Low- and No-Cost Sustainable Design Solutions for Existing Wisconsin Government Facilities

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Table of Contents

Figures

Tables

Foreword

This report presents a set of criteria for evaluating the environmental impact of government buildings and applies this analysis to one particular building which houses the Wisconsin Department of Revenue. The report is the product of a collaboration between the Robert M. La Follette School of Public Affairs at the University of Wisconsin–Madison and the State Building Commission of the Wisconsin Department of Administration. Our objective is to provide graduate students at La Follette the opportunity to improve their policy analysis skills while contributing to the capacity of the state government to effectively provide public services to the citizens of Wisconsin.

The La Follette School offers a two-year graduate program leading to a master's degree in public affairs. Students study policy analysis and public management, and pursue a concentration in a public policy area of their choice. They spend the first year and a half taking courses that provide them with the tools needed to analyze public policies. The authors of this report are all enrolled in Public Affairs 869, Workshop in Public Affairs, Domestic Issues. Although acquiring a set of policy analysis skills is important, there is no substitute for doing policy analysis as a means of learning policy analysis. Public Affairs 869 provides graduate students that opportunity.

The students were assigned to one of six project teams. One team worked on this project for the Wisconsin Department of Administration, while two teams worked with the Budget and Management Division of the Department of Administration of the City of Milwaukee, and one team each worked with the Wisconsin Department of Revenue, the Wisconsin Department of Natural Resources, and the Joint Legislative Council. The topic of this report—an analysis of the environmental impact of state government buildings—was chosen by Robert Cramer, the Secretary of the State Building Commission.

This report does not provide the final word on the complex issues the authors address. The graduate student authors are, after all, generally new to policy analysis, and the topic they have addressed is large and complex. Nevertheless, much has been accomplished, and I trust that the students have learned a great deal, and that Secretary Cramer and the staff of the State Building Commission will profit from the analytical framework to asses state buildings, and the Department of Revenue will benefit from the application of this framework to their building.

There has been a growing movement across the United States to increase the environmental sustainability of buildings. Wisconsin is no exception, and Governor Doyle has promoted a "Conserve Wisconsin" policy. One direct way that the state government can make a difference is to manage its own stock of buildings in more environmentally efficient ways. To do this, the State Building Commission first needs a set of criteria by which they can judge the current environmental performance of state buildings and set benchmarks for the future. The authors propose such criteria (employee transportation, water consumption, electricity consumption, natural gas consumption, and waste generation). To prove the practical usefulness of these criteria, the authors applied them to the Department of Revenue building. The analysis found that, in most respects, the building has relatively high environmental efficiency, but that some areas of improvement (for example, in the area of office lighting) remain. The authors also offer strategy sets—specific low-cost or no-cost changes to building management that can reduce the demand on resources. The strategy sets are designed to be broadly applicable to all state buildings, and therefore are a practical and widely applicable policy tool.

This report would not have been possible without the support and encouragement of Secretary Cramer. A number of other people also contributed to the success of the report. Their names are listed in the acknowledgments.

The report also benefited greatly from the active support of the staff of the La Follette School. Terry Shelton, the La Follette outreach director, along with Kari Reynolds, Mary Mead, and Gregory Lynch, contributed logistic and practical support for the project. Karen Faster, La Follette publications director, edited the report and shouldered the task of producing the final bound document.

I am very grateful to Wilbur R. Voigt whose generous gift to the La Follette School supports the La Follette School public affairs workshop projects. With his support, we are able to finance the production of the final reports, plus other expenses associated with the projects.

By involving La Follette students in one of the tough issues faced by Wisconsin state government, I hope the students not only have learned a great deal about doing policy analysis but have gained an appreciation of the complexities and challenges facing different levels of government in Wisconsin and elsewhere. I also hope that this report will contribute to the work of State Building Commission and their ongoing efforts to ensure that state buildings are both environmentally sustainable and financially efficient.

Donald Moynihan
May 1, 2006

Acknowledgments

We thank Professor Donald Moynihan for his guidance and feedback on this project throughout the semester, as well as La Follette Publications Director Karen Faster, for astute editing. We also thank the Department of Administration and the Department of Revenue for their assistance and cooperation throughout this project. Specifically, we would like to thank Naomi Babler, Gil Funk, Sharon Urbanowski, and John Walker at the Department of Administration, and Bert Rogers, and Jackie Wipperfurth at the Department of Revenue. Finally, we thank Secretary Cramer, whose interest in green building instigated our research.

Executive Summary

State governments play many leadership roles in our environmental and energy futures. One of these roles is promoting sustainable building design. In the United States, buildings account for 36 percent of total energy use, 65 percent of total electricity consumption, and 30 percent of waste output (U.S. Green Building Council [USGBC] 2006). Wisconsin state government includes 6,300 facilities and is one of the state's largest energy consumers (Public Service Commission of Wisconsin 2006). Minimizing the environmental footprint of these facilities sets the bar high for the rest of the state.

To make Wisconsin a leader in the green building movement, the Department of Administration (DOA) asked the Robert M. La Follette School of Public Affairs at the University of Wisconsin-Madison to identify a series of resource-saving measures that can easily be implemented in the 25 buildings under its direct control. DOA wanted these measures to form a template that can be used to evaluate and facilitate the greening of these buildings. The DOA also wanted to use the template to evaluate the Department of Revenue building at 2135 Rimrock Road in Madison.

We conclude that DOA should use five criteria to determine the environmental and energy footprints of state facilities:

1. Transportation of employees
2. Water consumption
3. Electricity consumption
4. Natural gas consumption
5. Waste generation

With these criteria in mind, we devised five measures, or strategy sets, that will help the state accomplish its green-building goals. They are:

1. **Minimize transportation impacts**: abate the environmental and economic costs of commuting by providing incentives for employees to use mass transit, carpool, and bike to work;
2. **Maximize water use efficiency**: reduce the burden on the potable water supply and wastewater systems by eliminating the use of potable water for landscape irrigation and reducing cooling tower water use;
3. **Maximize energy efficiency**: reduce the economic and environmental costs of energy consumption by setting and meeting energy consumption reduction targets, performing building retrocommissionings, instituting basic energy efficient operations and maintenance practices, and reducing summer peak demand for electricity;

4. **Minimize building waste**: set and meet building waste reduction targets, developing and instituting a building waste reduction policy, and establishing an efficient building recycling program; and
5. **Choose sustainable inputs**: reduce the environmental impacts of materials acquired for use in building operations, maintenance, and upgrades by evaluating materials with a life-cycle costing methodology.

In addition, this analysis is a foundation on which DOA can build a comprehensive, coordinated, long-term sustainable building policy for Wisconsin state government. For example, DOA should consider creating a building stock inventory of resource-use data from its properties; by collecting energy, water, and waste stream data for all facilities under its management, DOA could optimize resources dedicated to sustainable design.

We recommend *developing a schedule of building reviews* for the coming years. Using the criteria we developed, inspections should identify opportunities for new energy- and water- saving and waste-minimizing policies and practices, and determine whether current practices are actively implemented. Such building reviews should not only include physical inspections by building maintenance staff, but also email reminders to employees recapping current DOA policies.

When applying this template to other DOA-run buildings, *identify responsible officers for each building.* We suggest determining if any building engineers have a strong interest in green building design. Our research experience suggests that employees with such an interest would be most likely to successfully follow through in implementing our recommendations.

To ensure that the recommendations are successfully implemented, *identify a responsible office in the DOA.* We believe that it is important for the Department of Administration to designate a point-person in the DOA to develop a schedule for state building assessments, identify responsible officers for each building, and share with them the criteria and strategy sets provided in this report.

Use the strategies discussed throughout this report. We have detailed a number of energy and resource saving strategies that can be implemented in almost all state building with little cost. The relevance of each particular strategy set depends on the nature of the building and the outcomes of building assessments.

In terms of immediate actions for the DOR, we recommend:

- Using more efficient lighting practices
- Implementing a system to facilitate carpooling
- Encouraging bicycling and walking to work by adding sheltered bike racks and employee changing rooms
- Replacing broken urinals with “no-flush, no-touch” (NFNT) models

- Installing lower-wattage lights in the parking lot
- Cleaning and maintain HVAC systems on a regular basis
- Ensuring that all computers and monitors are turned off at night
- Conducting regular data collections of the building's waste stream
- Setting a "zero waste" goal and collaborating with DNR to achieve it
- Writing a sustainable purchasing subsection into the waste reduction policy
- Instituting a Toxics Use Reduction Program

Implementing these actions will, within a short time period, save money and reduce the environmental impacts of DOR.

Part I: Criteria and Strategy Sets for Green Building Assessments

Carefully choosing a building site and using sustainable building materials and energy efficient design help keep a building's environmental footprint as small as possible. However, after a building has been constructed, its operation and maintenance also have environmental impacts.

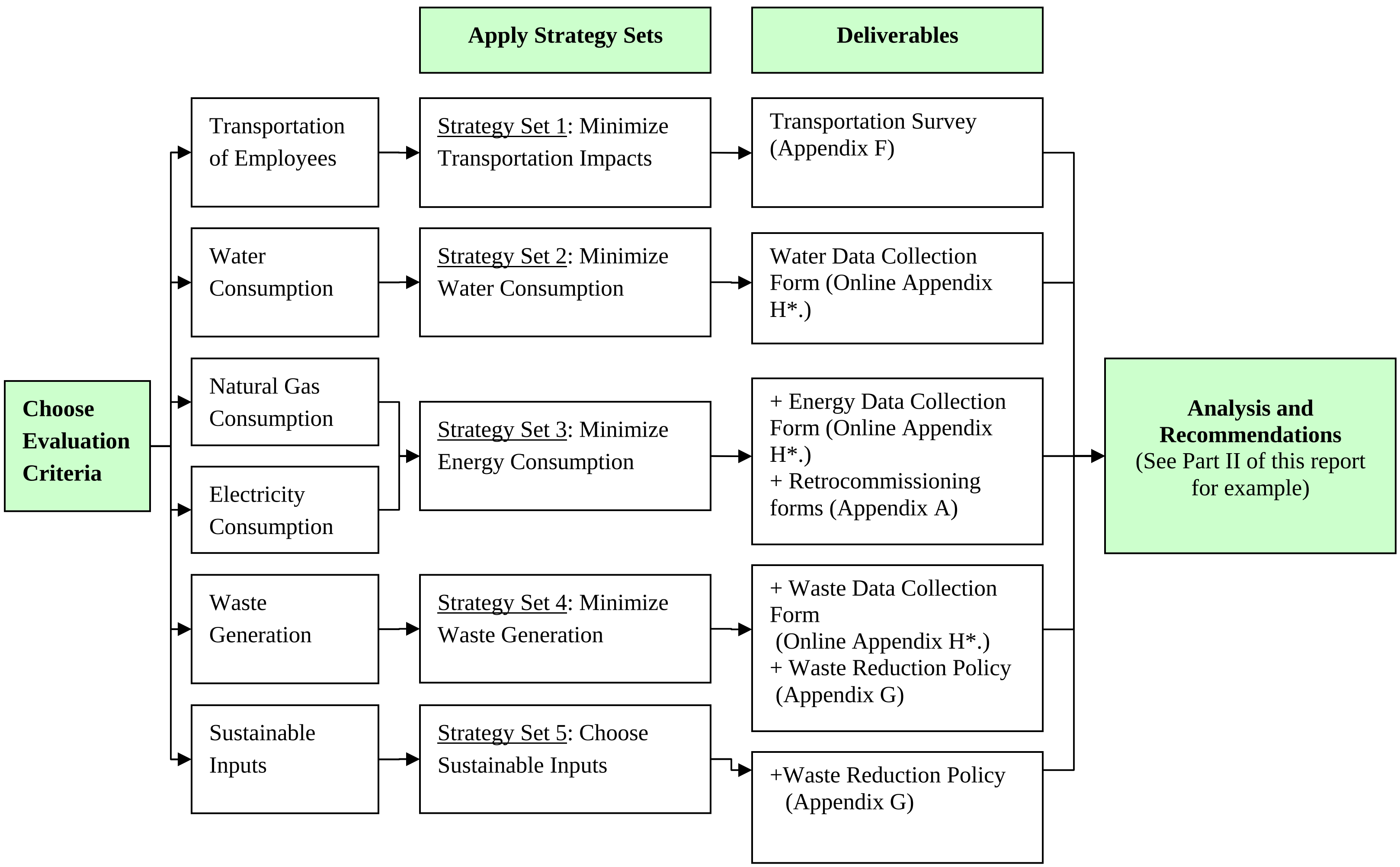
There are hundreds of ways to "clean and green" a large office building; the challenge is deciding which actions to take given a set of budget constraints. Some steps are more expensive than others. For example, achieving a Leadership in Energy and Environmental Design Existing Building (LEED-EB) Platinum rating[1] often requires building managers to make expensive capital improvements, such as installing high-efficiency chillers or rooftop solar panels. Although these improvements usually pay for themselves in less than five years, it may be politically (if not fiscally) infeasible to sink large sums of taxpayer dollars into upgrades for existing facilities (USGBC 2005b).

The Wisconsin Department of Administration (DOA) can use the analytic tools in this guide to implement low- and no-cost changes to the 25 buildings it manages for the state of Wisconsin. This report also provides a guide for conducting a whole-building energy and resource analysis.

We first develop a set of criteria, which we discuss in detail in the next section. For each criterion we devise and discuss a strategy set to reduce the environmental impacts of DOA facilities. The appendices present the strategy sets in more detail. They outline accessible and low-cost strategies that building managers can use. We also provide a set of deliverables that allows assessment of the environmental footprint for each criteria. The report demonstrates the use of these deliverables by assessing the environmental impact of the Department of Revenue building. Figure 1 outlines this process.

[1] Developed by the U.S. Green Building Council, LEED is a method of rating how energy efficient and sustainable a building is. Achieving LEED-EB Platinum status for a building requires at least 64 points on the U.S. Green Building Council's 85-point building sustainability scale.

Figure 1: Existing Building Sustainability Evaluation Chart



* Appendix is online at mywebspace.wisc.edu/xythoswfs/webui/jmronca/DOR-DOA%20Project?action=frameset&subaction=print&uniq=jndj9b

Background

The drive to construct green or sustainable buildings is one aspect of the U.S. environmental movement. Two key events in 1970 mark the inception of environmentalism in the United States: the first Earth Day (driven by former Wisconsin Senator Gaylord Nelson), and the establishment of the U.S. Environmental Protection Agency by President Richard Nixon. These events, in addition to the Arab oil embargo of the early 1970s, were the crucial factors that instigated the U.S. green building movement.

The oil shocks of the early 1970s spurred extensive investments in energy efficiency, solar technologies, building retrofittings, and energy recovery systems. The federal government provided tax credits for the design and use of these technologies. By the late 1970s, many of these practices became standard when states wrote them into their energy codes.

Although interest in resource conservation declined when energy prices fell in the early 1980s, it reemerged in the early 1990s for a variety of reasons, including the publication of *Our Common Future* (the Bruntland Report) in 1987 and the United Nations Conference on Sustainable Development (the Rio Conference) in 1992. One outcome of the 1993 Chicago World Congress of Architects meeting between the International Union of Architects and the American Institute of Architects was the Declaration of Interdependence for a Sustainable Future. Shortly after this meeting, the American Institute of Architects formed its Committee on the Environment. The U.S. Green Building Council was (USGBC) formed in 1993 in Washington, D.C., and held its first meeting in March 1994.

Concurrent green building movements helped fuel the U.S. movement. The British green building rating system, the Building Research Establishment Environmental Assessment Method, was developed in 1992. Several task groups within an international construction research networking organization, Conseil International du Batiment, formed in 1992, most notably Task Group 8 (Building Assessment) and Task Group 16 (Sustainable Construction). In 1994, these groups held international meetings in the United Kingdom and Florida.

Leadership in Energy and Environmental Design (LEED) emerged around this time along with an effort to develop green building standards by the American Society for Testing and Materials. This campaign effort was eventually set aside as the USGBC’s effort to create an American Green Building Standard moved to the forefront. In the United States, the renovation of Audubon House in New York City in 1992 was one of the first buildings that marked the start of the contemporary green building movement (Kilbert 2004).

Policy Background, Wisconsin

In March 2006, Governor Jim Doyle signed into law the Wisconsin Renewable Portfolio Standards, requiring electric utilities to provide 10 percent of their generation through renewable energy sources by 2015 (Public Service Commission of Wisconsin 2006). This supply-side energy policy is an important step towards a more sustainable energy future.

Wisconsin's Renewable Portfolio Standards law is part of the larger "Conserve Wisconsin" policy directive by Governor Doyle. The Governor's Conserve Wisconsin Agenda challenges public and private sectors to protect Wisconsin's lands and waters and to conserve energy. In this agenda, Governor Doyle calls for "establishing high performance green building standards [that] cut costs of operating and maintaining state buildings while conserving energy, water, materials and land while still improving worker health and productivity" (Renewable Portfolio Standards 2006). This paper builds upon this charge.

Building Evaluation Criteria

This analysis provides a template that will allow the DOA to assess the environmental impacts of the buildings in its real estate portfolio. Following the assessment framework is a series of strategies that can provide low- and no-cost methods of reducing resource consumption.

The template examines buildings across five primary environmental impact categories: employee transportation, water use, energy use, and waste production. Total energy use is also broken down to consider natural gas and electricity use separately.

According to the USGBC, these are the five key issues related to the sustainability of existing buildings. In addition, the USGBC recommends addressing indoor environmental quality and atmospheric pollution (USGBC 2005b). Due to time constraints, we do not address these two areas in this report. We recommend that DOA refer to USGBC Leadership in Energy and Environmental Design guidelines for Existing Buildings (LEED-EB) to address indoor environmental quality and atmospheric pollution related to facilities under its control.

Employee Transportation

Transportation accounts for one-quarter of total energy consumption in Wisconsin (WDOA 2005). Getting state employees out of single occupant vehicles and into carpools or buses, or onto other alternate transport options, will improve local air quality and reduce greenhouse gas emissions associated with state facilities. The average passenger vehicle emitted 40 pounds of nitrogen oxides, 600 pounds of carbon monoxide, and more than 11,000 pounds of carbon dioxide each year (U.S. Environmental Protection Agency 2000).

Reducing the number of vehicles state employees use can affect other environmental areas. Specifically, since roads and parking lots are sources of non-point water pollution, decreasing the number of vehicles on the roads can also result in healthier watersheds.

We measure the environmental impacts of methods by which employees commute to work. The evaluation itself is based on the results of an anonymous online survey sent to all employees of the building under consideration. Survey results can be compared with national trends, and the impact of reducing the number of drivers can be determined. Based on the results of the survey, suggestions can be made to help the agency being examined implement greener transportation policies.

Water Use

Wisconsin's watersheds cover more than 3,700 square miles (WDNR 2004)—this is a water rich state. As its steward, government has an obligation to use this resource wisely.

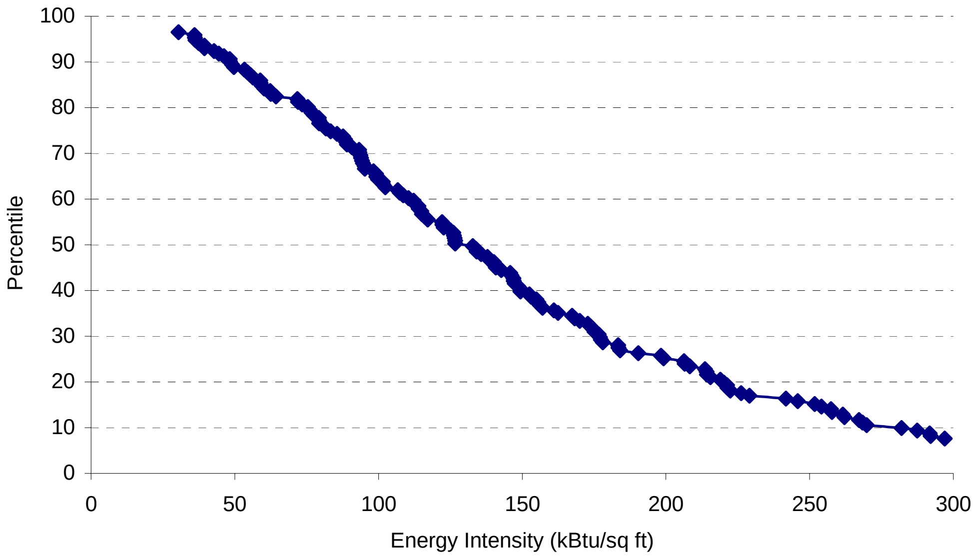
A building's water use should be considered over time and compared to the use by similar buildings. Comparing water consumption against other buildings provides a relative measure of a building's efficiency, whereas examining water consumption over time provides a measure of whether or not efficiency is improving with time.

Energy Use

The United States accounts for 4.5 percent of global population (U.S. Census Bureau 2006) and 47 percent of global energy consumption (International Energy Agency 2005). Given the increasing costs of energy, this level of energy intensity is not economically or environmentally sustainable.

As with water consumption, the energy consumption of a building should be compared to that of other buildings and to itself across time. Here it is important that the Midwest be distinguished from other regions to help control for regional environmental factors. Seasonal fluctuations in outdoor temperature, for example, greatly affect a building's energy use. To compare energy use, we suggest using the U.S. Department of Energy's 1999 Commercial Buildings Energy Consumption Survey (USDOE 1999). This survey includes energy-use characteristics of 5,430 buildings nationwide. Contained within the nationwide total are 909 buildings from Wisconsin's US Census division (the "East North Central"; other states in this division are Illinois, Indiana, Michigan, and Ohio). Of the 909 buildings, 171 are classified as office buildings; these could serve as the benchmark against which the DOA's buildings will be compared. Figure 2 shows the annual energy use from 1999 for the East North Central Census division.

Figure 2: Total Energy Use for the East North Central Census Division, including Wisconsin



Source: Commercial Buildings Energy Consumption Survey Public Use Data (USDOE 1999)

Since buildings use different types of energy, looking only at therms of natural gas or kilowatt-hours of electricity will not provide a complete picture of a building's energy use – indeed, since different energy types involve different units of measurement, a direct comparison is not immediately possible. However, the analysis' use of source kilo British thermal units (kBtus) avoids this problem by converting all energy used into a common metric (see, www.onlineconversion.com/energy.htm for conversion factors).

Waste Generation

In the United State, buildings use 30 percent of raw materials and produce 30 percent (or 136 million tons annually) of waste output (USGBC 2006). Minimizing building waste involves much more than recycling. Building managers and occupants must be aware that every item purchased, from paper to paint to light bulbs, has environmental impacts.

Building waste streams can be analyzed at two points: when materials enter a building and when materials exit a building. Building managers should choose inputs that minimize waste and environmental impacts. Outflow baselines for recyclable and non-recyclable waste must be measured. Once baseline outflows are established, building managers have references point against which to measure outflow reductions.

Strategies for Reducing the Environmental and Energy Impacts of State Facilities

The previous section outlined criteria for assessing the environmental impacts of a building. This section looks at strategy sets that contain specific actions to reduce this environmental impact. Additional detail on these strategy sets is found in Appendices A through E.

With so many green building programs, we had a large pool of ideas from which to build a program for DOA. The strategies and actions we suggest are drawn from many sources, including the U.S. Green Building Council's LEED-EB standards. We started with LEED standards, but went beyond those to examine cutting-edge programs in states, cities, and universities. To determine what is cutting-edge, we consulted the literature on sustainable buildings and talked to experts at the Center on Wisconsin Strategy at the University of Wisconsin-Madison.

Although states such as California simply require existing buildings to meet or exceed LEED-EB Silver ratings (USDOE 2006), other states have created their own sustainable building design guides that draw on, and in some cases, improve upon LEED. New York's cutting-edge "Green and Clean" State Buildings and Vehicles Guidelines (New York State Energy Research and Development Authority 2004) require energy saving measures for state facilities that exceed LEED requirements. The Minnesota Sustainable Design Guide (Regents of the University of Minnesota 2000) is customized to meet that state's environmental and energy priorities. Both state guides proved useful references for this analysis. For energy efficiency improvements, we found Platts Research and Consulting particularly helpful (Platts 2002). In addition to these sources, we employed local expertise. The Center on Wisconsin Strategy provided us with information on leading sustainable design policy and guides in use across the country.

Below we discuss five sets of low- and no-cost strategies for making DOA's facilities more sustainable. The five sets include transportation, water efficiency, energy efficiency, waste, and building inputs. This discussion is designed to familiarize the reader with how each of these areas of building operations can be made more efficient and environmentally friendly. Full outlines of each strategy set are in Appendices A through E.

Transportation

There are three primary strategies to minimize the environmental and economic impacts of transportation:

1. Encourage mass transit and carpooling
2. Use alternative fuels for fleet vehicles
3. Encourage alternative forms of commuting, such as bicycling

Encourage Mass Transit and Carpooling

As the cost of gasoline continues to increase, the amount of money that can be saved by using mass transit or carpools will also increase. Depending on the nature of the employees, the strategies used to increase use of mass transit and carpooling vary. For example, buildings where the majority of employees commute from rural suburbs are not the best candidates for a push to increase bus ridership.

To reduce the number of drivers commuting individually to work every day, several options exist. One option that has been implemented by the University of Wisconsin-Madison and the City of Madison is to offer all employees a free pass for unlimited rides on all Madison Metro bus routes (Madison Metro 2006).

While mass transit provides one option to reduce the number of individuals who drive to work alone, it will generally appeal to a limited audience. However, carpooling is another solution that may appeal to a broader audience.

The U.S. Environmental Protection Agency (EPA) offers a comprehensive guide for creating and implementing an employee carpooling program (USEPA 2005). We draw from this for the suggestions below:

Before attempting to implement a carpool program, it is important to determine whether interest exists among employees.

For a carpool program to be successful, interested parties must be able to easily find each other. This can be facilitated in a number of ways. For some people, a general reminder to consider carpooling may be enough for them to seek out and form their own pools; however, most will require additional facilitation and incentives.

A common complaint about carpooling is finding coworkers who live near each other. To resolve this problem, a simple ridesharing bulletin board can be posted in the cafeteria. The board should feature areas for each part of town and each suburb. It also should have index cards on which staff members can write their names, contact information, and work schedules. Employees can post their cards in the area in which they live. In larger buildings, finding a common break area for a bulletin board can be difficult; thus, an electronic bulletin board should also be considered. If this option is used, it should be placed on the building’s intranet to ensure that only employees have access.

Also helpful is giving incentives to people who carpool. Some incentives to consider are:

- *Offering preferred parking to carpool drivers*. These parking spaces should be close to the building's entrance and, if possible, sheltered. Further incentives can be given based on the size of the carpool (for example, drivers with two passengers receive better parking places than those with only one passenger).
- *Offering reduced price parking to carpool drivers*. At many buildings where parking is limited, employees have to pay a monthly fee for parking. Reducing or eliminating this fee for carpool members may provide an incentive for more people to sign up. Further, the fee can be reduced as the number of people in the carpool increases.
- *Allowing employees who participate in carpools greater flexibility in setting their work schedules*. One of the more frequently cited reasons that people say that they do not carpool is because they need to work irregular hours. By allowing employees greater flexibility in setting their work schedules, they would be able to more easily find a common schedule with the rest of their pool.
- *Holding monthly prize drawings for carpool members*. These prizes could range from something simple like a coffee mug or a T-shirt to something more substantial like a restaurant gift certificate. Monthly cash prizes can be considered.
- *Increasing the number of on-site services*. Another frequently cited reason for not participating in a carpool is the necessity of having a car to run errands during the day. On-site services can eliminate this problem. Since this solution would require a fair amount of remodeling and planning, this should be considered a more long-term solution.

Once the carpool system is in place, employees must be made aware of its existence. Aside from some of the more conventional methods of sharing information such as posting signs throughout the building or sending officewide e-mails, other less traditional methods can increase awareness: an officewide kickoff event can be held to promote the program, or an awards drawing for all employees who carpool can be held with the promise of future drawings for people who sign up.

Use Alternative Fuels for Fleet Vehicles

This option is less relevant than some of the employee-based solutions as not all buildings managed by the Department of Administration have state fleet vehicles. However, for those buildings that do, using alternative fuels such as E85 or other ethanol and gasoline blends can reduce emissions.

A similar initiative was recently undertaken at the University of Wisconsin – Madison; all UW fleet vehicles that previously relied on regular diesel fuel now use a 20 percent bio-diesel/80 percent ultra low sulfur diesel mix. This blend is estimated to cut particulate emissions by 15 percent, carbon dioxide emissions by 16 percent, and hydrocarbon use by 13 percent (University of Wisconsin-Madison 2005).

Encourage Alternative Forms of Commuting

While the suggestions for green transportation solutions thus far have operated under the assumption that employees must drive to work, this assumption is not universally true. Alternative forms of commuting (such as walking or riding a bike) generally provide some of the greenest methods of arriving at work. These solutions generally cannot be implemented on a wide scale (bicycling from the suburbs is generally not feasible, especially in the winter); however, for some employees, they do provide solid alternatives to cars or buses.

To enhance the likelihood that employees bike to work, the bikes must have a safe storage during the day, preferably an area that is sheltered to shield them from weather.

Also important is the existence of a changing room with lockers to store biking equipment such as helmets, and showers for employees to use prior to beginning work.

Beyond Strategies

While having a good set of strategies to reduce the environmental impact of transportation is good, the transportation specifics of a site should be compared to the situation nationally. These trends can be ascertained by comparing the results of the included transportation survey (see Appendix F) to a 2003 survey conducted by the U.S. Bureau of Transportation Statistics (USDOT 2003). Although these two assessments are not identical, there is enough overlap so that meaningful comparisons can be made.

Water Use

There are three groups of low- and no-cost actions DOA could employ to improve the water efficiency of facilities it manages.

First, *reduce potable water use.* Maximizing fixtures' water efficiency within buildings reduces the burden on the potable water supply and on wastewater systems. Examples of actions to reduce potable water use include using low-flow toilets, sinks, showerheads, and dishwashers, and using infrared faucets sensors, delayed action shut-off, or automatic mechanical shut-off valves.

Second, *reduce cooling tower water use.* Cooling towers use large volumes of water. For example, regularly cleaning the tower's blowdown detector reduces cooling tower water use. A dirty detector instigates blowdown early and discharges water for too long.

Third, DOA managers should *reuse non-potable (gray) water*. The first step is to evaluate building sites for opportunities to reclaim gray water (from exterior catchment areas, sinks, showers, etc.) and non-potable water uses (i.e. irrigation, toilets, etc.).

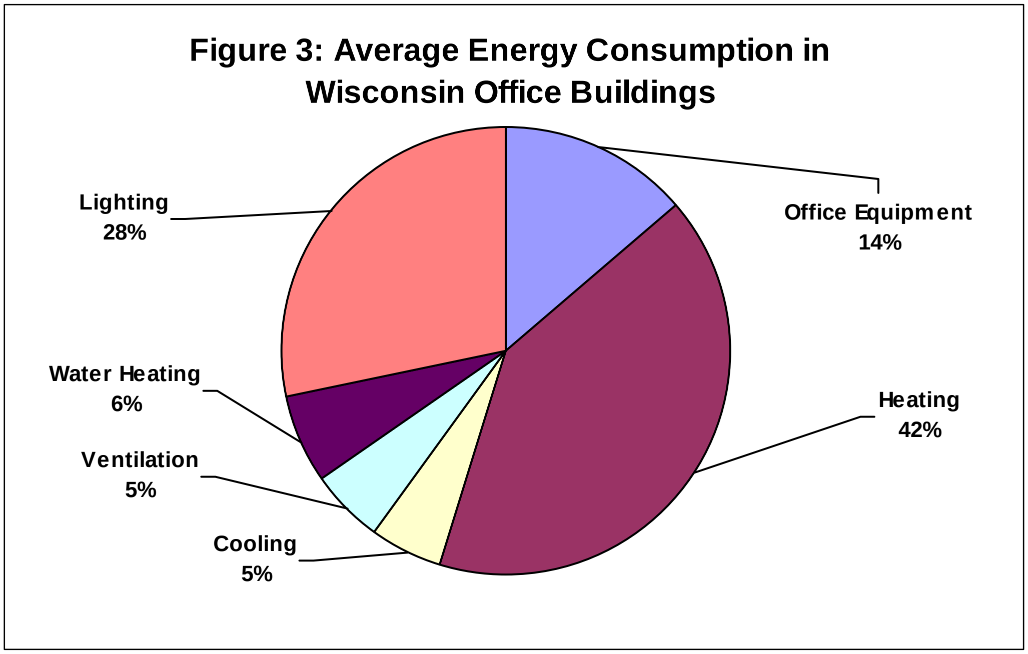
Energy Use

A standard approach to reducing the environmental affects of office buildings is to determine ways to reduce the building's energy consumption. However, simply reducing a building's energy consumption without first determining why its energy-use profile precludes the achievement of lasting reductions in energy usage. Therefore, we begin with a brief discussion of the energy use profile of office buildings in Wisconsin.

Wisconsin's Climate

The U.S. Energy Information Administration divides the United States into five climate zones. Wisconsin is in Climate Zone 1,[2] and as a result, its office buildings tend to have energy-use profiles similar to that shown in Figure 3.

[2] Fewer than 2,000 average annual cooling degree days (CDD); more than 7,000 average annual heating degree days (HDD).



Source: U.S. Department of Energy, 1999

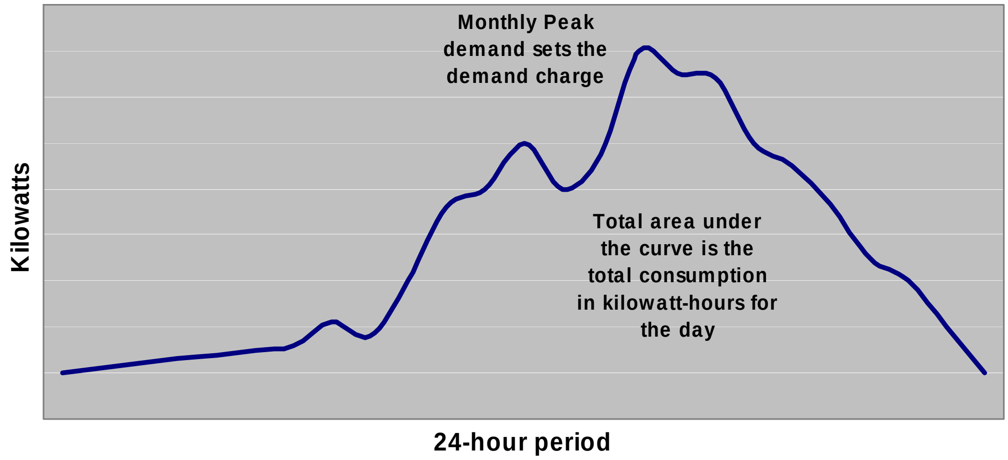
In general, Wisconsin state office buildings consume natural gas and electricity to complete the functions listed in Figure 3. Therefore, we consider specific measures to decrease electricity and natural gas consumption. Wherever possible, expected cost-savings are provided. Rates for electricity charges are published by Madison Gas and Electric (MGE) as of March 2006 (MGE 2005a, MGE 2005b, MGE 2006).

Natural Gas and Electricity – Important Differences in Billing Systems

Before we consider specific strategy sets, we distinguish between different billing systems for state of Wisconsin buildings. Natural gas utilities bill individuals and organizations are billed for the amount of energy delivered. For electricity, the Public Service Commission of Wisconsin determines charges using two distinct yet related measures: consumption and demand. Because both types of charges can have significant impact on a utility bill, each energy-saving recommendation includes treatment of consumption and demand concerns.

Note the ways in which consumption and demand differ. Consumption is the amount of electricity in kilowatt-hours that the building consumes during a month. Demand is the peak demand in kilowatts occurring in a given month. Figure 4 shows the relationship between these two measures of electricity usage.

Figure 4: Hypothetical Daily Load Shape



Utility companies charge industrial and commercial consumers for consumption (the area under the curve) and peak demand (the highest point on the graph). Because failure to deliver electricity when demanded would result in brownouts or even blackouts, utility companies invest resources to ensure that they can meet public demand for power at all times. Demand charges represent the power company's need to invest in power generation capacity as a result of the customer's energy demand.

Common Area Lighting

Wherever possible, dim hallway lighting during daytime hours to reduce demand charges and energy consumption.

Daylighting

Light shelves can shade and prevent glare in the bottom six feet of a room. By installing light shelving on the inside of windows, external light is reflected onto the ceiling and back down onto desktops. Employees are then able to work with a greater spectral range of light, making eye fatigue less likely and increasing productivity.

Computers and Office Equipment

The energy wasted by a single desktop computer that remains in the full-power "on" state, no matter how long it remains idle, is almost insignificant. But when hundreds of workstations operate on a local area network, the wasted energy can be quite significant. The most recent release of Microsoft Windows comes with power-management software installed. However, the software is inactive by default. Therefore, without a directive from management, employees and information technology staff members are unlikely to activate power-management settings.

The configuration of a computer (desktop or laptop, CRT or LCD monitor) will affect the power-saving potential of any power-management system. Possible combinations and their corresponding power-savings are indicated in Table 1. On average, a typical desktop computer and CRT monitor draw approximately 160 watts of power per day. Each computer left on overnight and during weekends could add more than $30 to the annual electricity bill.

Table 1:
Computer and Monitor Energy Demand

How computers are configured can reduce energy usage. This table shows how many watts each configuration uses.

Type of PC	Active	Suspended	Off
Desktop	55.0 watts	25 watts	1.5 watts
Laptop	15.0	3.0	3.0
CRT Monitors			
15 inches	61.0	19.0	3.0
17 inches	90.0	9.0	4.0
19 inches	104.0	13.0	4.0
20/21 inches	135.0	14.0	5.0
more than 21 inches	135.0	14.0	5.0
LCD Monitors			
15 inches	11.7	3.4	0.6
17 inches	16.7	4.8	0.8
18 inches	25.0	7.2	1.2
20/21 inches	31.7	9.2	1.6
more than 21 inches	35.8	10.4	1.8

Source: Platts 2006

One way to reduce power usage of networked computers is to collaborate with the information technology staff to develop and deploy logon scripts that control power-management settings. Because logon scripts tend to apply identical parameters to all users' working environments, the logon scripts should be designed to attain maximum energy usage reductions, but there should be flexibility in the policy for individual users to request that reasonable changes be made to reflect their individual work habits.

Space Heaters

Space heaters are expensive and inefficient, drawing upward of 1 kilowatt per hour of use. It is DOA policy to allow space heaters only for employees who require it for legitimate medical reasons.

The use of space heaters by employees signals poor heating, ventilating, and air conditioning (HVAC) system control. Addressing larger HVAC issues is beyond the scope of this analysis but may require attention from management if use of space heaters is frequent.

Temperature Setbacks

In general, natural gas consumption and peak electricity use can be greatly reduced by warming the building to 68 degrees during warming (winter) months and cooling the building to 72 degrees during cooling (summer) months; indeed, this is official DOA policy as of January 2006 (Wipperfurth 2006). When the building's temperature is between 68 and 72 degrees, neither air conditioning nor heating is required. Additionally, while the building is unoccupied, energy consumption can be reduced by allowing the temperature to rise as high as 74 degrees and to drop as low as 66 degrees, depending on the season. A programmable thermostat that allows facilities maintenance personnel to set a seven-day schedule will allow such a heating and cooling scheme to be implemented with minimum of employee burden.

HVAC Cleaning and Maintenance

Proper maintenance of the HVAC system can greatly reduce heating and cooling bills. The following are preventative maintenance steps that facilities personnel can incorporate into their monthly or annual building inspections.

- *Check the economizer*. Many air conditioning systems are equipped with a dampered vent, or economizer, that pulls in cool outside air, when available, to reduce the need for mechanically chilled air. Unless routinely inspected, the linkage on the damper can seize or break, thus leaving the economizer open. A malfunctioning economizer can allow cold air into the building during warming months and warm air into the building during cooling months, resulting in an annual utility bill increase of up to 50 percent (Platts 2002). Therefore, a licensed technician should check, clean, lubricate, adjust the controls, and repair (if necessary) the economizer once a year.

- *Check the air conditioning temperatures*. During cooling (summer) months, use a thermometer to check the temperature of the return air going into the air conditioning system and the temperature of the air exiting the system from the vent nearest the compressor. If the temperature difference is less than 14 degrees or greater than 22 degrees Fahrenheit, the system is not functioning at optimal efficiency and should be inspected by a license technician.

- *Changing the filters*. Filters should be changed on a monthly basis. However, because the Department of Revenue building is located on a highway, changing the filters more often may be necessary to achieve maximum HVAC efficiency.

• *Inspect the cabinet panels*. During cooling months alone, cold air escaping from the HVAC system can result in increased energy charges of $30 to $40 per month. To ensure efficiency, rooftop cabinet panels must be fully attached, all screws must be in place, and all gaskets must be intact to prevent leakage. To ensure year-round efficiency, repeat this diagnostic every three months.

• *Clean the condenser coils*. At the beginning and end of each cooling season, wash the condenser coils. When inspecting the cabinet panels be sure to inspect the condenser coils as well, removing any debris that may have accumulated since the previous inspection.

• *Check the airflow*. Hold an 8.5x11-inch piece of paper up to each register in the HVAC system. If there is insufficient suction to hold a piece of paper unassisted, then have a technician inspect, and clean the unit and duct work.

Interior Lighting

Higher efficiency fluorescent tubes will reduce the number of tubes used. Older, less efficient tubes often require four fluorescent tubes to achieve the level of light output obtainable using two high-efficiency tubes. Power consumption is greatly reduced, sometimes as much as 35 percent by reducing the number of bulbs in service and the amount of power each bulb uses (Platts 2002).

Parking Lot Lighting

The Illuminating Engineering Society of North America recommends that parking lots be lit at an average of one foot-candle or less of light. While lighting is often considered necessary for lot security, too much light can cause automobile accidents as drivers' eyes are unable to adjust to the darkness of the road after exiting an over-lit parking lot. At present, the trend in parking lot lighting is toward the use of high-pressure sodium lamps, because they are more efficient than metal halide lamps. However, the efficiency of the human eye is an important factor in choosing a parking lot lighting design scheme. Although inefficient, metal halide lamps produce most of their light in the blue region of the visible light spectrum. Even with minimal lighting, the human eye can use blue light extremely effectively. Thus, while metal halide may be inefficient, metal halide bulbs can be set at a very low wattage, below one foot-candle, and still provide adequate night lighting for drivers. By maximizing on the efficiency of the human eye, optimal cost savings will result (Platts 2002).

Waste Generation and Sustainable Inputs

Minimizing building waste involves much more than recycling. Building managers and occupants must be aware that every item purchased, from paper to paint to light bulbs, has environmental impacts. Today, there are extensive markets for sustainable products that were unimaginable a decade ago.

We suggest DOA consider the following strategies to assist with minimizing building waste.

- *Measure building waste streams.* Use recycling and garbage collection data from waste management entity to quantify current waste stream production volumes. Forms for acquiring these data are available in the online Appendix H.[3]
- *Develop and institute a waste reduction policy*. Decide how each waste type measured in can be minimized at the source through reuse and recycling; and develop and institute a waste reduction policy for the building.
- *Establish an efficient building recycling program*. Most recycling programs leave room for improvement. Consider employing cardboard balers, aluminum can crushers, recycling chutes, and other waste management techniques to enhance the recycling program. Explore implementing source reduction programs.
- *Institute a sustainable purchasing policy.* While minimizing waste flowing out of building is crucial, it is equally important to choose building inputs that have minimum environmental impacts. Any waste reduction policy should include a sustainable purchasing subsection to reduce the environmental impacts of the materials acquired for use in the operations, maintenance, and upgrades of buildings.

  Several free and easy-to-use computer programs help building managers choose sustainable inputs. One such program is the Building for Environmental and Economic Sustainability life-cycle methodology software. It helps users select the most sustainable products possible within a given budget (National Institute of Standards and Technology 2006).
- *Minimize the use of toxic cleaning products.* Cleaning products are often some of the most toxic substances in a building. Reducing the use of such products is good for both employee health, as well as for air and water quality. The City of Santa Monica, California, instituted a toxics use reduction program, which the U.S. Environmental Protection Agency has highlighted for its effectiveness (USEPA 1998). DOA should consider adapting this program for its own operations.

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[3] mywebspace.wisc.edu/xythoswfs/webui/jmronca/DOR-DOA%20Project?action=frameset&subaction=print&uniq=jndj9b.

Part II: Evaluation of the Department of Revenue Building

The buildings the Department of Administration operates can be evaluated with the methodology described in the previous section. To demonstrate the process by which this evaluation should occur, this section assesses the environmental impacts of the Department of Revenue building. After evaluating the building's environmental impacts, we discuss specific energy- and cost-saving procedures.

Transportation

To gain a better understanding of employee commuting habits, we administered an online survey beginning on March 14, 2006. The survey protocol allowed DOR employees two weeks to submit anonymous responses to questions about their commuting practices. On March 21, 2006, the survey protocol closed with 449 of 800 employees responding, a response rate of 56 percent. See Appendix F for the survey instrument.

Based on the survey results, we estimate that each employee makes a daily commute of 30 miles, round-trip. Survey results also suggest that approximately 80 percent of DOR employees commute in single-occupancy vehicles. With an average 240 workdays per year and a five-day work week, we estimate that the 640 DOR employees who commute in single-occupancy vehicles drive 4.6 million miles each year. The average fuel economy of cars in use in 2005 was 25.2 miles per gallon (USDOT 2005), which suggests that these 640 employees consume 183,000 gallons of fuel per year. If 10 percent of these employees carpooled with another DOR employee, annual fuel savings would amount to 18,300 gallons per year. These same fuel reductions could be achieved if these 64 employees commuted with a spouse, took the bus, biked, or walked.

Based on expected gas prices of $3 per gallon, each of these 64 employees would save approximately $857 annually on fuel costs. Similar savings would accrue to other individuals who commute in single-occupancy vehicles.

While gasoline is certainly the most apparent cost of driving a car, it is not the only cost. Indeed, every mile driven by a car causes it additional wear and tear. The state recognizes this and estimates that once these additional costs are considered, driving one mile costs 38.5 cents (including gasoline). Using this more comprehensive estimate, each of these 64 individuals who stopped commuting in single occupancy vehicles would accrue a savings of approximately $2,772 per year.

In light of the survey results, we consider different methods to reduce the number of drivers. First, a push to use more mass-transit (specifically Madison Metro Bus service) would likely yield poor results. Despite 36 percent of employees living within four blocks of a city bus stop, only 3 percent indicated they take the bus regularly. This is, however, in line with national trends (USDOT 2003).

Although roughly 18 percent of survey respondents indicated that the availability of free or reduced price bus passes might make them more likely to take the bus, the general tone of the comments suggests that this may not be the case. Indeed, many comments indicated that “nothing” would make them take the bus. Other comments suggest that structural inefficiencies will prevent bus service from being more widely accepted (one comment that echoes this line of thought notes that “it would take me over 1 ½ hours to take the bus from where I live in Middleton 10 miles away”). Many other comments note that, since no city buses travel to the suburb in which the respondent lives, there is no possible way that they could take a bus. Given the widespread discontent voiced about the bus system, we do not believe that a program that would make free- or reduced-price bus vouchers available to employees would attract people already using alternative transportation.

Another solution that should be considered is implementing a carpool program. Our survey found that nearly 20 percent of DOR employees ride to work with someone else. This is well above the national trend of 12 percent of drivers participating in carpools (USDOT 2003).

While this finding is something the department should be proud of, the DOR can still take further steps to improve carpool participation. Specifically, we recommend reserving the parking spaces closest to the entrance for those employees who participate in carpools and offering free parking passes for carpool drivers.

A frequent comment in the survey was that, since parking passes are paid for on a monthly basis, little incentive exists for people who want to carpool occasionally. We agree with this statement; however, due to issues with enforcement, we see relatively little that can be done to address this issue. Ideally, parking passes could be sold to carpool members for a prorated daily fee each time that an individual drives to work. However, given the system that is in place, we do not believe that this would be feasible at this time.

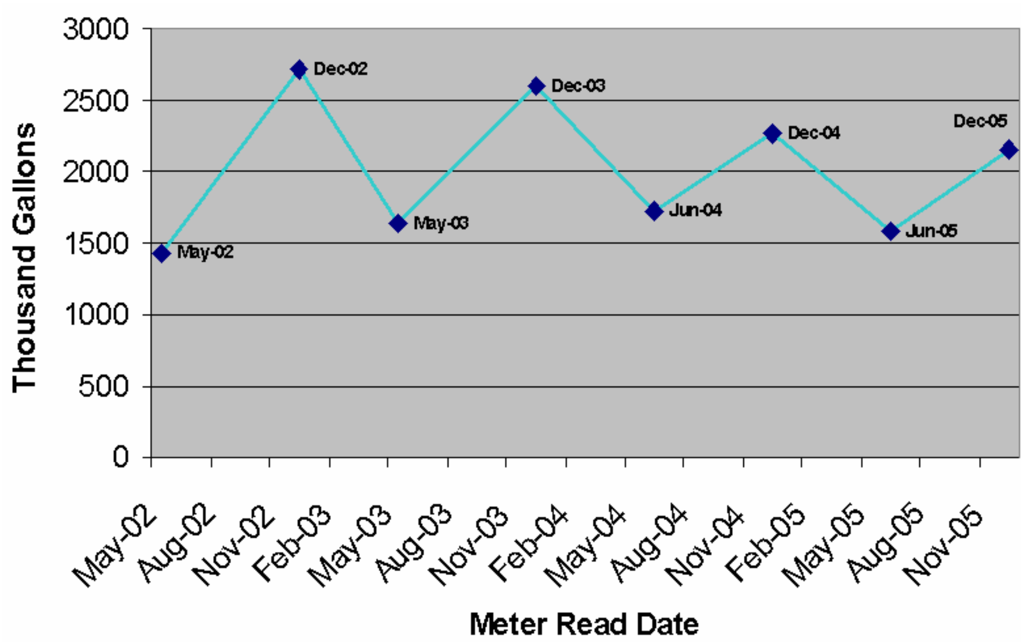
Finally, approximately 2 percent of employees bike in good weather, and another 1 percent walk. This is approximately the national average of 2 percent for the two activities combined (USDOT 2003). Based on survey responses, more awareness may prompt more people to bicycle or walk, but, but several survey respondents noted they do not bike due to a lack of bike paths from surrounding areas, an issue outside of the Department of Revenue’s control.

Please see Strategy Set One in Appendix A for further possible actions to reduce transportation impacts of DOR employees.

Water

Madison Water Utility bills the DOR twice annually for water used from January through June and from July through December, respectively. Figure 3 suggests that there are seasonal trends. However, given the infrequency with which readings are taken, it is difficult to determine activities leading to these apparent trends.

Figure 5
DOR Water Consumption



Source: Madison Water Utility, 2006

In considering the ways in which people in an office building such as DOR's consume water during daily operations, there is an obvious primary candidate for consideration: restrooms. Three types of bathroom fixtures consume water: sinks, toilets, and urinals. We consider each of these separately, and find that urinals provide the best opportunity to save water.

Sinks

The DOR uses motion sensors to activate restroom sinks and reduce water usage. Because this equipment greatly reduces the opportunity to waste water, there is little room to implement low-cost no-cost improvements with respect to restroom sinks.

Toilets

Few alternatives exist for the toilets in use by DOR. The building uses low capacity toilets with motion sensors to minimize water lost due to manually operated valves while maximizing facility sanitation between cleanings. There is little room to implement low-cost no-cost improvements with respect to restroom sinks.

Urinals

Urine is 96 percent water, and thus its adequate disposal requires very little, if any, additional water. Even though the 27 urinals in use in the DOR building use only 1 gallon of water per flush, these urinals waste considerable amounts of water because so little water is necessary to dispose of urine. We consider the use of no-flush no-touch urinals as an alternative to the current fixtures. In general, these urinals function by allowing urine to pass through an air-tight, biodegradable, liquid chemical layer. As the urine collects beneath this layer, it rises and eventually spills over into the drain and into the sewer.

Many of the maintenance issues that generate costs associated with flush urinals are irrelevant with respect to no-flush no-touch urinals. Some of these maintenance concerns include: broken cisterns; faulty photo-electric or infrared latching valves; and replacement, repair, or unblocking of flushing valves and water pipes. Annual maintenance costs an average of $75 per urinal, based on estimates provided by Falcon Waterfree Technologies Inc. (Falcon n.d.)

While no-touch no-flush urinals may save substantial funds over time, the initial cost of replacing flush urinals with no-flush no-touch models is quite high. According to the U.S. Government Services Administration’s purchasing schedule, the least expensive model has a list price of $232. As the DOR has 27 urinals, replacement of all urinals would cost approximately $6,500 in supply costs alone.

Table 2
No-Flush No-Touch Urinals versus
Traditional Urinals Cost Comparison

Savings Analysis Assumptions	
Total Facility Population	800
Percentage of males in Population	60%
Number of Males	480
Number of Urinals	27
Number of Uses per day per person	3
Gallons per flush of current urinals	1
Variable Water and Sewer Cost per 1000 gallons	$2.30
Operating Days	240
Annual Water and Sewer Savings	
(3 uses/day x operating days x number of users x water and sewer costs)	
Gallons Saved	345,600
Dollars Saved	$794.88
Annual Operating Cost Comparison	
Flush Urinal: Maintenance/valve repair ($100 per urinal)	$2,700.00
NFNT Replacement Cartridges ($35 per cartridge, 2 per year)	$1,890.00
Estimated Total Annual Savings	**$1,604.88**

Source: Author's calculations

Table 2 provides a hypothetical cost savings if the DOR were to replace each of its 27 urinals with no-flush no-touch models immediately. Because material costs would total at least $8,100, the annual operating savings of approximately $1,600 would not generate a payback for at least five years.

Recommendations

The DOR is very efficient with respect to water usage. Our only point of recommendation is with respect to the building's urinals. As current valves and flush mechanisms fail, rather than committing labor and funds to repair them, we advise that the DOR replace those units with no-flush no-touch models.

Electricity

Like nearly all office buildings in Wisconsin, the DOR consumes a significant amount of power during the summer in the operation of its HVAC. The DOR is metered by three on-site meters. Each provides information on different end-uses for electricity, and thus the monthly meter readings provide some insight into the types of building activities that result in the highest levels of power demand and consumption.

Meter E291750 measures the electricity used to operate the building fire suppression system. Because the fire system represents an important and negligible portion of total building electricity consumption, we forgo a formal discussion of the fire pump in this analysis.

Meter E291752 measures the power consumed by building systems such as the elevators, the HVAC system, and lighting. Because the power measured by this meter is used in building-level functions that are beyond the influence of most employees, policies aimed at reducing consumption and demand as measured by this meter should focus on increasing the efficiency of building environmental and lighting systems.

Meter E291778 measures the energy distributed to electrical outlets and small motor items such as computers to which employees need ready access. Policies to reduce consumption and demand as measured by this meter may need to focus on employee behavior and working habits to achieve noticeable reductions in energy consumption.

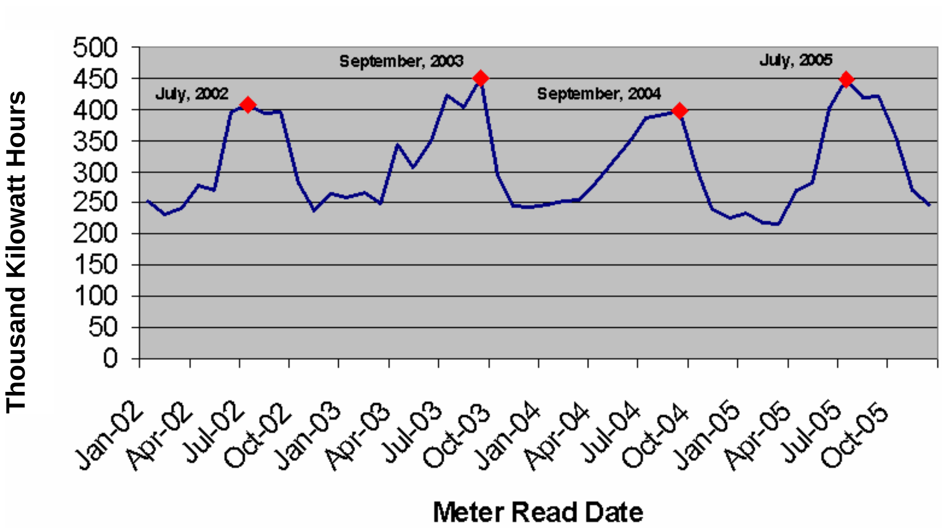
We consider each of these meters separately, with distinct considerations of consumption and demand charges. The activities that give rise to each of these four types of charges require separate consideration to evaluate effective policy options.

Building Systems Energy Consumption

Figure 6 shows the building systems energy consumption data as reported by meter E291752 since January 2002. Squares markers on the graph indicate the month in which DOR experienced its maximum power consumption for each year. Historical climate data suggest that the summers of 2002 and 2005 were abnormally hot and dry with daytime temperatures occasionally rising above 100 degrees Fahrenheit. Meanwhile, the summers of 2003 and 2004 were an average of 8 to 10 degrees cooler than normal. The increase in power consumption during September 2003 and 2004 may be related to temperatures on average, 7 to 11 degrees warmer than usual.[4]

[4] Wisconsin Agricultural Statistics Service www.nass.usda.gov/wi/cropweather

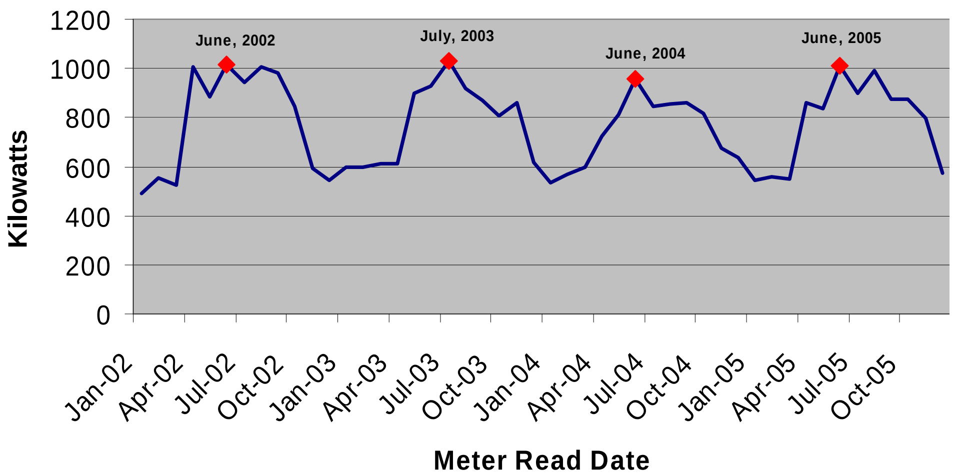
Figure 6
Building Systems Energy Consumption



Building Systems Demand

Figure 7 shows the trend in maximum monthly energy demand with the maximum demand month of each year indicated with a square. Peak demand on the E291752 meter occurs during cooling months. Though peak demand dropped somewhat during the cooler summers of 2003 and 2004, the summer months are still those in which DOR incurs its highest energy demand charges. Summer is the time of peak demand due to the need to cool the building to a temperature conducive to working.

Figure 7
Building Systems Maximum Demand

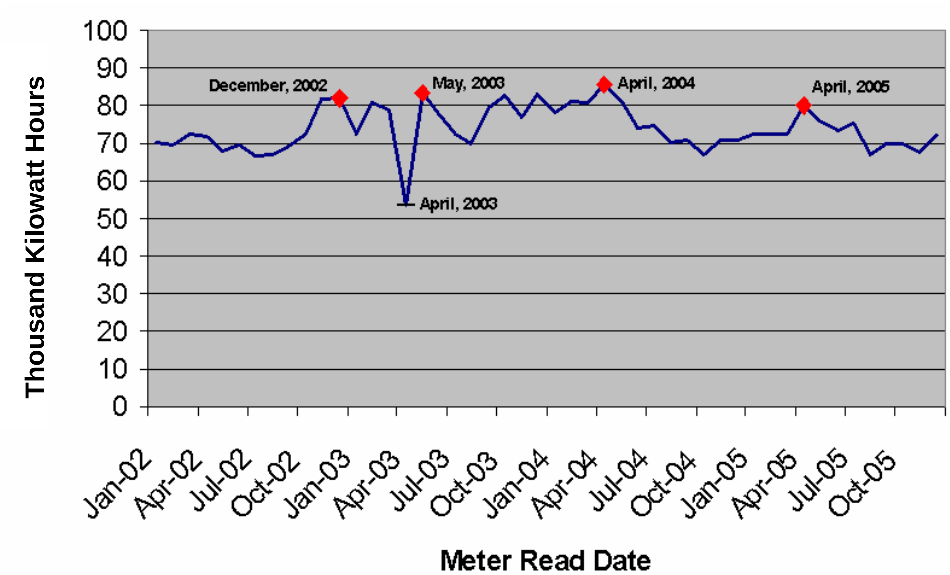


Source: MGE 2005a, 2005b

Employee-Driven Energy Consumption

Figure 8 shows the energy consumption data as reported by meter E291778 since January 2002. Squares on the graph indicate the month in which DOR experienced its maximum power consumption for the year. There is a seeming anomaly in the graph in April and May of 2003. However, upon closer inspection of the actual data, there is evidence suggesting that this anomaly is the result of specific timing of the meter read dates in those two months. In 2002, 2004, and 2005, MGE took meter readings approximately seven to 10 days after April 15 of that year. In 2003, the meter reading was taken a few days before April 15, and so the May 2003 reading captures the majority of April's energy consumption. Thus, since 2003, the power usage at DOR from electrical outlets and small motors is greatest during the month immediately following April 15.

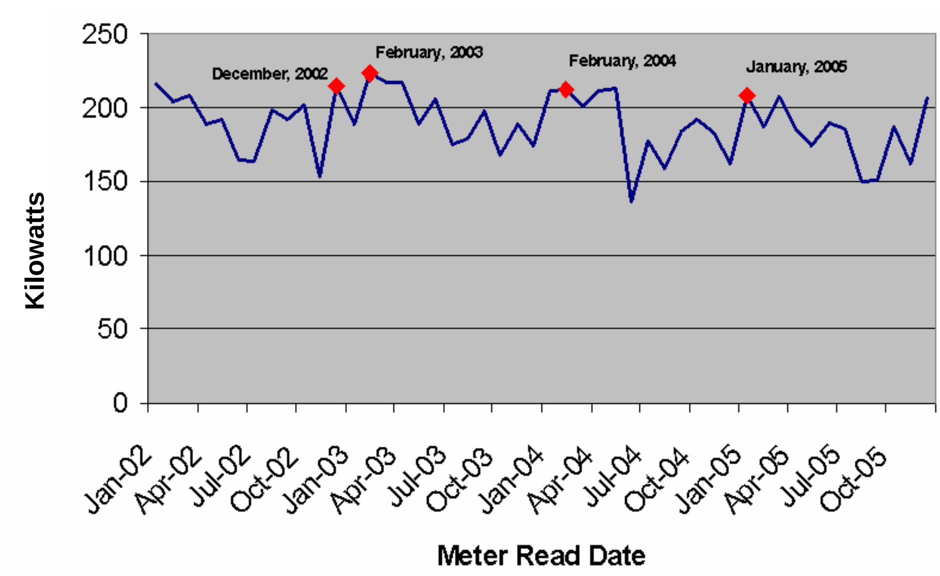
Figure 8:
Employee-Driven Energy Consumption



Employee-Driven Energy *Demand*

Figure 9 shows that energy demand peaks at unexpected times of year in the DOR building. While the electrical outlet and small motor meter tends to show a high level of power consumption from late April to early May, the highest level of demand occurs during the winter months.

Figure 9:
Employee-Driven Maximum Demand



Source: MGE 2005a, 2005b

In cross-referencing energy demand data against MGE heating degree day data, the maximum demand in each year since 2002 occurred in the month with the highest or second highest number of heating degree days, the coldest month of the year. Because this meter tracks electrical outlet usage and not HVAC power consumption, there is a clear question: Why are employees generating maximum demands for power during the coldest month of each year? We combine the following information about DOR's HVAC system to formulate a hypothesis. The DOR building does not have a peripheral heating system. As a result, workstations located near the external walls of the building may be considerably colder than office spaces located at the center of each floor. A comment made on the survey we sent to DOR employees supports this conjecture; one employee noted that jackets and space heaters are necessary to create a comfortable working environment. To the extent that use of space heaters is widespread in the winter, this offers an explanation for the seeming anomalies in the data. Due to time constraints and a lack of additional data, this hypothesis cannot be tested, and so no definitive conclusion can be drawn. However, DOR management may consider whether to give this finding additional attention and to determine the percentage of the building's staff that use space heaters on a regular basis.

Recommendations

To reduce overall building consumption and demand, the primary focus of conservation efforts should be on the building's HVAC and lighting system. Ensuring that the HVAC is operating efficiently and is cooling the building only to the extent necessary are low-cost no-cost actions that can have a significant impact on overall energy usage. Further, replacing standard fluorescent bulbs and ballasts with more efficient bulbs and electronic ballasts can reduce the building's overall energy consumption and demand.

Lighting Systems

Since November 2005, the DOR has taken major steps to install occupancy sensors in all workspaces. Additionally, evidence suggests that installing high-efficiency scotopic lighting systems will result in significant additional savings. The combination of higher efficiency equipment with occupancy sensors will minimize energy consumption and maximize cost savings. Table 3 contains a projected cost savings resulting from the installation of scotopic lighting with occupancy sensors throughout the entire DOR building.

Table 3

DOR Light Energy Usage and Cost Savings Analysis	
Occupancy Sensors and Scotopic Lighting Systems	
Cost per kWh (as of January 1, 2006)	0.07717
Number of Floors (and common areas)	8
Reduction in Energy Usage from Scotopic Lighting (based on DOA pilot)	35%
Energy Consumption per floor per week (kWh)	
Before Occupancy Sensors or Scoptopic Lighting	2252
After Occupancy Sensors	1895
After Scotopic Lighting Systems	1464
After Occupancy Sensors and Scotopic Lighting Systems	**1232**
Energy Costs per floor per week	
Before Occupancy Sensors or Scoptopic Lighting	$173.79
After Occupancy Sensors	$146.24
After Scotopic Lighting Systems	$112.96
After Occupancy Sensors and Scotopic Lighting Systems	**$95.07**
Annual Building-Wide Energy Costs	
Before Occupancy Sensors or Scoptopic Lighting	$72,295.33
After Occupancy Sensors	$60,834.65
After Scotopic Lighting Systems	$46,991.96
After Occupancy Sensors and Scotopic Lighting Systems	$39,550.55
Annual Building-Wide Energy SAVINGS with Occupancy Sensors and Scotopic Lighting	**$32,744.77**

Source: Authors' calculations

To maintain optimal working conditions, upgrades should be completed according to a timeline that allows employees adequate time to adjust to altered lighting schemes. We provide a suggested timeline for replacing the 3500 K[5] lamps that are used at DOR with the 5000 K lamps in use on the seventh floor as part of the DOA pilot to upgrade the lighting.

Step 1: Relamp the whole installation with fluorescent lamps rated at 5000 K CCT, removing one lamp from every third luminaire, except from those around the perimeter of the office space.

[5] K stands for "color temperature". Light bulbs with color temperatures of 5000 K or higher produce light similar to sunlight.

Step 2: Wait three months to allow workers time to adapt to the new lighting. Remove one lamp from every second luminaire except from those around the perimeter of the office space.

Step 3: Wait three months to allow workers time to adapt to the new lighting. Remove one lamp from every second luminaire except from those around the perimeter of the office space.

Step 4: Wait another three months to allow workers time to adapt to the new lighting. Remove one lamp from every remaining luminaire except from those around the perimeter of the office space.

Step 5: Provide task lights to workers who complain of too little light.

Recommendations

Though our recommendation is to cool the DOR building to no less than 72 degrees Fahrenheit, we note that there may be a problem with the current HVAC system that, while it requires attention, is beyond the low-cost no-cost scope of this analysis. Bert Rogers, building maintenance supervisor, noted that during the summer the heating and cooling systems must be operated simultaneously to maintain a uniformly comfortable working environment. There is little room to argue with the inefficiency inherent in this practice. Before considering any of the low-cost no-cost suggestions that pertain to the building's HVAC system, we recommend that the DOR commit resources to identifying the causes of the need to simultaneously operate the heating and cooling systems.

We adapt most of the following recommendations to reduce employee-driven electricity demand from work by the national energy research firm Platts Research and Consulting (2002) for application to the DOR building.

Interior Lighting

We recommend that the DOR replace its lighting system with a scotopic system with electronic ballasts and occupancy sensors. This will result in significant electricity consumption charges and will also help to reduce monthly demand charges. The cost savings computed in this section are not due to savings from reduced demand; savings may be higher than those presented here. It is also desirable to reduce electricity consumption and demand in the summer.

Parking Lot Lighting

The DOR parking lot is overlit. The Illuminating Engineering Society of North America recommends that parking lots be lit at an average of one foot-candle or less of light. We recommend replacing lighting fixtures with metal halide lighting fixtures and reducing wattage so as to provide less than 1 foot-candle of light.

Computers

Computers at the DOR operate on a local area network, which can waste significant energy. The computers and monitors at DOR have the ability to shift into a low-power state after some period of inactivity. While it is difficult to discern how many computers are left on overnight and during weekends, each of these computers could add over $30 to the annual electricity bill.

HVAC Cleaning and Maintenance

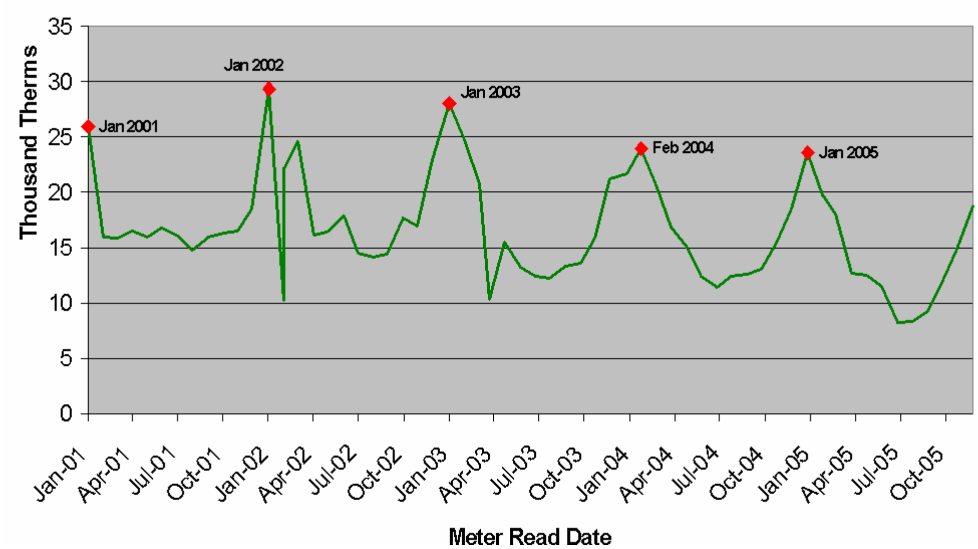
We recommend that the DOR follow the strategies outlined in the previous section, including:

- checking the economizer;
- checking the air conditioning temperatures;
- changing the filters;
- inspecting the cabinet panels;
- cleaning the condenser coils; and
- checking the airflow.

Natural Gas

Trends in natural gas usage at the Department or Revenue are shown in Figure 10. Natural gas consumption peaks during the winter when heating degree day counts are at their highest and the HVAC system is working hardest to keep the building at a comfortable temperature. Provided that the HVAC system is operating efficiently, there are no obvious problems with natural gas consumption in the DOR building. Consumption levels are declining. As of January 1, 2006, state mandate has required that the building be kept at a constant 68 degrees Fahrenheit during the winter. Given this new administrative measure, it would seem appropriate to evaluate in May 2007 how natural gas consumption has decreased. Natural gas consumption levels in 2006 should be among the lowest in the last five years, allowing for an establishment of a new baseline consumption level against which future natural gas consumption measurements can be compared. Apart from maintaining the efficient operation of the building's HVAC system, there are no low-cost no-cost recommendations that would improve upon the HVAC system with respect to heating.

Figure 10:
Natural Gas Consumption



Source: MGE 2001, 2006

Waste

Based on data provided by Waste Management Inc., we estimate that the DOR building has a waste stream that is 60 percent mixed paper and 36 percent garbage, as Table 4 shows.

Table 4: DOR Building Waste Stream

Garbage	Tons per Month	Tons per Year	Pounds per Employee per Month	Pounds per Employee per Year	Percent of Total Waste
	10	117	24	292	36%
Recyclable Material					
Commingled Recycling*	1	10	2	25	3%
Mixed Paper	16	194	40	484	60%
Total**	27	320	67	801	100%

Source: Waste Management Inc., Madison, WI.

*Includes aluminum, glass, and plastic cans and bottles

**Totals may not add due to rounding

Sixty-three percent of DOR's waste stream is recyclable. LEED-EB standards highest goal for waste stream recyclability is 50 percent (USGBC 2005). While a waste stream with a high percentage of recyclables is admirable, reducing the total quantity of waste generated should remain a primary goal of any environmentally conscious waste management effort.

Waste reduction goals

With waste baselines established, DOR can set waste reduction goals. How ambitious should these goals be? Many sustainable building programs set a long-term goal of zero building waste. This is consistent with the spirit of green building philosophy; waste reduction efforts should not end once certain targets are met. Striving to meet a zero waste target is both environmentally and fiscally sound. Consider the following examples of waste reduction efforts in the private sector.

- Allergan Inc. achieved a 32 percent reduction in cardboard and plastic waste by improving process efficiency. This effort conserved more than 544,000 pounds of these materials combined and saved more than $43,000.
- Calgene LLC conserved 400 pounds of paper, styrofoam, and plastic by switching from disposable to reusable cafeteria supplies.
- Lucent Technologies eliminated more than 475,000 pounds of paper by increasing the use of electronic commerce and reducing hard copy communications, saving more than $200,000.
- Herman Miller reduced fabric waste by more than 165,000 pounds by streamlining the manufacturing process, saving the company more than $498,800. The furniture manufacturer also reduced leather use and further decreased manufacturing waste by 8,800 pounds (US EPA 2006).

Waste reduction policy

An important first step towards achieving zero building waste is establishing a DOR waste reduction policy. An example policy, adapted from the California Resources Agency (2006), can be found in Appendix D.

More comprehensive waste management practices

The DOR should work with the Wisconsin Department of Natural Resource to develop more comprehensive waste management practices. In 2003, the Wisconsin Department of Natural Resource's Environmental Management System received International Standards Organization 14001 (ISO 14001)[6]

[6] ISO 14001 is part of a series of international standards on environmental management established by the International Organization for Standardization (ISO), a non-governmental organization made up of representatives of national standards institutes of 148 countries. The main thrust for development of the series came as a result of the Rio Summit on the Environment held in 1992.

certification (WDNR 2006a). With an overall vision of “Moving Toward Zero Waste,” DNR’s EMS establishes four goals:

1. Minimize and prevent waste, with a target of increased waste recovery and recycling;
2. Minimize the environmental impacts of landfills, with a target of minimizing the release of landfill gases and liquid leachate and the reduction of organic materials entering landfills;
3. Eliminate illegal backyard burning and dumping, with a target of reducing the incidence of illegal open burning without any increase in backyard dumping; and
4. Develop education programs to support the above goals (WDNR 2006b).

DNR waste management experts should help DOA expand its material source reduction, reuse, and recycling program by, among other actions, expanding the number of items recycled. Such items may include batteries, computers, and other electronic equipment.

Sustainable inputs

Purchasing for DOR is conducted through DOA, so this section pertains to DOA generally, and all state facilities under its direct control.

DOA’s waste reduction policy should be revised. Any waste reduction policy should include a *sustainable purchasing* subsection. Doing so will reduce the environmental impacts of the materials acquired for use in the operations, maintenance, and upgrades of buildings under DOA’s direct control. An example of a waste reduction policy that includes sustainable purchasing is in Appendix G.

Several free and easy-to-use computer programs can help building managers choose sustainable inputs. One such program is the Building for Environmental and Economic Sustainability (BEES 3.0) life-cycle methodology software. It helps users select the most sustainable products possible within a given budget (National Institute of Safety Standards and Technology 2006).

Cleaning products are often some of the most toxic substances in a building. DOA should *minimize the use of toxic cleaning products* in all facilities under its control. Doing so would be good for employee health and environmental quality. The City of Santa Monica, California, instituted a toxics use reduction program, which the EPA has highlighted for its effectiveness. DOA should consider adapting this program for its own operations.

Recommendations

Data show that 63 percent of DOR building waste is recyclable. While this is admirable, DOR should set a goal of zero building waste. To accomplish this, DOR and DOA personnel should work with DNR waste management experts. To minimize the environmental impacts of building inputs at DOR, DOA should incorporate a sustainable purchasing policy subsection into its waste reduction policy. We recommend DOA use one of several free software programs to assist with choosing sustainable inputs. Finally, we recommend DOA create a toxics use reduction program to minimize the use of toxic cleaning supplies used in facilities it manages.

Final Conclusions and Recommendations

This report has attempted to achieve two related tasks: identify a template for assessing the environmental impact of state buildings, and applying this template to a particular building. The recommendations that follow reflect both tasks.

Extend Building Reviews

We recommend that a schedule of building reviews be developed. By using the criteria we have developed, the inspections can identify opportunities for new energy-saving policies and practices, and identify whether current energy-saving policies are being implemented. Such building reviews should include physical inspections by building maintenance staff and e-mails to employees that recap DOA policies.

Identify Responsible Officers for Each Building

When applying this template to other DOA-run buildings, we suggest determining if any of the building's engineers has a strong interest in energy efficiency. Our research experience suggests that employees with such an interest would be most likely to successfully follow through in implementing our recommendations. Barring someone expressing a personal interest, we suggest having the building manager act as the project's lead contact due to her or his centrality.

Identify Responsible Office in the DOA

To ensure that the recommendations are successfully implemented, the Department of Administration should designate a point-person to a) develop a schedule for state building assessments, b) identify responsible officers for each building, and c) share with them the criteria and strategy sets provided in this report.

Use Strategy Sets

Throughout this report, we have detailed strategies that can be implemented in almost all state buildings with relatively little cost. The relevance of each strategy set depends on the nature of the building and the outcomes of building assessments. In the case of the DOR, the building has many positive energy use traits, it does have some room for improvement. Although all of the strategies detailed within this report deserve consideration, the greatest emphasis should be placed on adjusting the lighting due to its low cost, low difficulty, and high immediate payoff. We recommend the following immediate actions for the DOR building:

- Use more efficient lighting practices
- Implement a system to facilitate carpooling
- Encourage bicycling and walking to work by adding sheltered bike racks and employee changing rooms
- As current urinals break, replace them with no-flush no-touch models
- Install lower-wattage lights in the parking lot
- Clean and maintain HVAC systems on a regular basis
- Ensure that all computers and monitors are turned off at night
- Conduct regular data collections of the building's waste stream
- Set a "zero waste" goal and work with DNR to work towards it
- Write a sustainable purchasing subsection into the waste reduction policy
- Institute a toxics use reduction program

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Appendix A:
Strategy Set One: Minimize Transportation Impacts

Strategy 1.1: Encourage Mass Transit, Carpooling, and Bicycling

Purpose

Abate environmental and economic costs of commuting alone in an automobile.

Actions

1. Survey potential building occupants and determine if available mass transportation options meet their needs

2. Provide incentives, such as subsidized transit passes, to encourage occupants to use mass transit

3. Provide incentives for carpooling, such as preferred parking

4. Contract with a car-sharing company, such as Community Car in Madison, to reduce the number of cars on the road

5. Consider telecommuting options for employees

Resources to Assist with Specific Actions

1. Transportation survey in Appendix F

2. Cornell University instituted an innovative set of incentives to help manage the campus's growing traffic problems. Parking fees were raised, and the parking system was retooled to favor carpooling. Also, university students, faculty, and staff who forgo a parking pass can use unlimited, free public transportation anywhere in the county. Cornell's efforts annually save more than 400,000 gallons of fuel and 10 million vehicle miles traveled. (US EPA 2003)

   For more information, contact David Lieb, Cornell's Communications and Marketing Manager, (607)255-5592, djl5@cornell.edu.

3. Community Car (Madison), www.communitycar.com

Strategy 1.2: Use Alternative Fuels for DOA Vehicle Fleet

Purpose

Reduce air pollution associated with DOA vehicle fleet.

Actions

1. Use E85 or other ethanol and gasoline blend to fuel gas-powered vehicles in DOA fleet
2. Use biodiesel or biodiesel and low-sulfur diesel blend to fuel diesel-powered vehicles in DOA fleet

Resources to Assist with Specific Actions

1. Bill Roberts, University of Minnesota Fleet Services Director, (612) 625-8020, rober029@umn.edu
   (In 2000 and 2003, the University of Minnesota added E85 fueling stations at two campuses. Between 60 and 70 university vehicles can refuel at the stations.) (University of Minnesota 2004)

2. Rob Kennedy, University of Wisconsin-Madison, Senior Transportation Planner,
   (608) 263-3027, rkennedy@fpm.wisc.edu
   (UW-Madison started using a 20 percent biodiesel/80 percent ultra low sulfur diesel mix in its diesel fleet in early 2005. Using this blend in place of standard diesel will reduce fleet particulate emissions by 15 percent, carbon dioxide emissions by 16 percent, and cut hydrocarbon use by 13 percent.) (University of Wisconsin-Madison 2005)

Strategy 1.3: Encourage Bicycling

Purpose

Abate environmental and economic costs of commuting alone in an automobile.

Actions

1. Provide sheltered bicycle storage
2. Provide lockers/changing rooms, and showers

General Resources

Bicycle Federation of Wisconsin, www.bfw.org.

Calthorpe, Peter. *The Next American Metropolis.* Princeton Architectural Press, 1993.

Appendix B
Strategy Set Two: Maximize Water Use Efficiency

Strategy 2.1: Reduce Potable Water Use

Purpose

Maximize fixtures' water efficiency within buildings to reduce the burden on potable water supply and wastewater systems.

Actions

1. Establish baseline potable water consumption and set reduction goals
2. Use low-flow toilets, sinks, showerheads, and domestic and commercial dishwashers
3. Use infrared faucet sensors, delayed action shut-off, or automatic mechanical shut-off valves
4. Limit or eliminate the use of potable water for landscape irrigation
5. Educate building occupants and operations staff about water-saving practices
6. Post signage to encourage water conservation

Resource to Assist with Specific Actions

1. Water data collection form (Appendix E)

Strategy 2.2: Reduce Cooling Tower Water Use

Purpose

Maximize fixture water efficiency within buildings to reduce the burden on potable water supply and wastewater systems.

Actions

1. Regularly clean blowdown detector (if dirty, detector instigates blowdown early and discharges water too long)
2. If a conductivity meter exists, switch from a batch method to a continuous method (continuous, low-volume bleed-off keeps the conductivity steady at the desired level, which conserves water and reduces the need for treatment chemicals)
3. Use discharge water for irrigation

General Resources

U.S. Green Building Council, LEED-Existing Building Rating System, www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=913

Strategy 2.3: Reuse Non-Potable (Gray) Water

Purpose

To reduce the burden on potable water supply and wastewater systems.

Actions

1. Evaluate the site and building for opportunities for gray water reclamation (from exterior catchment areas, sinks, showers, etc.) and non-potable water uses (i.e. irrigation, toilets, etc.).
2. Evaluate availability of potential storage areas on the site (basins, cisterns, ponds, etc.)
3. Design and select appropriate gray water system based on site and building determinants
4. Educate occupants and operations staff about gray water strategies and systems.

General Resource

U.S. Green Building Council, LEED-Existing Building Rating System, www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=913

Appendix C
Strategy Set Three: Maximize Energy Efficiency

Strategy 3.1: Benchmark Building Energy Consumption

Purpose

Establishing building energy consumption baseline gives managers a reference point from which to measure building energy performance.

Actions

1. Collect at least five years of building's energy consumption data
2. Set energy consumption reduction targets
3. Produce an annual energy report to measure progress toward performance targets
4. Perform an annual building stock inventory using Energy Star Portfolio Manager

Resources to Assist with Specific Actions

1. Energy Data Collection Worksheet (See online appendix, mywebspace.wisc.edu/xythoswfs/webui/jmronca/DOR-DOA%20Project?action=frameset&subaction=print&uniq=jndj9b)
2. The California, *Green Building Action Plan*, sets a target of a 20 percent reduction by 2015 from 2003 levels for existing state office buildings (See, www.documents.dgs.ca.gov/green/GreenBuildingActionPlan.pdf)
3. New York State Energy Research and Development Authority (NYSERDA), *State Buildings and Vehicles Guidelines*, sets a target of a 35 percent reduction by 2010 from 1990 levels (See, www.nyserda.org/programs/State_Government/exorder111guidelines.pdf)
4. Annual Energy Report. For an example, see p. 88 of, The New York, *State Buildings and Vehicles Guidelines*, www.nyserda.org/programs/State_Government/exorder111guidelines.pdf
5. Energy Star Portfolio Manager www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Strategy 3.2: Building Retrocommissioning

Purpose

Confirm that basic building systems and assemblies are performing as intended to meet current needs and sustainability goals.

Actions

1. Perform building retrocommissioning if building has never been commissioned
2. Recommission building every five years

Resource to Assist with Specific Actions

A Practical Guide to Commissioning Existing Buildings,
eber.ed.ornl.gov/commercialproducts/retrocx.htm

General Resources

California Commissioning Collaborative, sample documents, such as plans, logs, requests for proposals, and final reports, www.cacx.org/resources/samples.html.

American Council for an Energy-Efficient Economy, *Screening Market Transformation Opportunities: Lessons from the Last Decade, Promising Targets for the Next Decade*, August 2002, www.aceee.org/pubs/u022full.pdf.

Strategy 3.3: Institute Basic Energy Efficient Operations and Maintenance Practices

Purpose

Making routine simple, low- or no-cost efficiency practices in offices will garner immediate savings.

Actions

1. Shut off office equipment when it is not in use
2. Ensure that building zones/spaces are set at appropriate temperatures:
    a. 68 degrees in winter and
    b. 72 degrees in summer.
3. Use compact fluorescent lighting where possible.
4. Wherever possible, dim hallway lighting during daytime to reduce demand charges and energy consumption.
5. Use metal halide bulbs set to low wattage in parking lot areas.
6. Light shelves can shade and prevent glare in the bottom six feet of a room. By installing light shelving on the inside of windows, external light is reflected onto the ceiling and back down onto desktops. Employees are then able to work with a greater spectral range of light, making eye fatigue less likely and increasing productivity.
7. Collaborate with information technology staff to develop and deploy logon scripts that control power-management settings. Because logon scripts tend to apply identical parameters to all users' working environments, the logon scripts should be designed to attain maximum energy usage reductions, but there should be flexibility in the policy for individual users to request that reasonable changes be made to reflect their individual work habits.
8. Cycle and restart equipment on a staggered basis to lower building's electricity load

Resource

U.S. Green Building Council, LEED-Existing Building Rating System, www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=913

Strategy 3.4: Reduce Summer Peak Energy Demand

Purpose

Saves taxpayer dollars by shaving energy demand during summer when electricity is most expensive and by lowering the need for building additional peak electricity generation units; lowers the probability of blackouts or brownouts; reduces environmental impacts of electricity generation.

Actions

No-cost actions that reduce peak energy use instantaneously

1. Raise thermostat settings.
2. Establish with electricity provider interruptible load status for building.
3. Turn off lights in unoccupied offices or conference rooms.
4. Cut electric light use by half where possible in occupied offices.
5. Turn off unused computers, printers, and other office equipment.
6. Turn off coffee makers, water cooler and heater, and ice machines if possible.
7. Reduce chiller capacity and air handle flow.
8. Take a third to a half of elevators temporarily off line.
9. Reduce exhaust air and outdoor ventilation temporarily.
10. If possible, switch to gas or steam cooling instead of electric chillers.

Peak load shedding actions for use with HVAC systems with enhanced automation

1. Use an air economizer to cool buildings at night and early morning.
2. Use carbon dioxide and occupancy sensors for demand-response ventilation to minimize use of the air handing subsystem of the HVAC system.
3. Shift peak-load through thermal storage for HVAC systems.
4. Raise set point of the chilled-water system temporarily to increase the efficiency of chiller operations.
5. Use controls to reduce lighting levels in non-critical building zones.

Operational actions to reduce peak loads

1. Implement a warm-weather dress code that allows employees to wear comfortable clothing during warm weather.
2. Adjust work schedules to reduce peak energy use, typically between noon and 7 p.m.

General Resources

California Flex Your Power, www.fypower.org

Strategy 3.5: Optimize Heating Ventilation and Air Conditioning (HVAC) System

Purpose

Maintaining the heating and cooling systems of DOA's buildings in top operating condition will help protect Wisconsin against price spikes, extend equipment life, improve occupant comfort, and minimize equipment failure.

Actions

1. Acquire up-to-date operational procedures and manuals for all equipment
2. Acquire up-to-date documentation on all building systems, including system drawings
3. Implement preventative maintenance programs in accordance with recommended maintenance schedules and maintain records of all maintenance performed for all equipment and systems
4. Identify trouble systems or components and commit to fixing at least one trouble spot each year
5. Offer professional development and training opportunities for maintenance staff
6. Create an energy operations and maintenance mission statement
7. Implement an advanced real-time monitoring program that tracks and documents building system and system component performance to identify and diagnose potential problems and track the effectiveness of the operations and maintenance program
8. Clean and maintain HVAC system properly
    a. *Check the economizer*. Many air conditioning systems are equipped with a dampered vent, or economizer, that pulls in cool outside air, when available, to reduce the need for mechanically chilled air. Unless routinely inspected, the linkage on the damper can seize or break, thus leaving the economizer open. A malfunctioning economizer can allow cold air into the building during warming months and warm air into the building during cooling months, resulting in an annual utility bill increase of 50 percent. Therefore, a licensed technician should check, clean, lubricate, adjust the controls, and repair (if necessary) the economizer once a year.
    b. *Check the air conditioning temperatures*. During cooling months, use a thermometer to check the temperature of the return air going into the air conditioning system and the temperature of the air exiting the system from the vent nearest the compressor. If the temperature difference is less than 14 degrees or greater than 22 degrees Fahrenheit, the system is not functioning at optimal efficiency and should be inspected by a license technician.
    c. *Change the filters*. Filters should be changed on a monthly basis. However, because the DOR is located on a highway, changing the

filters more often may be necessary in order to achieve maximum HVAC efficiency.

d. *Inspect the cabinet panels*. During cooling months alone, cold air escaping from the HVAC system can result in creased energy charges of between $30 and $40 per month. To ensure efficiency, fully attach rooftop cabinet panels, check that all screws are in place, and see that all gaskets are intact to prevent leakage. To ensure year-round efficiency, repeat this diagnostic every three months.
e. *Clean the condenser coils*. At the beginning and end of each cooling season, wash the condenser coils. When inspecting the cabinet panels, be sure to inspect the condenser coils as well, removing any debris that may have accumulated since the previous inspection.
f. *Check the airflow*. Hold an 8.5x11" piece of paper up to each register in the HVAC system. If there is insufficient suction to hold a piece of paper unassisted, then have a technician inspect, and clean the unit and duct work.

General Resources

New York State Energy Research and Development Authority, 2004, *Executive Order No. 11: "Green and Clean" State Buildings and Vehicles Guidelines*, www.nyserda.org/programs/State_Government/exorder111guidelines.pdf, pp. 53-61

Appendix D
Strategy Set Four: Minimize Waste

Strategy 4.1: Measure building waste streams

Purpose

Quantify current waste stream production volume.

Actions

1. Conduct building waste stream data collection
2. Establish building waste baselines for each type of waste measured in data collection

Resource to Assist with Specific Actions

Waste Stream Data Collection Form (see online Appendix, mywebspace.wisc.edu/xythoswfs/webui/jmronca/DOR-DOA%20Project?action=frameset&subaction=print&uniq=jndj9b)

Strategy 4.2: Develop an Effective Waste Reduction Policy

Purpose

Institutionalize waste reduction practices.

Actions

1. Decide how each waste type measured in data collection can be minimized at the source, and through reuse and recycling
2. Develop and institute a waste reduction policy for building

Resource to Assist with Specific Actions

1. Appendix C**:** Sample Waste Reduction Policy

Strategy 4.3: Establish Efficient Building Recycling Program

Purpose

Minimize recyclable materials in building waste stream.

Actions

1. Designate an area for recyclable collection and storage that is appropriately sized and located in a convenient area

2. Identify local waste handlers and buyers for glass, plastic, office paper, newspaper, cardboard, metals, organic wastes and other waste
3. Instruct occupants on building recycling procedures
4. Consider employing cardboard balers, aluminum can crushers, recycling chutes and other waste management techniques to further enhance the recycling program
5. Explore implementing source reduction programs

General Resources

Appendix C**:** Sample Waste Reduction Policy

Appendix E
Strategy Set Five: Choose Sustainable Inputs

Purpose

Reduce the environmental impacts of materials acquired for use in the operations, maintenance, and upgrades of buildings.

Actions

1. Materials are evaluated using a life-cycle methodology focusing on those used in large quantities or with significant negative environmental impact
2. Use non-toxic cleaning supplies

Resources to Assist with Specific Actions

1. Building for Environmental and Economic Sustainability (BEES 3.0) life-cycle methodology software, www.bfrl.nist.gov/oae/software/bees.html
2. City of Santa Monica, Toxics Use Reduction Program (See the U.S. Environmental Protection Agency's case study, www.epa.gov/opptintr/epp/pubs/santa.pdf)

General Resources

Appendix C**:** Sample Waste Reduction Policy

Appendix F
Building Occupant Transportation Survey

This survey was adapted from a survey produced by the University of Wisconsin-Madison survey center in 2006. A web-based program such as Zoomerang should be used to allow employees to respond to questions anonymously. When sending out the survey link to employees, be sure to include a brief note about the purpose of the project. The actual survey questions follow:

1.) How many miles is it **one way** from your current residence to your office?
Less than 1 mile
1 to 2 miles
3 to 5 miles
6 to 10 miles
11 to 25 miles
26 miles or more

2.) What is your most frequent way of traveling to work during **good weather**?
Walk
Bicycle
Moped or motor scooter
Motorcycle
Drive alone in car
Private commuter bus
Passenger in car (not carpool)
Driver or passenger in car- or vanpool
City bus
Other (please specify)

3.) How long does it usually take you to travel to work from your current residence in **good weather**?
10 minutes or less
11 to 20 minutes
21 to 30 minutes
31 to 45 minutes
46 to 60 minutes
61 minutes or more

4.) What is your most frequent way of traveling to work during **bad weather**?
Walk
Bicycle
Moped or motor scooter
Motorcycle
Drive alone in car
Private commuter bus
Passenger in car (not carpool)

Driver or passenger in car- or vanpool
City bus
Other (please specify)

5.) How long does it usually take you to travel to campus from your current residence in **bad weather**?
10 minutes or less
11 to 20 minutes
21 to 30 minutes
31 to 45 minutes
46 to 60 minutes
61 minutes or more

6.) On average, how many days a week do you drive a car or van to work?
Never, I ride with someone else (e.g. a friend, spouse, or carpool)
Less than once a week
About once a week
More than once a week
Every day

7.) Thinking about the times when you come to work by car/van/truck, **either as a driver or passenger**, how many people are usually in the vehicle (including the driver)?
One, I drive alone
Two
Three
Four
Five
Six or more

8.) Do you currently participate on a regular basis in a car/van/truck pool to work, either as a driver or passenger? Check all that apply:
Yes
No, I live too close to work
No, I don't know how to join one
No, I have irregular work hours
No, the cost of driving myself is not excessive
No, I need my own car after work
No, I need my car during the day
Other (please specify)

9.) Does a city bus stop within four blocks of your residence?
Yes
No
Not sure

10.) How often, if ever, do you commute to work by a city bus during **good weather**?
Never
Less than once a week
About once a week
More than once a week
Every day

11.) How often, if ever, do you commute to work by a city bus during **bad weather**?
Never
Less than once a week
About once a week
More than once a week
Every day

12.) If you take a city bus, what is the usual duration of your regular **one-way** bus trip to work, including transfers?
5 minutes or less
6 to 10 minutes
11 to 15 minutes
16 to 20 minutes
21 to 25 minutes
26 to 30 minutes
31 to 40 minutes
41 to 50 minutes
51 to 60 minutes
61 minutes or more
I never take the bus

13.) What would increase your likelihood of riding the bus? Check all that apply
More frequent service
Less crowded buses
Faster or more direct service
Free or reduced price passes
Other (please specify)

14.) Why do you not ride the bus?
I live outside the bus system
I need to run errands after work
Childcare responsibilities
I need a car during the day to perform my job
The bus takes too much time
I don’t have a pass
Other (please specify)
I do ride the bus

15.) What is your sex?
Male
Female

16.) What is your age?

17.) What is your zip code?

18.) Are there any comments you would like to make about your transportation experiences in coming to and from work?

Thank you for your time.

Appendix G
Sample Waste Reduction Policy

(Adapted from the California Resources Agency Waste Reduction Policy)

General Principles

The Wisconsin Department of Administration (DOA) recognizes the trust placed in it by the people of Wisconsin to wisely use resources in the most efficient manner possible. Therefore, DOA will

- help local government and businesses meet Wisconsin's waste diversion mandates by practicing waste reduction and recycled-content procurement in all aspects of internal and external operations;
- continuously minimize waste and support markets for recycled materials through waste prevention, reuse, collection/recycling and composting, and the procurement of recycled-content products;
- support the hierarchy of integrated waste management (first encourage waste prevention, then reuse, then recycle) when implementing waste reduction and procurement practices; and
- strive for cumulative environmental benefits when implementing waste reduction and procurement practices, such as purchasing "environmentally preferable" products that minimize both solid and hazardous wastes.

DOA will implement these principles through the following actions.

Waste Prevention

Each state facility managed by DOA will

1) Use information technology to maximize the efficient use of paper, through practices such as
   a) Setting electronic systems to default double-sided printing, including individual and network software.
   b) Printing all documents and communications double-sided.
   c) Using electronic mail and voice mail.
   d) Promoting access to agency information and publications via the Internet, prior to providing paper copies.

2) Review standard documents, templates, and publications for waste reduction opportunities, such as:
   a) Eliminating unnecessary reports and reducing report size.
   b) Using half sheets of paper for fax cover sheets instead of a full sheet (and use both sides).
   c) Designing mailers to avoid use of envelopes.
   d) Proofreading documents on screen and previewing before printing.
   e) Annually purging duplicate names and out-of-date entries from mailing lists.

3) Submit internal documents with minor handwritten corrections.

4) Utilize a centralized mailing system.
5) Review regular distribution procedures for waste reduction opportunities, such as:
   a) Circulating memos, documents, reports, periodicals, and publications, instead of distributing multiple copies.
   b) Posting announcements on bulletin boards.

6) Maximize waste prevention practices in the custodial, maintenance and landscaping practices of state-owned buildings. Contractual arrangements with facility management in leased buildings will maximize waste prevention in custodial, maintenance and landscaping practices, such as:
   a) Encouraging cafeteria discounts for use of own cup, plate, and utensils.
   b) Encouraging air dryers or cloth wipes in restrooms instead of paper towels.
   c) Implementing “grasscycling” and mulching of organic materials in place.

Reuse

Each state facility managed by DOA will
1) Establish systems that routinely reuse paper and other office supplies, such as:
   a) Reusing paper already printed on one side in fax machines, copiers, and printers, when printing draft documents.
   b) Making scratch paper and note pads with paper printed on one side

2) Reuse envelopes by placing a label over the old address.

3) Institute an office “trading post” next to supply areas to reuse supplies.

4) Donate old trade journals or magazines to libraries, schools, nursing homes, etc.

Recycling Collection

Each state facility managed by DOA will

1) Work with the Wisconsin Department of Natural Resources to set up, implement, or expand collection programs.

2) At a minimum, collect the following materials: white paper, newspaper, mixed paper, magazines, plastic, glass, and aluminum; and
   a) Provide desktop recycling containers for employees.
   b) Provide clearly labeled recycling bins near copiers, shipping and receiving areas, and in employee eating areas.

3) Periodically increase the level of white paper recycling and correspondingly decrease contaminants in white paper bins, using practices such as:
   a) Refrain from buying paper that is a contaminant in recycling, including thermal fax paper, glossy/plastic coated paper, envelopes with plastic windows, and bright colors (including goldenrod).
   b) Eliminate use of pressure-sensitive adhesives.

Procurement

Each state facility managed by DOA will

1) Buy recycled-content products (RCPs) rather than nonrecycled-content products. Quality and availability being comparable, each organization will:
   a) Buy only white copy/xerographic paper with at least 30 percent postconsumer recycled content.
   b) Purchase the product with the greater recycled content when faced with a choice of two recycled products.
   c) Use “recycled-content only” bids and RCP set-asides to purchase products.

2) Attain the mandated state agency RCP procurement goals, through practices including:
   a) Appoint a state agency buy recycled campaign (SABRC) contact.
   b) Require recycled-content information for all of the products purchased.
   c) Track all RCP and non-RCP purchases within the product categories.
   d) Annually submit the SABRC procurement report and plan.

3) Purchase products that prevent waste, through practices such as:
   a) Purchase high-quality, durable products.
   b) Purchase photocopiers with a fast, reliable duplex function designed for heavy loads.
   c) Purchase refillable pens.

4) Purchase used or reused products at every opportunity, through practices such as:
   a) Purchase reused diskettes.
   b) Reuse disks from software purchases.
   c) Purchase remanufactured toner cartridges for printers and copiers.

5) Purchase products with no packaging, less packaging, or reusable packaging.

6) Purchase products in bulk.

7) Request suppliers to reduce their packaging.

Employee Education and Outreach

Each state facility managed by DOA will

1) Develop an ongoing employee education and outreach campaign, through practices such as:
   a) Using an intranet (internal web site) to post in-house waste reduction information (policy, goals, procedures, and accomplishments).
   b) Providing all new employees with an in-house waste reduction policy orientation.
   c) Conducting employee educational activities on at least a quarterly basis.

2) Join the U.S. EPA's WasteWi$e program to show commitment to waste reduction practices.

3) Ensure all agency documents carry a recycling logo and/or environmental policy statement.

Coordination

Each state facility managed by DOA will

1) Coordinate efforts within and among organizations to improve the effectiveness of waste reduction and procurement practices, including:
   a) Organizing working groups of key personnel to implement new practices, including representatives from affected branches and from information technology and business services offices.
   b) Ensuring sufficient staff support to successfully achieve waste reduction and RCP procurement requirements.
   c) Consulting with the Wisconsin Department of Revenue where appropriate.
   d) Appointing waste reduction / recycling coordinators to implement programs and to coordinate with other organizations.

Appendix H
Water, Energy, and Waste Data Collection Forms

Water, energy, and waste data collection forms can be found online, with instructions, at

mywebspace.wisc.edu/xythoswfs/webui/jmronca/DOR-DOA%20Project?action=frameset&subaction=print&uniq=jndj9b.