CLIMATEMASTER®

Chewonki
Wiscasset, ME

Commercial Case Study

Maine's Chewonki Goes Green

The ultimate display of sustainability is to educate the next generation. After all, it's the younger set who'll be more conscious of our finite resources than today's consumers.

Wiscasset, Maine-based, nonprofit educational institution, the Chewonki Foundation, is doing just that. Nature-based courses are the majority of the curriculum, which can range from hour-long sessions to entire semesters. The Foundation took learning to a new level for the 40,000 students enrolled in any one of seven different courses.

The Foundation's largest building, the Center for Environmental Education, received an interesting addition to its mechanical system last year. A portion of the building's heating system was converted from fuel oil to an open-loop, water-to-water geothermal heat pump system. The retrofit is integrated with a data-logging unit which measures and records performance data.

The data, presented in a user-friendly format online, is available to Chewonki's students and incorporated into many classes and demonstrations. The information is transmitted to the Web by HOBOlink, a data-logging server. The geothermal retrofit is as much an ongoing experiment as it is a mechanical system upgrade.

The Maine Public Utilities Commission (MPUC) funded the project and insisted on data logging, hoping to gather impartial data on the efficiency of geothermal systems. The commission seeks hard information because managers there are actively researching the possibility of incorporating geothermal systems into public housing projects.

A link to the information can be found on the Foundation's website (chewonki.org). The data, updated automatically every five minutes, is displayed in several forms, including a user-friendly line graph.

Building, naturally

The students at the Chewonki Foundation are immersed in nature nearly every waking minute, something that the Foundation feels is the very core of deep-seated respect for the natural world. But, when weather doesn't permit outdoor learning, the two-story Center for Environmental Education is where the classes are held.

In addition to housing five large classrooms and staff offices, the building also has a 1,500 s.f. meeting room, Chapin Hall, known affectionately as the "whale room," stemming from the oddity of having a 30-foot finback whale skeleton suspended from the ceiling. It's this room, with high ceiling and plenty of glass in two exterior walls, that posed the greatest challenge to maintaining indoor comfort. That is, until the idea of a geothermal solution was raised.

And so, while the rest of the building's heat is supplied by fuel oil (see sidebar), the whale room and its human occupants are heated by geothermal energy.

"Chapin Hall was chosen as the location of the experiment for two reasons," said Peter Arnold, sustainability coordinator at Chewonki.

Arnold explained that the space is an ideally-sized heat load for the system (cooling in Maine was not a concern). Also, downstairs, the existing radiant heat manifold for Chapin Hall is located close to the geothermal heat pump, a three-ton TMW system manufactured by ClimateMaster. "This helps visitors without a mechanical background see and understand the entire system," added Arnold.

Mid Coast Energy Systems, based in Damariscotta, ME completed the original, oil-fired mechanical system installation as well as the geo retrofit. The 35-person company does installations and service in heating, plumbing, air conditioning, water treatment, geothermal, solar and IAQ.

According to John Blodgett, installation manager at Mid Coast, a staple-up, plated, PEX radiant heat system was installed on the ground floor of the entire building when it was completed in 1998, including Chapin Hall. Heat comes from two oil fired boilers in the basement. The second floor is heated by convection baseboard.

On top of the Center building is a solar array, consisting of 42 Photovoltaic (PV) modules, each producing 85 watts of power. What makes the array unique is its hybrid design. Under the panels is a Solarwall heat collector that preheats air going into the building's ventilation system in the winter, and also strips heat off of the PV modules, making them more efficient.

Au naturale with geo

The three-ton ClimateMaster TMW geothermal system was brought in to serve as the new, primary source of heat Chapin Hall's radiant heat system, allowing MidCoast pros to deactivate the first connection between the well-insulated, under-floor PEX tubing network and the oil boiler. "We calculated and re-calculated the heat load for the Center and came up with a well-confirmed need for 36,000 BTUs on a design day of -10F outdoor ambient," said Dr. John Logan, regional director for Water Energy Distributors, Inc (WEDI). "The three-ton geothermal system was a perfect fit, down to the last BTU."

According to Blodgett, they used several Taco components in the system, including the main and zone pumps, as well as mechanical water tempering equipment. The radiant heat flows through eight-port supply and return manifolds. "We prefer Taco gear because of its proven reliability with us," added Blodgett. "Precise flow control to the extensive, low-temp radiant heat system is a given with the right gear in place."

The water-to-water geothermal heat pump provides mechanically-tempered heat to the meeting hall via eight, 300-foot, 1/2" PEX radiant heat loops. The TMW unit is connected to an open loop well with a depth of 325 feet, and a recharge rate of 25 GPM; more than adequate. "We're very fortunate to be situated directly above a large aquifer, perfect for open-loop operation" said Arnold.

Water for the geo system's thermal exchange is pulled from the ample supply in the well, used for geo-exchange, then discharged into a drain that spills into a wetland nature area in the center of the campus.

The pilot geo system, which has just completed its first heating season, produced about 14.5 million BTUs at

an approximate COP of 4. As expected there were lessons learned. When the seasons data was collected the heat pump appeared to achieve a COP of 3 which was lower than expected. On inspection it was found that the BTU meter had been installed ahead of rather than after the heat pump. Calculations show the correct figure is a COP of 4 which will be verified next season with the meter in the correct location.

Refining the experiment

Two BTU meters record BTUs extracted from the well water and BTUs sent to the floor. A kilowatt sensor measures the draw of all of the system pumps and circulators. Temperature probes measure the air inside and outside the structure, as well as the temperature of water going into and coming out of the ClimateMaster system.

The entire project was funded through a grant from the Maine Public Utilities Commission (MPUC). In return, the Chewonki Foundation collected all data from the geothermal heating system through the heating season and made it available to the public. A report on this seasons successful geothermal heating experience will be submitted to the MPUC shortly.

The Downstream Dream

"Chewonki is an amazing place, open to innovative ways of doing things," said Dr. John Logan, regional director for Water Energy Distributors, Inc. (WEDI), a company, based in Hampstead, NH. They are a distributor of geothermal heat pumps, serving New England and New York (WEDI refined the "standing column well" ground source coupled heat pump approach in the 1970s).

Logan explained that when oil prices rise again, it's going to make the buying market much more receptive to new and different ways of doing things. "We believe that within a few years Chewonki will renew their interest in an idea we proposed initially for the Center: the 'half-sized' geothermal system approach," added Logan.

Logan explained that a half-sized system would meet the great majority of heating needs – potentially 90 percent of what the Center would require. And, when temperatures dip into the nether regions of winter's worst, that's when the oil-fired boilers could easily meet the need for supplemental heat.

"The Center would receive most of its annual heating from the half-sized geothermal system which, up front, would cost Chewonki only half as much as a full-service system would cost," continued Logan. "The existing boilers are already in place and could easily supply the additional heat when called upon. It's an approach we're eager to see more, especially well suited for retrofit applications."

Chewonki

Mechanical Contractor:
Mid Coast Energy Systems

HVAC Manufacturer:
ClimateMaster, Inc.
climatemaster.com

Equipment:
Tranquility® Water-to-Water Unit (TMW036)

ClimateMaster is the world's largest and most progressive manufacturer of geothermal heat pumps. The company is committed to innovation and dedicated to environmentally clean, economically sound and superbly comfortable home and business environments.

ClimateMaster has been designing and building equipment that enhances the environments we live and work in every day for more than 50 years. In addition to geothermal heat pumps, ClimateMaster offers the most extensive product line of water-source heat pumps for use in a wide variety of applications. ClimateMaster products are proudly built in the U.S.A.

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