



FILED VIA ePUC

January 14, 2022

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

Re: Hybrid Heating Research & Development Project, Phase 1

Dear Ms. Anderson:

By this filing, Vermont Gas Systems, Inc. (“VGS” or the “Company”) provides notice of its Hybrid Heating Research & Development Project (the “Project”), a new addition to our Climate Action and Innovation programming. 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.”¹ Section 5(d) requires VGS to provide 30 days’ advance notice to the Commission and the Department before commencing any spending on a project, program, or service under the Climate Action and Innovation Budget that exceeds \$25,000. As detailed below, spending on this Project is expected to exceed that threshold. Accordingly, VGS is providing the following notice, which includes the relevant content required by Section 5(e) of our Alternative Regulation Plan.

Introduction: Hybrid Heating with Cold Climate Heat Pumps

VGS is planning to promote hybrid heating systems by adding Cold Climate Heat Pump (CCHP) installation into our portfolio of behind-the-meter services, which we also refer to as in-home customer offerings. A hybrid system is the integration of a CCHP with a central fossil fuel heating system. These hybrid systems have the potential to greatly displace fossil fuel usage by providing customers an easy entry to highly-efficient electric heat through the introduction of a CCHP, allowing the customer to establish the CCHP as the primary heating source while still utilizing the legacy fossil fuel equipment when the heat pump cannot provide adequate comfort. As discussed below, an outside temperature “set point”² is established for when the system will switch between electricity and gas. Unfortunately, customers are not equipped with the knowledge or tools to choose set points that meet the systems’ carbon reduction potential, and too often CCHPs are used only for cooling or at set points that add minimal carbon reduction value. In response, VGS is striving to begin offering CCHP hybrid heating in a way that will

¹ See Exhibit VGS-JMP-5 filed May 21, 2021 in Case No. 19-3529-PET.

² With a hybrid heating system, the outside temperature set point (sometimes known as the outside temperature cut-off set point) is a setting in the smart thermostat that automatically switches the heating source from the heat pump to the gas furnace or vice versa based on outdoor air temperature. This is typically set by the HVAC installer.

empower customers to understand their hybrid systems and make personal carbon reduction choices.

As a critical component of the hybrid heating offering, we envision an interactive tool—the Cost vs. Carbon Calculator—that will (among other things) allow each customer to see their hybrid heating system’s specific carbon emitting fuel consumption and how both the system’s emissions and cost change with adjustments to the outside temperature set point. Additionally, some potential features of the Calculator we envision include:

- Estimating the customer’s home thermal carbon footprint based on the customer’s natural gas consumption data, weatherization status, the home’s heating system type, and the number of occupants in the home;
- Comparing the customer’s carbon footprint to their selected goal, providing choices such as modest improvement, deeper reductions compatible with Vermont’s commitment to limit warming to 1.5 degrees Fahrenheit³, or “all the way” to net zero CO₂ (which would include purchasing Renewable Natural Gas (RNG) attributes);
- Estimating the potential for CO₂ reduction from converting/augmenting their natural gas heating system to a hybrid/heat pump system, converting water heating to a heat pump water heater (HPWH), and purchasing RNG for some or all of the home’s consumption;
- Estimating the costs and benefits associated with purchasing new equipment and installing it, changing fuel sources, and purchasing RNG; and
- Scalability, that is, this tool would be applicable and available to Vermonters using other fossil fuels who are considering hybrid systems.

Developing the Cost v. Carbon Calculator will be a two-phase process. First, we will develop a prototype or prototypes and test market potential with prospective, interested natural gas customers who have already installed CCHPs as part of a hybrid system or who are considering such a system in the near future. Second, we will refine the prototype for production. The innovation investment described in today’s filing is specific to the first phase.

Background: The Status of Cold Climate Heat Pump Usage Today

According to Efficiency Vermont, approximately 37,000 CCHPs have been installed in Vermont to date since first launching their CCHP midstream program in 2015. The launch roughly coincided with the Vermont legislative adoption of a Renewable Energy Standard (RES), which established clean energy requirements for all electric distribution utilities (DUs) to achieve. The Tier 3 component of RES requires the DUs to annually reduce customer fossil fuel consumption. Because CCHPs are a cost-effective technology to displace large portions of propane and oil heating usage, they quickly became a cornerstone solution that the DUs promoted and incentivized to meet their Tier 3 obligations.

³ Under the 2015 Paris Agreement, countries agreed to cut greenhouse gas emissions with a view to “[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”. *See* Article 2, Section 1(a).

But natural gas customers do not see the same economic benefit from fuel switching to CCHPs. Historically, natural gas rates have been well below electric rates in terms of dollars per BTU, so the economics are decidedly not beneficial for using heat pumps instead of an average natural gas furnace or boiler. However, because CCHPs also make superior replacements for window-mounted air conditioners and can provide specific heating comfort in areas of the home that may be under-insulated (or in new additions), many VGS customers have adopted them for those purposes. But once installed, are they using them to reduce fossil fuel consumption as well?

We took a look. In 2019, VGS performed a high-level meter analysis of 356 residential customers that had installed one or more heat pumps between 2016 and 2018. Using pre-installation meter data, we separated the water heating and space heating loads and then weather-normalized the heating usage to establish baselines. The post CCHP installation analysis showed that those customers on average decreased their natural gas heating annual usage by only 35 ccf.⁴ This is an insignificant decrease where the average single-family home uses approximately 900 ccf annually for space heating.

We also queried several high-profile HVAC companies operating in the three counties we serve and customers who recently installed hybrid systems. The installers reported that when coupling a CCHP with a central natural gas-fired system, the outside temperature cut-off was set between 35 and 50 degrees, with most installations at 40 degrees and above. At that set point level, the heat pump will be used very little for heat—if at all—minimizing or eliminating the system's carbon reduction potential. Further, contractors and customers both reported that no consultation is conducted after installation about choosing a set point, and we found that the smart thermostats that can accommodate hybrid heating systems bury the set point controls under “installer option” settings. It appears that despite purchasing CCHPs and creating hybrid systems, customers are provided little education about or opportunity to access their systems' larger environmental potential.

From these initial inquiries, we surmised that installers assume economic value trumps carbon reduction for all customers, so we began to test that assumption. Earlier this year, we conducted a brief online survey with 226 customers asking how important reducing their carbon footprint was to them personally. 35% said that reducing their personal carbon emissions was very important while 57% said that it was increasingly important, demonstrating considerable awareness around the importance of reducing carbon emissions.⁵ The next step—Phase 1 of this Project—will test what customers will choose when given the tools to evaluate cost and carbon reduction for themselves.

⁴ This analysis would require a longer time horizon and greater segmentation between CCHP installation profiles to be conclusive, but it provides some substantive evidence that CCHPs are not significantly off-setting natural gas consumption. The analysis did not include centrally ducted CCHPs, which were not widely available until 2019.

⁵ Notably, VGS has 168 customers signed up to purchase Renewable Natural Gas so far and 152 of those are residential customers. About 60% of those customers signed up for RNG since our promotion around the Goodrich Farm digester. This evidences that customers are choosing to pay more to decarbonize and balancing that choice against what they can afford, which is informative to our hypotheses around the hybrid heating.

Phase 1 Project Description

VGS believes that if customers are given the opportunity to evaluate the carbon reduction benefits that can be achieved from optimizing a hybrid system, and are provided with tools that illustrate how adjusting the set point could cut their carbon emissions and impact their costs, many will independently choose to reduce their fossil fuel usage. VGS intends to prototype one such tool—the Carbon vs. Cost Calculator—that would enable customers to make decisions about their hybrid heating system based on cost and carbon reduction factors. Through Phase 1 of the Project, VGS will explore this idea and evaluate the feasibility of a Carbon vs. Cost Calculator by testing these primary hypotheses:

1. It is possible to closely estimate the potential CO₂ reductions and financial impacts from a hybrid heating system using simple inputs from the customer in conjunction with VGS's existing billing data.
2. Customers are motivated to reduce their “carbon footprint,” can articulate a goal that they want to reach, and are willing to pay for a service that helps them achieve this goal.
3. Customers will be more willing to pursue the installation of a hybrid heating system if the costs and benefits are framed in the context of CO₂ reductions toward their stated goal and take into consideration overall cost.

With the assistance of a consultant to help us construct and test calculator prototypes and objectively test our hypotheses with customers, Phase 1 will consist of: (1) customer enrollment, (2) calculator prototyping, (3) customer testing, and (4) conclusions. Customer enrollment will include analyzing each customer's home heating and cooling usage, and then a prototype will be developed to allow customers to populate relevant data points. Customers will test the prototype and provide survey responses about their experience, which will be compiled and analyzed. The quantitative outputs from the calculator will test our hypotheses about our customers and the value of carbon reduction, and the calculator prototypes will enable feedback about customer responses to the information, interface, and messaging. Finally, a report will be prepared presenting findings and recommendations, which we intend to share broadly with other partners.⁶

VGS intends to have forty to fifty customers interact with the Cost v. Carbon Calculator prototype. To identify customers willing to participate in our project, VGS will work with Burlington Electric Department to identify and engage mutual customers who have already installed CCHPs as part of a hybrid system or who are considering such a system in the near future. Using meter data and some basic customer information, our consultant will create baseline profiles for each of the participants to develop a granular understanding of their heating and cooling profile, pre- and post-installation.

Customer engagement will begin with a short survey to further the customer profile, enabling us to categorize and weigh responses. Next, we will conduct one-on-one discussions with customers to introduce the prototype calculator and observe the customers' interactions with it. The

⁶ We believe our findings will have value for Vermont's distribution utilities and energy efficiency utilities, both of whom are actively engaged in promoting CCHPs and, in the case of the DUs, ensuring that these solutions are offsetting fossil fuel usage per their Tier 3 obligations.

calculator will be prepopulated to include some of the information already provided by the customer and we will explain how to interact with the tool. Participants will be able to enter key variables such as their system specifications, temperature set points, weatherization status, and renewable gas purchasing. These variables will enable participants to see the cause and effect of specific choices as they relate to cost and carbon. We will record a “think-aloud” test where the customer describes their thought process as they interact with the calculator. During these discussions, we will observe such things as: What helps customers make decisions? How are they responding to specific results? How are they using trial and error to balance costs and personal carbon reduction goals?

Following the individual discussions, we will administer another survey focused on the customer’s experience and perspective on taking action to reduce their carbon footprint, with questions such as: Has your perspective been affected by using the calculator? What features had greater impact? What features were confusing? What features were helpful? What features were missing? At the conclusion of these customer test sessions, we will compile the survey data and qualitative observations to report on the answers to these questions:

- Were we able to affirm the key hypotheses that were identified at the beginning of this project?
- What else did we learn about the customer response to interacting with the calculator?
- What new questions arose based on these customer test sessions?
- Based on what we’ve learned, do we recommend pursuing this idea further?

Throughout the Project, we will collaborate with Efficiency Vermont (which has built a CCHP evaluation tool unrelated to carbon reduction⁷) and our DU partners. This collaboration will prevent duplication of efforts and allow us to build upon their experience and expertise as CCHP market leaders.

Phase 1 Project Cost & Timeline

The Climate Action and Innovation Budget spending for Phase 1 is approximately \$30,000 for fiscal year 2022. The spending will support developing a customer and climate-centric hybrid heating offering to add to our current portfolio of services. Funds spent will be focused on prototyping, customer engagement, and the testing of hypotheses specific to feasibility of concept and customer value propositions. The budget and proposed timeline are detailed below.

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See <https://www.efficiencyvermont.com/trade-partners/heat-pump-balance-point-tool>.

Description	Estimated Amount	Estimated Timeframe
Customer Enrollment: Consultant to assist with the enrollment of project participants and the analysis of their home heating and cooling usage	\$3,500	Jan-Feb 2022
Calculator Prototyping: Consultant to assist with the development of the prototype calculator, ready to be populated with data for the customers participating in the study	\$9,000	Feb-Mar 2022
Customer Testing: Consultant to assist with testing the prototype calculator with customers participating in the study, compiling survey responses, analyzing results, and delivering findings in a report	\$14,500	Mar-Apr 2022
Conclusions & Recommendations: Consultant to present findings to key stakeholders, incorporating feedback into the report, and providing final versions of all calculator instances, survey data, and other artifacts.	\$3,000	May-Jun 2022

This investment will not involve capital expenditures. It will be integrated in base rates through our innovation expense budget, impacting participating and non-participating customers equally. As a research and development program, it will not require any variance from VGS's current tariffs. If Phase 1 successfully validates our hypotheses, then we anticipate launching Phase 2, which would focus on production of the calculator along with a residential hybrid system pilot. This would take place over FY22 and FY23 and be presented to the Commission under separate notice.

Conclusion

Vermont's commitment and obligation to meet the goals established by the Global Warming Solutions Act places a premium on effective strategies in the building thermal sector. Since Vermont's electricity portfolio is approximately 93% carbon free, CCHP adoption has been identified as a top strategy to cut thermal emissions alongside heat pump water heaters.

However, because natural gas has been historically much less expensive than electricity and customers have not been encouraged to optimize the carbon reduction potential of their hybrid heating systems, it is reasonable to believe (and our limited analysis supports) that existing CCHPs are largely utilized for cooling and not for off-setting natural gas fuel loads. Accordingly, we believe an effective Cost vs. Carbon Calculator has the potential to (a) empower current users of hybrid heating systems to reduce their fossil fuel consumption and greenhouse gas emissions, (b) provide moderate income Vermonters with opportunities to reduce their carbon footprint within a budget, and (c) further the adoption of CCHPs overall.

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At this stage of the Project, we are engaging customers to educate *us* on the effectiveness of this tool, but as the Project moves to product development and eventually increased hybrid heating system adoption, we look forward to furthering customer outreach and exploring how VGS can effectively offer hybrid heating to all our neighbors equitably.

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