WISCONSIN
FOCUS ON ENERGY
A Powerful Vision

CASE STUDY

Learning from the sun:

UW-Green Bay goes solar

In 2001, the University of Wisconsin-Green Bay (UWGB) dedicated a new classroom building that showcases sustainable design, energy saving and energy producing technologies. This new building, Mary Ann Cofrin Hall, integrates cutting-edge solar power technology, daylighting, solar pre-heated ventilation air, energy efficient lighting and environmentally friendly building materials into one of the "greenest" buildings in Wisconsin.

Cofrin Hall under construction

Building Power

The new classroom building employs Building Integrated Photovoltaics (BIPV), an advanced type of solar technology that is widely used throughout Europe but is just beginning to be implemented in the United States. Conventional Photovoltaic (PV) systems are either installed on the rooftop of an existing building or placed on freestanding structures. With BIPV technology, structural materials are combined with PV material to create the roof, walls and windows of a building.

BIPV technology uses the sunlight falling on the photovoltaic cells to generate electricity. This electricity flows through power conversion equipment and into the building's electrical distribution system, feeding electricity to the building. BIPV technology enables the building's outer shell to not only protect the interior from the elements, but also produce a portion of the electricity.

Standing Seam Metal Roofing being installed

The Cofrin Hall PV system is the largest in Wisconsin and the largest BIPV system in the Midwest. Two BIPV technologies have been integrated into the roof and windows of Cofrin Hall: BIPV standing seam metal roofing and vision glass.

BIPV Standing Seam Metal Roofing

A portion of the building's roof uses a material called standing seam metal roofing. This material consists of long metal trays with raised edges that are snapped together to build the roof. Thin-film PV modules are glued or laminated to the tray surface. The new classroom building has 2,300 square feet of laminated modules installed on the south-facing wing.

BIPV Vision Glass

The windows in the Winter Garden atrium of Cofrin Hall use a new BIPV technology called vision glass. To the casual observer, the windows don't look different than any other window. But, they're actually generating electricity. A thin-film, semi-transparent PV panel is used as an exterior glass panel in an otherwise traditional double-pane glass window or skylight.

BIPV vision glass in Winter Garden Atrium

Skylights allow diffused light into Cofrin Hall classrooms

Electrical wires extend from the sides of each glass unit and connect to wires from other windows, building up an entire system.

Two hundred and fifty-two of these units comprise the 2,000 square foot system in the Winter Garden section of the new classroom building. The vision glass was laser-etched to create the desired light transmittance.

The vision glass installation in Cofrin Hall is the first of its kind in the United States. Given the newness for integrating this type of technology into a building, the Green Bay campus could be considered a test site for future use of BIPV vision glass on other college campuses and municipal buildings. The use of vision glass in the new classroom building will demonstrate to other designers and builders how it looks and operates, and also how to install and maintain similar systems.

Lighting the way

Daylighting aims to reduce the need for electric lighting by directing light from outdoors into indoor spaces during the day. The Cofrin Hall building design makes use of daylighting – including skylights, clerestories, borrowed light, daylight diffusers and direct sunlight – to bring daylight into its classrooms, offices and public spaces. Five different types of window glazing were selected to reduce solar gain, provide insulation, meet performance goals, and permit a "looking in on learning" atmosphere. Mechanical shading devices and occupancy sensors are also used to control light levels and use in the building. Daylighting allows electric lights to be turned off for much of the day to save energy.

Heating things up

In addition to producing electricity, solar energy also provides a portion of the classroom building's space heating needs by pre-heating ventilation air. The Solarwall® installation, an example of "transpired" solar collectors, covers 2,300 square feet of the building's south wall. These collectors that "give off" heat consist of metal sheathing with slits that allow fresh air to flow through. The metal absorbs solar radiation and heats the outdoor air pulled into the mechanical system of the building. In summer, the heated air is vented to the outside.

Meeting approval

After the BIPV and the Solarwall® systems were installed, they were tested to ensure that they were in working order and operating according to the way they were designed. This verification process, known as commissioning, was performed by Architectural Energy Corporation in cooperation with the building design and construction team.

The commissioning process began with pre-functional checklists, functional test plans, and short-term monitoring plans to assess system performance. Tests and short-term monitoring were then conducted during the latter stages of building construction. A commissioning report was also part of the process. It summarizes the results of the tests, reports on findings and provides recommendations regarding the operations of the solar energy systems.

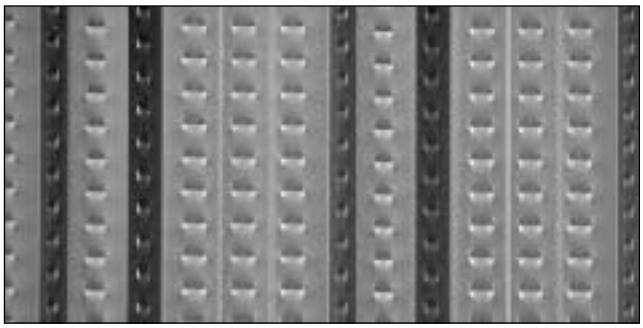
Seeing is believing

Cofrin Hall's renewable energy systems provide a rich, unique source of educational information and research opportunities for students, faculty, energy professionals and the general public. The systems demonstrate a variety of cutting-edge solar technologies to students and employees of the University and to local school children who regularly visit the campus. They will also provide training on these solar technologies for Wisconsin architects, builders and energy professionals.

Visitors to Cofrin Hall will be able to learn about the solar systems and other energy features through an electronic, interactive information kiosk installed in the Winter Garden. The kiosk provides real-time data on the performance of the BIPV systems as well as costs associated with the system and projections for future use. The kiosk draws attention to the BIPV system from inside the building and provides information about building construction.

Cofrin Hall Statistics

LOCATION	Green Bay, Wisconsin
SIZE	120,000 square feet, three stories
FACILITIES	Twenty classrooms, two distance learning facilities, faculty and staff offices
COST	$20 million
CONSTRUCTION COMPLETED	October 2001
STANDING SEAM METAL PV ROOFING	United Solar Systems Corporation, model SSR-120 (100 modules, 128 watts each) United Solar Systems Corp. 1100 West Maple Road Troy, Michigan 48084 http://ovonic.com/unisolar/
VISION GLASS	BP Solar MST-43LV (252 modules, 43 watts each) manufactured by Viracon, Inc. 800 Park Drive Owatonna, MN 55060 http://www.viracon.com
TRANSPIRED SOLAR AIR PREHEATER	Solarwall® manufactured by Conserval Systems Inc. 4254 Ridge Lea Road Buffalo, NY 14226 http://www.solarwall.com



Close-up of the transpired Solarwall®

Environmental Benefits

The BIPV system installed in Cofrin Hall generates approximately 27,500 kWh per year, enough to provide power for three to five of the building's classrooms. Additional energy savings are achieved by using daylighting, energy efficient lighting, lighting controls and the Solarwall® technology.

This system is expected to reduce the amount of coal burned by about 42,000 pounds per year. Reducing the amount of coal burned improves air quality by reducing carbon dioxide, sulfur dioxide, nitrogen oxides and other emissions. Additional air quality benefits are realized by using environmentally sensitive flooring and wall materials. These materials include low outgassing carpet, recycled porcelain tile, and rubber stairway treads and risers made from recycled tires.

Solar

Photovoltaic

Hydro

Biomass

Daylighting

Conclusion: In a class by itself

Classes began in Cofrin Hall in September 2001. It is an excellent example of Building Integrated Photovoltaic technology, using its roof, walls and windows to silently produce energy. Its design incorporates many new daylighting techniques to provide natural light, and it is one of the first buildings in Wisconsin to use Solarwall® to warm incoming air for winter space heating. The new building goes well beyond integrating its structural components with a clean, renewable energy system. It also ties together the environmental and educational mission of UWGB, the State of Wisconsin and Wisconsin Public Service Corp. with an aesthetically pleasing building design. Now that is true building integration.

For More Information

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System Specifications			
	Standing Seam Metal Roof PV	Vision glass PV	Solarwall®
System size	12.8 kW	11 kW	2,312 square feet
Installed system cost	$95,470*	$75,230*	$48,060
Projected annual generation	15,000 kWh	12,500 kWh	150 million Btu
Annual dollar savings	$930	$790	$1,060

*includes PV consultant fees divided proportionally

Total Annual Reductions to Emission Using BIPV	
Carbon Dioxide (CO2)	74,000 lbs.
Sulfur Dioxide (SO2)	240 lbs.
Nitrogen Oxides (NOx)	400 lbs.
Particulates (other emissions)	13 lbs.

Acknowledgements

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