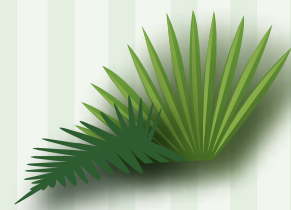


Creating a Green and Profitable Work Environment



An informative guide to "green" cleaning and maintenance practices which provide efficient, productive and healthy operation of commercial buildings in Florida.

2003



Creating a Green and Profitable Work Environment

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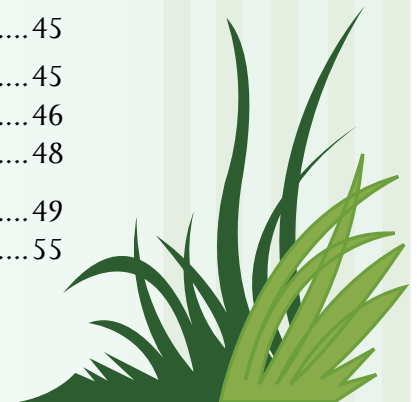
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1.0 Introduction to Guide

An important aspect of what separates the newly constructed buildings of today from older buildings is their environmental performance. Due to dwindling resources, rising energy and water costs, and awareness of the effects of air quality both inside and outside of the building, new buildings are constructed to not only fulfill their function, but also with conservation and health in mind. However, although the focus on construction, specification, and commissioning has changed, there is a commonality that links new buildings with those of the past. Often overlooked with regards to impacting the building's durability, energy and water use, and indoor air quality are recurring cleaning and maintenance activities. Such activities, including routine and scheduled actions, as well as emergency and other unplanned actions, have a profound effect on the environmental performance of a building, especially considering the fact that they continue over the entire life of the building, which can span 25-50 years.

Improving and/or maintaining the environmental performance of a building through cleaning and maintenance is an important consideration for many reasons. First and foremost, it can have direct positive impacts on the health of the occupants, who in many cases spend a significant amount

of time within the building. Particles such as dust, gases such as volatile organic compounds (VOCs), and biological materials such as mold can impact the health of occupants on a variety of levels, from simple annoyances such as itchy eyes, to more severe conditions such as asthma triggers. Poor

indoor air quality can result from improper or infrequent cleaning and maintenance practices, but it can also result from various cleaning agents and other supplies used. Therefore,

most susceptible are the individuals who are performing the cleaning and maintenance. Employees and visitors are also susceptible, especially children, the elderly, and those with pre-existing health conditions such as allergies and asthma. Poor indoor air quality can also result from improper maintenance and operation of the buildings heating, ventilation,

and air conditioning (HVAC) systems. Such problems may be difficult to uncover without thorough investigation, and can result in short-term effects such as comfort complaints, as well as

long-term effects on the quality of the indoor environment and the health of occupants.

Improving the environmental performance of a building through cleaning and maintenance practices can also lead to significant financial benefits. The health and overall well-being of employees is directly related to their productivity, morale, and absenteeism.

Financial benefits of green cleaning and maintenance include:

- *15-30% savings on cleaning costs*
- *35% energy savings*
- *20-60% water savings*

Streamlining cleaning and maintenance can lead to:

- *Improved occupant health*
- *Financial benefits*
- *Better building durability*



Considering that generally the largest recurring cost in a business environment is the salaries and benefits of employees, very small increases in productivity can lead to large increases in profits. Improving environmental

The term “green” has come to be defined as a holistic approach to improving environmental aspects of the built environment through energy and water conservation, healthy indoor environments, and the use of recycled and recyclable materials.

performance of cleaning activities focuses on streamlining operations to reduce the wasting of supplies, and improve the effectiveness of cleaning practices

thereby decreasing overall cleaning costs. It is estimated that the costs associated with cleaning the average urban office building are \$1.38 per square foot, and can run as high as \$2.32 per square foot. Savings of 15%-30% from implementing improved measures have been reported. Also affecting the bottom line of a business operating within the building is the amount of money spent on recurring energy and water use. Energy savings of up to 35% are possible through modifications in operational and management practices alone, and water savings of 20%-60% are possible simply by modifying landscaping and irrigation practices. Of extreme importance to the building owner is the durability of the building's structure and systems, and the frequency of performing upgrades and equipment replacement. Improving the environmental performance of cleaning and maintenance activities involves selection of products and

equipment partially based on longevity, as well as protecting the existing equipment and structure through preventive maintenance such that its full lifetime can be realized.

This guide is intended to provide a building owner or manager with suggestions and examples of how the environmental performance of a building can be improved through “green” cleaning and maintenance. The term “green” has come to be defined as a holistic approach to improving environmental aspects of the built environment through energy and water conservation, healthy indoor environments, and the use of recycled and recyclable materials. This guide is not intended for janitorial and maintenance personnel directly, for every building is different, and activities taking place within the building, architectural aspects, and current practices need to be taken into account in order to determine the applicability of the guide to an individual building, and before the recommendations can be put into practice.

This guide has been developed for commercial buildings in general, and does not comment on the applicability of recommendations to different building uses (retail, industrial, office, laboratory, etc.). However, depending on

the presence or absence of certain architectural features, most of the guide's recommendations should apply to an office building type of setting. There

are certainly building activities and types that are beyond the scope of this guide such as hospitals and laboratories where current practice, as well as state and federal regulations will supercede this guide's

For information on issues outside the scope of this guide, contact the Florida Department of Environmental Protection P2 Program: www.dep.state.fl.us/waste/categories/p2/default.htm

recommendations. To pursue additional or industry specific source reduction, waste minimization and recycling goals that go beyond the scope of this guide a building manager or other similar individual can contact the Florida Department of Environmental Protection Pollution Prevention Program. Contact information is provided in the Acknowledgment section of this guide.

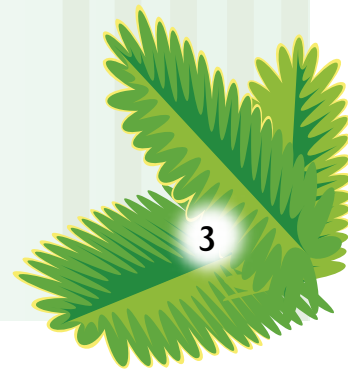
The guide's recommendations primarily deal with maintenance and upkeep of an existing building and its associated equipment. Although suggestions are made that may involve the purchase of minor equipment and supplies, detailed design considerations for major renovations and new equipment purchases are considered to be outside the scope of this guide. However, an appendix (Appendix A) is included to present potential opportunities for consideration if a small scale renovation project is planned for the building.

The remainder of the guide is organized as follows:

- **Set Facility Policy and Goals:** This section deals with determining a goal for the effort and setting building policies in order to gain support for efforts in terms of cooperation at multiple levels: from janitorial and maintenance staff, to building managers, to outside contractors, to other workers and employees.
- **Conduct a Baseline Study:** This section will assist the building manager in determining how the individual building features and the current cleaning and maintenance practices fit in the context

of this guide. A simple checklist is included that will help identify areas in need of attention.

- **Identify Opportunities I – Cleaning and Maintenance and Indoor Air Quality:** This section includes information on the selection of cleaning products to maintain a healthy building, including how to read a material safety data sheet in order to use each product safely. Details on effective techniques and equipment are given for control of soils, control of biological pollutants, and control of gaseous pollutants, including pest control activities. Information on facility-wide recycling and trash control is also provided.
- **Identify Opportunities II – Cleaning and Maintenance and Building Energy Use:** This section includes information on how routine and periodic maintenance activities can reduce the energy consumption in a commercial building including lighting maintenance, HVAC maintenance, and building envelope maintenance. A description of available resources for financial assistance is also provided.
- **Identify Opportunities III – Cleaning and Maintenance and Building Water Use:** This section deals with strategies to reduce water consumption both inside the building, as well as outside the building focusing on water use monitoring, water fixture retrofits, and landscape and irrigation practices.



2.0 Set Facility Policy and Goals

Chapter Highlights

- Develop an environmental performance strategy.
- Secure commitments at multiple levels.
- Set performance goals.
- Develop an action plan.
- Evaluate performance.
- Communicate successes.

The most effective way for a building or facility to achieve sustained environmental performance, and the benefits associated with that performance, is for facility and business managers to commit to an ongoing, integrated, and systematic approach to environmental management. This approach, as described by the US Environmental Protection Agency for energy management principles, can be extended to the principles of green cleaning and maintenance, and is outlined in Figure 1.

The approach begins with securing commitments from individuals involved; an activity required in order to ensure program success. Such commitments are required at multiple levels, for everyone in the building has a stake in the program, and therefore also has responsibilities to ensure a successful program. Building managers need to commit to the program, in order to put the wheels in motion through policy, purchasing authority, and changes in procedure. Janitorial and maintenance staff have an extremely important

role, for their support and performance is necessary for successful implementation of particular objectives and strategies. General occupants also have a certain responsibility; for they may be affected by policies aimed at minimizing a cleaning load, or conserving energy and water. They also play an important role in reporting various cleaning and maintenance issues, as well as acting as “first responders” to certain incidents. Outside contractors also have a responsibility, aimed at complementing, rather than counteracting the overall program. Lastly, product suppliers also have a responsibility; for they provide information regarding the hazards of certain products, and often provide training related to their proper use. Suppliers also need to offer products and equipment that meet the goals of the program.

Following securing commitment on multiple levels, performance goals should be set for the effort. Assessing current performance is an important aspect of this step, for most often goals are based on improvements over current practice. Goals can be comprehensive in nature, for those who desire to reap

full benefits of the green cleaning and maintenance principles, or goals may be specific and individual such as maintaining the health of employees or creating a new revenue stream through energy efficiency. The following section of this guide provides a simple checklist that assists with identifying areas in the realm of cleaning and maintenance

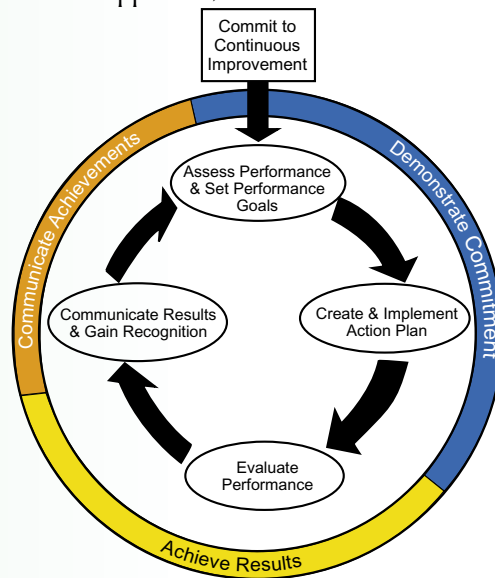
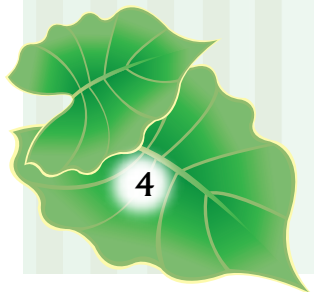


Figure 1. Environmental performance strategy. Source: US EPA



that have the potential to assist with the realization of stated goals.

Next, an action plan should be created and implemented aimed at achieving stated goals. The three Identify Opportunities sections of this guide provide specific recommendations that housekeeping and maintenance staff can implement towards that end, but again, activities in the action plan will target individuals at multiple levels. Management will play a crucial role through writing specifications for contracting with outside services, and the creation of various policies. Policies should be aimed at educating and empowering staff and general occupants to take an active role in the overall program. Occupants need to know what their role is when certain situations arise such as when to act, vs. when to report. Should an occupant adjust a thermostat when they feel uncomfortable, or should they report the problem? Should an occupant clean up a minor spill immediately, before it dries and becomes more difficult to remedy, or should they leave it until the cleaning staff stumbles upon it? Along with knowing when to act, occupants need to know how to act in order to fulfill their part in the program. Therefore, existence of and education on building policies such as those that may involve minimization of supplemental electrical loads through personal computer management need to be effectively communicated. In order to effectively carry out the action plan and monitor progress, individuals or groups should be designated to act as coordinators for the program(s). An overall coordinator should be appointed, or individuals may be appointed to coordinate individual tasks such as energy management, or pest control.

As plans are implemented, and goals are achieved, or not achieved, it is important to evaluate the program on a regular basis such that new goals can be created, or

procedures can be further modified in order to achieve existing goals. The process of evaluating performance will also assist with communication of successes to the occupants, as well as the general community. This will assist the staff responsible for the efforts with gaining well deserved recognition, and will also assist with communicating the overall benefits of the program in order to gain further support.

2.1 Resources and References

Environmentally Friendly Contract Specification and Purchasing Policy

Center for a New American Dream – www.newdream.org/procure/products/cleaners.html

Green Seal - www.greenseal.org

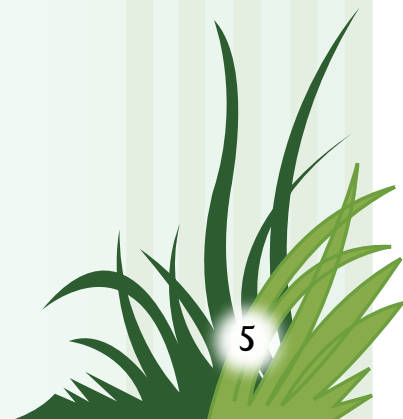
US Environmental Protection Agency Energy Star Program – www.energystar.gov

US Environmental Protection Agency IAQ Tools for Schools - www.epa.gov/iaq/schools/tools4s2.html

Green Building Management / Performance Strategies

US Environmental Protection Agency Energy Star Program – www.energystar.gov

US Green Building Council LEED™ for Existing Buildings Rating System
www.usgbc.org/LEED/existing/leed_existing.asp



3.0 Green and Profitable Work Environment Baseline Checklist

This checklist is designed to help the building manager determine current maintenance and cleaning activities taking place in the building that are within the scope of this guide, and the potential to modify activities based on the guide's recommendations. Whether the activity is carried out by in-house staff, or outside contractors, it is important to review the details of the activities with the persons responsible to determine if improvements are possible. If any of the items do not apply to your facility, write "N/A".

SET FACILITY POLICY AND GOALS

Written environmental policy in place.
Performance goals are set.
Periodic training of staff and occupants.

Current Practice	Needs Attention

CLEANING AND MAINTENANCE AND INDOOR AIR QUALITY

Products

Use of biobased products encouraged.
Staff familiar with format and location of MSDS sheets.
Staff familiar with desirable/non-desirable product ingredients/properties and products in use have been screened accordingly for:
 health hazards
 environmental hazards, biodegradability, and recycled content
 availability of concentrate
Staff follows instructions for product use including dilution, safety, and storage.
Proper disposal determined and appropriate training given to staff.

Techniques and Equipment - General

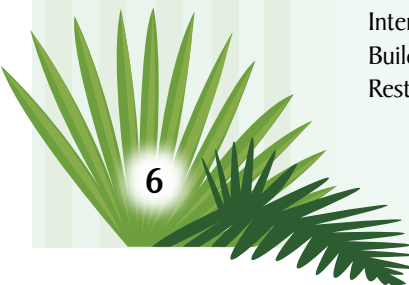
Major cleaning activities scheduled when building is unoccupied and adequate ventilation used. Occupants informed of operations.
Concise records of cleaning operations kept.
Procedures in place to report and correct accidents, spills, emergencies, and general complaints.
Chemical portion control equipment in use.

Techniques and Equipment - Soil Control

Building exterior and entry way targeted as a major component of soil control.
Cleaning schedules and intensity set according to amount of soil generation, foot traffic, and occupancy of areas.
Proper dust control used including damp vs. dry cloth and HEPA vacuum.
Janitorial equipment operates properly and is well maintained.

Techniques and Equipment - Biological Control

Building exterior regularly inspected for leaks and moisture accumulation.
Interior leaks and spills cleaned up immediately.
Floor drains and condensate pans checked regularly for proper operation.
Policies in place for potted plants.
Interior relative humidity is monitored on a regular basis.
Building maintained under slight positive pressure.
Restrooms and food areas regularly disinfected/sanitized.



Techniques and Equipment - Biological Control - cont'd.

Current Practice	Needs Attention
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Telephones, railings, door knobs, light switches, faucet handles, soap dispensers, trash cans, towel dispensers also sanitized.
Touch free equipment and devices used.

Techniques and Equipment - Gaseous Pollutants

Ventilation inlets away from contamination sources.
Drain traps checked and filled regularly.
Spray bottles use coarse spray rather than fine mist.
Chemical storage areas under negative pressure and directly vented outdoors.
Integrated pest management practiced.

Techniques and Equipment - Trash and Recycling

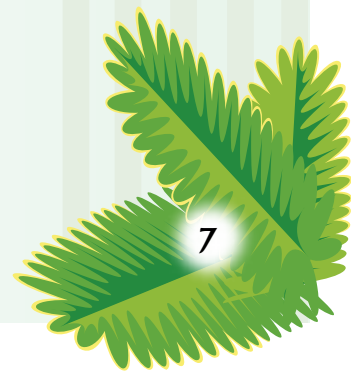
Trash removed from building on weekends and holidays.
Trash receptacles sized accordingly and free from obstructions.
Availability of local recycling infrastructure for materials investigated.
Facility wide recycling policy and efforts in place for all accepted items.
Occupants trained/informed of recycling policy and efforts.

CLEANING AND MAINTENANCE AND BUILDING ENERGY USE

Opportunities for interior lighting upgrades analyzed.
Interior lighting upgrades carried out.
Opportunities for exterior lighting upgrades analyzed.
Exterior lighting upgrades carried out.
Policies and measures in place for managing supplemental loads.
Building envelope inspected and infiltration pathways reduced.
Potential for window shading strategies analyzed.
Window shading strategies incorporated.
HVAC controls inspected for proper operation and schedules reviewed.
HVAC system is tested, adjusted, and balanced.
HVAC coils and filters maintained on a regular basis.
Incentives, rebates, and assistance for financing energy upgrades explored.

CLEANING AND MAINTENANCE AND BUILDING WATER USE

Fixtures regularly inspected for leaks.
Fixtures upgraded to EPACT compliance.
Fixtures upgraded to automatic controls.
Water bills monitored.
Water audit conducted by outside organization.
Plants, trees, and turf reviewed for need and proper location.
Mulch applied around plants and trees.
Efficient irrigation equipment and practices employed.
Preferable fertilizers applied only as necessary.
Landscape certified as Florida Friendly by Florida Yards and Neighborhoods.



4.0 Identify Opportunities I – Cleaning and Maintenance and Indoor Air Quality

Chapter Highlights:

- Workplace indoor environmental quality (IEQ).
- Measured (IEQ) improvements through green cleaning and maintenance.
- Cleaning product properties and selection.
- Material Safety Data Sheet (MSDS) information.
- Techniques and equipment for green cleaning and maintenance.
- Cleaning/Janitorial equipment properties and selection.
- Integrated pest management.
- Effective trash control and recycling.

Cleaning and maintenance activities are rarely viewed as contributors to indoor air quality problems, however many national organizations have reported on occupant health and productivity impacts related to such activities. Organizations such as the US Environmental Protection agency and the US Department of Energy estimate that indoor air quality problems account for anywhere between 3 percent - 20 percent losses in worker productivity equating to billions of dollars lost annually. Productivity losses can result from absenteeism due to sickness, as well as degraded performance caused by allergies, headaches, fatigue, and odors. All such symptoms have been shown to be related to various indoor pollutants such as dust, volatile organic compounds (VOCs), and biological pollutants such as mold.

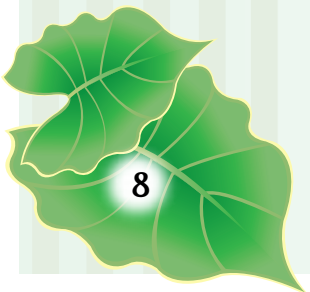
A study was conducted at the Frank Porter Graham Child Development Center on the University of North Carolina, Chapel Hill Campus that revealed significant reductions in dust, VOCs, and biological pollutants through the implementation of green cleaning techniques. The study was a collaborative effort of the US EPA, Research Triangle Institute, University of North Carolina, a building service contractor, and commercial cleaning industries and suppliers. Results from the studies are summarized in Table 1.

Green cleaning and maintenance principles as related to improving indoor air quality generally focus on an evaluation of products to find safe, effective alternatives to potentially hazardous formulas, and minimizing the amount of product required for a particular job. Principles are also aimed at re-evaluating techniques and equipment to develop safe, effective cleaning and maintenance practices.

Table 1. Results from green cleaning study conducted at UNC.

Air Pollutant	% Change with Improved Housekeeping
Dust	– 52%
VOC	– 49%
Total Bacteria	– 40%
Total Fungi	– 61%

Source: Adapted from PA Green Building Operations and Maintenance Manual



4.1 Products

Section Recommendations:

- Learn about potentially harmful cleaning product ingredients.
- Scrutinize cleaning products for hazards .
- Learn the usefulness of MSDS information and keep records up to date.
- Train staff on all aspects of product dilution, safety, equipment, storage, and disposal.
- Consider concentrated products.
- Consider paper and plastic products with recycled content.
- Scrutinize other maintenance products such as caulks, solvents, paints, adhesives, and sealants for VOC content.

A key aspect of a green cleaning and maintenance program is the selection of cleaning products. It is important that products selected be effective for the job at hand, for maintaining a clean building is necessary to ensure employees remain healthy and productive, and visitors are safe. Ineffective products will often counteract the benefits of a green cleaning program, through the use of more product, and requiring longer durations to complete the job at hand. However, it is important to realize that while some cleaners are effective at performing their intended task, they can often contribute to indoor air quality and environmental problems due to the nature of various ingredients. Some ingredients pose harm to the environment when disposed of, while others may be derived from non-renewable resources.

4.1.1. Harmful Product Properties

The toxicity of a product to humans as well as aquatic life is one of the most important properties to investigate when selecting a particular cleaner or other chemical. Not all ingredients of a particular product are toxic, but those that are may damage organs and tissues, and inhibit systemic functions of plants and animals alike. Pathways of exposure for humans include oral intake, inhalation, and absorption through the skin. Those suffering from short-term exposure may experience skin and respiratory irritation, and long-term exposure can result in more permanent damage. Exposure to a toxic product may result from direct product use, as well as contact with residuals left behind.

Most often such cleaning products are concentrated, and dilute mixtures are prepared by cleaning staff before actual use. Incorrect mixtures involving multiple products can lead to harmful exposure through the production of poisonous gas.

Exposure to such concentrated products can make maintenance staff more susceptible to the inherent dangers of such products than other employees.

Such products with toxic ingredients, whether in concentrated or diluted form, can also pose harm to the environment, for residuals are often washed down drains, and disposed of with product packaging

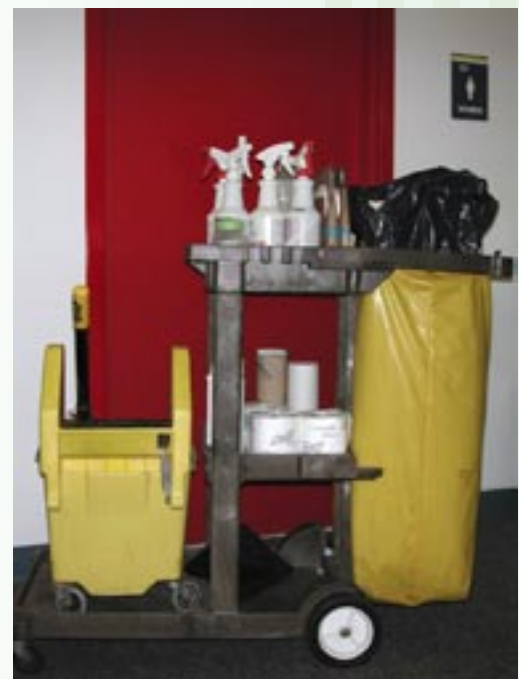


Figure 2. A key aspect of a green cleaning and maintenance program is the selection of cleaning products.

Sherril Shields, FSEC

and with cleaning implements such as rags, mops, etc. Therefore, biodegradability is another important aspect to consider. A product's biodegradability is a measure of the time required for relatively large molecules to be broken down in the environment. A readily biodegradable product or ingredient would begin to break down immediately into relatively benign compounds such as salts, water, and carbon dioxide. Products that are slow to degrade in the environment pose a threat to the environment, including plant and animal life, through accumulation.

Avoid cleaning products that are:

- *Toxic to humans and the environment*
- *Slow to degrade in the environment*
- *Corrosive*
- *High in VOCs*

The corrosiveness of a particular product is also a consideration, for extremely acidic and alkaline properties may cause skin irritations, burns, and can stain and otherwise damage certain surfaces. This property can be determined by the pH of a product, and the preference is to use products with a neutral pH, close to 7. The pH of a product can range from 0 indicating the most acidic, to 14, indicating the most alkaline. There are other factors that contribute to the corrosiveness of a product, and will be indicated on a product Material Safety Data Sheet, as discussed in a subsequent section.

Volatile Organic Compounds (VOCs) contained in products often contribute to many indoor air quality problems due to the fact that they evaporate very easily. Immediate reactions such as coughing and sneezing from the odor of a cleaner are often caused by VOCs. VOCs can further react in an indoor environment when exposed to other drivers such as sunlight, and cause further problems. Exposure to high levels of VOCs

can cause symptoms such as eye and throat irritation, nausea, vomiting, and headaches. It is important to note that cleaning products are not the only source of VOCs in a building. Other sources include particleboard contained in cabinets and furniture, carpets, and paints. Cleaning products selected should have the lowest percent VOC content available

when diluted for use. Although fragrances are often formulated with cleaning products, they are often covering offensive odors caused by extreme VOC

levels. The fragrances themselves can cause exposure effects in some individuals, and should be avoided.

4.1.2. Where to Find Information Regarding Properties

In order to investigate the health, safety, and environmental aspects of a particular cleaner or one of its ingredients, one must know where to find such information. Container and product labels begin to describe proper use of the product through directions for use and ingredient lists. However, due to space constraints, some information may be left off the label. Also, labels tend to get damaged and become unreadable. A more reliable and complete source of information is the product material safety data sheet (MSDS). The US Department of Labor's Occupational Safety and Health Administration (OSHA) requires all manufacturers to issue an MSDS with the first shipment of any hazardous chemical product, and requires that users of the product keep a copy on file and available for review by employees. All new cleaning and maintenance employees should be given training regarding the location of

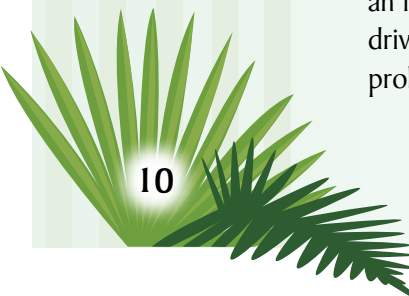
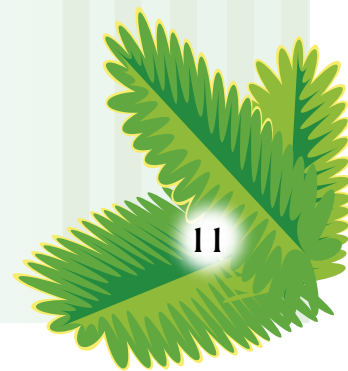


Table 2. Pertinent MSDS information.

MSDS Section	Description
Chemical Product and Company Information	Provides an overall product summary, including manufacturer address, MSDS date, emergency phone numbers, and a brief description of any hazard.
Composition and Ingredients	Provides information about each component of the product including its percent by weight (PCT) and Chemical Abstract Services registry number (CAS). Also contains whether component is listed in SARA 313 (Superfund and Reauthorization Act or "Community Right to Know Law." If listed, and more than the specified amount is used, use must be reported to USEPA every year. The Threshold Limit Value (TLV) and the Permissible Exposure Limit are the maximum airborne concentration for an 8-hour exposure as recommended and regulated, respectively.
Hazard Identification	Provides an emergency overview and ratings of the product from the Hazardous Materials Information System and the National Fire Protection Association. This section also outlines physical or health hazards posed by the product including risks to eyes, skin, lungs, risk of absorption through skin, and risks of poisoning and other long term effects.
First Aid	Provides medical attention required in the event of exposure.
Fire Data	Lists all flammability concerns, what media to use to extinguish a fire, and any safety precautions necessary to fight a fire.
Accidental Release Measures	Describes personnel qualified to respond to an emergency involving a spill and outlines containment and clean-up techniques, as well as any necessary evacuation procedures.
Handling / Storage	Provides general guidelines for safe handling of product as well as all storage requirements.
Exposure Controls / Protective Equipment	Outlines safe practice for use such as eye wash station nearby and any necessary protective gear such as eye, skin, and inhalation protection.
Physical / Chemical Properties	Lists information such as physical state, color, odor, solubility, boiling point, melting point, specific gravity, pH, and corrosivity.
Stability / Reactivity	Lists storage conditions, including moisture and temperature requirements as well as compatibility with substances stored nearby.
Toxicological Information	Summarizes data gathered from research with animals, including lethal dosages and concentrations (LD50), effects on reproduction, skin toxicity data, carcinogenicity, and mutation data.
Ecological Information	Assesses the material's environmental impact on aquatic and terrestrial plants and animals and the potential for the material to persist in the environment.
Disposal Considerations	Outlines any dilution guidelines, container information, and national environmental regulations required to safely and legally dispose of the product.
Transportation Information	Lists proper shipping name, hazard class, ID number, and packing group.
Regulatory Information	Outlines all known regulatory guidelines spelled out by OSHA, SARA, Clean Water Act, RCRA, and known state regulations.
Other Information	States the product's intended use and lists reference materials.

the MSDS and proper interpretation of the sheets. A safety training for all cleaning and maintenance employees should be conducted for all new chemical products in the workplace. This safety training should also

include training on proper product disposal, and a review of pertinent hazardous waste regulations (see "Resources and References" section of this chapter.) MSDS sheets over two years old should be updated with current versions.



MSDS sheets are divided into various sections that present various types of health, safety, and environmental information. A description of such sections and important information contained within is presented in Table 2 on the previous page. It is important to note that some of this information may not be listed on a product's MSDS, and that it may be listed in sections other than those identified. It is also important to note that an MSDS may not list an ingredient if present in extremely small quantities. If information of interest cannot be found on the MSDS, or if there are concerns regarding listed or unlisted product ingredients, call the manufacturer customer service. If the service desk cannot answer your questions, ask to speak with someone in the research or production departments.

The MSDS information for a particular product should provide all information necessary to select cleaners based on their potential to cause indoor air quality problems, exposure effects, and environmental harm. Specifics regarding preferable and non-preferable ingredients are listed for common cleaners in Appendix B, which has been adapted from the Green Seal Standard GS-37 and the Pennsylvania Green Building Operations and Maintenance Manual. Even after a safer alternative has been identified it is extremely important that its instructions for use be followed at all times, including use of protective gear, proper dilution ratios, spill cleanup procedures, and disposal information.

4.1.3 Other Product Properties

Along with a cleaner's potential to cause human and environmental harm, there are other issues to consider when selecting a green cleaner. For instance, many cleaners are designed to be effective for multiple cleaning purposes. Occasionally this may require varying dilution ratios or

utilizing different cleaning implements, but a **multipurpose** cleaner can replace several different cleaners, which simplifies purchasing, tracking, disposal, and employee training. Training remains important however, for improper dilution may damage certain surfaces, leave floors slippery increasing the risk of falls, and may increase the time to complete a particular activity especially if the incorrect tools and techniques are employed.

Concentrated products are also beneficial, for as a result of a greater percentage of active ingredients, the amount of packaging needed is reduced. This results in reduced cost of product from packaging and shipping concerns, and helps free up storage space. **Reduced packaging** will also help to minimize solid waste generated by the facility. Concentrated products may be less desirable from a disposal standpoint than non-concentrated products, so care should be taken to ensure that the entire quantity purchased will be successfully used by the facility before the product expires. Trials should be undertaken to ensure the product meets all needs and expectations before bulk quantities are purchased. Concentrated and non-concentrated products alike may be available in **reusable containers**, which will also reduce solid waste generated by the facility. All cleaners should be purchased with **locally recyclable packaging** where available such as high-density polyethylene (HDPE) plastic. Preference should be given to manufacturers that supply products in recycled packaging containing post consumer content. More details on recycling are given in a later section of this guide.

Waste minimization concerns can also be extended to supplies other than cleaning products. Recycled content should be specified when purchasing bathroom/ facial tissue, paper napkins/towels, general purpose

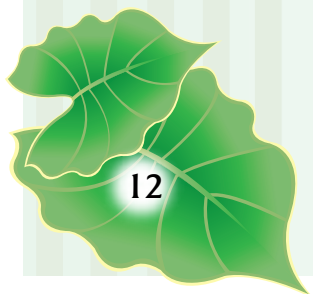


Table 3. Recycled content standards for a few common items.

Product	Percent Recovered Materials	Percent Post-Consumer Content
Bathroom Tissue	20 - 100%	20 - 60%
Paper Napkins	30 - 100%	30 - 60%
Paper Towels	40 - 100%	40 - 60%
General Purpose Industrial Wipes	40 - 100%	40%
Facial Tissue	10 - 100%	10 - 15%
Plastic Trash Bags	N/A	10 - 100%

Source: USEPA Comprehensive Procurement Guidelines

wipes, and plastic trash bags. Table 3 lists specific information for specifying recycled content for common paper and plastic items. The table should be read as: X% recovered fiber, including Y% postconsumer fiber NOT X% recovered fiber plus Y% postconsumer fiber. When purchasing paper products a few other issues to consider are no use of de-inking solvents containing chlorine or any other chemicals listed in the US EPA Toxics Release Inventory, and no use of chlorine or chlorine derivatives in the bleaching process.

It is important to note that cleaning products are not the only culprits for causing detrimental health, safety, and environmental effects. Other maintenance products used on the interior of the building such as caulks, solvents, paints, adhesives, and sealants should be selected on the basis of similar concerns to cleaning products, primarily with respect to their VOC content. Items certified as having “zero VOC content” or “low VOC content”, which for paints represents products with less than 150 grams/liter of VOC, prior to tinting should be selected.

4.2 Techniques & Equipment

Section Recommendations:

- Follow the “10 Commandments of Housekeeping.”
- Consider using portion control equipment.
- Prevent soil from entering the building.
- Practice effective soil removal on floors as well as elevated surfaces.
- Scrutinize cleaning equipment (vacuums, floor machines, etc.) for proper function and ability to capture fine particles.
- Consider non-chemical cleaning techniques.
- Control moisture to control mold and mildew.
- Develop effective disinfection/sanitation routines.
- Control gaseous pollutants for health and comfort.

Proper selection of products is not the only strategy to employ in a green cleaning and maintenance program. There are general techniques and philosophies that should be incorporated where appropriate when dealing with cleaning and maintenance functions, routines, and equipment. Stephen P. Ashkin of the Ashkin Group has developed the



“10 Commandments of Housekeeping” that detail these strategies. Additional information from other sources has been inserted here using Mr. Ashkin’s framework.

1) Clean to protect health first, and appearance second. It is not what is seen that is the real area of concern in the indoor environment. Even clean-appearing buildings can be extremely unhealthy. Thus, focus on cleaning for health and in most cases appearance will be addressed at the same time.

2) Clean and maintain the building as a whole, not just as separate components. Cleaning and maintenance in one area of a building can have a major impact on other areas. For example, the fumes from the stripping and recoating of a floor in one area can contaminate adjacent areas or even the entire building via the HVAC system. Appropriate actions must take place to ensure health and safety throughout the entire building. If possible, schedule work involving odorous or hazardous chemicals for periods when the building is unoccupied, and ventilate during and after the use of such chemicals.

3) Schedule routine maintenance, yet plan for accidents and emergencies. Scheduled maintenance that is frequent and thorough is the most efficient and effective method for building maintenance and cleaning. Concise plans and records are a must. In addition, specific procedures need to be developed to address accidents as small as spills and leaks, and emergencies as large as hurricanes, floods, etc.

4) Scrutinize outside contractors. Pest control services and roofing contractors may not be as concerned or even aware of the impact of their activities on building occupants. The building owner or manager

should pay particular attention to the type of products that “outsiders” are using and recognize that the HVAC system may need to be adjusted to mitigate potential problems. Outside contractors should commit to upholding any building environmental policy in place.

5) Minimize human exposure to harmful contaminants and cleaning residues. Workers should always use the appropriate personal protective equipment, areas where work is taking place should have adequate ventilation, work schedules should be established to minimize exposure to building occupants, and the products used should be the most benign to accomplish the task. For major cleaning operations, building occupants should be informed as to the maintenance that is to take place and to any other specifics that may impact their health.

6) Minimize chemical, particle, and moisture residue when cleaning. The products that are used for building maintenance due to their ability to quickly and efficiently remove oils, soils, living organisms, etc. can also contribute to a building’s problem if used incorrectly. Use the minimum quantity of cleaning agent necessary to perform a task and ensure that all residues are removed. More information on techniques and equipment related to this strategy follows.

7) Ensure worker and building occupant safety at all times.

8) Minimize the amount of pollutants entering the building, while maximizing the amount of pollutants extracted. It is significantly more effective in terms of both time and money to keep contaminants out of the building than to try to remove them once they have entered. This is true for not just airborne pollutants, such as vehicular exhausts, but for

dirt and dust from pedestrian traffic, as well as biopollutants from roof leaks and standing water. More information related to these strategies follow.

9) Dispose of cleaning waste in environmentally safe ways. Cleaning wastes themselves can contribute to indoor environmental problems when stored or disposed of improperly. Reactive products can give off toxic fumes and even water-based wastes can become the ideal breeding grounds for disease-causing organisms.

10) Focus on people. A successful cleaning and maintenance program requires constant efforts in operation and training. Cleaning as an industry faces high personnel turnover rates. Thus, ongoing training is necessary. Furthermore, an indoor air quality coordinator should be designated and trained to provide a focal point and to create feedback loops between occupants and building management.

4.2.1 Cleaning Product Portion Control Equipment

Use of portion control systems and equipment provide a number of benefits for the facility and janitorial and maintenance staff. Sophistication of equipment can vary, from units that allow controlled dispensing of concentrate or pre-prepared mixtures, to units that feature potable water hookups and automatic dilution of concentrate. Such systems enhance staff safety by minimizing physical contact with concentrated cleaning chemicals and preventing product misuse through labeling. Stand-alone measuring devices and assurance of sometimes complicated dilution ratios are also minimized. Such features facilitate staff training, and time required to prepare solutions. As previously mentioned, the use of concentrates alleviates some environmental

concerns such as the need for packaging and waste disposal. Many units control spillage with overflow drip trays. Dilution control equipment should be periodically checked for the accuracy of dilution.

Implementation of portion control systems has shown to increase the efficiency of maintenance and cleaning operations through a 30%-65% reduction in product usage, by providing a safer and simpler working environment, and by improving inventory control and space utilization.

4.2.2 Soil Control

By reducing the amount of soil such as dust, dirt, sand, pollens, and grease that enters a building, and by reducing the amount of collected material that escapes from poorly constructed or maintained vacuuming equipment and dust cloths and mops, it is possible to maintain a clean building with significantly less effort. In addition, proper soil control can have a positive physical as well as psychological effect on the occupants. Complaints of illness and discomfort have been associated in buildings with high dust levels, and other particles such as pollens can cause various allergic reactions.

The cleaning industry estimates that approximately 85% of all soils and particles that housekeeping and maintenance staff remove from a building have been tracked in from the outside through entryways.

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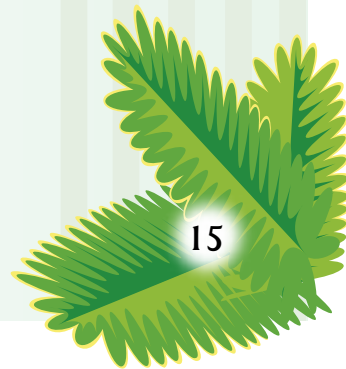




Figure 3. Periodic pressure washing of the building exterior and walkways is one way to minimize the amount of soil tracked into the building.

Therefore, the first priority in soil control is to examine the outside of the building for potential sources, and determine ways to control or reduce them. It is important to pay similar attention to entryways other than the main building entrance. Back doors, loading docks, garages, etc. all present routes from the outside of the building to the inside, although foot traffic is much lighter than main entrances. Poorly drained parking lots and entrances can collect soils left behind after standing water evaporates.

Drainage patterns can be improved, or particular attention can be paid to manually removing soils on a regular basis. Periodically hosing off and/or pressure washing hard surface areas adjacent to entryways can help control the problem. Plant material in the vicinity of entranceways is another source of soil that can be tracked or blown in the building by wind. Plants that do not have a tendency to drop berries, leaves, flowers, or excessive amounts of pollen should be chosen. Ensure plant beds bordering entryways and walkways contain

An effective walk-off mat needs to be at least 10-12 feet in length such that each foot of a walking person hits the mat at least twice.

material such as mulch or gravel to minimize erosion of the soil. Irrigation and rain events can cause loose soil to deposit on walkways where it can be tracked into the building. Although organic mulch does help retain water, inorganic mulch may be a better choice for maintenance concerns since organic mulch requires 1-2 upgrades per year to maintain aesthetics. More information and resources on plant selection and the use of mulch is given in the Building Water Use section.

Other strategies can be employed to minimize soils that do remain in the entryway area from being brought into the building. Such strategies primarily involve implementing an element to remove soils from the bottom of shoes. On the exterior of the entryway textured approaches such as stone, bricks and textured concrete perform better than smooth surfaces. Inside the entryway, architectural gratings perform a similar function. In lieu of renovations, high quality walk-off mats can be placed inside as well as outside of the entryway. An effective walk-off mat needs to

be at least 10-12 feet in length such that each foot of a walking person hits the mat at least twice. Since mats are not an infinite sink for soils, they

should be well vacuumed / cleaned at least daily. The undersides of the mats should be periodically cleaned as well. Soils can enter a building through windows as well as doors, therefore window coverings will also require frequent cleaning. Mini blinds (blinds with less than 2 inch horizontal surfaces) should be avoided due to their difficulty to clean.

Maintaining a positive pressure within the building through proper ventilation can also reduce the ability for particulate matter to

drift or blow in through openings. More information on this strategy is presented in the Mold, Mildew, and Moisture control section.

4.2.3 Soil Removal

Once soils have made it into a building, it is important that equipment and techniques be employed to effectively remove the soils, rather than move them from one location to another. Certain common dusting techniques (both floor dusting with dust mops and hand dusting) only stir up accumulated soils, making them airborne, rather than capturing them. Such soils eventually land on the same original surface, or another surface, and are not effectively removed from the building.

Frequency and degree of soil removal should be scheduled according to the amount of foot traffic/occupancy taking place in the particular building area. High traffic areas such as floors in entrances, lobbies, stairwells, and elevators typically require daily cleaning and in many cases require cleaning several times per day. Focus should be put on traffic lanes for efficiency, which often represent 25% of the entire floor area. In the case of walk-off mats, the first 6-9 feet often trap most of the soil that is tracked in. Particular attention should also be paid to mail/copy/computer rooms, for the elevated amount of paper use produces a large amount of particulate matter. In such areas, various inks and toners inevitably end up on light switches and door knobs, so special attention should be paid to ensure such soils are not transmitted to other areas of the building.

4.2.3.1 Floors

For floors, a vacuum cleaner with a hard surface floor attachment or a micro-fiber flat mop are preferred over a chemically treated dust mop. If a dust mop treatment is used, choose a water based product and be sure



Eric Martin, FSEC

Figure 4. Walk off mats like this one may not be long enough to be effective.

to follow the manufacturer's instructions for safety, as well as effectiveness. Highly soiled carpets, carpeted walk-off mats, and carpets in high traffic areas such as lobbies will require vacuuming in both directions.

Regardless of the vacuuming application, vacuums themselves should be selected on the basis of five issues of importance: **Airflow** – should be greater than 90 cubic feet per minute (cfm). **Static lift** – a measure of the suction capability, should be greater than 80 inches of water. **Filtration** – models with high efficiency particle arresting (HEPA) filters are recommended. Such filters are extremely efficient (99.97%) at capturing the small particles (≥ 0.3 microns) that ordinary vacuum cleaners allow to escape with air that is vented from the unit. Models equipped with HEPA filtration do carry a price premium however, so models with filtration approaching the HEPA level are also acceptable. **Durability** – equipment should be selected from manufacturers that offer a

warranty of at least four years. **Ergonomics** – equipment should be easy to handle (push) and have flexible options to make it easier to maneuver around furniture. This will help prevent back and other injuries that result in lost work to janitorial staff.

Properly operating equipment should not give off odors as the equipment is operating. Every attempt should be made to empty canisters / replace disposable bags outdoors, to prevent captured debris from being released back into the indoor environment.

Small particle collection capability, is also important for other floor cleaning machines such as buffers and burnishers, which can create considerable dust during use. Models equipped with active vacuum attachments for particle capture are recommended.

4.2.3.2 Elevated Surfaces

In order to effectively remove the soils on elevated surfaces, while minimizing chemical dust treatments, the preferable implement is a lint-free, micro-fiber, damp dust cloth that is neatly folded to permit periodic unfolding and refolding to expose dust free surfaces. Once all sides are soiled, the cloth must be rinsed out. Hand held feather dusters may also be wrapped with a damp dust cloth. Vacuum or otherwise remove dust from heating, cooling, and ventilation grilles and vents periodically, especially in mail/copy/computer rooms. The ceiling and wall surfaces adjacent to the grilles and vents should also be cleaned to remove

visible dust. Light fixtures should also be regularly cleaned not only for soil control, but also to maintain efficiency. Details regarding light fixture cleaning are given in the Building Energy Use section.

4.2.4 Biological Control

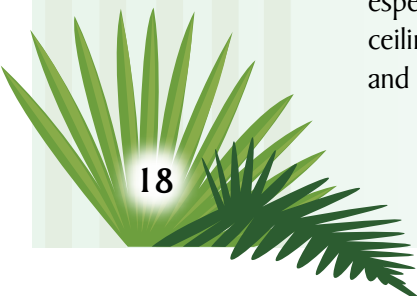
4.2.4.1 Mold, Mildew, and Moisture Control

One of the biological contaminants of concern for indoor air quality problems is mold and mildew. There are four critical requirements for mold growth: available spores, available food, appropriate temperatures, and considerable

moisture. The removal of any one of these requirements will minimize mold growth, however three of the four are impractical, and nearly impossible to control.

Ranging in size from 3 to 40 microns (human hair is 100-150 microns), mold spores are ubiquitous – they are literally everywhere. There is no reasonable, reliable and cost-effective means of eliminating them from environments that humans inhabit. So, trying to control mold growth through the elimination of mold spores is not feasible. If all three other requirements are met, almost any substance that contains carbon atoms (organic substance) will provide sufficient nutrients to support mold growth. Even the oil from your skin that is left when you touch an otherwise unsuitable surface, like stainless steel, or the soap residue left from a good cleaning will provide sufficient nutrients to support the growth of some molds. And

The only requirement for mold growth that is controllable is the presence of considerable moisture. When considerable moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed.



many of the most common materials found in buildings like wood, paper and organic fibers are among the most preferred nutrients of mold. Thus, eliminating mold food from your environment is a virtually impossible task. Unfortunately, most molds grow very well at the same temperatures that humans prefer. In addition, anyone who has cleaned out their refrigerator quickly realizes that temperatures close to freezing are not cold enough to prevent mold growth and temperatures that are much warmer than humans prefer, like those of the tropics, will grow abundant quantities of mold. Therefore, it is not feasible to control mold growth in a building environment through the control of temperature. The only requirement for mold growth that is controllable is the presence of considerable moisture. When considerable moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed.

Moisture problems can have many causes, and many can be addressed by examining the exterior of the building. Roofs need to be regularly inspected, not only for the presence of problems that may lead to leaks such as split seams, separated layers, and failed flashings, but also for problems that may cause water to accumulate such as accumulated debris and blocked drainage systems. If gutters are present, inspections should be conducted to ensure they are clear and functioning properly, and that downspouts discharge at least three feet from the building to ensure moisture does not accumulate near the foundation of the building.

At ground level, maintenance staff should ensure that plants are not within two feet of the building, for they may require irrigation systems to deliver water too close to the

foundation. Regardless of plant placement, any irrigation system should be maintained such that sprays and rotors are not directed to hit the building. Visible leaks such as plumbing leaks and leaks in the building envelope such as from roofs and around windows, water accumulation, and water damaged materials need to be responded to within 24-48 hours to prevent mold growth. Frequently eliminate moisture accumulation in wet areas such as restroom and shower areas, and clean up all spills as quickly as possible. Besides leading to mold growth, such accumulation can lead to dangerous slippery conditions. Walls and floors of wet areas need to be sanitized periodically to prevent accumulation of mold and mildew. This is especially true in tiled areas, for such contaminants can easily grow in porous grout, which is difficult to clean. Air



Figure 5. Flat roofs like this one are prone to water accumulation.

conditioner condensate drain pans should be regularly inspected for overflow and blockage problems, and drain lines should be checked for proper operation. Other floor drains in restrooms and other wet areas should also be checked for proper operation. Amends should be made in janitorial closets or other areas of the building for cleaning staff to clean equipment and dilute cleaning products without making a large mess that needs to

be cleaned up such as floor drains and large slop sinks. Care should also be taken on the placement of plants inside the building to ensure moisture does not accumulate on carpeting. Plants can also transpire a significant amount of water in the vapor form.



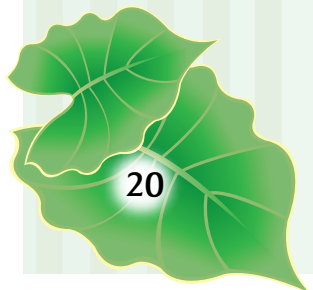
Neil Moyer, FSEC

Figure 6. Water can enter a building envelope in the vapor form, and become trapped behind an impermeable barrier, such as vinyl wallpaper.

Although many efforts are carried out to control water in its liquid form, water also enters and is present in buildings in a vapor form. Some of the water intentionally introduced in restrooms and at sinks in eating areas, as well as unintentionally by leaks and spills, evaporates and joins water vapor that is exhaled by building occupants. Water vapor can also enter the building through the movement of humid outside air. Generally outside air is intentionally introduced into commercial buildings for ventilation purposes, however space conditioning systems are designed to handle this moisture load. Many buildings however suffer from unintentional movement of outside air into the building through unintended pathways such as cracks and crevices in the building envelope. To some degree, this happens naturally, and building materials can often safely absorb certain amounts of moisture,

and subsequently dry out. Problems occur when pressure driving forces cause excessive infiltration of this air through the building envelope. This is often caused by an unbalanced space conditioning system causing the building to become negatively pressurized while the system is operating. Ideally, most areas of a building (aside from certain hazardous storage areas) should be under positive pressure with respect to the outside environment. Three common causes of negative pressure are improper balancing of ventilation and exhaust systems (fume hoods in laboratories, exhaust hoods in kitchens, etc.), supply duct leakage, and insufficient pathways for return air. Excessive infiltration of outside air through unintended paths in the building envelope can eventually lead to hidden mold and mildew problems inside of building assemblies such as walls and floors, as building materials are not permitted to dry. Impermeable coverings such as vinyl wallpaper and vinyl flooring contribute to the problem by not letting moisture escape. Water vapor can also condense on surfaces inside of assemblies that are excessively cold.

When designed properly, space-conditioning systems are designed to maintain a comfortable humidity level inside the building. Due to equipment age, malfunction, or maintenance issues, problems can arise, often unexpectedly. Interior relative humidity should be monitored in all areas of the building, as an indicator of problems. Sophisticated monitoring equipment need not be employed, simply a hand held relative humidity monitor. On a regular basis, maintenance staff should measure and record relative humidity in all areas of the building, during both occupied and unoccupied conditions. Problems can also ensue during unoccupied conditions, when the space conditioning systems are turned off, but ventilation air continues to be supplied. If



relative humidity levels greater than 60 - 65% are observed for prolonged periods of time, an inquiry into the cause of the elevated humidity should be conducted. Prolonged periods of time may be considered as an entire work day, or an entire unoccupied period such as an evening, weekend, or holiday. Specific strategies regarding the testing, adjusting, and balancing of the HVAC system are given in a later section that can lead to more effective and efficient system operation.

If mold problems are discovered, and remediation is required, consult the US EPA Document "Mold Remediation in Schools and Commercial Buildings", listed in "Resources and References" section of this chapter, for specific tips and strategies.

4.2.4.2 Sanitization/Disinfection

Another source of biological contamination can be generated and transmitted by occupants of the building. This makes proper disinfection/sanitization an important aspect of a green cleaning and maintenance program. Most buildings do not need to be disinfected. Sanitizing is sufficient in most situations, and can be done with less toxic products. However some critical areas found in hospitals and other regulated buildings/industries do require disinfection.

In the restrooms, floors should be mopped with a sanitizer on a regular basis, paying close attention to areas around toilets and urinals. All other surfaces that come into contact with occupants should also be sanitized such as fixture handles, soap dispensers, countertops, door knobs, towel dispensers, and light switches. Trash cans and recycle bins should also be sanitized. Food preparation and eating areas are also of concern, and similar procedures apply, including to refrigerators, countertops, and tables. Undersides of tables should be

periodically cleaned as well. Items that come into contact with many hands throughout general areas of the building should also be periodically sanitized including door knobs, light switches, hand railings, and telephones. Floors and sinks in janitorial closets and other chemical storage areas should also be regularly sanitized.

In order to minimize the need for frequent sanitization of a multitude of surfaces, devices that operate without needing to be touched can be installed. Such devices minimize pollutant transmission, minimize cleaning time, and maximize durability. Examples include infrared fixtures and light switches, and touch-free towel dispensers/hand dryers.

4.2.5 Control of Gaseous Pollutants

Another aspect of a green cleaning and maintenance program is to control gaseous pollutants that may enter the building from outside, or are generated within. Although the HVAC system has filters and other equipment to help minimize particulate transfer throughout the building, gaseous pollutants are easily transferred via this mechanism. During the exterior inspection, special attention needs to be paid to the location of areas where outside air is introduced into the building such as ventilation air inlets and windows. Such air inlets should not be in the vicinity of motor vehicle exhausts, such as near shipping/receiving and loading docks. Trash should also not be stored in the vicinity of such air inlets. Sources of gaseous pollutants from areas neighboring the building such as streets and industrial facilities are certain to drift in open doors and windows from time to time, however maintaining a positive pressure inside the building can help to minimize this. This strategy is discussed more in the Building Energy Use section of this guide.

Drain traps can also cause gaseous pollutant problems when water in the trap evaporates due to infrequent use. A building under negative pressure exacerbates the problem, for soil or sewer gas can be drawn indoors through a dry trap. Staff should ensure that traps do not run dry from evaporation by pouring water down drains that are seldom used such as floor drains present solely for overflow purposes, and rarely used sinks and toilets.

Integrated pest management (IPM) is a process for achieving long term, environmentally sound pest suppression through the use of a wide variety of technological and management practices.

As previously discussed, various ingredients of cleaning products can cause irritation and trigger allergic reactions among building occupants. When using products dispensed from spray bottles such as glass cleaner and carpet cleaner, it is recommended that directed streams/coarse sprays are used rather than fine mists to minimize the amount of material that is atomized. Such techniques will also minimize over-spray. Areas where such chemicals are stored should ideally be under negative pressure with respect to the rest of the building, and be directly vented to the outdoors.

4.3 Pest Control

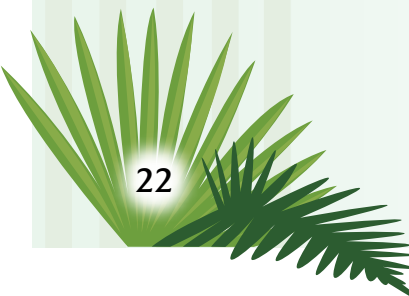
Section Recommendations:

- Develop and implement an Integrated Pest Management (IPM) Plan for the building.
- If using an outside contractor, select one skilled in IPM and designate an in-house coordinator.

Pest control in any building must accomplish certain objectives: it must protect both the health and safety of occupants, minimize pest damage to structures and personal property, and improve the quality of the work environment by avoiding annoyance and disruption of work caused by pests. Relying solely on pesticides to solve pest problems will eventually fail at accomplishing these objectives. Pesticides are a class of semi-volatile

organic compounds and include a variety of chemicals in various forms. Improper selection and use of pesticides can often do as much harm as good. Pesticide resistance can often lead to loss of control and resurgence in pest numbers. Also, with an improper application of pesticide, there is the potential to contaminate the work environment and expose occupants to pesticide residues. Pesticides can cause discomfort in the workplace due to lingering odors and their potential to trigger allergic reactions in some individuals. Extreme exposure can lead to pesticide poisoning and is especially problematic for children and pregnant women.

Integrated pest management (IPM) is a process for achieving long term, environmentally sound pest suppression through the use of a wide variety of technological and management practices. Control strategies in an IPM program extend beyond the application of pesticides to include structural and procedural modifications that reduce the food, water, harborage, and access used by pests. IPM can reduce the use of chemicals and provide economical and effective pest suppression. IPM does



not involve the complete elimination of the use of pesticides, nor does it involve solely substituting “good” pesticides for “bad” pesticides. IPM attempts to achieve a balance of both chemical and non-chemical methods to control pest problems. Whether pest control is handled in house or by an outside contractor, IPM principles are an important part of a green cleaning and maintenance program. There are essentially five main aspects of IPM that include:

- Monitoring and prevention of pest populations.
- Application of pesticides only “as needed” after prevention and physical controls have been implemented.
- Selecting the least hazardous pesticides for control of targeted pests.
- Precision targeting of pesticides to areas not contacted or accessible to the occupants.
- Notification of occupants as to when and where pesticide application is to take place.

Monitoring and keeping records of pests and pest control activities is an important part of an IPM program. Pest activity should be monitored through the use of traps or visual inspection, and logs kept of such activity. This practice will assist with the determination of pest threshold levels that will indicate when control actions are required. Logging such actions will reveal when a particular strategy needs to be modified or changed in order to maintain effective control, and to prevent duplication of efforts. As discussed in the Set Facility Policy and Goals section, occupants will play a role in pest monitoring, and will need to know details of how to respond.

Non-chemical strategies should be employed before the use of pesticides to both prevent and control pest problems. Such strategies

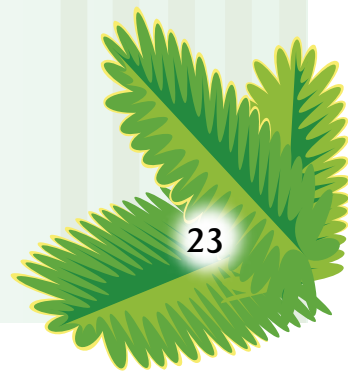
are most likely to be permanent, and prevent recurrence of problem. Non-chemical strategies are also the easiest to carry out safely and effectively for pesticides may require protective gear that maintenance staff may find cumbersome to wear and may neglect its importance. Such strategies are often the most cost-effective to implement for they often represent a one time fix, and hence cost, rather than a recurring expense. Along with purchase cost, pesticides often carry costly licensing and other fees for both use and disposal.

Some important non-chemical aspects of an IPM program include:

Education – Occupant education is a cost effective strategy aimed at changing people’s behaviors such as how they dispose of wastes and recyclables, and how they store food. Providing education about the details of the general IPM program will ensure occupants know how to respond/report problems and will ensure that they take part in the program, such as by providing assistance with monitoring, rather than counteract the program, such as by bringing in pesticide sprays from home. Providing info on the benefits of the IPM program and the dangers of pesticide-only conventional programs can facilitate their involvement.

Pest habitat modification – Pests need food, water, shelter to survive. If any one of these can be removed/reduced, the environment will support fewer pests.

Building modification – This technique involves incorporating pest resistant structural materials, fixtures, and furnishings. Examples include moving trash receptacles away from the building and use of wire shelving to reduce insect habitat. Mounting various furnishings on casters facilitates cleaning



activities. Cleaning of gutters and redirecting downspouts helps keep moisture away from foundation.

Sanitation – Frequent and effective sanitation practices can reduce available food for insects.

Eliminating sources of water for pests – Leaks should be fixed immediately, surfaces should be kept dry overnight, and standing water should be eliminated.

Eliminating pest harborage and access – Examples include caulking cracks and crevices, screening vent pipes, eliminating clutter, and removing dense vegetation near the building.

Modification of landscaping activities – Healthy plants are less prone to problems. Often incorrect plants are chosen for a particular application, put in the wrong place, or improper care is given to plants. Certain plants can attract beneficial insects that assist with pest control. Creating and maintaining Florida Friendly Landscapes by incorporating principles of the Florida Yards and Neighborhoods program promotes healthy plants and IPM, and details of the program are listed in the Building Water Use section of this guide.

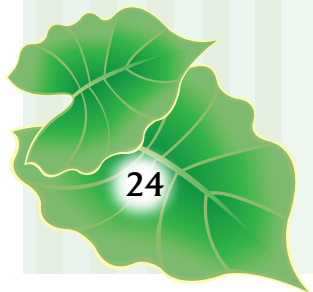
Applying physical controls – As mentioned in a previous section vacuuming should be conducted with effective filtration to effectively remove food for pests as well as eggs and larva. Some equipment has special attachments that assist with spot based insect control. Trapping is generally used for monitoring purposes but can also assist with control. Place traps out of reach of occupants to prevent them from being disturbed.

When pesticides are used, certain aspects must be considered to complement the IPM strategy:

Choose the least toxic pesticides and application techniques – As with cleaning chemicals, toxicity and other information can be found on a pesticide's MSDS. Pesticides should be effective against their target pest yet should also be the least disruptive to other non-target organisms. In landscape settings, one must avoid killing off the natural enemies of pests that aid with control. Often pesticides are more toxic to natural controls than target organisms. Chosen pesticides should also have a low acute and chronic toxicity to mammals, and should also biodegrade rapidly in the environment. Some products that meet these requirements include:

- Insect growth regulators – Growth regulators are synthesized insect hormones that prevent juvenile insects from maturing to adults and reproducing. Humans and other mammals are not affected.
- Desiccating dusts – Materials such as diatomaceous earth are made from natural materials and kill insects by dehydrating them.
- Pesticidal soaps and oils – Such products are primarily designed for use in the landscape and are made from refined natural products that are effective yet decompose rapidly in the environment. Although not harmful to mammals, they can be harmful to fish.

Application methods and forms of pesticides need to be scrutinized as well as the product formulation and ingredients. Aerosol sprays contribute to the over use of product and produce fine mists that are easily dispersed throughout the building environment. Baits on the other hand can be applied to a controlled area effectively and are not readily volatile, and therefore do not affect air quality.



Time treatments accordingly - Treatments need to be timed properly so pesticides are applied during susceptible stages of target pests and resistant stages of beneficial insects providing natural controls. Monitoring is key to determining appropriate timing. Treatments must also be timed in accordance with operation of the building's HVAC system.

Use spot treatments – Treatments should be applied only where needed. It is rarely necessary to treat an entire building or landscape area for a pest problem. Cost and occupant exposure to pesticides can be minimized by spot treating.

When using a pesticide, ensure that the pesticide is registered for use in Florida and ensure you are aware of all laws regarding its use. Some pesticides are only permitted to be applied by sufficiently trained individuals. Read the label and follow all restrictions and directions for use, dilution, protective equipment, storage, handling, and disposal. Only mix and dilute pesticides outdoors or in a well-ventilated area. Ensure application equipment is appropriate for the target area. Keep records of pesticide applications and pesticide MSDS sheets.

Building occupants should be notified as to when and where pesticide application will occur before the actual application. Many individuals are sensitive to various products, especially children and those with pre-existing conditions. This strategy will enable such individuals to take any necessary precautions.

When selecting an outside pest contractor, one should look for a contractor skilled and knowledgeable about IPM. Qualified contractors should offer services that include:

- Development of a pest-monitoring program that includes inspection of

building areas and identification of pests and pest threshold levels.

- Making pest control recommendations that emphasize maintenance and sanitation.
- Applying pesticides only when necessary, such as when thresholds are exceeded.
- Using the least toxic chemical and applying only when the building is unoccupied or otherwise prepared.
- Providing hazard and toxicity information for all chemicals used.

When utilizing an outside pest control contractor, an individual from the cleaning or maintenance staff should act as an in-house IPM coordinator. The coordinator should be in charge of keeping records and assisting with proper monitoring and should meet with the contractor on a regular basis to keep them abreast of day-to-day activity. The coordinator will also ensure that recommendations made by the contractor to assist with IPM are carried out.

4.4 Trash and Recycling

Section Recommendations:

- Coordinate trash storage/removal with IPM activities.
- Place generously sized trash receptacles in accessible areas.
- Develop an in-house recycling plan in accordance with local infrastructure.
- Maximize effectiveness of recycling through staff training and education.

Along with issues that affect the sanitary nature of the workplace and protecting the health of occupants, excessive accumulation of trash can cause odor and aesthetic problems in the workplace. Also, as discussed in the previous section, improper trash management can attribute to a pest control problem, and proper management is key to a successful

integrated pest management program. In many cases it is totally unnecessary to remove trash from all areas on a daily basis, however it should be pulled and disposed of before weekends and holidays, so it is not left in the building over extended periods of time. If trash is found to contribute to a pest control problem, certain measures should be taken, possibly on a temporary basis, while attempting to gain control of the pest problem. Items include daily removal, more frequent sanitation of receptacles, and using tightly covered containers. Similar amends should also be made for outside trash storage such that it also does not attract pests, and outside receptacles may need to be relocated away from the building.

Recycling is a key component to a green cleaning and maintenance overall solid waste program, and should be incorporated to some degree. In order to determine sorting strategies such as which materials to separate and what types of containers to use, it is important to check with local solid waste departments, haulers and recyclers, and facility managers to determine what strategies the local infrastructure supports/recommends. If it is discovered that a potential exists to cost effectively separate and make available a high volume of a particular recyclable that the local infrastructure does not support, the opportunity should be presented to appropriate individuals such that future amends can be made to support the recycling of the item.



Eric Martin, FSEC

Figure 7. The blue enclosure in the background allows trash dumpsters to be kept away from the facility.

In order to minimize the amount of time cleaning staff spend managing trash, workspaces and common areas should have minimal obstructions to trash receptacles and trash shoots. Generously sized trash receptacles should be placed in high traffic and high occupancy areas such as restrooms to minimize the frequency of trash removal from these areas. Undersized receptacles are prone to frequent overflow, which aside from health aspects, will cause a negative aesthetic concern.

To maximize the effectiveness of the recycling effort training and ongoing communication with all building occupants are critical. Policies should be put in place by building management that set goals and procedures for occupants, visitors, and other individuals to follow. Management should provide adequate containers, but such individuals should be made aware of the types of items that the building recycles, as well as procedures for doing so. Procedures may vary according to local recycling infrastructure and presence of other issues such as a pest control problem. For example, individuals may be asked to rinse soda cans and glass bottles before placing them in an appropriate bin, and a procedure may be put in place to report full or overflowing containers. The importance of proper separation should be emphasized, for improperly sorted materials will often end up destined for the landfill rather than being recycled. Management and janitorial staff can stress such messages by developing friendly reminders such as informative signs near trash and recycling receptacles.

Common waste items generated within commercial buildings with the potential to be recycled include:

Clear glass	Fluorescent Lamps and ballasts
Colored glass	Toner and ink jet cartridges
White office paper	Batteries
Mixed (colored) office paper	Computer floppy and compact discs
Newspaper	Carpet
Cardboard	Leftover paint
Telephone books	Ceiling tiles
Metal	Computer and other office equipment
Plastic	Oil and other fluids

4.5 Resources and References

Cleaning Product Selection and Specification

“Guidelines for Green Building Housekeeping and Maintenance.” City of Austin, Sustainable Building Guidelines, Vol III.

“Center for a new American Dream”
www.newdream.org/procure/products/clean.html

“Pennsylvania Green Building Operations and Maintenance Manual.” Commonwealth of Pennsylvania.
www.dgs.state.pa.us/dgs/lib/dgs/green_bldg/greenbuildingbook.pdf

“Green Seal’s standard for Industrial and Institutional Cleaners” (GS-37).
www.greanseal.org/standards/industrialcleaners.htm

MSDS Information

www.msdssearch.com
www.msdsprovider.com
www.msdsonline.com

Hazardous Waste Regulations

Florida Department of Environmental Protection. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/hazardous/hwsum97.pdf

Recycled Content Standards
US Environmental Protection Agency
Comprehensive Procurement Guidelines.
www.epa.gov/epaoswer/non-hw/procure/index.htm.

Housekeeping and Maintenance Techniques and Equipment for Enhanced Indoor Air Quality.

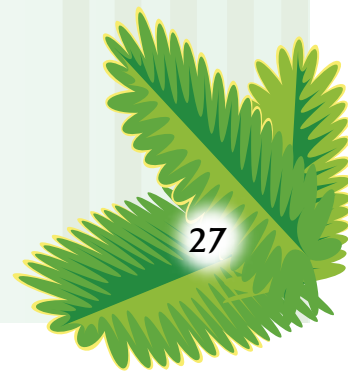
“Guidelines for Green Building Housekeeping and Maintenance.” City of Austin, Sustainable Building Guidelines, Vol III.

“Pennsylvania Green Building Operations and Maintenance Manual.” Commonwealth of Pennsylvania.
www.dgs.state.pa.us/dgs/lib/dgs/green_bldg/greenbuildingbook.pdf

“The Impacts of Cleaning on Indoor Air Quality.” Stephen P. Ashkin, Rochester Midland Corporation.

“Green & Clean: The Designer’s Impact on Housekeeping and Maintenance.” Stephen P. Ashkin, Rochester Midland Corporation.

“The Financial Case for Cleaning.” Stephen P. Ashkin, Rochester Midland Corporation.



“Mold Remediation in Schools and Commercial Buildings.” US Environmental Protection Agency, Office of Air and Radiation, Indoor Environment Division. EPA 402-K-01-001.

Integrated Pest Management Planning, Techniques, and Contract Specification

“Integrated Pest Management for Schools: A Catalog of Resources.” Clay W. Scherer and Philip G. Koehler, Eds., Department of Entomology and Nematology, Institute of Food and Agricultural Sciences, University of Florida.

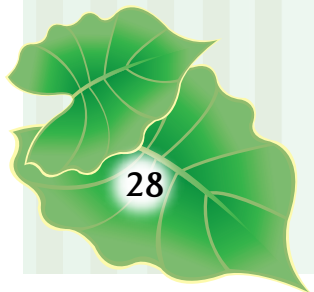
http://schoolipm.ifas.ufl.edu/school_ipm.pdf

University of Florida Institute of Food and Agricultural Sciences - County Extension.

<http://extension.ifas.ufl.edu/>

“IAQ Tools for Schools.” US Environmental Protection Agency. www.epa.gov/iaq/schools/tools4s2.html

“Guidelines for Green Building Housekeeping and Maintenance.” City of Austin, Sustainable Building Guidelines, Vol III.



5.0 Identify Opportunities II- Housekeeping and Maintenance and Building Energy Use

Chapter Highlights

- Use of energy efficient indoor and outdoor lighting.
- Developing building policy that targets supplemental loads.
- Building envelope maintenance.
- Effective control of building systems.
- Testing, adjusting, and balancing of building systems and controls.
- Heating and cooling system maintenance.
- Financing energy improvements.

Energy represents 30% of the typical office building's costs and is a property's single largest operating expense. Reductions in energy consumption of more than 35% are possible through changes in building operations and management strategies alone, along with increased asset value from energy performance improvements, and increased tenant satisfaction and retention. Employing strategies that effectively reduce the energy use of a facility will also have side benefits such as improving occupant comfort, improving indoor air quality, and improving building durability. Making low or no cost adjustments to a building will not only minimize current costs, but will also lower future maintenance costs. Such adjustments will also lower future equipment replacement costs for as energy savings measures are undertaken, the sizes and capacities of equipment necessary to maintain comfort are often reduced. Undertaking the process of uncovering opportunities will help the building manager and his staff understand

the building's operational needs. Occupant comfort is generally paramount in terms of a building's operational needs, and occupants are prone to modify a space in order to achieve comfort, whether it involves bringing in devices from home, manually adjusting thermostats, or blocking vents, all of which can cause elevated energy use. Undertaking the process will also reveal how the building is intended to operate, and how current operation can be improved.

5.1 Lighting

Section Recommendations:

- Evaluate lighting requirements properly.
- Conduct a comprehensive lighting retrofit including bulbs, ballasts, and luminaries.
- Consider advanced lighting controls.
- Develop an integrated planned lighting maintenance program.
- Consider opportunities for exit lighting and exterior lighting.

Typical lighting upgrades result in payback periods of three to four years and can cut lighting electricity bills by 50% or more. Due to the low risk and high profitability of lighting upgrades in a commercial building, the energy savings gained from such efforts can assist with the financing of subsequent building upgrades.

Lighting consumes 25 – 30% of energy in commercial buildings, and is a primary source of heat gain and waste heat. Typical lighting upgrades result in payback periods of three to four years and can cut lighting electricity bills by 50% or more. Due to the low risk and high profitability of lighting upgrades in a commercial building, the energy savings gained from such efforts can assist with the financing of subsequent building upgrades.



Steven C. Spencer, FSEC

Figure 8. In this office, desks are positioned to take advantage of available daylight. Light shelves extend horizontally from the windows and help diffuse the natural light and control glare, as do interior blinds.

Upgraded lighting systems can also improve the quality of lighting in the building that can increase worker comfort, mood, safety (through effective emergency and exterior lighting), and productivity, as well as reduce absenteeism through a reduction in eye fatigue and an improvement in performance on visual tasks. Lighting also greatly affects the aesthetics and perception of the building, as well as the business conducted within. Although it may seem appealing to implement only the easiest and quickest payback opportunities when it comes to lighting upgrades, a more comprehensive upgrade will ensure that the other savings due to productivity will also be realized.

5.1.1 Indoor Lighting

When beginning to search for opportunities to conduct a lighting upgrade, one must first examine appropriate lighting needs of occupants, such as the quality and quantity of light, that depend on various tasks that are performed in the building. Such assessments must also take into account issues other than those attributed to artificial light sources, such as availability of daylight and glare. Therefore part of a lighting upgrade may involve relocation of desks and other task areas to take advantage of available natural light, or minimize glare. Lighting devices brought in by employees may indicate additional lighting needs.

As with many other conservation efforts, bigger is not always better. That is to say more light does not always lead to better functionality. Therefore the correct amount of light for the task to be completed must be determined, and achieving such target levels should involve a combination of available daylight and artificial light. Table 4 indicates average recommended levels for various tasks, as measured in footcandles. To conduct such an assessment oneself, a light meter will be necessary, available at most industrial and commercial equipment supply stores. Alternatively, resources for assistance are presented at the end of the Building Energy Use section. Analyzing lighting needs for various tasks, coupled with quantity of light available from the use of efficient bulbs and luminaries may reveal an instant savings opportunity where the number of bulbs in a particular fixture can be reduced, termed “delamping”.

Quality of light is also important, and involves taking into account glare, light color and light temperature. Lights are classified on the basis of the color rendering index (CRI) on a scale

Table 4. Recommended lighting levels for various activities.

Activity	Recommended Light Levels (footcandles)
Average reading and writing	50 fc
Offices with computer screens	50 fc total
Task lighting	25 fc
Ambient lighting	25 fc
Hallways	10 fc
Stockroom storage	30 fc
Loading and unloading	10 fc
High-volume retail	100 fc
Low-Volume retail	30 fc
Roadway lighting	0.3 – 1.6 fc
Parking lots	0.8 – 3.6 fc
Building entrance	5 fc

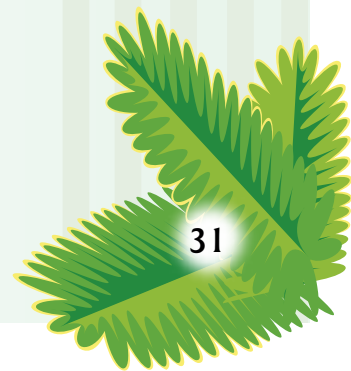
Source: EPA / IESNA Lighting Handbook.

of 0 to 100. The higher the number, the more natural and bright people and objects appear, therefore it is recommended to use lights with the highest CRI that still meet energy use criteria. Light color is more of an aesthetic choice where lights with warmer sources (temperature below 3500° K) are generally preferred in lower illuminance environments and lights with cooler sources (temperature above 3500° K) are preferred in higher illuminance environments.

Although more prevalent in residential settings, many commercial buildings contain various fixtures (both installed and stand alone such as desk lamps) that use incandescent bulbs. Replacement of incandescent bulbs with compact fluorescents (CFLs) can produce 66%-75% savings from such lighting fixtures for CFLs use only 1/3 – 1/4 the wattage of a comparable incandescent bulb, with the same, if not more light available, and at a comparable quality of light to that of the incandescent. CFLs are now available in a wide variety of shapes, sizes, and wattages to fit just about all incandescent fixtures. The rated life of CFLs also represents a dramatic

improvement over incandescent fixtures, with many offering 10,000 hours or more compared to an average of approximately 1250 hours for incandescents. Care should be taken when selecting CFLs for use in incandescent recessed lighting fixtures (also known as “cans” or “high hats”). Although such fixtures often readily accept CFLs, the design of such fixtures does not directly lend themselves to achieving similar performance with CFLs as they do incandescents. On one hand, the design of such fixtures can shorten the service life of CFLs due to heat build-up. Secondly, installing a CFL in a standard recessed fixture may cause performance and optic problems such as glare. Accessories such as drop in reflectors and other optics are now on the market that solve many of these problems. Therefore, when selecting CFLs as a replacement for incandescents, it is important to keep the intended application in mind. Consulting with a lighting designer or the bulb’s manufacturer will ensure optimum performance.

One of the most common light sources in commercial buildings is the linear



(or sometimes circular) fluorescent lamp. The presence of T-12 type fluorescent lamps, combined with magnetic ballasts, presents the greatest opportunity to reap large degrees of energy savings through the replacement of bulbs and ballasts. Without ballast replacement, standard T-12 lamps can be replaced with more energy efficient versions with the potential to produce 15% energy savings. Where both lamp and ballast replacement is feasible, T-8 lamps should be used along with electronic ballasts. Electronic ballasts have less audible noise and lamp flicker, have the ability to power 4 lamps rather

than only 2 therefore increasing efficiency as well as first cost, and some have dimming capability. Electronic ballasts with instant start circuitry offer an additional 5% efficiency over rapid start ballasts, but may decrease lamp life under frequent on/off conditions. For such conditions, such as when the light is coupled to an occupancy sensor as soon to be discussed in this guide, programmable start ballasts should be used which "soft start" the lamp to maximize lamp life. Utilization of T-8 lamps in conjunction with electronic ballasts has the potential to save approximately 35% over standard T-12 lamps / magnetic ballast configurations.

Further efficiency benefits can be gained through modification of a linear fluorescent fixture itself. A fixture, or luminary, is designed to direct light efficiently by getting the maximum amount of light to exit the

fixture, while maintaining control over its distribution. A reflector is a device that can be added to existing fixtures that uses highly reflective surfaces to redirect light out of the fixture, thereby minimizing internal loss. Reflectors can improve the internal surface

reflectance of newer fixtures by 17%, and even more in older fixtures, depending on how degraded the reflecting surfaces are. Consideration of reflectors is usually done in conjunction with an analysis of lighting quality and quantity as previously discussed, and aimed at improving lighting performance when delamping activities are undertaken.



Figure 9. Examples of fluorescent bulbs.

Many linear fluorescent fixtures contain a diffuser or louver primarily designed to block direct view of a lamp or to diffuse or redirect light. Diffusers (often semitransparent plastic sheets) do help spread light evenly across the face of the fixture but also tend to absorb a large quantity of light, rendering them somewhat inefficient. Clear plastic lenses with special surface texturing can be used instead to improve both efficiency and distribution of light. Louvers do a better job at controlling glare than diffusers, but louvers with small cubes (less than 1 inch) are quite inefficient. Larger "deep cell" louvers provide excellent efficiency and light control and are available for retrofit in most existing fixtures.

Along with reducing the fixture wattage of lighting through bulb and ballast replacement and improving the efficiency of light distribution through reflectors and louvers, an



Figure 10. In this example, a fixture containing four T-12 lamps is slated for delamping.



Figure 11. The fixture is stripped of its lamps.

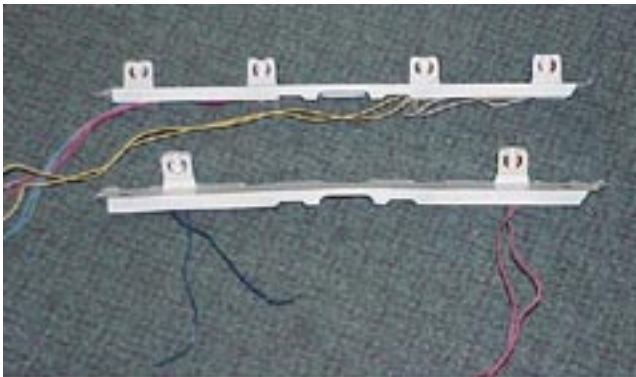


Figure 13. One electronic ballast replaces two magnetic ballasts.



Figure 12. Two T-8 lamps are used in place of the four T-12 lamps, and recentered.

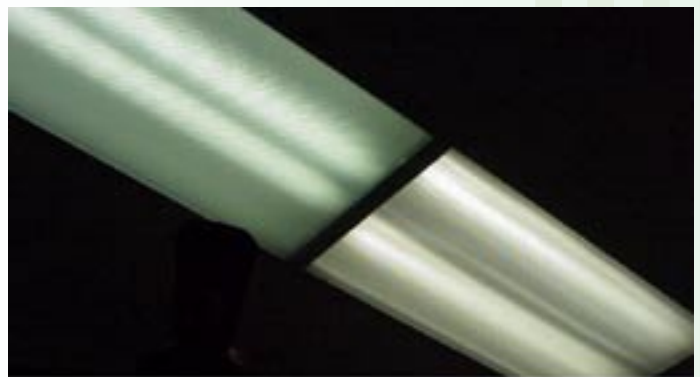


Figure 14. Comparison of the four T-12 lamp fixture and the new two T-8 lamp fixture.

Photos by: Dave Chasar, FSEC



Figure 15. Two examples of infrared motion sensors. The one on the left is a ceiling mount, and the one on the right is a wall mount.

equal potential for savings exists through the use of advanced controls. Advanced controls are designed to ensure that lights are active only when needed either through motion or timer control, or to ensure that the total light levels (artificial light + available daylight) are maintained at the minimum amount required. This is achieved through daylight sensing devices coupled with light dimming controls. Although extremely effective at achieving savings in lighting energy use, due to the potentially intensive and costly nature of retrofitting a building for advanced lighting control, details are not provided with this guide. Readers are suggested to consult the US EPA Building Upgrade Manual listed as a reference at the end of this chapter for further information. If advanced controls are not present in the building, a regular inspection should take place after hours to ensure lights do not remain on overnight. This can be part of a comprehensive lighting maintenance program, described next.

Another aspect of maintaining efficient lighting within a commercial building is to develop and integrate a planned lighting maintenance program. Such a program will further enhance savings achieved from utilization of efficient equipment with savings achieved in labor. Lighting systems experience a decrease in system performance and efficiency over

time as lamps age and their output decreases. Eventually the lamps will burn out. Over time dirt can also accumulate on reflective surfaces of fixtures that decreases their efficiency. Such factors can degrade a system's efficiency by 60%, consequently wasting energy, and compromising safety, productivity, and building aesthetics. Taking part in a maintenance practice called "group re-lamping" minimizes such problems and adds to lighting savings. Group re-lamping involves developing a plan whereby a large number of lamps are replaced at once, generally at about 70% of their expected life, which represents their maximum economic value. Depending on the number of fixtures in the building, re-lamping may be done throughout the entire building, or by developing a rotating schedule whereby only certain areas of the building are re-lamped at any one time. Regardless of the re-lamping schedule, proper waste fluorescent lamp management should always be practiced (consult the Resources and References section at the end of this chapter for information). Group re-lamping enables lighting systems to be right sized such that one does not need to compensate for differences in lighting levels between newer lamps and older lamps. In addition, even though group re-lamping involves replacing lamps before they burn out, it does reduce the amount of time spent replacing individual lamps and time spent

responding to expired bulb situations, often reducing an overall lighting maintenance budget by 25%. Group re-lamping may also reduce the costs of bulbs themselves through bulk purchasing, and also reduces storage space necessary to keep a large amount of spare bulbs on hand at all times.

Another part of a planned lighting maintenance program is fixture cleaning. Fixtures should be cleaned during each group re-lamping. Generally fixtures only require a simple dusting, using the techniques presented earlier for soil control on elevated surfaces. If used, lenses and diffusers may need a washing (both sides) with mild detergent. Lenses and diffusers should be replaced less frequently than bulbs, and can be replaced during ballast replacement.

When each of the above mentioned strategies are carried out together in a comprehensive lighting maintenance program, considerable savings can be achieved. Table 5 presents an average performance comparison of fluorescent lighting retrofit options and maintenance practices.



David Floyd, FSEC

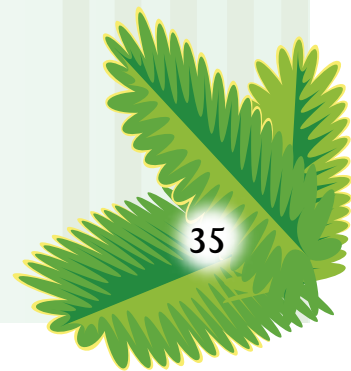
Figure 16. Regular fixture cleaning is an important part of a planned lighting maintenance program.

Along with ambient and task lighting inside commercial buildings, exit signs are another type of light fixture that have the potential to produce significant savings with a cost effective retrofit. Exit signs are available that utilize light emitting diodes (LED) and operate on 5 W or less per face, in lieu of conventional incandescent bulbs often operating on as much as 40 W per face. When installed throughout a building, LED exit signs can generate savings in both energy and maintenance costs. One sign alone can save approximately \$15-\$20 annually on electricity costs, and can last up to 25 years

Table 5. Performance comparison of fluorescent lighting retrofit options.

	Case 1: T-12 Lamps w/ magnetic ballasts	Case 2: Energy Saving T-12 lamps	Case 3: T-8 lamps w/ electronic ballasts	Case 4: Case 3 + reflector lens and 50% de- lamping	Case 5: Case 4 + occupancy sensors	Case 6: Case 5 + maintenance program
Average Maintained footcandles	28	25	30	27	27	27
Input watts per fixture	184	156	120	60	60	50
Energy Savings	N/A	15%	35%	67%	80%	83%
Operating Cost Savings	N/A	15%	35%	67%	76%	80%
Simple payback (years)	N/A	2.4	4.7	2.7	2.9	2.8

Source: EPA / E Source, Lighting Technology Atlas, Table 3.1



without a lamp replacement, compared to approximately one year with an incandescent version.

Along with the savings in lighting energy a successfully implemented lighting retrofit and maintenance program offers, improving the efficiency and effectiveness of interior lighting also leads to savings in energy used to air condition the building. Lighting is a



Eric Martin, FSEC

Figure 17. Light fixtures that direct light downward, where it is needed, minimize light trespass.

primary source of heat gain and waste heat in a commercial building resulting from the fact that energy consumed by the system that is not used to produce light (approximately 70%-80% of total energy consumed) is turned into heat. This heat places an additional load on a building's HVAC system, for in order to maintain the desired temperature in a building, the HVAC system must remove this heat. Efforts incorporated to reduce the electrical

consumption and improve the effectiveness of lighting often involve the use of equipment such as bulbs and ballasts with higher efficiencies, and therefore produce less heat. Such a reduction in the heat load placed on the building's HVAC system results in a savings in the energy used for cooling. Magnitude of cooling saving vary depending on situations but for a typical 100,000 sqft office building that upgrades to T-8 lamps, electronic ballasts, and occupancy sensors achieving a 1 W/sqft lighting savings (equating to 300,000 kWh/year) a 14% savings in energy used for cooling (equating to 41,000 kWh/year) can also be achieved.

5.1.2 Exterior Lighting

Maintenance of exterior lighting for efficiency and effectiveness has many of the same concerns and recommendations as for interior lighting. Appropriate light levels should be maintained for tasks (see Table 4); efficient bulbs, ballasts, and fixtures should be utilized, and an appropriate and effective maintenance program should be developed. Fluorescent lights should be used where appropriate, however need for consistent operation through a wide variation in temperature regimes as well as need for high output lighting often calls for metal halide or high-pressure sodium lamps. With exterior lighting, advanced controls, whether motion, timer, or daylight sensing based, are extremely important to ensure light is only available when needed.

Exterior lighting does have some unique concerns of its own related to poor design. Light trespass, caused by the inappropriate selection, tilting, or aiming of outdoor luminaries for a particular lighting task, is light that strays from its intended target causing an annoyance or nuisance. Along with being an annoyance, it is an efficiency concern for light not falling on its intended target is wasted. Light trespass can result from uncontrolled light emitting horizontally from a fixture, emitting upwards towards the sky from a fixture, or light emitted from a fixture that is reflected from a surrounding surface. In order to control light trespass, outdoor lighting should only be located where it is needed. Use carefully aimed and directed fixtures that point downwards to illuminate signs and entrances. For ambient lighting such as in parking lots, place light fixtures below tree canopies rather than above. Cutoff lighting fixtures should be employed that emit no light above the plane of the horizon.

5.2 Building Policy and Supplemental Loads

Section Recommendations:

- Eliminate unnecessary supplemental loads.
- Utilize efficient office equipment.
- Implement office equipment power policies.

Supplemental loads in commercial buildings include office equipment and other plug loads that consume electricity. Along with consuming electricity, such equipment, similar to lighting, produces waste heat. One strategy is to seek out all “common use” supplemental loads and eliminate those that are unnecessary. Examples include disabling lights used for vending machines and illuminated signs during the daytime. Another strategy is to encourage or require the use of efficient office equipment such as computers and copiers. Efficient equipment standards and equipment are becoming more widely recognized and incorporated into the workplace, such as equipment certified under the US EPA Energy Star® program (for more information, visit www.energystar.gov). However, a building manager may not have control over the purchase decisions for such equipment. One thing the building manager can do is consult with those responsible for conduction of business within the building to jointly develop policies that are aimed at

reducing the energy use of supplemental loads that are already present in the building. For example, policies can be incorporated that involve turning off equipment, such as computers, when the equipment is not in use for a long period of time, especially overnight.



Analysis conducted by researchers at the Florida Solar Energy Center shows that 50 computers left on after hours each night without power management features operating consumes an unnecessary 41,000 kWh/year, costing a facility an unnecessary \$2,000 - \$4,000 per year depending on impact in peak demand.

Analysis conducted by researchers at the Florida Solar Energy Center shows that 50 computers left on after hours each night without power management features operating consumes an unnecessary 41,000 kWh/year, costing a facility an unnecessary \$2,000 - \$4,000 per year depending on impact in peak demand. Vending machines and other non-essential equipment may also be unplugged or otherwise turned off. Energy efficient appliances should be selected where possible, such as those that qualify for the US EPA Energy Star® designation. Regular maintenance should be conducted on appliances so their efficiency can be maintained, for instance

periodic and through refrigerator coil cleaning. If computers in the workplace are all equipped power management features, users may be instructed to enable them properly, for instance to take effect shortly after a screen saver has been activated. Excess heat is a leading cause of equipment failure, and power management features enable the equipment to generate less heat, leading to improved longevity and reliability.

5.3 Building Envelope

Section Recommendations:

- Reduce uncontrolled infiltration of outside air.
- Examine ceiling plane for air barrier effectiveness.
- Implement effective window shading.

Energy efficient operation and maintenance strategies as applied to the building envelope generally involve reducing air infiltration. Reducing infiltration of hot humid air, as well as cold drafts, can greatly improve occupant comfort, as well as reduce energy use. Reducing infiltration can also improve indoor air quality, for uncontrolled air flows have no means of filtration, and often pick up additional dust and debris as they flow through building assemblies such as walls, roofs, and attics. Infiltration of outside air can also be exacerbated by other phenomena in the building causing excessive negative pressure such as duct leakage and unbalanced ventilation/exhaust. Developing a strategy to reduce infiltration will also reduce the amount of conditioned air that leaks out of

the building. Energy savings available from “weatherizing” the building envelope vary widely, but can be on the order of 5% of heating and cooling costs for a large office building.

In order to carry out this strategy leaks in the building envelope must be located via occupant complaints and by inspection. Utilizing services of outside contractors such as energy raters, utility companies, and energy performance contractors may enable a “blower door test” to be performed on the building to gauge the extent of infiltration and assist with identification of major leaks. Many leaks may be found around windows and doors, and can be attended to with items such as caulk and weather-stripping. Use of revolving doors should be encouraged if present, and automatic doors should be calibrated properly to ensure they don’t remain open for extended periods of time. Roofs and attics are another concern for building infiltration, especially if an effective air barrier is not in place between the attic space and the conditioned environment. Many commercial buildings have been designed with a suspended t-bar ceiling that was intended to act as such an air barrier, however, studies have found that in most cases, such ceilings are not effective air barriers. Ceilings created from drywall on the other hand, as in many residential situations, are much more effective air barriers. If a suspended t-bar ceiling is suspected to be a major pathway for infiltration of outside air (as most are) energy savings can be achieved by sealing vents and other gaps in the building envelope above the plane of the ceiling.

Another low cost strategy for reducing energy consumption through building envelope measures is window shading. A significant amount of heat gain on a building in Florida is through the solar gain through windows,



Steven C. Spencer, FSEC

Figure 18. T-bar ceilings, such as the one in this classroom, do not perform well as an air barrier.

and is directly proportional to the amount of window area. Window solar gain also varies according to the direction each window faces, with east and west facing windows experiencing the largest gains as the sun rises and sets. Such time periods also typically coincide with more expensive utility “on-peak” rates. A number of strategies are available for reducing solar gain including the use of window films, interior shading devices such as blinds, and exterior shading devices such as awnings, and roller blinds. Strategically placed trees also perform quite well for shading purposes.

Savings from window shading vary widely depending on a number of issues, but large degrees of savings can be achieved in buildings with any of the following characteristics:

- The window to floor area ratio is large (greater than 15%).
- The building is in a sunny location with little natural shade for windows on south, east, and west sides.
- Windows in the building are single pane.
- Windows in the building are clear, and not tinted or colored.

5.4 Building System Controls

Section Recommendations:

- Periodically check calibration of building sensors and controls.
- Analyze equipment schedules for applicability to building use.

If not checked periodically, controls that operate in conjunction with a building’s HVAC system can cause the system to operate inefficiently and unexpectedly. Poorly calibrated sensors can cause increased heating

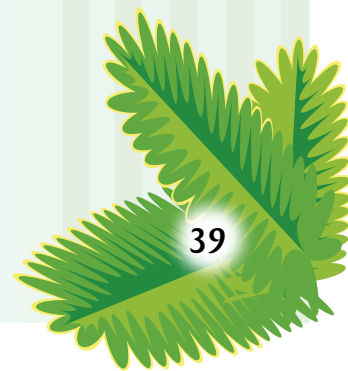


Steven C. Spencer, FSEC

Figure 19. Window shading devices can be incorporated into the architecture of a building, such as these exterior light shelves at the Florida Solar Energy Center in Cocoa.

and cooling loads, and can lead to occupant discomfort. Wall thermostats may be adjusted by occupants so comfort can be maintained, leading to further energy consumption. Savings from review and correction of problems associated with building system controls vary widely depending on individual situations, but average approximately 30% of heating and cooling costs.

Calibration of indoor and outdoor building sensors such as thermostats and humidistats should be checked periodically to ensure they are operating within original design specifications. Such activities may require specialized knowledge or equipment however, and may require outside professional assistance. Resources for such assistance are given at the end of the Building Energy Use section of this guide. Mechanical type controls such as those operating dampers and valves should also be inspected to ensure proper functionality. Pneumatic or pressure activated controls can develop system leaks, and dampers may become stuck in either the “open” or “closed” position. Such inspections may reveal controls that have been previously disconnected for any number of reasons.



While analyzing control functions, it is important to also analyze equipment schedules, a process that may uncover further opportunity for savings. Since occupancy schedules and building uses change frequently

Since occupancy schedules and building uses change frequently over the life of a building, an analysis of HVAC control operation may reveal a control scheme that reflects a previous building schedule, or one that does not account for daylight savings time.

over the life of a building, an analysis of HVAC control operation may reveal a control scheme that reflects a previous building schedule, or one that does not account for daylight savings time. HVAC controls must be adjusted

to properly condition the building for optimum comfort during occupied times, but thermostats and other controls can be set to modify operation to achieve energy savings during unoccupied times, when comfort is not a concern. This includes ventilation air, of which the amount required is directly dependant on occupancy. Ventilation air often consists of unconditioned outside air that puts extra heat and moisture loads on HVAC systems. Controls should be set such that the building is returned to a comfortable and safe environment by the time occupancy resumes at the beginning of each day, to avoid discomfort. The utility rate schedule should also be reviewed in conjunction with control operation. Utilities typically have varying rates for energy depending on the time of day it is used, termed “on-peak” and “off-peak”. Such an analysis may uncover the possibility to operate certain equipment during “off-peak” times, resulting in direct savings. Analysis and correction of HVAC control related problems can be conducted by in-house qualified individuals, but in some

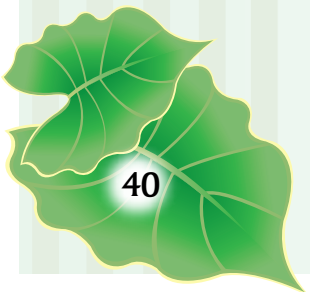
cases may require outside expertise. If this is the case, and comfort problems have been reported, it may be beneficial to enlist a contractor to conduct testing, adjusting, and balancing of the HVAC system that generally includes controls analysis. This is discussed in the following section.

5.5 Testing, Adjusting, and Balancing

Section Recommendations:

- In the absence of trained in-house personnel, seek outside assistance to test, adjust, and balance the HVAC system.

Testing, adjusting, and balancing (TAB) is a process whereby the current state of the HVAC system is evaluated or tested and air and water flows are regulated or adjusted for the purpose of balancing the system such that it can meet all applicable loads and provide adequate indoor air quality. TAB of the HVAC system should be carried out periodically when it appears as though the system is not functioning as designed. Indicators of such problems include occupant complaints about hot and cold spots in the building, and frequent adjustment of HVAC components and controls to maintain a comfortable environment. TAB should also be conducted after renovation of spaces for different uses or occupancy. Since this happens frequently in buildings, but TAB does not, chances are that carrying out a TAB on an older building will uncover opportunities for savings. Again, savings potential can vary widely from building to building, but range in upwards of 10% of heating and cooling costs. TAB is most often conducted through the use of trained contractors, but can also be conducted by qualified in-house individuals. Services



*Testing, adjusting, and balancing (TAB) is a process whereby the current state of the HVAC system is evaluated or **tested** and air and water flows are regulated or **adjusted** for the purpose of **balancing** the system such that it can meet all applicable loads and provide adequate indoor air quality.*

available from utility companies and energy performance contractors may be leveraged for this item, and such services are discussed in a later section.

A TAB program may include review of a building's original design documentation and will focus on a number of areas. Such areas include analyzing supply, return, exhaust, and outside air flow rates and temperatures through system components and ductwork. Focus will be on ensuring the correct amount of air is going where it is supposed to and is delivered at an appropriate temperature while minimizing the amount of ventilation air delivered and maintaining a slight positive pressure within the building. Ventilation air is primarily hot humid air from outside the building, and operating with the minimum amount necessary reduces heat and moisture loads on the HVAC system, while still maintaining adequate indoor air quality. Ductwork should also be inspected for leaks that can affect proper flow distribution and lead to building durability concerns through building depressurization. If present, the HVAC water system will be tested in a similar fashion. Flow control devices including fans, pumps, and dampers will be checked

for correct speeds, pressures, and other proper functionality, and control settings and operation will be reviewed. Based on the TAB analysis, and the recommendations that result, the TAB activity may lead to HVAC system adjustments to achieve operation that satisfies current load conditions, as well as result in savings.

5.6 Heating and Cooling System Maintenance

Section Recommendations:

- Maintain heat exchange surfaces such that they are free of dust and debris.

Maintenance of heating and cooling systems needs to be performed on a regular basis, not only to maintain equipment efficiency for energy savings, but also to ensure that systems have the ability to maintain appropriate comfort levels in the building. Many routine maintenance items concerning heating and cooling equipment can be handled by in-house staff, however buildings with complicated systems or buildings with limited amount of knowledgeable maintenance staff may need to rely on outside contractors to maintain systems properly.

Relatively easy yet important maintenance of heating and cooling systems involves maintaining heat exchange surfaces such as heating and cooling coils to keep them free of dust and debris. Accumulated dust and debris reduces the amount of surface area available for heat transfer and adds to the pressure drop across the coils, both leading to decreased system efficiency. A regular maintenance program that involves inspection and replacement of all air and water filters is an important concern for preserving equipment life, efficient operation,



Figure 20. Heating and cooling system maintenance needs to be performed regularly to maintain equipment life and occupant comfort.

and building indoor air quality. However, even with effective filter replacement regimes, heating and cooling coils eventually become dirty enough to require cleaning. The airside of coils may be cleaned with compressed air, dust rags and brushes, or via power washing. The waterside of coils is generally inaccessible for mechanical cleaning, and is generally maintained with chemical treatments added on a periodic basis to the water in order to prevent biological and mineral scale build up. The types of heating and cooling equipment in commercial buildings vary, but all require additional maintenance and tune-ups from time to time. For more information on other maintenance issues related to various types of heating and cooling equipment, consult the US EPA Buildings Upgrade Manual listed as a reference at the end of this chapter.

5.7 Resources and Assistance for Financing Energy Improvements

Section Recommendations:

- Consider leveraging one of the listed resources for technical and financial assistance with energy retrofits.

Although many operational and maintenance issues aimed at reducing energy costs are designed to eventually create a positive cash flow for the building through energy savings, some require an initial up front investment. For example, some lighting savings can be achieved through gradual replacement of bulbs and ballasts, however much larger savings can be achieved by undertaking fixture upgrades and installation of advanced controls, which represent an up front cost. Savings can be achieved through proper maintenance of existing HVAC equipment, but a much greater savings can be achieved in the long run by replacing aging and improperly designed systems with newer, properly designed systems. Initial cost of equipment, plus need for use of outside contractors to diagnose and suggest cost effective upgrade strategies often render the largest potential for savings and long term building durability out of reach of many building managers due to tight budgets and lack of additional funding. Avenues do exist however to assist building managers in such situations, two of which include utility company incentives and rebates and energy performance contractors.

Most electric and gas utility companies have incentive and rebate programs that building managers can take advantage of to achieve energy savings. Even though utility companies

are in the business of “selling” energy, they have some stake in energy conservation to ensure that they can continue to satisfy all customers’ needs with existing generation capacity. Utility companies have realized that conservation is much more cost effective than construction of new generation capacity, and offer assistance to customers with similar goals through “demand-side management.” Incentive and rebate programs vary from utility to utility, but example programs include:

- Free business energy evaluations.
- Rebates for undertaking lighting upgrades.
- Rebates for replacing cooling systems with qualifying high efficiency models.
- Rebates for improving building envelopes through window treatments, insulation, and reflective roofing.
- Rebates for custom and innovative energy savings strategies.

Utility companies have realized that conservation is much more cost effective than construction of new generation capacity, and offer assistance to customers with similar goals through “demand-side management.”

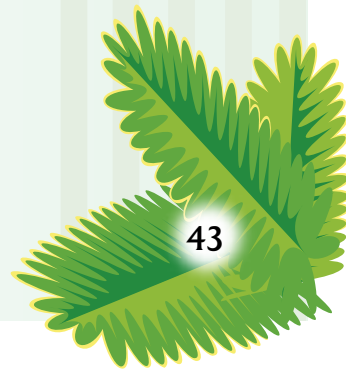
To find out about available rebates and incentives, and to partner with the utility to take advantage of such programs, begin by contacting the utility’s commercial/industrial/business solutions center.

Another avenue for building managers that can lead to assistance with financing energy

improvements is by contracting with an energy performance contractor or energy service company (ESCO). Such companies provide turnkey services including opportunity analysis, and purchase and installation of equipment, improvements, and services, all at zero cost to the business or building owner. Contracts are based on guaranteed energy savings, of which the ESCO assumes all risk involved with the retrofit. Payment for ESCO provided services and equipment comes directly from energy savings, which are split between the ESCO and the business/building owner. Contracts are generally long term, and monitoring equipment is most often installed to assist with verification of savings.

Different ESCOs may focus on different strategies. Some are housed within utility companies and focus on conservation of a particular fuel use. Others are housed within equipment companies and focus on use of particular equipment. Different building situations call for different ESCO services, but often the largest opportunities for savings and performance are gained by utilizing an ESCO that considers all possible conservation strategies, including water conservation. For more information on energy performance contracting, visit www.escperform.org.

Rebuild America is a program of the U.S. Department of Energy (DOE) that focuses on energy-savings solutions as community solutions. Rebuild America began in 1994 with the mission to accelerate energy-efficiency improvements in existing commercial, as well as other, buildings through private-public partnerships created at the community level. Today, Rebuild America is helping commercial buildings and building managers across the country sort through an often overwhelming array of options for building improvements and develop and implement an Action Plan that



meet their needs. Working on a local level, Rebuild America helps commercial building managers access innovative technologies, industry services, customized assistance, and a variety of business and technical tools needed to perform energy retrofit on buildings. Rebuild America can connect building managers with other community partnerships that are working on the same issues, businesses that provide efficient products and services, technical tools that can help expedite a project, and with information on energy audits, financing strategies and energy-efficient technologies. Rebuild America has an active partnership working in Florida, as well as smaller partnerships working at the local level. To date, the Florida partnership has retrofitted 6,084,352 square feet of building space to achieve a total annual energy savings of \$11,006,219. To find out more about Rebuild Florida, or local partnerships, visit www.rebuild.org for contact information.

5.8 Resources and References

Building Energy Upgrades

“Building Upgrade Manual.” US Environmental Protection Agency.
http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual

Ceiling Air Barrier Integrity

“Best Practice for the Location of Air and Thermal Boundaries in Small Commercial Buildings.” Cummings, James. B. and Charles R. Withers, Florida Solar Energy Center. Proceedings of 12th Annual Symposium on Improving Building Systems in Hot and Humid Climates, San Antonio, TX, May 2000.

Lighting and Equipment Disposal Information and Regulation

Florida Department of Environmental Protection - Hazardous Waste Division
http://www.dep.state.fl.us/waste/quick_topics/publications/shw/hazardous/fact/c&dwaste.pdf
http://www.dep.state.fl.us/waste/quick_topics/publications/shw/hazardous/fact_mcl.pdf

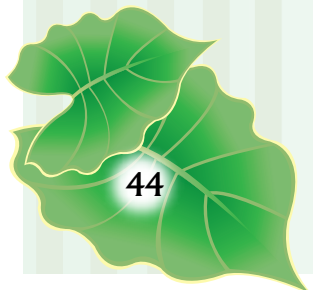
Technical and Financial Resources for Energy Upgrades

Florida Solar Energy Center –
www.fsec.ucf.edu

Building Energy Raters –
www.energygauge.com/search.htm

Rebuild America – www.rebuild.org

Energy Performance Contracting –
www.escperform.org



6.0 Identify Opportunities III – Housekeeping and Maintenance and Building Water Use

Chapter Highlights

- Strategies to reduce indoor water use.
- Strategies to reduce outdoor water use.

6.1 Indoor Water Use

Section Recommendations:

- Retrofit older fixtures with EPACT compliant models.
- Use conservation devices in existing fixtures such as aerators and water displacement devices if fixture cannot be upgraded.
- Consider automatically controlled water fixtures.
- Monitor all water fixtures and piping for leaks.

Primary sources of water consumption inside commercial buildings are found in restrooms, and to some extent, food preparation and eating areas. The largest potential for savings is often found in buildings constructed before 1992 with fixtures that do not comply with the Energy Policy Act (EPACT) requirements. The Energy Policy Act of 1992 placed maximum flow requirements on all water fixtures, and effectively required their use. Upgrading to EPACT compliant fixtures can have a significant impact on water use. Water faucets used primarily for hand washing should consume no more than 1.5 gallons per minute of water. If the fixture cannot be changed, a faucet aerator can be installed that effectively lowers the flow of a high flow faucet. Urinals should use no more than one

gallon per flush, while toilets should use no more than 1.6 gallons per flush. Urinals and toilets that pre-date EPACT could easily be using 3-5 gallons per flush. As shown in Table 6, savings achieved by retrofitting older urinals with EPACT compliant models can be substantial. Performance of older toilets that have tanks can also be improved with water displacement devices, such as toilet dams, bags, or weighted bottles, in lieu of an equipment retrofit.

If upgrading older water consuming devices, consider upgrading faucets, urinals and toilets to automatic models. Automatic faucets limit the length of time water flows during any one activation, and ensure flow is not inadvertently left on. Automatic urinals can be programmed to operate under a water saving mode that flushes the urinal after more than one use. As previously discussed, automatic equipment aids with disinfection activities due to “touch-free” operation.

Maintenance routines should also be aimed at conserving water. All water fixtures should be monitored for leaks, and as with other



Figure 21. Automatic faucets limit the length of time water flows during one activation, thereby ensuring flow is not left on.

Eric Martin, FSEC

Table 6. Projected annual water savings per urinal obtained from retrofit of three gal/flush units to one gal/flush units for three building types.

Building Type	Number of Males	Number of Urinals	Uses per Day	Days used per Year	EPACT savings per Flush (gal)	Average Annual Water Savings per Urinal (gal)
Small Office	25	1	3	260	2	39,000
Restaurant	150	3	1	360	2	36,000
School	300	10	2	185	2	22,200

Source: Adapted from Environmental Building News Vol. 7, No. 2, Feb. 1998.

concerns this guide addresses, a system set up for occupants to report leaks. A leaking toilet can waste more than 50 gallons of water each day, and a dripping faucet can waste up to 1,000 gallons per week. Water bills should be monitored, for an unusually high bill may indicate a leak.

A leaking toilet can waste more than 50 gallons of water each day, and a dripping faucet can waste up to 1,000 gallons per week.

For assistance with conducting a water audit of your building that can uncover opportunities for water

conservation, consider contacting the local water management district for assistance and resources. Contact information for all five of Florida's water management districts can be found on the web at: www.dep.state.fl.us/secretary/watman/index.htm. Rebuild Florida, as previously described, can also assist with water efficiency retrofits and strategies.

6.2 Outdoor Water Use

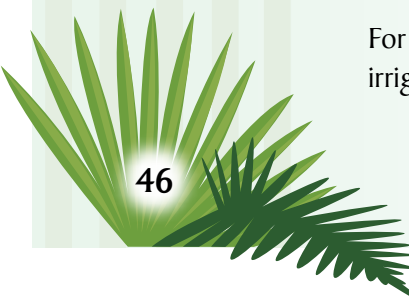
Section Recommendations:

- Practice "Florida Friendly" landscaping and irrigation practices.

For commercial buildings in Florida with an irrigated landscape, a significant amount

of water is consumed throughout the year in order to maintain the plant material in the landscape. Much of the water used for irrigation has been treated by a municipality to potable standards, which consumes chemicals and energy for treatment and distribution. Both commercial and residential buildings alike are charged for use of this water, and are also often assessed sewer charges, even though water used in the landscape does not directly enter a municipal sewer system. Implementing "Florida Friendly" landscape and irrigation practices outside of a commercial building has the potential to reduce water use anywhere from 20% to 60%, depending on initial conditions and procedures. This strategy, as promoted by the University of Florida's Florida Yards and Neighborhoods Program (FY&N), places emphasis on the use of low maintenance plant material and landscape design. Florida friendly landscapes not only require less water, fertilizer, and pesticide to maintain, but also require less human interaction to maintain, resulting in further labor and personnel savings.

Lower fertilizer and pesticide requirements enable Florida friendly landscapes to also contribute to the protection of the quality of Florida's fresh water resources. Storm-water runoff is the reason. Rain falls on landscapes, roads and parking lots, and then washes into various tributaries, carrying pollutants like fertilizers, pesticides, soil, and



petroleum products. Fertilizers and pesticides from commercial as well as residential areas have become serious threats to the health of Florida's waters. When runoff contains nitrogen from fertilizers, algae can become so abundant that sea grasses are smothered, oxygen is depleted, and fish kills may result. In some freshwater environments phosphorus is often the nutrient responsible for algae blooms. Toxic substances, such as common landscape and household pesticides, can damage reproduction in marine life.

To assist with the preservation of the quality and quantity of Florida's water resources, the FY&N program was created and maintains an office in the extension service of nearly every Florida county. Coordinators are available to provide free assistance to building owners and managers who are interested in creating a Florida friendly landscape, or looking for Florida friendly tips and techniques to maintain their existing one. To obtain contact information for the program in your county, visit <http://hort.ufl.edu/fyn/count.htm> on the web, or look up the phone number for the extension service in your local phone book. FY&N operates a certification program whereby those who incorporate enough of their principles can achieve the designation of maintaining a "Florida Friendly Yard".



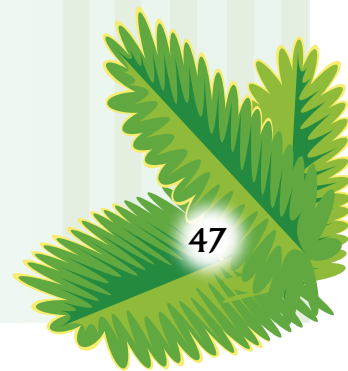
Eric Martin, FSEC

Figure 22. Florida friendly landscapes place emphasis on the use of low maintenance plant material and landscape design.

Some of the principles that lead to water and maintenance savings in a commercial landscape include selecting the correct plant material according to landscape conditions, watering efficiently, utilizing mulch to retain water, and applying appropriate amounts of fertilizer.

Plant selection is an important aspect of maintaining a Florida Friendly landscape and will determine the level of maintenance required, how much money will be spent on water or electricity to run a pump, and how much fertilizer or pesticide may be required. Plant selection also will determine how long your landscape will last. Fast-growing plants often have a shorter life span than slower-growing species. Plants should be selected on the basis of soil conditions such as pH, as well as sun/shade conditions to ensure they can thrive with little addition of water, fertilizer, and pesticide. Plants with similar requirements should be grouped together. Native plants are well adapted to local conditions and greatly minimize maintenance requirements, as do drought tolerant plants. Mulch should be applied 2-3 inches deep around plants, extending to the drip line of trees. Leave some open space near the plant base. Mulch assists with water retention and weed control. Turf is the largest consumer of water and chemicals in the landscape, and should be limited if not all together excluded and replaced with mulched plant beds or groundcovers. If turf is desired, a drought tolerant species should be selected. Turf areas should be evenly shaped and no turf should be placed on berms for effective watering. Trees and other tall

Implementing "Florida Friendly" landscape and irrigation practices outside of a commercial building has the potential to reduce water use anywhere from 20% to 60%, depending on initial conditions and procedures.



Turf is the largest consumer of water and chemicals in the landscape, and should be limited, if not all together excluded and replaced with mulched plant beds or groundcovers.

plants are excellent at providing for a shady landscape that will consume less water, and have the potential to reduce energy costs by shading the building.

As previously mentioned, plants should be placed at least two feet away from the building foundation to minimize moisture accumulation.

Proper plant selection and placement can provide for a landscape that, once established, survives primarily on rainfall and requires no supplemental irrigation. If irrigation is installed, certain steps can ensure water is applied effectively, rather than wastefully. The system should be calibrated to apply no more than $\frac{3}{4}$ inches of water per application, which should only be applied 1-2 times per week. Most plants, including turf, will not benefit from more than $\frac{3}{4}$ inches of water per week and excess watering on a regular basis can promote shallow root growth and weaker, disease prone plants. A rain shut-off device should be installed on automatic systems, and turf areas should be watered separately from plant beds. Consider using micro or drip irrigation for plant beds rather than sprays or rotors.

If a plant is appropriate for the soil and site where it is located, it may not require additional nutrients from fertilization. Fertilizers are generally used to achieve a specific goal such as more or larger blooms, faster growth, greener leaves, or more fruit. If it is determined that nutrients are required to maintain healthy growth, try to locate a source of compost that will provide additional benefits in the soil along with providing nutrients. If compost is not available

a basic fertilizer that contains slow-release, water-insoluble nitrogen and other essential nutrients is the most environmentally safe and cost-effective alternative. At least 30 percent of the nitrogen in the fertilizer should be listed as water insoluble. Fewer applications are necessary when using a product with water insoluble nitrogen. Fertilizer should contain little phosphorous, for most soils in Florida contain natural sources. When applying fertilizer use a maximum of one pound of nitrogen per 1,000 square feet no more than twice per year, for instance in March and September. Excellent results may be seen with much less fertilizer use, depending on plant and soil conditions. You can also reduce the risk of nitrate leaching into ground or surface waters by applying one-half pound of nitrogen per 1,000 square feet four times per year (March, May, September and early November).

6.3 Resources and References

Indoor Water Conservation and Savings Potential

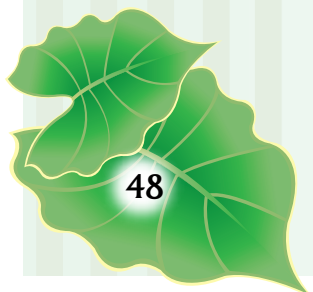
Florida Water Management Districts
www.dep.state.fl.us/secretary/watman/index.htm

"Big Savings from Waterless Urinal."
Environmental Building News Vol. 7, No. 2, February 1998.

Outdoor Water Conservation and Florida Friendly Landscapes and Irrigation

"A Guide to Environmentally Friendly Landscaping: Florida Yards and Neighborhoods Handbook." Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
<http://hort.ufl.edu/fyn/hand.htm>

County Horticultural Extension Offices -
<http://hort.ufl.edu/fyn/count.htm>



Appendix A: Opportunities to Consider When Undertaking a Renovation Project

The primary scope of the “Creating a Green and Profitable Work Environment” guide is to focus on procedural modifications to cleaning and maintenance activities, which may involve minor capitol expenditures. However, as most commercial buildings undergo some sort of renovation during their lifetime, this appendix is included to highlight potential opportunities that a building manager may suggest to the renovation design team. Incorporation of these recommendations will inevitably require more detailed research, design, and analysis than presented here, but if successfully incorporated, can further enhance the indoor environmental quality, energy efficiency, and water efficiency of the building, while reducing the amount of waste generated during building operation, cleaning, and maintenance. For more detailed recommendations, building managers are encouraged to consult the various green building standards and reference documentation available from the Florida Green Building Coalition (www.floridagreenbuilding.org) and the US Green Building Council’s LEED™ rating system (www.usgbc.org/LEED/LEED_main.asp).

Indoor Air Quality

Design professionals consistently incorporate features and strategies into building renovation projects that practically and efficiently enhance the comfort and productivity of the occupants, but often overlook similar needs of cleaning and maintenance staff. Recommendations in this section focus on renovation projects involving restrooms and tenant areas. Most of the recommendations in this section have been

detailed by Stephen Ashkin of the Ashkin Group in his paper “Green & Clean: The Designer’s Impact on Housekeeping and Maintenance”, published by the American Institute of Architects.

Restrooms

As previously mentioned in this guide, restrooms consume an enormous amount of time of cleaning personnel to maintain adequate aesthetics and health. Incorporating simple design strategies into a restroom renovation can significantly reduce the amount of time required of cleaning staff to maintain the restroom, effectively reducing an overall cleaning budget as well as enhancing indoor environmental quality.

- Flooring Materials – Hard surface, non-porous materials such as ceramic tile and terrazzo are an excellent choice to minimize harborage of bacteria and maximize ease of cleaning. If tiles are used, larger sizes should be selected to minimize grout, and the grout lines themselves should be as small as practical. Darker colored grouts are easier to maintain than lighter colors.
- Floor Drains – Drains should be installed in restroom floors to allow them to be flood mopped easily.
- Counters & Sinks – Counters should be designed to incorporate a recessed sink, or include a sink molded into the counter as a single unit for ease of cleaning. Sinks should be free of difficult to clean ribs and ridges, and deep to minimize splashing. The counter should be slightly



Sherri Shields, FSEC

Figure 23. Stalls and partitions should be suspended from the ceiling or extend from a wall to permit easy floor mopping and reduce build-up of soil on legs and other floor supports.

graded to eliminate standing water, and a front lip should be included to prevent water from leaking onto the floor. Hot and cold water taps should be installed underneath the counter to facilitate filling of a mop bucket, or connection of a hose.

Recommended counter materials include, cultured marble, ceramic tile, Dupont Corian[®], and other

hard surface, non-porous materials. Marbleized and textured surfaces have been found to hide water spots and soils better than solid colors. Many solid surface countertop materials are often free of formaldehyde containing glues and binders, that offgas over time. This presents an additional health benefit to the facility.

- Mirrors – To minimize the water spots on mirrors, and the resulting need for cleaning, mirrors should be installed above a large splash plate.
- Toilets & Urinals – Visible piping and plumbing should be minimized to reduce the amount of surfaces that require cleaning. If possible, toilets and urinals should be suspended from the wall they are up against to permit easy cleaning underneath and around them. Further recommendations regarding reduction of water consumed by toilets and urinals is given in the water efficiency section of this appendix.

- Stalls & Partitions – As with other materials used in bathroom construction, stalls and partitions should also be of non-porous, solid materials. Painted materials and wood laminates eventually become damaged and can harbor bacteria. Where possible, urinal partitions should be avoided to reduce the amount of surfaces that need regular cleaning, and all stalls and partitions should be suspended from the ceiling or extend from a wall. This will permit easy floor mopping and reduce build up of soil on legs and other floor supports.

Tenant Areas

Along with restroom upkeep, tasks such as dusting, vacuuming, and spot cleaning consume a large portion of cleaning staff's time, and therefore also contribute significantly to the cleaning budget for a commercial building. When redesigning or renovating tenant space, consider the following suggestions.

- Electrical Outlets – An abundance of electrical outlets throughout the building can reduce the amount of time that cleaning and maintenance staff spend dealing with extension cords as they maintain the building with vacuums, floor buffers, etc. This is particularly important in high traffic areas where such activities are conducted quite regularly.
- Finishes – Often overlooked when selecting interior finishes is their ability to resist soiling and ease of maintenance. Minimizing the number of materials with differing cleaning requirements (glass, metals, tile, wood, etc.) can significantly increase cleaning productivity and reduce the amount of cleaning products used. Soft materials, including softer metals such as brass and chrome, and softer

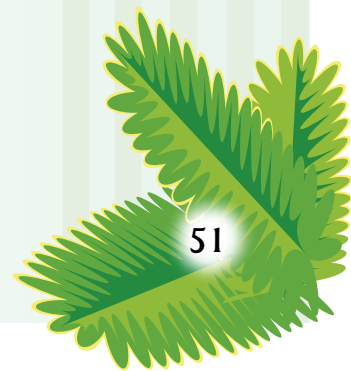
woods such as pine and fir have been identified as materials to avoid if possible, due to their tendency to become easily damaged by cleaning staff as well as other occupants.

- Interior Design Features – Minimizing the amount of horizontal surfaces present that have the ability to collect dust can increase the productivity of cleaning staff by allowing otherwise collected dust to fall to the floor where it can be removed easily by vacuuming or mopping. Interior design features to avoid where possible include shelves, moldings, and trims.
- Flooring – There are many issues to consider when selecting a finished flooring material, including ease of cleaning, durability, potential to contribute gaseous pollutants to the workplace, and impact of disposal. Non-porous, hard surface flooring can often perform better than carpet from a cleaning standpoint, due to some carpet's potential for harboring dust mites and other allergens. Hard surface flooring also tends to be more durable in response to both traffic, and staining/soiling. When selecting a hard surface flooring, it is important to ensure the flooring is not constructed or installed with materials that will emit large quantities of VOCs. Such materials include binders, backers, adhesives, and protective top coats. Flooring constructed from a sustainable source of material such as bamboo, cork, or certified sustainable lumber also helps maximize natural resources.

When selecting carpet, there are a myriad of issues to consider, and a myriad of types and styles to choose from that address some or all of the issues. The organization Green Seal has produced

a “Choose Green” report on carpet, that provides an excellent overview of the issues, as well as details on how specific carpet products respond to those issues. The report can be found at: www.green seal.org/cgrs/Carpet_CGR.pdf, and summarized here are items from its “checklist” when shopping for green carpet:

- Buy refurbished carpet wherever possible.
- Specify carpet with high overall recycled content (in the face fiber and backing), preferably postconsumer. EPA's Comprehensive Procurement Guidelines (CPG) designate a 25–100 % total recovered materials content (all post-consumer) for polyester carpet face fiber. The guidelines for nylon carpet are currently available only in draft form, but they recommend that the face fiber should have a total recovered materials content of 25–100% (1–100% of it post-consumer) and that the backing should be made of 100% recovered materials (with a post-consumer content of 35–70%).
- Ask whether environmental leasing or take-back programs are provided, to ensure that the carpet will be replaced only as necessary and reused or recycled by the producer.
- Use carpet tiles where appropriate to extend the life of the installed floorcovering. The use of carpet tiles allows for selective replacing of damaged or worn areas.
- Buy carpet made from recyclable materials and likely to be easily accepted for recycling under existing programs. Carpet containing nylon 6 face fiber and vinyl-backed carpets



are currently recyclable. No recycling programs currently exist for polyester carpet.

- Consider purchasing carpet made of wool or other natural fibers if your primary concern is the use of non-renewable resources.
- Buy carpet that is solution-dyed.
- Buy carpet that meets CRI Indoor Air Quality standards (Green Label program).
- Ensure that low VOC adhesives (CRI certified) are used during installation.
- Buy a carpet product that is consistent with the desired performance level, expected use pattern, and replacement schedule.
- Select an appropriate color for the carpet application. Light colors tend to get soiled easily and may require the frequent use of harsh cleaning chemicals and/or replacement.

Energy

There are many options available to improve the energy efficiency of a commercial building or facility. Many of these options do not require a renovation project to implement, but can often be financed/budgeted in conjunction with an upcoming renovation project. More detailed information regarding the opportunities presented in this section, along with design guidance can be found at the website for the Florida Solar Energy Center: www.fsec.ucf.edu.

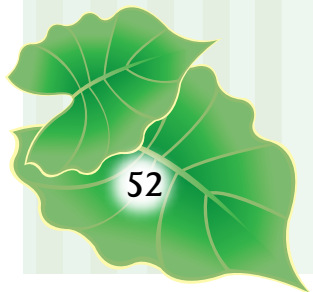
Solar Water Heating

Solar water heating systems can reduce water heating costs from anywhere between 50%-100% in commercial buildings over electric resistance and gas water heaters. This is an ideal retrofit option for small to medium office and other commercial buildings since

the demand for hot water is often very small (primarily hand washing and lunch room uses) and the demand is almost exclusively during daylight hours. Extent of savings depends on a number of factors including system size, hot water demand, etc. and often a conventional electric resistance or gas backup is also installed for times of high demand. In buildings where the need for hot water is not seen as critical (such as restroom hand washing only), reliability of solar systems has proven to be sufficient to supply adequate hot water without a backup system. The large degree of savings available from the installation of a solar hot water system will often offset any additional monthly loan cost when included with a renovation project, and the savings will continue to accrue eventually creating a positive cash flow and provide a hedge against rising electric and gas rates. Information regarding manufacturers, vendors, and installers of solar hot water systems in Florida can be found through the Florida Solar Energy Industries Association at www.flaseia.org. Design primers and equipment descriptions can be accessed on the Florida Solar Energy Center website at: <http://www.fsec.ucf.edu/Solar/index.htm>.

Solar Exterior Lighting

The use of solar energy for exterior lighting is another excellent opportunity for commercial buildings in Florida, offering up to 100% reduction in energy used for exterior lighting. Applications are many including parking lots, entrances, walkways, and security lighting. In most installations, a small solar photovoltaic panel is installed for each light fixture, which charges a battery during daylight hours. Sensors or timers activate the light at nightfall which operates off of the battery power. Critical applications such as security lighting may be installed with an electric backup. All solar lighting uses the most efficient bulbs and fixtures available, and many conform with the



suggestions mentioned earlier in this guide dealing with minimization of light trespass. The website of the Florida Solar Energy Center contains documents dealing with solar exterior lighting fundamentals, technical specifications, and equipment vendors and can be accessed at: <http://www.fsec.ucf.edu/PVT/RESOURCES/publications/pubs3.htm>

Roofing

If a renovation project involves a roofing replacement or recovering, light colored roofs in a hot and humid environment such as Florida's have been shown to significantly reduce energy used for space cooling, in some cases in upwards of 30%. Testing conducted by the Florida Solar Energy Center has revealed that a white ceramic tile or white metal roof performs best. These types of roofs will last 30-40 years compared to the 15 years that is typical of asphalt shingle roofs. White reflective roofs can lower attic temperatures by up to 25-30 degrees F. Many commercial buildings with central AC have ducts in the attic where there is a significant amount of heat gain. The white roof lowers the attic temperature greatly increasing the air distribution efficiency of the HVAC system. The lower attic temperatures can also reduce heat gain encountered by uncontrolled airflow leaking into the conditioned space through a leaky ceiling plane, as previously mentioned in this guide. Along with white metal and ceramic tile, various white coatings and light colored asphalts have shown some lesser improvement over darker colors. More information on "cool roofs" can be found at: <http://www.fsec.ucf.edu/bldg/commercial/nonres/walls-roofs/index.htm>.

Windows and Window Shading

A significant amount of solar heat gain is placed on a commercial building's HVAC system as it enters through the building's



Steven C. Spencer, FSEC

Figure 24. A variety of solar exterior lights undergoing testing at the Florida Solar Energy Center.

windows. If it can be accommodated by a renovation project, installing spectrally selective windows or architectural features to shade existing windows can offer significant cooling energy savings, depending on a number of factors such as the amount of glazing, and the direction it faces. Retrofitting improved windows, shades, or other attributes can represent a costly investment. However, replacing old conventional windows with well-chosen energy-efficient ones can result in significant yearly energy savings, better comfort, and improved occupant satisfaction. This can also increase productivity in commercial or office buildings, which often saves more dollars than the entire energy bill itself. Detailed information on window selection and shading strategies can be found at: <http://www.fsec.ucf.edu/bldg/active/fen/>.

Water

Many common strategies that will reduce water consumption in a commercial building such as water fixture retrofit and exterior landscaping / irrigation considerations are discussed in section 6.0 Identify Opportunities III – Cleaning and Maintenance and Building Water Use of this guide. Such strategies can often be undertaken independent of a renovation project, and any capitol outlay is often well rewarded

through large savings in water and/or sewer charges. In this appendix, waterless urinals are discussed as an opportunity for further savings. Various case studies involving the use of such units have found a need to lower the position of the urinal drain line, making the installation of such a unit more of a renovation project than a simple fixture retrofit.

Waterless Urinals

Waterless urinals have been on the market since 1992, and today there are three companies that offer similar units. All three designs operate by utilizing a lightweight fluid (lighter than urine) that allows urine to flow down through the trap, but keeps gaseous odors from entering the restroom from the sewer. Prices of waterless urinals vary from about the same as conventional urinals, to about twice as much as conventional urinals, but due to zero water use during flushing, savings can be achieved almost immediately.

Manufacturers of waterless urinals state that hygiene is enhanced through use of a waterless unit, due to the fact that bacteria require a moist environment in order to live. The primary source of bacteria in restrooms is that which becomes airborne as toilets are flushed, and settles on close by surfaces. Since waterless urinals are designed to dry out between uses, they do not provide as hospitable of an environment as do conventional urinals and sinks.

Waterless urinals do require periodic maintenance involving a regular cleaning, as well as periodic replenishment of the lightweight fluid (monthly, depending on use) for a nominal fee. A small amount of this fluid is lost with each flush, but has not been determined to pose any environmental impact on wastewater treatment operations. Two of the available units require a trap replacement a few times a year (ranging from \$6 - \$35

per trap) due to sediment build up overtime. The third and most expensive unit does not require trap replacement, but instead a thorough monthly flushing.

Although waterless urinals have their own maintenance considerations, many case studies have found them to be less intensive than maintenance typically carried out on conventional urinals such as valve replacement and dealing with clogged and overflowing units. Waterless urinals have been operating with favorable results in various federal government, local government, school, military, university, and sports arena sectors.

For more information on waterless urinals, contact the manufacturers or read reviews in Environmental Business News.

Waterless Company – www.waterless.com
Reviewed in Environmental Building News
Vol. 7, No. 2, February 1998.
www.buildinggreen.com/products/waterless.cfm

Falcon Waterfree Technologies –
www.falconwaterfree.com
Reviewed in Environmental Building News
Vol. 11, No. 2, February 2002.
www.buildinggreen.com/products/falcon.cfm

Duravit USA, Inc. – www.duravit.com
Reviewed in Environmental Building News
Vol. 12, No. 2, February 2003.
www.buildinggreen.com/products/mcdry.cfm

Appendix B: Cleaning Product Considerations

For information regarding selection and procurement of general purpose cleaners, bathroom cleaners, and glass cleaners, please refer to Green Seal's Standard for Industrial and Institutional Cleaners (GS-37) available at: www.greenseal.org/standards/industrialcleaners.htm.

General Purpose Cleaners

General purpose cleaners include, among other things, products used for routine cleaning of hard surfaces including impervious flooring such as concrete or tile. It does not include cleaners intended primarily for removal of rust, mineral deposits, or odors. It does not include products intended primarily to strip, polish, or wax floors, and it does not include cleaners intended primarily for cleaning toilet bowls, dishes, laundry, glass, carpets, upholstery, wood, or polished surfaces. This category also does not include sterilizers, disinfectants, or sanitizers or other products required to be registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Bathroom Cleaners

Bathroom cleaners include products used to clean hard surfaces in a bathroom such as counters, walls, floors, fixtures, basins, tubs, and tile. It includes products that are required to be registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), such as disinfectants and sanitizers, but does not include products specifically intended to clean toilet bowls.

Glass Cleaners

Glass cleaners include products used to clean windows, glass, and polished surfaces. This category does not include any products required to be registered under FIFRA.

The following list of cleaning product considerations has been adapted from the Pennsylvania Green Building Operations and Maintenance Manual. The list is not intended to be complete, but presents some typical issues for the majority of cleaning products used within commercial buildings that are not covered by the Green Seal Standard GS-37.

Carpet Cleaner

See General Purpose Cleaners. In addition, select carpet cleaners that when dry are not sticky or tacky. This minimizes resoiling and extends the time between cleaning.

Chrome Cleaner/Polish

Chrome cleaner/polish frequently uses petroleum distillates, which are poisonous and derived from a non-renewable resource. The following are some of the specific issues to compare for this product category:

- VOCs: Prefer those that have no or low VOCs as compared to alternatives with higher levels.
- Bio-Based/Renewable Resources: Prefer products that use oils derived from renewable resources as compared to oils from non-renewable resources.
- More Preferable Ingredients: none identified

Floor Finishes

Floor finishes must be durable and appropriate for the prescribed maintenance method, but they typically contain heavy metals. Importantly, floor finishes must be compatible with the stripping solution. The following are some of the specific issues to compare for this product category:

- **Durability:** Prefer finishes that are more durable (require less maintenance such as buffing, restoring, and recoating) than less durable finishes that require more frequent maintenance.
- **Heavy Metals:** Prefer non-metal cross-linked polymers as compared to those containing heavy metals. Another significant benefit of non-metal polymer formulas is that frequently they can be removed with less hazardous floor strippers.
- **More Preferable Ingredients:** metal-free polymers.

Floor Strippers

Floor strippers typically have extreme pH, solvents, and ammoniated compounds necessary to remove metal cross-linked floor finishes. Floor strippers must be compatible with the floor finish. The following are some specific issues to compare for this product category:

- **pH:** Prefer those with a pH closer to neutral (in the range of 10 to 12) as compared to those with extreme pH (closer to 14).
- **VOCs:** Prefer those that have no or low VOC as compared to alternatives with higher levels.
- **Bio-Based / Renewable Resources:** Prefer those containing naturally derived solvents as compared to those containing non-renewable derived solvents.
- **More Preferable Ingredients:** d-Limonene (citrus solvent) and methyl esters.

Furniture Polish

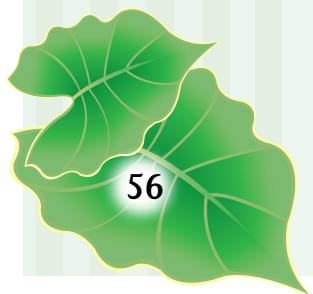
Furniture polishes frequently use petroleum distillates, which are poisonous and derived from a non-renewable resource. The following are some of the specific issues to compare for this product category:

- **VOCs:** Prefer those that have no or low VOCs as compared to alternatives with higher levels.
- **Bio-Based/Renewable Resources:** Prefer those that use oils derived from renewable resources as compared to oils from non-renewable sources.
- **More Preferable Ingredients:** citrus (lemon and orange oils)

General Degreaser

General degreasers are typically heavy-duty cleaners that include solvents for removing oil-based soils. Traditional solvents are typically derived from a non-renewable source such as petroleum, can be flammable, have a high degree of VOCs which can cause respiratory irritation and contribute to environmental pollution, and some have severe health impacts. The following are some of the specific issues to compare for this product category:

- See General Purpose cleaners
- **VOCs:** Prefer those that have no or low VOCs as compared to alternatives with higher levels.
- **Bio-Based / Renewable Resources:** Prefer those that use oils derived from renewable resources as compared to oils from non-renewable resources.
- **Flashpoint:** Prefer products that have a high flashpoint compared to those with a low flashpoint.



- More Preferable Ingredients: d-Limonene (derived from citrus fruits) and methyl esters from soy and corn.

Graffiti Remover

Graffiti remover used to be formulated with chlorinated solvents such as methylene chloride before they were banned due to their environmental impact. Many graffiti removers are packaged in aerosol containers which often contain hydrocarbon propellants such as propane or butane, which are highly flammable and can contribute to indoor air quality problems. The following are some of the specific issues to compare for this product category:

- VOCs: Prefer those that have no or low VOCs as compared to alternatives with higher levels. Consider detergent based products compared to those containing solvents.
- Flashpoint: Prefer products that have a high flashpoint compared to those with a low flashpoint.
- pH: Prefer those with a neutral pH (closer to 7) as compared to those with extreme pH (closer to 1 or 14).
- More Preferable Ingredients: n-Methyl-2-Pyrrolidone, d-Limonene.

Gum Remover

Gum removers used to be formulated with chlorinated solvents such as Freon before they were banned due to their environmental impact. Dry ice and carbon dioxide are preferable replacements. Degreasers can be used in some situations (see General Degreasers). The following are some of the specific issues to compare for this product category:

- VOCs: Prefer those that have no or low VOCs as compared to alternatives with higher levels. Consider detergent based products compared to those containing solvents.

- Flashpoint: Prefer products that have a high flashpoint compared to those with a low flashpoint.

- pH: Prefer those with a neutral pH (closer to 7) as compared to those with extreme pH (closer to 1 or 14).

- More Preferable Ingredients: dry ice, carbon dioxide.

Lime & Scale Remover

Lime & scale removers are acids because of the need to remove mineral deposits from sinks, bowls, and urinals. The following are some of the specific issues to compare for this product category:

- pH: Prefer those with a more neutral pH as compared to those with extreme pH (closer to 1). Environmentally preferable lime and scale removers may fall more in the range of pH 4 as compared to traditional products that may have a pH below 1.

- More Preferable Ingredients: citric or acetic acid.

Solvent Spot Removers

Solvent spot removers are necessary for spot removal particularly on carpets. Use detergent base spotters if possible, which must be followed with extraction or other method to remove/absorb the detergent. The following are some of the specific issues to compare for this product category:



- See General-Purpose Cleaners.
- VOCs: Prefer products that have no or low VOCs compared to those with higher VOCs content.
- Flashpoint: Prefer products that have a high flashpoint compared to those with a low flashpoint.
- More Preferable Ingredients: d-Limonene (derived from citrus fruits) and methyl esters from soy and corn.

Urinal Deodorizers

Urinal deodorizers are traditionally blocks placed in urinals to reduce odors. Preferably these deodorizers should be eliminated altogether through more frequent cleaning and other methods of deodorizing. However, if urinal deodorizers are still required preference should be given to those with the safest ingredients. The following are some of the specific issues to compare for this product category:

- Biodegradability: Prefer ingredients that are readily biodegradable as compared to those that are slower to degrade. Unfortunately, many older formulations use excellent performing ingredients that have been found to have serious environmental and health concerns.
- More Preferable Ingredients: surfactants containing terms such as lauryl, amides, and glycosides.

Wood & Stone Floor Coatings

Wood & stone floor coatings have traditionally been solvent-based products. While extremely durable to protect flooring materials that are very expensive to replace, these coatings can be quite hazardous during the drying and curing period. The two primary issues to consider during product selection include the use of zero or low-VOC containing materials which will reduce indoor air quality concerns and the product's durability which is important to protect the flooring. Many janitorial firms lack specific expertise in application for these types of finishes, thus supplier support, such as training, is very important. The following are some of the specific issues to compare for this product category:

- Durability: Prefer durable finishes that require less maintenance and recoating than less durable finishes that require more frequent recoating.
- Flashpoint: Prefer products that have a high flashpoint compared to those with a low flashpoint.
- More Preferable Ingredients: water or epoxy based finishes.

