FILED VIA ePUC

July 29, 2022

Holly R. Anderson
Clerk of the Commission
112 State Street
Montpelier, VT 05620-2701

Re: Notice re Climate Action and Innovation, Geothermal Services

Dear Ms. Anderson

By this filing, Vermont Gas Systems, Inc. ("VGS" or the "Company") provides notice of a new program pilot in connection with our Climate Action and Innovation programming.[1] VGS is exploring what role it can play in expanding geothermal heating and cooling in Vermont. This notice provides background on geothermal systems, discusses the role of utilities, and introduces VGS's geothermal program pilot. It also serves to notify the Commission that the Company is using innovation funds on exploratory pre-development work for various potential geothermal projects.

Data supplied by the Vermont Agency of Natural Resources[2] show that approximately 34% of all Vermont's carbon dioxide emissions are from heating, cooling, and hot water systems in residential and commercial buildings. Geothermal represents a rare opportunity to align decarbonization with affordability in a manner compatible with our utility business model, presenting new approaches that ensure low-to-moderate income Vermonters can participate in and receive economic benefits from the State's policy-driven decarbonization programs. Initially, VGS is providing support to building owners and developers interested in geothermal systems as an alternative to traditional heating and cooling. This will help answer key technical, workforce, regulatory, and financial questions that will enable the Company to further develop a geothermal program.

---

[1] Section 5 of the Company's Alternative Regulation Plan provides that VGS shall pursue "projects, programs, and services that support Vermont's statewide energy goals by advancing promising technologies to facilitate efficient, lower carbon energy choices for its customers." *See* Exhibit VGS-JMP-5 filed May 21, 2021 in Case No. 19-3529-PET ("ARP") at 5.

[2] *See Energy Action Network, Annual Progress Report for Vermont 2020/2021* at 11, available at https://www.eanvt.org/wp-content/uploads/2021/05/EAN-APR2020-21_web-1.pdf.

Background: Geothermal Heating and Cooling

The Technology & Carbon Benefits

A geothermal system is a time-tested, highly efficient energy technology used to heat and cool a building by transferring energy to and from the earth. In Vermont, the temperature underground is close to 50 degrees Fahrenheit year-round, presenting a renewable and consistent energy source. A geothermal system takes advantage of this constant temperature by transferring it through a ground source heat pump ("GSHP") to provide space heating and cooling.[3]

Although there are many possible variations and system configurations, a typical installation consists of an underground closed loop system outside and a GSHP and ductwork or hydronic piping inside the building. The ground loop system is filled with water or a non-toxic water-glycol medium that acts as the heat exchanger between the internal systems and the ground loop. During winter, the temperature-steady heat from the ground is absorbed by the water solution as it circulates through the subterranean piping. The warmed medium is then carried into the building where a heat pump concentrates the thermal energy and transfers it through an air or hydronic distribution system. In warm weather, this process is reversed to cool the building. Because GSHPs are utilizing the steady-state ground temperature, there are no performance issues during times when extreme outside air temperatures often present challenges to air source heat pumps, such as cold climate heat pumps. Comfort and efficiency are not sacrificed, and, often, no backup heating systems are required to keep the space comfortable depending on the design. Additionally, these systems serve for decades; a closed loop pipe system can last 40-50 years and well-maintained GSHP equipment can last 20 years. As the U.S. Department of Energy states, "Relative to air-source heat pumps, they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air."[4]

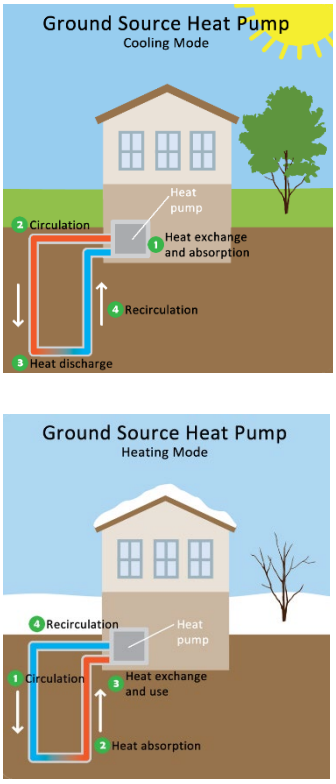

Figure 1 Images courtesy of EPA

Further, geothermal systems are considered the most efficient heating and cooling systems available. According to the U.S. Environmental Protection Agency, "For every unit of electricity used in operating the system, the heat pump can deliver as much as five times the energy from the ground, resulting in a net energy benefit."[5] GSHPs typically have an efficiency rating between 3.0 and 5.0. This means for every unit of energy into the GSHP, it can generate 3-5

---

[3] For more information on how geothermal systems function, see NYSERDA's short video, *How it works Ground Source Heat Pumps*, available at https://www.youtube.com/watch?v=qV48cX4d-WY.

[4] https://www.energy.gov/energysaver/geothermal-heat-pumps

[5] https://www.epa.gov/rhc/geothermal-heating-and-cooling-technologies

times *more*. High efficiency natural gas furnaces are rated around 0.97, and the best boilers are around 0.95. There is no other thermal technology currently that outperforms GSHPs.

Because geothermal uses the steady temperatures of the earth, it is considered a renewable resource, requiring very little energy to extract. Any greenhouse gas emission associated with geothermal system operation comes from the electricity source powering the GSHP. For example, Green Mountain Power's ("GMP") electricity is 100% carbon-free. In GMP territory, a geothermal system carrying the complete thermal load of an insulated building would mirror the carbon impact of its electricity sources. Thus, by displacing traditional oil, propane, or natural gas, geothermal systems deliver a non-trivial carbon benefit for generations.

Geothermal and the Role of Utilities in Our Region

Initiatives Underway in Neighboring States

While geological, regulatory, and infrastructure conditions vary from state to state, there is tremendous opportunity for mutual learning across our region. VGS is in contact with several regional stakeholders willing to help think through pertinent issues related to design, regulatory, workforce, and financial models. For example, both Massachusetts and New York have recognized geothermal as a key decarbonization strategy and, through policy and regulatory forums, have launched geothermal initiatives.

In Massachusetts, the Department of Public Utilities approved two gas utility-led geothermal projects connecting multiple homes in neighborhoods needing significant gas line replacements.[6] The pilots will demonstrate how utility-scale geothermal systems can provide a viable and affordable alternative to piped fossil fuels. Significant state incentives are now available in Massachusetts to help jumpstart the market. Eversource, one of the gas utilities involved, believes geothermal could "complement or replace delivered fuels and natural gas service for heating and cooling."[7]

In New York, a similar story is unfolding. In 2021, NYSERDA awarded $15 million to support dozens of "Community Heat Pump Systems Projects" across New York State[8] with a focus on advancing community geothermal systems in residential and commercial developments. NYSERDA is promoting a "community-style thermal strategy that can accelerate

---

[6] *See* Boston Gas Company, D.P.U. 21-24 (Dec. 15, 2021) and NSTAR Gas Company, D.P.U. 19-120, at 138-156 (Oct. 30, 2020).

[7] https://www.eversource.com/content/ema-c/business/save-money-energy/clean-energy-options/geothermal-pilot-program

[8] *See* https://www.nyserda.ny.gov/All-Programs/Community-Heat-Pump-Systems/Winners.

decarbonization of the building stock, moving from a building-by-building approach to a block-by-block and community-by-community model."[9]

Improving Accessibility in Vermont

Until 2021, Vermont was the only state in New England without a statewide geothermal incentive.[10] According to the national geothermal trade association, U.S. Geoexchange, approximately 30,000 ground source heat pumps were sold in the U.S. in 2020. Vermont—a national leader in energy efficiency—was home to only 10. Beginning in 2021, Efficiency Vermont and nearly all the electric utilities collaborated to offer healthy incentives. But only two geothermal projects have resulted from these incentives to date. The primary market barriers to choosing geothermal are cost,[11] design complexity, and quality assurance. In addition, there are currently only a few contractors serving Vermont with sufficient experience to design and construct these systems.

VGS is well positioned to address these barriers. A utility-style geothermal offering will closely resemble our existing construction and gas distribution business. It involves installing underground piping, designed to last up to 50 years, and serving entire neighborhoods or multiple customers. It involves servicing energy infrastructure and maintaining integrity and reliability over its useful life. And it involves recovering cost over time through periodic charges like those found on customer bills today. These similarities position VGS as a strong market catalyst, applying our core competencies to complete, or partner on, projects that may otherwise be unrealized.

Paramount to this effort is developing a model where the total geothermal energy costs are competitive with traditional solutions, including natural gas. This will enable utility scale partnerships with affordable housing organizations wherein VGS can help develop permanently affordable *all-electric* homes, something that has been out of reach to this important market sector. We believe that time is of the essence as well, given that funding is now available for creating more permanently affordable housing over the next several years. Together, we can ensure energy affordable housing, while preventing another generation of fossil fuel reliant buildings.

---

[9] To support this, NYSERDA is funding accredited geothermal workforce training. Their partnership with ASHRAE resulted in a 17-part webinar series "designed to engage and educate all stakeholders involved in community heat pump system design and implementation." https://www.ashrae.org/professional-development/chp-webinars/ashrae-nyserda-community-heat-pump-systems-webinar-series

[10] In 2021, Efficiency Vermont and the electric distribution utilities launched a geothermal program that provides technical assistance and rebates. *See* https://www.efficiencyvermont.com/rebates/list/ground-source-heat-pumps.

[11] The cost to install a geothermal loop can add 30-40% to the project when compared to installing a traditional heating/cooling system.

VGS's Geothermal Program Pilot

Pilot Objectives

VGS's geothermal pilot will answer key technical, regulatory, workforce, and financial questions to inform developing a larger offering. These questions include:

- Is there a demand for alternative thermal solutions that is not being met?
- Is it generally feasible to provide geothermal loops and GSHPs as an alternative to delivered fossil fuels and gas service?
- What are appropriate regulatory, financial, and business models?
- What are the construction and workforce requirements to install a ground loop?
- What are the equipment installation and maintenance requirements to maintain GSHPs?
- What are the overall maintenance requirements for a ground loop?
- What are the efficiencies that can be gained from a shared loop system?[12]

VGS has identified two geothermal project classes to pursue:

- Single-customer small-to-medium commercial installations, where a stand-alone geothermal loop serves the heating and cooling needs of a single commercial building; and
- Multi-customer loops, where a single wellfield serves several customers (see figure 2).

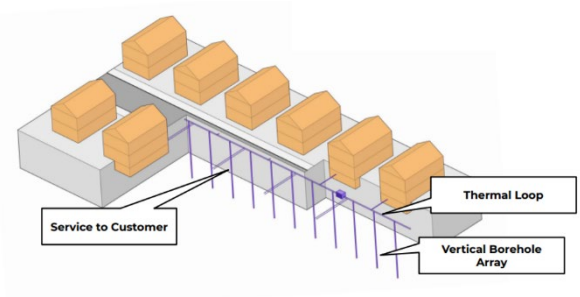

Figure 2 Illustration of a community geothermal loop courtesy of HEET

The small-to-medium commercial installation approach will benefit the pilot by providing VGS with geothermal design, financial modelling, and construction/implementation experience, at a relatively low cost because of the scale of the project. Piloting the multi-customer approach will add unique elements associated with providing geothermal systems on a utility scale, but at a higher cost. Both project types offer value to program development and we remain open to pursuing either or both in the pilot, as the goal is to gain timely experience that illuminates paths for a geothermal business model. Ultimately, though, it is the multi-customer approach that we believe aligns best with our role as a thermal utility. This model closely resembles our existing business model: constructing and maintaining networked infrastructure for the delivery of thermal energy and recovering that cost over time. Developing this community loop approach will also enable decarbonized thermal services for many other sectors, including municipalities, schools, and the affordable housing markets.

---

[12] Answering this question will require engaging a "community geothermal" project.

Beyond customer interest, pilot eligibility is site and project specific. It will be based on the building type, the number of buildings, the uses of the buildings requiring service; whether an adjacent location for wellfield loops is available; favorable subsurface geologic conditions; and, if involving existing building(s), the potential to utilize existing internal heating/cooling distribution systems. The sites for these projects may be within our current gas distribution area or nearby, and projects may be both new construction and existing building retrofits. The pilot will initially target projects that demonstrate:

(i) the benefits of geothermal technology to building owners and occupants;
(ii) technical practicality of various installation types;
(iii) opportunities to study physical system operation and customer usage patterns; and
(iv) long-term financial structures that address barriers to adoption.

VGS currently supports projects under this pilot by providing the property owner with the technical, financial, and site modeling needed to evaluate project appropriateness. For example, we are exploring a commercial new construction project for a non-profit organization slated for early 2023 construction in our service area. Working with our consultant and the owner's design team, we completed an economic comparison between a traditional heating/cooling system and a geothermal system. From this model, VGS provided a financial analysis with estimated annual operating and maintenance costs. If the geothermal model proves mutually favorable and acceptable to the client, the next steps are to drill a test well on site and perform a thermal conductivity test.[13] This will help us develop a more granular understanding of the project cost and refine the project financials. In another example, we are working with an institutional customer on a campus with multiple buildings, many of which are slated for HVAC upgrades. We will perform a similar cost and energy analysis and consider the longer-term opportunity to connect more buildings to the system. Both of these active pilot examples represent tremendous opportunities for VGS to learn and lead.

Once in service, projects will be evaluated in collaboration with the associated EEU and electric distribution utility across a variety of metrics over a multi-year horizon comparing the design expectations to actual results, including:

- System installation costs;
- Ongoing operation and maintenance costs;
- Carbon emission reductions;
- Overall system performance;

[13] Thermal conductivity testing is a critical step to understand how well the earth around the geothermal loops will absorb or transfer the heat to the water medium within the loops. Poor conducting conditions (like with sand) will drive up the project costs while high conducting conditions (like with bedrock) can reduce the number of wells and loops needed, lowering costs. To learn more, see https://geothermalprosandcons.net/geothermal-conductivity-test-pros-and-cons/.

- GSHP technology performance;
- Changes in customer energy consumption and costs; and
- Customer satisfaction.

The pilot will also seek to develop a model that supports geothermal without increasing customer costs. We expect a geothermal customer's heating and cooling energy costs may include their electric bill and a geothermal charge from VGS. As a utility geothermal provider, VGS would likely own and maintain the ground loops, and recover costs, as with our current infrastructure. At the developer's or owner's option, we may also own and maintain the GSHPs inside the building through a lease agreement similar to our existing in-home offerings. We have much to learn about which financial model will best serve customers and ratepayers, but are exploring several, with the ultimate goal to offer geothermal options that are cost-competitive, less volatile, and low or no carbon.

Funding

This filing provides notice that VGS is using innovation funds on exploratory pre-development work for various potential geothermal projects. VGS is using innovation funding for consultant expenses and test wells, among other costs, for projects under the program pilot. These pre-development costs vary based on many factors, but are likely to range from $10,000 to $25,000 depending on the need for test wells and conductivity testing.[14] VGS has expended innovation funds investigating various potential projects, which have grown incrementally over time. We are submitting this notice for Commission review now because our geothermal program has matured with aggregated expenses reaching a significant level, and because a couple of projects are approaching development potential. The following table shows VGS's approximate spend to-date on projects under this umbrella.

Description	**Spend To-Date**
Consulting on planning and assessment of geothermal projects for the Company, including but not limited to design, engineering, and costing.	Project A – Commercial Campus Retrofit: $12,585.00 Project B – Non-profit Stand-Alone: $9,937.50 Project C – Non-profit, Stand-Alone, on a Campus: $9,545.00 Project Misc: $1,360.00
Test wells and geo-conductivity tests	Project A – Commercial Campus Retrofit: $10,000

The cost to fully install a geothermal system depends on many factors including the geological characteristics of the site, the building size and use, the diversity of energy loads (the time that energy is used and the type of uses in the buildings), the peak energy load requirements, and the

[14] With each of the potential pilot projects, VGS is collaborating with the Energy Efficiency Utility and Distribution Utility as discussion and assessment progresses. In support of the larger project development costs, such as test wells, VGS will work with the customer, EEU, and DU to share costs.

thermal shell characteristics. The energy needs of a single building will dictate the size of the wellfield and the GSHPs. A utility-geothermal project connecting multiple customers, like a new community of homes, may achieve some economies of scale specific to the costly outside loops. In all cases, system design is a critical element for maximizing performance and minimizing capital costs.

If a project advances to development stage, VGS may use innovation funding for capital expenditures and fully recover its value over the project's life. Geothermal installations are considered permanent, and while some components might be replaced, the system's general value is derived from the continuous service it provides to the property owner or occupant. Project development will be funded differently depending on the customer's resources and the project's informational value to the Company. When appropriate, we expect to use innovation funds to actualize promising projects. As required by our Alternative Regulation Plan, we will provide 30 days' advance notice to the Department and Commission before spending more than $25,000 of innovation funds on a particular project in the development phase.[15] Notably, we have preliminary agreement with one customer to enter development and are preparing to file a notice specific to that project. We will report on projects that require little or no development-phase innovation funding as part of the annual status report for this umbrella filing.[16]

Conclusion

Geothermal systems have many benefits, including:

- Low operating and maintenance costs;
- No exposed outdoor equipment;
- Levelized seasonal electric demand;
- No on-site combustion;
- Long life expectancy;
- Low-cost integrated water heating;
- No supplemental heat required; and
- Low environmental impact.

Potential utility applications for geothermal systems in Vermont are widespread. Drilling and trenching technologies are fundamental to VGS, and the pipe materials used for geothermal applications are nearly identical to those for natural gas service. As a utility, VGS has distributed energy to heat homes and businesses for 65 years. Now we are actively pursuing a future in which customers continue to rely on us for home heating in a decarbonized world.

---

15 *See* ARP at 5.
16 *See* ARP at 6.

Vermont has set ambitious climate obligations for itself and VGS is committed to providing critical support for decarbonization through innovative services. Geothermal is a unique proposition that lessens or potentially eliminates fossil fuel consumption, reduces total energy consumption, electrifies residual energy requirements, and provides summer cooling with zero incremental capital expense. It is a largely untapped approach in Vermont, ideal for VGS's commitment to transition our legacy business to net zero by 2050. As an existing, regulated thermal energy supplier, VGS is best positioned to address both the cost barrier that has resulted in low adoption, and the ongoing infrastructure construction and maintenance requirements that widespread adoption of geothermal technologies would require to go from concept to reality.

As always, we are available to the Commission and the Department to answer any questions about this filing.

Respectfully submitted,

/s/ Jill Pfenning

Jill Pfenning
VP, Financial & Regulatory and General Counsel
Vermont Gas Systems, Inc.
jpfenning@vermontgas.com