

Definition of "Advanced Wood Heat" for the Clean Heat Standard

Version 2 – October 16, 2024

Question for TAG Consideration:

How should “advanced wood heating” be defined for the purposes of determining which advanced wood heating installed measures are eligible clean heat measures under the Vermont Clean Heat Standard?

Option 1: Only fully automated, high-efficiency pellet and wood chip boilers and furnaces should be defined as “advanced wood heating” and considered eligible clean heat measures.

Option 2: All types of wood heating appliances (stoves, furnaces, and boilers) installed indoors **using all types of fuels (cordwood, pellets, and chips)** and meeting defined criteria for performance efficiency and air pollutant emissions should be defined as “advanced wood heating” and considered eligible clean heat measures.

Option 3: All types of wood heating appliances (stoves, furnaces, and boilers) installed indoors **using pellets and chips** and meeting defined criteria for performance efficiency and air pollutant emissions should be defined as “advanced wood heating” and considered eligible clean heat measures. Cordwood appliances should be excluded until such time as their emissions performance can be determined based on updated test methods.

Note: Proposed definitions and eligibility criteria are provided below, in the discussion of options.

Statutory Language

Act 18 includes “advanced wood heating” on a list of eligible clean heat measures. It also refers to advanced wood heating as one of several “installed clean heat measures” that require capital investments in homes and have measure lives of 10 years or more.

- 30 V.S.A. § 8127 (d) List of eligible measures. Eligible clean heat measures delivered to or installed in residential, commercial, and industrial buildings in Vermont shall include:
 - (7) advanced wood heating
- 30 V.S.A. § 8124 (d) (2) Of their annual requirement, each obligated party shall retire at least 16 percent 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. The Commission may identify additional measures that qualify as installed measures.

Discussion of Options

Option 1: Fully automated, high-efficiency pellet and wood chip boilers and furnaces are eligible

Discussion: The VT Clean Energy Development Fund and Efficiency Vermont provide incentive payments to installers of automated heating systems that largely replace other, fossil-fueled whole-home heating systems. One possible definition of Advanced Wood Heat is to restrict eligibility to those automated systems that are designed as whole building heating systems.

The report, “2022 Update: Advanced Wood Heat Sector in Vermont” prepared by VEIC for the Vermont Department of Public Service Clean Energy Development Fund defines “automated wood heating” as “a subset of advanced wood heating that includes high-efficiency boilers and furnaces that are automatically fueled with either wood pellets or chips and can sustain automated operations for several days at a time.” Notably, this definition excludes cordwood boilers and furnaces.

Proposed eligibility criteria under Option 1: Pellet and chip boilers and furnaces meeting the following criteria for efficiency and emissions would be eligible clean heat measures:

- Fully automated fuel feeding and bulk storage adequate for at least a week of continuous operation.
- Wood chip boilers and furnaces: Meets 80% HHV peak efficiency and less than 0.08 lbs per mmBtu PM2.5 (recognizing EPA or EN13240 test methods) and be classified as an indoor system and installed indoors.
- Pellet boilers and furnaces: Meets 85% HHV peak efficiency and less than 0.07 lbs per mmBtu PM2.5 (recognizing EPA or EN13240 test methods) and be classified as an indoor system and installed indoors.

The above criteria generally align with incentive eligibility requirements for these system types in Vermont incentive programs, including Efficiency Vermont and the Small Scale Renewable Energy Incentive Program (SSREIP).

Option 2: All types of wood heating appliances and fuels meeting defined efficiency and emissions criteria are eligible

Discussion: As another option, the term "Advanced Wood Heat" can have a broader definition. Emma Hanson, the former wood fuels coordinator at the Agency of Natural Resources communicated the following with respect to the range of wood heating options included as "Advanced Wood Heat" in the Clean Heat Standard: The [whitepaper](#) behind the Clean Heat Standard states, “Vermont has a long history of relying on wood for heat, and, more recently, significant experience in more efficient, lower-emitting advanced wood heat systems. Options today include efficient pellet stoves, automated pellet or chip boilers or furnaces, and efficient cordwood stoves.”

For each category of appliance and fuel type, efficiency and fine particulate matter (PM2.5) emission criteria could be applied to distinguish between “best in class” and “run of the mill” appliances. The dividing line here is not to limit market choice of fuel (cordwood, pellets or chips) or appliance type (stove, boiler or furnace), but to set standards to encourage the market toward systems and fuels that have the best outcomes.

This approach is currently used for determination of eligibility for Efficiency Vermont rebates. Efficiency Vermont currently offers incentives for cordwood and pellet stoves and pellet boilers and furnaces in its residential program, as well as custom incentives for chip and pellet boilers installed in commercial buildings over 5,000 square feet. The efficiency and emissions eligibility criteria listed below align with Efficiency Vermont requirements.

Under Option 2, at least some of the stove installations that occurred after January 1, 2023, would be available for early action credits. Additionally, by including stoves as an eligible measure, this option allows for a clean heat measure that is more affordable and accessible to low- and moderate-income (LMI) Vermonters.

Proposed eligibility criteria under Option 2: Wood-burning appliances meeting the following criteria for efficiency and emissions would be eligible clean heat measures:

- Wood chip boilers and furnaces: Same as Option 1.
- Pellet boilers and furnaces: Same as Option 1.
- Cordwood boilers and furnaces: Meets 78% HHV peak efficiency and less than 0.08 lbs per mmBtu PM2.5 (recognizing EPA or EN13240 test methods) and be classified as an indoor system and be installed indoors.
- Cordwood stoves: Meets 75% HHV peak efficiency and less than 2.0 grams per hour PM2.5 (recognizing EPA or EN13240 test methods)
- Pellet stoves: Meets 75% HHV peak efficiency and less than 1.8 grams per hour PM2.5 (recognizing EPA or EN13240 test methods)

Option 3: Pellet and chip-burning appliances meeting defined efficiency and emissions criteria are eligible; cordwood appliances are not eligible until such time as their emissions performance can be determined based on updated test methods.

Option 2 would base eligibility for advanced wood heating measures on criteria for equipment efficiency and emissions performance. However, currently there is no reliable method to determine which cordwood stoves have acceptable levels of PM2.5 emissions. Additionally, there is no agreed-upon test method for cordwood whole home heating appliances and subsequently little research on their emissions to underpin a recommendation at this time. Therefore, Option 3 would specifically exclude cordwood appliances from eligibility as a clean heat measure.

Per a 2023 U.S. Environmental Protection Agency (EPA) Inspector General report assessing the effectiveness of EPA’s residential wood heater program,¹ stove certification testing data under

¹ Available at https://www.epaoig.gov/sites/default/files/reports/2024-04/_epaoig_20230228-23-e-0012_2.pdf

EPA's program cannot be relied on to identify high-efficiency, low-emitting appliances. The EPA Inspector General report concluded that the federal program cannot be fixed without development of new and improved test methods along with a rule revision, stating that "state regulators and the public cannot rely on the EPA's wood heater program to ensure that only compliant appliances reach homes, and the EPA and states may be wasting millions of dollars on changeout programs by subsidizing new appliances that may not be substantially cleaner in real-world conditions." It also notes, "The EPA's 2015 New Source Performance Standards for residential wood heaters is flawed, and the EPA has approved methods that lack clarity and allow too much flexibility. As a result, certification tests may not be accurate, do not reflect real-world conditions, and may result in some wood heaters being certified for sale that emit too much particulate-matter pollution. In fact, data from an EPA-approved testing lab indicate that some certified wood heaters do not meet emission standards."

The largest concerns are around high PM emissions are for cordwood stoves. While certification data for all appliances is suspect, independent testing found pellet stove values are within an expected margin of error, based on Northeast States for Coordinated Air Use Management (NESCAUM) testing data published in the *Journal of the Air & Waste Management Association*.²

There is limited research on the emissions impacts for cordwood boilers and furnaces. According to the limited literature available, cordwood hydronic heaters had high emissions upon startup, but then were generally lower emitting compared to cordwood stoves. Overall, PM_{2.5} emissions are clearly higher than for pellet boilers and furnaces.³ Cordwood appliance performance is also more dependent on wood quality and how the appliance is operated than appliances that use pellets or chips. Option 3 proposes to exclude all cordwood appliances, but potentially could be modified to exclude only cordwood stoves and allow cordwood boilers and furnaces.

Eligibility of cordwood appliances as a clean heat measure could be reevaluated in a few years, if and when an accepted testing method is widely applied that can more accurately determine the levels of PM_{2.5} emissions for these appliances. NESCAUM recently received a \$9 million grant from EPA to test new wood-burning appliances and create an independent data set using new/improved test methods. NESCAUM is currently testing all types of wood heaters (central heaters and stoves, pellet and cordwood), but it will take several years and additional funds to get 300+ commercially available appliances tested. This dataset is intended to provide state, local, and Tribal agencies information to inform their efforts to address air pollution from residential wood heating while EPA works on new federal requirements (anticipated 2029-33 timeframe for rule implementation).

² Available at <https://doi.org/10.1080/10962247.2022.2056660>

³ Lindberg, J., Vitillo, N., Wurth, M., Frank, B. P., Tang, S., LaDuke, G., ... Butcher, T. (2022). Characterization of in-stack particulate emissions from residential wood hydronic heater appliances under different combustion conditions. *Journal of the Air & Waste Management Association*, 72(7), 720–737. <https://doi.org/10.1080/10962247.2022.2049398>