic process by which an organization reaches formal agreements for the purchase of the supply of goods and/or services. The most significant difference between purchasing and procurement is that purchasing merely reflects the act of acquisition while procurement encompasses more of the components of the supply chain (logistics, transportation, packaging, etc.).

Previously, purchasing meant buying things at the lowest possible price. The bottom line was the most important thing for any organization: staying within the budget or getting an item as cheaply as possible, maximizing profit. Sustainable procurement expands the definition of “price” to include costs associated with the entire product or service life cycle as well as impact on the environment and people.

Facility managers may share the responsibility for purchasing with other departments such as purchasing/procurement and finance. If an organization has committed to sustainable procurement, facility managers will need to review their purchasing practices according to sustainable considerations and be able to justify their choices. They may need to search out new providers and bring sustainable options to the organization.

An analysis of a potential provider or supply chain partner will include factors such as the ability to meet the organization's requirements for product performance, the level of quality control, the stability of pricing, the timeliness of delivery and miscellaneous added-value items (e.g., ability to warehouse and manage inventory for the facility).



From a sustainable point of view, facility managers should be able to:

- **Determine a product's total cost of ownership and its life-cycle costs.** Total cost of ownership (TCO) is a financial management strategy that accounts for the complete life-cycle costs of a product (both direct and indirect) from acquisition to disposal. From a facility manager's perspective, TCO is useful because it provides a more complete cost comparison, reflecting not only the cost of acquisition but also the cost of operation and ancillary costs. When costs are viewed over time, changes in cash flow may support sustainable purchasing options.
- **Ensure the validity of sustainability claims.** The world is filled with products and packages that announce their environmental features in hopes that they will influence purchasing decisions. The facility manager must determine the validity of sustainability claims and not be swayed by the green-washing (false claims of sustainable activities and impacts). The most common method for validating a product's sustainability claim is a third-party certification. A third-party certification process involves an independent entity conducting an audit and issuing a certificate stating that a product or process complies with a specific set of criteria or standards. Acceptable certifications are conducted by an independent, neutral party with no interest in the manufacturer being certified.

The sustainable procurement process follows the same model introduced in the *Finance and Business* competency. The major difference is the application of sustainable criteria. Evaluating and deciding between two sustainable options, or even deciding if options are sustainable, is not always easy. Comparing the options using a checklist often uncomplicates the process and ensures that equitable comparisons between vendors are being made. The first part of the checklist in Exhibit 2-27 on the next page is for the purchasing of sustainable products. The second checklist is for assessing the parent organization as a whole. These lists are not meant to be all-inclusive of every criterion that should be used but are to provide an idea of some of the most commonly used criteria.

Benefits of sustainable procurement

Some of the benefits to an organization as a result of adopting a sustainable procurement policy are:

- Controlling costs by adopting a wider approach to whole life costing.
- Improving internal and external standards through performance assessments.
- Complying with environmental and social legislation.
- Managing the organization's risk and reputation.
- Building a sustainable supply chain for the future.
- Involving the local business community.



Exhibit 2-27: Sustainable Selection Checklist

	✓	Option ____	✓	Option ____
Product Criteria				
Reusable				
Recyclable				
Salvaged, refurbished or remanufactured				
Durability				
Made from recycled content				
Nontoxic				
Minimal emissions of volatile organic compounds				
Biodegradable				
Minimal packaging				
Proximity to location				
Locally purchased				
Certification				
Amount of materials needed to maintain				
Nontoxic cleaning/maintaining materials				
Organization Criteria				
Human rights				
Labor conditions and practices				
Health and safety				
Resource-efficient manufacturing				
Company mission, vision and values				
Sustainable supply chain				
Local community involvement				
Partnerships				
Associations				
Certifications				
Carbon footprint				

Barriers to sustainable procurement

Lack of understanding of sustainability within the organization, when matched with poor training and a lack of accountability, are significant barriers to building supplier capacity with sustainable suppliers. Other common barriers and some ideas on how to address or overcome them are listed below.

- **Lowest price.** Greater consideration must be given to more areas than just price. This is a shift for many organizations where the lowest bidder always wins. One must also not assume that just because the item is sustainable it is automatically more expensive.



- **Leadership.** Mixed messages as to the importance of sustainability often come in the request or tender. It is important for the organization to have a consistent message from top to bottom of the importance and value placed on sustainable options.
- **Setting priorities.** Sustainability is often not listed as a “real” priority in a bid or tender. It is important for organizations to clearly state their intentions and where sustainability fits in the overall priority of the requests within the bid.
- **Improving the supply chain.** In the past, there have been a limited number of vendors that have products and processes that are sustainable. Do not get caught in a situation in which, due to the strict requirements of a request, there is no opportunity for supplier redundancy. “Putting all of your eggs in one basket” is not a good business practice, no matter what the initiative.
- **Verifying product claims/certifications.** It is often challenging and time-consuming to verify a vendor’s sustainability claims about their product. Third parties, such as the Global Ecolabelling Network or the International Organization for Standardization (ISO), are often used to certify vendors’ claims.

Building a sustainable supply chain

According to “Supply Chain Sustainability: A Practical Guide for Continuous Improvement,” supply chain sustainability is the management of Triple Bottom Line impacts throughout the life cycles of goods and services. It also includes the encouragement of responsible governance practices. The purpose or objective of supply chain sustainability is to protect and grow environmental, social and economic value when bringing products and services to market. Through supply chain sustainability, organizations protect the long-term viability of their business.

Recent emphasis on sustainability has made supply chain management even more complex. Still, sustainable supply chain management is seen as one of the cornerstones of corporate social responsibility.

Why is a sustainable supply chain important?

Organizations investigate and start creating a sustainable supply chain for many different reasons. Top among those reasons is compliance with recent changes in laws and regulations influencing the manufacturing, importing and exporting of goods and services. Next are responses to pressures from various



internal and external stakeholders to become more responsible for the social, environmental and economic impacts of the organization. By meeting the legal requirements and seeking to improve the environment through the management of their supply chain, organizations meet their own needs and those of society at large.

What are the steps in building a sustainable supply chain?

Building a sustainable supply chain is about finding a process that can be used to guide decisions regarding organizations within the supply chain. The process will include the following steps:

- **Ensuring organizational commitment to a sustainable supply chain.**
This may involve selling the benefits of sustainable supply chains to management. These include:
 - Reduced risk from supplier misbehavior and noncompliance.
 - Reduced carbon footprint.
 - Helping to grow a competitive market of sustainable products.
 - Providing a competitive edge or improving the organization's branding.
 - Meeting stakeholders' concerns.
- **Establishing a good working relationship with selected suppliers.**
Facility managers should ensure that suppliers understand the organization's sustainability goals and policies and plan for continuous communication and alignment of personnel.
- **Measuring the impact on the organization's goals.** Facility managers should establish upfront what data is meaningful to measuring progress toward individual goals. The facility manager must then ensure that this data is collected and analyzed.
- **Monitoring the relationship.** Similar to other change initiatives, it is important to check on compliance. This can be done through either a formal or informal auditing process. Most organizations use a three-step process for vendors that are not in compliance: 1) the vendor is given a warning, 2) the vendor is put on formal probation and 3) the vendor is removed from the program and all contracts are terminated.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. What are the three basic goals of sustainable facility energy use?

2. List at least one way in which a facility manager could improve the sustainability of each building facet or system.

Domestic water heating: _____

Electrical: _____

Heating and cooling: _____

Ventilation: _____

Lighting: _____

Building envelope: _____

3. Which of the following statements about building commissioning is correct? *(Select all that apply.)*

- ☐ a. Retrocommissioning can be performed only in buildings less than 10 years old.
- ☐ b. Building commissioning projects may have payback periods of less than one year.
- ☐ c. Continuous commissioning requires the ability to collect and analyze data in an ongoing manner.
- ☐ d. All commissioning projects should include facility management and O&M staff training.

4. A facility is having problems getting occupants to turn off cubicle work lights and electronics. Describe at least three approaches a facility manager might take to improve occupant compliance with this energy conservation initiative.



5. Which of the following statements about renewable energy sources is correct? *(Select all that apply.)*
- ☐ a. The cost and source of purchased electricity will affect the decision to install photovoltaic systems.
 - ☐ b. Biomass can be converted into energy direct (by burning) or indirectly (to produce a gas for burning).
 - ☐ c. Wind power is feasible only in large installations.
 - ☐ d. Utility rebates are available only for photovoltaic systems.

6. Electricity demand is
- ☐ a. the volume of electricity consumed by an end user.
 - ☐ b. the trend in end-user usage.
 - ☐ c. the rate at which an end user consumes electricity.
 - ☐ d. the time at which use occurs.

7. A renewable energy certificate (REC)
- ☐ a. allows a facility to request a government rebate for installing equipment to generate renewable energy on site.
 - ☐ b. entitles a facility to a tax deduction granted for buying electricity generated with renewable energy sources.
 - ☐ c. is a symbolic recognition of a facility's success in decreasing carbon emissions granted by chartered organizations.
 - ☐ d. documents that a facility has purchased the environmental value of a certain amount of electricity generated from renewable sources.

8. What water use goals will help a facility operate more sustainably?

9. The benefits of water submetering include *(Select all that apply.)*
- ☐ a. increase the efficiency of water-using appliances.
 - ☐ b. establish baselines of water use.
 - ☐ c. target operational areas for water conservation projects.
 - ☐ d. identify difficult-to-detect leaks.

10. List at least two ways in which utilities might charge for water consumption.



11. List at least one way for each of the strategies listed below that would help facility managers lower the amount of potable water withdrawn from public systems.

Reduce: _____

Recycle: _____

Capture and use: _____

12. List goals related to materials that will help a facility operate more sustainably.

13. List two benefits of and two barriers to sustainable procurement.

Benefits: _____

Barriers: _____

14. List the steps in building a sustainable supply chain.



Progress check answers

1. The three basic goals of sustainable facility energy use are to reduce energy consumption, to increase the amount of energy consumed that has been generated from renewable energy sources and to use energy in an environmentally and socially sustainable manner. (p. 2-60)
2. Examples of core building system sustainability initiatives include the following.
Domestic water heating: Install low flow showerheads. (p. 2-65)
Electrical: Implement predictive and preventive maintenance program. (p. 2-65)
Heating and cooling: Install VSD in boiler pumps, use economizers, adjust set points seasonally. (p. 2-63)
Ventilation: Implement demand control ventilation. (p. 2-63)
Lighting: Reduce levels of light in some areas and eliminate lighting when areas are unoccupied. (p. 2-64)
Building envelope: Reduce solar gain by installing low E windows or install window films. (p. 2-62)
3. b, c and d (p. 2-66)
4. A facility manager might:
 - Attend department meetings to explain the energy costs of these practices and the potential savings.
 - Provide power-down strips for all occupants.
 - Install occupancy sensors.
 - Make sure occupants have controls to turn off their lights. (p. 2-74)
5. a and b (p. 2-69)
6. c (p. 2-71)
7. d (p. 2-76)
8. Understand pricing and water use factors; reduce use; recycle when possible; capture for use if possible. (p. 2-77)
9. b, c and d (p. 2-78)
10. Utilities can charge for water consumption through access rates, inclined-block or declining-block pricing structures, seasonal rates, or one-time withdrawal rates. (p. 2-79)
11. Reduce: Install water-saving appliances and fixtures, identify and repair leaks quickly, improve efficiency of boilers and cooling towers (p. 2-79)
Recycle: Use gray water for irrigation, recycle condensate into supply water for cooling towers (p. 2-80)
Capture and use: Use rain gardens to lower irrigation use, capture and store stormwater for fountains and irrigation (p. 2-81)
12. Use less materials; use resources from sustainable and/or recycled sources; purchase in a sustainable manner; avoid using materials that contribute to pollution or are hazardous. (p. 2-82)
13. Benefits include controlling costs by adopting a wider approach to whole life costing, improving internal and external standards through performance assessments, complying with environmental and social legislation, managing the organization's risk and reputation, building a sustainable supply chain for the future, and involving the local business community. (p. 2-83)
Barriers include lowest price, leadership, setting priorities, improving the supply chain, and verifying product claims/certifications. (p. 2-84)
14. Ensure organizational commitment; establish good working relationships with selected suppliers; measure impact on goals; monitor the relationship. (p. 2-86)



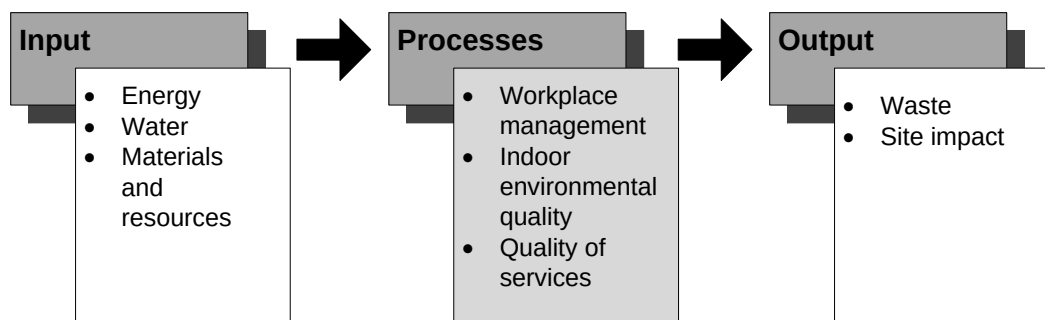
Chapter 5: Focus Areas for Sustainable Facility Management (Processes)

After completing this chapter, students will be able to:

- Explain how workplace management improves facility sustainability from environmental, economic and social perspectives.
 - Describe ways in which workplaces have evolved in current facilities and facility management responses to these changes.
 - Define the components of indoor environmental quality (IEQ) and describe how IEQ contributes to sustainable facility management.
 - List common threats to indoor air quality (IAQ).
 - Describe initiatives a sustainability facility professional might implement to improve a facility's IEQ.
 - Describe the role of occupant surveys in contributing to IEQ.
 - List steps a facility manager can take to improve the sustainability of the facility's use of hazardous materials.
 - Explain how facility services can be affected by organizational commitment to sustainability.
 - Describe tactics to improve the sustainability of mail services, printing and copying, content and document management, food service, meeting services, hardscape maintenance and landscaping and property amenities.
-

This chapter focuses on sustainable goals and practices in the categories listed under processes in Exhibit 2-28. Sustainability in these categories focuses on ongoing organizational activity that facility management is pledged to support: an efficient and effective workplace, a healthy and safe environment for occupants, and the various services that occupants need and want.

Exhibit 2-28: Major Categories of Sustainable Facility Management



✦ Topic 1: Workplace Management

Program goals The nature of work and the individuals and organizations that perform it have changed. The work is more complex and time-sensitive. It requires both technological and social skills, and it is more team-based and collaborative rather than individual and competitive. Modern organizations now value agility and leanness, changing frequently to meet changing customer needs and marketplace factors. Organizations tend to be less hierarchical.

Sustainable workplace management means balancing new organizational and occupant needs with environmental considerations to accomplish basic Triple Bottom Line criteria:

- It helps ensure the comfort and productivity of occupants by providing sufficient space and space of sufficient quality—space that is free of distractions but promotes collaboration. Workplace management focuses on fitting the workplace to the work, not the other way around.
- It treats space as an asset that must be managed to support the organization's mission and deliver economic value.
 - Available space is allocated efficiently as measured by desk-to-occupant ratios or utilization rates.
 - Workspace is also managed for effectiveness in supporting occupant productivity and creativity. The space accommodates and leverages new technologies that remove the traditional tethers of desks and phone sets, a global economy that challenges traditional work hours, new work patterns and new types of work that require flexible combinations of individuals and teams. One applicable metric here is the proportion of meeting space to total workspace.
 - The organization avoids unnecessary capital and operating costs, including the considerable costs associated with churn. Churn—the relocation of employees in response to reorganizations, reductions in staff and transfers—is expensive financially but also in terms of productivity.
- It reduces the facility's impact on the environment. Fewer resources are used to construct and operate new spaces (which may be only partially occupied), and less waste is generated in construction and demolition. Reducing new development relieves pressure on the environment (preserving ecosystems), on communities and on historically significant structures and areas.

Exhibit 2-29 summarizes some of the changes in organizations and the challenges they pose for facility managers.



Exhibit 2-29: Changing Work and Workplaces

Change	Workplace Adaptations	Workplace Challenges
Increased use of teams, including cross-functional teams	More meeting space with greater variety Project rooms Display space Unassigned workspaces Greater interior visibility Mobile communication and computing support Personal lockers	Noise, distractions and interruptions
Dispersed, sometimes global, work groups	Video conferencing Technological support for meeting rooms Extended facility hours	Scheduling facility services Providing technological support
Continual reorganization	Flexible infrastructure Modular and mobile furnishings	Acoustical problems (e.g., sound traveling through ceilings)
Mobile work patterns	Hotelling/hot desks Support for mobile devices	Scheduling access to space and tracking use
Improved quality of work life to attract talent	More equitable space distribution and access to daylight More facility amenities	Selling equitable access in hierarchical organizations

Source: Judith Heerwagen, Kevin Kelly and Kevin Kampschroer. "The Changing Nature of Organizations, Work, and Workplace." February 2006, www.wbdg.org/resources/chngorgwork.php.

This topic focuses on three ways in which facility managers can manage facility workspace in a more sustainable manner, by:

- Increasing flexible use of facility space to decrease churn or minimize its impact on workplace productivity and facility costs.
- Supporting organization initiatives aimed at "virtual" workplaces.
- Increasing the quality of facility workspace.

(Workspace management is also discussed in the *Human Factors* competency, from the perspective of steps facility managers can take to ensure a productive and creative work environment.)

Increasing flexible use of space

By using available space in a more flexible manner, facility managers can avoid unnecessary expansion of the facility and reduce the churn rate. Increasing flexibility requires both organizational and technological tools.



Facility managers can question the rationale behind requests for moves within the facility, moves to new facilities or for larger team areas. Is it necessary that all the occupants in a particular department work in close proximity? Would it meet the organization's goals to ensure that team members can keep in touch anywhere in the facility and that teams can have access to meeting rooms, bullpens or pods whenever they are needed? Can areas be assigned to projects, rather than individuals, with occupants moving fluidly into and out of the project area as the project evolves?

If organizations are willing to flex to this new model of workspace management, and when it is appropriate, departments can be “virtual,” with occupants using unassigned workstations. Facility managers can support this organizational strategy by implementing wireless phone and data services, allowing occupants to receive calls and messages no matter where they are in the facility and access computer networks from any workstation or through a wireless network. As appropriate, team information/display/work areas can be created.

When churn cannot be avoided, it can be accomplished more efficiently by doing the following.

- **Designing space with churn in mind.** Some facilities are designed with fixed spine walls that serve as conduits for power and data cabling. Cabling can also be located in raised floors or plenums or in overhead service carriers.
- **Designing a flexible IT structure.** Voice and data cabling can now be combined. An occupant's voice service can be reassigned by computer, rather than by rewiring. Wireless networks can be added when occupants are highly mobile within the facility.
- **Using modular furniture.** Modular furniture systems can be easily relocated and reconfigured to spaces with different sizes and shapes. An additional benefit is that these furnishings are usually designed to adjust to an individual's ergonomic needs—for example, adjusting work surface height and angle, adjusting monitors to decrease glare, and adding accessories for specific tasks, such as document holders used in typing.

Supporting virtual workplaces

Workplaces become virtual when occupancy is distributed among multiple facilities that may be located around a country or even the globe, when project teams cross organizational lines and when occupants who don't need to be or can't be at a facility work off site—telecommuting and hotelling or hot-desking when they are on site.



Facility managers can support virtual workplaces by:

- Implementing real-time software applications that allow occupants to book unoccupied space when they plan to be on site. These software tools automate the process and allow occupants to plan at their convenience. By offering real-time information, they also ensure that workstations will not be double-booked.
- Equipping all hot desks with laptop docking stations and mobile phone chargers.
- Supporting wireless network access.
- Supporting desktop and meeting room videoconferencing.

Creating productive workspaces

Workspaces need to promote and support teamwork, collaboration, trust and relationships. This affects the types of shared spaces facilities plan for, where they locate these spaces and how potential distractions are managed. Facility managers should consider the accessibility of meeting rooms and services (the range of distance among occupants, how easy they are to find), possible distractions they may cause to neighbors through noise and foot traffic, and how well they contribute to group exchange of ideas and information, creativity and problem solving.

Ideas for using facility space more creatively include:

- Aligning amount and quality of space according to productivity. Large corporate suites may be decreased in size to allow more space for project team areas.
- Locating teamwork space in common areas, such as cafeterias.
- Distributing service areas equitably in terms of space and centrally to avoid distractions.
- Locating meetings rooms to improve access and space quality and minimize distractions (i.e., noise, traffic) to nearby occupants.
- Improving sound privacy for individual workstations. (This is discussed further in the next topic, “Indoor Environmental Quality.”)

*** Topic 2: Indoor Environmental Quality**

Program goals

How has the idea of the quality of an indoor environment evolved into a core concept of sustainability? Part of the answer lies in the role of occupants in sustainable facility management and the social factor in the Triple Bottom Line. Another part lies in the increasing role that place plays in occupants’ lives. The Royal Institute of British Architects estimated that people spend 20 hours a day inside buildings at work or at home. In the U.S., the Environmental Protection



Agency has estimated that people spend 90 percent of their day indoors. The final part of the explanation lies in a growing awareness of the poor condition of that critical indoor environment. Studies by the U.S. EPA have shown indoor air quality (IAQ) levels to be two to five times worse than outside air quality, and the World Health Organization (WHO) has estimated that 30 percent of buildings have IAQ problems. Consequently, facility managers interested in sustainability must look at their interiors from two perspectives: that of a facility manager interested in energy efficiency and life-cycle impact on the environment and that of a facility occupant who seeks—and deserves—healthful and comfortable surroundings.

IEQ refers to the strategies and systems used to provide occupants with a healthful, comfortable and safe workplace. To create a quality indoor environment, a facility manager must:

- Ensure IAQ, including the amount of fresh air supplied through natural and mechanical ventilation and the quality of that air, judged by the amount of indoor pollutants it may contain.
- Contribute to thermal, visual and acoustic comfort.
- Gather feedback from occupants and document steps taken to act on this data.
- Control hazardous materials used and stored in the facility.

Ensure indoor air quality

IAQ is defined by ASHRAE as air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80 percent or more) of the people exposed do not express dissatisfaction. Sustainable IAQ is marked by sufficient levels of fresh air and minimal levels of harmful gases and pollutants.

Achieving IAQ starts with understanding threats to IAQ that sustainable facility management can prevent or control. Contaminants may enter the indoor environment from both outside and inside the facility, as described in Exhibit 2-30.

Exhibit 2-30: Threats to IAQ



Outside threats to IAQ may come from the air being drawn into the building, moisture collecting on the roof or around the foundation of the facility, and pollutants emanating from the soil below and around the facility.

- **Ambient air pollution.** Pollutants, irritants and odors can be drawn into the facility with the fresh air supply. This might include dust, pollen and spores, smoke, emissions from neighboring facilities, and exhaust fumes from vehicles (e.g., idling trucks, exhausts from vehicles caught in traffic snarls on adjacent roads).
- **Recaptured facility exhaust.** If the building ventilation system is not designed correctly, the HVAC system can draw exhaust air back into the facility instead of fresh air. This obviously increases levels of pollutants and also the level of CO₂.
- **Moisture.** Precipitation collecting on roofs and around the foundation creates the potential for mold. Spores can readily enter the facility through ventilation and be tracked into the facility on occupants' shoes.
- **Soil pollutants.** These pollutants can include gases such as radon and methane and fumes from underground fuel storage. Facility managers should be aware of previous facility uses that may have left pollutants (e.g., lead) in facility soil. Chemicals from exterior pest management and nonsustainable landscaping and exterior cleaning can also be tracked inside the facility on occupants' shoes.

Inside threats to IAQ come from elements related to the following.

- **Inadequate ventilation and indoor climate control.** The facility's HVAC system can contribute to poor IAQ by:
 - Providing insufficient supplies of fresh air and inadequate air filtration of dust, spores, bacteria and viruses.
 - Promoting growth of mold by operating at inappropriate levels of humidity. Humidity above 60 percent can contribute to mold and microbial growth.
 - Promoting irritation of occupants' respiratory systems by failing to maintain adequate levels of humidity—above 20 percent.
 - Releasing mold spores and microorganisms from inadequately maintained components, such as condenser coils, condensate trays, humidifiers and ductwork.
 - Releasing ozone from electrostatic air cleaners.



- **Processes.** Facility processes (e.g., cooking, photocopying, fabricating, manufacturing) and equipment used in those processes can also emit pollutants that must be properly exhausted. For example, copiers and laser printers release ozone, which is a respiratory irritant. Cleaning supplies may include ammonia. Nonsustainable pest management practices may introduce toxic chemicals and volatile organic compounds (VOCs). Cleaning processes may also contribute to higher moisture levels and the growth of mold through, for example, wet carpet cleaning. Buildouts, remodeling and alterations can increase levels of particulates and, potentially, more dangerous materials such as asbestos. Facility managers should be particularly aware of the presence of any asbestos in the facility and ensure that it remains contained.
- **People.** In addition to producing CO₂, occupants in facilities that allow smoking, even in restricted areas, can be introducing tobacco smoke. They can also facilitate the release of chemicals from certain cosmetics and fragrances.
- **Building interiors.** Building materials and furnishings can emit a number of irritating and toxic gases, including VOCs (from paint, caulks, carpeting and glue) and formaldehyde (from building materials and furniture). Building furnishings can also greatly contribute to the amount of dust and fibers in the air.

Measuring IAQ

IAQ can be measured by the using CO₂ sensors, sending samples of facility air to labs, conducting visual inspections for mildew and mold, gathering indirect signs of poor IAQ (e.g., rates of respiratory illnesses among occupants), and by surveying occupants.

A key and objective indicator of the adequacy of ventilation is the level of carbon dioxide in a facility. In general, indoor CO₂ levels that exceed 1,000 ppm or exceed outside levels by more than 700 ppm produce occupant symptoms of discomfort, such as fatigue, headaches or respiratory reactions.

HVAC systems are designed to ensure that the necessary amount of fresh, appropriately conditioned air is supplied throughout the facility. Deciding on the right amount of fresh air and creating an adequate physical distribution system can be problematic, however. In general, fresh air requirements are calculated by multiplying the number of occupants by recommended fresh air rates per person:

$$\text{Fresh air rate (m}^3\text{/s)} = \text{Fresh air rate per person} \times \text{Number of occupants}$$



The amount of fresh air needed will depend on factors such as the type of facility, the area of the facility (e.g., kitchens, copy centers), the type of activity (e.g., strenuous physical labor, desk work) and variability in occupancy levels. Determining the number of occupants to be used in calculating fresh air needs can be tricky. Using an average occupancy rate creates the risk of underventilating the area for a significant portion of the time. Using the maximum occupancy rate, however, can increase the cost of heating and cooling. Many HVAC system designs do not use maximum allowed occupancy levels to calculate ventilation needs. As a result, the fresh air rate set during HVAC design may need to be reassessed during operation and the ventilation rate adjusted accordingly. Assessing ventilation should be part of a commissioning and retrocommissioning process.

Even if the required air supply is calculated accurately, other HVAC design characteristics can affect the adequacy of ventilation. For example, some variable air volume systems supply air to a particular area based on temperature. When that temperature is achieved, fresh air supply may be closed off. Sharp turns in ducts can reduce air flow velocity and the amount of fresh air an area receives. Improperly maintained air filters can impede air flow.

Initiatives to improve IAQ

Facility managers can improve facility IAQ through a variety of measures, including operational changes, implementation of maintenance policies and procedures aimed at reducing threats to IAQ, and change management initiatives aimed at occupants.

Operational initiatives

Demand-controlled ventilation (discussed in the previous chapter under “Energy”) can help improve IAQ while also improving energy efficiency. DCV combines CO₂ sensors with automated air handling systems. It can adjust supply air levels to actual facility occupancy rather than an arbitrary maximum occupancy selected during the facility’s design.

Less capital-intensive equipment investments might include installation of higher efficiency air filters and ultraviolet light units near air conditioning evaporators to control mold and microbials.

A facility manager might also:

- Look at how space is used and organized in the facility. Work areas that emit a high level of pollutants can be separated from occupied areas and ventilation can be increased.
- Adjust an overnight purge of facility air to increase the amount of fresh air available in the morning.



- Implement a policy of reviewing the purchase of all facility materials and furnishings for their pollutant-emitting potential.
- Conduct periodic audits for IAQ threats and issue corrective work orders and changes in procedures and maintenance as required.
- Ensure that risk management plans are developed to identify and address possible IAQ issues during remodeling projects. The Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) publishes IAQ Guidelines for Occupied Buildings under Construction. It includes tables, project checklists and methods of remediation for harmful substances such as lead and asbestos.

Maintenance initiatives

HVAC system preventive maintenance and one-time inspection and repairs can avoid or mitigate many threats to IAQ:

- Ductwork lining that can collect dust and mold should be removed and replaced with liners made with substances such as mylar.
- Ductwork should be tested for leaks and blockages and repaired.
- Exhausts should be inspected and cleaned to improve air flow. Intake dampers should be checked to make sure they are operating as designed.
- Filters should be cleaned—or changed if they cannot be cleaned effectively—according to a regular schedule or according to environmental conditions, such as dust storms. Changing air filters should be part of preventive maintenance work orders.
- Areas subject to leaks (e.g., pipe connections, gaskets) should be inspected regularly, and areas subject to moisture buildup should be inspected and cleaned regularly. Outlets for condensate and condensate trays should be cleaned and inspected to ensure that they are draining properly.

It is also critical that facility managers ensure that performance of maintenance activities is documented in logs and that they review these logs regularly to identify issues. Two major examples of operations and maintenance activities that impact IAQ are the facility's cleaning and pest control practices. Sustainable approaches to managing these activities are discussed below.

Policy

Facility managers can urge the adoption of policies that restrict smoking inside the facility and near entrances and fresh air intakes. They can urge adoption of lists of “banned” products, such as those that contain VOCs. Some facilities implement “no perfume” zones in response to occupant complaints. Facility cleaning and pest control practices can be defined in policy to support more sustainable approaches. (These two topics are discussed further below.)



Since people can affect the quality of the indoor climate, occupants should be involved in IAQ initiatives. Occupants should be educated about sources of indoor pollution and their health effects. Facility managers can enlist their help in monitoring facility conditions and reporting issues that could contribute to poor IAQ.

Facility cleaning policy

Occupants must also be educated about realistic cleaning goals in the facility—that real hygiene is more important than surface appearances. The message is that frequently refinished, shiny floors do not equate with cleanliness but do introduce chemicals into the air that the occupants—and, equally significant, the people applying the chemicals—breathe. This can relieve pressure on facility management to practice cleaning procedures that are not sustainable. Facility cleaning can affect IAQ through the following.

- Emissions from cleaning equipment
- Emissions from cleaning supplies
- Increased airborne dust and particulates
- Increased potential for mold

The facility's cleaning practices should be assessed for their level of sustainability and improvements implemented as needed. Assessing a facility's sustainable cleaning practices entails product and equipment selection as well as the ways in which those products are used. It also includes facility management practices, such as:

- Developing sustainable cleaning standard operating procedures (SOPs).
- Conducting regular inspections or audits of facility cleaning.
- Ensuring proper training and supervision of custodial staff.
- Providing input, if possible, on the selection of office furnishings to ensure that materials can be cleaned, can be cleaned without harmful chemicals, and do not promote the accumulation of dust or growth of mold.

A good sustainable cleaning practice is to create a facility-specific SOP manual that defines what will be cleaned, how often, to what specification, in what manner, and with what products and materials. These SOPs integrate practices that improve IEQ. For example, SOPs on maintaining carpeted areas may minimize the use of carpet shampooing (which can contribute to mold) by requiring more frequent vacuuming and spot cleaning. SOPs may define dry extraction methods (e.g., encapsulation) as the standard approach to carpet cleaning. Using a microfiber mop rather than a traditional string mop to apply floor finish may decrease the amount of VOC-emitting chemicals used. Specifications on the use and maintenance of matting or grates at entries can help prevent pollutants from being tracked into and through the facility.



If custodial services are contracted, these SOPs can be communicated to the vendor and support the request for proposal process. They can also be used to generate key performance indicators that can be tied to vendor payment and/or incentives.

Periodic visual inspection of the facility can ensure compliance with SOPs; identify cleaning practices that may pose risks to IEQ, such as areas of standing water in restrooms or utility areas or accumulations of dust near air supply vents; and identify potential problems in scheduling of especially noisy cleaning activities that can affect occupant comfort.

Pest control

Sustainable pest control involves adopting integrated pest management practices, both inside and outside the facility. Integrated pest management (IPM) differs from the conventional methods with which facility occupants are probably familiar: regularly scheduled visits to apply inorganic pesticides extensively inside the facility, with little interaction with facility management or occupants. In contrast, IPM:

- Uses pesticides only as an alternative when nonchemical strategies (e.g., closing off access to food sources, improving sanitation) have failed.
- Relies on baits more extensively than sprays and aerosols.
- Uses sprays when necessary primarily in crevices rather than on surfaces.
- Focuses on excluding and trapping undesirable “intruders,” such as rodents and birds, rather than killing them.

Most significantly, IPM is practiced proactively, trying to manage the facility environment to prevent pests, and facility management and occupants are recruited in this effort.

IPM begins by clearly identifying the problematic pests and choosing responses specifically aimed at those pests. An IPM specialist inspects the facility to determine how pests are entering, what is attracting them, and where they are living. Each species is unique and calls for customized responses.

Some general IPM strategies include:

- Eliminating food sources by cleaning up all food residues and tightly sealing foods and removing trash more frequently.
- Sealing access to the buildings, such as through uncaulked cracks in foundations (the most common access point for ants).
- Creating barriers—basaltic sand to deter ants, stainless steel screening to prevent termites from moving up from a foundation into a building, metal grates over vent openings to deter birds and bats.
- Removing safe harbors, such as cardboard boxes or rolls of carpet.



- Addressing leaks and wet spots. Some pests, such as termites, cockroaches and fruit flies, are attracted to moisture.
- Prompt action. It may be appropriate to spray a crack from which ants are swarming but only while they are swarming.
- Nonchemical responses, such as routine vacuuming to remove spider webs or steam, heat or cold treatments for infested areas.

IPM may also require changing occupant and staff behaviors. Occupants need to be educated about the risks of the indiscriminant use of pesticides and their role in controlling pests in the facility. Some change management tactics are obvious: policies about storing snacks in desk drawers can be communicated to occupants, and kitchen workers can be required to follow SOPs on cleaning equipment, work surfaces and vents on a daily basis. It may be more difficult to convey to occupants that the risks associated with intensive, conventional pest management are not always worth the benefits—that vacuuming webs, rather than spraying insecticides in a room to deter spiders, may be preferable in terms of IAQ.

Ensure occupant comfort

Thermal comfort

Thermal comfort can be improved by adopting a temperature setpoint that is a compromise between occupant preferences and the facility's need for efficiency and by ensuring that HVAC systems maintain temperature settings and achieve desired air flow rates. Minimally, a facility manager can ensure that air temperature and humidity is being monitored at frequent intervals. The LEED O&M manual for existing buildings calls for sampling intervals that do not exceed 15 minutes and alarms to signal the need for adjustments and repairs.

Facility managers should also conduct routine walking inspections of the facility, experiencing the indoor climate as occupants do and looking for visible signs of possible issues. These signs could include:

- Fans and space heaters added to cubicles or areas.
- Sweaters and jackets on chairs that could indicate excessive swings in temperature or cold or hot spots.
- Paper taped over air ducts or homemade air flow diverters that could indicate drafts.

Visual comfort

Occupant comfort and productivity can be affected by visual issues in the indoor environment.



Facility managers can support healthful and productive workplaces by avoiding the following problems:

- **Glare** is defined as any excessively bright source of light within a visual field that creates discomfort or loss in visibility. It can also be created by excessive contrast between the task or targeted lighting and background lighting. Glare can be direct (e.g., a light that shines directly into an occupant's eyes) or indirect (e.g., reflection of natural or artificial light off of a monitor). Glare can lead to headaches, stress and higher blood pressure. Glare on computer screens contributes to eye strain and lowers productivity. Glare can be controlled in a variety of sustainable ways that can suit both new or remodeled and existing facilities. One architectural lighting designer used a combination of dark-tinted, low-E glass, frits (reflective ceramic elements applied to glass) and motorized, perforated shades to combat glare in a facility. Balancing ambient and task lighting can also help avoid glare, as can installing parabolic diffusers on overhead lighting fixtures.
- **Lighting with a poor Color Rendering Index (CRI)**, such as sodium lights and some fluorescent lamps, may not seem as bright to occupants and distorted skin tones may have a negative effect on mood.
- **Flicker** can occur in fluorescent lighting because of older magnetic ballasts or the use of dimmers with the wrong types of lamps.
- **Lack of individual occupant control** is a problem. A sustainable lighting strategy would use zoned overhead lighting (smaller banks of lights that can be controlled by occupants more easily) that provides adequate but not excessive ambient lighting. Ambient lighting can be augmented with task lighting and avoid creating the potential for glare associated with excessive lighting.
- **Lack of natural light** is also a problem. Daylight is an excellent source of illumination because it is a full-spectrum light. Studies in work and academic settings have shown improved productivity with increased natural light. An additional benefit of introducing more natural light into a space is that it almost necessarily entails adding views of the outside—even if those views may be only of clouds. These views provide momentary visual and mental “vacations”—breaks for tired eyes and over-concentrated minds. Some countries have regulations about the distance between sources of natural light and workstations. Although the most obvious solutions to providing more daylight are architectural (e.g., more windows, clerestory and skylights),



facility managers can also help draw more light into rooms by rearranging workspaces and using devices to reflect more light farther into the building's interior. Automated systems, called daylight harvesting systems, can reduce artificial light sources when sensors indicate the availability of natural light.

Did You Know?

The Illuminating Engineering Society of North America (IESNA) publishes guidelines for lighting levels. IESNA guidelines recommend lighting levels for seven categories of applications, grouped under three headings:

- Orientation and simple visual tasks (Little reading is done and visual performance is not critical.)
 - Public spaces: 3 foot-candles (fc)
 - Simple orientation for short visits: 5 fc
 - Working spaces where simple visual tasks are performed: 10 fc
- Common visual tasks (Visual performance is important.)
 - Tasks with high contrast and large size: 30 fc
 - Tasks with high contrast and small size or tasks with low contrast and large size: 50 fc
 - Tasks with low contrast and small size: 100 fc
- Special visual tasks (Visual performance is critical.)
 - Tasks near the threshold: 300 to 1,000 fc

Sustainability facility professionals can compare these recommendations with actual facility lighting levels using a handheld photometer. In some cases, adding fixtures—specifically task lighting that illuminates only certain areas—can allow overhead, general lighting to be reduced.

Acoustical comfort Noise management is another poorly rated area in occupant surveys, even in sustainable facilities. The Center for the Built Environment conducted a survey of occupants in over 15 buildings and found that over 60 percent found that poor acoustics interfered with their productivity.

Some noise problems may have been created through sustainability efforts aimed at other issues and modern construction techniques:

- Because of IAQ issues with dust and mold associated with more intricate moldings or fabric-covered walls and carpeted floors, surfaces in sustainable facilities tend to be harder, which increases reverberation. Sound-dampening materials, such as fiberglass batting, may have been removed from air ducts.
- Mechanical ventilation aimed at ensuring adequate fresh air often results in ductwork being located in overhead plenums, which makes it more difficult to separate occupants from ventilation noise.



- Thinner walls designed to reduce use of materials may provide insufficient acoustic separation.
- The trend toward more open workspace areas and lower cubicle walls makes ventilation simpler and allows daylight to travel further into the room. However, it also allows conversations to be overheard more easily, creating distractions as well as threats to privacy.
- Windows opened to increase fresh air also allow street and other noise into the facility.

Some sustainable initiatives to correct noise issues include the following:

- Sound masking systems (sometimes referred to as white noise machines) electronically generate a broadband, low-level sound designed to muffle conversations and distracting noises without becoming a source of irritation itself. Sound masking system vendors say that these systems essentially triple the distance between occupants. Installations do need to be carefully calibrated under actual conditions to ensure that they are loud enough to mask but not to draw attention to themselves.
- High-performance windows can decrease sound from outside the facility.
- HVAC systems can be specified to produce an ambient sound level appropriate for the space use and occupancy level.
- Rigorous maintenance inspections and repair routines can ensure that noisy ventilation ductwork is repaired quickly.
- Noisy operations can be relocated away from areas requiring quiet, or these activities can be scheduled for times when the area is unoccupied.
- Occupants with similar types of tasks (and presumably producing similar noise levels) can be grouped together.

Vibration

Related to acoustic comfort is the problem of vibration. Occupant discomfort can be caused by vibration both inside and outside the facility—by, for example, a heavily traveled roadway lying right outside an office building or by an elevator rumbling past a hotel room. It can be a comfort or health issue for an entire work area or for the individual operator of a vibration-emitting piece of equipment. The term “hand-arm vibration” has been coined to describe this occupational safety issue that can affect custodial staff. Vibration can be problematic even if it is only intermittent or infrequent, depending on the interval and the length and strength of the vibration.



Facility managers can address vibration issues by:

- Assessing facility equipment for excessive vibration and fixing or retrofitting equipment to lower vibration.
- Ensuring that equipment is properly installed or mounted and with awareness of the potential for vibration.
- Equipping workers with protective gear and limiting exposure time.
- Enforcing routine maintenance procedures and ensuring that vibration is assessed during inspections. For example, fan-driven cooling towers can transfer fan vibration into the building. Routine inspection should check for excessive fan vibration and ensure the integrity of vibration-isolating components.
- Installing vibration-dampening mountings, pads or platforms under equipment.
- Separating occupants from continuous and unavoidable sources of vibration.
- Scheduling processes that create problematic levels of vibration during low-occupancy times.

Engage occupants

Questionnaires or surveys can be used both to gather general information and target specific issues. Occupant surveys allow facility managers to:

- Get a general impression of occupants' satisfaction with a facility.
- Identify specific problem areas.
- Prioritize action plans.
- Assess occupant satisfaction with improvements made in the facility. In a new facility, surveys may be part of a general post-occupancy evaluation (POE) to ensure that the building has achieved its sustainability goals.
- Justify expenditures on IEQ projects to management.
- Facilitate communication between occupants and management or building owners/operators. For example, occupant reactions to facilities can influence the decisions of corporate real estate departments to relocate, expand or alter leased facilities.

In addition to measuring occupant satisfaction, surveys can increase occupants' sense of control over their environments by providing an opportunity for input. Facility managers can enhance this sense of control by following up on surveys and providing reports on findings and planned facility responses.

Control hazardous materials

The International Labour Organization (ILO) estimates that about 400 million metric tons of chemicals are produced each year, and 1,200 new chemical entities are developed each year in North America alone. It would be safe to say that a fair share of these chemicals finds its way into facilities—as part of an organization's business operations or as part of facility operations. Of these chemicals, a portion is probably designated by local regulatory agencies as hazardous, dangerous or toxic materials.



Improper use, storage or handling of hazardous materials poses a serious ethical, environmental and economic risk to an organization. One of the responsibilities of a facility manager is to help ensure that the organization fulfills its responsibilities to occupants, visitors, neighbors and the environment and complies with all local and national regulations. Facility managers should be mindful, in particular, of custodial staff or service providers who come into contact with hazardous chemicals as part of their facility tasks. A sustainable indoor environment must be sustainable for all its occupants. Cleaning products and equipment can take a particularly high toll on custodial staff. One report projected that six percent of custodians will be injured by using a cleaning product. Of these injuries, 20 percent will be serious chemical burns.

To manage hazardous materials sustainability, facility managers must ensure that:

- Use of hazardous materials is minimized.
- Materials are appropriately identified and information about the materials and their use is easily accessed by occupants and staff.
- All those using hazardous materials are appropriately trained and equipped with protective gear and devices.
- Hazardous materials are safely stored to prevent unauthorized access and accidental release into the environment.

The facility manager's responsibility to ensure proper disposal of hazardous waste is discussed in Topic 1 of Chapter 6, "Waste."

Minimizing use of hazardous materials in facility

One can assess a facility's sustainable use of chemicals and management of hazardous materials by referring to the basic considerations of sustainability. To what degree does the facility:

- Avoid or minimize use of unsustainable chemicals?
- Recover and reuse materials? (The potential to recover and reuse process chemicals will vary by facility.)
- Substitute less toxic chemicals?
- Store, use and dispose of chemicals in a sustainable manner?

Facility managers should create and maintain an inventory of chemicals approved for use within the facility. This list serves several purposes:

- It can be attached to RFPs and service agreements to ensure that the practices and materials used by contracted service providers are consistent with the facility's position.
- The inventory can indicate where and how the chemicals are used and stored and whether they are considered hazardous. This can be helpful



for emergency departments in the event of a facility fire or a natural disaster.

- The list can be revisited periodically to see if it can be reduced. Lists can be compared with inventories and orders for materials to identify chemicals that are rarely used and can be eliminated or at least may be ordered in smaller quantities.

Ensuring identification and information

Safety data sheets are product-specific summaries of information critical to a chemical product's safe use, storage, disposal and remediation in the event of a spill or accident. The specific title and contents of these documents may vary by regulatory agency. They may also be referred to as material safety data sheets (MSDS) or hazard data sheets (HDS).

Manufacturers are required to provide safety data sheets with their products, and workplaces may be required to ensure ready access to this information by workers and emergency personnel, either in binders or in a paperless form such as CDs. Regardless of local regulations, facility managers should ensure that this information is available.

Ensuring appropriate training and equipment

Training topics include proper dilution of concentrated products, proper application, use of collection bins for contaminated materials (e.g., blood-contaminated matter), use of protective gear, safety precautions and accident procedures. Occupants and staff should also be made aware of the safety and environmental hazards of improper disposal of chemical products. Training must be documented, and the facility managers should plan on auditing both safety equipment and training documentation regularly. Training, of course, is not sufficient. Facility managers must ensure, perhaps through drills, that equipment is being used and procedures are being followed.

Occupants handling hazardous materials must be provided with required personal protective equipment (PPE). The specialized equipment needed to handle hazardous materials often includes items such as fume hoods, biosafety cabinets, eyewash stations, decontamination showers and clean rooms.

Facility managers should be familiar with the PPE requirements of the hazardous materials used in the facility and ensure that PPE is available, functional (e.g., of the right size) and, most important, used.



Ensuring proper storage

To ensure safe storage, facility managers should:

- **Inspect storage facilities regularly.** Storage areas should be dry, well-ventilated and the appropriate temperature. They should be capable of sequestering leaks or spills from the drainage system and free from possible sources of combustion. If appropriate, access to storage areas should be restricted.
- **Inspect chemicals regularly for leaks and proper labeling.** Hazardous materials should be clearly indicated on their packaging. Maintaining original labeling is critical to ensuring a product's safe and proper use and eventual disposal. Missing labeling also may require that products be disposed of, which adds to the challenge of managing the impact of these chemicals on the environment.

* Topic 3: Quality of Services

Program goals

An organization's commitment to sustainability obliges a facility manager to look for ways to align facility management with the organization's sustainable goals, both in terms of operations and maintenance and in the quality of services the facility provides its occupants and visitors.

This topic will focus on how a facility manager can improve quality of services by introducing sustainable practices in:

- Facility mail, shipping and delivery services.
- Copying/printing services.
- Content or document management.
- Food service.
- Facility meeting services.
- Hardscape maintenance.
- Landscape and property amenities.

Sustainable mail services

Mailing services can include complex systems of incoming mail sorting and distribution, shipping, express delivery services and intrafacility communication. Sustainability is not an issue for physical mail alone; e-mail practices can also defy sustainable facility goals.

Improving the sustainability of these services requires more than technological fixes. Often, the facility manager must stand back and identify unsustainable issues such as junk mail, reengineer facility processes to address the issue, and enlist occupants in supporting the processes. Facility managers should also



consider how communication between facility management and occupants can occur more sustainably. It may be possible to create a facility management Web page on the organization's or building's Web site. After some education of occupants, the facility Web site can substitute for paper and electronic mail as a way of communicating events, policies and changes.

Did You Know?

Forestethics.org reports that more 100 billion pieces of junk mail are sent each year in the U.S. alone. This translates into one-third of all the mail in the world. Forty-four percent goes into landfills unopened. The U.S. Postal Service estimates that more than 100 million trees were processed to produce the paper in junk mail and that manufacturing processes generated about 51 tonnes of GHG emissions.

There are arguments to be made for the legitimate uses of junk mail, but decreasing the volume of unread (and therefore pointless) junk mail can probably be agreed on as a good goal for sustainable facilities.

Sustainable copying and printing services

Sustainable copying and printing services focus on the materials and equipment used. Exhibit 2-31 lists some ideas to improve sustainability in this service.

Exhibit 2-31: Sustainable Copying/Printing Initiatives

- Purchase paper that has a high percentage of post-consumer content and is manufactured without chlorine bleach.
- Select packaging materials with an eye toward reuse and recycling. Encourage reuse of padded envelopes.
- Use soy-based inks, water-based adhesives and solvents low in VOCs for printing.
- Avoid document designs that will render the printed item unrecyclable.
- Recycle toner cartridges.
- Maintain toner cartridges according to use rate. This can decrease the amount of waste created by poor print quality.
- Facilitate recycling of paper and other supplies (e.g., binders, intrafacility envelopes) by placing collection containers near the printers.
- Shape occupants' behavior by encouraging them to use electronic document management instead of printing; to proofread and spell-check before printing; and to use sustainable printing/copying practices, including printing on both sides and reusing single-side documents for scratch paper and faxes.
- Save energy by replacing multiple, single-purpose equipment with multipurpose models (i.e., combining printing, copying, scanning, faxing) and by ensuring that equipment employs power-saving tools.



Sustainable document management

Electronic records management can be used to reduce the amount of printing, copying and mailing as well as the need to allocate expensive physical space to records. Documents can be scanned into management system folders and accessed electronically by all occupants. Fewer documents are lost. These systems also audit access and can provide a trail of who has used a document and altered it. This can be particularly valuable for organizations that need to demonstrate compliance with complex regulations.

With content/document management systems, organizations can avoid having to maintain large storerooms of paper files or negotiating and managing control over satellite storage facilities.

Sustainable food service

A sustainable food service operation meets several criteria.

- **It is designed, constructed and operated in a sustainable manner.** Sustainable considerations can influence the choice of building materials and operating supplies, the incorporation of natural light and adequate ventilation, and the installation of energy- and water- efficient appliances and energy-efficient HVAC and lighting systems. Food offerings and preparation methods can support occupant health and safety. Food service staff can be provided with fair wages and safe working conditions. Nonhazardous cleaning materials and practices can be implemented.
- **It purchases food and supplies in a sustainable manner.** A food service operation can increase its sustainability by purchasing foods that have been produced in a sustainable manner (e.g., produce certified as organic, free range poultry products), that are packaged sustainably (e.g., bulk rather than single-use packaging, packaged using less material, packaged in recyclable containers) and that are sourced locally. Buying locally means that the supply chain includes less transportation and fewer carbon emissions.
- **It manages its waste stream responsibly.** Reusable ware reduces solid waste. Recycling bins located at logical points can encourage recycling of containers. Supplies can be selected based on the percentage of post-consumer content and recyclability. Cooking oil can be recycled and possibly used on site as a biomass energy source or as a biodiesel fuel for facility vehicles. Food waste can be composted (in compliance with local regulations).



- **It educates occupants about sustainable choices.** Food service venues offer the opportunity for frequent, regular and relatively lengthy contact with occupants. They are therefore an excellent vehicle for educating occupants about sustainability issues such as healthy eating choices, recycling and purchasing from local growers.

Sustainable meeting services

Facility managers may be called upon to organize or host meetings on site and off site. One of the first questions a facility manager should ask is whether a face-to-face meeting, rather than a video or Web conference, is actually necessary. If the meeting is necessary, the facility manager can encourage occupants to consider the meeting location they have chosen. Can the choice of location be optimized to reduce the overall amount of traveling required by participants? Can more sustainable travel options be used, such as high-occupancy vehicles or mass transportation? If air travel is required, facility managers can suggest that meeting planners build carbon offsets into their meeting budgets.

For meetings held on site, facility managers can introduce sustainable meeting practices, such as using paper with recycled content and low VOC markers or offering alternatives to bottled water. For off-site meetings, facility managers can recommend sites located near public transportation and venues committed to sustainable meeting practices.

Sustainable hardscape maintenance

Hardscape management refers to the maintenance of building exteriors (e.g., windows, walls and roofing, sidewalks, roadways). These maintenance activities include:

- Cleaning windows, building exteriors and amenities (e.g., pools).
- Painting and repairing building exteriors.
- Cleaning and repairing paths, roadways and parking areas.
- Removing snow and ice.

These activities involve products, equipment and processes that have the potential to deplete finite resources, pollute the environment and interfere with the productivity and well-being of occupants. A facility manager might improve the sustainability of hardscape management by doing the following.

- **Developing new policies and procedures for exterior cleaning and maintenance.** Environmentally friendly products should be specified. Staff should be trained in appropriate cleaning methods, dilution of concentrated products and precautions for avoiding spills. Noisy or distracting operations should be scheduled during low-occupancy times of the day or week.



- **Reducing the amount of maintenance and exterior cleaning that is needed.** Facility managers should analyze materials for renovation or repair projects not only for their cost, appearance and longevity but for the amount of cleaning and maintenance they will require. Sustainable maintenance characteristics can help avoid the need for harsh chemical cleaners, annual stripping and refinishing, or frequent replacement, which creates waste.
- **Gradually replacing nonsustainable equipment.** As with landscape equipment, hardscape maintenance equipment—pressure washers, vacuums, sweepers, plows, deicer spreaders—should be replaced over time with equipment that is powered by biodiesel fuel, electricity or liquid propane. Noise and emission levels should meet or exceed recommended standards. The amount of water used by cleaning equipment should also be minimized.
- **Ensuring the sustainability of snow and ice removal.** Snow removal requires the use of motorized equipment and different chemicals, most of which affect the environment negatively in some manner. Salt, for example, increases the salinity of surface water, which affects aquatic life, and damages vegetation. Ineffective snow removal can also pose a hazard to occupants and increased costs and risks for facility owners. Facility managers might also consider closing some facility entrances to decrease the fuel and chemicals associated with removing snow and deicing in that area.

Sustainable landscape and property amenities

A facility's grounds offer various opportunities for increasing facility sustainability. A sustainable plan for grounds and facility management can restore lost wildlife habitat and plant communities. It can also help restore the physical and mental health of hardworking or stressed occupants or neighbors. Unsustainable practices, however, pose significant potential to damage the environment, deplete finite resources and impair stakeholders' well-being.

Sustainable landscaping

Sustainable landscaping activities include the following.

- **Plant selection.** Landscape designs should not include any plants that have been declared as noxious or weeds by local jurisdictions. Weeds are often defined by gardeners as “plants growing where they’re not wanted.” This is especially important when these plants might affect local agriculture and increase the need for herbicides. As much as possible, landscape design should specify native species—to be distinguished from exotic species, which are introduced from other ecosystems. Native species are well adapted to the local climate, resistant to local pests and will require less water.



Plants should also be purchased from nurseries or growers who use sustainable practices and can certify that plants have not been removed from natural landscapes. This is a common issue with desert vegetation.

- **Low maintenance design that is not resource-intensive.** Landscape experts recommend that facility managers reorder the facilities' priorities in landscape, emphasizing trees and shrubs more than turf and seasonal color, since this landscape uses water and chemicals more sustainably. Mulching can be used to decrease the growth of weeds and the need for weeding or herbicide applications. (Mulches can include lawn clippings, which then lowers creation of landscape waste.)
- **Modifying use of powered landscape equipment.** Facility managers should identify opportunities to replace powered equipment with manual equipment—for example, using hand rakes instead of leaf blowers, hand clippers rather than electric trimmers. When power equipment is more feasible, facility managers should look for opportunities to replace aging equipment with models that do not use fossil fuels but instead are powered by electricity, liquid propane and even solar energy. The acoustic and emission levels of existing and replacement equipment should also be reviewed and gradually improved. Maintenance practices can also be revised to reduce their effect on occupants. Mowing, for example, can be scheduled for low-occupancy times.
- **Practices that promote plant health with minimal use of fertilizers, herbicides and pesticides.** Facility managers should ensure minimally that all local regulations about use of landscaping chemicals are followed. But facility managers should consider practices that may exceed legal requirements, such as use of slow-release synthetic fertilizers with appropriate nitrogen levels and organic alternatives such as compost tea. Turf should be aerated to prevent compaction and improve absorption of water and nutrients. By testing and amending soils as needed, facility managers can avoid excessive and inappropriate use of fertilizers. The use of herbicides can be reduced by tilling and by using weed fabric and mulch.

Preventive IPM landscaping measures include monitoring turf areas for proper drainage, removing diseased plant matter promptly and treating pruned limbs and landscape equipment with a mild antiseptic to prevent contaminating healthy plants. Pests should be identified and the frequency and timing of infestations recorded. In some cases, facility managers may opt to remove plants that have proven vulnerable to infestation and try



another plant species. Less environmentally toxic pesticide alternatives can be tried. Biological controls can counter some insects with their natural predators, parasites or pathogens.

- **Greater use of trees and taller shrubs for shading and windbreaks.** It has been estimated that strategic planting of trees and shrubs—so as to provide shade and block wind—can reduce buildings’ cooling needs by 30 percent and heating requirements by 20 to 50 percent.
- **Habitat restoration or protection.** Carving out a place for wildlife in a facility’s landscape recognizes that animals are also stakeholders in a sustainable facility. It is also a matter of human self-interest. The Sustainable Sites Initiative reports that approximately 80 percent of plants are dependent on pollination by animals.
- **Design that protects surrounding environment and facility structures.** If the facility includes surface water bodies such as ponds or rivers, there should be a vegetative buffer between the tended landscape or structures and the shoreline to filter pollutants that can enter surface water with runoff. A robust vegetative strip may also protect the facility property against storm surges and flooding. In some areas, facility managers may also need to consider the potential for wildfires and maintain a perimeter around facility structures that obstructs the spread of grass fires and especially the climbing of grass fires into tree tops that could then spread fire more quickly to structures. Fire prevention includes removing dead, dried vegetation that serves as fuel for fires.
- **Sustainable landscaping features.** Landscape features include benches and objects that create visual interest—ideally using recycled materials and salvaged materials rather than purchasing new landscape structures. Retired agricultural equipment or salvaged metal structures from demolished buildings can become focal points for a landscaped area and keep these objects out of landfills.

Natural and less toxic chemical controls should be used to prevent the growth of algae, pathogens or insects include artificial water bodies and fountains, such as ozone, aeration and thermal treatment. Landscape features should build on, rather than contradict, their natural settings. Large reflecting ponds or extensive fountain designs are inappropriate in an arid setting unless they serve some other purpose, such as water treatment.



Outsourcing landscape services

In reviewing proposals from landscaping companies, facility managers should consider both environmental and social aspects of landscaping. For example, many landscaping companies that describe themselves as environmentally friendly make no mention of their employees and steps that are taken to ensure their well-being.

A sustainable landscaping service should be assessed by its:

- Policies on the use of herbicides, fertilizers and pesticides.
- Approach to landscape design (e.g., selection of drought-resistant native plants).
- Expertise in irrigation systems that conserve water.
- Strategies for waste reduction and recycling.
- Reduction in the use of powered equipment.
- Flexibility in scheduling services for occupant comfort.
- Training and equipment of employees (e.g., employees are trained in the safe application of chemicals and provided with hearing protection when operating noisy equipment).

Contracts should be tied to specific performance, such as avoidance of certain listed chemicals and recycling/composting of landscape waste. Facility managers should then monitor landscaping activities to ensure that these contract criteria are being met.

Sustainable facility amenities

Sustainable facility amenities address the needs of all of the facility's stakeholders. This includes the facility's managers and also occupants and neighbors. Facility managers should look for ways to add "oases" of amenities, areas that will allow occupants to exercise (e.g., walking and bike paths, exercise stations, volleyball or basketball courts), to relax or take a break (e.g., engaging vistas, quiet areas by ponds or bird feeders) or to socialize with other occupants. These amenities should be accessible to the disabled, and facility managers might want to consider ways in which they may also be made available to community residents. For example, a portion of facility grounds could be converted into a community garden, which would provide exercise and fresh food and cut down on the amount of property to be maintained. Some organizations have directed produce from facility gardens to local food shelves.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. In the left column list five key changes in modern work and workplaces. In the right column list possible adaptations consistent with the principles of sustainability that facility managers may employ to support these changes.

Workplace Changes	Sustainable Facility Support Solutions

2. Describe two ways to minimize the cost and disruption of facility churn.

3. Which of the following would probably be perceived as a productive floor plan?

- () a. Meeting rooms, services and amenities are located on a single floor to increase equitable access.
- () b. Corner window spaces are allocated to management offices for greater visibility.
- () c. Meeting rooms and amenities are located at the building core to improve access.
- () d. Amenities are located in one corner of each floor to create fewer distractions.

4. List the four key components of IEQ discussed in this chapter.



5. Name at least two threats to IAQ outside and inside the facility.

Outside Threats to IAQ	Inside Threats to IAQ

6. For each of the tactical means below list at least one tactic a facility manager could implement to improve facility IAQ.

Operational: _____

Maintenance: _____

Policy: _____

7. Which of the following statements about facility lighting is true? (*Circle all that apply.*)

- () a. Studies have shown that lighting can affect health and productivity.
- () b. Best practice is to set ambient or room illumination levels to the needs of the occupant with the lowest visual acuity.
- () c. Glare can be reduced by decreasing the contrast between ambient room light and work area light.
- () d. Daylighting systems can enhance productivity.

8. Describe three steps a facility manager might take to improve facility use of chemical and hazardous substances.



9. Describe three ideas for improving the sustainability of facility copying/printing services.

10. Describe three ideas for improving the sustainability of facility food service operations.

11. A facility can contribute to surface and groundwater pollution through which of the following activities? (*Circle all that apply.*)

- ☐ a. Applying fertilizer to landscaped areas
☐ b. Routine cleaning of window exteriors
☐ c. On-site storage of deicing materials
☐ d. Emptying residual indoor cleaning agents into facility sink



Progress check answers

1. Increased use of teams: more and more varied meeting spaces, unassigned workspaces, mobile communication support
Dispersed teams: videoconferencing, extended facility hours
Continual reorganization: Flexible infrastructure, modular furnishings
Mobile work patterns: Hot desks, mobile support
Demand for quality of work life: Equitable distribution of space, amenities, daylight; more amenities to meet occupant needs (p. 2-92)
2. Ways to minimize the impact of churn include combining voice and data connections, using distributed IT connectivity, locating services in an accessible space such as a plenum and underfloor space, and using modular furnishings. (p. 2-94)
3. c (p. 2-95)
4. IEQ comprises indoor air quality, thermal comfort, visual comfort and acoustical comfort. (p. 2-96)
5. Outside IAQ threats: ambient air pollution, recaptured exhaust, moisture, soil pollutants
Indoor IAQ threats: HVAC equipment, facility processes and materials, people, building components and furnishings (p. 2-96)
6. Operational: Install CO₂ sensors, implement overnight purges of facility air, separate occupant areas from processes that may emit pollutants, install UV lights in cooling systems (p. 2-99)
Maintenance: Clean equipment air filters regularly and replace at recommended intervals, ensure intake/exhaust system is working properly, inspect and clean areas subject to mold and mildew (p. 2-100)
Policy: Smoking bans in facility and within certain distance of entrances and fresh air intakes, list of restricted products, sustainable cleaning policy, use of integrated pest management, occupant education and involvement (p. 2-100)
7. a, c and d (p. 2-103)
8. Answers might include any of the following:
 - Maintain an inventory of chemical products and hazardous materials used in the facility.
 - Inspect storage facilities regularly.
 - Inspect products for leaks and proper labeling.
 - Ensure that safety data sheets for products are available.
 - Ensure proper occupant and staff training.
 - Monitor for safe and proper use of chemical products.
 - Ensure that first aid instructions are communicated and equipment is available.
 - Educate occupants and staff about what to do in the event of a spill or accidental release of a hazardous chemical.
 - Communicate with local emergency and fire departments.
 - Arrange for proper disposal of chemical waste. (p. 2-107)
9. Answers might include any of the following copying/printing practices: using recycled paper and environmentally sensitive and recyclable materials; maintaining toner cartridges; educating occupants about ways to improve use of services; promote and facilitate recycling at printing point; promote



electronic document management; purchase multifunctional equipment that will print, copy, scan and fax. (p. 2-111)

10. Answers might include any of the following: reducing energy and water use by using daylighting, ensuring that windows and doors are energy-efficient, purchasing energy- and water-efficient appliances, installing efficient lighting; using food purchasing and preparation practices to promote sustainable and local agriculture and to improve occupants' health; and making the food service's use of materials more sustainable by purchasing supplies with high levels of post-consumer recycled content, employing reusable plates, cups and utensils and composting (if allowed locally). (p. 2-112)
11. All the choices are correct. Exterior uses of landscape and cleaning chemicals can filter into groundwater or enter surface water through stormwater runoff. Pollutants from on-site storage or facility activities can enter stormwater runoff. Even indoor activities can affect water quality. Materials emptied into facility sinks end up in the wastewater stream discharged from the facility. (p. 2-113)



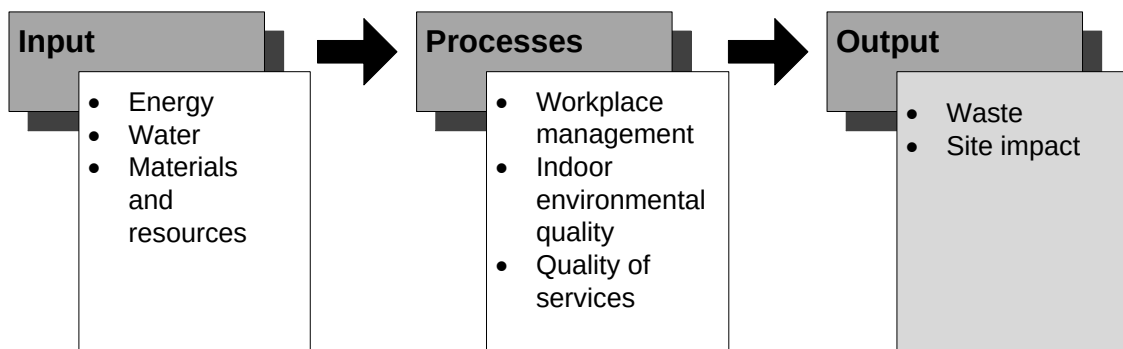
Chapter 6: Focus Areas for Sustainable Facility Management (Output)

After completing this chapter, students will be able to:

- Describe goals that will help facilities manage their waste output in a sustainable manner.
 - Describe the different ways in which waste is collected and disposed of.
 - Describe strategies for reducing waste.
 - Describe the criteria for a successful recycling program.
 - List and describe the steps in developing, implementing and tracking a facility recycling program.
 - Describe how hazardous waste is managed in a sustainable facility.
 - Describe sustainable site goals that will help minimize the impact of the facility site on its surroundings.
 - Describe how site impact can be reduced in the following areas:
 - Stormwater management
 - Light pollution
 - Heat island contributions
 - Transportation use
-

This chapter focuses on goals related to the two output categories of sustainable facility management and describes briefly some initiatives aimed at those achieving those goals. These areas are shown in Exhibit 2-32.

Exhibit 2-32: Major Categories of Sustainable Facility Management



✦ Topic 1: Waste

Program goals To improve the sustainability of the facility's management of waste, a facility manager must first understand how waste is collected and disposed in the facility's community and what options might exist for reducing the amount of waste that must be disposed of.

Based on that understanding, facility managers can then apply different strategies to manage waste that conform to the waste hierarchy:

- Reduce waste
- Recycle waste
- Dispose of hazardous waste in a sustainable manner

Understand waste disposal options

Managing waste has traditionally consisted of collection, followed by disposal and, depending upon the type of waste and the area of the world, some sort of processing. This processing may be to reduce the hazard of the waste, recover material for recycling, produce energy from the waste, or reduce it in volume for more efficient disposal. In addition to the creation of waste, the process of waste management is energy-intensive.

Knowing the liabilities of waste disposal—energy loss, pollution potential, financial cost—facility managers can explore options in their communities and develop waste management operations that are sustainable for the organization, the environment and the community.

Waste collection

Collection methods vary widely between different countries and even within a country. Management of nonhazardous waste in metropolitan areas is usually the responsibility of local government authorities, while management of hazardous waste is usually the responsibility of the generator.

The two predominant collection methods are pickup and dropoff. In pickup, the waste is taken to a central point (in a facility, this might be containers in a less visible area) where the collection agency picks it up. The generator of the waste has the ultimate responsibility in the dropoff method. The waste is collected, transported and “dropped off” at the collection agency by the generator.

Waste disposal methods

Disposal methods also vary widely around the world. In Australia, the most common method of disposal of solid waste is to send it to a landfill, because it is a large country with a low-density population. Japan is just the opposite: It is more common for waste to be incinerated, because the country is smaller and land is scarce. Other, more sustainable alternatives have emerged.



Landfills

Disposing of waste in a landfill is the most traditional method of waste disposal, and it remains a common practice in most countries. A well-run landfill can be a clean and relatively inexpensive method of disposing of waste materials. Older or poorly managed landfills can create a number of adverse environmental impacts, including wind-blown litter, attraction of vermin and the leaching of soluble contaminants into the groundwater. Many countries tax waste sent to landfills, usually based on the tonnage that is delivered.

Incineration

Incineration is the process of destroying waste material by burning it. Incineration is still used in many countries (especially developing countries) as a waste management tool. However, it is becoming a highly controversial practice, in these same developing countries, because the gases and the ash residue produced are uncontrolled and could be toxic. In most developed countries, incinerators use elaborate pollution control measures for exhaust gases to reduce the amount of toxic products released into the environment. Even after taking these extra measures, many environmental organizations are questioning the toxicity of the pollutants released during incineration.

Resource recovery

A recent shift in thinking has caused waste material to be considered a resource as opposed to a burden, a potential source of income rather than a liability. There are many ways that latent value in waste can be recovered, some more costly than others. New technologies for waste recovery are emerging, but many are cost-prohibitive. Three of the more common resource recovery methods that are used by facilities throughout the world are:

- **Recycling**—the process of reusing a material (beyond its intended use) or producing a new product from recycled materials. An example of recycling is the widespread collection and reprocessing of single-use beverage containers (plastic, glass or cans).
- **Composting**—a process that decomposes the organic matter and kills any pathogens. The output is then recycled as mulch or compost for agricultural or landscaping purposes.
- **Thermal treatment**, including pyrolysis and gasification—a process in which where materials are incinerated at extremely high temperatures with limited oxygen. Converting material to energy this way is more efficient than direct incineration, with more energy able to be recovered and used. Gasification is used in biomass power stations to produce renewable energy and heat.



Reduce waste

If waste cannot be prevented, the next best strategy is to reduce the amount of waste that a facility produces. Reducing waste requires deconstructing and analyzing each waste stream in the facility. Alternative products and procedures must be identified that are appropriate for each area. This section illustrates this approach by looking at waste in two common facility services: food service and construction (facility buildout or alteration).

Waste reduction in food service

Food service includes cafeteria, vending machines and catered meals. One of the markers of efficient food service is lack of waste, and efficient food service saves a facility money and generally is better at satisfying and retaining customers (occupants).

Exhibit 2-33 lists some activities that an organization can undertake in order to better control its waste stream and eventually reduce the amount of waste produced.

Exhibit 2-33: Food Service Waste Stream Management Activities (continued on next page)

Strategy Area	Tactic
Reuse	• Use rubber mats around bus and dish-washing stations to reduce china and glass breakage. • Use refillable condiment bottles instead of single-use packets. • Use dishes instead of Styrofoam. • Use reusable coasters. • Use reusable table linens. • Use reusable hats for kitchen employees instead of disposable paper ones.
Reduction	• Reduce packaging for takeout. • Eliminate the use of trays. • Offer straws and condiments only upon request. • Use rolled paper towels instead of precut. • Offer a discount to customers who bring reusable coffee cups.
Recycling	• Establish glass, plastic and cardboard recycling. • Flatten cans before putting them in the recycling bin to save space.
Composting	• Develop a composting program. • Use separate collection bins specifically for food waste.
Purchasing	• Purchase products in bulk. • Purchase products made from recycled materials. • Ask suppliers to take back shipping boxes for reuse. • Purchase products locally.
Electricity conservation	• Develop a cleaning and maintenance program for all equipment. • Use energy-conserving fluorescent lights instead of incandescent bulbs. • Use low-wattage bulbs in exit signs. • Clean refrigerator coils. • Use energy-efficient and water-conserving appliances. • Install motion or timer lights in restrooms, pantries and freezer units. • Set thermostats at reasonable levels.



Exhibit 2-33: Food Service Waste Stream Management Activities (concluded)

Strategy Area	Tactic
Water conservation	• Clean spills with squeegee, broom or vacuum. • Install low-flow faucet adapters and automatic turnoff faucets. • Never hose materials down the drain. • Using hand scraping for food scraps. • Provide drinking water to customers upon request. • Replace rubber faucet gaskets with brass gaskets and automatic shut off nozzles. • Create a periodic leak inspection program.
Food and grease management	• Clean fryers and filter the oil daily. • Set up a rendering service for waste grease, fat and cooking oil.
Cleaning	• Choose environmentally friendly cleaning products. • Use cloth towels for cleaning rather than paper equivalents. • Purchase cleaning supplies in concentrate form. • Purchase multiuse products.

Waste reduction in construction

Construction projects, by their nature, generate a large amount of waste. Construction and demolition waste is a significant portion of the waste currently going into landfills. Research shows that between 15 and 20 percent of municipal solid waste comes from construction and demolition projects.

The waste stream in a construction project is continuous. Therefore, it is important to plan for and educate contractors on the expectations regarding how the stream will be managed. Exhibit 2-34 lists some activities that can help facilities control their waste stream and eventually reduce the amount of construction waste produced.

Exhibit 2-34: Construction Waste Stream Management Activities

Stream	Activity
Salvage (reuse)	• Remove salvageable items as early in the project as possible. Allow time for this on the front end of the project schedule. • Allow workers to reuse scraps. • Save large scraps for use in other projects.
Recycle	• Return durable packaging to the suppliers. • Separate smaller scraps and nondurable packaging when used. • Post a list of items to be recycled and where to place them for workers. • Place properly marked recycle bins or carts around the site for easy use. • Schedule the collection of recyclables so the bins and carts do not overflow. Once a bin is full, people are more likely to place the item in the trash. • Move bins and carts to where the work is being completed. The proximity of recycling increases participation rates. • Reward participation in the recycling program.



Construction waste management plan

A construction waste management plan is a short, simple document that manages construction waste throughout a project. It includes instructions for both the construction crew and subcontractors on which materials will be reused, recycled or sent to the landfill; where they will be taken; and how each material will be handled. It is important to have the plan posted in a prominent spot at the job site so anyone can refer to it at any time.

There are many different ways to go about creating a construction waste management plan. IFMA recommends a simple nine-step process that creates a comprehensive plan that is easy to follow. (See Exhibit 2-35.)

Exhibit 2-35: Steps to Create a Construction Waste Management Plan (continued on next page)

Step	Details
Step 1: Identify the responsible party.	- Identify who is responsible for creating the plan and ensuring that it is followed. - Every plan should include details of the person who drafted it, the person in charge of the project and (if one has been appointed) the contractor's identity. - If there is more than one contractor, details of the principal contractor must be included. - The plan should be kept either at the site office or, if there is no site office, on site.
Step 2: Identify types and quantity of waste.	Identify the different types and quantities of waste that will be produced by the project at all stages.
Step 3: List waste management options.	- Identify waste management options and identify changes in design and materials specifications that can minimize this waste. - Consider how to reuse, recycle or recover the different wastes produced by the project.
Step 4: Identify sites and contractors.	- Identify waste management sites and contractors for all wastes. - Require the companies to demonstrate that they are complying with local regulations.
Step 5: Conduct training.	- Conduct any necessary training of internal and external staff to ensure that everyone understands the requirements of the plan. - Post waste requirements throughout the site.



Exhibit 2-35: Steps to Create a Construction Waste Management Plan (concluded)

Step	Details
Step 6: Document any site constraints.	- Plan early for efficient materials and waste handling, bearing in mind any constraints imposed by the site and its location. - The plan should describe the construction site and its location and the work proposed, including the estimated value of the site, and record decisions on the nature of the project, its design and construction method or materials employed.
Step 7: Document the actual waste produced.	- Measure and compare the quantity and type of waste produced against the plan to ensure that waste is properly managed and lessons are learned for the next project. - All figures should be recorded on a data sheet. - Every time waste is removed from the site, the plan should be updated with further information, including: - Type of waste removed. - Destination site. - Waste management contractor removing the waste.
Step 8: Monitor.	Monitor the implementation of the plan to ensure that it is being followed, and be prepared to update the plan if the project parameters change.
Step 9: Conduct post-project review.	Review the success of the plan at the end of the project, identifying learning points for future reference.

Recycle waste

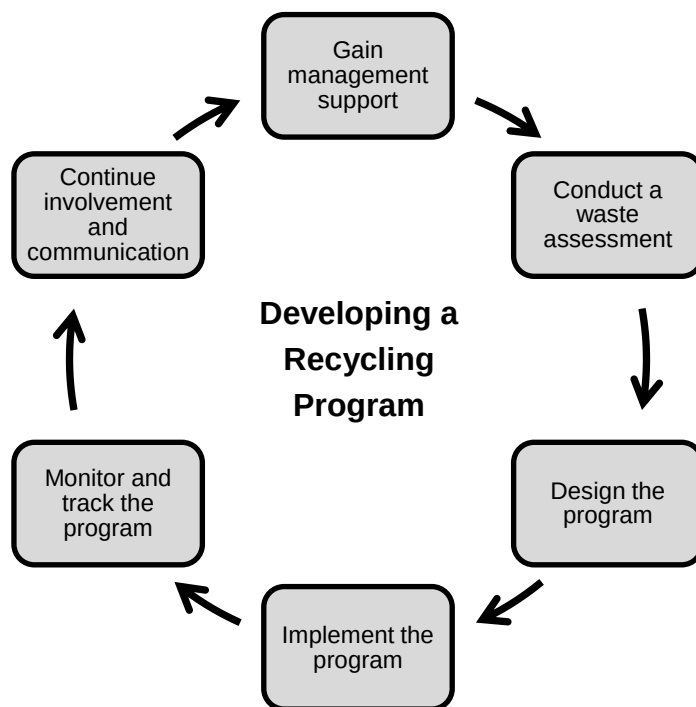
A successful recycling program should fulfill the following criteria:

- The program must be viable. It should not involve a significant impact on existing work processes.
- The program should be desirable. People need to want to participate.
- The program should be adaptable. It needs to be a phased solution that can expand and decrease with the changes in demand from the organization.
- The program should be feasible. There should be local organizations that accept recyclable materials.

There are many models available for developing a successful recycling program. Exhibit 2-36 shows six simple steps to develop a facility recycling program. If the organization already has a recycling program, these steps can be used to analyze the current program and determine if any improvements or adjustments are needed.



Exhibit 2-36: Developing a Facility Recycling Program



Step 1: Gain management support.

Management's role in a successful program is to:

- Implement a companywide recycling policy.
- Allocate resources (personnel and money).
- Lead by example—reducing waste, recycling and buying recycled.
- Stay committed and involved.
- Offer incentives to reward staff participation.

Step 2: Conduct a waste assessment to determine targeted materials.

To conduct a waste assessment, a facility manager first determines what kind of waste the organization is currently generating and where in the facility it is being generated. Highest volume materials are called targeted materials. A recycling program should be built around these materials and targeted at areas with high waste volume.

Step 3: Design the program.

A good recycling program includes five aspects:

- **Removal**, either by a recycling service provider or by self-hauling. The facility manager must be prepared to select a service provider who can meet the



facility's needs in terms of volume, types of materials collected, frequency of pick up and compliance.

- **Collection.** Single stream recycling is easier for occupants than dual stream recycling, which requires recycled materials to be separated by type. A successful facility recycling program makes the process as easy as possible—ensuring that there are ample recycling bins in the most appropriate places and providing explanatory signage. Facility managers must also plan for temporary storage of recyclables between scheduled pickups.
- **Education.** Before the program is implemented, facility managers should consider who they need to communicate with, what information needs to be communicated, and how best to communicate that information. Communication programs are discussed in more detail below, under implementation of the recycling program.
- **Policy.** The organization should have policies and procedures that communicate the company's commitment to both waste reduction and recycling. Having this clear vision will help with goal setting and ensure management support. The policy should be communicated companywide.
- **Purchasing.** Sustainable purchasing decisions can greatly support recycling program. One way of showing support is to make it a company practice to purchase products with recycled content whenever possible. Some organizations have even gone as far as saying that all products purchased in certain categories must use a minimum percentage of recycled content (i.e., 100 percent recycled paper).

Step 4: Implement the program.

Items that must be completed prior to the kickoff of the program are:

- Approving the company policy.
- Contracting with the service provider.
- Putting out the collection bins.
- Communicating the program to occupants.

The topic of how to effectively implement recycling programs is essentially the same regardless of business size. At its most basic, there are three components to implementing a successful recycling program: make it easy, promote the program and motivate participants, and educate staff, occupants and visitors about what's involved.



Below are some ideas for types of messages to share with employees about recycling:

- Show environmental results (using one of the environmental benefits calculators found online).
- Explain how the facility's recycling program supports specific local legislation.
- Show recycling trends in the facility over time.
- Highlight a department or individual who recycles.
- Participate in special days aimed at recycling (e.g., Earth Day).
- Offer seasonal tips (e.g., different items are recycled more at different times of the year).
- Celebrate the recycling program's anniversary.
- Celebrate milestones toward collection goals.

Step 5: Monitor and track the program.

Specific measurements of the amounts of materials being generated are very useful when evaluating the success of a program. It is important to track both revenues from recycling and savings such as lower waste removal bills.

In addition to financial numbers, it is also important to gather anecdotal feedback from employees about what is and is not working. This can be done using a comment card box, conducting a companywide survey or interviewing employees on their recycling experience.

Reporting results. Reporting of recycling program metrics is an important and often overlooked aspect of a successful program.

Reporting on the recycling program benefits the organization's efforts to be sustainable by:

- Increasing occupant and organization awareness (line of sight) of the actual amount of tonnage being recycled by the organization.
- Providing data to support requests for additional funding and/or sustainability certification.
- Giving positive feedback to the organization and occupants, celebrating the success of the program.
- Motivating other occupants to participate.

Reporting and feedback should be provided to both management and occupants, reflecting their particular interests in the program. Depending on local requirements, facility managers may also be expected to submit a report to the local authorities.



Step 6: Continue involvement and communication.

Like any initiative, once the excitement of the kickoff has passed, it is still important to keep all parties informed. Recycling program updates should be issued on a regular basis. The key is to show people that their participation matters and produces results. Some suggestions to keep both management and employees informed about the success of the recycling program are to:

- Write an article for the organization or facility newsletter.
- Send e-mail updates on volume, participation rates, money saved, etc.
- Post flyers as a reminder of company goals.
- Post progress charts of current recycling numbers against company goals.
- Give awards to employees or departments who have demonstrated innovative recycling strategies.

Recycling in construction/renovation

Unless recycling or reuse is specified as a requirement in a demolition/construction contract, most construction waste goes into the local landfill. Ensuring that construction waste is recycled will take deliberate action by the facility manager.

Construction waste recycling is the process of separating and recycling recoverable waste materials created during construction. The two most important steps for the recycling of construction waste are on-site preparation and a solid program. Exhibit 2-37 reviews the steps involved in preparing and creating a successful construction/renovation recycling program.

Exhibit 2-37: Setting Up a Construction Recycling Program (continued on next page)

Steps	Details
Step 1: Commit to reuse and recycle.	• Put recycling into all bid specifications and contracts. • Determine ways in which waste can be reduced and materials reused during construction and put these methods into the contract. • Issue a statement explaining why construction waste recycling is important to the project. • Establish who will control the waste stream.
Step 2: Include waste reduction, reuse and recycling from the start.	• Order materials just in time and send extra inventory back. • Ask suppliers to reduce packaging. • Discuss and encourage reduction, reuse and recycling at preconstruction meetings.
Step 3: Identify target materials.	Identify the targeted materials that should be recycled. Some examples of construction-created target materials, such as wiring and ductwork, wood flooring and carpeting, and structural elements (e.g., doors and windows).



Exhibit 2-37: Setting Up a Construction Recycling Program (concluded)

Steps	Details
Step 4: Select a collector.	• Develop a local vendor list. • Write an RFP. • Select the recycling vendor.
Step 5: Review the site waste management plan for additional recycling opportunities.	• Review the steps to create a construction waste management plan for additional areas where recycling can be done. • Set a goal for the percentage of waste to reuse and recycle. • Analyze the projected types of waste to be generated, including types and quantities. • List the targeted materials for recycling. • List the responsible parties. • Note the trash and recycling service provider(s). • Determine site logistics (e.g., placement of collection containers, bins and signs). • Document the education and motivation plan. • State waste auditing procedures. • Create documentation for any special procedures.

When recycling is not an option

If traditional recycling is not an option, there are still options for handling and disposing of the waste the facility generates in normal day-to-day operations or during a construction project.

- **Reduce consumption.** The first choice goes back to the previous discussion of materials: reduce the amount of consumption. Methods for reducing consumption that should be considered include (but are not limited to):
 - Double-sided printing of all materials.
 - Printing draft documents on one-sided reused paper.
 - Using reusable cups and dishes for meetings.
 - Offering a discount in the facility cafeteria for those who bring their own cup.
 - Using electronic communication tools instead of print materials.
- **Implement sustainable procurement.** The organization can commit to create and follow a sustainable purchasing policy. Purchasing recycled products decreases the demand for “new” products in the marketplace, thereby reducing the strain on the environmental resources used to create those products. Sustainable purchasing policies should include specific details on the expectations for purchasing items made with recycling content.



- **Donate.** What cannot be reused by an organization should be donated. Donation can be an important part of an organization's corporate social responsibility program and can have a global or local focus.

Disposal of hazardous materials

The disposal of most hazardous materials is strictly regulated. Do not dispose of any hazardous material in the sewer, on the ground or in the trash. The environmental health and safety department (or FM) is usually responsible for collecting hazardous waste and treating it or preparing it for shipment to an approved hazardous waste disposal facility. Waste products must be clearly labeled with the complete names of the contents, and they must be stored in nonleaking, safe containers.

In many cases, disposal is difficult, and the preferred solution is to:

- Use an alternative material.
- Recycle where possible.
- Use the material completely and then solidify the residual and dispose of the container as prescribed by the provider.

If an organization has a recycling program, it is important to occasionally audit the program to ensure that hazardous waste materials are being disposed of properly.

Inspection of hazardous materials storage and handling

Just as recycling programs should be audited, facility managers should also audit or inspect the collection and storage area for hazardous waste materials. It is recommended that this inspection be conducted on a weekly basis.

An inspection should ensure that:

- Accumulation start dates are clearly marked on containers.
- Containers are closed and in good condition, with no evidence of leaking.
- Wastes are compatible with the container material.
- Incompatible wastes are properly separated.
- Waste has not exceeded the accumulation limits.

Most facilities have an inspection log and checklist to ensure consistency. It is a good idea to use the checklist each time an inspection is conducted by logging each inspection on the form and keeping the form at the site.



✦ Topic 2: Site Impact

Program goals

Managing a site in a sustainable manner obliges a facility manager to:

- Avoid degrading a site's ecosystem through the facility's presence. The facility manager should also undertake initiatives to upgrade the site's ecosystem if the site has been damaged by previous development.
- Use the principles of biomimicry—emulating models, systems or processes in nature to solve human problems sustainably—whenever possible. This minimizes reliance on solutions that are resource-intensive and generate waste.
- Think in terms of systems—analyzing facility projects to ensure that the possible effects of initiatives on complex ecosystem relationships have been fully understood and addressed. The ecosystem includes the site's resources, plants and wildlife but also occupants, employees and other stakeholders.
- Consider the future as well as the present—the generations to come who will be affected by today's actions.

This topic will examine ways in which facility managers can reduce site impact by:

- Improving stormwater management practices to decrease the volume and increase the quality of stormwater discharges from facility property.
- Reducing light pollution from facility exterior lighting.
- Reducing the contribution of facility hardscapes to urban heat islands.
- Improving the sustainability of facility and occupant transportation.

Manage stormwater

Stormwater from facilities contributes to pollution by washing soil, debris and pollutants from the facility into municipal stormwater systems, surface water (e.g., rivers and lakes) and groundwater (i.e., aquifers). It also places a burden on municipal systems. The greater the volume of stormwater a facility generates, the greater burden it places on municipal systems. Poor facility stormwater management also creates the potential that, during extremely heavy rains, stormwater may exceed the municipal system's capacity and back up, untreated, into the environment.

A facility manager can improve the sustainability of the facility's management of stormwater by:

- Maintaining the integrity of stormwater control mechanisms, such as drains and catch basins.
- Capturing and reusing stormwater for facility purposes (e.g., holding for irrigation) if stormwater capture and reuse is permitted by local regulations.



- Identifying and correcting grading issues that impair proper drainage or contribute to erosion.
- Increasing permeable surfaces that allow absorption of stormwater, including bioretention areas (e.g., rain gardens, filtration vegetative strips).
- Using fertilizers and pesticides sparingly and appropriately.
- Adding landscaping features to filter and clean stormwater and using native vegetation to remove nitrogen, phosphorus and other pollutants.
- Developing policies about use, disposal and storage of possible pollutants.
- Educating occupants and employees about the importance of water quality and the potential impact of facility practices on water quality.

Reduce light pollution

Light pollution is defined as excess sky light created by human activities that interferes with astronomical observations and affects the environment. Light from facilities can:

- Affect wildlife—disrupting feeding, hunting, procreating and migration activities.
- Diminish the aesthetic appeal—and, in some areas near observatories, the scientific value—of the night sky.
- Interfere with the vision of passing motorists.
- Diminish the well-being and property enjoyment of facility neighbors.

Light trespass

Light trespass occurs when a facility sheds more light onto a neighboring property than the neighbor sheds onto the facility. Avoiding light trespass is an ethical obligation consistent with the general considerations of sustainable facility management. However, it may also be a legal issue. Local codes may restrict facility lighting from negatively affecting neighbors. Complaints can result in costly lawsuits.

Facility managers should be aware of and comply with local regulations and codes regarding exterior lighting, but they can also help reduce a facility's contribution to light pollution by shielding exterior lights and preventing light trespass onto neighboring properties. Shielded fixtures minimize the upward escape of light from the fixture, either directly or by reflection off the fixture or lamp casing. Light trespass can be avoided or minimized by manipulating the angle, height, amount and timing of the problematic illumination. Facility managers should consider whether the lighting is even necessary and be ready to see the issue from neighbors' perspectives and to work with them to create effective and practical solutions.



Decrease heat island effects

The urban heat island effect refers to the absorption of solar radiation by the surfaces of hardscape features such as pavement and roofs and the radiation of that heat into the surrounding air. There are various ingredients to the heat island effect:

- Higher ratio of impervious surface to vegetative cover that reduces the amount of surface moisture available for evapotranspiration and the amount of heat transpired by about 25 percent.
- Solar reflectivity of surface materials, or albedo. Reflectivity usually, but not always, corresponds with color: a dark color has a low albedo and absorbs rather than reflects solar energy, while a lighter color has a high albedo and reflects more solar energy, while absorbing less heat. (Newer materials are being engineered that are both dark-colored and have high albedo.) A surface with a low albedo, such as a green asphalt shingle, reflects less solar energy and has a solar reflectivity index (SRI) of less than 20 percent. On a summer day with full sun, the temperature on a low albedo surface can be much warmer than the surrounding air—90°F compared to 50°F (or 50°C compared to 27°C).
- Heat storage capacity and thermal emissivity rate of materials—the ability of a material to absorb and store solar energy and the ability of a material to release absorbed heat. Some materials, such as stone or unpainted steel, are able to retain large amounts of heat and release that stored heat slowly. This feature makes them attractive for creating passive solar heating features in buildings but less desirable from a heat island perspective.
- Building height and proximity. Taller buildings that are close together reflect light onto neighboring walls that then store the energy. Taller buildings can also block wind and reduce emission of stored heat at night.
- Human activity, such as cooling processes and waste heat released from buildings, houses, cars, appliances and other equipment.

The difference in nighttime temperature between an urban heat island dominated by impervious surfaces with low albedo and high heat capacity, and surrounding rural areas can be significant.



It is a sustainable practice to reduce heat island effect because:

- Heat islands increase the use of air conditioning and therefore increase energy use, greenhouse gas emissions and air pollution.
- Elevated temperatures diminish comfort and affect health.
- Stormwater runoff is warmer and can affect water quality and aquatic life.

Did You Know?

Heat can also harm air quality by increasing smog and ground-level ozone. In Los Angeles, for every 1°C the temperature rises above 22°C (or 0.5° above 72°F), smog increases by five percent.

Sustainable facility management practices aimed at curbing the heat island effect include the following:

- Increasing the SRI and the permeability of paved areas. To raise the surface reflectivity, lighter-colored asphalt can be used, and concrete can be used for walkways and as an overlay on asphalt. Permeability can be increased by using alternatives to pavement whenever possible—such as mulched or graveled paths—and by increasing planted areas, especially plantings with trees.
- Using cool roof technology or vegetative roofs. Cool roof upgrades can be done as an add-on to an existing roof in good repair or as part of a scheduled roof replacement. In some instances, light-colored roof coatings can be applied over an existing roof. A vegetative roof (also called a “green” roof or an eco-roof) is completely or partially covered by a layer of living vegetation. Vegetative roofs should be installed by experts and monitored and maintained carefully.

Manage impact of travel

Facility managers must consider the effects of transportation associated with supply chain transportation and with the movement of occupants to and from the facility. Transportation impact can also include occupants’ air travel for organizational purposes. Air travel is an issue for a sustainable facility because, while air transportation may use less fuel than an individual commuter when per traveler calculations are made, greenhouse gases emitted at higher altitudes are more damaging to the environment.

Exhibit 2-38 lists examples of strategic objectives facility managers could pursue in this focus area and possible tactics for each program.



Exhibit 2-38: Sustainable Transportation Initiatives

Strategic Objectives	Tactics
Decreasing number of occupants commuting to work by car or annual facility vehicle miles traveled (VMTs)	• Encourage use of public transportation. • Support organization's off-site work policies. • Promote bike or walk-to-work alternatives. • Sponsor on-site car-share program. Ensure availability of personal services for occupants.
Promoting use of vehicles powered by alternative fuels	• As fleet vehicles are replaced, choose plug-in, hybrid, fuel cell or other alternative fuel vehicles. • Provide preferential parking spaces or services for alternative fuel vehicles.
Optimizing parking area	• Implement a shared parking scheme. • Support condensed workweek schedule.
Increasing vehicle occupancy	• Promote carpooling and ride-sharing programs.
Increasing availability of public transportation	• Become involved in local government transportation planning.
Decreasing impact of occupant air travel	• Install videoconferencing facilities or promote Web conferencing. • Purchase carbon offsets for air travel.



Progress Check Questions

Directions: Read each question and respond in the space provided. Answers and page references follow the questions.

1. Which of the following is NOT a resource recovery technique?
 - () a. Recycling
 - () b. Composting
 - () c. Pyrolysis
 - () d. Incineration

2. Provide one example for each of the following sustainable waste management strategy areas in food service.

Strategy Area	Tactic
Reuse	
Reduction	
Recycling	
Composting	
Purchasing	
Electricity conservation	
Water conservation	
Food and grease management	
Cleaning	



3. The purpose of a construction waste management plan is to _____

4. What are the four criteria for a successful recycling program?

5. List the six steps in developing a recycling program.

6. If a facility manager is trying to be sustainable and recycling is not available, what are two options?

7. List at least three ways in which facility management can manage the impact of the facility on the environment and its community.

8. List three ways in which facility managers can improve site stormwater management.



9. Which of the following statements about light pollution is correct? *(Select all that apply.)*
- ☐ a. Light trespass occurs when a facility emits more light onto a neighbor than it receives from that neighbor.
 - ☐ b. Light pollution is primarily a concern for humans, not animals.
 - ☐ c. There is no legal obligation to correct light trespass issues; it is only an ethical issue.
 - ☐ d. Light trespass issues often involve relatively simple solutions.

10. Define the term “heat island effect.”

11. Describe how contributing to the urban heat island effect violates a sustainable facility’s obligation to the following. *(Provide at least one example for each category.)*

People:

Planet:

12. Which of the following facility projects could be useful in curbing the facility’s heat island effect? *(Circle all that apply.)*

- ☐ a. Incorporating more trees into the facility’s landscape
- ☐ b. Increasing building insulation
- ☐ c. Applying light-colored roof covering where possible
- ☐ d. Using more sustainable refrigerant in facility’s cooling systems

13. List at least two ways in which facility managers could increase occupancy in vehicles used for commuting to the facility.



Progress check answers

1. d (p. 2-124)
2. See Exhibit 2-33 for examples. (p. 2-126)
3. It instructs both the construction crew and subcontractors on which materials will be reused, recycled or sent to the landfill, where they will be taken, and the handling procedure for each material. (p. 2-128)
4. The program must be viable, desirable, adaptable and feasible. (p. 2-129)
5. Gain management support, conduct a waste assessment, design the program, implement the program, monitor and track the program, continue involvement and communication. (p. 2-130)
6. Reduce consumption, implement sustainable procurement, donate. (p. 2-134)
7. Improve stormwater discharge, reduce light pollution, reduce contribution to heat island effect and increase the sustainability of facility transportation use (p. 2-136)
8. Maintain integrity of stormwater control mechanisms, capture and reuse stormwater if compliant, avoid erosion, increase permeable surfaces, minimize or eliminate use of potentially polluting materials, use landscaping to filter stormwater, educate occupants and staff about impact of facility practices on water quality (p. 2-136)
9. a and d (p. 2-137)
10. The heat island effect occurs when solar radiation is absorbed by an area's hardscapes, which then radiate heat into the surrounding atmosphere. (p. 2-138)
11. People: The heat island effect threatens people's health and comfort and contributes to social inequity, since it affects most the poor and those on fixed incomes (often the elderly).
Planet: The heat island effect increases the amount of energy consumed for cooling, contributing to global warming. It worsens air pollution and can warm surface water bodies, harming aquatic life. (p. 2-139)
12. a and c (p. 2-139)
13. To promote carpooling and ride sharing, facility managers might promote programs and facilitate occupant enrollment. They might also provide financial incentives to individuals who opt to carpool or to drivers. High-occupancy vehicles could be granted preferential parking. (p. 2-140)

Next Steps

You have completed this competency of the IFMA Facility Management Learning System. Next, check your understanding by completing the online competency-specific chapter quizzes and case study to help you identify any concepts that need additional study. Check your understanding another way by selecting the competency-specific eFlashcards, or visit the Resource Center to download printable flashcards.

Once you have completed the chapter quizzes, reviewed the eFlashcards, completed the case study and feel confident that you have mastered the information, you can advance to the next competency.

