

TAG Responses to Opinion Dynamics' Responses to TAG's 8 July 2024 memo [Draft]

Date: 8 August 2024

Note: TAG original in black font, OD responses in blue, and TAG responses in red

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To: Deirdre Morris, Thomas Knauer, Vermont Public Utility Commission

From: Rick Weston, Chair, CHS Technical Advisory Group

Date: 8 July 2024

cc.: TAG members

Re: Early Win Measure Characterizations

Members of the TAG have reviewed Opinion Dynamics' document, "Vermont Clean Heat Standard: Early Win Measure Characterizations" and its cover memo, dated June 28th. In preparation for the upcoming meeting of the full TAG (this Thursday, July 11th) and our discussion with Opinion Dynamics staff about the characterizations, a subset of TAG members met today to share reactions to the documents and identify questions and issues in want of fuller exploration. I forward them to you now, for sharing with Opinion Dynamics before Thursday's meeting. The outline of our questions follows that of the characterizations document.

Thank you.

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Building Envelop Measures

- The formula for calculating the emissions-reduction effects of weatherization employs area of insulation installed as a key variable. How does it relate to the square footage of the building served, such that the formula in some way accounts for the varying type and size of buildings? Put another way, there's a question about whether average residential fuel mix and heat load are sufficient for the purposes of the CHS.

In its current form, the residential building shell insulation measure is agnostic towards the type, size or heating load of buildings; the algorithm calculates savings based on the change in conductive heat loss over the area in which insulation is installed. The conductive heat loss in Btu/h is directly proportional to insulation surface area and temperature differential and inversely proportional to thermal resistance (R-value). The surface area and R-values (pre and post) will vary by job.

Regarding the heating fuel, the measure characterization in its current form provides options for either assuming an average heating fuel mix or collecting the heating fuel as site-specific input. The latter approach provides more certainty in the savings results but increases administrative costs. If the TAG and PUC feel that more specificity is needed, we could modify the characterization to allow one approach or the other. We welcome additional feedback from the TAG on data collection requirements for this measure and all measures more broadly.

TAG: We are satisfied with the response regarding measuring insulation savings. (For shorthand later in the document: "OK") As for fuel mix, using the average fuel mix has potential administrative benefits (in simplicity, fairness, and efficiency), but also we think that, in order to give obligated parties flexibility to meet their obligations, they should

have the opportunity to rely on site-specific data (documented and verifiable) if they so choose. We realize this raises questions about, among other things, program administration, point-of-market interfaces, the derating of the average mix to account for site-specific savings, and the kinds of registry data that will be required. Moreover, we want to mitigate undue biases in the program. At present, the use of the average fuel mix is best practice. We remain open to whether and how it might be modified in the future.

- Where partial building weatherization occurs (e.g., just one unit in a three-unit building), how will the savings be calculated and what data will be used to measure the savings?

The current measure design facilitates this type of scenario. Here, the implementer would capture the surface area of insulation installed in square feet, its location (attic/ceiling, exterior wall, or basement) and the pre- and post-R-values of the insulation. The heating system fuel and system type could optionally be captured, or blended values could be assumed.

TAG: Partial building weatherization appears to be captured by this approach.

- Weatherization improvements target not only insufficient insulation, but also air infiltration. It is not clear that air infiltration is addressed in this measure characterization. What assumptions are being made in this respect and how are potential savings from improved air-tightness being captured?

This measure includes building shell insulation only. Air sealing is a separate measure that is currently under development.

TAG: OK.

- It appears that the data on heating loads cited by OP are not the most up-to-date data used by the Vermont Department of Public Service and other state agencies. These data should match what the state uses.

Please clarify the specific parameters you are referring to. The home's heating load is not an input for this measure.

TAG: We are interested in sources that you used for the relative shares (the percentages) of primary fuel use as an input to the "average fuel mix".

We refer to Table 2 in your "early win" measure characterization document. Vermont Primary Heating Fuel Mix, Residential Buildings, has a large "unknown" natural gas fuel source value of 27%. Since VGS is a regulated utility the precise number of accounts and usage should be known or knowable. If the "unknown" value in the table represents known gas accounts with an unknown primary fuel (i.e., hybrid heating with gas and heat pump (s)), that makes sense, but we'd be grateful if you could clarify that.

The same table also appears to have a low value for the percentage of buildings heated with wood, showing 8% of single- and 1% of multi-family buildings using wood as the primary fuel. The latest Annual Energy Report (2024) (based on US Census - American Communities Survey Data, 2022) on page 79 suggests a higher wood fuel percentage. <https://publicservice.vermont.gov/sites/dps/files/documents/2024%20AER%20FINAL.pdf>.

- Would it be possible to cite actual source material for many of the assumptions and inputs? For instance, instead of citing Vermont’s efficiency and Tier III technical reference manuals, please cite the DOE and other sources on which those TRMs rely (“Remove the middleman” where possible).

We considered this issue and chose to deliberately cite the Vermont TRMs where used to clearly indicate what parameters were adopted from these existing sources. Elsewhere, our aim was to reference the actual source material instead of the secondary source. Based on the feedback we received during the 7/11/2024 TAG presentation, we will include both secondary and primary sources in our citations for now.

TAG: OK.

- Will Opinion Dynamics make the documents it references available to us?

Yes. The only exceptions might be where we have referenced parameters from the Vermont TRMs that are themselves references to documents we do not have access to.

TAG: OK. Please provide the documents as soon as possible.

- What sources of data will be used to perform weatherization calculations for CHS credits? Will these sources be linked in some way to the registration of actual projects? [This question may not be answerable at this time.]

The sources of data are indicated in each the characterization: data to be collected onsite is listed under “Program Data Tracking Requirements”; other data sources are referenced in the Endnotes. Questions regarding the project registry are outside our scope of work.

TAG: OK. We are aware that *Efficiency Vermont* is working with OD to develop these data.

Residential HVAC - Advanced Thermostats

- Our understanding is that emissions reductions are calculated with respect to the hourly capacity of the heating unit rather than the annual heat load of the building. If that’s the case, then the thermal efficiency of the house is not accounted for. Please explain.

The algorithm is a standard form for this measure. It calculates the savings as a percentage of the annual heating load, which is approximately equal to the capacity of the heating unit controlled by the thermostat (in Btu per hour) multiplied by the equivalent full load hours. The thermal efficiency of the house is reflected in the capacity of the heating system, which is assumed to be sized according to the design heating load of the house: all other things being equal, a poorly insulated house would need a larger heating system than the same house with better insulation.

TAG: OK.

- Please confirm that lifetime GHG emissions savings will be converted to and expressed

in annual credits. [This applies to all measures.]

We had not planned to express emissions savings in annual credits, but based on this feedback we are happy to do so once a CO₂e to credit equivalency is established.

TAG: OK. (Refer to §8127(c) of Act 18.)

- OD has included savings from the effects of advanced thermostats on cooling loads in its measure characterizations. This seems reasonable. However, the TAG is aware that a question has been raised by at least one party to the proceeding about whether the measure, as it relates to non-onsite fossil energy loads (i.e., electricity), should be eligible. What clarification from the PUC has OD received on this point?

We discussed this issue in early meetings with the PUC. Staff were interested in including cooling impacts but did not take a position on whether cooling impacts should be eligible for clean heat credits. We suggested that expressing cooling impacts could be beneficial for evaluating the cost-effectiveness of clean heat programs, even if cooling impacts themselves do not qualify for clean heat credits.

This same issue applies to other non-thermal impacts associated with some measures. For example, the Building Shell Insulation measure includes fan and pump electrical energy savings; installing insulation decreases the heating load of the house, which reduces furnace fan or boiler pump runtime. Our current approach is to express all significant energy impacts of each measure. We could modify the characterization format to indicate which energy impacts qualify for clean heat credits and which are ancillary impacts if desired.

TAG: OK.

- Are savings from the effects of advanced thermostats on fossil systems calculated differently from their effects on heat pumps? [Manufacturers recommend that heat pumps be maintained on a steady setting, rather than being cycled during night times and when houses are empty, to maintain unit efficiency of unit.] Are the energy savings assumed to be the same (though the emissions savings will clearly be different)?

This is an excellent point. We are not aware of heat pump-specific studies on advanced thermostats but expect that the savings potential from advanced thermostats would be much lower if temperature setbacks are not available as control strategy. Based on the comments in the 7/11/2024 TAG presentation, we intend to keep heat pumps as an eligible system for this measure but derate the heating savings according to the estimated proportion of heat pumps in VT residential heating systems.

TAG: Please explain the statement: “. . . but derate the heating savings according to the estimated proportion of heat pumps in VT residential heating systems.”

- [Question raised by a member of the public:] To the extent that heat pumps will be cycled on at times when marginal emissions on the electric system are greater, will this be accounted for? [Note: the TAG has not taken a position on the nature of marginal carbon emissions from the electric grid and today's subgroup is neither agreeing or disagreeing with the premise of this question.]

We have not yet finalized our approach for grid electricity emission factors; while we

understand that marginal emissions may vary by time of use, it is unclear whether existing data sources are sufficient to capture this effect on a lifecycle basis.

TAG: OK, but this warrants further discussion. We understand that California uses 24-hour emissions data, to relate the time-of-use of clean heat measures more closely to their actual emissions effects and thereby create disincentives to measure operations at times of low generation of non-emitting power. We recognize that such granularity may be harder to develop in Vermont's case, to the extent that we are relying on renewable energy credits (RECs) for non-emitting entitlements, rather than contracts or owned resources.

Residential HVAC – Heat pump water heater

- Measure characterizations are split between water heater tanks less-than-55 gallons and greater-than-55 gallons. The characterizations treat the efficiency of the measures the same; is this reasonable? Would it be better to base savings on usage (assuming the data are available) rather than tank capacity? The Tier III TRM shows that the smaller systems produce higher savings than the larger one, which may not necessarily be logical, but it is nonetheless relevant.

The current measure characterization considers both usage and efficiency. The usage is embedded in the variable Q_{load} , the average water heating load, which is based on average household hot water usage. The average water heating load is divided by the efficiency of the water heater to yield energy consumed. The 55 gallon threshold comes from Code of Federal Regulation (CFR) standards for water heaters which base efficiency on tank size.

TAG: OK (if this mirrors the Tier III approach, then it is likely that savings will be higher for smaller units).

- The system that is being replaced is critical to the calculation, too. For example, isn't there a meaningful difference between replacing the energy use of an on-demand water heater and that of a non-heat pump storage system? Are such differences accounted for?

Yes, this characterization considers the energy use of the water heater being replaced; Table 18 provides formulas for baseline efficiency based on water heater fuel and tank volume. We did not include on-demand water heaters in our first iteration of this measure but will add these for the final draft.

TAG: OK.

- Do the calculations account for the fact that heat pump water heaters typically must be larger than a standard water heater in order to meet the same level of demand (it's not a 1:1 size replacement)?

By "size" we assume you are referring to the tank volume. Tank size does not directly relate to the energy consumption; a water heater's energy consumption is directly proportional to hot water usage and inversely proportional to the water heater efficiency. Hot water usage is assumed to be the same in the baseline and efficient cases in our characterization. Tank size only comes into play in our characterization because the baseline water heater is assumed to be a new unit meeting the CFR minimum efficiency standard; for storage water heaters, the CFR standard is a formula based on tank size (see Table 18 in the Heat Pump Water Heater Characterization). The efficient unit is assumed to be a new heat pump water heater on the NEEA Northern Climate

Specification qualified products list. The NEEA specification provides Cold Climate Efficiency (CCE) ratings that are not based on tank size.

TAG: OK.

Residential low-flow faucet aerators

- Does aeration reduce the thermal capacity of the water by injecting more air into the water and therefore requiring more energy to achieve desired temperatures or does it simply reduce the flow of water?

We are not aware of the effect that is described. Low flow aerators directly reduce the flow of water resulting in a reduction of hot water usage and thus thermal energy. Our characterization is consistent with TRM characterizations in Vermont and industry wide.

TAG: OK.

Residential low-flow showerheads

- [Same questions as for low-flow faucet aerators]

TAG: OK.

Residential induction stove tops

- There is some confusion about whether gas for cooking is considered “thermal” under Act 18. The RCI definition includes all uses of fossil fuels, but earlier guidance from PUC staff to a TAG member indicated that cooking and back-up power generation were considered non-thermal and should **not** be included in the registry. Please clarify what guidance PUC has provided OD on this issue.

We do not recall specific guidance from the PUC on this issue. We included induction stove tops because they were included in the measure list for the clean heat potential study. We shared our intended measure list with the PUC on April 22nd and it was distributed to the TAG on April 29th. We understand that the PUC intends to provide guidance on this issue.

TAG: OK. It appears that induction stove tops will be considered clean heat measures, but we await PUC clarification.

- Measure cost is given here, as it is for the other measures. Is there a particular reason that it's included?

We discussed whether we should include measure costs in clean measure characterizations with PUC staff in early meetings. Staff suggested including costs to allow for cost-effectiveness analysis. Therefore, we have been including measure costs where readily available, drawing from secondary sources. However, the primary focus of our work is characterizing the carbon and energy impacts.

TAG: OK. Please clarify if costs are total measure costs or incremental? If incremental, what assumptions did you make to determine them?

Commercial/Industrial Sector: Advanced thermostats, low-flow faucets, and low-flow showerheads

- [Same questions as for the same residential measures]

TAG: OK.

General

Thank you for this opportunity to weigh in on measure characterizations. We encourage OD to take full advantage of the TAG's expertise in these matters, as it continues to develop and refine its analyses. We hope that on Thursday OD will identify any matters that it would like the TAG to dig into now and provide more immediate input on (rather than waiting until a complete draft of the TRM is made available).

Thank you. We have provided a specific list of questions below we would like the TAG's input on at this time:

1. What approach should we use for heating fuel inputs? We have listed several options below.
 - a. Continue with our current approach: write the characterizations to allow for either approach (average mix or site-specific input).
 - b. Devise an average fuel mix for all Residential measures, and one for all Commercial/Industrial measures. Write the characterizations to only use average fuel mixes.
 - c. Write all characterizations to require the baseline fuel type to be collected.
 - d. Require the fuel type to be collected only for measures involving fuel switching. All other measures would assume average fuel mixes.
 - e. Require the fuel type to be collected only for the highest impact measures; for example, the top 25% of savers as identified in the clean heat potential study.
 - f. Other (please describe).

TAG: The approach described in sub-bullet "a" provides the most flexibility for obligated parties, but presents challenges. Refer to our response to the first bullet (under "Building Envelope Measures") for details.

2. Please review the accompanying Decarbonization Summary Table example and advise whether changes are needed.

TAG: The Decarbonization Summary Table generated a lively discussion among the TAG. A number of points were raised and some warrant further discussion.

- Some TAG members felt whatever approach is used, it should provide as much certainty to the credit owner as possible. Others felt that emissions reductions should reflect actual performance of installed measures to the extent possible.
- Act 18 requires that clean heat measures be awarded annual savings. Some members feel that projected annual savings over the life of the measure should be calculated (awarded) for installed measures at the time of installation. This provides a measure of certainty for the obligated parties.
- If reflecting actual emissions reductions is a priority, awarding projected annual savings in a single year can create a problem if we learn that installed measures are achieving greater or lesser savings than had been projected.
- We talked about ways to deal with this potential problem, but came to no consensus at this time. There will be updates to the projections every three years, but whether they should be applied going forward to previously installed measures raises important questions having to do with fairness, certainty, and risk. One approach suggested was to set credit values only for three years and then reset them when new projections are

determined. It was noted that this will affect both incentive levels and how they get paid.

- Lastly, we asked ourselves how should savings be shared with parties – by means of full tables with annual projected savings or a more simplified approach? We didn't reach a conclusion, but have reserved it for further discussion.