October 24, 2024

Via email only
puc.clerk@vermont.gov

Re: Comments regarding modeling the economic impacts of the Clean Heat Standard

To Whom It May Concern,

I am writing in my capacity as a member of the Vermont Climate Council[1], to which I was appointed by the Vermont Legislature to provide expertise in energy and data analysis. On the Climate Council I chair the Science & Data subcommittee and serve on the Cross-Sector Mitigation subcommittee and the Council Steering committee.

I am writing in response to the PUC's request for input on modeling and assumptions of economic analysis related to the Clean Heat Standard. My recommendations fall into two broad categories:

1) Recommendations related to inputs, assumptions, and approaches to economic analysis of the Clean Heat Standard, specifically, and

2) A recommendation that any alternative proposals to a Clean Heat Standard, including a Thermal Energy Benefit Charge, be subjected to the same economic analysis.

1) Recommendations related to inputs, assumptions, and approaches to economic analysis:

a. Please only utilize modeling that provides transparent assumptions and calculations. "Black box" studies, such as recently conducted by NV5, in which key assumptions and calculations are hidden in a proprietary model, limit transparency. For trust, confidence, and open dialogue, transparency of assumptions, calculations, and models is crucial.

b. Please differentiate between–and be clear about the differences between–societal costs (and benefits), customer costs (and savings), and program administration costs.

As Act 18 (Section 6 (i)) states, the PUC report due January 15, 2025 "shall include, to the extent available, estimates of the impact of the Clean Heat

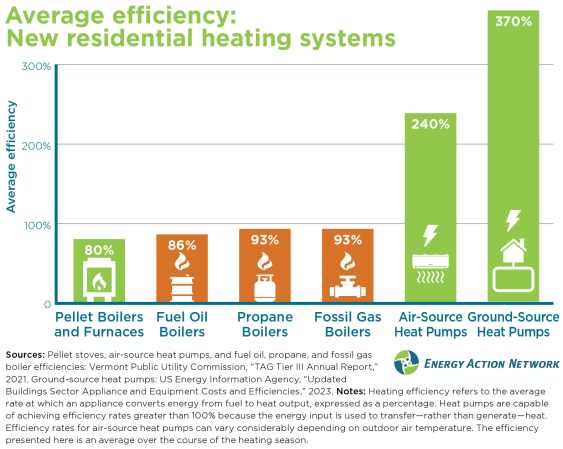
[1] To be clear and in accordance with the Climate Council's governance document, I am writing on my own behalf, as an individual Councilor, not on behalf of the entire Council. See: https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Climate%20Council%20Governance%20-%2020231211.pdf

Standard on customers, *including impacts to customer rates and fuel bills for participating and nonparticipating customers*, *net impacts on total spending on energy for thermal sector end uses*, fossil fuel reductions, greenhouse gas emission reductions, and, if possible, impacts on economic activity and employment. The modeled impacts shall estimate high-, medium-, and low-price impacts." (italics added)

It is important to note that customer rates and fuel bills include not just fuel oil, kerosene, propane, and fossil gas (which together make up about 70% of Vermont heating fuel use), but also electricity, cord wood, wood chips, and wood pellets (which together represent about 30% of Vermont heating fuel use). And "participating customers" refer to those Vermonters who take advantage of clean heat measures. Therefore, "impacts" will be both positive (savings or benefits) and negative (costs), depending on the fuel type(s) used and whether customers are participants or non-participants.

Additionally, "net impacts on total spending on energy for thermal sector end uses" can be fairly summarized as analysis of "Vermont's total heating bill," including not just possible increased prices on the fossil fuels (which may or may not lead to increased spending on fossil heating fuels, depending on how warm winters are and future heating load demand), but also possible *decreased* prices on renewable fuels and electricity, and the net spending on residential, commercial and industrial (RCI) fuels after accounting for both, as well as accounting for the efficiency and energy use of the changing mix of heating appliances. For instance, heat pumps and heat pump water heaters are far more energy efficient, on average, than combustion based equipment, presenting significant opportunities for both energy and cost savings relative to fossil fueled equipment, as illustrated below.

Figure 3:



c. **For societal analysis, it is crucial to model and report the costs, benefits, and net benefits, not just the costs. For customer analysis, it is crucial to model and report not just potential costs to non-participants, but also the projected savings to clean heat participants.**

   i. Costs are just one part of one side of the relevant equation. I find this simplified equation to be important and helpful: **Benefits – costs = net benefits** or **net costs**. Please be comprehensive in your discussion of costs *and* benefits, including energy cost savings from reduced reliance on high-cost fossil fuels.

   ii. When calculating costs, recognize that much of Vermont's heating equipment will need to be replaced over time anyway. Many costs related to heating equipment are "matter of course" replacement costs that will inevitably occur and should not be treated as discretionary costs to be applied only in a Clean Heat Standard compliance scenario. In other words, in many cases (such as a heat pump water heater replacing a fossil fueled water heater; a pellet boiler replacing a fossil fueled boiler; or a centrally ducted heat pump system replacing a fossil fueled furnace), it is only appropriate to model the *incremental* cost of the clean heat equipment measure vs. a new piece of fossil fuel equipment, not the full cost of the clean heat measure.

d. **When conducting societal benefit-cost analysis, utilize the Social Costs of Greenhouse Gases (SC-GHG) adopted by the Vermont Climate Council[2], in alignment with recently updated EPA estimates**.[3] Note that the costs per metric ton vary by year and by gas, and that SC-GHG values should align with EPA values at the 2% discount rate.

e. **Recognize and communicate the large degree of uncertainty in projecting costs–especially equipment costs–years into the future**. For this reason, I would recommend limiting economic analysis to the next 5-10 years. There is simply too much uncertainty regarding key variables for numbers out to 2050 to have a meaningful degree of confidence associated with them.

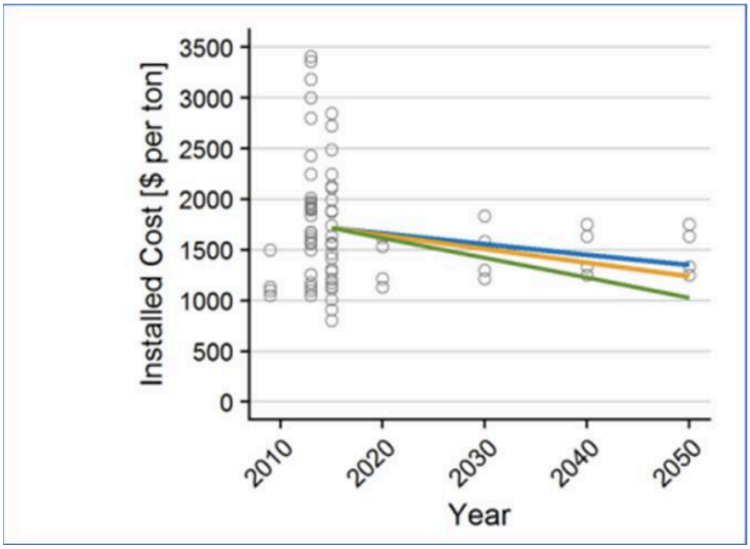
   i. Rather than remaining constant, equipment costs for emerging technologies tend to decrease per unit as technology advances and

[2] See: https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Vermont_Climate_Council/SDSC_Recommendation_SCGHG%20August_09_2024_track_change_edits.pdf?_gl=1*jtl6am*_ga*MTA1MDA5ODkzLjE3MTE1NDYxNTU.*_ga_V9WQH77KLW*MTcyODkzNjQyNi43Mi4xLjE3Mjg5MzY0NDIuMC4wLjA.

[3] https://www.epa.gov/environmental-economics/scghg

economies of scale are achieved. This should be anticipated in modeling of the costs of heat pump technology, in particular. Several years ago, the National Renewable Energy Laboratory (NREL) released a report that, among other things, forecasted how heat pump prices are expected to decline in the future as electrification advances. This pace of decline is likely to accelerate even faster given the Inflation Reduction Act (IRA). Pasted below is a graphic illustrating their conclusion.[4]

Figure 2: Installed unit costs for residential ASHPs for space heating applications



f. **Avoid using single number cost or benefit estimates (or cost or saving estimates) that convey a false degree of precision or confidence. Instead, utilize estimated ranges of possible costs and benefits (or costs and savings) under different scenarios, as in low, medium, and high cases.**

g. **When estimating impacts on fuel prices and rates, ensure that the analysis is relative to a business as usual scenario that recognizes continued investment in clean heat measures through existing programs**, including Efficiency Vermont and the other efficiency utilities, the state low income weatherization program, the electric utilities Tier 3 compliance, federal tax credits, federal rebates, etc. In other words, ensure that any fuel price/ rate impacts only incorporate the additional investment needed to meet the remaining margin of clean heat activity that is not already occurring/ expected to occur.

[4] Jadun, P., McMillan, C., Steinberg, D., Muratori, M., Vimmerstedt, L., & Mai, T. (2017). Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-70485. P. 42. https://www.nrel.gov/docs/fy18osti/70485.pdf

h. Comprehensively model price effects on *all* available heating options, not just on fossil heating fuels.

i. Much of the public discussion of the Clean Heat Standard's potential effect on the cost of heating has been limited to a focus on the possible upward pressure on the cost per gallon of fossil heating fuels like fuel oil and propane (under the assumption that the fossil fuel corporations who import fossil heating fuels into Vermont and who are obligated to reduce climate pollution under ACT 18 will pass their cost of compliance for reducing pollution onto their fossil fuel customers). Unfortunately, little attention has been paid to the lower costs for heating that Vermonters would experience due to the anticipated price *decreases* for cleaner heating options, including both lower-emitting fuel alternatives and installed clean heat measures.

   If fossil heating fuel importers have to generate emissions reductions below what would otherwise be the case, they will have to either deliver clean heating options and/or pay others to do so. How will they get Vermonters to make cleaner heating choices beyond what they otherwise would? By lowering the cost of cleaner fuels and/or by increasing incentives for clean heat installations to increase demand for them.

ii. While the potential price effect on a gallon of fuel oil is an important thing to measure and consider, there are other important price effects that will work in the other direction, and, in the interest of presenting a full picture, we should have transparent information about those as well. Specifically, given that the Clean Heat Standard is "revenue neutral" in design (i.e., any price increase that gets passed through on the fossil fuel side will go toward *decreasing* the price of cleaner heating options, primarily via lower costs and/or incentives, for activities that generate clean heat credits), analysis should also consider the estimated price effects on:

   a. The cost of weatherization – how much will the new and/or increased incentives that are expected to result from a Clean Heat Standard lower the cost of weatherization projects for Vermonters, especially for Vermonters with lower- and middle-incomes?
   b. The cost of various types of heat pump installations - how much will the new and/or increased incentives that are expected to result from a Clean Heat Standard lower the

cost of heat pump installations for Vermonters, especially for Vermonters with lower- and middle-incomes?

c. The cost of advanced wood heating equipment - how much will the new and/or increased incentives that are expected to result from a Clean Heat Standard lower the cost of technologies like efficient wood pellet boilers and stoves, especially for Vermonters with lower- and middle-incomes?
d. The cost of wood pellets - how much will the value of clean heat credits decrease the average per ton cost of wood pellets sold in Vermont?
e. The cost of various biofuels, including B-99 biodiesel, renewable diesel, and renewable propane. How much will the value of clean heat credits decrease the average cost per gallon of lower-emitting fuels, some of which are drop-in replacements for fuel oil and propane?
f. The cost of electricity. For instance, analysis by the Energy Futures Group estimated downward price pressure on electricity from a Clean Heat Standard, concluding that, "changes in retail [electricity] sales forecasts given the level of fossil fuel displacement under each of the policy scenarios largely resulted in decreased [electricity] rates, as costs are spread over a larger rate base."[5]

iii. For context, consider the experience Oregon has had with their Clean Fuels Standard, a performance standard policy that is similar to the Clean Heat Standard, except that it applies to fossil transportation fuels rather than fossil heating fuels. While Oregon's Clean Fuel Standard had a price effect of an additional $0.05 to $0.06 per gallon of fossil fuel in 2021, in that same year it also brought down the price of biodiesel from used cooking oil by about $1.16 per gallon, and the price of biodiesel made from soybean oil by about $0.61 per gallon, making *biodiesel less expensive than diesel*.[6]

The practical effect of this in Vermont's context would be that customers who currently use fuel oil and who want to save money should be able to use biodiesel or renewable diesel instead, thereby lowering their heating costs (if the price of B100 biodiesel from used cooking oil or from a

[5] See pages 84-86, here: https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/VT%20Thermal%20Analysis%20Final%20Report%2011_28%20revisions.pdf
[6] See: https://www.youtube.com/live/C4vHeWo16vc?t=6244s, from about 1;44:00 to 1:48:00

standard soybean biodiesel is reduced as much in Vermont as we saw in Oregon) relative to continuing to use fuel oil. If we only model the effect on fuel oil costs without at the same time modeling the projected price decreases on the cleaner alternatives that are or will become available to Vermonters, we are presenting a very limited and one-sided view of the program's potential effect on heating prices and the array of options that will be available to Vermonters.

Overall, it is likely that a Clean Heat Standard will decrease the cost of cleaner heating options while putting upward price pressure on the cost of more polluting heating options (indeed, the latter will pay for the former, especially to ensure that Vermonters with lower and middle incomes will access and benefit from cleaner heat). Whether or not someone saves money or pays more money will be the result of their choices and how they respond to downward prices for cleaner and more efficient heat vs. upward prices for fossil fuel heat.

In summary, any potential price increase on fossil fuels would come as a result of and go towards the need to reduce costs of cleaner, more efficient heating options for Vermonters. In this way, a Clean Heat Standard would be revenue-neutral – i.e., any money from higher fossil fuel prices will go toward lowering the cost of cleaner alternatives, especially for Vermonters with low- and moderate-incomes, in compliance with Act 18's intent that a Clean Heat Standard, "shall enhance social equity by prioritizing customers with low income and moderate income and those households with the highest energy burdens,"[7] including by requiring in § 8124 d) 2) that, "...each obligated party shall retire at least 16 percent [of their annual requirement] from customers with low income and an additional 16 percent from customers with low or moderate income. For each of these groups, at least one-half of these credits shall be from installed clean heat measures that require capital investments in homes, have measure lives of 10 years or more, and are estimated by the Technical Advisory Group to lower annual energy bills. Examples shall include weatherization improvements and installation of heat pumps, heat pump water heaters, and advanced wood heating systems."[8]

i. **Conduct a sensitivity analysis regarding how costs and benefits would be estimated to change if the PUC were to exercise the discretion already given to it in Act 18 to**

[7] § 8121 Intent.
https://legislature.vermont.gov/Documents/2024/Docs/ACTS/ACT018/ACT018%20As%20Enacted.pdf
[8] https://legislature.vermont.gov/Documents/2024/Docs/ACTS/ACT018/ACT018%20As%20Enacted.pdf

push the first CHS compliance deadline beyond December 31, 2029, out as far as December 31, 2032. The specific section of statute is § 8124 (a) (4), which reads:

> "The Commission may temporarily, for a period not to exceed 36 months, adjust the annual requirements for good cause after notice and opportunity for public process. Good cause may include a shortage of clean heat credits, market conditions as identified by the Department's potential study conducted pursuant to section 8125 of this title, or undue adverse financial impacts on particular customers or demographic segments. The Commission shall ensure that any downward adjustment has the minimum impact possible on the State's ability to comply with the thermal sector portion of the requirements of 10 V.S.A. § 578(a)(2) and (3)."

j. Show estimated price effects on fuels on an annual basis, not combined and/or averaged over 25 years. Additionally, please be transparent about how many customers are estimated to be paying estimated prices for the different fuels in different years (i.e., the number of people estimated to still be using fuel oil in the out years is likely to be much smaller than today).

i. To be honest and clear with consumers, please estimate and share projected fuel price effects by year, showing the estimated marginal increase from one year to the next. For instance, an independent report commissioned by the Agency of Natural Resources estimated only a 1 cent increase in the price of fuel oil in the first year of the Clean Heat Standard program and only 1-2 cents per year between now and 2030.[9]

For the 2030 Clean Heat Standard policy scenario, the projected cumulative price effect on a gallon of fuel oil was 9-12 cents a gallon (representing 7 years of annual investments in cleaner heating being provided to thousands more Vermonters, especially to Vermonters with lower and middle incomes).

The unbelievably high per gallon price increase estimates that the fossil fuel industry has been circulating are generated by inappropriately taking 25 years of estimated costs (which have a very high degree of uncertainty and error) and then making Vermonters think that those costs would show up in fossil fuel price increases in the near term. This is both intellectually dishonest and deeply misleading.

[9] See page 56, here: https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/VT%20Thermal%20Analysis%20Final%20Report%2011_28%20revisions.pdf

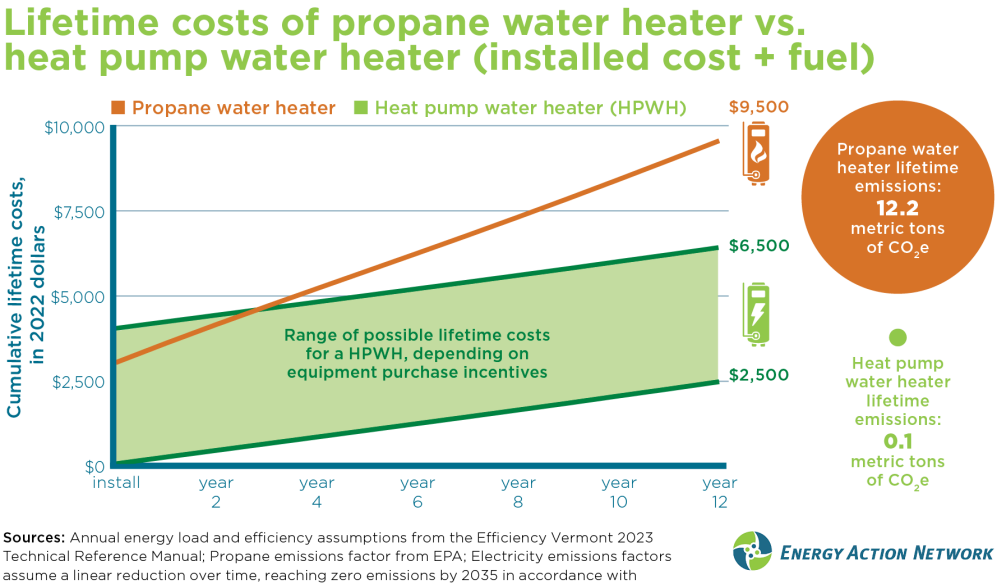
To be honest and transparent with Vermonters, we need to analyze and report year by year price effect estimates (again, in both directions – likely upward for fossil fuels and *downward* for cleaner fuels and equipment), in line with near-term compliance requirements. Near term compliance requirements are the only numbers we can have relative regulatory clarity about, and therefore, are the only numbers we can have a relatively high degree of confidence in.

k. **Do not assume that the full cost of those clean heat measures that deliver clean heat credits over many years will be fully expensed up front by obligated parties**. Doing so is unrealistic given business accounting practices and inflates up-front compliance costs, ignoring that installed clean heat measures like weatherization, heat pumps, and efficient wood heating equipment will generate clean heat credits of value for many years, enabling their cost to be spread out and paid back over the period of time that those measures generate clean heat credits. Obligated parties like VGS have made clear that they have a financial incentive and the ability to amortize these investments over the period of time that the clean heat measure will be generating value for them in the form of clean heat credits. Other large importers of fossil heating fuels, from Global to Irving to Amerigas to Suburban, similarly almost certainly have the financial ability to spread investments out over time. And for any smaller fuel importers that don't have the financial wherewithal or desire to spread out investment costs over time, they nevertheless have the ability to sell their future year credits to obligated parties who can, so that they are not carrying the costs (or earning the value) of 15 or 20 years worth of clean heat credits, if they do not wish to do so.

l. **Please make sure to avoid "end effects" issues in modeling**. For example, ensure that the full up-front cost of a clean heat measure that is installed in 2049 and that has a 25-year lifespan doesn't get calculated as having 25 years of costs (represented, in large part, by the up-front installation cost) but only gets credited for 1 year of benefit in terms of fossil fuel and emissions reduction/ clean heat credit generation before the modeling time period cut-off date. For this reason, costs and benefits should be levelized over the measure lifetimes.

   As an example of why it is important to levelize costs and benefits, consider a heat pump water heater (HPWH), which (depending on incentives) may cost more up-front than a propane water heater but will likely cost significantly less over its lifetime, primarily as a result of fuel savings (see graph below). It would be inappropriate and misleading to exclude the cost savings that will result from the HPWH investment by only focusing on the purchase cost comparison.

Figure 3:



Sources: Annual energy load and efficiency assumptions from the Efficiency Vermont 2023 Technical Reference Manual; Propane emissions factor from EPA; Electricity emissions factors assume a linear reduction over time, reaching zero emissions by 2035 in accordance with Vermont's Renewable Energy Standard. Prices shown are in 2022 dollars and reflect projections from EIA's 2023 Annual Energy Outlook for 2024-2035. **Note:** While installed costs of propane water heaters can vary, there is greater variation in heat pump water heater installed costs due to the availability of incentives. Different installed costs for heat pump water heaters reflect federal tax credits and state-level incentives for various income levels, including Switch and Save and Weatherization Assistance Program incentives that can bring the upfront cost as low as $0.

ENERGY ACTION NETWORK

m. To align with Vermont's official Greenhouse Gas Inventory, utilize fossil fuel sales data from the Vermont Department of Taxes, which is the most comprehensive and accurate data available on fossil heating fuel use in Vermont, rather than from the Energy Information Administration (EIA), which is representative data based on a limited survey.

i. If the LEAP model is utilized, make sure to calibrate thermal sector emissions to correspond with those in the official GHG Inventory, given that the Inventory is the legal basis for measuring GWSA compliance. Be aware that the LEAP/VT Pathways has consistently and significantly undercounted statewide emissions relative to the official Inventory.[10]

n. Please utilize the latest and highest quality data regarding heating degree day projections.

In its recent paper, "Analyzing changes in fossil heating fuel use in Vermont, 2018 – 2023,"[11] EAN included population-weighted heating degree day data for Vermont, accessed from the National Oceanic and Atmospheric Administration (NOAA) for 1990 to 2023.[12] While there is year to year variability, incorporating

[10] See pages 3 and 4, here: https://eanvt.org/wp-content/uploads/2024/09/GHG-Inventory-Summary-2024-2.pdf
[11] See: https://eanvt.org/project/fossil-heating-fuel-changes/
[12] See: https://ftp.cpc.ncep.noaa.gov/htdocs/degree_days/weighted/legacy_files/heating/statesCONUS/

a regression trend line shows that the average number of heating degree days in Vermont is not holding constant and has declined by about 4% from 1990 to 2023, or roughly an average decline of 0.13% each year.[13] In contrast, the NV5 study held winter temperatures/ heating degree days constant, which I believe was inappropriate, as it was unsupported by the available data.

Warming winters (or fewer heating degree days) result in lower heating loads and therefore contribute to declining fossil fuel use. As unfortunate as the reality of our warming winters may be, this physical reality should not be ignored in fuel use assumptions that will have to go into any economic modeling.

2) Please conduct economic analysis not just of a Clean Heat Standard but also of the PUC's proposal for a Thermal Energy Benefit Charge (TEBC). For the TEBC proposal to be considered as a fully developed alternative, it should be subjected to the same analysis.

a. **Recognize the difference between program complexity, efficiency, and cost effectiveness for the PUC, on the one hand, vs. complexity, efficiency, and cost effectiveness for Vermonters, on the other**.

   i. While a CHS may be more complex for the PUC to oversee (including requiring registering, tracking, and ensuring there is not double counting of Clean Heat Credits) than assessing a TEBC on fossil heating fuels imported into Vermont, that is not the same as being less complex, efficient, or cost effective for Vermonters.

For additional context about my 2nd recommendation, I am happy to share why, as an appointed member of the Vermont Climate Council, I supported a Clean Heat Standard as a primary strategy to reduce thermal sector emissions rather than a Thermal Energy Benefit Charge:

- To achieve climate pollution reduction at the lowest cost per ton avoided, I believe it is preferable to have an open and dynamic market in which as many public and private entities as possible have an incentive to uncover and deliver services that reduce thermal sector climate pollution. Generally speaking, lower supply leads to higher costs, which is why I believe we should want as many public and private entities eligible to deliver clean heat measures as possible rather than trying to funnel all clean heat activity through publicly funded and managed programs.

  While a TEBC might be easier for the PUC to administer than a CHS, it would likely narrow the scope of activity to those existing, expanded, or new public programs funded

[13] There may be better data to use for future HDD projections, perhaps via the Vermont or National Climate Assessments. However, a winter warming/ lower HDD trendline over the past few decades in VT is clear.

with the resulting revenue. For sake of efficiency, cost-effectiveness, and market competition, I think it is beneficial for Vermonters to have those private market actors (who are obligated parties under a CHS) also have an incentive to uncover and deliver pollution reduction activities in the private marketplace.

- A TEBC would create a negative disincentive for selling fossil fuel but, unlike a CHS, it would not create a *positive incentive* for delivering pollution reducing fuels and services, represented by the value of Clean Heat Credits, which any private or public actor could get paid for generating or delivering. A CHS would provide a new source of revenue, via Clean Heat credits, for businesses that want to innovate and expand. A TEBC would not (at least not directly). The less that is done to incentivize new and expanded clean heat services, the less that is done to reduce costs for clean heat activity, including both qualifying equipment and fuels.

- The effectiveness of a TEBC in terms of pollution reduction and addressing energy inequities would depend, in large part, on the wisdom of the resulting investments. In contrast, the value of a clean heat credit is directly tied to a metric ton of greenhouse gas emissions and Act 18 requires that Vermonters with lower and middle incomes receive clean heat services that result in a large amount of clean heat credits. Without design features like these built into Act 18, it is unclear whether a TEBC would cost-effectively reduce climate pollution in either an efficient and/or equitable way.

- Assuming that a TEBC would be set to achieve the thermal sector's portion of emissions reduction obligations in line with GWSA requirements, I think it is possible that the program costs associated with the TEBC could actually be larger than those associated with a CHS. This is because, to achieve our climate pollution reduction obligations, we will need to significantly expand thermal sector transformation efforts. Under a TEBC framework, this would mean expanding existing and/or creating new programs to receive public funding from the resulting revenue. I think it is likely that the transaction costs of having to manage all of this activity through public programs could far exceed that cost of simply regulating a market, where that activity would happen, in large part, through the private sector.

Respectfully submitted,

/s/ Jared Duval

Jared Duval
Vermont Climate Councilor
Chair, Science & Data Subcommittee
Member, Cross-Sector Mitigation Subcommittee