State Government Buildings: Meeting the ENERGY STAR® Challenge

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ABSTRACT

Public organizations such as state government have a challenge and an opportunity in managing large and diverse building portfolios. This paper will present information on energy saving initiatives in Wisconsin state agencies over the past several decades.

Efforts include large-scale performance contracting, internally funded retrofit projects, and maintenance-level changes. Other efforts include improvement of the state's purchasing policies, building design guidelines, and equipment specifications. Most discussion will focus on low cost approaches that worked in Wisconsin and are widely transferable to other commercial building fleets. A case study will be presented of one agency's energy saving campaign that saved 5% in one year, primarily through lighting controls and other low cost measures.

Wisconsin state government has recently signed on to the ENERGY STAR Challenge, EPA's challenge to commercial building owners to reduce energy use by 10%. The ENERGY STAR Challenge provides a useful roadmap to see Wisconsin's recent past and future efforts.

Introduction

Wisconsin has a large and diverse building fleet that presents a challenge for saving energy. Energy expenses for these buildings were $128 million last year. This cost has doubled in the last ten years, although square footage has increased only 13%. The state owns nearly 80 million square feet of building space, builds an additional million square feet, and retrofits about two million square feet per year. In addition, the state leases approximately three million square feet of space. Wisconsin's state buildings include its capitol, office buildings, state university facilities, parks and recreational facilities, and custodial facilities such as prisons, veterans' homes, and schools for the blind and deaf. (WDOA 2006)

The paper reviews the achievements of the last thirty years and emphasizes recent energy saving activities. Using the framework of the ENERGY STAR Challenge, this paper describes some of the energy activities the state has implemented. The ENERGY STAR Challenge calls on businesses and institutions to reduce energy use by 10% or more through three important actions:

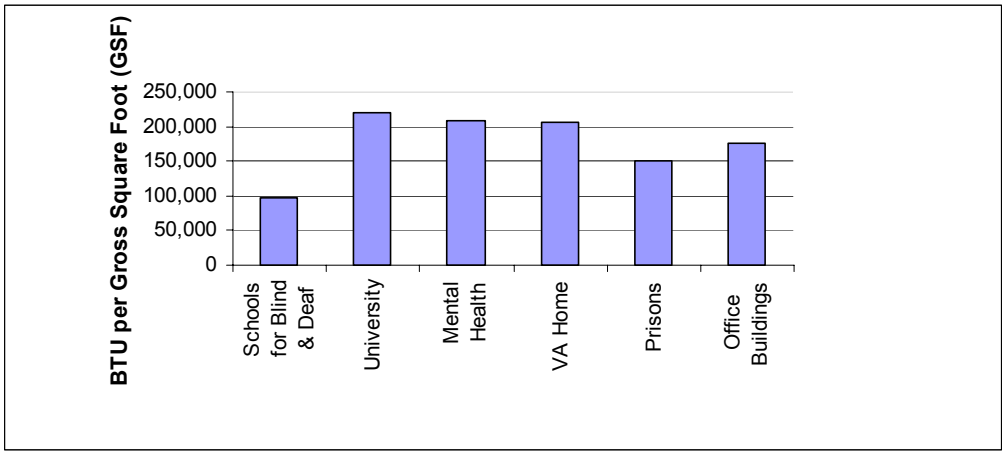
1. Determine how much energy buildings are using,
2. Establish efficiency improvements goals, and
3. Make improvements.

Determining State Buildings' Energy Use

Wisconsin began to track energy use in state facilities in 1972-73, particularly in the largest buildings that account for 75% of the state's total gross square footage (GSF). The diversity of agencies' energy use intensity is illustrated in Figure 1. Building types tend to cluster by agency. The University of Wisconsin buildings are the most energy intensive. Because of

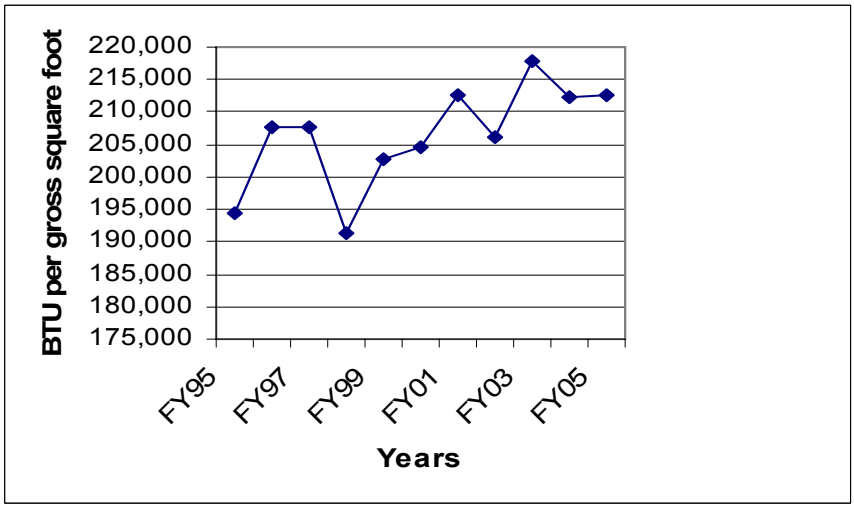
their large square footage, University of Wisconsin buildings also account for 75% of the energy consumed. Other state agencies account for the other 25% of consumption.

Figure 1. Energy Intensity in State Buildings, FY05



Source: WDOA 2006,44

Figure 2: Recent Trend in Energy Intensity in State Buildings



Source: WDOA 2006, 4

State buildings averaged 247,694 Btu/gross square foot when the state first started tracking its use in FY73. Through early energy saving initiatives, energy intensity dropped 26% to its lowest level in FY83. However, since then energy intensity has generally grown. For example, in the last ten years, energy intensity has grown over 9%, to 212,708 Btu/gross square foot in FY2005 (Figure 2). Several developments have tended to increase building energy intensity since the nadir of the early 1980's, including: increased building ventilation rates in response to concerns about indoor air quality, the introduction of personal computers, new energy-intensive University laboratories, and other factors. Continuing growth in square footage, weather variation, and changing equipment mixes in buildings contributes to dynamic trends in energy use.

One challenge in determining energy use is that many of the state's large campuses operate with few electric, gas, or steam meters. To improve energy analysis at a building level, the state is launching an effort to install more building meters. Also, equipment sub-metering is planned in select cases. The state is also in the process of installing internet-based energy tracking software to allow real-time energy use tracking from a central location. This metering and tracking will also assist with measurement and verification for energy saving projects, recommissioning, and identifying additional energy saving projects. These tools will also help in analyzing the interactive effects of reduced heat load and HVAC requirements.

Establishing Energy Saving Goals

Executive orders and legislation specify energy saving goals for state buildings. Wisconsin governors have issued several executive orders on this subject since the 1990s. Most recently in April 2006, the Governor issued Executive Order 145, requiring:

1. State agencies to set energy use per square foot reduction goals, to attain at least 10% improvement by FY08 and 20% improvement by FY10, from a FY05 weather-adjusted baseline[1].
2. New state facilities to be built 30% more energy efficient than code.
3. To develop sustainable building operation guidelines for owned and leased properties, based on LEED and other comparable guidelines. To issue an annual performance report on implementation of these guidelines.
4. New construction practices including use of energy modeling, Advanced Building Guidelines for buildings up to 80,000 square feet, commissioning and retrocommissioning, and ASHRAE 62.1-2004 for ventilation.
5. Renewables and alternative heating and cooling demonstrations at the Capitol, Executive Residence and other state facilities (WEO 2006).

The goals of this Executive Order are in line with the aims of the ENERGY STAR Challenge. Also in April 2006, the Wisconsin legislature passed Act 141 that requires state facilities to develop annual energy cost reduction plans, create standards for state building projects and equipment purchases, and review building code on a three year cycle rather than every five years.[2] (WLC 2005).

The executive orders and legislation are useful for providing the authority for state facility managers to prioritize energy retrofit projects. In addition, these directives illustrate the public attention garnered by energy consumption in state facilities. The energy management practices of state government are a subject of public scrutiny, and that makes state buildings ideal demonstration sites for best practices for the larger commercial building market.

[1] State fiscal year (FY) is July 1 through June 30th.

[2] Act 141 also establishes a renewable standard for state government facilities of 20% by 2011 for the six largest agencies.

Making Improvements - Financing

Performance Contracting

After the oil embargo years of the mid 1970s, Wisconsin state government began to systematically identify and implement energy efficiency improvement projects. In 1992, the state instituted the Wisconsin Energy Initiative (WEI), a performance contracting program, to more comprehensively address energy saving opportunities. This program's goal was to reduce energy use in state buildings by 15%. Audits and studies of energy use in state facilities were initiated under a performance contractor that also implemented the improvements. These projects were financed with state bonding. After bonding authority was exhausted, performance contractors provided project financing, with energy savings repaying the contractor investments. By the end of 2005, 56 projects were completed at 39 facilities, campuses and institutions. Contracts provided a long period, in the ten to fifteen year range, over which to realize and verify energy savings and generate cost savings.

In the WEI program, lighting was installed first because it was the easiest measure to implement. The state's large volume purchasing of electronic ballasts is believed to have helped reduce the cost of these ballasts for all Wisconsin buyers in the early and mid-1990's. The state re-lamped buildings, typically, one campus or large facility at a time. After some initial problems with electronic ballasts, this wholesale approach changed most lighting in state facilities. In this first phase, WEI installed over 700,000 fluorescent T-8 lamps, 350,000 ballasts, and tens of thousands of exit signs and compact fluorescent bulbs.

In 1998, the state launched a second phase of WEI to focus on upgrading HVAC and other mechanical equipment and water-saving devices. These improvements included lighting occupancy sensors, steam traps and air handling and distribution systems. This second phase was more difficult and time-consuming than the first phase. An example of achievement in the second phase included UW-Madison's installation of 2,000 premium-efficiency motors (meeting National Electrical Manufacturers Association [NEMA] guidelines), more than 8,500 occupancy sensors, and replacement of 3,000 toilets with water saving, ultra-low flow models.

Technology Evolution. WEI has seen technologies evolve over its many years. For example, exit signs were widely installed in the initial phase. The program replaced 20 and 40 incandescent watts with 7 and 15 total CFL watts. During the second phase, exit sign retrofits upgraded to ENERGY STAR LED signs of 5 watts. Now the state is installing 0.86 watt LED exit signs. This technology has evolved such that the current installations use about 2.5% of the energy used 15 years ago.

In another example, during the first phase, the state changed troffers from four tube T-12 fluorescent tubes with standard wire wound ballasts (200 watts per troffer) to three T-8 tubes with electronic ballasts (88 watts per troffer). Currently there is a plan to replace three tubes (60 lumens per watt) with two high performance tubes (90 lumens per watt), to achieve 57 watts per troffer. The technology has improved troffer consumption from 200 watts to 57 watts.

In spite of the achievements of WEI, many opportunities remain, even among the technologies targeted by this program. For example, numerous old exit signs and incandescent bulbs operate in state facilities.

Capital Budgets

Many retrofits are underwritten with the capital budget rather than WEI funding. Including both new construction and retrofit projects, Wisconsin state government's capital budget is $1 billion over the biennium. Large construction or retrofit projects ("enumerated" projects) in the capital budget can include energy efficient technology, though conservation is not the main purpose of these projects. The rest of the capital budget is set aside for non-enumerated projects and falls under the "all agency funding" heading. This would be a logical place to fund energy efficiency projects, but very little of this funding is earmarked for projects whose main goal is energy conservation. Earmark categories for this funding include: maintenance and repair, health and safety, and hazardous waste. Agencies usually find these earmark categories a higher priority than energy conservation. Funds are constrained: for all categories, agency requests for funds are generally 50-100% greater than the funds available. Furthermore, increasing capital budgets by pledging future energy savings for capitalizing future projects is infeasible, because capital budgets are separated from operating budgets. Another barrier to proposing and implementing projects specifically for saving energy is decreasing staff assigned to facilities management. Staff do not have the time and energy available for energy saving projects, because their top priorities are keeping the buildings operating.

Making Improvements - Policy Change for Long Term Energy Saving

Sustainable Facilities Guidelines

The state's Division of State Facilities has outlined a goal of establishing a Sustainable Facilities Guideline. This "green building" guideline will incorporate energy and environmental best practices into the design and construction of each building project. It is expected to be based on the US Green Building Council's LEED system, and is scheduled for initial adoption during 2006. The Sustainable Facilities Guide will be subject to ongoing review with scheduled annual updates. The guideline is envisioned to be an umbrella for new as well as existing policies related to building design. The state's Master Design Guidelines for architects will be included as a module of the Sustainable Facilities Guide. One unique element of Wisconsin's Master Design Guidelines is its Daylighting Guideline (WDOA 2003).

Master Specifications

Sustainable Facilities guidelines and Master Design Guidelines need translation to the practitioner level. For the construction of new facilities or the retrofit of existing facilities, the the state maintains a set of Master Specifications related to energy (Master Specifications 2006). These lay out specific requirements for equipment, installation and operational characteristics. All architects and engineers who do projects for the state must know and follow the state's Master Design Guidelines and Master Specifications. Most architects and engineering firms in the state do have some role on state government building projects. Hence, the state's guidelines and specifications are very influential throughout the A&E community. Many firms find it expedient to incorporate the state's guidelines into their standard practices for all of their projects.

The Division of Energy has worked with its sister Division, the Division of State Facilities (DSF), to incorporate ENERGY STAR and other nationally recognized efficiency guidelines into the state's Master Specifications. Energy efficiency guidelines from these organizations have proved the most helpful: NEMA (National Electrical Manufacturers Association), CEE (Consortium for Energy Efficiency), NBI (New Buildings Institute), FEMP (DOE's Federal Energy Management Program), FSTC (Food Service Technology Center, and the US Green Building Council's LEED (Leadership in Energy and Environmental Design).

Many of these organizations regularly review and upgrade their specifications. ENERGY STAR in particular does this. ENERGY STAR has a goal that approximately twenty percent of market share be units that qualify and that there must be more than two qualifying brands. This assures competitive bidding for price and quality while encouraging more suppliers. As market share increases beyond fifty percent, ENERGY STAR upgrades the energy efficiency specification. ENERGY STAR has also become a mark of quality for some products.

Examples from the Master Specifications include the ENERGY STAR requirement for transformers since the mid-1990s, and the requirement for NEMA Premium motors since the late 1990s. This includes a requirement that new motorized equipment (such as packaged air conditioners) must have NEMA premium motors included. The review of new specifications is continuous. Several changes to the Master Specifications are currently under review:

High performance lighting. The CEE guideline for high performance T-8 lighting is scheduled for inclusion into the Master Specifications in 2006. This guideline will increase light output from 60 lumens per watt to 90 lumens per watt. With this guideline in place, each fixture is expected to have a longer lifetime, reducing maintenance costs and lifetime costs.

Commercial HVAC. The recent Energy Policy Act of 2005 (EPACT 2005) included energy efficiency specifications for several types of large commercial equipment, including commercial HVAC equipment. These federal minimum efficiency standards do not go into effect until later in this decade. However, Wisconsin may adopt these standards sooner by incorporating them into the state's Master Specifications.

Green buildings. Over the past few years, the state's Division of State Facilities (DSF), which oversees all state building projects, has been active in incorporating elements of the US Green Building Council's LEED certification into new projects, and adopting some LEED documentation processes into the state process. There is an intense effort to get more LEED-certified design engineers and architects who can do business with the State. Act 141, passed in April 2006, will move the state toward greater participation in LEED (WCL 2005). The costs of meeting high ventilation requirements are considered an obstacle to meeting LEED standards by some observers. Part of the exploration of green buildings has included several demonstration projects. One demonstration project is UW Green Bay's Mary Ann Cofrin Hall, which includes extensive daylighting, and three types of solar technologies. In addition, the state has built a new office building for the Department of Natural Resources that is LEED-certified.

Opportunities in State Leased Property

Energy savings potential is present in leased facilities. The State of Wisconsin leases nearly 10 million square feet of office space, mostly for a simple financial arrangement similar to

flat dollar rate per square footage (light and heat included in the rent). The state tenant does not currently have an incentive to save energy, nor the authority to install energy-saving equipment into the building. However, this is an area with good potential for change.

New leases are often negotiated with requirements that the space be modified to meet the needs of the tenant agency. These may include lighting, security, food service, HVAC and other items. Because the equipment is owned by the lessor, the state has no say over it. The Division of Energy is working with the DSF to incorporate benchmark energy usage or ENERGY STAR criteria into various lease agreements as leases are renegotiated for renewal.

Purchasing Policy and Controlling Plug Loads

The State of Wisconsin continues to improve its equipment purchasing policies including requiring ENERGY STAR wherever possible (Harris et al. 2004). For example, the state requires ENERGY STAR for purchase of all office equipment and personal computers and monitors. Recent changes to the ENERGY STAR level for monitors to incorporate annual energy usage has led to a move toward the use of liquid crystal displays (LCD) units rather than the more energy intensive CRT units. ENERGY STAR Tier II will help complete this change.

University housing purchases appliances such as refrigerators, clothes washers, room air conditioners, and boilers. With assistance from the Division of Energy, the agency's purchasing staff has revised bid specifications to include ENERGY STAR requirements. In some instances it was questioned whether suitable ENERGY STAR models were available. In every case, one was found. The University has also begun to use modulating condensing boilers in some of its housing.

Using purchasing policies to require ENERGY STAR for electronics is a big step toward reducing plug loads. Education also works together with good purchasing policies. Providing energy education and behavior change campaigns for building occupants is an untapped potential in most Wisconsin state buildings. Building occupants can be encouraged to turn off or unplug equipment when not in use, such as coffee makers, microwaves, mini-refrigerators, radios, task lighting, TV/VCR/DVDs, popcorn poppers, fans, humidifiers, air cleaners, and battery or cell phone chargers. Replacing halogen torchieres with ENERGY STAR lighting can be a unified message put out in coordination with fire officials.

In office buildings, it has been helpful to periodically survey the time-out settings of office equipment to keep them from being on for extended periods when not in use. New occupancy-sensor power strips and other controls are becoming available that automate this. Many PCs are left on continuously. New PC network control software programs such as Verdiem® are being considered for installation in appropriate network locations to manage the ENERGY STAR sleep mode that operates PCs and monitors at about 1 watt each when not actively in use. Alternatively, the energy used by PC units can be reduced in a no-cost way by employee use of the built-in standby or sleep modes.

Policies to Address Food Service and Vending Machines

Most food service in state office buildings is contracted through the Wisconsin Council for the Blind. Cafeterias in state office buildings, vending machines, and roadside rest areas are operated through this central source. This simplifies addressing installation of ENERGY STAR appliances/products for state food service. Efforts also are underway with the Council for the

Blind to incorporate ENERGY STAR vending machines and controllers into their ongoing programs.

The University of Wisconsin (UW) does not participate in this program, but has a large number of vending machines. Because of this, UW has leverage when negotiating with bottling companies about implementing energy saving measures. Bottlers are more willing to meet higher standards when dealing with a larger customer. Vending machines are a challenge as bottlers and vendors supply the machines, while the host facility pays the utilities, creating split incentives. Bottlers may see these machines as advertising, and have little motivation to turn off the lighting. All vending machines on UW campuses are controlled through a central purchasing agent who handles agreements with bottlers. Requirements for vending machine controllers or ENERGY STAR are being incorporated in bid specifications as agreements are re-bid over the coming five years. A recent move by vending machine companies to convert vending machines to more efficient lighting such as T-8 or LED may provide more efficient vending machines. Several models have been installed with no lights in locations where all of the machines were changed at the same time so there is no differentiation between lit and unlit machines.

Policies to Purchase Renewable Energy Service

The state has contracted for solar thermal energy for university pools in a novel project. The state signed a contract with a private company that agreed to purchase, install and maintain rooftop solar water heaters at five university pools. In return, the state agreed to purchase the heat at a floating price per therm, indexed to the current natural gas price (a fixed amount below that price). This innovative method has allowed the universities to reduce their use of natural gas.

Making Improvements – Technology Building Blocks

High Performance T-8 Pilots

The Division of State Facilities (DSF) has undertaken a pilot project related to the new lighting standard. The state is planning to adopt the CEE guideline for high performance T-8 lighting as a specification for all state buildings. DSF has installed the high performance T-8 lighting in one building (10 floors). This particular pilot also used spectrally enhanced 5000K color temperature versions of the lighting. In addition, some de-lamping was done at the same time, so that three-tube troffers were replaced with two tubes. Building occupants have accepted the lighting change. The few complaints stemmed from the perception that the new lighting was too bright. The offending troffers were further de-lamped. DSF's parent agency, the Department of Administration (DOA) is planning to expand this effort to all its buildings, though not necessarily using the spectrally enhanced option.

The pilot was useful. Using their staff engineers, DSF metered the savings of the T-8 retrofit at 35%. They also obtained vendor quotes showing a 6 year simple payback, which drops to just 2.5 years if only the lamps are changed (not the ballasts). Furthermore, DSF used the experience to quantify the time and labor costs involved for this project, using staff electricians. Since the market for CEE-qualifying high performance T-8 lighting in Wisconsin is embryonic, it is anticipated that the state's new specification will create some important demand and momentum in the market. Anticipating this, the engineers at DSF have organized a workshop to introduce the high performance T-8 lighting to all private sector architects, engineers and

lighting designers who work with the state. Since state government is the owner of the largest amount of square footage in the state, this movement to high performance T-8 lighting is expected to impact the market noticeably.

CFL Demonstrations

Pilot efforts described earlier indicate that there is potential for more lighting efficiency in state facilities. CFLs in particular are an opportunity, even in the commercial buildings that predominate in the state government portfolio (Mapp, Smith & Reed 2005). Significant savings opportunities are present because incandescent bulbs are still used widely for common area lighting, as well as in dorm rooms, and prison cells. Wisconsin's capitol and other state office buildings have installed a number of CFL bulbs in various test locations as a demonstration of the benefits of energy efficient CFL lighting. More than 80% savings in wattage is typical.

For example, in one state office building vestibule and reception area, where lights are on 24/7 for security reasons, 75-watt elliptical reflector incandescent floods were replaced with 16-watt ENERGY STAR CFLs. Typical lifetime of the incandescent bulbs was two to three months compared to 8,000 hours for the CFLs. There is negligible difference between the commodity cost of a long-life (2,000 hour) 75-watt incandescent being used previously and an 8,000 hour 16-watt CFL. The simple payback is immediate, and the annual savings are 517 kWh. At a typical commercial electric rate in 2005 of 7.5 cents per kWh, this will save $39. There will be reduced maintenance time for replacing burned out bulbs and lower inventory carrying costs. In this area, there were 50 interior lamps on 24 hours per day and 20 exterior lamps on 12 hours per day. This is the equivalent of 60 lamps operating 8,760 hours per year saving 59 watts each. For 60 equivalent units the savings is 31,000 kWh or about $2,325 per year.

Notice that replacing each 75 watt incandescent saves the same wattage as two high performance troffers (88-57 watts/troffer) and saves the same energy as four high performance troffers at 4,000 hour annual usage. Making the decision to change one incandescent to a CFL is often much easier, administratively, than making a decision to change a troffer. It is important to keep CFLs in mind as easy savings opportunities.

Reducing energy used by the lights also reduces the need for air conditioning. Replacing a 100 watt incandescent bulb with a 25-watt CFL saves 75 watts of lighting energy, but also saves 25 watts of air conditioning load. So this one change has saved the entire 100 watts of the incandescent bulb. In a sense, the lighting is now *free*. This change saves the entire 100 watts during the times when air conditioning is in use. This is nearly all year in state office buildings because of high internal gains. Also note that lighting in government buildings is virtually always on at during peak demand times, so savings help reduce peak load.

Scotopic Lighting Demonstrations

Wisconsin is experimenting with higher color temperature or spectrally enhanced lighting in state facilities. The goal is to investigate the effectiveness of the use of higher color temperature lighting during times or in locations where the blue-light-sensitive rods of the eye are more critical to visibility. This includes low light conditions, such as in dim corridors and nighttime exterior lighting, and general illumination of interior offices. Several demonstration sites indicate that under high-temperature (bluer) lighting, room occupants find documents clear enough that it is possible to go from three or four to one tube per fixture or two tubes with dual

light switching. In a demonstration office, four-lamp troffers were reduced to three-lamps. Troffer placement directly over work spaces further reduced the number of troffers needed in many offices, by one quarter. The goal is to move to less than 1 watt of installed lighting per square foot, in order to reach the 0.6 watts per square foot Lighting Power Density levels outlined in EPACT 2005.

In a pilot installation in the dimly lit entry hallway of a historic state office building, decorative 100-watt incandescent lamps were initially replaced with 27-watt CFLs with a temperature of 2700-degrees Kelvin. The lighting was inadequate with both the original and replacement lamps to illuminate the beautiful WPA (Works Progress Administration) ceiling decorative accents. The initial CFLs installed were pin-based, magnetic ballasted lamps. The illumination levels were considered too low. Next, 3500-degree, 20-watt CFLs and 4100 degree CFLs of 27 and 20 watts were tried. The bluer/whiter light from the 4100 degree lamps was considered best. An informal survey of occupants found no difference in brightness between the 27- and 20-watt CFLs, so the 20-watt CFLs were installed. Occupants have remarked how much brighter the corridor is since the change and noted that they did not realize there were decorative elements on the ceiling. These lamps are lit approximately 12 hours every day.

Another demonstration project focused on outdoor lighting at the capitol. This area included 196 100-watt incandescent lamps inside decorative globes on pedestals by each door. These are lit approximately 12 hours every day, at night. They also serve as security lighting. As replacements, 7-watt CFLs of 4100-degree Kelvin were installed. The CFLs were found to be indistinguishable from the 100-watt incandescent bulbs. The substantial energy savings was feasible because there is a property of the eye to be more sensitive to lower light levels using the rods and activated by light in the blue part of the spectrum.

Case Study: Agency Saves 5% in One Year with Low Cost Measures

One recent effort by an agency demonstrated low cost approaches to save energy. Wisconsin's Department of Administration (DOA) directly manages about 30 buildings. In 2004 DOA initiated an effort to reduce the energy use in these buildings. With a goal of saving five percent over the year, the team met the goal primarily by installing low-cost measures.

Major savings came from reducing the hours of operation of the air handling systems. The start time for daytime operation mode was postponed from 5 am to 6am, and the end time was moved from 6 pm to 4pm. Drift kept the buildings cool enough until 6 pm. During the winter, the high internal gains - heat from people and equipment - kept the building warm. Previously, the air conditioning had operated some weekends because of one floor's seasonal weekend workers.

DOA also implemented some simple lighting changes. DOA put its internal resources to use to demonstrate technologies in its home building before disseminating them to its other 29 buildings where it acts as landlord to other agencies. The DOA main building houses the Division of State Facilities (DSF), with electrical and mechanical engineers who oversee building operation throughout the state. Using these internal resources, the agency installed technologies that were considered too different or risky in the past. The 5% energy reduction goal gave well-placed internal champions the support to pursue efforts that had been long contemplated.

For example, all Exit signs were replaced with ENERGY STAR LED models. Buildings such as the DOA main building (ca 1996) were too young to have been touched by the WEI

program, but still had potential to improve its exit signs, which this effort tapped. The Capitol's exit signs had not been changed before. By trying six different retrofit kits, several were identified that were acceptable for this historical building. Another measure implemented was installing occupancy sensors for lighting emergency exit stairwells. Starting with one fixture, and expanding to a whole stairwell, this pilot put half the lighting on occupancy sensors. Given its success, this pilot will be expanded to stairwells in all 30 DOA buildings. Another effort replaced continuous high pressure sodium lighting in the underground parking area with fluorescent lighting with motion sensors. After an initial adjustment, building occupants have found the change acceptable.

Conclusions

Wisconsin's experiences illustrate how state government facilities can take a leadership role in implementing energy efficiency and light the way for other commercial building managers. Recently, Wisconsin pledged to participate in the ENERGY STAR Challenge, using the steps outlined in this program to save 10% on their energy use. The ENERGY STAR Challenge provides a useful framework in which to view recent past and potential future efforts.

Wisconsin has leveraged the size of state government to make energy retrofit projects more feasible. Since the state purchases a great deal of products and material, it can bargain for lower prices for equipment, such as ballasts or high performance T-8 lighting. State government can also insist on longer warranty periods. Governments can insist their vendors attempt innovative energy practices, such as buying and placing ENERGY STAR vending machines. When a technology works well, state government can also immediately adopt this technology across a broad range of building types. State government has an advantage in its access to professional engineers on staff. This means there is more monitoring of effectiveness and reliability of energy efficient equipment than may be the case in smaller private facilities.

Since public institutions are subject to greater scrutiny, government buildings are a particularly visible platform for touting better energy practices. Governments can also obtain important public support by communicating their achievements in energy saving. Pressure to show that government is wisely spending public funds during a time of rising energy prices also makes energy efficiency efforts good public relations for state governments, as well as an environmentally responsible choice.

References

[ASHRAE] American Society of Heating, Refrigerating, and Air-Conditioning Engineers. www.ashrae.org

[CEE] Consortium for Energy Efficiency. www.cee1.org

Energy Star. www.energystar.gov

[FEMP] Federal Energy Management Program. www.eere.energy.gov/femp

[FSTC] Food Service Technology Center. www.fishnick.org

Harris, J., M. Brown, J. Deakin, S. Jurovics, A. Khan, E. Wisniewski, J. Mapp, B. Smith, M. Podeszwa, and A. Thomas. 2004. "Energy Efficient Purchasing by State and Local Government: Triggering a Landslide down the Slippery Slope to Market Transformation." In *Breaking Out of the Box: Proceedings of the 2004 American Council for an Energy Efficient Economy Summer Study on Energy Efficiency in Buildings,* 6:190-205. Washington, D.C.: American Council for an Energy-Efficient Economy.

Mapp, J., B. Smith, and J. Reed. 2005. "The Untapped Resource: CFLs in the Commercial Sector." In *Reducing Uncertainty through Evaluation: 2005 International Energy Program Evaluation Conference*, 873-884. Madison, Wisconsin: International Energy Program Evaluation Conference.

[NBI] New Buildings Institute. www.newbuildings.org

[NEMA] National Electrical Manufacturer's Association. www.nema.org

[WDOA] Wisconsin Department of Administration. 2003. Daylighting Standards for State Facilities. Available online: www.doa.state.wi.us/dsf/masterspec_view_new.asp?catid=21. Madison, Wisconsin: Wisconsin Department of Administration, Division of State Facilities.

[WDOA] Wisconsin Department of Administration. 2006a. *Energy Use in State-Owned Facilities Fiscal Year 2005.* Madison, Wisconsin. Available online: www.doa.state.wi.us/docs_view2.asp?docid=990. Madison, Wisconsin: Wisconsin Department of Administration, Division of State Facilities.

[WDOA] Wisconsin Department of Administration. 2006b. Master Specifications / Design Guidelines. Available online: www.doa.state.wi.us/dsf/mastspec_new.asp. Madison, Wisconsin: Wisconsin Department of Administration, Division of State Facilities.

[WEO] Wisconsin Executive Order 145. 2006. *Relating to Conserve Wisconsin and the Creation of High Performance Green Building Standards and Energy Conservation for State Facilities and Operations.*

[WLC] Wisconsin Legislative Council. 2005. *Wisconsin Legislative Council Act Memo: 2005 Wisconsin Act 141.* Available online: www.legis.state.wi..us/lc. Madison, Wisconsin: Wisconsin Legislative Council.

University of Wisconsin-Green Bay, Mary Ann Cofrin Hall. www.buildingsolar.com

[USGBC] United States Green Building Council. www.usgbc.org