

Fond du Lac High School, a Showcase for Renewable Technologies

By Charlie Schneider

When Margie Winter and Earl Jewett learned that Fond du Lac was planning to build a new high school, they recognized a great opportunity to demonstrate the lessons about energy efficiency that Margie teaches her students. Along with other members of the school's science department, they approached the school district and suggested that alternative fuel sources and other "green" design elements and technologies be taken into consideration for the new school.

The teachers' vision came to life in the fall of 2001 with the opening of Fond du Lac's 400,000-square-foot high school which, from an energy efficiency perspective, is the most up-to-date school building in the state. Fond du Lac High School succeeded in finding a combination of design and equipment options that enhance student comfort, reduce or avoid harmful emissions, provide a unique educational opportunity for its students and the building community, and avoid an estimated \$290,000 annually in operation and maintenance costs when compared with more conventional choices.

Getting Started

According to Jim Gescheidle, supervisor of building and grounds, the Fond du Lac School District has always been progressive in terms of energy conservation. So, the school district responded to the teachers' suggestion by creating an energy committee to explore energy efficient systems and technologies to be considered for the new facility.

Five teachers, the facilities director, and custodians made up the core committee. They also brought in professionals such as energy consultants, an architect, and electrical and HVAC engineers. As the research progressed, the committee added local utility

representatives and experts from programs that offered financial services and expertise to promote renewable resources and increase efficiency.

Doing their Homework

Committee members began by contacting resources that might help them. The Energy Center of Wisconsin suggested that they look at both ground-source heat pump technology and Cool Daylighting. Through the Wisconsin Focus on Energy, the school received a Demand Side Applications of Renewable Energy grant for technical analysis of various options. DSARE linked the committee with critical resources, including an expert at the national Geothermal Heat Pump Consortium. The committee also took advantage of an incentive program and other assistance offered by the district's electric utility, Alliant.

Geothermal systems capture the earth's natural and steady supply of heat energy and move it from the earth and through a building. In the summer, heat from the building is sent back to the ground to offset cooling loads. The committee learned that ground-source heat pumps could take advantage of the earth's heat in several ways. Soil, bedrock, water tables and other considerations determine the cost effective options that exist for any particular ground-source, heat pump system.

Committee members took two field trips to learn more about, and see for themselves, the technologies they were considering. School district representatives and the school's architect and engineer toured the Iowa Energy Center and several Iowa schools that use ground-source, heat pump heating and cooling systems. A second trip was taken to Fort Wayne Indiana to tour the Water Furnace Heat Pump Plant as well as

the DuPont Medical Center, a ground-source, heat pump manufacturer's plant, and other locations that used a closed-loop, pond design in their ground-source, heat pump system.

Committee members also attended a workshop to learn about Cool Daylighting, which incorporates natural lighting into the building design without creating excess solar heat gain or excess glare on work surfaces and computer monitors. As they closed in on the technologies that interested them the most, they grilled manufacturing representatives. Every potential design option and technology was thoroughly researched, analyzed, and considered for inclusion in the school plans.

An Integrated Hybrid System

Based on the Energy Committee's recommendations, the Fond du Lac Board of Education selected a ground-source, heat-pump system for its new high school. In addition to adopting a renewable source of energy for the HVAC system, the school also incorporated nearly every other efficiency design option that would save energy cost effectively including the latest designs in lighting and insulation specifications that exceed the state's R-value guidelines.

Ground-source, heat pump systems have been used for more than 30 years and are a proven option that is being installed in homes, businesses and schools across the country. Geothermal heat pumps are not new to Wisconsin, but the school's use of a closed-loop pond system, in which thousands of feet of pipe lie on the floor of two man-made ponds covering 12 acres, was unique in the state for a building of this size.

The most common installation, a vertical loop system, employs side-by-side pipes buried in deep wells to exchange heat. While this is cost effective in many cases, for a structure the size of Fond du Lac High School, the cost would have been prohibitive. The

closed-loop, pond system made the best use of the school's site and made the use of geothermal viable for Fond du Lac High School.

A key component of the system is the heat recovery on the ventilated air. The system recovers up to 80 percent of the heat exhausted when fresh air is brought into the school. Rooms are provided with 15 cubic feet per minute of fresh air, with seven air changes per hour. Heat recovery made it possible to have a smaller ground-source, heat-pump system that meets the entire ventilation load. Four 1.9 million Btu, high efficiency boilers back up the loop and the ventilation system during extreme weather conditions.

The school's design makes maximum use of daylight, which reduces the need for electric lighting and space cooling. The roof was designed with a higher pitch in some areas, to bring in more daylight. The high performance, Low-E glass used for the windows reduces glare as well as heat gain or loss. Window blinds between the layers of glazing reduce maintenance costs and improve indoor air quality. The school also adopted the latest technologies in efficient lighting, including energy efficient lighting fixtures, light level and room occupancy sensors, and dual lighting controls.

While some initial installation costs were higher than less-efficient options, the school board supported the approach that considered life-cycle economies. The school's operating and maintenance costs are expected to be 40 percent lower than with a conventional HVAC system. Taxpayers will benefit from the lower fuel cost and a more stable budget, since the school will be less reliant on energy resources that are subject to price fluctuations.

Many Benefits

Making the numbers and funding work was a high priority, but the committee recognized that its recommendations also had to work for the students, teachers, and staff. The geothermal system and other design decisions offer a variety of ongoing benefits including increased comfort, superior air quality, enhanced atmosphere for learning, reduced environmental impacts, and a unique learning opportunity for students and others.

For maximum comfort, a geothermal system can be zoned. The system the school district selected uses 179 water-to-air heat pumps. This includes one for each classroom, so teachers have direct control over the heating and cooling for their classrooms. Adding to students' comfort are the many benefits daylighting offers beyond energy savings and reduced construction costs. Studies show that student performance improves when daylighting is available in the classroom.

The use of renewable energy also provides a benefit for the environment. By reducing its use of coal-fired electricity for air conditioning and natural gas for heating, the school will reduce CO₂ emissions by about 15 percent.

The teachers who convinced the district to look at alternatives are now taking full advantage of the learning opportunities the school's unique system offers them. Specially installed monitoring equipment will help the school track its energy use and provide students, as well as engineers, architects and energy professionals, with an ongoing laboratory for learning about the system's effectiveness, efficiency, and impact on the environment.

Lessons for All

The Fond du Lac High School project may have begun with two teachers, but its completion is the culmination of the efforts of many people who were willing to step outside of their comfort zones. Superintendent Dewitt R. Jones notes, “There were critics of the proposal for the high school but the board’s response was that future boards would look back and thank them for making this investment.”

Along the way, the school has created and strengthened a new community of experts and advocates for energy efficient technologies, which can inform and inspire other Wisconsin businesses, institutions, and residents to explore energy options that can benefit them economically and environmentally.

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Primary Contractors

CDH Energy Corporation, energy technologies engineer

Bray Associates Architects, Inc., architect

Thelen Engineering, design engineer

C. D. Smith Construction, general contractor

J.F. Ahern Co., HVAC, plumbing and fire protection contractor

J&H Controls, direct digital controls contractor

Information and Resources

Wisconsin Focus on Energy is a public-private partnership that offers energy information and services to energy utility customers throughout Wisconsin. The program encourages

energy efficiency and the use of renewable energy to enhance the environment and ensure the future supply of energy for Wisconsin. The services of Wisconsin Focus on Energy are delivered by a group of firms contracted by the Wisconsin Department of Administration's Division of Energy.

If you are interested in learning more about ground-source heat pump systems, or other alternatives to conventional heating systems or daylighting for your school, business or farm, Wisconsin Focus on Energy is the place to start. We will help you identify, access and evaluate sources of information; link you with key programs, resources and experts; and help you navigate energy efficiency options and programs, including potential grants and financing mechanisms.

For information, call 1-800-762-7077 or visit www.wifocusonenergy.com.

Geothermal

Geothermal systems, also called ground-source heat pumps, take advantage of the Earth's ability to store vast amounts of naturally occurring heat in the soil. These systems "capture" this steady supply of heat energy and "move" it from the ground and through a building. It uses less energy—nationally estimated to be 25 percent to 50 percent less than conventional systems—saving money and protecting users from energy price variations. Using geothermal as an energy source also creates less air pollution compared to traditional heating systems that rely on combustion, either on site or at the power plant.

Daylighting

Daylighting is the term used to describe using direct or indirect light from the sun as the primary, daytime illuminant in a room or building. Wisconsin's Daylighting

Collaborative recommends Cool Daylighting, a low- to no- cost approach for new construction that provides energy savings in both new and retrofit applications. Cool Daylighting reduces the need for electric lighting and space cooling by making full use of natural light and employing the latest technology, including tinted low-E windows, energy efficient lighting fixtures, and light level and room occupancy sensors. Good daylighting design actually reduces the amount of light available to ensure high quality, spectrally neutral light that eliminates glare. It then integrates this light with quality electric light design.

Schneider is the Schools Program manager for Wisconsin Focus on Energy.