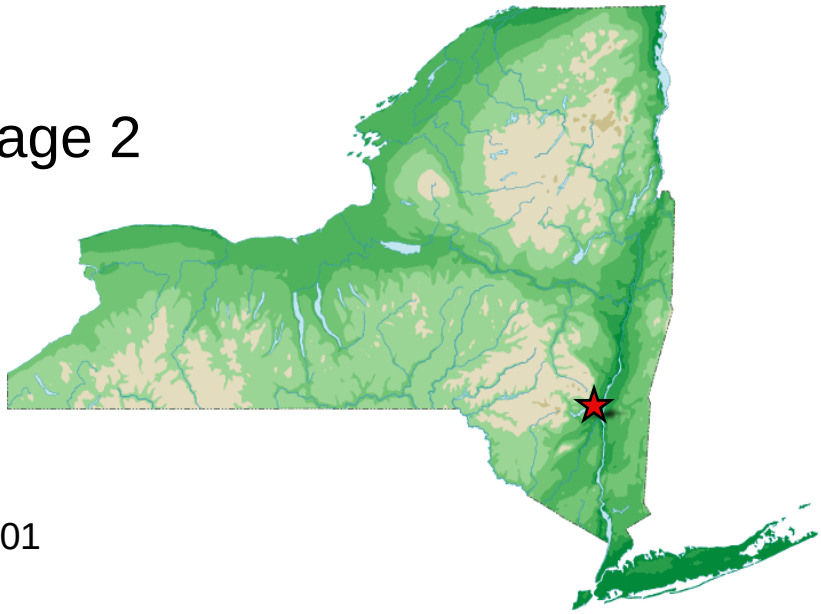
NEW YORK STATE OF OPPORTUNITY.

Geothermal Clean Energy Challenge

Advanced Report – Stage 2



Applicant: Ulster County

Address: 380 Boulevard
Kingston, NY 12401

Site Name: 380 Boulevard

Project Summary

This potential project was modeled as a single closed loop ground source heat pump (GSHP) system with 758 tons of cooling capacity that will serve the building listed on the next page with a total conditioned area of 277,000 square feet. The GSHP system is expected to serve an existing building that will require little to no significant interior modifications during installation to integrate with existing building HVAC systems, and this factor is reflected in the GSHP cost assumptions used in the model.

The analysis in this report is based on the results of a streamlined building energy model (BEM) using the supplemental data you provided for the building associated with your potential GSHP site. The BEM was used to fine-tune the energy load patterns and economic and technical results in this report. Compared to the Stage 1 report, this fine-tuning led to a larger GSHP system being required (758 tons in Stage 2 vs. 632 tons in Stage 1), slightly lower annual energy cost savings, and higher capital costs for traditional HVAC that would be avoided with a GSHP system. The net effect of these changes was an approximately three-year increase in the period needed to pay back the GSHP investment in the Stage 2 report compared to Stage 1, primarily due to the higher capital costs necessitated by the larger GSHP system in Stage 2.

As a reminder, the results presented in this report are preliminary, and a detailed feasibility assessment is a necessary next step in thoroughly exploring a GSHP project. Financial and technical support for conducting a detailed design study, including American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Level 2 targeted audits, site geotechnical testing and analyses, and schematic GSHP system design is available to eligible applicants in Stage 3 of the Geothermal Clean Energy Challenge.

Energy, Financial, and Environmental Savings Opportunities from GSHP Implementation

Buildings Included in the Site		
Building Name	**Building Type**	**Building Conditioned Area (sqft)**
Ulster County Law Enforcement Center (UCLEC)	Prison and Sheriff's Office	277,000

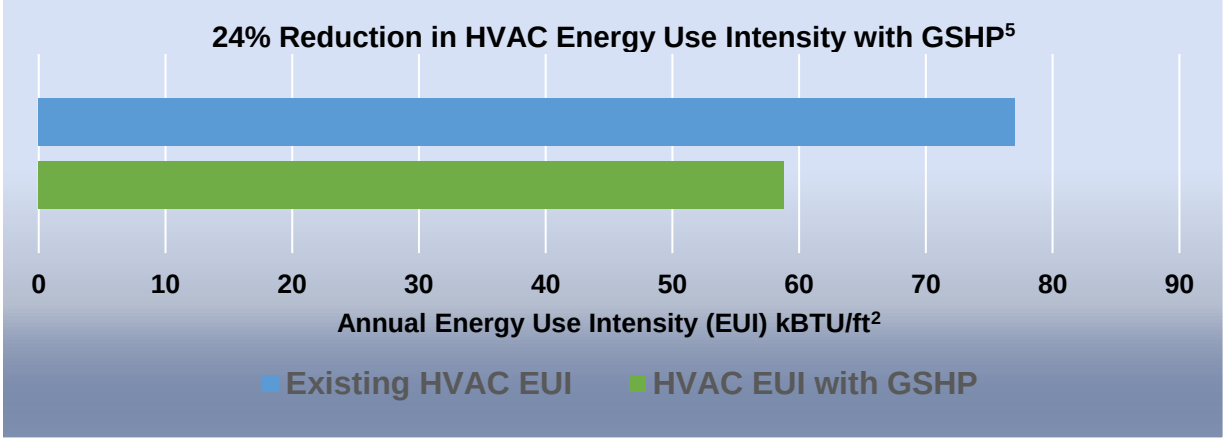
The tables below summarize the savings opportunities estimated for the site in terms of costs, energy and greenhouse gases when comparing the implementation of a ground source heat pump (GSHP) system to the existing (or planned) building HVAC systems.[1]

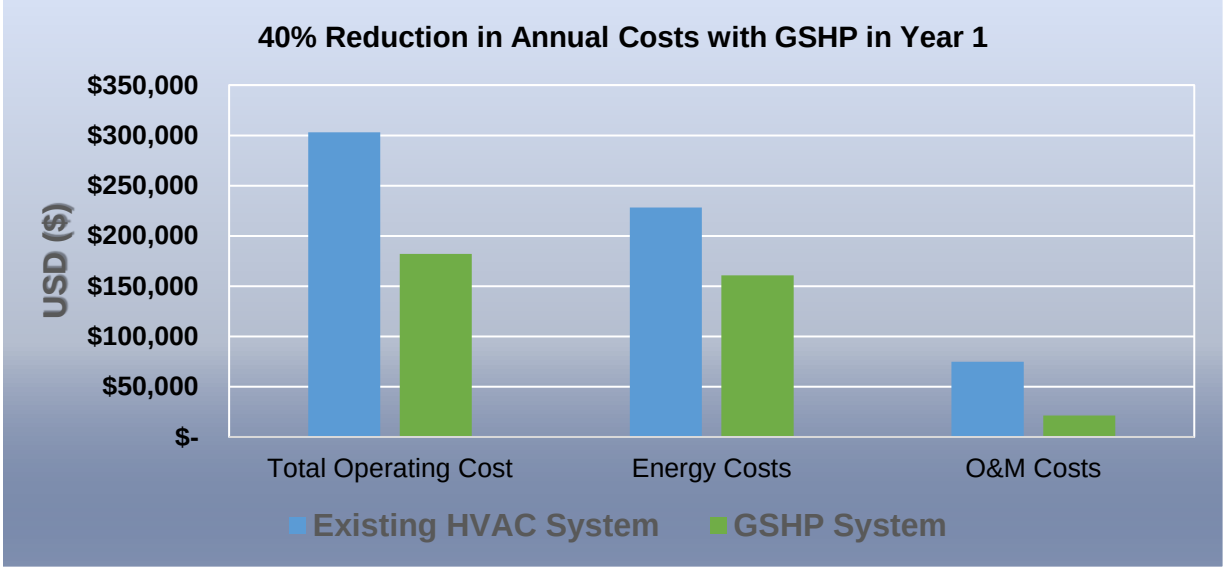
Note: the value of the carbon emissions included in the table is not directly monetizable by the applicant, but rather reflects the overall value to society provided by the reduced carbon emissions. The value is not used as a factor in the economic analysis in this report. However, the benefits to society can be substantial, particularly when buildings consuming fuel oil switch to GSHP.

Volumetric Savings / Increases	
Annual Propane Savings	0 gallons
Annual Fuel Oil Savings	107,348 gallons
Annual Natural Gas Savings	0 [1000 ft3]
Annual Electricity Increase	944,795 kWh
Annual GHG Emissions Reduction	877 metric tons (CO2e)
Cost Savings ($)	
Annual Energy Bill Savings	$ 67,599
Annual O&M Savings[2]	$ 53,475
Investments & Incentives[3] ($)	
Installed GSHP System Capital Costs (Est. Range)	$ 4,963,384 - $ 5,509,356
Avoided Capital Costs for Traditional HVAC System	$ 937,486
NYSERDA Incentive Payment for GSHP System	$ 500,000
Societal Value of Reduced Carbon Emissions[4]	$ 1,638,469

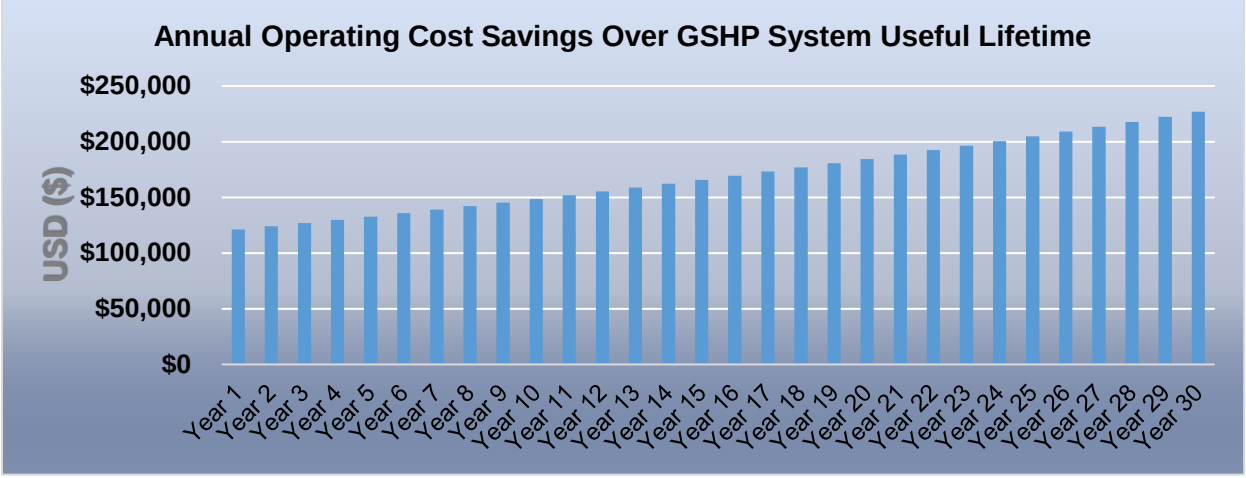
[1] The findings presented in this report are preliminary and should not be used as the sole basis for investment decisions.
[2] O&M savings include the savings associated with the avoided use of a cooling tower at the site.
[3] Estimated capital costs in this report reflect an expected range based on similar projects, but they may differ from the final minimum or maximum project costs that a GSHP site encounters in practice. Further incentives may also be available for GSHP systems through utility programs; contact your utility for more information. For-profit entities with sufficient tax liability may additionally be eligible for a 10% federal tax incentive on GSHP systems.
[4] Societal cost of carbon (30 year net present value) calculated using EPA 3% average data in 2017 dollars (https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html)

Excluding NYSERDA Incentive	Including NYSERDA Incentive
GSHP Simple Investment Payback Period (Estimated Range)	
25 - 27 years	22 – 25 years
GSHP Net Present Value (Estimated Range over 30-year life)	
(-$ 1,814,102) – (-$ 1,268,130)	(-$ 1,314,102) – (-$ 768,130)
GSHP Savings to Investment Ratio (Estimated Range)	
0.67 - 0.74	0.74 - 0.83



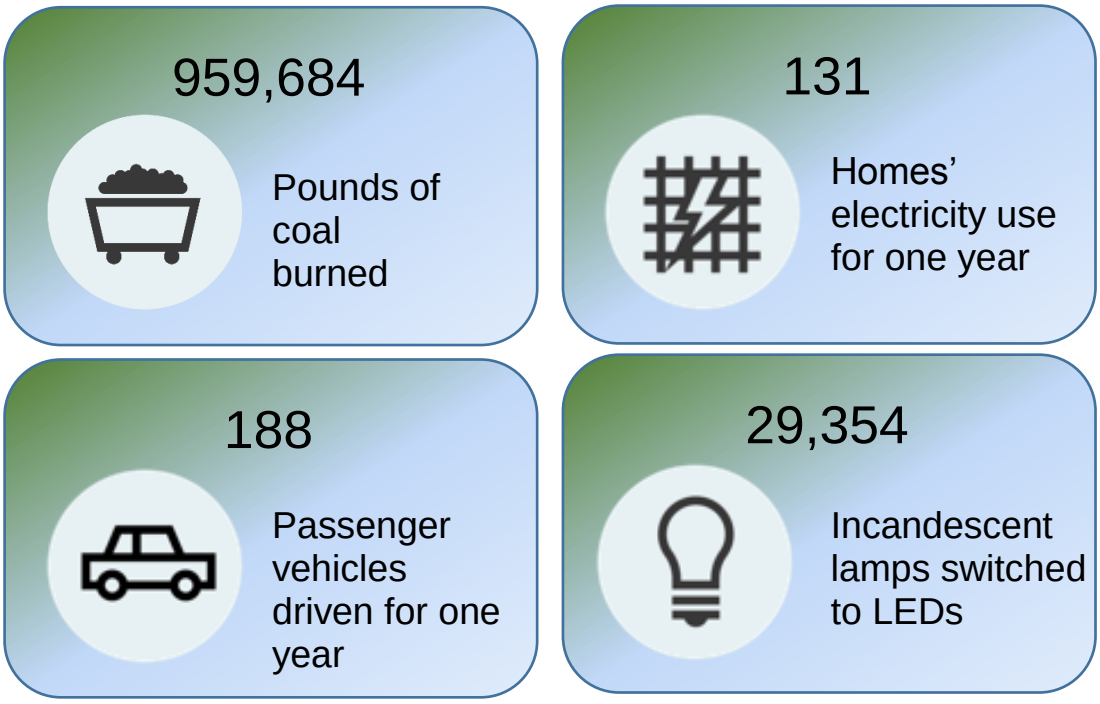


[5] Energy Use Intensity is calculated based on source energy and encompassing all the energy used in delivering energy to a site, including power generation, transmission and distribution losses. (https://www.governor.ny.gov/news/no-88-directing-state-agencies-and-authorities-improve-energy-efficiency-state-buildings)



Greenhouse Gas Reduction Equivalencies

The annual carbon emissions reduction from the implementation of a GSHP system at your site can be translated to an equivalent reduction in any one of the following alternatives, including pounds of coal burned, electricity used by a home in one year, number of passenger vehicles driven in one year, and number of incandescent lightbulbs replaced with LED bulbs.[6]



[6] EPA Greenhouse Gas Equivalencies Calculator (as of November 2018): https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Environmental Permitting Considerations

Although GSHPs are clean energy technologies, some environmental factors should be considered to best manage the installation process. The following is an introductory, non-comprehensive list of considerations when GSHP boreholes are drilled:

- The drilling process can bring large amounts of ground water to the surface, and this water needs to be managed and disposed of in an appropriate manner. The volume, rate of flow, water quality, and local site conditions dictate the most appropriate approach. Most of the time, settling ponds with geotextile "silt fencing" and/or hay bales is sufficient, which allows an acceptable amount of slightly discolored water to run off via normal storm water drainage systems.
- GSHP projects in Western New York and the Southern Tier (counties west of the Catskill Mountains along the northern border of Pennsylvania) in particular may encounter pockets of natural gas, which must be handled with experience and caution.
- There are no state permits required for geothermal bore holes less than 500 feet deep. All bore holes deeper than 500 feet must apply for a permit from the Department of Environmental Conservation (DEC) for each hole. Local jurisdictions should also be contacted regarding specific requirements.
- Construction and grouting must be done in accordance with federal, state, and local regulations as well as current industry best practices to minimize contamination risk from either surface run-off or cross aquifer sources of contamination.

Additional considerations associated with each type of geothermal loop field can include:

Closed Loop	Open Loop	Standing Column
Less than 500 feet: No additional considerations *Greater than 500 feet*: Must apply for DEC permit; permit may require drift monitoring and/or a bond to cover costs associated with abandonment.	*Supply Well*: Must comply with water well permitting and construction requirements as regulated by the New York State Department of Health (DOH). *Discharge Well*: Must be reviewed by DEC; if initial water quality meets discharge standards and nothing will be substantially added during use, the system is not required to obtain a discharge permit.	Must apply for DEC permit, which requires drift monitoring and a bond to cover abandonment costs. Due to the open nature of the borehole in which groundwater is recirculated, the water chemistry will change as geologic formations are dissolved. This can potentially increase the concentration of dissolved solids or salinity, which can impact the reliability of the heat exchange surfaces.

For more information on different types of GSHP loop fields and on environmental factors in GSHP system construction and operations, please see:

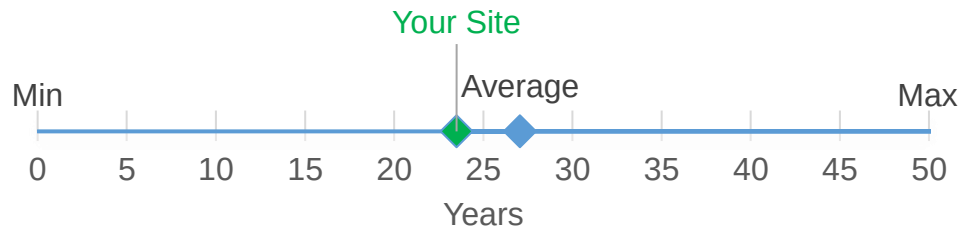
- NYPA's *Geothermal Clean Energy Challenge* website: https://www.nypa.gov/about/geothermalchallenge.
- NYSERDA's *Renewable Heating and Cooling Policy Framework*: https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/NYSERDA/RHC-Framework.pdf.

- NY-GEO, a nonprofit trade association dedicated to geothermal heating and cooling: https://ny-geo.org/pages/frontpage.
- U.S. Environmental Protection Agency's *Renewable Heating and Cooling* website: https://www.epa.gov/rhc/geothermal-heating-and-cooling-technologies.

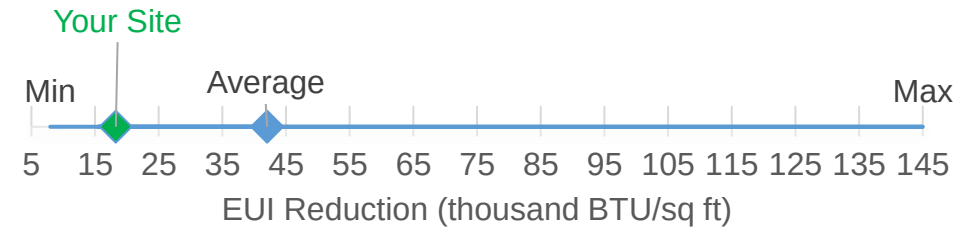
Site Specific Considerations and Selection Criteria

A set of screening criteria was used to determine the most viable sites for the implementation of a GSHP system from those applying to the Geothermal Clean Energy Challenge. The criteria include a quantitative analysis of the technical and economic viability of a potential system and a review of important qualitative implementation factors for potential sites. Your site was one of the top-ranked sites selected to advance to Stage 2 of this Challenge. A description of each criteria is provided on the next page. The graphs below demonstrate how the benefits of a GSHP installation at your site compare to the benefits at other sites that applied. Your site is shown in green, compared with the minimum, maximum, and average values from the pool of applicants.

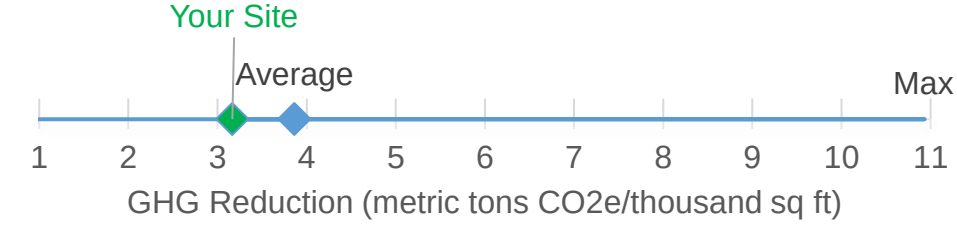
Simple Payback Comparison



Annual Energy Savings Potential



Annual GHG Emissions Reduction



Screening Criteria	Description
Presence of a GSHP Champion	Is there an individual, or group of individuals, within the applicant organization that is significantly invested in making sure a GSHP system is installed at the site? This person can be a facility manager, board member, or any other influential individual. Often the presence of a champion can make or break whether a GSHP system is ultimately implemented.
Accessibility of Data for Screening Analysis	How responsive and forthcoming was the applicant during the facility engagement process? Were they able to provide data at the individual building level, or only at the campus level? Detailed building level data significantly improves the accuracy of the inputs used for the screening analysis and provides a higher level of confidence that the results from this first round economic screening are reliable.
Organizational Readiness to Implement	Does the applicant appear able and willing to pursue implementation of a GSHP system soon? Are there examples of previous or ongoing efficiency and renewable work funded by the applicant? Given the capital-intensive nature of a GSHP project, existing financial commitments for energy savings can help illustrate a readiness to undertake the investment required.
Sustainable Program Commitment	Does a GSHP system integrate into an existing sustainability program that the applicant has created (or is participating in)? Will the GSHP system be able to be tied to educational or community engagement work? A key goal of the Geothermal Clean Energy Challenge is to promote public awareness and education of GSHP systems within the State of New York.
Technical Viability	Are there any significant technical hurdles for implementation of a GSHP system at the site? Is there green or brown field space available on location?
Economic Benefits	Does the preliminary screening indicate that the installation of a GSHP system is financially attractive? The financial merit of the project is evaluated across three different standard financial metrics: Net Present Value (NPV), Savings to Investment Ratio (SIR) and Simple Payback Period.
Greenhouse Gas (GHG) Reductions	How significant are the estimated GHG reduction benefits? Is fuel switching from GHG intensive fuels such as fuel oil planned? GHG benefits are estimated based on reduction in annual metric tons of CO2 emissions.
Site Adds to Program Sectoral Diversity	Is the site part of a sector that is under-represented in the general applicant pool? If so, then the site is helping to add valued diversity to the types of facilities included in the program.
Site Adds to Program Geographic Diversity	Is the site part of a geographic region that is under-represented in the general applicant pool? If so, then the site is helping to add valued diversity to the types of facilities included in the program.