



KENDYL DEPOALI MIDDLE SCHOOL | CASE STUDY

Alerton behind a geexchange heating and cooling system allows middle school to earn top scores for energy savings

Conception of the brand new Kendyl Depoali Middle School in the South Meadows neighborhood of Reno, Nevada, started out with the question “What if?” Begun in 2002, the design of Washoe County School District’s newest middle school was a community effort from start to finish. District stakeholders held more than 15 town hall meetings during which administrators, educators, parents, architects and engineers solicited and gathered community input that directly influenced the final design.

The district wanted Kendyl Depoali to be “an icon of how all future schools would be constructed and maintained in the district.” To that end, they chose a facility design that was as cost, energy and water efficient as possible, and could subsequently be used as a teaching tool for environmental stewardship. At the core of the design for the environmental controls was a closed loop



Vivid, comprehensive graphics enable Kendyl Depoali Middle School students to see customized displays of building and energy data.

geoexchange—also known as ground source—heating and cooling system, which uses the earth’s relatively constant underground heat temperature to provide heating and cooling to the school’s individual mechanical systems. Although

geoexchange heating and cooling is a standard component for the district—five other schools feature the system—Kendyl Depoali Middle School’s system would be the most ambitious and its success the farthest reaching. To tie the geoexchange system into the overall building controls, Washoe County School District chose Alerton’s local service provider Wilson-Mohr and its associate dealer, Building Control Service Inc (BCS).

“There were three main areas of consideration when we designed this building: There’s the incredible learning environment that we’ve created; the green sustainability; and the cost efficiency of this building,” said Elizabeth Wright, director of accountability, finance and public relations, Washoe County School District.

The district and the community wanted Kendyl Depoali to be an example of how a school could operate at peak energy efficiency while creating a learning-conducive environment for more than 1,400 students, and staff and visitors as well. From centralizing its lighting and environmental controls to monitoring its water and electricity use, Kendyl Depoali would personify cutting edge green sustainability.

Of equal importance was the ability of Kendyl Depoali teachers to use the school’s mechanical systems as a teaching tool. That meant enabling educators to use the devices and metrics that actually run the school’s systems in their lesson plans for math, science and other curriculum.

“We wanted to show the students what the building actually does,” said Joe Gabica, director of planning and design for capital projects, Washoe County School District. “That way, it’s tangible and means more to them.”

For \$210 a square foot, we have constructed an amazing learning environment that is green and will cost less to operate in the future for the school district.

*Elizabeth Wright, Director of Accountability, Finance & Public Relations,
Washoe County School District*



An energy recovery ventilator (ERV) unit is installed in each wing of the school to increase indoor air quality and reduce energy costs.

The mechanical design Engineer, CR Engineering, had conducted several group coordination meetings early in the design phases with the WCSD energy manager, Bruce Deetken, the commissioning team, and the

energy management control contractor (BCS) to ensure that the control strategies and executions were implemented into the design to maximize energy efficiencies and comfort control into the new school.

The team of BCS Inc technicians installed Alerton's BACnet®-based control system, which integrated Kendyl Depoali Middle School's open loop geexchange heating and cooling system with the building controls. The installation includes 373 ground source heating wells, 200 Carrier wide-range water source heat pumps, energy recovery units, and makeup/exchange units. Operator workstations—distributed over the Washoe County School District's existing IP network—manage all the building's functions through Alerton's native BACnet system, Envision for BACtalk™. The district also uses Alerton's WEBtalk system, which displays real-time site data through a Web browser, enabling facilities staff to remotely monitor and control the Kendyl Depoali system from anywhere they have Internet access.

Even in winter, Washoe County schools require more cooling than heating, which occurs more often in the mornings before equipment start-ups and human bodies raise the inside temperature.

"There are days in winter when we do an early morning warm up, but once everyone's there, there is very little heating needed," Gabica said.

Early on, the district established test wells that subsequently showed the average water temperature came back at 64 degrees; that meant it would require very little energy to heat or cool the water for building purposes. Administrators quickly realized they were onto an idea that could generate colossal energy savings.

The district sunk ground source heating wells underneath the meadow that eventually became Kendyl Depoali Middle School's

athletic field. A survey on the test well to measure tonnage and BTUs determined that 373 wells at a depth of 300 feet would meet the system demand of the 187,343 square foot school. The school originally considered a larger space to house mechanical equipment, but that design would have made less room for the wells outside—and because space was at a premium in the meadow, the wells would have been fewer and dug deeper. But the deeper the test well was sunk, the hotter the supply water was, which raised the amount of energy needed to cool it for building purposes. Instead, Gabica reduced the size of the mechanical room and sunk more wells at a shallower depth, keeping to a minimum the amount of energy required to cool the water.

Heat pumps are situated along the hallways of the school—out of the students' way, but accessible without disturbing any of the 62 classrooms. There are also heat pumps in each of the three team teaching rooms, which are larger rooms where multiple classes can come together, discuss the subject and collaborate on the topic they are working on at that time. Doors to the pumps open into the team teaching rooms, where Alerton system data—water temperature, delivery air temperature, room temperature and more—is displayed in real time. Students can see the screen display of the pumps, and then open the doors to see the pumps and know exactly what is going on inside them.

BCS programmed on-demand heating and cooling to maximize efficiency and reduce energy use. Each heat pump has a two-way valve that only opens when there is a call for heating or cooling. When temperatures reach their setpoints, variable air volume (VAV) controls slow and then shut down the pumps. The wide-range water source heat pumps accept a greater variety of water temperatures instead of limiting the desired temperature to within just a few degrees of the delivery temperature.

The Alerton system also provides demand control ventilation (DCV)—using CO₂ sensors to bring in supply outside air based on occupancy—to increase indoor air quality (IAQ). DCV also reduces the cost of ventilating unoccupied spaces or over-ventilating under-occupied spaces. Kendyl Depoali Middle School installed energy recovery ventilator (ERV) units in each wing of the building. ERVs bring fresh outside air into the facility, pre-cool it and then exhaust an equal amount of stale air. By tempering the air, an ERV lowers the required tonnage load for the building, and simultaneously recaptures most of the heat from the hot and cold airstreams using an air-to-air heat exchanger. In doing so, the school significantly reduces its energy consumption and spends less money to condition the exchanged air.

Designers considered building a pump room outside the school to house the heat pumps and hot water header manifold, but



The deliberately exposed mechanical room and flat-screen TV displaying building data turns the entire building into a teaching tool, enabling students, faculty and visitors to not only learn about the inner workings of the school systems and energy usage, but to see their tax dollars at work.

So many people talk the talk saying how green they are, but this building walks the walk. It's not just "doing" green things, we're teaching green things.

*Joe Gabica, Director of Planning & Design for Capital Projects,
Washoe County School District*



Customizable BACtalk displays show comprehensive, real-time data; in this example, a heat exchanger visual shows temperatures for outside air and supply air.

Gabica nixed the idea. Instead, the mechanical room is now behind a glass wall and features a 42" flat-screen television displaying building data in vivid detail. In addition, the pipes for the geexchange heat pump system, heating and air conditioning are

all exposed and labeled to encourage students to inquire and learn about the sustainability and green features of the building.

"I wanted everybody to be able to see the manifold, and see the supply and return pumps," Gabica said. "They can see the whole processing, beginning to end, and how it saves energy. It's a holistic view and also a way for parents and other visitors to see their taxes at work."

BCS used BACnet to integrate a LC&D lighting system and use its sensor data to incorporate the Alerton sequences of operation. Since the school was already using motion sensors for lighting, it was easy for technicians to use the same information for on-demand heating as well.

Other energy efficient measures taken by the school include:

- A cool roof that deflects radiant energy so that less energy is required to cool the building
- Natural daylighting with skylights and daylighting windows, the latter which allows greater light penetration into the classroom
- Light shelves, which bounce sunlight off the ceiling of a room, allowing light to enter the classroom further than daylighting windows and reducing the amount of artificial light needed

The next steps will be to install photovoltaic panels to capture solar energy and turbines to capture wind energy. Both will tie into the HVAC system and the data subsequently displayed with the other Alerton building information. Students will be able to see statistics such as how much solar and wind energy is being generated, how

much of it the school is using, and what percentage of the energy use is solar, wind or geothermal.

The geexchange heating and cooling system controlled by the Alerton solution inside Kendyl Depoali Middle School uses 40–70% less energy than conventional systems. Where the most efficient fuel-burning heater can reach efficiencies around 95%, a geothermal heat pump can move up to four units of heat (BTUs) for every unit of electricity (KWH) needed to power the system, which results in a practical equivalence of more than 400% efficiency[†]. Occupancy-based heating, cooling and lighting and demand control ventilation—in combination with other energy-reducing measures deployed by the school that are tied into the building controls for centralized monitoring—generate maximum cost, energy and water efficiency.

"Depoali Middle School utilities are anticipated to be 60% per square foot less than the middle schools we built in the 1990s. These savings will be realized in the general fund—which is critical in funding teachers and supplies for our students—for years down the road," Wright said.

"We thought it would be about a six-year payback, but it's actually going to be a three-year payback," Gabica said. "Clearly [geexchange heating and cooling] is a more expensive system, but it pays for itself more quickly. Our schools are on the ground for 50 to 60 years, so that's a lot of money."

The comprehensive but intuitive programming makes it easy for the school district's facilities staff to maintain and operate the system. Equally important, it enables Kendyl Depoali teachers to use the building as a teaching tool in the classrooms. Besides viewing the exposed piping and equipment, using vivid displays that share and explain building functions and data provide students with hands-on learning about renewable and non-renewable energy resources, how water can be used as a renewable resource, and more.

"The whole building itself is like an open book; it's a teaching tool from the moment they walk in the doors to the moment they walk out at the end of the day," said Juliana Annand, principal of Kendyl Depoali Middle School.

"Being able to integrate energy management into our students' curriculum is really a cool thing, especially because it's presented at a level where they can understand it," Gabica said. "It links them to LEED design principles, how energy works, what energy is and how they can save the planet."

[†] Geothermal Heat Pump Consortium

