

Lessons from a Renewable Heat Ordinance for New Construction in a Small Vermont City

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ABSTRACT

In 2022, the small city of South Burlington, Vermont passed an ordinance requiring that all new residential and commercial buildings have space heating and water heating systems supplied by renewable fuels. The requirement can be met with either electric heat pumps and heat pump water heaters or combustion equipment coupled with a long-term contract for biogas or other renewable fuel. Hybrid electric-fossil fuel space heating systems are permitted as long as the electric heat pump can meet at least 85% of heating needs. Developers can also request an opt out from ordinance requirements if they can document that compliance would not be cost-effective when reductions in CO₂e emissions are valued at \$100 per ton.

To date, no developers have selected long-term renewable fuel contracts or requested opt outs. Over 40% of new single-family detached homes and as much as 25-30% of new duplex, triplex and multi-family housing units are all-electric. The remainder were built with hybrid electric-fossil fuel heating. Analysis of gas utility bills suggests that post-ordinance buildings with hybrid heating systems are consuming gas for space heating at levels that are not significantly different from pre-ordinance buildings. This unexpected result could be a function of contractors setting high switchover temperatures, some building occupants deciding to use heat pumps only or primarily for cooling, and/or heat pumps being undersized. On the other hand, baseload gas consumption is significantly lower for post-ordinance buildings, suggesting the ordinance's prohibition on fossil fuel water heating is having its intended effect.

Introduction

The Intergovernmental Panel on Climate Change has estimated that limiting global warming to 1.5° C relative to pre-industrial levels will require achieving net zero emissions of greenhouse gases (GHGs) by 2050 (IPCC 2022). That level and timing of GHG emissions reduction is widely regarded by scientists as necessary to avoid the most catastrophic potential effects of climate change (IPCC 2022).

Achieving net zero GHG emissions requires addressing all major sectors of the economy that currently produce emissions. In the United States, residential and commercial buildings account for 13% of GHG emissions – the fourth largest source after the transportation sector (30%), electric power generation (24%) and industry (23%) (EIA 2026). Vermont's electricity is relatively clean, both because of a renewable portfolio standard which requires a minimum of 63% of each electric utility's generation to be renewable 2025 (and 75% by 2032) and because some utilities in the state have committed to decarbonizing their generation faster than that.

Vermont also has colder winters than most other states, so buildings require more energy for space heating. As a result, GHG emissions from residential and commercial buildings account for nearly one-third of the state's total (EAN 2025). Residential and commercial building emissions represent an even larger portion (49%) of total GHG emissions in the City of South Burlington (Chittenden County Regional Planning Commission, 2025).

Reducing emissions from the buildings sector is challenging, particularly in colder climates that rely extensively on burning of fossil fuels to provide space heating – as well as water heating, cooking and other needs. In South Burlington, approximately 70% of the city's 8,500 residential housing units use natural gas as their primary heating fuel, 15% use fuel oil or propane and 15% – mostly in rental housing – use electricity (City of South Burlington 2022). Anecdotal evidence suggests that the vast majority of new buildings constructed over the past couple of decades use natural gas for space heating.

Renewable Heating Requirements

In November 2022, as part of its climate action plan, South Burlington passed what is commonly called its Renewable Heating Ordinance which requires all new residential and commercial buildings to have renewable space heating systems. Renewable water heating systems were also mandated for single family homes, with the intent to extend such requirements to multi-family and commercial buildings following a three-year exemption period to address concerns about market readiness of applicable technology. The ordinance went into effect for new building permits requested after February 15, 2023. Builders are given three different options for meeting the South Burlington ordinance's renewable space heating system requirements:

- **Electricity.** Since state building codes preclude use of electric resistance heat, the electric heating option effectively requires the use of heat pumps. Importantly, builders can choose to either meet 100% of heating needs with heat pumps (coupled with electric resistance back-up for very cold days) or to use hybrid electric-fossil fuel heating systems, as long as the electric component of those hybrid systems is sized to meet at least 85% of the building's design heating load.
- **Wood.** The ordinance specifically names wood chips or wood pellet heating systems as options.
- **Other Renewable Fuel.** Builders can choose heating systems that rely on fuel "used by conventional primary heating systems, including renewable gas, biodiesel, and renewable district heating, if the building owner provides a contract demonstrating that the fuel required by the conventional primary heating system is fully sourced from such other renewable fuels for the life of that conventional heating system." In essence, builders can deploy conventional fuel heating systems such as furnaces or boilers, as long as they demonstrate that they have a long-term contract for biofuels.

The same three options, plus solar thermal, are also available for meeting the ordinance's renewable water heating requirements for single family homes.

Importantly, the ordinance gives builders the ability to apply for a waiver from the renewable heating and water heating requirements if they certify that using such renewable

systems would be “uneconomical.” To be deemed uneconomical, the 25-year capital and operating costs of the least expensive renewable systems, net of any financial incentives available, must be greater than the comparable cost for non-renewable systems. The cost comparisons must also include externality costs of \$100 per ton of carbon (adjusted year-to-year for inflation) expected to be emitted throughout the lifetime of the non-renewable system.

Builders are required to complete and submit to the City a one-page “application” for a certificate of compliance with the ordinance. The application form documents whether they are applying for a waiver and, if not, what renewable heating fuel and renewable water heating fuel they are choosing to use. The ordinance states that the City shall “upon the recommendation of the city manager” appoint a building inspector to review and process the application forms (including proposals for waivers) and issue a certificate of compliance with the ordinance. The City does not have a building code. The Fire Marshall has been appointed the City’s building inspector and ensures that the required application forms have been submitted. There has been no enforcement beyond compliance with self-certification.

Political Process

South Burlington has had a long-standing commitment to improve the city’s energy and climate performance. Early efforts by the South Burlington Energy Committee date back to 2015 with a bid for the Georgetown Energy Prize and a 2017 resolution to join the Vermont Climate Pledge Coalition to meet the Paris Agreement goals. However, the Energy Committee’s nominal commitment lacked clear goals and mechanisms for driving action until a city resolution passed on July 23, 2021 that established a task force to draft a Climate Action Plan (CAP) and directed the city to “strive to take actions based on the Climate Action Plan.” When the CAP was adopted in October of 2022, it identified transportation and fossil fuel heating in buildings as the largest sources of greenhouse gas emissions, since electricity supply from the local electric utility is considered to be nearly 100% carbon free (Green Mountain Power 2026).

While the CAP drew the boundary for tracking and reducing emissions to include all activities within the city, not just those directly controlled by the municipality, residents and businesses in South Burlington would need to modify the way they acquire, maintain, and operate their buildings and vehicles in order to achieve these goals. The city has three main ways that it can motivate these changes: communication and education, fees or incentives, and regulations. One of the more powerful regulatory tools at the city’s disposal is the building code. Building codes require proactive installation of low-emissions equipment in new buildings, generating a significantly lower marginal cost than replacing equipment later. Furthermore, allowing new installations of fossil fuel systems would mean they would remain in place for their full lifespan, which conflicts with the city’s climate goals. Therefore, the city developed a renewable heating ordinance, largely following the model established by the neighboring city of Burlington a few years earlier (City of Burlington 2021), but with an additional requirement for renewable energy-powered domestic hot water systems.

Vermont is a Dillon’s Rule state, which means that municipalities are only able to regulate what is authorized under state law. The renewable heating ordinance draws authority from 24 V.S.A. § 3101¹ (Chapter 083: Building Inspectors and Regulation of Building), which

¹ <https://legislature.vermont.gov/statutes/section/24/083/03101>

allows municipalities to establish their own building codes. Burlington opted to include a fee for non-compliance, which required them to petition the Vermont General Assembly for a charter change. As this would have added significant time and expense to the process, South Burlington did not include that aspect in their ordinance.

As is required for any new ordinance, the city held two public comment sessions during City Council meetings. Residents, builders, and other interested parties attended to present their views in favor or opposition of the ordinance. Proponents typically cited the climate benefits of heat pumps and offered testimony of their ability to provide heat even through cold weather. Opponents spoke of personal choice, affordability, and concerns about the reliability of the electric grid during cold weather. Based on feedback that affordable and reliable commercial-scale domestic hot water heat pumps were not yet available, the ordinance was edited to delay the requirement for those systems by two years. One member of the five-seat city council recused himself from the vote due to deep professional and family ties to the fossil fuel industry in Vermont and the remaining Councilors voted in favor of passing the ordinance. In 2025, the ordinance was amended to further delay the requirement of hot water systems in commercial new construction until June 2027.

Role of Vermont Gas

Vermont Gas Services (VGS), the state's only gas utility, was supportive of South Burlington's interest in developing a renewable heating ordinance. It also played an active and important role in shaping the design of the ordinance. The utility's efficiency experts and public policy team met with City staff and members of the City Council to ensure they had the information they needed to design an effective policy. The Company provided technical feedback to City Staff and the City Council on a range of issues including the design and efficacy of hybrid gas-electric heating systems, the market availability of efficient electric water heating technology and potential implementation challenges for new residential and commercial buildings. The utility also shared concerns raised by developers, engineers, and contractors related to equipment sizing, water heating recovery capacity, space constraints and lifecycle cost assumptions, which informed discussions around implementation timelines and ordinance flexibility.

That feedback supported several important refinements to the ordinance, including an initial two-year delay (to 2025) in applying renewable water heating requirements to multi-family buildings to address concerns about availability of efficient electric technology. VGS' support of the ordinance as ultimately drafted also helped give comfort to policymakers about its technical viability, customer acceptance and affordability of new construction.

Once the primary heating ordinance was approved and took effect in 2023, open channels of communication allowed the utility to provide further input on implementation. The utility was able to channel the feedback they heard from developers who were seeking to build compliant residential and commercial buildings into policy adjustments that better reflected technical feasibility. When City staff identified that stakeholders could not cost-effectively meet the multi-family requirements of the primary water heating ordinance when its 2025 implementation date arrived, the City Council reviewed their analysis and voted to extend the implementation deadline by two years to allow for greater preparation. VGS's technical input supported the Council's decision for continued flexibility.

VGS’ support for the ordinance is consistent with the Company’s commitment to finding solutions to concerns about global climate change. VGS has publicly acknowledged the climate impacts of natural gas and committed to a different path consistent with Vermont’s 2020 energy policy, the Global Warming Solutions Act (GWSA), which requires an 80% reduction in economy-wide emissions from 1990 levels by 2050. The Company has translated this commitment into a three-pillar Climate Plan designed to reduce emissions while maintaining the core responsibilities of a regulated utility: safety, reliability, and affordability. The first pillar expands energy efficiency, particularly weatherization and programs for income-qualified households—as the most immediate and cost-effective climate solution. The second focuses on reducing emissions from the gas system through renewable natural gas, green hydrogen pilots, and utility-scale geothermal systems. The third extends VGS’s role behind the meter through technologies and services such as heat pump water heaters, air-source heat pumps, hybrid heating optimization, and equipment leasing that lowers upfront cost barriers. Delivering this strategy has required organizational change, including leadership roles dedicated to decarbonization and innovation, broader employee engagement, and strengthened partnerships with policymakers, utilities, technology providers, and community organizations. VGS’ support of South Burlington’s renewable heating ordinance is an example of its commitment to such partnerships.

Results

Builder Design Decisions

From the inception of the ordinance’s requirements in mid-February 2023 through the end of November 2025, builders have proposed the construction of nearly 200 new housing units plus five commercial buildings. As Table 1 shows, about 70% of the proposed housing units are single-family homes (either detached or duplexes/triplexes). There are only two buildings with four or more units – one 4-unit building and another 46-unit building. Another 12 housing units are part of two of the five commercial buildings that are designed for mixed use. As of the writing of this paper, only 91 builder self-certifications have been submitted to the City – all of them for single-family homes (roughly evenly split between detached and duplex/triplex buildings). Some of the certifications have not yet been provided because construction has not yet begun. For other buildings, the City is currently contacting builders to obtain certifications.

Table 1: Buildings Proposed and Certifications Received through November 2025

Building Type	Number of Units Proposed		Certifications Received	
	Buildings	Residential Housing Units	Buildings	Residential Housing Units
Single-Family Detached	62	62	41	41
Duplex/Triplex	34	71	21	50
4+ Unit Buildings	2	50	0	0
Commercial/Residential Mixed Use	2	12	0	0
Commercial only	3	0	0	0
Total	103	195	62	91

Based on data from Zillow.com and the Planning and Zoning office, with the exception of one very large home (5,617 square feet), single-family detached homes range in size between 1,600 and 3,900 square feet, with an average of approximately 2,400 square feet of finished space. The duplex/triplex housing units range in size from 625 to 1,555 square feet, with an average of 982 square feet of finished space. The multi-family buildings have an average of 1,095 square feet of finished space per housing unit.

To date, no builder has applied for a waiver for the renewable heating or water heating requirements. Further, 100% of the certifications that the City has received state that the builder has installed or intends to install both electric space heating systems and electric water heating systems. The City's certification form has not historically required builders to differentiate between whether they plan to use all-electric heating systems or hybrid electric-fossil fuel systems. However, beginning in 2026, the City's certification form requires buildings using electric heat to specify whether buildings will use all-electric or hybrid heating systems.

Impact on Natural Gas Consumption

To identify the number of buildings that certified use of electric heat and were using hybrid electric-gas systems, as well as understand the magnitude of gas use in such systems (and whether it was likely to be consistent with the expectation that the renewable energy-powered heating system can supply at least 85% of the building's heating demand), the authors analyzed gas billing data for participating homes. South Burlington City staff assembled lists of all permits for single family and multi-family buildings that were submitted since the ordinance was enacted, as well as a similar list for the two preceding years to use as a baseline for comparison. Due to lack of baseline data for pre-ordinance commercial buildings as well as greater variability in commercial building heating loads, this building type was not included in the analysis.

VGS staff used the addresses from the building permit records to match as many buildings as possible to their corresponding VGS accounts. The counts for the number of premise IDs are shown in Table 2. The dwelling units without VGS premise IDs either do not have gas service or data quality issues prevented a successful match.

Table 2: Counts of Matched VGS Premise IDs from two-year pre- and post-ordinance periods

	Single Family Detached		Multi-Family (Duplex, Triplex or Buildings with 4+ Units)	
	Pre	Post	Pre	Post
Permits	71	63	38	36
Dwelling units	71	63	514	127
Distinct VGS premise IDs*	66	36	66	41
Premise IDs with billing data	65	28	64	32
Adequate data and model fit	56	18	42	21

* For the single-family post-ordinance data set, 25 of the 27 buildings with no VGS premise ID are from a single development where the developer opted not to bring gas service to any of the buildings. There are 36 post-ordinance housing units without a VGS premise ID. These could be all-electric buildings, though it is also possible that there are some for which differences between the City's and VGS' recorded addresses precluded identification of the VGS premise ID.

One multi-family permit indicates 46 dwelling units but only has a single VGS premise ID, suggesting that the building is master-metered. It was excluded from the analysis, along with five other multifamily accounts (four pre-ordinance and one post-ordinance) that have annual weather-normalized gas use over 4,000 therms, which suggests that the billing data includes multiple housing units.

VGS provided all available monthly billing data through January of 2026 for this analysis. When reviewing the data, we noticed that many of the data sets showed higher gas consumption in the initial billing period, relative to that period's heating degree-days, than the rest of the bills for those homes. Consequently, we used the most recent year of data for the analysis presented here, assuming that it represents the most typical conditions for fully-occupied homes.

The billing data was matched to National Oceanic and Atmospheric Administration (NOAA) weather data from Patrick Leahy Burlington International Airport (KBTV), the nearest weather station to most of the VGS territory. We used OpenDSM's OpenEEmeter2 to create partwise regression models against the average daily outdoor dry bulb temperature. Those models were then used to predict daily energy use for NOAA's typical meteorological year, version 3 (TMY3) data for the same weather station. The software provides not only whole-building energy use estimates, but also heating and base load estimates using the slopes and intercepts of the model. Figure 1 shows percentile cumulative distribution function (CDF) plots to compare the populations of pre- and post-ordinance buildings to see if the distribution of energy use was influenced by the ordinance. Only homes that use at least some gas are included in the plots. The "Post-ordinance" line should be to the left of the "Pre-ordinance" line if the ordinance is reducing energy consumption in buildings connected to the VGS system.

It's notable that there was a larger portion of the pre-ordinance population of multifamily homes that had very low annual consumption, which appears to be driven by an increase in the post-ordinance heating load, particularly in the lowest-consuming 20% of the population. It's possible that some multifamily builders had switched to heat pumps before the ordinance went into effect as it is an affordable way to air condition units. However, this doesn't explain why none of the post-ordinance buildings are showing similarly very low heating loads.

The base (non-weather-dependent) load would be expected to include any domestic hot water (DHW) fuel use. However, as there is no allowance in the ordinance for a fossil-fired backup DHW system, we would expect that all post-ordinance residential buildings are using non-gas water heaters. Since homes are still allowed to use gas for cooking and clothes drying, there will likely still be some gas base load. Here we mostly see the expected trend, with most percentiles showing a significant drop in annual base load. The multifamily charts instead show a number of low-consumption units at the bottom end of the distribution for the pre-ordinance

² <https://opensdm.energy/documentation/eemeter/>

population, suggesting that a non-trivial fraction of pre-ordinance homes were also not using gas for water heating. It would be helpful to have a larger sample to determine how frequently these outliers occur and what that means for the overall population.

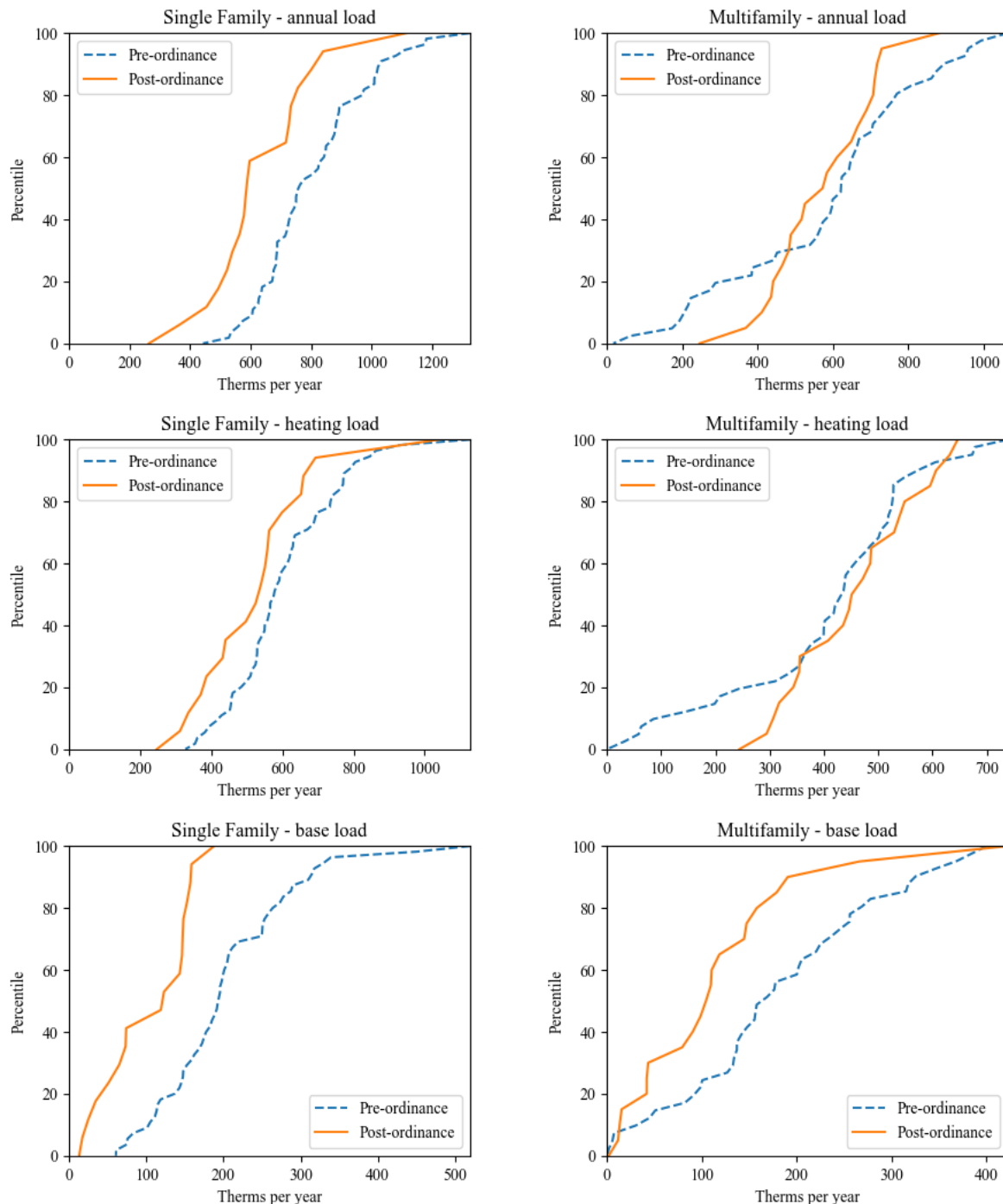


Figure 1. Cumulative distribution function plots for single family and multifamily population weather-normalized annual gas consumption as well as disaggregated heating and base loads.

As a check on the base load disaggregation from the weather modeling, we compared the base load implied by the daily use from summer (June – August) bills for single-family homes,

after excluding a small number of bills from summer periods with over 170 degree-days. The pre-ordinance homes in Figure 2 are indicated in blue and the post-ordinance homes in green; the red dashed line is the 1:1 line where the model disaggregation and summer bill proxy base load estimates are in perfect agreement. Most of the pre-ordinance homes are showing similar estimates via both methods (the bill-based estimate is 93% of the model disaggregation), while the post-ordinance homes show more, primarily such that the model is indicating a larger base load variability (the bill-based estimate is 75% of the model disaggregation). This could be caused by pre-ordinance homes with gas DHW, since inlet temperatures are higher in the summer and the summer-bill-derived base load estimates would thus underestimate the true annual base load since the DHW load would be higher in the winter when inlet temperatures are lower.

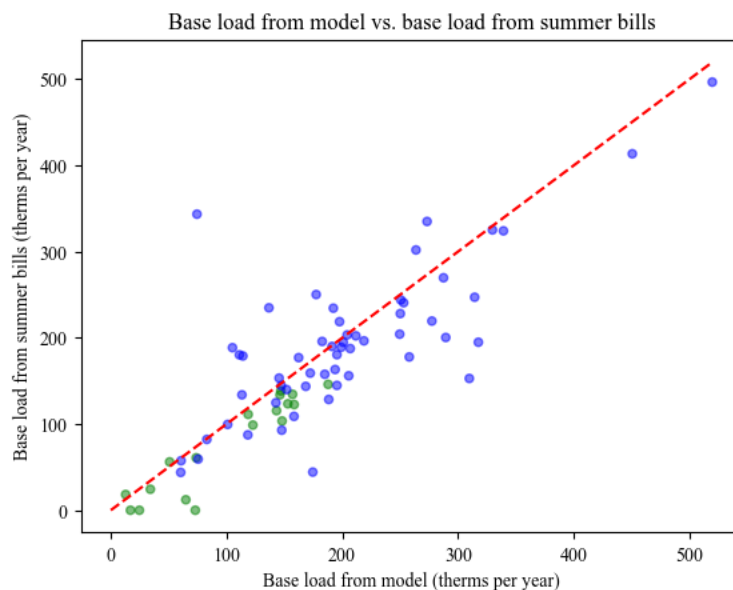


Figure 2. Validation of single family base load disaggregation against annualized summer bills

Table 3: Average per-home weather-normalized annual gas consumption in therms, excluding homes with no gas billing data

	Single Family		Multi-Family	
	Pre	Post	Pre	Post
Pre/post ordinance data				
Annual load	803	624	578	566
Heating load	602	522	399	452
Base load	202	102	179	114

Looking at the average weather-normalized per-home consumption in Table 3, there is very little change between the pre- and post-ordinance populations. The single-family homes' base load was reduced nearly in half, dropping by 100 therms per year, but the heating load

decreased by less than 15%. The multifamily annual base load seems to have dropped about 65 therms while those homes increased their heating load about almost the same amount.

The most important finding from the analysis of all buildings is the lack of a significant change in the gas heating consumption among homes that use gas. We would have expected gas to no longer serve very much of the heating load at all, and there is not any strong evidence of that kind of change in this data. This result may merit revisiting, given the small sample size of homes included in the analysis.

The strongest evidence that the ordinance may be working is from the large number of homes that were built with no gas service at all. However, this is almost entirely due to a relatively large single development. For the homes built with backup gas-fired heating systems, it appears that those “backup” systems are carrying most or all of the heating load. While there is some indication that the water heating system requirements in the ordinance may be shifting DHW load from gas to electricity.

Feedback from Key Builders

City of South Burlington staff received feedback from three developers responsible for 58% of the residential buildings built after the ordinance and one HVAC contractor that worked in almost all new residential development.

Developers stated they are meeting the ordinance by adding heat pumps to the ducted HVAC systems and including a control that switches from using the heat pumps to using the backup gas system depending on outside temperature. This allowed them to basically maintain their original designs. Developers mentioned that the ordinance requirements increased the cost of new homes by \$2,500-\$7,000, mainly for equipment, and that they transferred those costs to clients. Many contractors mentioned that the additional price and the uncertainty of maintenance and complexity of operation was a challenge for new homebuyers. The HVAC contractor mentioned that many homebuyers were not educated on what it means to have a hybrid system. In one case, a new owner did not install Wi-Fi and the control switch could not operate as designed because it could not check outside temperature from a web server.

With regards to hot water heating, the HVAC contractor mentioned that they get numerous complaints on heat pump hot water heaters installed in South Burlington because of the noise, compressor failures and over-cooling of the basement, where they are usually located.

All those who submitted feedback said they would prefer that the homebuyer have a choice in the fuel for their heating needs.

Conclusions and Recommendations

Several key conclusions can be drawn from the analysis conducted for this paper:

- The South Burlington ordinance is likely having a significant impact in moving some builders to all electric homes, with significant GHG emission reductions.

- Homes that choose hybrid gas-electric heating systems appear to be using much more gas for space heating than expected.
- The ordinance’s prohibition on installation of fossil fuel water heaters appears to have reduced baseload gas consumption significantly.

These results suggest the biggest challenge with the effectiveness of the ordinance is with regard to how hybrid heating systems are designed and used. Changes to the ordinance may be necessary to address limited heating use of heat pumps in such systems. Based on the findings of this study, these changes may include:

- Requiring central heat pump systems (i.e., prohibiting ductless mini-split heat pumps unless there is no fossil fuel heating system).
- Requiring load calculations to document that the heat pump component of hybrid systems can meet 85% of design loads.
- Requiring controls that have default settings for switchover to fossil “back-up” systems at sufficiently low temperatures.
- Prohibiting the use of fossil fuel backup systems entirely, with exceptions for hard-to-serve cases.
- Implementing an inspection regimen that can verify the appropriate system was installed and that it was commissioned correctly.
- Education for local developers and engineers about how to meet the ordinance, as well as for new homebuyers.

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