Clean Heat for a Cooler Planet:

The Clean Heat Standard

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EAN Clean Heat Working Group

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Note to readers: this draft is subject to revision,
Please send comments and suggestions to the authors

An Energy Action Network (EAN) White Paper

Contents

I. Introduction

1. Focus of this Paper: Clean Heat in Vermont

Vermonters spend at least $750 million per year[1] to purchase fossil heating fuels that we know we can no longer responsibly burn. Importing those fuels imposes a huge drain on the Vermont economy and exposes Vermont families and businesses to substantial fuel price volatility in global markets. Fuel oil, propane, and gas bills also impose substantial and disproportionately high energy cost burdens on lower-income households. Fossil-fuels used for thermal purposes (what this paper calls "fossil heat" for simplicity) account for 34% of Vermont's total GHG emissions.[2] Those emissions must be reduced by at least 15% below 2018 levels by 2025 and then by 40% by 2030 and 80% by 2050 to meet our carbon reduction goals.[3] In this report we aim to tackle these problems through a performance-based program, the **Clean Heat Standard**, that would ensure that Vermont's heat suppliers and local enterprises transform their businesses greenhouse gas (GHG) emissions and fossil heating costs in Vermont buildings.

Why focus on heat?

We focus on heat for numerous reasons. First, as noted above, fossil heat accounts for 34% of Vermont's climate pollution, and is the second largest source of those emissions, after transportation. Unless we rapidly revamp the heating sector we can't come close to meeting Vermont's climate goals. In Vermont's climate, heat is also an essential service -- for health, comfort, and a viable economy. Warm homes and businesses are healthier, and cleaner heating systems are key to lowering local air pollution levels as well as global warming gasses. Ensuring that warm homes and clean heat are affordable remains critical, and is a central goal of the clean heat initiative. Furthermore, fossil heating has historically been high-cost and particularly price volatile, putting a major strain on Vermonter's budgets.

[1] Note: In 2018, per ACCD (using EIA SEDS data) VT spent $769.4 million on thermal fossil fuels across the residential, commercial, and industrial sectors. Specifically, $343.6 million on fuel oil, $309.5 million on propane, and $116 million on natural gas. Averaged over the past decade, fossil thermal spending has been $758 million per year. Source: Ken Jones, Economic Research Analyst at ACCD.

[2] https://dec.vermont.gov/sites/dec/files/aqc/climate-change/documents/_Vermont_Greenhouse_Gas_Emissions_Inventory_Update_1990-2017_Final.pdf

[3] Vermont's Global Warming Solutions Act – i.e., reductions of 26% relative to 2005 levels by 2025, 40% relative to 1990 levels by 2030 and 40% relative to 1990 levels by 2050. Reductions from statutory reference dates were converted to common 2018 emissions level based on the Vermont Energy Action Network's Annual Progress Report for Vermont for 2020/2021 (https://www.eanvt.org/wp-content/uploads/2021/06/EAN-APR2020-21_finalJune2.pdf).

What's included in fossil heat?

This paper and the Clean Heat Standard address the problem we call "fossil heat." As previously noted, while heating buildings (space heating) is the largest use of fossil heating fuels, it is not the only end use in this sector. Fossil fuels are also burned for water heating, clothes drying, cooking, and some industrial processes. These and other on-site combustion uses would be included in the total sales figures covered by the Clean Heat Standard. Figure 1 provides a breakdown of greenhouse gas emissions in Vermont's thermal sector.

We recognize that for some of these uses it will be more difficult to substitute low-emitting heat sources. Therefore, the design of the CHS would not require reductions in all end uses to the same degree or at the same pace.

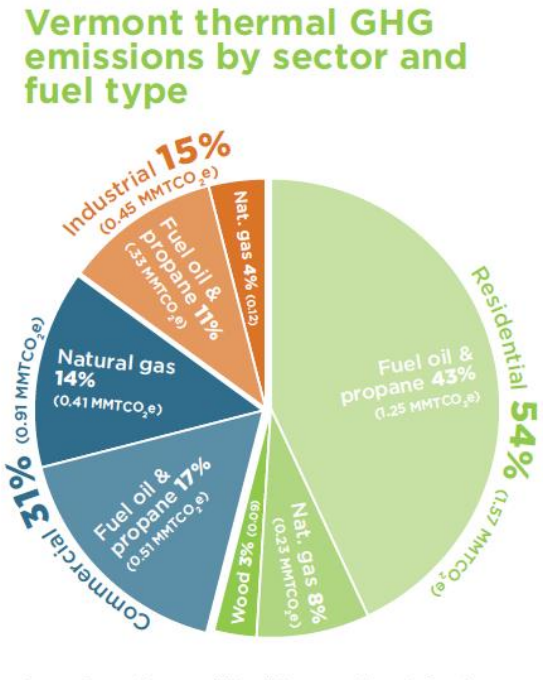


Figure 1. Vermont thermal GHG emissions by sector and fuel type

2. Vermont and the Global Climate Imperative

Over the past decade public awareness of global climate change has evolved from thinking of it as a long-term problem, to recognizing it as a looming crisis requiring urgent, early action – from thinking of climate change as a problem about slowly melting glaciers to recognizing it as a cascade of wildfires, floods, and droughts. In 2020, the Vermont Legislature, acting on the evidence and accepting that we too have a responsibility to act, passed the Global Warming Solutions Act (GWSA).[4]

In the GWSA the Legislature found that there is indeed a "climate emergency," and adopted legally-enforceable emission reduction requirements for the Vermont economy. The Act also created the Vermont Climate Council, which is directed to create a Climate Action Plan that will meet a challenging set of greenhouse gas emission reduction targets[5], not less than:

- 26% below 2005 emission levels by 2025;
- 40% below 1990 emission levels by 2030; and
- 80% below 1990 emission levels by 2050.

[4] "A climate emergency threatens our communities, State, and region and poses a significant threat to human health and safety, infrastructure, biodiversity, our common environment, and our economy." H.688 (2020) Sec. 2 (1)

[5] 10 VSA Sec. 578 (a).

The Plan must also "achieve net zero emissions by 2050 across all sectors" of the Vermont economy.[6]

In addition to meeting these overall goals, the Climate Action Plan must "include specific initiatives, programs and strategies that will reduce greenhouse gas emissions from the transportation, *building, regulated utility, industrial, commercial*, and agricultural sectors" of the economy.[7] Moreover, the Plan must provide for GHG emission reductions "that reflect *the relative contribution of each source* or category of sources of emissions."[8]

Clearly, this legislation requires Vermonters to develop realistic strategies that will reduce GHG emissions from fossil heat sources – not just in buildings but also, where feasible, in industry and agriculture. Those reductions must be proportionate (roughly 34% of all reductions) and must be ambitious and timely, meeting the requirements for 2025, 2030, and 2050 noted above.

It's time to focus on thermal pollution

In Vermont, as in the US generally, most climate pollution has come from three sources: electricity generation, transportation, and the thermal sector, which includes heat for buildings, hot water, and some industrial processes.

Of these three sectors, to date Vermont has made significant progress only on electricity. The electricity sector has been paying for and delivering the overwhelming majority of the GHG reductions we have seen in Vermont to date, while the fossil fuel sector has delivered only a small share of the savings we need to lower customer bills and climate pollution. Our electric and pipeline gas utilities have been delivering substantial energy efficiency savings on a firm schedule. Electric utilities have also been generating or purchasing an ever-increasing portion of their electricity from hydro, wind, solar and other renewable sources.

These gains did not happen on their own – they resulted from government policies, including the Renewable Energy Standard, that required improved performance across energy businesses, ramping up over time. We aim to take the same approach to clean heat.

What do we propose?

As the best way to meet the challenges noted above, we propose creating the **Vermont Clean Heat Standard (CHS).** The CHS is a performance standard, applied to the providers of fossil heating fuels to Vermont, requiring them to deliver a gradually-increasing percentage of low-emission heating services to Vermont customers.

Because Vermont imports 100% of the fossil fuels we use for heating, the CHS would be applied upstream, at the wholesale level – that is, on the state's only regulated natural gas supplier, VGS[9], and

[6] 10 VSA Sec. 592 (b)(4).
[7] 10 VSA Sec.592(b)(1) (emphasis added).
[8] 10 VSA Sec 592 (d) (2) (emphasis added).
[9] Formerly "Vermont Gas Systems"

on the large-scale fossil fuel companies that deliver fuels to Vermont's numerous fuel dealers.[10] The standard would apply to all substantial fossil fuel sales, including fuel oil, propane, natural gas, and kerosene.

How the Clean Heat Standard would work: (see Figure 2, next page)

(1) The CHS is akin to the Renewable Electricity Standard and the efficiency performance standards in effect in Vermont, and in many other states and nations. The overall standard and major milestones are set by the legislature, and a regulatory agency is authorized to supervise implementation.

(2) Fossil heat wholesalers ("obligated parties") are required to deliver clean heat solutions to Vermont customers on a percentage basis that rises over time. While each year's clean heat additions could be modest (perhaps 4% per year), clean heat additions would add up over time to meet Vermont's climate goals.

(3) Those fossil heat providers could meet the standard through a wide range of actions. Most directly, they could blend qualified biofuels or renewable natural gas into the fuels they sell into Vermont. Or, working with Vermont families and businesses, they could help customers to install low-emission heating systems such as cold-climate heat pumps and advanced wood heating equipment[11], or to better insulate their buildings.

(4) We expect most of the customer-level work to be done in coordination with local enterprises -- Vermont fuel dealers, heating contractors, Efficiency Vermont, our weatherization programs, and others. Anyone delivering qualified clean heat solutions to Vermont homes and businesses could earn Clean Heat Credits, which could then be sold to the upstream fossil providers who will need them to meet their annual performance obligations.

[10] While imposing a clean heat performance obligation on wholesale fossil heat providers is a new approach to managing climate pollution, obligations on fossil fuel providers at the wholesale level are not unusual. Fuel quality standards, blending requirements, and the federal Renewable Fuel Standard are customarily applied at the producer or wholesale level. Under the California Low Carbon Fuel Standard (for transportation fuels), the obligation to supply low-carbon fuel applies to fuel producers and importers, not to the operators of retail gas stations. The Transportation Climate Initiative (TCI) in our region, applies to fuels as they are removed from a storage facility (a "terminal rack") or delivered into a TCI jurisdiction. The Vermont CHS should, similarly, apply at the wholesale level where permitted, or to "jurisdictional wholesalers and importers" if Vermont's jurisdiction is found to be more limited. This legal question will be examined in a companion document. Whether the CHS obligation would apply exclusively to fuel wholesalers and VGS, or to fuel importers as well, does not alter the other program design elements and recommendations in this white paper.

[11] 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 (AWH). Options today include efficient pellet stoves, automated pellet or chip boilers or furnaces, and efficient cord wood stoves. See page 24 of the 2020/2021 EAN Annual Progress Report (https://www.eanvt.org/tracking-progress/annual-progress-report/2021-annual-progress-report/)

(5) A critical feature of the CHS is **customer choice.** The CHS does not require a homeowner or business customer to change their heating system or to choose any particular clean heat option. The program allows customers to choose among a range of options, or to take no action until the time is right for them. But it will provide incentives, information, and support for clean heat options, and we know from experience that these measures can accelerate the transition to cleaner and more efficient buildings across the state.

This paper describes such a standard and explores how it could be designed and implemented.

The paper first examines the reasons for selecting a CHS for Vermont, in relation to other program options that decision-makers might consider to tackle thermal climate pollution. It then sets out the key design principles driving the structure of the program, before describing the major program elements. The CHS Working Group --which includes individuals with deep experience in energy supply, energy efficiency, customer service, heating systems, finance and regulation -- has examined the key elements of the CHS in depth. In this paper we describe the major design issues, and some related pros and cons, and answer the fundamental question, "how would it work?"

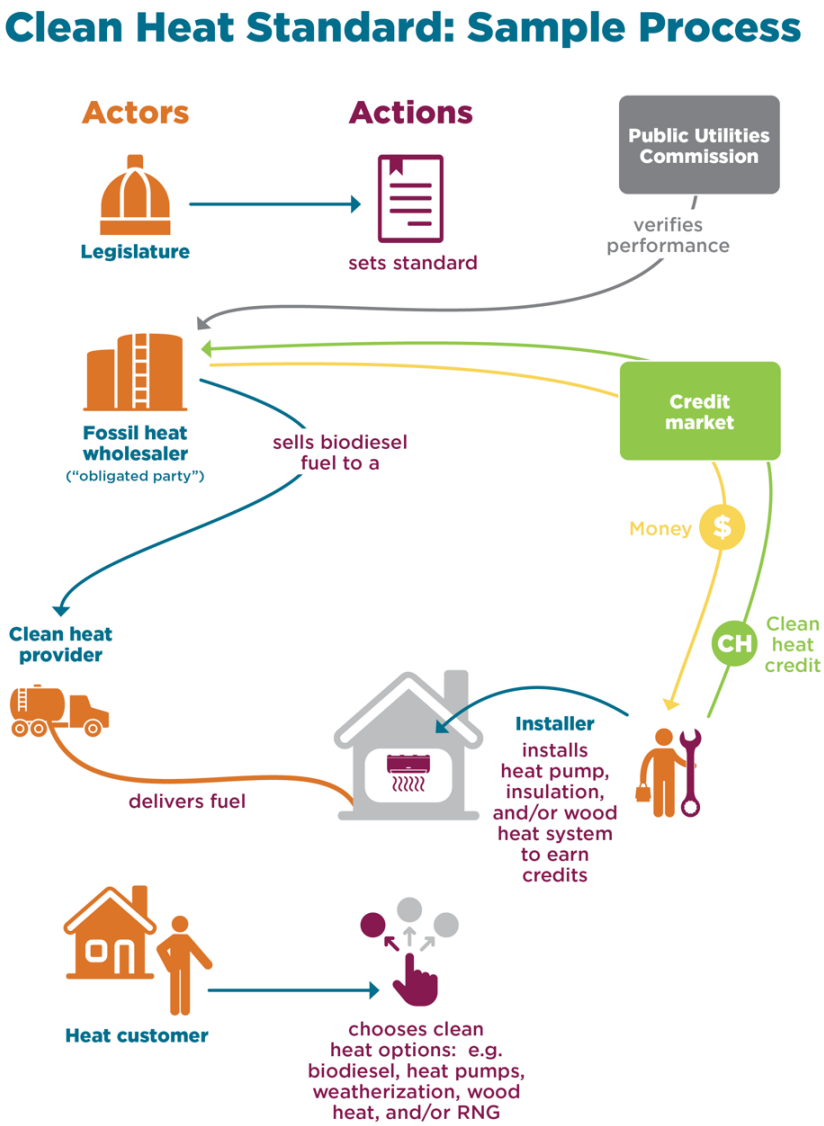


Figure 2. How the Clean Heat Standard would work

The sections below explore design and implementation issues in some depth, which might lead a reader to conclude that the CHS is a complex endeavor, and perhaps hope that "there must be a simpler way." However, there is no single "magic bullet" solution to climate change, nor to the thermal sector's contribution to the problem. If there were, the problem might have been solved already. It is the design details that allow the program to maximize customer choice and

equitable solutions, minimize costs, and assure real reductions in climate emissions. Vermont and many other states have succeeded with similar well-established programs in energy efficiency and renewable power, and they all have implementation details that don't rise to the level of legislative decision-making and can instead be delegated to administrative agencies. By studying the implementation details ourselves ("kicking the tires," so to speak) the CHS Working Group has tested this concept well enough to conclude that it really can work.

Note that though this paper focuses on Vermont's thermal and industrial sectors, the concept of the Clean Heat Standard could also be applied to or expanded to include the transportation sector.

The Clean Heat Working Group and the CHS Design Process

This whitepaper and CHS recommendations have been guided by the Clean Heat Working Group, a group of industry experts and stakeholders focused on reducing GHG emissions from the thermal sector in Vermont. The group was formed in response to a proposal by Richard Cowart and Don Rendell at the Energy Action Network's 2020 Summit, and has been supported by EAN from the outset. The Working Group has met regularly over the past year to consider all of the elements of a Clean Heat Standard, to hear from fuel industry leaders and experts, and to review and refine the proposal described in this paper.

The Working Group has included experts from the fuel delivery sector, Vermont legislators, Vermont's pipeline gas utility (VGS) electric utilities (GMP and BED), independent energy experts (especially RAP, EAN and EFG), Efficiency Vermont, the Department of Public Service, and the Public Utility Commission. We also received expert advice and counsel from the Vermont Fuel Dealers Association, the National Biodiesel Board, the National Oil Heat Resource Alliance, among others.

From the outset, our Working Group has worked in tandem with a similar group focused on Weatherization at Scale, recognizing that reducing Vermont's emissions affordably requires building shell improvements as well as changing heat energy supply sources.

The authors are grateful for the expertise, good ideas, and support given by EAN staff, Working Group participants and other experts who have helped us to develop the whitepaper. We achieved a high level of consensus on the architecture of the CHS and on nearly all of the CHS design elements. However, in the final analysis, the details of the proposal and any errors or omissions are ours alone.

– Richard Cowart and Chris Neme, September 2021

II. The Case For a Clean Heat Standard

Among policy paths to reduce fossil heat, why do we propose the Clean Heat Standard ?

In a recent article in Scientific American,[12] Professor Naomi Oreskes points out that some problems we may think of as "hard" (manufacturing a Covid vaccine, for example) are in some senses "easy" (mass-production techniques can scale up rapidly). Meanwhile, other problems we might think are easy can actually be quite hard. Delivering vaccines to millions of people in thousands of locations is actually quite difficult, even though most people have a strong interest in their own health, and the vaccine has been free. Professor Oreskes concludes with this observation: "When it comes to solving real-life

[12] Naomi Oreskes, "What Makes a Problem 'Hard'?" Scientific American May 2021 at 77.

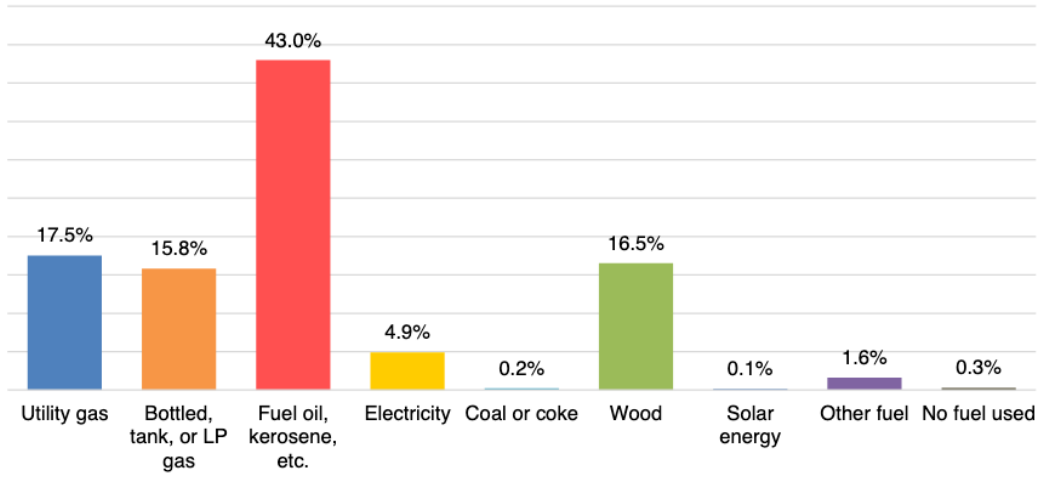
problems, it is the supposedly straightforward ones that seem to be tripping us up. The vaccine-vaccination paradox suggests that the truly hard sciences are those that involve human behavior."

The problem of thermal pollution is one that very deeply involves human behavior. It is no small thing to create a public policy that can reach out to just about every building owner in our state and lead them to make substantial investments in new heating systems to address a global problem. Technology is not the limiting issue. We have the technology to "vaccinate" most buildings in Vermont with cold-climate heat pumps, biofuels, and advanced wood heat systems. But we lack the programs to deliver enough units to enough buildings fast enough to meet our climate goals.

There are approximately 332,000 housing units in Vermont[13]. As shown in Figure 3 below, over 77% (over 255,000) of those homes are heated primarily by fossil fuels.

Home fuels

Figure 3-17: Vermont homes by primary heating fuel



Source: U.S. Census Bureau: American Community Survey 5-year estimates, 2013-2017 (Table B25040) from housingdata.org.

Changing out hundreds of thousands of heating systems, weatherizing hundreds of thousands of buildings and developing many large new sources of renewable biofuels every year for the next two decades is technically possible. But getting it done requires a delivery system that works with customers on an individual basis to install and service non-fossil appliances, water heaters and new heating systems and to retrofit individual homes and businesses with more insulation and sealing of unwanted leaks. On the supply side, we will need to work with farms, foresters, and other businesses to develop and install biofuel processing equipment and the delivery infrastructure needed to move the biofuels to market. This requires a diverse workforce that is skilled in customer service, analysis of a range of technical products, and equipment installation.

Heating systems are not a mail-order item. We need Vermont-based businesses with customer relationships and, literally, "boots on the ground." The Vermont economy already contains an array of

[13] VHFA Vermont Housing Needs Assessment, February 2020. The report shows a total of 331,106 as for 2017, adjusted up slightly to account for growth (which is very slow in recent years).

fuel dealers, renewable energy companies, and heating contractors who could, if refocused and incentivized, do a lot of this work. We need a Clean Heat Standard that will support those businesses and ensure that they deliver heating solutions at the scale needed to meet Vermont's climate, equity, and economic goals.

A Clean Heat Standard is by no means the only policy option available to reduce thermal consumption and GHG emissions. We have considered several other options including, among others: carbon pricing, thermal energy efficiency programs, building codes, heating equipment appliance standards, and reliance on electric utility mandates. All of these approaches have some merit, and any or all of them could be adopted to work in tandem with a Clean Heat Standard. To the degree that any of these parallel strategies lower demand for fossil heat, or lower the cost of delivering clean heat solutions, they only make it easier to deliver cleaner fuels and heating conversions, speeding up the transition to clean heat in Vermont.

However, we conclude that none of these other options is likely to succeed on its own, and none would be as singularly effective as a Clean Heat Standard in delivering tangible progress. In brief, here's why:

- **Carbon pricing**, by itself, is a weak and potentially expensive means to drive change in the buildings sector, where actions must be taken by individual building owners facing significant barriers to change. Cap-and-invest programs can help, but changes in fuel prices alone have not historically driven much change in heating systems.[14]

- **Thermal energy efficiency programs** are essential to delivering equitable and effective heating solutions in Vermont, and we judge that a program like the "Weatherization at Scale" proposal is needed as a companion to the CHS. But even ambitious weatherization efforts can deliver only about 25% reductions in the heat demands of a typical Vermont home, so up to 75% of the needed fossil reduction has to come from switching to cleaner energy sources.

- **Building codes and appliance standards** can improve the performance of new construction in Vermont, and of replacement water heaters and furnaces. But the pace of new construction, less than 1% per year,[15] and the expected percentage improvement in appliance efficiencies are too low and too slow to deliver the reductions we need in fossil heat consumption in coming decades.

- **Electric utilities -** Vermont has succeeded in delivering electric energy efficiency, renewable power, and some fossil fuel avoidance through performance standards imposed on electric

[14] In economic terms, the price-elasticity of demand for heating fuels is quite low. It would likely require an unacceptably high carbon price to drive building owners to install new heating systems, unless the carbon program also provided customer assistance and financial incentives to accelerate change.

[15] Building energy codes also govern additions and changes to existing buildings. However, such savings are still likely to provide only a modest contribution to the substantial levels of GHG emission reductions required to meet the state's goals. That is because (A) only a small fraction of existing building energy use is affected by codes each year; (B) building energy codes typically establish a "floor" for efficiency, not efficiency levels that are optimal in the context of aggressive climate policy; and (C) even optimal levels of efficiency improvements in buildings – though essential to enabling *affordable* decarbonization – will not be enough to achieve even close to a 40% emission reduction by 2040, let alone 80% by 2050.

utilities, including Tier 3 of the RES. However, it makes little sense to impose additional performance obligations on our cleanest major source of energy (electricity) while imposing almost no obligations on the fossil fuel providers that are delivering the most carbon-intensive fuels we consume (fuel oil, propane, natural gas). To deliver the depth of change required, we need to engage the existing fossil industry in its own transition to a clean thermal sector.

Additional discussion and support for these conclusions is set out in Appendix 1 of this paper.

Building on Experience:
Renewable Portfolio Standards, Energy Efficiency Obligations, and Vermont's Tier 3

The Clean Heat Standard would not be the first time that performance obligations were placed on energy providers. In Vermont, across the United States, and in many other countries there are decades of experience with clean energy performance standards, applied to the electric power sector and in some cases to regulated pipeline gas companies. What's unique about the Vermont Clean Heat Standard is that it would apply a performance standard to energy providers across both regulated and non-utility energy companies.

The most widely-known examples of clean energy performance standards are the electric Renewable Energy Standards in place in many jurisdictions to mandate continuing increases in renewable energy generation as part of utilities' portfolio of electric power provided to end-use customers. At least 30 US states have electric RPS's in place and 5 states have "clean energy standards" that include some non-renewable power in the obligation pool.

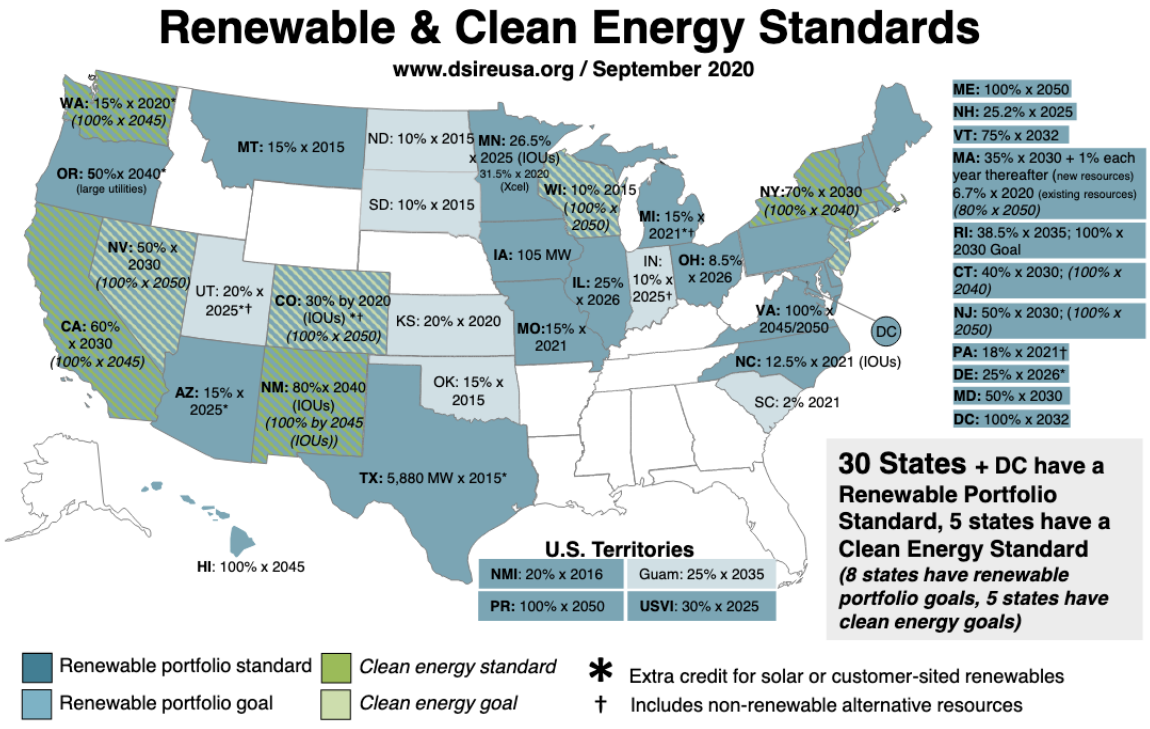


Figure 5: Renewable and Clean Energy Standards in the US

In a similar vein, at least 31 states have an Energy Efficiency Resource Standard (EERS) or similar obligation in place, requiring regulated utilities or retail electricity suppliers to deliver energy efficiency savings to and with their end-use customers.

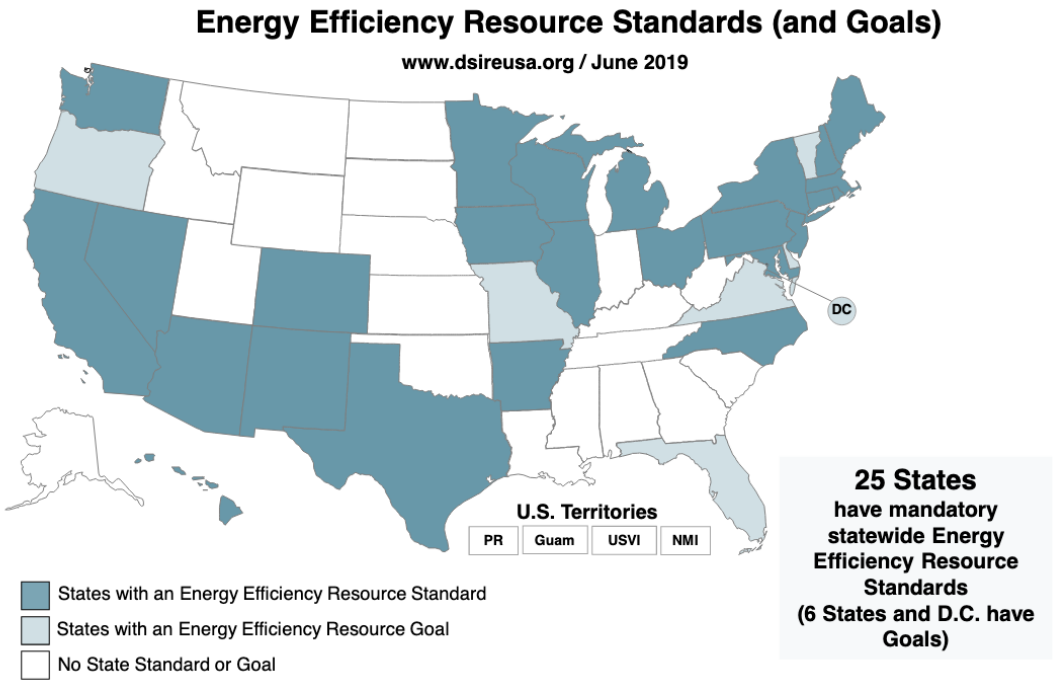


Figure 6. Energy Efficiency Standards in the US

Renewable energy standards (RESs) and energy efficiency obligations have worked well to drive change in the electricity sector. In some jurisdictions, as in Vermont, efficiency obligations also apply to the regulated pipeline gas utilities, also with notable success. As previously discussed, Vermont is also now in its fifth year of remarkably smooth and successful implementation of its RPS Tier 3 requirement for electric utilities to reduce their customers' direct consumption of fossil fuels.

Our national experience with these performance standards reveals five broad observations:

1. **Change at scale.** Renewable Portfolio Standards and Efficiency Resource Standards have delivered a large fraction of the renewable energy and energy efficiency services received by end-use customers in the states that have enacted them.

2. **High prices not required**. They have delivered these clean energy improvements largely in the absence of carbon taxes or cap-and-trade regimes. They can deliver systemic changes without relying on higher prices to change consumer behavior. Carbon revenues can be quite helpful, but carbon taxes are not required to deliver renewable power or energy efficiency as power system resources.

3. **Focus on adding "good" resources, not on limiting "bads."** Both the RPS and EERS have been designed to require the addition of desirable resources to energy systems, rather than imposing a cap or a penalty on the production or consumption of less desirable resources. Even so, by

adding low-emission resources to energy systems, they have displaced worse energy sources and substantially reduced environmental harms, including greenhouse gases.

4. **We know how to administer them**. Performance standards require ways to measure and count performance, and across the country we now have decades of experience in how to do this. The details can seem complicated, but across all of these programs, utilities, administrators, and stakeholders have developed the procedures and verification methods to make implementation a relatively routine matter.

5. **Competition lowers costs and drives innovation.** To the degree that performance standards permit flexibility in resources and delivery methods, they can promote new ideas and uncover cost-savings opportunities. For example, spurred by RES obligations, many utilities have conducted competitive solicitations for renewable supplies from independent producers, leading to rapid reductions in the cost of solar and wind power.

All of these observations could apply in the administration of a Clean Heat Standard:

- Like the RES and the EERS, the Clean Heat Standard is not a fee-based system or a tax. Its continued success does not depend on annual governmental appropriations.

- Designing the CHS to focus on the delivery of resources that are perceived as "good" avoids pointless arguments over how to/why to limit the use of fossil resources that most people and businesses view as perfectly normal. The CHS will provide opportunities and incentives for consumers to switch away from fossil heat systems, but it does not require any individual end-consumer to make that choice.

- As with numerous energy efficiency programs, CHS success requires finding ways to work with both upstream vendors[16] and end-use customers to deliver solutions in thousands of distributed locations.

- The CHS would be a performance-based obligation, without detailed prescriptions, imposed on fossil fuel sellers on a competitively-neutral basis. This creates the environment to deliver clean heat solutions and incentivizes innovation and lower costs over time.

- Finally, the electricity RPS has guided numerous electricity providers to new business models that work sustainably in the emerging low-carbon economy. In like manner, the Vermont Clean Heat Standard is designed to help Vermont's heating enterprises, including traditional fuel companies, to transition and thrive while helping their customers to switch to cleaner, sustainable heating choices.

It's time to do for heating what we have done for electricity– to serve Vermonters better by reducing carbon pollution and fossil energy bills. This has not happened, and won't happen, just through wishful thinking or the actions of a few well-meaning early adopters – *it requires a clean heat performance standard, applied on a competitively neutral basis to all major suppliers of heating fuels in Vermont.*

[16] The CHS will need and support agricultural and other businesses that can develop biofuels, as well as heating equipment vendors and installers, the advanced wood heat value chain, and others.

III. Design Principles for a Clean Heat Standard

The central idea of a Clean Heat Standard is a performance standard applied to all suppliers of fossil-fuel heat in Vermont, requiring them to serve Vermont customers with gradually-increasing percentages of low-emission heat, while phasing down their sales of fossil fuels over time. Just as the electricity RES's are replacing coal and gas-fired generation with hydro, wind and solar power, the CHS would replace fuel oil, propane, fossil gas, and kerosene heat with renewable biofuels, cold-climate heat pumps, advanced wood heat, district heating, energy efficiency improvements and other low-carbon options.

There are of course many ways to approach this design challenge, so it has been helpful to keep in mind a few guiding principles to test our decision-making on various aspects of the CHS. A successful Clean Heat Standard will:

1. **Meet Vermont's climate goals**. The CHS program must reduce both local air pollution and global greenhouse gasses and have a high likelihood of meeting the thermal sector's share of emission reductions called for in the Global Warming Solutions Act.
2. **Provide customer flexibility** -- giving homeowners, building owners, and other consumers a wide range of low-emission heating options to choose from.
3. **Promote supplier flexibility** -- offering numerous pathways for obligated entities to meet their Clean Heat obligations.
4. **Minimize cost** -- maximizing flexibility will enable emission reductions to be achieved at the lowest possible cost.
5. **Maintain resource diversity** -- minimizing negative side-effects, avoiding over-reliance on single technologies, and minimizing exported environmental harms from cleaner heating choices in Vermont.
6. **Enhance social equity** -- building social equity into the architecture of the program, and particularly minimizing adverse impacts on low-income households and those most burdened by high energy bills.
7. **Scale over time** -- growing gradually in scale over time, the CHS should provide opportunities to benefit from new technology, capture economies of scale, and provide reasonable certainty to market participants that the market for clean heat solutions will continue and grow.
8. **Be as simple as possible --** minimizing complexity of administration, while maintaining enough regulatory rigor to ensure that emission reductions are real and consistent with state goals. Vermont's CHS should be capable of meshing with programs in other states, if they are created, but we should not delay our own progress waiting for other states to act.
9. **Mesh well with other policies** -- The Clean Heat program should work well with, and be mutually-reinforcing with Vermont's weatherization, Tier 3 and other carbon reduction initiatives.
10. **Enhance local economic development** -- supporting jobs and growth in the Vermont economy, including new jobs and job training opportunities, and fuel dealers' ability to transition to new and economically sustainable business models.
11. **Leverage existing institutions** – working with existing Vermont policies and institutions will boost progress, ensure consistency across policies, and avoid recreating the wheel.

IV. Clean Heat Standard Proposal

As with any policy concept, the key elements of a Clean Heat Standard could be structured in a variety of ways. The CHS Working Group has considered many of these program options in depth. In this section we provide our recommendations on a number of the key elements of a CHS for Vermont. The section concludes with a table that summarizes all of the recommendations and can serve as a quick reference.

More detail on some of these elements and the rationale for our recommendations is included in Appendix 2.

A. Nature of the Obligation: Delivering Clean Heat Credits

Recommendations

1. **Credit system**. Obligated parties will be required to produce or acquire a specific number of clean heat credits each year. The annual requirement will grow over time to enable achievement of Vermont's climate policy goals (see subsection C on the Size of the Obligation).
2. **Clean heat credits expressed in CO2e**. Clean heat credits will be expressed in units of carbon dioxide equivalents (CO2e).
3. **Credits are based on the magnitude of emissions reductions at Vermont homes and business sites**. Credits will not account for the historic upstream emissions associated with the production and delivery of fossil fuels to those sites. However, the net impacts of biofuel replacements will be assessed on a lifecycle basis to avoid exporting emissions that would remain unaccounted for.
4. **Attribution not required**. The obligated party must simply demonstrate than an emission reduction has been achieved and that it owns the rights to that reduction. It does not need to demonstrate that it was directly responsible for producing the reduction.

Discussion[17]

Clean Heat Credits. Designing a market-based program to ensure specific levels of reductions in fossil emissions in Vermont begins with a choice between two systems: (a) a system that requires fossil providers to earn *credits for positive actions* (e.g., selling renewable fuels or installing heat pumps) or (b) one that *reduces emissions under a declining cap* and distributes those emission allowances among fuel sellers by auction or some other means. The cap-and-allowance system is more akin to the method used in the Regional Greenhouse Gas Initiative. The credit-based system is more akin to the systems Vermont has used for Renewable Energy Standards and Efficiency Obligations.

Each of these approaches has pros and cons. The main advantage of a cap-and-allowance system is that it provides a fair degree of certainty on the absolute level of emissions over time. A cap-and-invest system (e.g., RGGI) can also raise financial resources to support energy transitions.

[17] More discussion about each of the recommendations for delivering clean heat credits is available in Appendix 2.

We propose a Clean Heat Standard based on an earned-credit system, akin to the electric RES. Like the RES, the CHS would provide a clear picture of the rate of change required. It would create a commercial value for each heat pump, wood pellet stove, home weatherization job, gallon of biofuel and other measures. That, in turn, could help fuel dealers, contractors, farmers and others to transition their businesses to selling such products and services.

The main advantage of a credit system over an allowance system is that it focuses on the delivery of concrete, delivered clean solutions rather than on allowance limitations and pricing as a tool to drive down consumption of fossil fuels. A key goal of the CHS is to stimulate suppliers, whether based in Vermont or elsewhere, to deliver clean heat solutions to Vermont customers. This connection is stronger in a credit-based system.

The common denominator to measure credits should be CO2e. In the Renewable Energy Standard, performance is counted in delivered kWh. Since the CHS is designed to match the emission reductions required by the Global Warming Solutions Act, CHS credits should be measured in terms of CO2 equivalents, which would give credit for the CO2 emissions avoided by the addition of clean heat solutions. Using CO2e also allows a variety of clean heat options, from weatherization to biofuels, to be compared on an apples-to-apples basis.

Credits Expressed in Terms of On-Site Emission Reductions. The current Vermont Greenhouse Gas Emissions Inventory measures emissions at the point of combustion of fossil fuels. That is the simplest way to measure both baseline emissions and future emission reductions. It is also consistent with the structure of the Global Warming Solutions Act. However, to avoid the problem of "exporting" emissions or overlooking new impacts from biofuels, biofuel additions can only earn credits on a net basis, after accounting for the lifecycle emissions associated with their creation and consumption.

Attribution is Not Required. One of the most attractive features of the CHS is that it can recognize credits for the delivery of clean heat solutions without needing to consider which program or entity (or combination thereof) "caused" the solution to be delivered. The Vermont GWSA requires specific levels of emission reduction by 2025, 2030 and 2050. A Clean Heat Standard is simply a policy tool for ensuring that those reductions are achieved in Vermont's thermal sector. Thus, what matters is whether emissions actually go down and the correct number of clean heat credits have been generated. It does not matter who generates those credits or why they were generated.

This is akin to how Vermont's current electric RES works. Electric utilities must simply show that a certain percent of their electric generation each year is from wind, solar and other renewable energy sources. It does not matter whether a customer would have put photovoltaic panels on their roof without a utility program or whether a wind turbine would have been built without any utility support. As long as the utility acquires the renewable attributes of such resources, they can use them to demonstrate compliance with their RES obligation.

B. Who Are the Obligated Parties?

Recommendation

1. **The obligation for reducing emissions would be imposed on Vermont Gas Systems (VGS) and wholesale suppliers of fuel oil, propane and other fossil fuels sold to Vermont homes and businesess.**

Discussion

As Vermont does not produce fossil fuels, we are entirely dependent on imports, and we spend about $750 million each year to import fuels to heat buildings and hot water, to cook, boil maple sap, and to run industrial processes. These fuels are sold into the state via truck and rail by a small number of major energy suppliers operating in a few locations, including Boston, Montreal, Albany, Burlington, Essex, Rutland, Hartford, and North Walpole, NH. There are, in contrast, a larger number of retail providers (currently 96) of oil, propane, kerosene, and natural gas, ranging in size from very large corporations to local, family-owned fuel dealers. Vermont retailers also operate about 75 bulk storage facilities for distillate products, and about 50 bulk propane storage facilities in state.

Should the CHS obligation be imposed "upstream," on wholesale providers, or "downstream," on retail delivery companies? There are pros and cons for either choice.

At a very practical level, delivering on a CHS requires thousands of building owners to make major changes to their heating systems. We do not envision enacting a mandate directly requiring those owners to replace their heating systems, so how can we best support them to make those changes? The principal reason to place a clean heat obligation on retail fuel providers is that they have a direct relationship with end-use customers, and thus have the opportunity to work with them on heat-switching choices. In addition, in the long run, clean heat services will be a big business opportunity in Vermont, and it serves the state's economic goals to develop that expertise in-house and in-state, as we have for energy efficiency and solar power. Placing an obligation on existing fuel providers on a competitively-neutral basis might well provide a needed boost in that direction.

However, "upstream" wholesalers have much greater financial and management capacity, and they have the opportunity to acquire and blend renewable fuels into the system, which could quickly deliver at least some carbon savings without requiring actions by end-users. Wholesalers could also meet their clean heat obligations by purchasing credits from others, or contracting with a range of delivery entities, including fuel dealers, heat pump contractors, or organizations such as the Vermont Fuel Dealers Association or Efficiency Vermont. Finally, obligated parties might wish to use this opportunity to build up a clean heat line of business, akin to the work that many traditional energy companies have been doing in transitioning to renewable electricity. An upstream obligation would still give retail fuel dealers the opportunity, but not the direct obligation, to deliver fuel-switching services to their customers.

All things considered, our working group recommends placing the CHS performance obligation on wholesale providers of fossil heating fuels, and allowing multiple pathways to earn credits. However, since either upstream or retailer obligations could work, the ultimate choice might well come down to the practical preferences of Vermont's fuel dealers and other energy service providers. Whichever way the CHS is designed, it should provide ample opportunity for both regional and Vermont-based fuel dealers and energy companies to develop new lines of business and to thrive in a low-carbon energy environment.

C. Size of Annual Obligation

Recommendation

1. **The PUC would be authorized and required to set annual Clean Heat obligations of sufficient magnitude to achieve the thermal sector's portion of Vermont's GHG emission reduction goals.** The obligation would rise over time in line with the GWSA's requirements.
2. **Technology carve-outs are not needed.** The CHS can be met in many different ways, allowing customer choices, provider choices, and competition to deliver solutions.
3. **The PUC would be enabled to make adjustments to the Standard requirements.** The PUC would be authorized, on evidence and after public hearings, to adjust the level of obligation on a forward-going basis: (a) upward if credits are meaningfully oversupplied; and (b) downward, subject to strict conditions, in response to serious, unavoidable technical problems, supply constraints, and adverse market conditions.

Discussion

The Clean Heat obligation rises over time in sync with climate mandates. The essential idea of the Clean Heat Standard is to add clean heat resources to Vermont homes and businesses over time. Heating, like electricity, is an essential service. Just as the Renewable Energy Standard seeks to add clean resources to the power mix, without imposing a cap on consumption, the Clean Heat Standard seeks to add clean heat services to the thermal sector without putting a limit on how much heat is delivered or consumed. Adding clean heat solutions in Vermont serves multiple purposes: they keep fuel dollars in the local economy, promote jobs in advanced heating technologies, improve indoor and outdoor air quality – and lower GHG emissions. Lowering climate pollution is not the only reason to create a Clean Heat Standard.

That said, as the fraction of clean heat in Vermont will grow over time, GHG emissions from the thermal sector will naturally decline. The Standard should be designed to sync with the State's overall climate mandates, recognizing as well that the CHS is not the only tool called upon to reduce emissions from the thermal sector.

The chart below shows how emissions from the thermal sector should decline in keeping with the GWSA requirements. In very general terms, the rate of improvement set out in the law is roughly 2% per year until 2025, rising to just under 7% per year between 2025 and 2030, and then settling to a reduction in emissions of about 3.3% per year from 2030 to 2050.[18]

[18] Note that these percentages are all measured from the starting year in each time period, not from each year's immediately preceding year.

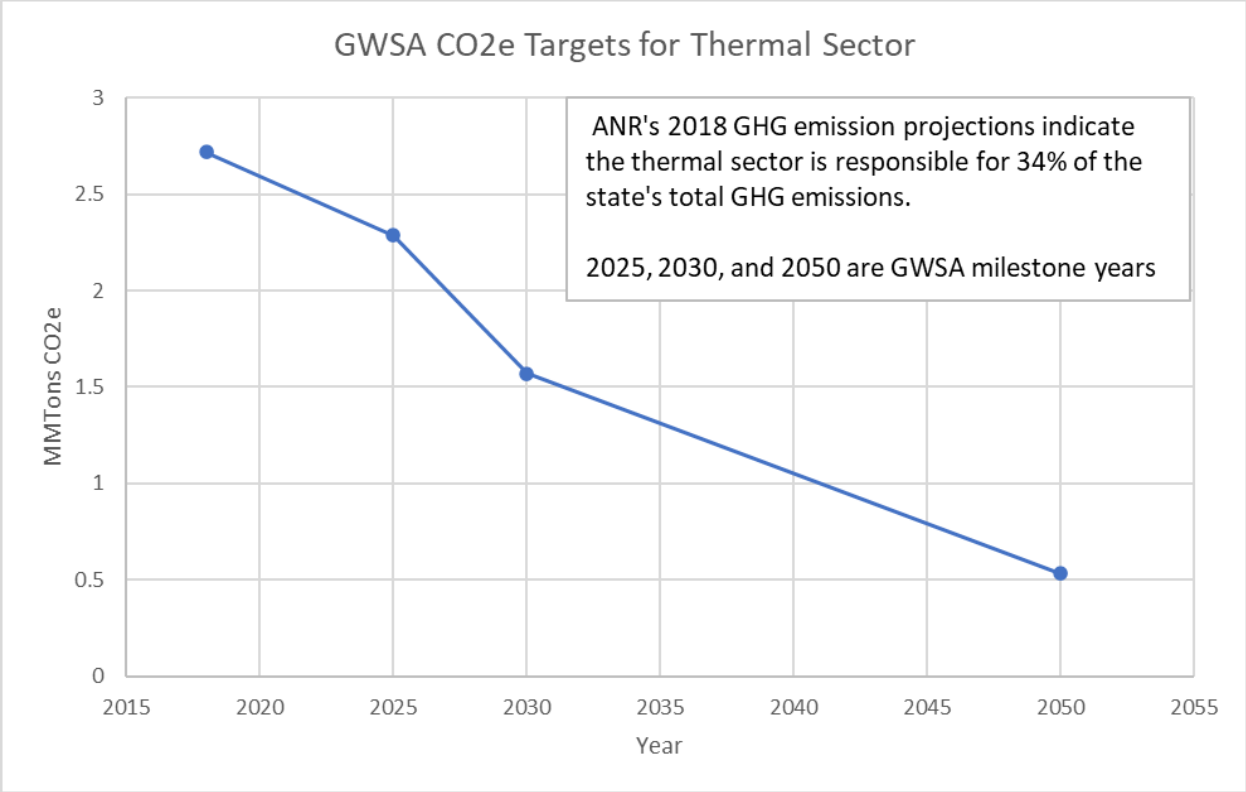


Figure 7. Global Warming Solutions Act: emission reductions required for the thermal sector

The CHS would enable a variety of clean heat choices. With these climate objectives in mind, what heating solutions should the Standard require? We conclude that the CHS should permit a range of technologies and fuels to compete for the ability to earn clean heat credits. A series of analyses by the Energy Action Network[19] reveals that the CHS standard could be met in many different ways, combining different numbers of weatherization jobs, heat pumps, advanced wood heat systems, and/or different blends of renewable pipeline gas and biofuels. One such "pathway" is shown in the chart below. As the chart illustrates, to meet Vermont's climate requirements, we will need very substantial increases through a variety of means. Heat pumps both for water and space heating, building weatherization, and advanced wood heat make up the majority of the measures likely to be used, but many other options are available as well.

[19] The EAN analyses have been built on the work of Leigh Seddon, Mei Butler and Jared Duval. (citations needed)

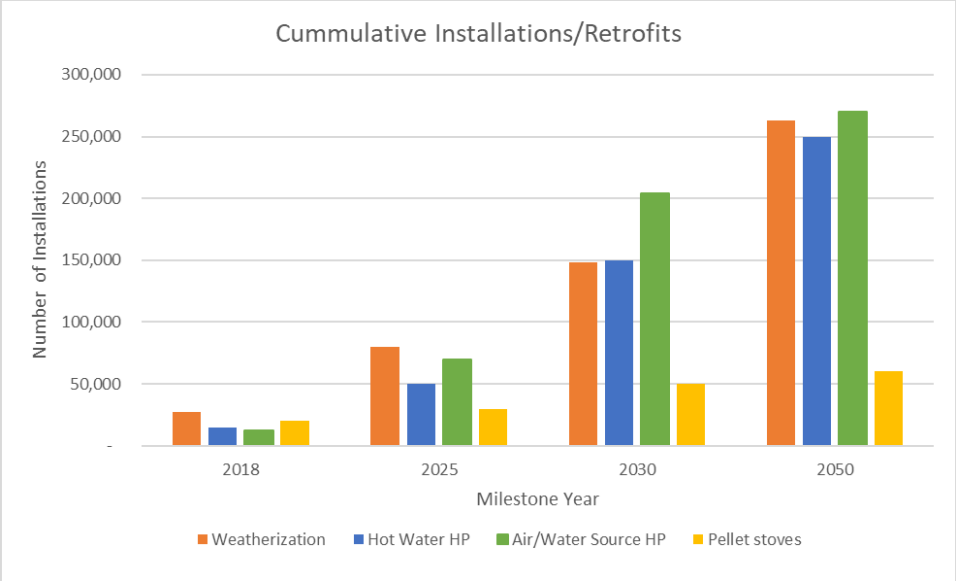


Figure 8: One possible heating mix scenario meeting GWSA requirements
(Note: this chart will be revised to add in additions from biofuels, RNG)

The chart above shows just one possible pathway among many. What is our "crystal ball" prediction for the future mix of heat pumps, advanced wood heat, biofuels, district heat, green hydrogen, and renewable natural gas in Vermont in 2050? We don't know, and we don't need to know. A crucial aspect of the Clean Heat Standard is that it is not necessary for the state to specify the exact pathway to meet our climate goals. Those decisions will be made by individual consumers and their heating suppliers.

Adjustments to the Standard should be permitted in response to the performance of other thermal policies, and to supply constraints and unanticipated market conditions. Decades of experience with energy policies, including utility integrated resource plans, renewable portfolio standards, and efficiency programs have taught providers and regulators that the costs of environmental improvement often come down more quickly than first projected. When renewable portfolio mandates created a growing market for wind and solar power, initial costs were relatively high. However, economies of scale, experience, and competitive bidding for renewables drove down costs much more quickly than analysts expected. With a certain and growing market in Vermont for installed heat pumps, pellet stoves, and biofuels, we should expect to see reductions in the cost of customer contacts and installation over time.[20]

In addition, as equipment vendors, contractors and supply houses gain experience with these cleaner technologies, heating markets may gradually be transformed, as has happened over

[20] The cost of delivering and installing clean heat solutions should drop with increased scale and experience in Vermont. If other states adopt similar policies, the manufactured cost of clean heating equipment might be reduced, while equipment performance is likely to continue to improve. The cost of biofuels might rise due to potential supply limitations. Increased penetration of heat pumps could deliver positive benefits to power systems, could be costly if usage is not managed over time through advanced rate designs, storage and smart grid techniques.

time with a number of lighting technologies. This evolution could lead to two positive results. Most directly, lower costs for clean heat systems would yield a greater supply of clean heat credits, moderating the cost of the CHS program for providers and consumers. Beyond that, with higher uptake and lower costs for the CHS, decisionmakers might have the opportunity to increase the pace or ambition of the CHS itself, which would deliver deeper GHG savings earlier in the program. This might be needed if climate progress in other sectors moves more slowly than desired and/or if the Global Warming Solutions Act is revised to require faster or deeper emissions reductions than currently outlined, in line with evolving scientific guidance.

On the other hand, economic conditions might change dramatically enough to cause a real shortage of clean heat opportunities, or supply chain disruptions could interfere with delivery of new equipment.[21] For all of these reasons, we recommend building into the CHS legislation an opportunity for state regulators to revise the obligation level on a forward-going basis. Any adjustments to slow down progress should be subject to strict limits to protect the essential purposes of the CHS.

D. Design for Equity

Recommendations

1. **From the outset, the CHS should be designed to mitigate the disproportionate energy burdens and negative distributional effects of existing fuel costs in Vermont.**
2. **CHS program planners should call attention to essential complementary programs, such as low-income weatherization and fuel assistance programs, to assist in the transition to cleaner heating solutions.**
3. **Details of CHS program design and ongoing program implementation should be guided by the principles of procedural inclusion, learning from lived experience, and equity.**

Discussion

The Global Warming Solutions Act identifies quite clearly the equity imperative that attends the transition to a low-carbon future: the transition must be effective, and it must be a "just transition." It would be difficult to find a sector besides the thermal sector in which these twin imperatives operate more obviously.

As the American Community Survey documents, lower income Vermonters spend a high and disproportionate fraction of their income on household energy, compared with higher income households. This is despite their consuming substantially less energy for home heating and electricity. See chart below.

[21] As we launch a CHS program that could run for 25 years, it's obviously impossible to anticipate events like the housing crisis of 2008, the Covid-19 pandemic or the shortage of computer chips that is slowing down production of automobiles in 2021.

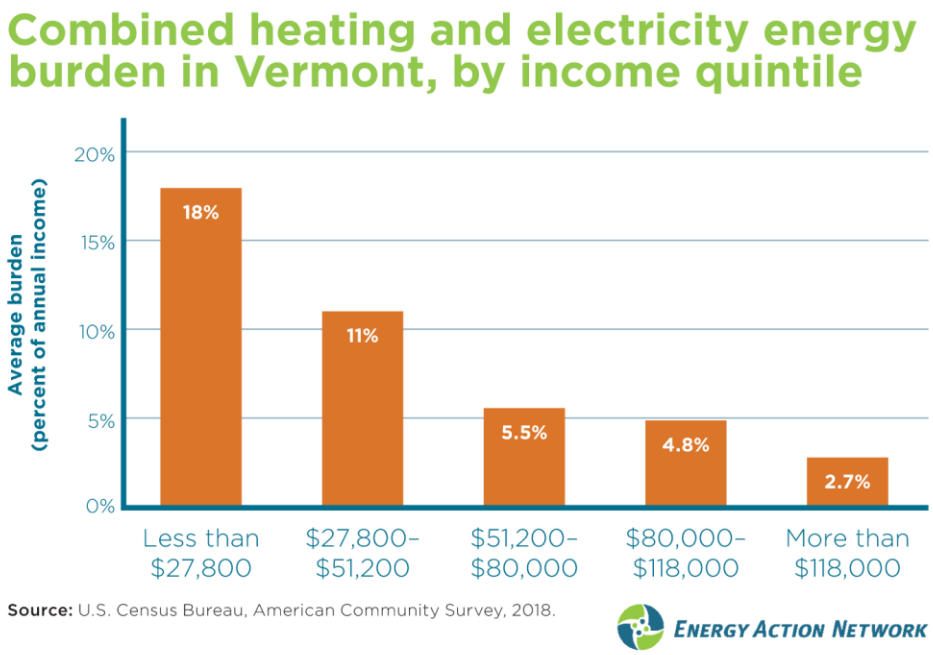


Figure 9. Energy burden by income quintile in Vermont

Meeting Vermont's climate goals requires a comprehensive reduction in emissions from across all segments of the building stock, including (and probably most importantly from) the worst-performing building stock, often the homes of the lowest-income households. Decarbonizing this fraction of the housing stock will make the greatest proportional contribution to reduced energy burdens, improved health outcomes, and transitional equity. Both building shell improvements and heating conversions will be necessary to improve this fraction of the housing stock, and since the private resources of occupants are by definition limited, public policies will be needed to make it happen. Those strategies should be built into the CHS program design from the beginning.[22]

A number of options have been considered by the Working Group to deliver an equitable clean heat transition, but we have not yet settled on precise recommendations. Those design features would greatly benefit from input from a broader public engagement process. Some preferred ideas include:

- **Early action to benefit those most burdened by high energy costs**. From the outset, the CHS program should focus on energy-burdened households by requiring a high fraction of all credits earned to be sourced in those housing units. The program rules could mandate, for example, that at least one-third of heating upgrades must be delivered in the housing units occupied by those in the lowest income quintile, and that at least for the first five years two-

[22] There is, on the surface, tension in program design between dedicating efficiency and heat-switching resources to consumers with the highest energy-burdens, versus maximizing early pollution reductions by focusing on the "quickest reductions from anywhere." We recognize that a just transition requires both "justice" and an effective "transition," so multiple objectives must be served. At this point we judge that the balance should favor early action to improve heating systems for those who bear the greatest energy burdens. Ultimately, clean heat solutions will have to be delivered to most homes and businesses across Vermont, so almost everyone will ultimately be served. We think it is both equitable and ultimately cost-effective, to provide clean heat solutions to the most energy-burdened households disproportionately earlier in the process than would be the case if the distribution of benefits were left to market forces alone.

thirds of the upgrades must be delivered to households in the lower half of the income distribution. Ultimately, of course, households in every income category must be transitioned to low-carbon thermal uses, and this is what the CHS program envisions. But a policy to address the "most burdened, first" would be consistent with the goals of the just transition.

- **Close coordination with weatherization programs.** While thermal efficiency actions are creditable under the CHS, we do not expect the CHS to be able to carry the very large financial weight of thermal modernization of the entire building stock of the state. That will require a suite of financial instruments, mandates, public funding and tax credits, landlord incentives and more. However, with a focus on the most burdened households and most vulnerable communities, it will be important to pair up clean fuels options and weatherization programs to deliver comprehensive low-carbon solutions in the most affected households and neighborhoods.

- **Minimum efficiency standards for multi-family rental properties.** Low-income households are disproportionately renters. Regulations that require multi-family building owners to meet minimum standards for insulation levels, air leakage, heating system efficiency and the efficiency of other appliances is one way to address the challenging "split incentive" barrier to efficiency investments.[23] The City of Burlington, Vermont currently has such a regulation, but the rest of the state does not.

- **Targeted subsidies at point of sale, and early appliance retirements.** Lower income households are those most at risk of running unsafe and inefficient heating and hot water appliances, and they are at high risk of having to replace failed appliances in an emergency situation. Those implementing the CHS program could design an outreach effort specifically designed to reach lower-income/energy-burdened households with deeper incentives and community-based assistance, for the purpose of proactively replacing those inefficient and unsafe units before they fail.

- **Dedicate alternative compliance payments to low-income solutions.** While the overall CHS program should be focused disproportionately on the lowest income households, the default service provider (and recipient of any noncompliance payments) could focus its efforts 100% on the toughest housing stock and the most-burdened households.

- **Equity strategies for pipeline gas.** As a regulated network, VGS has heightened responsibilities and opportunities to serve the needs of low-income households. And as the uses of the VGS network change, and possibly contract, equity concerns will be elevated. VGS should consider ratemaking techniques to avoid a situation in which low-income customers are left paying for a high fraction of the system's fixed costs. Options include accelerated depreciation in the near term, phasing in low-income rates, and targeted assistance (including weatherization and clean heat options) to energy-burdened households. The option to create a district heating

[23] "Split incentives" refers to the fact that building owners who make decisions about capital investments often have little incentive to improve efficiency because they do not pay the higher energy bills resulting from inefficient structures and appliances. Conversely, tenants who pay the energy bills do not have the authority to make major efficiency investments; even if they had the authority, given uncertainty over whether they will even reside in a building long enough for a major efficiency investment to pay for itself, they also have little incentive to make such investments.

system serving especially dense neighborhoods is also a possibility. An equitable transition should be built into the approved regulatory plans for VGS in the coming decade.

- **Other solutions, including leveraging public funds, should also be studied.**

In addition, as a matter of **procedural equity** and openness to new ideas in program design, we conclude that a process of outreach to impacted communities and low-income representatives should be undertaken. Input from housing agencies, weatherization and efficiency practitioners, and finance experts should support this engagement. It is important to open the design process to ideas that can emerge from energy-burdened communities, housing providers, and others with lived experience and professional expertise delivering weatherization and heating solutions.

E. Eligible Measures – What Actions Earn Clean Heat Credits?

Recommendation

1. **Only measures that directly reduce combustion of fossil fuels in Vermont homes and businesses would be eligible for clean heat credits.** Categories of measures that would be eligible include:

    a. Liquid biofuels and renewably-sourced pipeline gas;
    b. Electrification measures, particularly heat pumps for space heating and heat pump water heaters;
    c. Advanced wood heat options, particularly pellet stoves and pellet and wood chip boilers;
    d. Thermal energy efficiency measures;
    e. District heating systems; and
    f. Hydrogen fuel and on-site carbon capture and storage.

    Emissions offsets (e.g., tree planting or reductions in fossil fuel combustion outside of the Vermont thermal sector) would not be eligible. Reductions in fugitive emissions upstream from homes and businesses, from fossil fuel storage systems, the VGS distribution system, and shared propane facilities would not be eligible.

2. **Only biofuels "delivered" to Vermont are eligible**. Biofuels with lower lifecycle GHG emissions than the fossil fuel they are replacing would be eligible measures provided they are delivered and used to fuel heating systems and other appliances in Vermont homes and businesses.[24]

Discussion

Direct Reductions in Fossil Fuel Combustion in Vermont Homes and Businesses. Vermont's GWSA clearly articulates a preference for direct reductions in Vermont's gross emissions. In addition, reducing

[24] VGS and some fuel dealers already offer voluntary renewable fuels options to their customers. Continued sales of this type should be eligible to earn Clean Heat credits. However, to avoid a form of double-counting, the quantity of such sales should be reflected in the baseline numbers used to set the Standard at the outset.

Vermont's reliance on imported fuels and building clean heat jobs in Vermont require us to focus on the direct delivery of clean heat solutions in Vermont homes and businesses. Direct reductions from Vermont homes and businesses are also much easier to document as being real (i.e., actually occurring), legitimate (e.g., relative to an appropriate baseline), and not being double-counted (e.g., relative to emission reduction requirements in other sectors and/or in other jurisdictions).[25] For example, it would be very challenging to verify whether investment in forest preservation, especially in another country, effectively achieved the level of GHG emission reduction assumed. Similarly, it would be challenging to determine whether GHG emission reductions at an industrial facility in another state were both (A) attributable to the actions or payment of an obligated party in Vermont;[26] and (B) not also being counted towards other emission reduction requirements in the host state or even a third state.

"Deliverability" Requirement for Biofuels. The requirement that any biofuels substituted for fossil fuels be "delivered" to Vermont homes and businesses is consistent with the principle of focusing on curbing emissions from Vermont facilities. For biodiesel and/or other biofuels displacing fuel oil, propane, or kerosene, this requirement means that Clean Heat credits can be earned only for biofuel physically delivered to Vermont homes and businesses. Biogas (biomethane) that is trucked to a Vermont home or business would also be an eligible measure. Giving credits simply for the *creation* of biofuels anywhere in the world – or even anywhere in the North America or the U.S. – would overwhelm the Vermont CHS and undermine its fundamental goal to change the nature of heating in our state. Put simply, the CHS should be a Clean Heat program for Vermonters, not an offsets support system.

The concept of deliverability is a little more complicated in the context of the pipeline delivery system for methane gas because it is not possible to trace which molecules of methane are burned in which homes and businesses. Thus, for pipeline biogas, deliverability is satisfied by purchase and sale of what Vermont Gas Systems (VGS) calls a "bundled" product. Specifically, VGS must both purchase the biogas itself (including its GHG emission reduction attributes) and have a contractual pathway for physical delivery of the biogas from the point at which it is injected into a pipeline all the way to the VGS distribution system. This is analogous to how VGS currently acquires both fossil and renewable gas.

This concept is also consistent with the way RECs are credited in Vermont's electric RES, where renewable electric generation in Quebec, New York, and other New England states is eligible to count when the power is delivered to the power grids and markets that directly serve Vermont. Renewable generation cannot earn RES credits in Vermont, on the other hand, when the generator is located on a remote power grid and sold in a remote power market (e.g., in California or Georgia) that do not deliver electricity in our region.

[25] As discussed in the next sub-section on Credit Values for Eligible Measures, some of the concerns about offsets, such as ensuring that reductions actually occurred, ensuring proper baselines from which reductions are measured and ensuring reductions are not credited for multiple purposes (or in multiple jurisdictions), are potentially applicable to biofuels as well – especially if they are produced out-of-state. However, biofuels are different in that they can be measured when directly displacing fossil fuels burned in Vermont homes and businesses.

[26] While it is not necessary to document attribution for direct reductions in Vermont emissions, it makes no sense to allow counting of any emissions offsets without requiring a demonstration of attribution.

F. Credit Values for Eligible Measures

Recommendation

1. **A technical advisory group (TAG) should be charged with developing deemed assumptions regarding the credits that common clean heat measures produce.** That would include the number of credits a measure is worth each year, the life of the measure (i.e., the number of years for which it would earn credits), any degradation in credit values over time, and other relevant assumptions.
2. **Credits for biofuels will be based on the "but for" principle – i.e., what emissions would have occurred absent use of the biofuel to displace a fossil fuel in Vermont.** This will require consideration of deliverability (see above) and all regulations, including GHG regulations, applicable to agriculture, forestry, and other relevant sectors in the jurisdiction in which the biofuel is produced.
3. **Credits will be "time-stamped"**. Measures that produce emissions reductions over multiple years – e.g., heat pumps, other electrification measures, advanced wood heat, and weatherization measures – would earn an appropriate number of credits for the year they are installed as well as each subsequent year during which they would be expected to produce emission reductions. Only the credits with the current year "time-stamp" would apply to the current year obligation; credits with future year time-stamps would apply against credit requirements in those future years.
4. **TAG assumptions will be updated annually**. The update process will include formal approval by the PUC and will be concluded in the Fall of each year so that obligated parties can have sufficient notice of changes in assumptions to adjust their plans for meeting their obligations the following year.
5. **Once approved, TAG assumptions will be "locked" for the year in question, and will not be changed with retroactive effect.** Credits earned by any measure installed during that year – including credits for future years associated with long-lived measures – will not be changed.
6. **Credits for uncommon measures not addressed by the TAG process will be estimated by obligated parties on a custom basis**. Such estimates will be subject to review and regulatory approval.

Discussion[27]

1. Technical Advisory Group (TAG)

A Clean Heat Standard (CHS) Technical Advisory Group (TAG) would be akin to existing Technical Advisory Groups that have been created to (a) develop of energy savings assumptions for Vermont's efficiency utilities and (b) develop assumptions for fossil fuel reduction measures that Vermont's electric utilities employ to meet their RPS Tier 3 requirements. Indeed, the CHS TAG would be able to leverage the substantial work already done in Vermont to characterize efficiency measures and other fossil fuel reduction measures. In fact, it would be important that any underlying assumptions used for efficiency programs, electric RPS Tier 3 initiatives and the Clean Heat Standard be the same.

2. "But for" Principle for Biofuels

[27] Additional discussion on recommendations 1-3 are available in Appendix 2.

As previously discussed, combustion of biofuels typically produces the same amount of CO2 emissions at point of combustion as combustion of the fossil fuels they are displacing. The difference is that the biofuels provide other GHG emission reduction benefits – either eliminating emissions of other GHGs and/or removing CO2 from the atmosphere before they are burned. Thus, CHS credits for biofuels need to be based on their net effect on GHG emissions. To estimate that net effect one must understand what GHG emissions would have occurred absent the substitution of the biofuel for fossil gas, fuel oil, propane or any other fossil fuel. That is the "but for" test.

3. Time-Stamping Credits

Some clean heat measures have a one-year life. For example, a gallon of biodiesel reduces GHG emissions only in the year in which it is burned. Other clean heat measures – such as heat pumps, wood pellet stoves and home weatherization projects – provide GHG emission reductions for 15 years, 20 years or even longer. The CHS needs to assign emission reduction credit values for these long-lived measures.

4. Annual Assumption Updates

In order ensure that the credit system results in actual GHG emission reductions that are consistent with the state's climate policy goals, assumptions regarding the number of CHS credits attributable to different clean heat measures will need to be regularly re-evaluated and, when appropriate given new information, updated. As discussed further in the Verification and Evaluation section in the appendix, an important source of input for updates will be evaluation studies managed by the Department of Public Service.

To provide clarity and reduce uncertainty for obligated parties, that update process should be prescribed and institutionalized rather than occurring on an ad hoc basis. The most logical approach would be to update assumptions annually. Ideally, such updates would be approved through a regulatory process managed by the PUC, with final regulatory decisions available in the Fall of each year. That would give obligated parties sufficient notice of changes in assumptions to adjust their plans for meeting their obligations the following year.

5. Assumptions "Locked" for Lifetime of Approved Measures, Until Next Update

Once an annual update to assumptions has been approved by the PUC, those assumptions should be considered "locked" for any measures installed until the next updates are approved. For example, if in the Fall of 2025 the PUC approves an updated assumption that a 3-ton centrally-ducted heat pump provides 5 clean heat credits for each of the fifteen years of its assumed life, any heat pump installed in 2026 would earn five credits in 2026 and each year thereafter through 2040 (its fifteenth year). Those credits would remain as assigned in 2026, even if a future evaluation suggests that such heat pumps produce more or less GHG emissions reduction than 5 credits per year would imply. In other words, the number of credits a common measure provides is determined by the PUC approved assumptions for the year the measure is installed. New evaluation data used to update measure assumptions would only apply prospectively – i.e., only to measures installed in years after measure assumptions are updated.

This approach provides certainty for obligated parties regarding the number of credits they can earn for different measures – at least within a given year. While the tradeoff for that certainty is potentially understating or overstating the actual amount of GHG emission reductions achieved, such deviations are likely to be small if there is a commitment to on-going evaluation and annual updates to assumptions based on the results of such evaluations. It should be noted that this approach to "locking" assumptions a year in advance for the purpose of determining whether goals or obligations have been met is very common across the United States – including in Vermont – for energy efficiency programs. It is also implicit in the way Vermont's electric utilities' compliance with RPS Tier 3 requirements is determined.

6. Credits for Custom Measures

The process of establishing deemed average assumptions for clean heat measures only works for common measures that are deployed across many different customers and for which the transaction costs of site-specific calculations would not be worth it. It is impossible to identify in advance every type of clean heat measure that may be deployed. Moreover, for larger projects for commercial and industrial customers it may make more sense to develop customized, site-specific estimates of clean heat credits. In such cases, the obligated entities would be responsible for developing custom estimates with regulators responsible for reviewing and adjusting such estimates as appropriate. This is common practice in Vermont today for custom efficiency measures/projects as well as for custom RPS Tier 3 projects (an example of the latter would be the reduction in diesel fuel consumed by a generator at a quarry that results from extension of an electric line to the quarry).

G. Multiple Ways to Acquire Credits

Recommendations

1. **Obligated parties should have flexibility on the types of actions and transactions used to acquire credits.** That flexibility should include the following options:
    a. Generating credits themselves;
    b. Contracting with other parties to produce credits;
    c. Buying credits on the open market; and/or
    d. Assigning their obligation to a "default delivery agent".
2. **Obligated parties should have flexibility to acquire credits from any customer in the state.**

Discussion[28]

Many Ways to Acquire Credits. Flexibility will be essential to minimizing the costs of compliance with the Clean Heat Standard. It may also be essential to enabling the standard to be met, as different obligated parties will have different levels of capacity and interest in the way credits are developed or acquired. The system should be open to at least five options, as seen in Figure 10 below:

1. Obligated parties should have the option to **generate credits directly,** by helping customers to install different emission reduction measures (e.g., heat pumps, wood pellet stoves, and weatherization of buildings) and/or by purchasing and selling biofuels to customers, as this is

[28] Additional discussion on the ways to acquire credits is available in Appendix 2.

the simplest way for them to comply with the Clean Heat Standard. This is analogous to how efficiency and renewable energy credits are acquired in Vermont today.

2. If an obligated party does not want to work with customers directly, it could **hire contractors to install** clean heat measures on their behalf. This is also analogous to how many utility efficiency programs operate in Vermont and across the country.

3. Third, an obligated party could hire a more broad-based **third-party program administrator**, who might earn credits through a range of services, and might deliver them on behalf of multiple obligated parties. This is analogous to the way that Efficiency Vermont works today on behalf of multiple electric utilities.

4. As a fourth option, the obligated party could **buy credits on the open market**, which allows a variety of private sector businesses to use the Clean Heat Standard as a vehicle to advance existing or new business models. For example, a current fuel oil dealer or an HVAC contractor could decide to diversify its business by selling heat pumps or wood pellet stoves, generating credits that could then be sold to any obligated party. When an obliged party buys those credits, it would defray the cost of making heat pump and/or pellet stove sales, ultimately lowering costs to customers and/or increasing the profitability of the business selling the clean heat products.[29]

5. The final option would be assigning emission reduction obligations to a **"default delivery agent"** designated by the PUC. This could be an "option of last resort", providing an "out" for any obligated party that does not want to have to deal with the planning and management of efforts to acquire credits in some other way.

[29] If other states were to create a Clean Heat Standard equivalent to Vermont's, it's possible to envision a multi-state market for Clean Heat credits. Vermont has experience in some of these markets, including the Regional Greenhouse Gas Initiative, the regional market for renewable credits, and credit trading under the Clean Air Act. However, we conclude that it is unnecessary and would be unwise for Vermont to wait for other states to act before launching our own Clean Heat program. Many of the benefits of clean heat, including air quality, health, lower fossil fuel bills, and economic development benefits, are local, and the program is aimed at improving the Vermont building stock. There is no reason to wait for other states to act before delivering these benefits in Vermont.

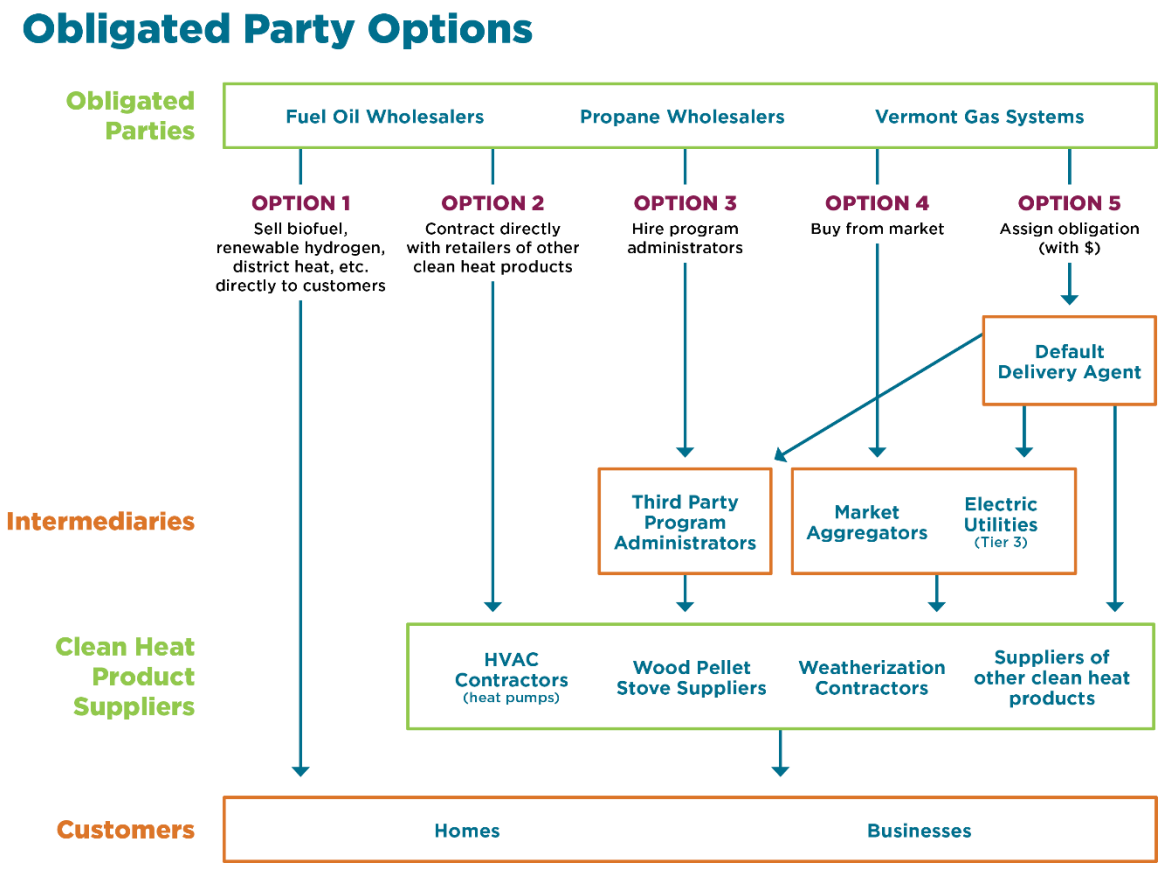


Figure 10. Obligated parties can choose among multiple options to acquire CHS credits

Regardless of which of these options or combinations of options are utilized, a mechanism would be needed to establish "ownership" of credits, both to create a strong credits market and to avoid double-counting (or double-selling of credits). This is not a new or onerous challenge. For example, it currently exists with regard to bidding of efficiency resources into the New England ISO's capacity market, and the attribution of renewable energy credits (RECs) to obligated parties throughout the New England states.

Any Vermont customer can create clean heat credits by reducing their use of fossil heat. Another potentially important aspect of flexibility is the ability of an obligated party to acquire clean heat credits, not just from their own customers, but for measures installed in *any* Vermont home or business. That would include customers who buy fossil fuels from other obligated parties. For example, wholesale fuel oil company A could acquire credits resulting from the installation of a heat pump in a home that buys fuel oil from provider B. Or a fuel oil company could acquire credits resulting from the installation of a pellet stove in a propane or natural gas heated home.

This customer flexibility will serve several purposes. It will broaden the range of options for obligated parties and create greater competition in the market, lowering the cost of compliance with the Clean Heat Standard. It should also it will make it easier for businesses selling clean heat products and

services – e.g., HVAC contractors selling heat pumps, vendors of pellet stoves, and weatherization contractors – to find markets and the best prices for the credits they could generate.

H. Interaction with Electric Utilities' Tier 3 Requirements

Recommendation

Vermont electric utilities' RPS Tier 3 requirements should remain in place, and the CHS and Tier 3 programs should be administered to be mutually supportive.

Discussion

Electric Utility RPS Tier 3 Requirements Would Remain.
Vermont's Electric Utility RPS Tier 3 requirements to reduce customers' consumption of fossil fuels is an innovative, landmark policy. It has clearly launched the state down a path to reducing GHG emissions from the thermal sector (most Tier 3 emission reductions are coming from the thermal sector, primarily from heat pumps displacing fossil fuel heat). Now in its fifth year, implementation of the policy is running smoothly with even faster progress in reducing emissions than initially planned.[30] Based on both results to date and the annual goals set in statute, we estimate that Tier 3 requirements will ultimately require annual thermal sector emission reductions of about 7% by 2030. That represents a significant "down payment" on the 40% reductions by 2030 required by the 2020 Vermont Global Warming Solutions Act. While the state could conceivably meet the thermal sector portion of the GWSA's 2030 emissions reduction goal by increasing the magnitude of the Tier 3 requirements by a factor of five or six, we believe a Clean Heat Standard that imposes an emission reduction obligation on suppliers of fossil fuels makes more sense than an expanded obligation on electric utilities.

On the other end of the spectrum, the *Clean Heat Standard* could be designed to achieve the ***total*** emissions reduction required to meet the thermal and industrial sector contributions to State GHG emission reduction goals, without any contribution from Tier 3 projects. However, we believe that there are significant advantages to keeping the electric RPS Tier 3 requirements in place – in concert with the Clean Heat Standard. The policy appears to be working very well, with the state's electric utilities having developed an effective program infrastructure for delivering and documenting reductions in fossil fuel consumption. It would be better to build on that infrastructure than to tear it down and start the CHS from "ground zero". In addition, requiring both electricity providers and fossil providers to deliver fossil fuel emission reductions adds diversity to the mix of clean heat providers.

The existing Tier 3 program and the new CHS could work together quite well. As shown in Figure XX below, Tier 3 savings could count towards a utility's Tier 3 obligations, and also be credited as a part of the overall CHS reduction requirements. In this case, electric utilities could sell credits earned through thermal projects to fossil fuel providers who need them to meet their CHS obligations. Other arrangements are possible, and are discussed in the Appendix. In general, we find that Vermont's

[30] Green Mountain Power, which accounts for about three-quarters of the state's electricity sales, achieved about twice as much fossil fuel reduction as required by statute in 2020 (Green Mountain Power, *Cutting Carbon: RES Tier III Savings Report, 2020 Plan Year*, March 15, 2021.

existing Tier 3 requirements and a broader Clean Heat Standard could work together quite well, and would lower costs and increase diversity in the delivery of clean heat solutions.[31]

Figure 11: Tier 3 & CHS Interaction

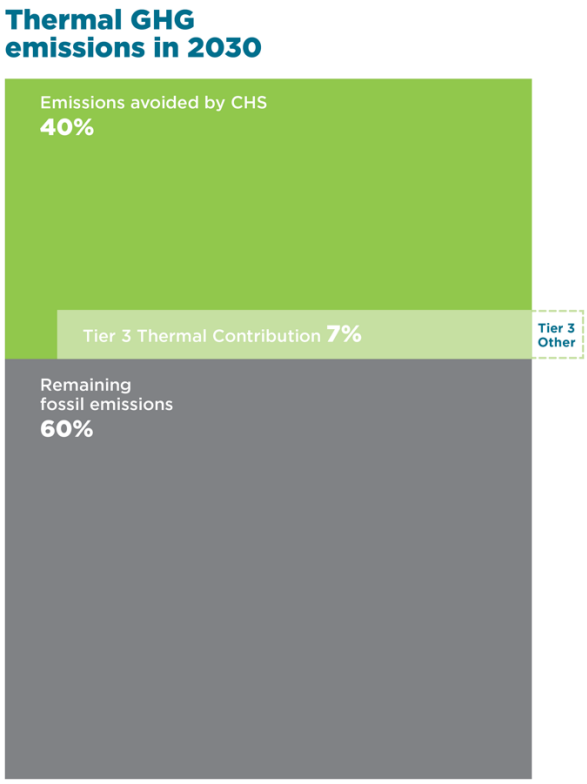


Figure 11. Most utility Tier 3 actions could also contribute to meeting CHS requirements

I. Ensuring Compliance: Default Delivery Agent, Non-Compliance Payments

Recommendations

1. **The PUC should appoint a statewide default delivery agent hired through a competitive solicitation for a multi-year period.**
2. **Obligated parties that fail to acquire the number of credits required in a given year should have to make a non-compliance payment, set to exceed the estimated cost of delivering clean heat credits**
3. **Non-compliance payments should be given to the default delivery agent to acquire emission reductions that make up for the shortfalls that precipitated the payments.** Special

[31] We recommend that the same principle apply to other existing programs that are reducing emissions. For example, efficiency investments made by the state's low income weatherization assistance program, by Efficiency Vermont and by Vermont Gas would all be creditable.

Consideration should be given to disproportionately applying such payments to delivering clean heat solutions to low income customers.

Discussion[32]

Default Delivery Agent. To ensure attainment of clean heat goals, the PUC should appoint a Default Delivery Agent, which would be directed and funded to deliver creditable clean heat solutions to Vermont homes and businesses if either (A) an obligated party chooses to assign its obligation to the default provider; and/or (B) any obligated entities that chose to retain their obligation fail to produce or acquire the number of clean heat credits they were obligated to produce or acquire in any given year. The default delivery agent should be hired through a competitive procurement process run by the PUC (as was done in the past for the Efficiency Vermont contract).

Non-compliance payments. As with any regulation, in order to ensure that emission reductions are actually achieved there would need to be a penalty for obligated parties that fail to meet their obligation. We call that a non-compliance payment. To provide a sufficient inducement for obligated parties to meet their emission reduction obligations on time, the magnitude of the non-compliance payment should be significantly greater than the cost of acquiring clean heat credits would have been.

Non-compliance payments should be provided to default delivery agent and used to acquire additional emission reduction credits within two years of when the payments are received. The generation of such additional credits will offset the previous year's credit shortfall which precipitated the non-compliance payment.

Consideration should be given to requiring additional credits acquired with non-compliance payments solely or disproportionately from low income customers. This is one potential mechanism for addressing equity concerns.

J. Fuel Dealer and Workforce Assistance

Recommendations

1. **The CHS should be designed and implemented to provide new business development opportunities, particularly for current Vermont fuel dealers**. That includes supporting Vermont fuel dealers who want to expand their businesses to install clean heat measures.
2. **The CHS should be designed and implemented to provide** transition assistance, where needed, to employees of fossil energy companies, and to provide job training, job enhancement, and high-quality certification opportunities to workers in clean energy enterprises.

Discussion

Business development opportunities. As noted above, one of the reasons to choose the Clean Heat Standard (and a Clean Heat credit system) as a principal climate policy in the thermal

[32] Additional discussion of default delivery agent and non-compliance payments can be found in Appendix 2.

sector is that it provides a very direct opportunity for Vermont's existing fuel dealers to transform their businesses from ones that focus largely on fossil fuel sales to ones with a forward focus on installing and servicing clean heating technologies. Such businesses and their trained employees will potentially be needed to deliver and service over 250,000 clean heating installations in Vermont.

A substantial portion of fuel dealers' business transition costs and employee training costs will likely be recoverable through the new services they will provide, and through payments from obligated wholesalers for the Clean Heat Credits that Vermont heating providers will earn. But additional public funding should also be provided for both purposes.

Training the Clean Energy Workforce. Vermont's clean energy transition – which will include building retrofits, distributed renewable energy, implementing the Clean Heat Standard, and more -- will create a large number of job opportunities. One goal of the Clean Heat Standard is to add jobs in Vermont in place of the funds we export to purchase fossil fuels. One advantage of the CHS, compared to government-budgeted programs, is that the CHS can deliver a steadily increasing demand for clean energy services, which allows employers and employees alike to expect the new jobs to be career jobs, not short-term project jobs. But the transition will not be done well unless the work force is well trained and properly qualified. We propose a concerted effort across agencies and training programs to launch such programs and recruit the clean energy workforce.

We can envision a number of sources of funding for these purposes, but our Working Group is not the best forum for figuring this out. The legislature has commissioned work on this topic, and others are working on this challenge. We recognize that delivering on the promise of the Clean Heat Standard will support a significant number of clean energy jobs and will require a package of financial supports and training programs.

K. Summary of Design Recommendations

The following table summarizes the key CHS design parameters discussed above and/or in more detail in Appendix B.

Design Element	Proposal Summary
Obligated Party	• VGS and wholesale distributors of fuel oil, propane, kerosene, and other fossil fuels delivered to buildings and/or industry in Vermont
Nature of Obligation	• "Credit system" in which obligated entities are required to have produced or acquired a certain number of CHS credits each year. • Credits to be expressed in CO2e. • Credits based on magnitude of emission reductions at Vermont homes and businesses. They will not account for related upstream emissions associated with the production or delivery of fossil fuels to those sites. • Attribution is not required. Obligated parties must simply demonstrate that an emission reduction has been achieved and that it owns the rights to that reduction. It does not need to demonstrate that it caused the reduction to occur. This is analogous to the electric RPS (attribution for causing a PV panel to be installed is not required).

Size of Annual Obligation	• PUC to establish growing annual obligations of sufficient magnitude to achieve the thermal and industrial sectors' portion of Vermont's GHG emission reduction goals (i.e., 15% reductions by 2025 and 40% reductions by 2030 – relative to 2018 levels) • PUC to periodically adjust future obligation levels as necessary to ensure achievement with state emission reduction goals and/or to address unanticipated market challenges.
Eligible Measures	• Only measures that directly reduce combustion of fossil fuels in Vermont homes and businesses are eligible for CHS credits. This includes: o Electrification (e.g., heat pumps, heat pump water heaters) o Advanced wood heat (e.g., wood pellet stoves) o Biofuels (e.g., renewable gas, biodiesel) o District heating with low-carbon fuels o Energy efficiency o Hydrogen (if production process is less CO2e-intensive than displaced fossil fuels) • No credits provided for "offsets" (e.g., tree planting) or for reductions in VGS distribution system losses. • For biofuels to count, they must be "delivered" to Vermont homes and/or businesses. For fuels displacing fuel oil and propane, this means delivery directly to a Vermont customer. For biogas, it means a "bundled" product where Vermont Gas both owns the biogas and its attributes, and has secured a contractual pathway for physical delivery to the VGS system. This is analogous to the Vermont electric RPS.
Credit Values for Eligible Measures	• Deemed annual values and number of years earned to be established by formal Technical Advisory Group, analogous to current TAG for Efficiency Vermont and current electric utility Tier 3. • Magnitude of credits for biofuels based on "but for" principle – what emissions would have occurred absent use of biofuel to displace fossil fuel combustion. That would require consideration of regulations (including regulations of GHG emissions) applicable to agricultural, forestry and other relevant sectors. • Credits to be "time stamped" – i.e., assigned to specific years. o For renewable fuels, they are assigned to the year they are sold/consumed by end use customers. o For fuel-switch measures, credits assigned to each year of expected measure life (as determined by TAG) • TAG assumptions to be annually updated, with such updates formally approved – or approved with modifications – by the PUC. • Once approved, TAG assumptions will be "locked" for the duration of the following year. Any credits earned that year will not be changed based on new information that may surface in the future. • Values for custom projects not addressed by TAG process to be estimated by obligated entities on a custom basis.
Banking of Credits	• Obligated parties that acquire more credits than they need to meet their obligation in a given year may bank credits and apply them to future year obligations.
Options for Acquiring Credits	• Obligated parties have flexibility on a range of transactions for acquiring credits: o Generating credits themselves (selling renewable fuel, installing heat pumps, etc.); o Contracting with other parties to produce credits; o Buying credits on the open market; or o Assign their obligation to a "default delivery agent" along with payments – set by the PUC – necessary for the "default delivery agent" to acquire the credits necessary to meet the obligation. • Obligated parties have flexibility to acquire credits from any customer in the state – not just those customers to whom they currently sell fuel.

Default CHS Delivery Agent	• There should be a single statewide default delivery agent hired for a multi-year period. • The default delivery agent should be hired through a competitive solicitation run by the PUC.
Non-Compliance Payment (NCP)	• Obligated parties who fall short of credit requirements in any year must pay an NCP. • Magnitude of NCP to be established by PUC, at should be substantially higher than the cost of assigning an obligation to the default delivery agent. • NCP is given to Default Delivery Agent to acquire credits to make up for the shortfalls that precipitated the NCP. Consideration should be given to disproportionately applying such payments to the acquisition of credits from low income customers.
Interaction with Electric Tier 3 requirements	• Electric Tier 3 requirements would remain in place. • Emission reductions achieved by electric Tier 3 efforts could also count towards CHS goals – and vice versa. • Electric utilities would be able to sell such credits to CHS obligated parties – and vice versa.
Verification & Evaluation	• Verification of compliance would be performed annually by the Department of Public Service (DPS). • The PUC should annually certify compliance or non-compliance, leveraging the DPS review but also considering other evidence and perspectives put forward by other parties. • The DPS should also sponsor evaluation studies of actual field performance of CHS measures to support regular updating of assumptions through TAG process. • A small surcharge applied to all gas and delivered fuels should be established to pay for DPS verification/evaluation costs.
Fuel Dealer Transitiont Assistance	• Training and other business development support to be offered for fuel dealers interested in broadening businesses – e.g., selling & servicing heat pumps, selling wood/pellet stoves/boilers, weatherization, etc.

Social Equity	• Need to include policies to minimize adverse effects on low income customers and potentially other customer segments for which there may be equity concerns.
	• Option within CHS design:
	  ○ Fuel-switching "carve outs" – e.g., must support at least one low income heat pump, pellet stove for every 2 non-low income installations/jobs. Maybe even a higher ratio in the early years – to serve low income customers disproportionately early.
	  ○ Substantial low income weatherization requirements (or carve out), especially in early years
	• Other complementary state policies
	  ○ VGS rate designs for low income customers
	  ○ Enhanced/increased state low income fuel cost assistance
	  ○ Statewide minimum efficiency requirements for rental properties
	  ○ Fee-bate for heating equipment (lowering incremental cost of low GHG options)
	  ○ Broadening the range of measures the state low income Wx program promotes (not just Wx, but also renewables, heat pumps, etc.)