ENERGY DESIGN GUIDELINE

Wisconsin Department of Administration
Division of Facilities Development (DFD)
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I. Introduction

This guideline is intended to reduce the use of fossil fuels in state owned facilities without adversely affecting program operations. Recognizing that the greatest cost of owning state facilities over their lifetime is the cost of energy to heat, cool, light and operate them, DFD expects project designs to:

1. Incorporate environmentally responsible and sustainable concepts and practices into the planning, design and construction, as described in the State's sustainable design guidelines.
2. Achieve the highest energy efficiency and lowest energy consumption that life-cycle costing will justify;
3. Incorporate the most energy-efficient materials, products, equipment and systems consistent with program and budget;
4. Incorporate renewable energy technologies at the earliest possible stages of design whenever they are technically and economically feasible;
5. Consider the impact on the utility infrastructure of the existing building/institution;
6. Utilize an integrated design approach with all disciplines working together from conceptual design on, to evaluate the energy performance of architectural design concepts (e.g.: orientation, massing, fenestration, treatment of façade, materials, insulation), mechanical and electrical design criteria and concepts to produce high performance buildings with low first costs and operating costs.

II. Buildings

General: Integrate building design with mechanical and electrical design to reduce building energy consumption (Reference ASHRAE 2011 Applications, Chapter 58). Work cooperatively as a team using building modeling and life cycle cost analysis (Guidelines for Life-Cycle Costing on State Building Projects) to evaluate and revise the basic building concepts such as orientation, massing, envelope, materials, fenestration, shading, space programming and finishes to minimize heating, cooling, lighting and electrical requirements and energy consumption. Periodically collaborate in design team peer review during conceptual, preliminary and construction document phases of design to re-evaluate energy use and achieve an integrated energy conserving design.

Programming: Group occupancies and functions based on operating schedules and ventilation requirements to allow zoning of mechanical and electrical systems for minimum equipment and fixture operating hours.

Envelope: Design for low infiltration and highest practical insulation values. Detail envelope structural penetrations, soffits, window and door openings, pipe and conduit penetrations for low air infiltration and high weather resistance. Specify Low E double or triple glazing with low shading coefficient. Reference Daylighting Standards for State Facilities.

Finishes and Furnishings: Use light colors for better illumination at lower lighting levels.

Landscaping: Select shade trees and shrubbery adjacent to buildings for reduction of cooling loads. Select plantings for minimal watering. Minimize turf areas and select native species. Specify mulches for plantings to retain soil moisture.

Equipment (Food Service, Lab, Process, Refrigeration, etc.): Select and specify water and energy consuming equipment to minimize water use and maximize energy efficiency. This includes vehicle/pedestrian equipment, security/detention equipment, commercial equipment, residential equipment, food service equipment, educational/scientific equipment, entertainment equipment, athletic equipment and healthcare equipment. Equipment shall meet or exceed efficiencies in the following standards unless determined to not be life-cycle cost effective or technically feasible:

1) U.S. E.P.A. Energy Star
2) U.S. D.O.E. Federal Energy Management Program (FEMP)
3) ASHRAE 90.1

Do not use domestic water for heat rejection.

Renewable Energy: All projects are to make maximum use of passive solar energy (typically smaller external load dominated buildings) and daylighting (Daylighting Standards for State Facilities). The design of all state facilities will, to the fullest extent possible, incorporate natural lighting, to replace the need for electric lighting during daytime hours. Use geothermal technologies for space and water heating systems where technically and economically feasible.

Projects over $500,000 are expected to make maximum practical use of active solar heating and renewable electric generation from solar thermal or photovoltaic systems, wind power, geothermal technology, biomass, fuel cells using renewable fuel or tidal or wave action and small hydro when technically and economically feasible.

III. Plumbing Systems

Water Conservation: Specify low flow fixtures (0.5 GPM lavatories/lab sinks/kitchenettes aerators, 1.5-2.2 GPM showerheads, 1.28-1.6 gallon/flush water closets, 0.25-0.5 gallon/flush urinals, 1.0-1.6 GPM foodservice prerinse sprayhead). Specify water conserving dishwashers and clothes washers. Do not use domestic water for heat rejection, heating or cooling purposes.

Pumping: Specify control to shut down domestic hot water recirculating pumps when unoccupied.

IV. Heating, Ventilating and Air Conditioning (HVAC)

General: For projects over $500,000 and for other projects as required by the DFD Project Manager, provide life cycle cost analysis (Guidelines for Life-Cycle Costing on State Building Projects) of building heating, air conditioning and domestic water heating systems taking into account first cost, energy cost, maintenance cost, replacement cost, annual recurring and non-annual costs. Select system and equipment types for lowest operating cost.

Do not use domestic water for heat rejection except as an emergency backup to another system.

Ventilation and Air Conditioning: Design to shut down as much equipment as possible when not needed or during unoccupied hours. Incorporate occupancy sensor zone controls to shut down terminal units and reduce overall ventilation air when unoccupied. Zone large single use spaces such as auditoriums, gymnasiums, lecture halls, etc. on single unit. Use hot water and steam heating systems, rather than air handling systems, for unoccupied temperature maintenance during the heating season wherever feasible.

Design air and water distribution systems and components to minimize pressure losses and fan and pump motor sizing.

Do not air condition swimming pools, mechanical/electrical rooms, unoccupied storage spaces (except food and drug storage), correctional facility inmate areas, state park toilet/shower facilities, vehicle service and storage buildings, industrial/shop occupancies, utility buildings, wastewater treatment plants and similar areas. Non-program revenue food service and laundry occupancies may only be cooled to 80^{o}F.

Gas and Oil Burning Equipment: Select for highest thermal efficiency appropriate for application. Consider use of waste oil unit heaters in service garages where appropriate.

Building Automation Systems and Controls: Use reset schedules to minimize energy use for discharge air temperature control, heating hot water temperature and humidification setpoints.

V Lighting and Electrical Systems

Reference the following design guideline and standard for electrical systems and lighting:
Electrical System Standards and Design Guidelines
Daylighting Standards for State Facilities.

VI Additional Information

Additional energy use related guidelines beneficial to designers can be found at:
DOA/DFD Energy Use Policy
Energy Cost Reduction Plans.
Sustainable Facilities Policy and Guidelines

End of Energy Design Guideline

STATE OF WISCONSIN ENERGY-USE POLICY

Wisconsin Department of Administration
Division of Facilities Development (DFD)
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I. Introduction

This policy is intended to reduce the use of energy from fossil fuels and other sources in state owned and leased facilities without adversely affecting program operations. Agency heads, building users, managers, physical plant staff and facility designers share the responsibility for achieving this goal. (Designers reference DFD Energy Design Guidelines.

II. Energy Conservation

Energy conservation is not a one-time activity or project. It is an on-going responsibility, requiring daily attention and providing daily opportunities. Reducing energy usage in state government helps state agencies to manage utility budgets and reduce the demand for fossil fuels and generation of related air emissions.

III. Agency Heads and Program Managers

Energy conservation starts here. Agency heads and program managers in state agencies are in position to provide strong leadership in the area of energy conservation. Building users, building managers, and physical plant staff look for leadership in this area and for clear direction and purpose. The management of facilities is a difficult and complicated task. Energy conservation efforts impact the physical work environment and individuals may not be

completely comfortable with set temperatures, air movement, or other environmental variables. Physical plant staff and building managers may be asked to adjust the physical environment to address individual comfort levels.

Agency heads and program mangers provide leadership and direction by reinforcing the policies that support energy conservation and working with building users to balance comfort with conservation. Clear communications regarding what to expect in work settings, support for energy conservation, and continued attention to energy conservation as a leadership and management responsibility can greatly improve the effectiveness of the state's Energy-Use Policy. Equally, lack of attention to energy conservation, poor role-modeling, and lack of support for building operational decisions can undermine the effectiveness of the Energy-Use Policy and lead to excessive use of energy in state operations.

Recognize that energy conservation is a continuing responsibility in state government and not a one-time effort to address current situations. Successful energy policies are supported visibly by agency heads and are continual, building on prior successes to achieve long-term success.

IV. Building Users

A. Buildings

Windows: Close operable windows when heating or air conditioning space. If windows have storm windows, use during heating season.

Window Blinds and Shades: Adjust blinds and shades during air conditioning season to reflect direct sunlight outdoors. At other times adjust to maximize natural daylighting. Close blinds and shades during heating season at night.

Doors: Keep passage and overhead doors closed as much as possible and do not block open while heating or air conditioning.

Elevators: Promote the use of stairs in place of elevators, where possible.

Process Equipment

Fume Hoods: Close sashes when not in use. Do not use as storage cabinets or to evaporatively dispose of chemicals.

Kilns, Drying/Curing Ovens, Sterilizers: Minimize preheat and run times. Shut off when not in use.

Food Service and Kitchen Ventilation Equipment: Shut off when not in use.

Wood Dust Collection, Process Exhaust and Makeup Air Ventilation: Shut off when not in use.

B. Plumbing Systems

Water Conservation: Avoid using domestic water as a source of heating or cooling. Water lawns and plantings before 10 a.m. or during the evening hours. Run dishwashers and clothes washers using full loads. Minimize shower time. Sweep paved areas clear of debris rather than hosing off.

C. Heating, Ventilating and Air Conditioning (HVAC)

Thermostats: In small buildings and in exterior zones of large buildings, adjust to 68^{o}F maximum in the winter and 76^{o}F minimum in the summer. Reduce to 60^{o}F during unoccupied winter hours.

In interior variable air volume zones of large buildings, adjust to 76^{o}F minimum.

In interior constant air volume zones of large buildings, adjust to 68^{o}F maximum in the winter and 76^{o}F* minimum in the summer. Reduce to 60^{o}F during unoccupied winter hours. *(For reheat systems, subject to discharge reset control strategy and temperature setting necessary to minimize cooling and reheat.)

In vestibules, stairwells, mechanical/electrical rooms, elevator equipment rooms, unoccupied storage and similar spaces, adjust to 60°F in the winter.

Dress for comfort and plan for the conditions in your working environment.

Ventilation and Air Conditioning: Shut down equipment during unoccupied hours. Use building automation systems or time clocks to automate operations.

D. Lighting and Electrical Systems

Lighting: Turn off lights when space is not in use or natural daylighting is adequate. Use task lighting to reduce overall illumination levels.

Office Equipment: Turn off personal computers, printers, copy machines and other office equipment when not in use and during unoccupied hours. Use Energy Star rated electrical products and appliances. Set up office equipment for automatic sleep modes.

Personal Equipment: Eliminate use of individual cooking, space heating or cooling appliances and incandescent or halogen floor lamps.

V. Building Managers and Physical Plant Staff

A. Building

Insulation: Repair damaged, displaced or missing building insulation.

Windows and Doors: Maintain weather stripping, glazing compound, caulking, seals and door closers to minimize infiltration. Repair broken glazing. Keep overhead doors closed as much as possible when heating or air conditioning. Close operable windows when heating or air conditioning space. If windows have storm windows, use during heating season.

Finishes and Furnishings: When refinishing and refurnishing, use light colors for better illumination at lower lighting levels. Minimize height of systems furniture and partitions for transfer of daylight.

B. Plumbing Systems

Water Conservation: Repair leaking faucets, fixtures, valves and piping. Avoid using domestic water as a source of heating or cooling. Water lawns and plantings before 10 a.m. or during the evening hours. Use maximum 0.5 GPM flow restrictors on faucet outlets and 2.0 GPM restricted flow showerheads. Use maximum 1.6 gallon/flush water closets and 0.5 gallon/flush urinals when replacing fixtures. Select water conserving models when purchasing dishwashers and clothes washers.

Pumping: Shut down domestic hot water recirculating pumps when unoccupied. Adjust domestic water pressure booster pumps for the minimum pressure and run time necessary to maintain adequate delivery pressure to fixtures.

Water Heaters: Periodically blow down water heaters to eliminate sediment buildup on heat exchange surfaces. Adjust burners and induced draft fans for optimum combustion efficiency. Adjust water temperature setpoint to minimum acceptable to building occupants.

C. Heating, Ventilating and Air Conditioning (HVAC)

Thermostats: In small buildings and in exterior zones of large buildings, adjust to 68°F maximum in the winter and 76°F minimum in the summer. Reduce to 60°F during unoccupied winter hours.

In interior variable air volume zones of large buildings, adjust to 76°F minimum.

In interior constant air volume zones of large buildings, adjust to 68°F maximum in the winter and 76°F* minimum in the summer. Reduce to 60°F during unoccupied winter hours. *(For reheat systems, temperature setting necessary to minimize cooling and reheat dependent on discharge air reset control strategy.)

In vestibules, stairwells, mechanical/electrical rooms, elevator equipment rooms, unoccupied storage and similar spaces, adjust to 60°F in the winter.

Use setback thermostats for perimeter heating zones.

Calibrate thermostats on a regular basis.

Ventilation and Air Conditioning: Shut down equipment during unoccupied hours.

Do not air condition swimming pools, mechanical/electrical rooms, unoccupied storage spaces (except food and drug storage), correctional facility inmate areas, state park toilet/shower facilities, vehicle service and storage buildings, industrial/shop occupancies, utility buildings, wastewater treatment plants and similar areas. Non-program revenue food service and laundry occupancies may only be cooled to 80°F.

Filters: Routinely replace or clean filters to minimize pressure drop.

Belts: Routinely adjust drive belts for proper tension and replace worn belts.

Bearings: Routinely lubricate motor and equipment bearings.

Dampers: Inspect dampers, damper seals, linkages and operators for proper sealing and operation. Repair and replace as needed for proper cycling, full closure and tight sealing.

Insulation: Repair or replace damaged or missing pipe, duct and equipment insulation. Provide high level of insulation in unconditioned spaces.

Piping Systems: Routinely blowdown strainers and clean strainer screens. Repair or replace leaking system components. Where excessive pump throttling is used, trim impellers or add variable frequency drive pump control.

Air Systems: Seal leaks in ductwork, around coils and in air handling equipment with duct sealer and/or sheet metal closures. Periodically check louver screens and accessible turning vanes and clean to minimize pressure drop.

Building Automation and Controls: Train appropriate building operators in the use of building automation and controls to minimize energy use. Optimize building start/stop equipment schedules to minimize operating time and stagger start-up times to limit electrical, central plant steam and chilled water demand. Shut down non-essential equipment when not occupied, heating pumps when heating isn't in demand and cooling/condenser pumps when cooling isn't in demand.

Calibrate controls and check for correct operation on a regular basis.

Review air compressor run times on a routine basis, adjust pressure setting to minimum acceptable and repair pneumatic system leaks.

Use reset schedules to minimize energy use for discharge air temperature control, heating hot water temperature and humidification setpoints.

Boiler Tubes, Chiller Tubes, Coils and Heat Exchange Surfaces: Clean fouled surfaces on a routine basis to ensure efficient heat exchange and minimal pressure drop. Use proper chemical water treatment program to minimize scale, fouling, corrosion and biological activity.

Boiler and Cooling Tower Blowdown Systems: Check and adjust automated blowdown systems to minimize blowdown while maintaining appropriate cycles of concentration.

Cooling Towers: Check and clean spray nozzles, distribution basin, fill and sump screens.

Burners: Routinely analyze flue gas and adjust burners for optimum fuel-air ratios.

Steam Traps: Routinely test and repair or replace leaking or failing steam traps.

D. Lighting and Electrical Systems

Lighting: Turn off lights when space is not in use. Use occupancy sensors indoors and photoelectric sensors outdoors when retrofitting systems. Maintain sensors to ensure lights are off when not needed. Use LED exit lights when retrofitting.

Office Equipment: Turn off personal computers, printers, copy machines and other office equipment when not in use and during unoccupied hours. Use Energy Star rated electrical products and appliances.

V. Types of Facilities

The application of the above guidelines will vary by type of building. Agency decisions regarding energy conservation need to reflect facility type and operational needs.

A. Residential Facilities

Residential facilities with varying occupancies, such as college dormitories, should schedule lighting, room temperature setpoints and equipment operating schedules to take advantage of periods of light use or no occupancy. Facilities with continuous occupancies should schedule similar energy reduction measures for unoccupied hours in common areas with intermittent or daytime only use.

B. Office Buildings

State office facilities should be managed to reflect primary business hours and non-business hours. Office facilities should take maximum advantage of energy conservation during non-business hours and weekends. HVAC systems should be scheduled to reflect the limited use of these buildings on weekends. Motion sensors for lighting and HVAC terminal control and other passive energy conservation tools should be used extensively in these buildings.

C. Research Facilities

Research and laboratory facilities are particularly energy-intensive and need to be carefully managed to ensure maximum conservation while meeting the program needs of occupants. Building users, building managers and program managers should jointly identify and implement energy conservation plans and operating procedures. Research facilities should not be operated 24x7 as if fully occupied at all times; agencies should initiate energy conservation planning for these buildings based on office building hours of operation and make adjustments, if warranted, from this. Usage may be monitored during non-business hours and on weekends to determine if HVAC systems need to be operated beyond minimal levels. Operating procedures, such as closing the sashes of fume hoods when not in use, need to be set with building users, communicated, and followed for maximum energy conservation.

D. Academic Facilities

Usage of academic facilities varies from location to location and may differ from office buildings and research buildings. Building managers and building users should assess the hours of use and plan for energy conservation based on building scheduling. Opportunities for energy conservation exist in classrooms if not used through the day, if unused on certain days, and during off-hours such as weekends and evenings.

E. Other Facilities and Infrastructure

Exterior Lighting: Evaluate the amount of exterior lighting provided around facilities and on the grounds of campuses and institutions. Lighting is required for safety, security and way finding and can be accomplished with energy-efficient fixtures. Lighting for purposes other than safety, security and way finding should be assessed and reduced as appropriate.

Athletic Facilities: Assess the hours of operation and usage patterns to identify appropriate hours of operation for HVAC systems, lighting systems, exterior lighting, and other electrical systems.

Central Heating and Power Plants: State agencies own and operate central heating and power plants at many institutions across Wisconsin. Improvements in the operational efficiency of these facilities can have significant impacts on energy usage at state facilities.