State of Wisconsin
Department of Natural Resources

Energy and Green Design

at the

George W. Mead
Wildlife Area

Green by Design

The Stanton W. Mead Education and Visitor Center is a renewable energy and green design showcase. Five different renewable energy systems heat, cool and generate electricity: wind, photovoltaic, solar hot water, geothermal, and biomass.

But it is the little things that make this an award-winning facility modeling conservation and energy efficiency: a high-performance building envelope, low-toxin recycled and recyclable materials, energy-efficient lighting and appliances, water-efficient plumbing fixtures, and much more. They are all detailed inside this brochure.

Why Green Design?

In a world of limited energy and material resources, it is the right thing to do. The Department of Natural Resources wants to model conservation in everything it does and that includes its facilities. It is economical, too. In a time of escalating fuel and electricity costs, this building uses no fossil fuels for heating and cooling, and some of the time generates more electricity than it uses. That means you as a taxpayer get more for your money and everyone benefits from less air and water pollution and greenhouse gases.

Information Sources

Midwest Renewable Energy Association (MREA)
www.the-mrea.org

Energy Center of Wisconsin
www.ecw.org

Wisconsin Daylighting Collaborative
www.daylighting.org

Wisconsin Advanced Buildings Program
www.poweryourdesign.com

Wisconsin Energy Star Homes (WESH)
www.weccusa.org

RENEW Wisconsin
www.renewwisconsin.org

WisconSUN
www.wisconsun.org

Wisconsin Green Building Alliance (WGBA)
www.wgba.org

Renewable Energy Yellow Pages
www.doa.state.wi.us/depb/boe/publications/yelpages.asp

Energy & Environmental Building Association (EEBA)
www.eeba.org

U.S. Green Building Council (USGBC-LEED)
www.usgbc.org

Environmental Building News
www.buildinggreen.com

Oikos Energy Information Clearinghouse
www.oikos.com

GreenHouse Network
www.greenhousenet.org

Thomas Brown, Architect
www.tombrownarchitect.com

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focus on energy
The power is within you.

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www.meadwildlife.org

Energy and Green Design in Your Home

You may be thinking, “OK, this green design is great for a public or commercial building, but what does it have to do with me?” The answer: Everything! The same design concepts used here can be applied to your home. You will benefit by living in a healthy home that saves money and one that is environmentally friendly.

New Homes:

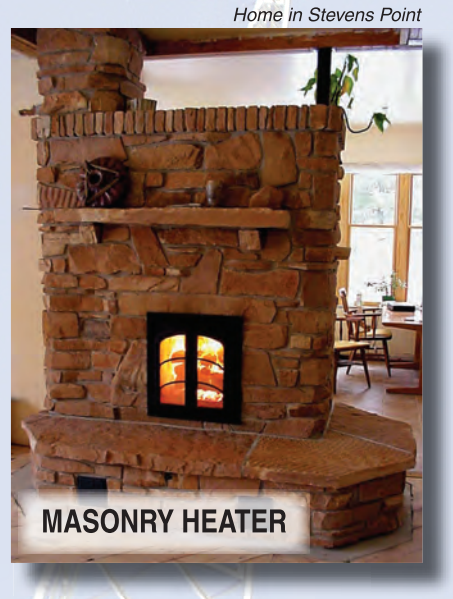
- Orient to the sun. Take advantage of passive solar heating and lighting.
- Build an efficient structure. A well insulated envelope means less energy needed for heating and cooling. Use low-e windows of the highest rating.
- Use the highest rated lighting fixtures and electrical appliances. This means choosing compact fluorescent lighting and appliances that meet or exceed the EPA Energy Star standards. Visit the Energy Star website for product comparisons: www.energystar.gov.
- Use green materials: wood from certified sustainable forestry practices; carpets, paints and furniture that emit few if any toxins and are easily recycled; water-saving faucets, shower heads, dishwashers, and clothes washers (they save energy too).
- Consider advanced energy systems such as geothermal heat pumps, a central masonry heater, or even photovoltaic or solar hot-water panels.

Existing Homes:

- Replace lights with compact florescent bulbs and fixtures. Replace old faucets, toilets, and shower heads with low-flow units.
- When replacing appliances, choose Energy Star models.
- When re-painting or replacing furniture and carpets, choose those with low toxic emissions. Select materials that are recyclable or even made with recycled content.

Home in Stevens Point

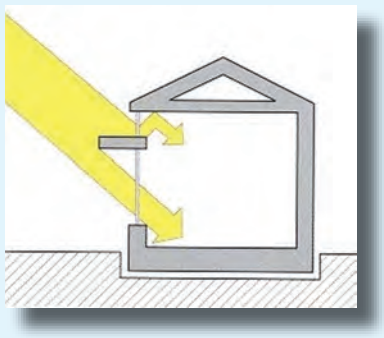
Home in Stevens Point



- Add a sunroom. You can have all the benefits of passive heating and lighting. Add solar tubes in existing rooms for natural daylighting.

Renewable Energy and Sustainable Design Features

Passive Solar Heating & Cooling



Buildings can collect, store and distribute the sun's heat by virtue of their design. An east/west elongated layout exposes more of the interior to the sun in winter and is easier to shade in summer. The choice and placement of windows or "glazing" maximizes winter heat gain and minimizes summer heat gain. Additional interior thermal mass stores the energy and minimizes internal temperature fluctuations. "Direct gain" designs allow the winter sun to penetrate deep into the interior. "Indirect and isolated gain" designs use a sunspace or mass wall between the exterior and interior occupied spaces. Passive cooling uses thermal chimneys and promotes cross-ventilation, often augmented by "whole-house" fans.

The Mead facility is elongated on an east-west axis and utilizes the "direct gain" method with good passive solar penetration during the winter heating season. Roof overhangs are designed to shade the windows and interior from direct sunlight in the summer cooling season.

Active Solar Heating & Domestic Hot Water

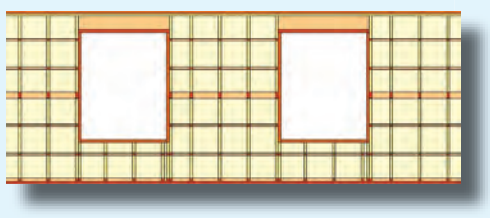
Buildings incorporate systems to mechanically collect, store and distribute solar heat. One or more collector panels are used to circulate warm air, water or other liquid through a glazed component that allows a rapid temperature rise. This heat is then stored in a tank or container and circulated through the interior space. Systems are sized to provide a major share of the space-heating load or to provide sufficient hot water for domestic use.


Solar hot water collectors

The Mead facility has a three-panel ground-mounted solar hot water collector array for domestic hot water, with a solar photovoltaic pump. It is supplemented by a Geothermal Heat Pump for hot water purposes.

High Performance Building Envelope

A high-performance building envelope is essential to minimize the energy required to operate the facility and maintain indoor comfort levels for the occupants.



The Mead facility uses interior strapped-wall construction, consisting of 2x6 structural stud walls with an added layer of horizontal 2x2 and 2x4 strapping across the inside face of the studs to provide a thermal break, reducing the ratio of solid framing to cavity insulation and providing a 7" insulated cavity. The result is airtight/super-insulated construction with wood-frame construction details modified for air-sealing. Other envelope features include:


Insulated strapped wall

- Recycled-content spray-cellulose insulation in wall cavities.
- A heavily-insulated concrete foundation & slab floor, with hydronic-radiant heat distribution.
- A raised-heel cantilevered wood-frame truss system to allow for increased levels of attic insulation.
- Extended roof overhangs sized for winter sun penetration and summer sun shading.
- Recycled-content blown cellulose attic insulation.
- Taped and sealed interior vapor-barrier.
- Airtight electrical box enclosures to ensure integrity of the wall vapor-barrier.

The projected energy savings for the Mead facility, from incorporated energy-conservation measures, is estimated at **73% better** than for a similar building built to meet basic energy codes.

Cool Daylighting & Advanced Lighting

Cool daylighting involves configuring the building design to harvest and take advantage of natural light, without allowing direct penetration of sunlight in the spring, summer and fall, to reduce electricity usage for lighting and reduce the need for additional mechanical cooling.

The Mead facility has:

- Ceiling heights tied to height & location of clerestory windows.
- Exterior overhangs to reduce glare, overheating and to reduce cooling loads.
- Interior transom windows to allow for borrowed light from adjacent spaces.
- Interior ceiling finishes and configurations to allow for bounced-light penetration into the interior.
- Interior wall finishes to allow for reflected light penetration and to reduce contrast.
- Suspended direct/indirect pendant lighting and cove lighting to provide diffuse ambient lighting.
- Supplemental task lighting at workstations and task areas.
- Sensor-operated controls for lighting fixtures.
- Low-wattage fluorescent and compact-fluorescent lighting fixtures.
- Low-wattage LED exit signs.

High-Performance Mechanical Systems

Mechanical systems should be appropriately-sized to maintain desired comfort levels, and use energy efficiently. Individual comfort control is desirable for the occupants.


Geothermal heat pumps

The Mead facility uses non-CFC equipment to avoid atmospheric ozone depletion; individually-zoned controls for heating, cooling, humidity and ventilation; zone-controlled energy-recovery ventilation equipment for mechanical ventilation & make-up air; zone-controlled in-floor hydronic-radiant heat distribution; and monitoring for indoor air quality.

Sustainable Building Strategies & LEED certification

Sustainable or "green" design practices significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas: sustainable site planning; safeguarding water and water efficiency; energy efficiency and renewable energy; conservation of materials and resources; and indoor environmental quality.

The Mead facility has been designed to comply with standards of the LEED green building rating system, which was developed by the U.S. Green Building Council for certification purposes. Sustainable design measures include:

- Reduced site disturbance at building, site access roads, parking & utilities to reduce erosion.
- Bio-swales and retention ponds to reduce and treat runoff.
- Cut-off exterior lighting fixtures to eliminate glare and light pollution.
- Non-irrigated drought-resistant plantings and restored prairie plantings to reduce water needs.
- Reduced energy load and renewable energy sources for heating & cooling.
- On-site construction waste management.
- Panelized construction to reduce construction waste.
- Construction practices to minimize contamination and degradation of materials and systems.
- Use of low or non-VOC paints, finishes, sealants, adhesives, etc.
- Operable windows for light, views and ventilation.
- Water-efficient plumbing fixtures for water conservation.
- Recycled-content building materials and finishes, such as ceiling panels, wallboard, etc.


Installing the radiant floor

Wood Biomass Energy

Biomass energy refers to energy produced from the decomposition of organic material, such as manure and waste from harvesting crops. Wood energy is stored during the tree's growth. When used properly, advanced-design wood stoves will burn wood efficiently, producing low emissions and little wasted energy. Some designs use "catalytic" combustors to provide more complete combustion and reduce pollution, or employ secondary combustion to optimize the burning of gases by maintaining high temperatures. Other designs utilize wood pellets or other agricultural-based fuels. Long-term radiant heat storage and distribution can be accomplished with a Central Masonry Heater, that employs a special refractory masonry core and an extended flue/heat-exchange channel to absorb heat from a relatively short and hot fire. They combine high efficiency and very low emissions.


Masonry Heater

The Mead facility has a Central Masonry Heater for radiant heating, with a hydronic heat exchanger for hot water radiant floor heating.

Photovoltaic Electricity

Photovoltaic (PV) electricity is converted directly from sunlight. Sunlight strikes the surface of a panel, generating electricity in the form of "direct" or DC current that is stored in batteries for later use or used immediately to operate lights, appliances and equipment designed to operate on DC. Since most buildings use "alternating" or AC current, an inverter is used to convert the DC to AC for conventional use. PV systems can be stand-alone "off-grid" systems with no utility connection, or "grid-tied" systems that allow excess electricity to be sold back to the utility. PV systems can consist of fixed panels arranged in banks of flat collectors or in sets of "tracking" collectors. "Building-Integrated" Photovoltaic Panels (BIPV) are building elements, such as roof panels, shingles or glazing, that have integral PV components. PV systems are "modular", with the ability to add panels and expand as conditions allow.

The Mead facility has a "grid-tied" 2.3 kW free-standing pole-mounted dual-axis tracking array, with 18 Kyocera KC125 125 watt panels, with an estimated annual energy output of 3,700 to 4,100 KWH/yr.


Photovoltaic and wind generators

Wind Energy

Wind Energy is produced as electricity generated by a wind-turbine, typically mounted on a tall tower to reach the higher wind speeds present above trees and other landscape features. As with Photovoltaic electricity, it is generated as DC current that can be stored in batteries or converted to AC current. A wind energy system can be "off-grid" or "grid-tied" and can also be used in combination with a PV system.

The Mead facility has a "grid-tied" 10 kW Bergey XL wind turbine on a 120' free-standing tower, with an estimated annual energy output of 8,400 to 10,800 kWh/yr.

Geothermal Heating & Cooling


Installing the ground loops

Geothermal energy utilizes an electric ground-source "heat pump" and the temperature of the earth or groundwater to store and harvest heat. A "closed-loop" system circulates water or liquid through tubes buried in trenches or in drilled wells. An "open-loop" system draws water from wells or a body of water and discharges it to repeat the cycle. The circulated water enters the heat pump at the near-constant ground temperature and a small fraction of this temperature is exchanged with a refrigerant in the heat pump. The equipment raises the pressure and temperature and this heat is exchanged with a separate internal water loop. This hot water is circulated to heat the interior. The process can be reversed for summer cooling to remove excess interior heat and discharge it to the ground.

The Mead facility has 8 closed-loop ground-source heat pumps for heating & cooling. There are 4 water-to-water units for multi-zone in-slab hydronic-radiant floor heating, with a 16 ton heating/cooling capacity rating. There are also 4 water-to-air units for multi-zone ventilation & conditioned-air, with a 13 ton heating/cooling capacity rating. Outside the building there are 32 exterior heat-exchange ground loops, each 600' long, buried 8 feet deep.