



MEMORANDUM

To: Burlington City Council

From: Darren Springer, General Manager
Chris Burns, Director of Energy Services
Jen Green, Director of Sustainability and Workforce Development
Bill Ward, Director of Permitting & Inspections
Patricia Wehman, Housing Division Manager

Date: 12/5/2022

Subject: Final Report on Thermal Charter Change Work/City Council Resolution Relating to Decarbonizing All Buildings in Burlington by 2030

Burlington Electric Department (BED) and Department of Permitting and Inspections (DPI) are pleased to provide this final report and policy recommendations to the City Council related to our work on the May 9, 2022 Council Resolution to Decarbonize All Buildings in Burlington by 2030. The Resolution is included as an attachment to this memo, as well as our interim memo from July 18, 2022.

Process and Work Since the July 18, 2022, Memo

In the several months since issuing our interim memo, BED and DPI have engaged in additional outreach and analysis, including:

- The BED and DPI teams held two group stakeholder meetings with building owners on August 30, and October 25, as well as some individual meetings with stakeholders.
- BED participated in a 2030 District webinar with building owners and building design professionals.
- BED has worked intensively with the Building Electrification Institute (BEI) to analyze policy proposals and draw on their expertise working with cities around the nation.
- BED attended NPA meetings to share possible approaches and seek feedback from the community (Wards 1/8 Nov. 9; Wards 2/3 Nov. 10; Ward 5 Nov. 17; Wards 4/7 Nov. 30; Ward 6 Dec. 1).

Policy Recommendations

Based on our additional work, BED and DPI offer the following proposed policy recommendations for consideration, intended to balance cost and technical considerations with the need for additional climate progress in our building sector. *We note and emphasize these recommendations would not apply to existing*

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residential buildings (including single family homes, apartment buildings, or condos), or to small commercial buildings. These are focused to solely impact new construction permitted beginning in 2024, large existing commercial buildings, and City buildings.

- **Cross-Cutting Definitions:**

- **Carbon Pollution Impact Fee** – A fee, subject to voter approval, that would be assessed for alternative compliance for new construction or large existing buildings that do not use a renewable technology or renewable fuel under this proposed policy. We propose the fee would start at \$150 per ton of greenhouse gas emissions, for permit applications starting in 2024. It would increase annually at the rate of inflation but limited to no more than a 5 percent increase in any given year. The fee would be assessed based on a net present value calculation of the total amount of greenhouse gas emissions that would be produced by the thermal system over its lifetime and charged upfront at the time of permit. The goal would be to level the playing field for renewable technologies and represent the full societal, health, and environmental cost of the carbon pollution of the fossil fuel system.

We note that some cities are using higher carbon alternative compliance fees in their thermal sector policies. New York is using \$268 per ton, and Boston is using \$234 per ton. On the other hand, Vermont’s Climate Council has looked at analysis suggesting \$128 per ton for use as a social cost of carbon in Vermont.

For existing buildings only, we propose capping the amount of the carbon pollution fee for any thermal system covered by the proposed policy to 75 percent of the system’s installed cost. This reflects the fact that existing buildings with existing distribution systems may have fewer cost-effective options in certain scenarios to move to electrification relative to new construction.

- **Renewable Technology or Renewable Fuel** – Any renewable thermal technology or fuel, as defined in Burlington Ordinance Chapter 8, Article V. We would propose also including renewably-sourced hydrogen as an additional option, and creating an option for DPI to certify additional renewable fuel or technology options as new fuels or technologies come online, including options to use customer-procured or on-site renewable electricity generation that supports thermal decarbonization. We also propose clarifying that for a renewable fuel such as renewable gas or renewable thermal credits provided by the proposed McNeil district energy system, compliance could be indicated either by a long-term contract for the fuel with the provider that lasts at least as long as the expected lifetime of the permitted system, or requiring a compliance certification annually from the permit applicant and/or fuel provider that the applicant is purchasing renewable fuel to cover the entire need of the thermal system. In the event the annual certification is selected, non-compliance in a given year would subject the applicant to the carbon pollution impact fee for a pro rata share of the remaining expected life of the conventional thermal system installed.

Further, starting in 2023 as it relates to renewable district energy, such as is proposed for connecting the McNeil plant to customers in the City, for a customer purchasing Renewable Thermal Credits from the district energy system for utilization in a Burlington building or

buildings prior to incurring a compliance obligation under this proposed policy (either for new construction or related to a large existing building), the total cumulative quantity of district energy Renewable Thermal Credits purchased prior to the compliance obligation can count as a credit toward offsetting the carbon pollution impact fee. This credit could also be applied for customers purchasing other renewable fuel.

- **New Construction:** BED and DPI propose expanding upon the existing primary renewable heating requirement in Ordinance Chapter 8, Article V. We propose that, starting January 1, 2024, any permit for new construction of a building in Burlington require that not only the primary heating system, but all thermal systems – including domestic water heating, back-up heating systems, cooking, and appliances – be renewable under the definition above, or pay the carbon pollution impact fee.

We note that we heard from affordable housing developers and providers that have raised a concern around the inclusion of domestic water heating in this policy in the near-term due to concerns about operating and maintenance costs in a multi-family building context based on current available technologies, and discussed a delay on the application of that provision to affordable housing developments. It may be appropriate to delay implementation until 2026 of the requirement for renewable domestic water heating in multi-unit residential new construction buildings to allow for additional commercial technology to be available.

In addition, we propose that the existing renewable primary heating system requirement also be subject to the alternative compliance carbon pollution impact fee, and the exemption process in that Ordinance be removed in lieu of the fee. This will ensure that all new buildings are designed consistent with our Net Zero Energy Roadmap vision and our local climate goals.

- **Major Renovations:** BED and DPI believe this area requires additional study, given the complexities. We recommend taking no action at this time for major renovations, while leaving this open for future action while we gain policy implementation experience with the proposal for new construction and large existing buildings.
- **Large Existing Buildings:**
 - **Definition** - BED and DPI propose defining a “Large Existing Building” for purposes of a proposed ordinance as a building that is 50,000 square feet or larger, accounting for space-conditioned square footage. The requirement would only be based on that square footage, and would not be impacted by whether, for example, two smaller buildings are connected to a central heating system. There are approximately ~80 buildings that fit this 50,000 square foot or larger definition and are non-residential within the City.
 - **Exemptions** - We propose that all residential buildings, including affordable housing and rental or condo or dormitory properties, be excluded from this definition. We also propose that buildings listed, or eligible to be listed, on the National Historic Register that would otherwise be covered be allowed to apply for an exemption, provided they can demonstrate that there is no renewable technology or renewable fuel option available to the building due to the historic

nature of the building and limitations imposed by being on the Register, or eligibility to be on the Register.

- **Requirements** – We would propose that starting January 1, 2024, buildings in this category that submit a permit to DPI for a new heating system or domestic hot water system be required to use a renewable technology or renewable fuel in order to obtain the new permit. In the event the use of such a technology or fuel is impractical or not cost-effective, the building would be subject to the alternative compliance carbon pollution impact fee. Process steam, including steam for cooking for dining, humidification for library storage or at museums, or for research, and that is not utilized for space conditioning is not included in the requirement. For situations where one or more buildings are over 50,000 square feet and connected to the same central plant, possibly along with other smaller buildings, the requirement should apply to the portion of fossil fuel output attributable to space conditioning and domestic water heating for the building or building(s) that are 50,000 square feet or larger and not the entire central plant.

Credit – For buildings subject to this requirement, if the building owner undertakes to replace a thermal system not covered under this requirement (i.e. cooking, appliances, process heat, etc.) with a renewable system on or after January 1, 2023, the building would receive credit for the lifetime greenhouse gas emissions reductions from that new system against any future carbon pollution impact fee from a system covered under this requirement (heating or domestic hot water). A portfolio approach may be used to generate credits where a building owner has multiple buildings. For instance, an upgrade that reduces thermal fossil fuel use done in an exempted building. Further, the purchase of district energy or renewable fuel starting in 2023 can create a credit against future obligations as outlined in the definitions section.

- **Emergency Waiver** – DPI should have the ability to waive the requirements for an emergency temporary system installation in the event of an unexpected thermal system failure, but the requirements would still apply to any permit for a permanent replacement system.
- **City Buildings:** BED and DPI propose that all City Buildings be subject to the “large existing building” requirements with the exception that the City not be subject to the fee. Instead, the City should ensure that starting January 1, 2024, all City buildings replacing a heating system or water heating system use renewable technology or renewable fuel for the replacement, with no alternative compliance fee option.

BED and DPI recommend that the proceeds from the carbon pollution impact fee could be used for the following purposes:

- Capital needs for the City Fleet to continue to electrify, reducing emissions and saving taxpayers on operating costs;
- A new City fund to support clean heating technology installations for low-income Burlington households and renters, consistent with the Advisory Ballot Question 7 from Town Meeting Day 2021; and

- For existing buildings that are assessed a carbon pollution impact fee, a significant portion could be available to be refunded to the payor, if the payor submits a plan to support new projects at their site or in their Burlington operations to reduce emissions in their own fleet (vehicles, lawn equipment, etc.) or energy efficiency or electrification work that reduces fossil fuel use in their facilities. The payor should submit a reimbursement request for such projects within one year from project close out.

We propose periodic review by the Administration Council and/or Council committees, at least every three years, of the broader policy as well as how certain pieces (such as the ability of payors to utilize a portion of their carbon pollution impact fee at existing buildings to pursue other emissions reduction projects) are working.

Analysis

BED worked with BEI to conduct analysis using real world recent examples of new construction and existing building thermal systems design in Burlington.

Upfront Capital Costs

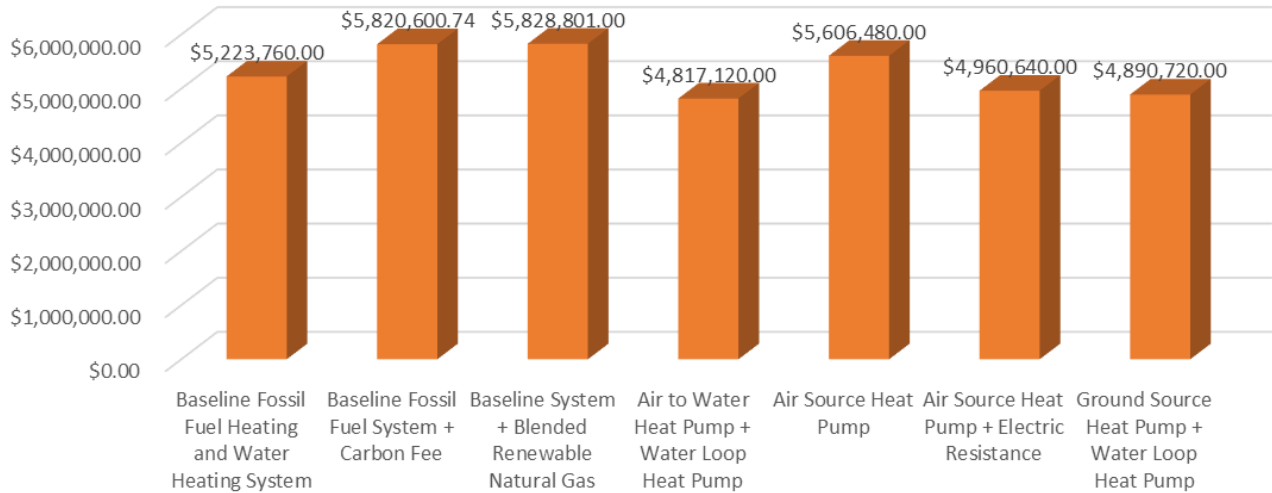
Please note these examples are illustrative, but not representative of the economics for all building types. The cost and opportunity to install ground source heat pumps, for example, could vary based on conditions at each individual site. The examples below also look primarily at upfront capital costs, not longer-term operating costs.

- **New Construction** - The below example¹ is based on an actual new construction building in Burlington. It outlines how the fee would work in practice, and how it would impact potential capital investment decisions relative to a baseline fossil fuel system and renewable options. What the chart demonstrates is that in this example, the conventional baseline fossil fuel heating and water heating system was approximately \$5.2 million to install. Some electrification technologies had a cheaper upfront cost, such as ground source heat pumps with a water loop (approx. \$4.9 million), while some were higher such as air source heat pumps (approx. \$5.6 million). When adding in the carbon pollution impact fee, the baseline system cost would be approx. \$5.8 million, and all of the electrification technologies would then be lower cost than paying for a conventional system plus the carbon pollution impact fee.

New Construction Building	Install Cost	Fee or Tariff	Total
Baseline Fossil Fuel Heating and Water Heating System	\$5,223,760.00	0	\$5,223,760.00
Baseline Fossil Fuel System + Carbon Fee	\$5,223,760.00	596840.74	\$5,820,600.74
Baseline System + Blended Renewable Natural Gas	\$5,223,760.00	\$605,041.00	\$5,828,801.00
Air to Water Heat Pump + Water Loop Heat Pump	\$4,817,120.00	0	\$4,817,120.00
Air Source Heat Pump	\$5,606,480.00	0	\$5,606,480.00
Air Source Heat Pump + Electric Resistance	\$4,960,640.00	0	\$4,960,640.00
Ground Source Heat Pump + Water Loop Heat Pump	\$4,890,720.00	0	\$4,890,720.00

¹ The carbon pollution fee and the renewable fuel options are based on net present values but determined using assumptions for the lifetime fuel use of the system or systems.

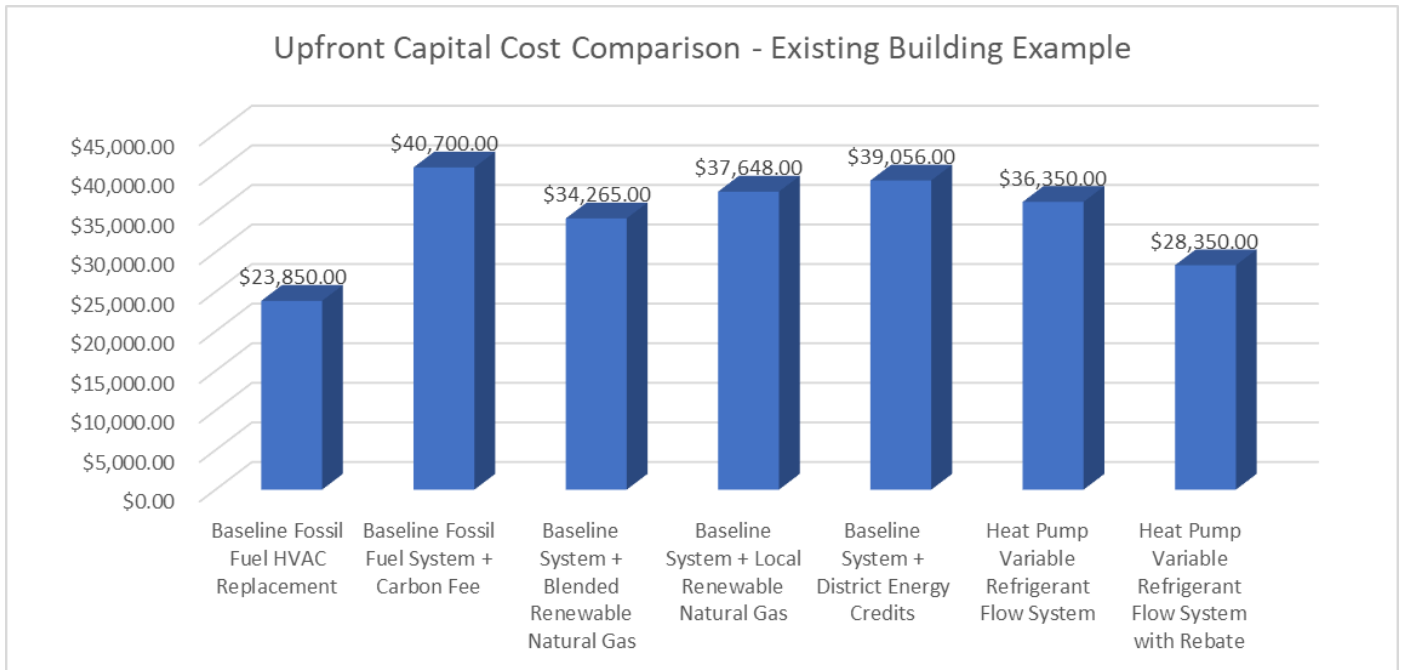
Upfront Capital Cost Comparison - New Building Example



We also worked with BEI to analyze an existing commercial building example. The below looks at an existing commercial building in Burlington, just under 50,000 square feet, that replaced a natural gas rooftop unit with a heat pump variable refrigerant flow (VRF) unit.² The chart shows that the baseline fossil fuel system had an install cost of \$23,850. That was less expensive than a heat pump VRF system which cost \$36,350. However, when the baseline system includes a carbon pollution impact fee that accounts for externalized costs of pollution, the conventional system cost would be \$40,700, making the heat pump system more cost competitive. Further, when you include the utility rebate for the heat pump system, the comparison would be \$40,700 for baseline plus carbon fee compared to \$28,350 for the heat pump system. In addition, all renewable fuel options (renewable gas or district energy) all would be more cost-effective than the baseline fossil fuel system plus the carbon pollution fee. The carbon pollution impact fee helps level the playing field.

Building Example	Install cost	Fees/ or Tariff	Total
Baseline Fossil Fuel HVAC Replacement	\$23,850.00	\$0.00	\$23,850.00
Baseline Fossil Fuel System + Carbon Fee	\$23,850.00	\$16,850.00	\$40,700.00
Baseline System + Blended Renewable Natural Gas	\$23,850.00	\$10,415.00	\$34,265.00
Baseline System + Local Renewable Natural Gas	\$23,850.00	\$13,798.00	\$37,648.00
Baseline System + District Energy Credits	\$23,850.00	\$15,206.00	\$39,056.00
Heat Pump Variable Refrigerant Flow System	\$36,350.00	\$0.00	\$36,350.00
Heat Pump Variable Refrigerant Flow System with Rebate	\$28,350.00		\$28,350.00

² Note – District energy system credit price is reduced significantly after first 20 years, when infrastructure financing costs are paid off. The carbon fee, Renewable Natural Gas prices, and district energy system credit prices are net present value (utilizing 4.5% discount rate).



Operating Costs

Operating costs is another aspect that staff considered when developing these policy recommendations. In particular, stakeholders inquired about the annual operating cost difference between conventional natural gas space heating equipment (over 95% of Burlington’s buildings utilize natural gas for space heating) and heat pump technology at current rates (current rates can be found on BED’s and VGS’s websites). Currently, annual operating costs in a single-family residential context for high efficiency heat pumps equipment can be close to, and sometimes lower than, conventional heating systems. This is partly driven by BED’s lower residential rates relative to other parts of Vermont and the New England region.

Work with BEI has included the development of a Home Electrification Impact Calculator that models operating costs and greenhouse gas emission reductions. Modeling results of a typical single-family home shows heat pump savings of \$80 to \$150 annually at current rates. For an apartment in a small multi-family building, heat pump savings at current rates in the Calculator would be \$40 to \$90 annually. Using a different calculator with different assumptions from Efficiency Maine, but utilizing Burlington rates, shows an \$8 annual cost increase for a heat pump relative to a gas boiler. It should also be noted that heat pumps provide air conditioning at much higher efficiency levels so further annual operating savings are possible.

For larger multi-unit residential buildings or commercial buildings, the operating cost economics can vary from the smaller residential analysis above, and the operating costs for domestic water heating systems also can vary. It also is important to recognize that the cost delta for heat pump technology relative to conventional systems has fluctuated over the past decade as rates for electricity and natural gas have changed, and there have been times when heat pumps have cost more to operate. Future operating costs will depend on the relative rate pressure on the various fuel sources. In addition we note some affordable housing developers have raised concern about the maintenance costs and expected system lifetime for heat pump-based systems relative to fossil fuel systems.

We propose ensuring that in drafting the policy, all available state and federal incentives as well as utility incentives be able to be applied to ensure the most cost-effective application of the policy.

Conclusion

BED and DPI make the above recommendations based on our best assessment of the opportunity to make cost-effective, practical progress towards Burlington’s Net Zero Energy goals while reducing fossil fuel use in the thermal/building sector. We look forward to answering questions on this report at the December 5, 2022 City Council meeting, and appreciate the multiple steps – including both Council and voter consideration as well as subsequent work on Ordinance language if voters approve the proposal – required to enact these policy recommendations.