


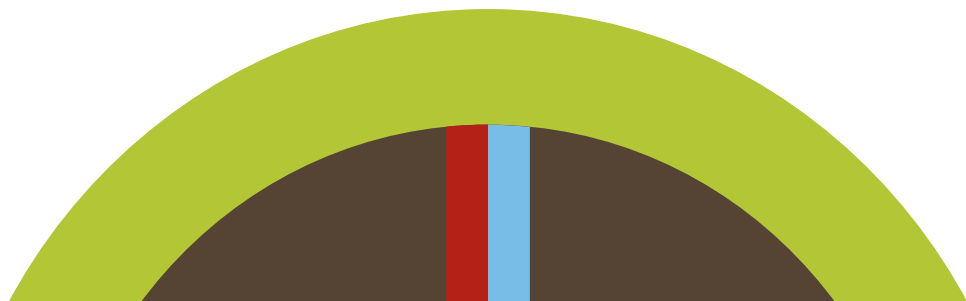


# GET IN THE LOOP

A wide-angle photograph of a modern elementary school building. The building features a mix of red brick and light-colored panels, with several large windows and a prominent glass entrance. The sky is overcast.

# Geothermal makes the grade

Get an inside look at  
**Glenwood Elementary School**



# PROJECT PROFILE

## Welcome to Glenwood Elementary School

Constructed in 2011 to serve students in kindergarten through fourth grade, Glenwood Elementary School in Chatham, Ill., currently uses unitary loop geothermal energy systems to heat and cool the classrooms in the single-story, 74,000-square-foot building.

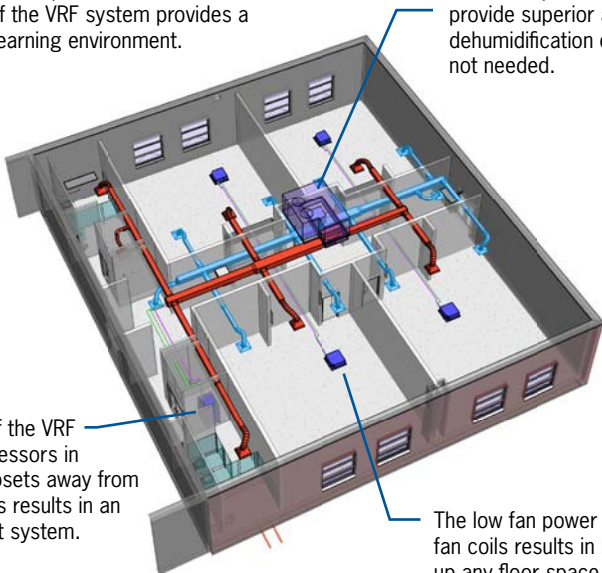
A state-of-the-art geothermal Variable Refrigerant Flow (VRF) system is being installed as part of an addition that will provide nearly 20,000 square feet of space. The geothermal VRF system will serve 12 classrooms in three expanded wings. Each wing has its own VRF system and geothermal well field consisting of approximately 215 feet of well per nominal ton. Each VRF heat pump is connected to multiple fan coils via refrigerant pipe in a heat-recovery arrangement that allows individual control and heat transfer between rooms when needed. Classrooms use a ductless ceiling cassette fan coil mounted near the center of the room.

To meet the code-required ventilation needs, each wing will include an air-source heat pump rooftop unit with a variable speed compressor, Electronically Commutated Motor (ECM) fans, hot gas reheat and an energy recovery wheel, resulting in an exceptional Integrated Energy Efficiency Ratio (IEER) of 19.2. The unit normally operates as an air source heat pump, but uses gas heat when outdoor temperatures are below zero degrees or when defrosting the heat pump. Because the ventilation units only run about 18 percent of the year, air-source heat pumps were selected to reduce construction cost and help balance the load on the otherwise cooling-dominated well field.

## Enhanced Learning Environment

Individual room temperature control and adjustability of the VRF system provides a comfortable learning environment.

The rooftop-mounted ventilation units provide superior air filtration and active dehumidification even when cooling is not needed.



The location of the VRF system compressors in mechanical closets away from the classrooms results in an inherently quiet system.

The low fan power of the ceiling cassette fan coils results in low noise without giving up any floor space in the classroom.

## Cost-Conscious Design

The cost-conscious design strategy exploits the strengths of each component to deliver a premium system at a low construction cost. The total HVAC system construction cost was \$23.67 per square foot. This is on the low end the range for a school geothermal system (\$22-\$30 per SF) and only about \$2 per square foot more than a similar air-cooled VRF system but with superior energy-saving characteristics.

**\$30/  
S.F.**

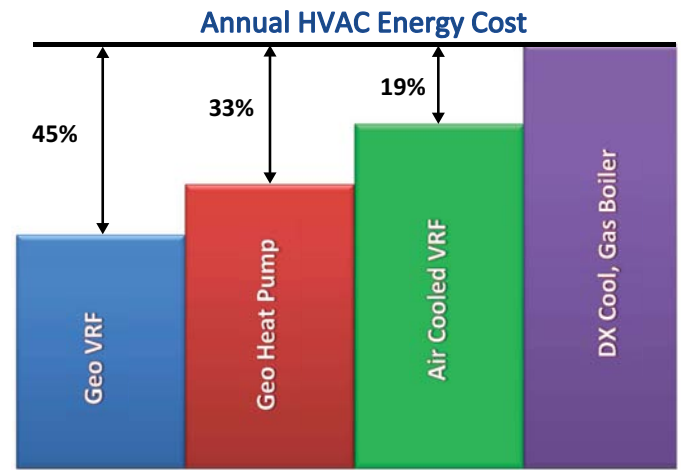
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# Energy Efficient

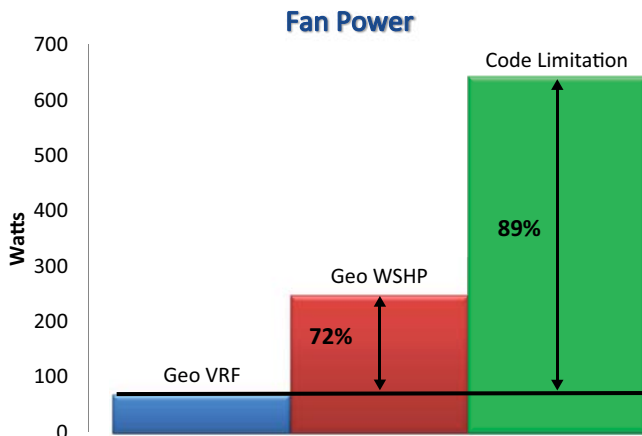
The geothermal VRF system combines two of the most efficient systems available. The VRF compressor uses a permanent magnet motor with a variable speed drive. The system is capable of heat recovery to simultaneously heat one room and cool another on the same refrigeration cycle.

Combining this with the moderate temperature of the geothermal energy source yields exceptional energy savings. The following chart compares the calculated annual energy costs of four common HVAC system types considered on this project.



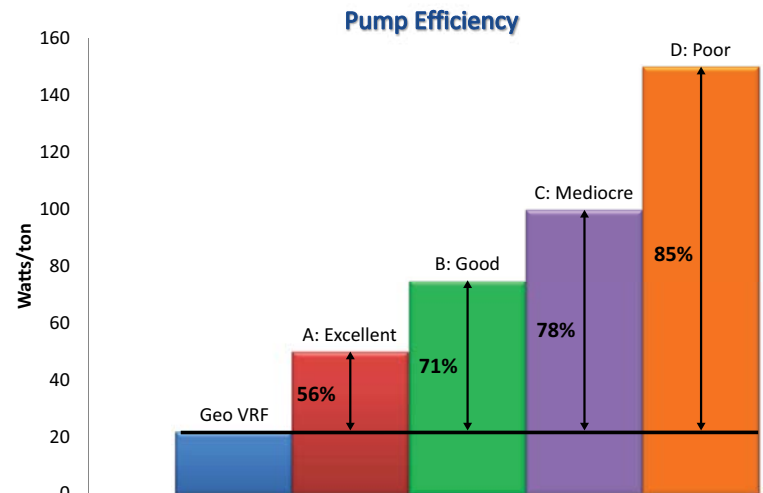
Note: Estimated energy use does not include energy for ventilation from Dedicated Outdoor Air Units.

The use of ductless ceiling cassettes results in extremely low fan power requirements. The fan power is 89% less than code prescribed limits and 72% less than a traditional water source heat pump installation when measure in watts consumed.



Note: The code limitation value was calculated using a formula listed in the ASHRAE Standard 90.1-2010: Energy Standard for Buildings Except Low-Rise Residential Buildings.

The distributed medium size well fields take advantage of diversity while keeping the pump pressure drop down. The heat pumps are large enough to justify the use of ECM pumps with a permanent magnet motor to further reduce pump power. This adds to the overall energy savings resulting in a pump efficiency rating that is 50% less than the ASHRAE “A-Excellent” rating for geothermal installations in commercial and institutional buildings.



Note: The rated pump efficiencies (A-D) are from the ASHRAE Handbook: Ground-Source Heat Pumps, Design of Geothermal Systems for Commercial and Institutional Buildings by Stephen P. Kavanaugh and Kevin Rafferty.

## MAINTENANCE ADVANTAGES

- Simplicity of a single water pump per heat pump
- Self-addressing packaged controls, no custom controls required
- Centralized location of compressors
- Web-enabled controls for remote access and alarm
- No antifreeze needed – geothermal fluid is water
- Individual zone control for each room, adjustable with capability to limit adjustment
- Corrosion-resistant components to minimize water treatment costs and prolong system life
- Air separator and expansion tank reduce air-entrapment and pressurization problems
- Permanent magnet motor in the pump extends pump life
- Permanent temperature and pressure gauges for easy troubleshooting
- Can be purged with a residential size purge cart



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For more information about the Glenwood Elementary School project, please contact:

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