Hot and Steamy: Ground-Source on Campus

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Even historical buildings can take advantage of heat sourced from the ground, like Davison House at Vassar. **(Vassar College / Tamar M. Thibodeau)**

In true necessity-is-the-mother-of-all-invention fashion, the folks at the College of Southern Idaho (CSI) have added innovation to innovation as they've expanded their 1979 **ground-source heating system** to accommodate an ever-expanding campus.

"We started off with 5 or 6 buildings that were using geothermal as direct injection," explains Allen Scherbinske, the CSI's assistant physical plant director. "As the campus grew, we retrofitted our buildings and then added water-source heat pumps. This allowed us to add buildings and reduce our water consumption by about 75 percent in each building where water to water heat pumps are being used, which gives us additional water to build future buildings as well."

Ground-source heating and cooling systems are catchy things. Promising to provide low-carbon conditioning for buildings of all shapes and sizes, geothermal heat pumps, as they're often called, are incredibly reliable and cost-effective. They're so popular that most institutions with geo-heat pumps--including **College of Southern Idaho** with a modified open loop system and **Vassar College** with 35 closed loop geothermal wells--continue to expand their use throughout campus.

There are a number of users tapping into the geothermal source, and in order to maintain adequate levels within the aquifer a moratorium is now in place to restrict how much each user can draw. CSI's water consumption cap is 6.2 cubic feet per second. Knowing they could squeeze even more energy from their existing system, they devised a way to stretch out the water to provide heating for more buildings.

Today, the two original wells at CSI provide heating for 663,705 square feet spread over 17 buildings--enough to condition 80.2 percent of their campus' entire square footage. The same system will also provide conditioning for their new LEED-Gold building set to come online in January 2010.

Heating such a large total space with so few wells hinges largely on the high temperatures and volume of their geothermal water source. Open loop wells delve deep into the earth to extract hot groundwater that is

then pumped through the system. "We get [geothermal] water that's 100 degrees Fahrenheit (with an **artesian** element to it) out of our 1,800-foot deep vertical wells, which is a medium temperature source," says Scherbinske. Extracting the heat as it moves through several buildings and then reheating it again with geothermal heat pumps around campus allows them to extend the overall heating capacity to many more buildings.

CSI's original heating and cooling system has been expanded to accomodate more buildings since its installation in 1979. **(Randy Dill/ College of Southern Idaho)**

And stretching the water means stretching their dollars. Using their hybrid system, they're able to get about $4 worth of heat from $1 worth of electricity drawn from Idaho Power. Compared to conventional heating, this system saves the school big time every year. Randy Dill, physical plant director at CSI, explains the numbers: "If we were to buy a gas-fired boiler system to replace our geothermal system that we use now, the price for running that boiler over one season of heating would run us almost $260,000."

The operational savings aren't the only benefit of CSI's heat pumps, according to Dill. "Compared to a conventional heating system there are some different maintenance duties--such as removing and replacing well casing and rebuilding pumps--but these are required very infrequently." Although there was an initial investment in stainless steel equipment (any other material becomes corroded by the geothermal water), their ground-source system has been very low-maintenance, even after 30 years of service. "Over time, certain parts deteriorate requiring us to recondition the well," he explains. "It costs about $15,000 each time, but we've only had to do this twice in my 11 years."

Dennis Nieves, HVAC supervisor at Vassar College, also reports a high level of satisfaction with Vassar's three geothermal wells. "Primarily the only maintenance we do is filter changes. We've had one or two fans and pumps burn out, but other than that, they're very reliable. They're less maintenance that most other systems."

And although they are controlled somewhat differently than traditional conditioning units--they have to be switched from heating to cooling mode when summer hits, and back to heating mode in the fall--students become very familiar with the systems in no time at all. "The only grumblings we hear from students occur when there's a disagreement about how cold or warm to set the thermostat."

Vassar's three ground-source systems are spread throughout campus and are part of their efforts to tap into a source for heating and cooling that would reduce their carbon footprint. "If we had installed energy efficient gas fired boilers we actually would have spent less in capital expenditures but we would have increased our carbon footprint," comments Thomas Allen, executive director of Buildings and Grounds Service.

Research for the Draft Sustainability Plan revealed that 80 percent of Vassar's carbon emissions were related to heating and purchased utilities (for electricity). The plan, which currently calls for improvements in building efficiencies and reducing energy consumption for heating and cooling, was the impetus for choosing geothermal, and when a target for institutional greenhouse gas emissions is set in the near future, these goals will be updated.

The original geothermal system was installed between 2001 and 2002 to provide heating and cooling for the Terrace Apartments (student residences). This was augmented this year with two new installations. Ten units came online January 2009 for the townhouse apartments for heating and cooling.

Part two of this year's ground-source installation saw a geothermal system

drilled into the ground at the 105 year-old Davison House (a 66,700 square foot dorm for 182 students and one faculty member) to provide year-round cooling for data closets. Paul Rammelsberg of the **S/L/A/M Collaborative** who worked with Vassar on the 2009 project explains: "In this building, the geothermal was selected primarily for its unique benefits--its ability to operate efficiently year-round and because it did not need an outdoor condensing unit ... Given the siting and design of the building, it would have been very hard to hide [a condensing unit on the roof or on grade]."

Rather than tapping directly into a geothermal steam vent, the wells in Vassar's systems take advantage of the average difference in ground versus air temperature to provide heating and cooling and are therefore shallower than those at CSI--typically 300 feet each--but they still provide the equivalent of about 31,500 BTUh of energy. "During the design of the townhouse project, we calculated approximately 20 percent operating savings on the cooling side with geothermal," Rammelsberg says. "Heating costs with the geothermal, at the utility rates Vassar was paying at the time of the analysis, were slightly more expensive. That could easily flip if the cost of gas were to rise faster than the cost of electricity, which we thought to be a somewhat likely scenario."

Though CSI and Vassar have adapted geothermal technology in widely different ways to suit their campus heating and/or cooling requirements, it's evidence that geothermal is accessible to campuses across the country, whether they're located over deep geothermal steam vents or not. And with lower overall costs and reduced maintenance requirements, it's no surprise that Vassar and CSI, as well as many of the **other institutions** using **ground-source heating and cooling**, are pleased with their geothermal investments. The repeated use of the technology is confirmation enough. "Adding geothermal heat pumps over the years has allowed us to accommodate the HVAC needs of our growing institution," reflects Dill.

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