Feasibility Study of Geothermal Heating and Cooling for Rockbridge Middle School

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With a possible renovation coming up for the Rockbridge Middle School, the school district is interested in comparing different types of heating and cooling systems. With the renovation, the district is interested in determining which type of heating and cooling system is most feasible. The school district has built geothermal heat pump systems at four schools in the district. The purpose of this project is to compare the economic feasibility of a geothermal heat pump system to a conventional HVAC system. The focus will be the initial capital costs and the operating costs, including the payback time.

Using plans from the school, we put the building design into the Carrier Hourly Analysis Version 4.20a. ASHRAE Handbooks were referenced for national standards. With the load data, we chose heat pumps and then calculated the costs and compared them to a conventional boiler and chiller system using Means Cost Data for Mechanical Systems (2006).

The costs of a geothermal system, to include drilling, HDPE pipes, propylene glycol, as well as the heat pumps were calculated and used to determine the capital cost of the system. The same was done for a conventional water source heat pump, only all the ground loop equipment was replaced with a boiler and a chiller. A Bin analysis was used to determine the number of hours each year the system would be running. This was used in determining the cost of running each system per year based on current energy prices. Using both the capital costs and cost of running the system, the payback for installing a geothermal system was determined.

The payback time for installing a geothermal system instead of a conventional water source heat pump system, based on simple payback, is approximately three years, and two years for eight percent interest for a system with an electric boiler. Using a propane water heater the payback time increases to almost eight years for simple payback and thirteen years at eight percent interest. The geothermal system will completely eliminate dependence on fossil fuels for HVAC purposes. Using an electric boiler or water heater, a conventional water source system will have the same result.