RENEWABLE
ENERGY

Clean Energy is Good for Business

CASE STUDY

BIOMASS

GEOTHERMAL

HYDROPOWER

SOLAR

WIND

To learn more about Focus on Energy, call 800.762.7077 or visit focusonenergy.com

COURTESY OF NIELS WOLTER

The Ritger Law Office building proves that energy efficiency and renewable energy can improve the bottom line for small businesses.

The Ritger law office demonstrates the value of sustainable energy design for commercial buildings

When lawyer Ed Ritger needed to build a new law office near Sheboygan, his personal interest in protecting the environment played a major role in its construction. The result is one of the greenest commercial buildings in Wisconsin: Not only is it partially powered by the sun, but it also features a geothermal heat pump system for more efficient heating and cooling, daylighting for illuminating offices with natural light, highly insulated walls and many recycled and recyclable building products. Even the wood used in the trim and paneling is from storm-damaged trees and forest thinnings. The building also stands on ground that was once a landfill. In every regard, the Ritger Law Office demonstrates a sustainable office building.

SEALING THE DEAL

Ritger learned that to ensure maximum efficiency, his two-story structure (approximately 5,250 square feet) would need to be sealed from drafts and outdoor temperatures. The building's first floor exterior walls are made from insulated concrete forms—interlocking polystyrene blocks filled with reinforcing bars and concrete. These materials provide good insulation and retain heat to reduce temperature swings. Outside the building, the walls are sided with stones collected by the Ritger family.

To insulate the second story walls, the ceiling and the rim joists, cellulose was used because it has good insulation properties and is made from recyclable materials. The siding used on the second story is made from wood fibers and cement, creating a durable, low-maintenance exterior surface. The windows Ritger chose are energy efficient double-pane glass with low-e coatings and filled with argon gas.

Finally, Ritger's contractor used durable standing-seam metal roofing to create a gambrel roof—a two-pitched roof style sometimes seen on barns.

HEALTHY LIGHTING—NATURALLY

Ritger also learned that natural lighting saves energy while keeping employees healthy and motivated. His building features 10-foot ceilings that allow natural light to reflect from the white-colored ceilings and walls for glare-free illumination.

PHOTOS COURTESY OF NIELS WOLTER

(above left) **T-shaped windows on the south side of the building increase the general light level in the office while reducing glare on computer screens.**
(above right) **Photovoltaic thin film was applied on site to conventional standing-seam metal roofing panels, shown here ready to be installed on the upper surface of the building's gambrel roof.**

High ceilings and light-colored walls help bring light far into the first floor of the building. Fluorescent lights have automated controls that allow dimming when natural light is available. The east and west walls have just a few windows in order to reduce glare and solar heating in the summertime.

Sun tubes bring light into interior spaces on both the first and second floors. Sun tubes are highly reflective tubes that light a room by reflecting light from a domed outdoor opening onto a ceiling fixture that resembles a ceiling lamp.

ENERGIZING THE ROOF

Capturing the sun's power for electricity was one of Ritger's main goals. He chose to cover part of the roof with thin-film photovoltaic (PV) material. This material was shipped in rolls, laminated onto the standing seam roofing panels, and installed on the upper section of the south-facing roof.

Ritger's building-integrated solar electric roof section is 96 feet long by 10 feet wide (960 square feet). The solar electric roofing provides reliable shelter while generating about 6,400 kWh per year of environmentally friendly electricity.

Though the building's annual energy use is greater than the energy produced by the solar electric roofing, the system nevertheless offsets some of the need for purchased power. During times of low occupancy, excess power is fed into the utility grid, providing power to neighboring homes and businesses.

PUTTING ENERGY IN STORAGE

The Ritger building is also protected against utility power outages. Eight of the 80 PV panels are dedicated to charging the batteries of an uninterruptible power supply (UPS) system. If utility power goes out, the UPS system can provide power for four hours to the phone system, computers, lighting and circulation pumps. During extended outages, all 80 PV panels can support the UPS system. Once the batteries are fully charged, the excess power from these eight panels is fed into the utility grid.

TAKING IT UNDERGROUND

Instead of putting in a furnace, water heater and air conditioner, Ritger installed one system that could do the job of all three while using a local renewable resource. A geothermal heat pump (GHP) system provides heating, cooling and hot water to the new office building.

The six-ton unit heats and cools the first floor by drawing well water into a heat pump for the in-floor radiant heating system. This heat pump is an open-loop system where well water is circulated through a heat exchange pipe and discharged into a one-acre pond (see diagram). In the summer, this water is cooler than the ambient temperature; in the winter, it is warmer.

The second floor is heated and cooled with a three-ton geothermal heat pump in a forced air system. In a forced-air heat pump system, the blower and refrigerant coil provide both the heating and cooling, and the refrigerant in this case is well water. Air is distributed through a duct system above the ceiling and is controlled by a centrally located programmable thermostat.

A BREATH OF FRESH AIR

The building includes an air-to-air heat exchanger to provide the ventilation required by the commercial building code. The exchanger uses the heat exhausted from the conference room and restrooms to preheat outdoor air before it's blown into the building's air ducts. This provides fresh, heated air to every room in the building, while keeping humidity at a comfortable level.

A two-stage blower operates continuously at low speed (approximately 400 cubic feet per minute) when people are in the building. When a restroom or conference room is occupied, it switches to high speed (500 cubic feet per minute). When the building is empty, it turns off.

AFTER THE HONEYMOON

When Ed Ritger leased the building's remaining offices; he found that the green design helped sell the space—not because his tenants particularly value energy efficiency, but rather because the

building is exceptionally comfortable. Even on an overcast winter day in a room with only north-facing windows and no lights on, lighting levels are more than adequate, the air is fresh and the first-floor radiant heating keeps feet warm.

Much of the building's success stems from Ritger's judicious selection of features. For instance, occupancy sensors are commonly used in office buildings to make sure lights are turned off when no one's around, but he chose not to install them for cost reasons. Today, he suspects that such sensors would activate the lights more often than his staff does because the daylight is almost always sufficient—so good, in fact, that he considers cool daylighting the building's most surprising success.

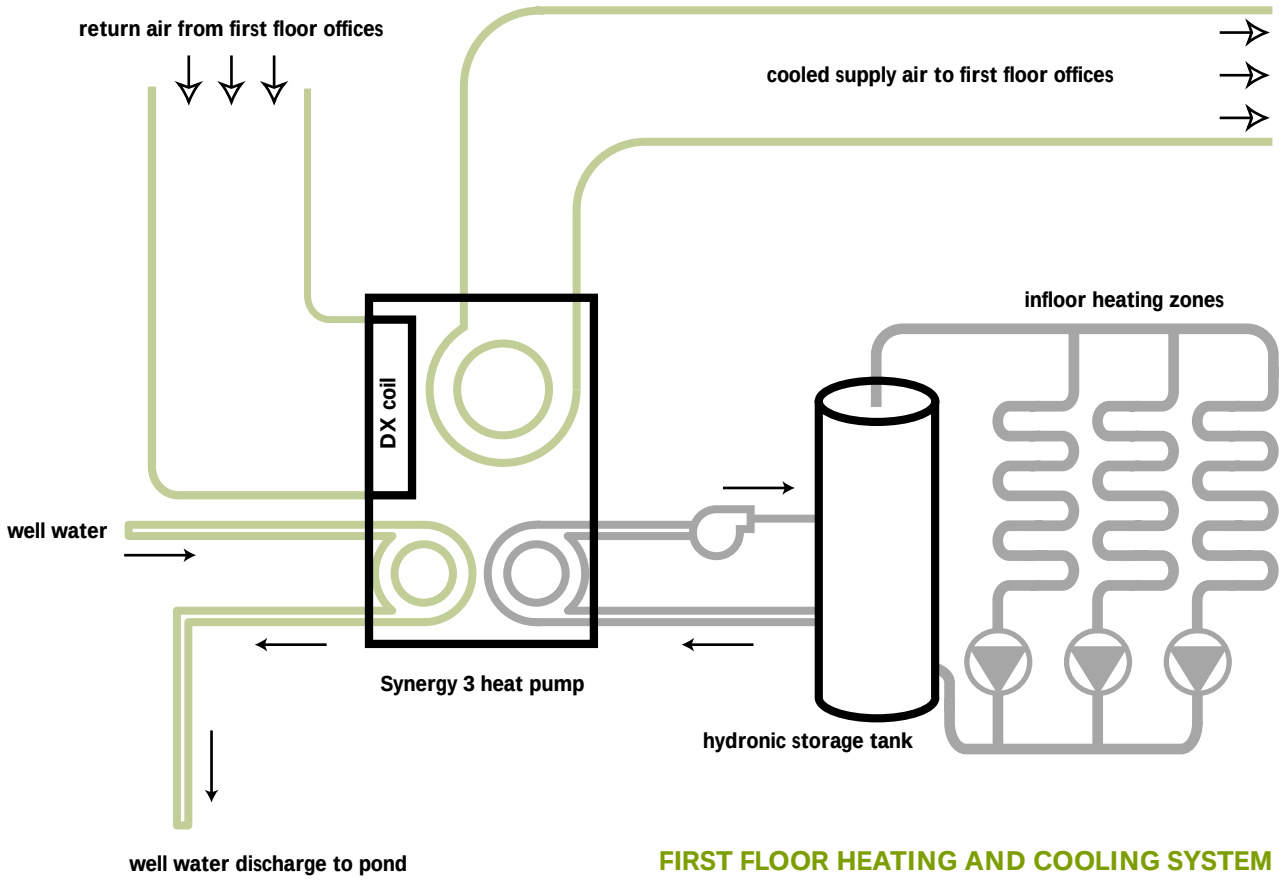
On the other hand, Ritger is very happy to have spent more than originally recommended on his battery backup. Snowstorms have twice knocked out the power to the building, but the PV-charged batteries kept critical functions going. What's more, the water running through the floors holds heat for so long that the circulating pumps could be off for two days before anyone noticed.

Many of the building's green features—daylighting, recycled lumber, dimmable lighting—require the same or less capital than the mainstream alternatives, in addition to reducing operating costs and providing a hedge against volatile fuel prices. Perhaps the strongest indication that Ritger considers the building to be both a technological success and a sound investment is that he's considering building a duplicate of it on an adjoining lot.

CONCLUSION: MAKING THE GRADE

In its first nine months of operation, the energy bills for the all-electric 5,250 square foot Ritger Law Office were $75 to $150 per month. (In comparison, the energy bills for the previous Ritger office building, which at 1,700 square feet was one-third the size, were $90 to $200 per month.) Now that all the space is occupied, the bills are still only $240 per month. The staff in the office building is very comfortable with their building. And thanks to the daylighting, insulation and concrete walls, the heating and cooling system is shut off during most of the spring and fall months.

RITGER LAW OFFICES



FIRST FLOOR HEATING AND COOLING SYSTEM

The Ritger Law Office Building is heated and cooled by two water-source geothermal heat pumps, both of which use well water. This diagram shows the heating and cooling system for the first floor, which employs hot water radiant heat in the floor and ducted forced air cooling. Heating and cooling for the second floor are both ducted forced-air.

SYSTEM DIAGRAM COURTESY OF JOHN PIPCORN

Case Study Facts

Ritger Law Office

Date Completed: December 2000

Personnel

Owner: Ed Ritger (Ed and Stephanie Ritger were their own general contractors)

Architect: LIM Architects, Inc. Sheboygan, WI

Solar Energy Consultant: L&S Associates, Spring Green, WI

Building and Site

The Ritger Law Office building is located in Random Lake, WI. Building cost of the 5,250-square-foot building was $110/square feet, and energy costs average .02 per square foot compared to $.09 per square foot at the law firm's previous space (a 78 percent reduction).

Equipment

GEOTHERMAL HEAT PUMP

Installed by John Pipcorn of Butler, WI, the geothermal heat pump system is open-loop, groundwater-source (well), discharging into an existing pond. The first-floor unit is a six-ton WaterFurnace Synergy3, which heats via radiant in-floor piping and cools via a forced air system with blower and refrigerant coil. The second-floor unit is a three-ton WaterFurnace Premier which both heats and cools via forced air.

PV SYSTEM

Installed by Lake Michigan Wind and Sun of Sturgeon Bay, Wisconsin, the PV system is grid-intertied with battery back-up for uninterruptible power. Eighty 64-watt thin film Uni-Solar panels (5.12 kW total), laminated to standing-seam metal roofing. Eight 64-watt panels are dedicated to recharging battery bank. There are two Xantrex SunTie inverters, ST2500 (2.5 kW capacity each), and one Xantrex inverter SW 5,548 (5.5 kW). Sixteen 12-volt batteries provide 420 amp hours total capacity.

VENTILATION

The energy recovery ventilator is a Venmar Van-E 500ei

Equipment Costs and Benefits

INSTALLATION COSTS

PV System: The system cost $51,090, and generates 6,400 kWh/year, displacing $584 of utility-generated electricity/year (calculated at the "green" rate of $0.0912/kWh).

Geothermal System: The system cost $31,000, including in-floor piping, and produces 106 million Btu per year, displacing $2,000–$3,000 per year in electricity and natural gas costs.

The above systems received a $10,000 grant from the WisconSUN PV demonstration program, and a $23,000 grant from the Wisconsin Focus on Energy Pilot Program as clean energy incentives.

ENERGY AND ENVIRONMENTAL BENEFITS

Pollution avoided: 25,133 lbs CO_2; 26.6 lbs Nox; 51.1 lbs SO_2

(Calculations based on 1.988 lbs CO_2/kWh; 4.16 lbs Nox/MWh; 7.99 lbs SO_2/MWh and 117.08 lbs CO_2/MMBtu)

Focus on Energy is a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. The goals of this program are to encourage energy efficiency and use of renewable energy, enhance the environment and ensure the future supply of energy for Wisconsin. **800.762.7077. focusonenergy.com**

focus on energy℠
The power is within you.