

REGULATORY ASSISTANCE PROJECT

A Clean Heat Standard for Massachusetts

Prepared for the Massachusetts Executive Office of Energy
and Environmental Affairs

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Authors and Acknowledgments

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The Clean Heat Standard concept and some information in this paper are repurposed, with gratitude and permission, from a 2021 white paper published by Energy Action Network and written by Richard Cowart of RAP and Chris Neme of the Energy Futures Group. That publication, titled *The Clean Heat Standard*, is available here: <https://www.eanvt.org/chs-whitepaper/>

That said, responsibility for the information and views set out in this RAP paper lies with the authors.

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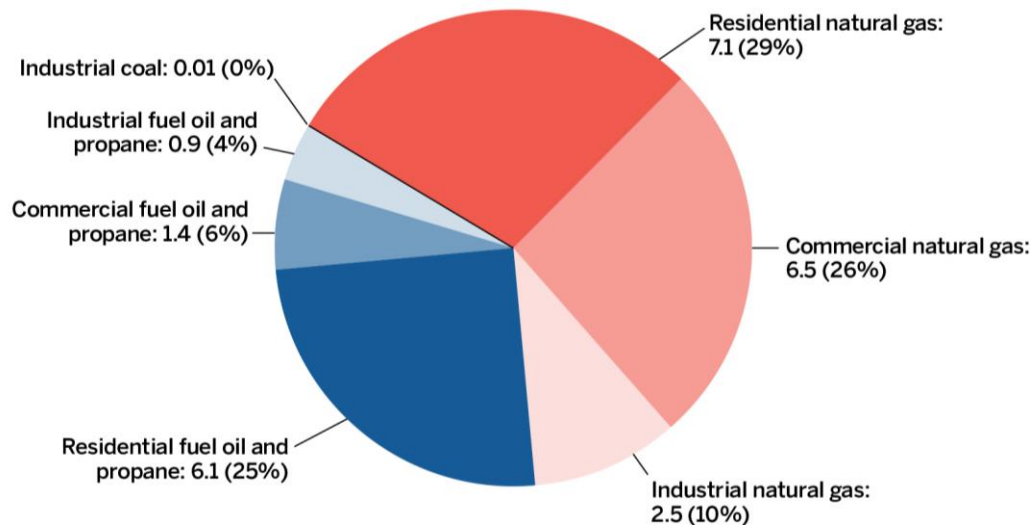
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Introduction

This paper addresses the problem that RAP calls fossil heat. Fossil heating fuels include natural gas, fuel oil, liquid propane and smaller amounts of kerosene and coal. Although 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, municipal and commercial operations and important industrial processes. In recent years, families and businesses in Massachusetts spent nearly \$6 billion annually¹ to purchase fossil heating fuels across these end uses, even before recent price spikes. These costs are a burden across the Commonwealth, particularly for low-income households, struggling small businesses and disadvantaged communities, and importing those fuels imposes a drain on the broader economy.

Furthermore, fossil heat accounted for 34% of Massachusetts' climate pollution in 2018² and was the second largest source of greenhouse gas (GHG) emissions, after transportation. Figure 1 provides a breakdown of greenhouse gas emissions from fossil fuels in Massachusetts' thermal sector in 2018.³ Natural gas combustion emissions made up nearly two-thirds of those emissions, and residential oil and propane combustion emissions were approximately one-quarter. Oil and propane combustion in the commercial and industrial sectors made up the vast majority of the remaining 10%, with small amounts of industrial coal combustion.

Figure 1. Massachusetts 2018 thermal fossil fuel greenhouse gas emissions (million metric tons CO₂)



Data source: Massachusetts Department of Environmental Protection. (n.d.). *MassDEP Emissions Inventories*. Appendix C

¹ In 2019, the residential, commercial and industrial sectors in Massachusetts spent nearly \$5.96 billion on thermal fossil fuels. Specifically, \$1.69 billion on fuel oil, \$417 million on propane and nearly \$3.85 billion on natural gas. Averaged over the past decade, fossil thermal spending has been \$5.76 billion per year. Data are from the U.S. Energy Information Agency State Energy Data System, as compiled by the Massachusetts Executive Office of Energy and Environmental Affairs.

² Percentage calculated using gross greenhouse gas emissions including agriculture, land use, industrial processes and waste. Massachusetts Department of Environmental Protection. (n.d.). *MassDEP emissions inventories*. Appendix C. <https://www.mass.gov/lists/massdep-emissions-inventories#greenhouse-gas-baseline,-inventory-&-projection->

³ Massachusetts Department of Environmental Protection, n.d.

State law requires the Commonwealth to reduce greenhouse gas emissions, including those from space heating and other thermal uses. In addition, cleaner heating systems can reduce local air pollution and improve indoor air quality. Of course, in our New England climate, heat will always be an essential service — for health, comfort and a viable economy. Similarly, thermal processes are essential to many commercial and industrial operations. As a result, we must find effective, affordable and equitable pathways to rapidly revamp the thermal sector in Massachusetts. In this paper, the authors describe the concept of a new requirement on heating energy providers, which RAP calls a **Clean Heat Standard**. There are several major design choices necessary to implement this concept, and numerous additional details that can affect the operation of the program.

At the highest level, a Clean Heat Standard is a credit-based performance standard that would be applied to suppliers of heating energy in Massachusetts, notably gas utilities and providers of heating oil and propane, and possibly electricity suppliers. These parties would be obligated to serve their customers with gradually increasing percentages of low- or zero-emissions heat, so that sales of fossil fuels are phased down over time. Just as a renewable portfolio standard (RPS) requires electricity providers to replace coal- and gas-fired generation with wind, solar and other clean electricity generation, the Clean Heat Standard would replace fuel oil, propane and fossil gas heat with weatherization improvements, energy efficiency improvements, heat pumps, clean district energy and other verified low-carbon options, potentially including renewable methane, clean hydrogen, biodiesel, renewable diesel and advanced wood heat.

As a performance standard, the Clean Heat Standard requires measured additions to the clean heat side of the ledger, replacing fossil heat with clean heat and drawing down emissions from actions by customers as well as heat providers. For some end uses, especially in the industrial sector, it will be more difficult to substitute low-emitting heat sources. However, because the design of the standard includes credit trading and other compliance flexibility measures, greenhouse gas reductions from various heat end uses can help with compliance. Importantly, a Clean Heat Standard can work alongside many other policies to reduce thermal emissions.

The Challenge and Opportunity of Decarbonizing Heat

In 2008, the Massachusetts General Court passed the Global Warming Solutions Act (GWSA), which included an overarching framework for reducing greenhouse gas emissions in the Commonwealth substantially over time.⁴ In 2021, the General Court passed An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, which Governor Charlie Baker signed on March 26, 2021.⁵ The Climate Roadmap law

⁴ Chapter 298 of the Session Laws of 2008.

⁵ Chapter 8 of the Session Laws of 2021.

enhanced and updated the requirements of the GWSA. Those updated statutory requirements include:

- Economywide greenhouse gas emissions must be reduced, relative to 1990 levels, by at least 50% by 2030 and at least 75% by 2040.
- In 2050, statewide GHG emissions must be net zero, and gross GHG emissions levels must be at least 85% below 1990 levels.
- GHG emissions limits must also be set for 2025, 2035 and 2045.

Of particular relevance to this paper, the secretary of the Executive Office of Energy and Environmental Affairs (EEA) is now required to set sublimits for specific sectors, including commercial and industrial heating and cooling, residential heating and cooling, industrial processes, and natural gas distribution and service. These named sectors include, but are not strictly limited to, the thermal sector. The greenhouse gas emissions for all these sectors must be quite substantially reduced on an ambitious schedule to stay within the overall GHG emissions reduction mandates. The 2021 Climate Roadmap law also added a requirement to “set numerical benchmarks and track adoption within the commonwealth of ... solar thermal technologies, [and] air-source and ground-source heat pumps” in addition to other nonthermal technologies.⁶ In addition, the 2021 Climate Roadmap law added a new requirement that the relevant greenhouse gas regulations “shall achieve required emissions reduction equitably and in a manner that protects low- and moderate-income persons and environmental justice populations.”⁷

At present, EEA modeling suggests that the emissions reduction percentages for heating and cooling buildings may be set just below the overall 2030 greenhouse gas emissions reduction requirement of 50% relative to 1990 levels, while emissions from industrial processes (which are only partly due to thermal applications) may rise. The relevant sectors ultimately covered, in whole or in part, by the Clean Heat Standard will likely be required to reduce their GHG emissions by around 49% from 1990 levels by 2030, which is approximately 40% below 2020 levels. Table 1 on the next page shows historic Massachusetts GHG emissions by sector with the corresponding limits for 2025 and 2030 set by the EEA.⁸

⁶ M.G.L. C. 21N, §5(xi).

⁷ M.G.L. C. 21N, §6

⁸ Massachusetts Executive Office of Energy and Environmental Affairs.

Table 1. Economywide greenhouse gas emissions limits and sector sublimits for 2025 and 2030

Sublimits	Gross emissions (million metric tons of CO ₂ equivalent)			Reduction (increase) from 1990	
	1990	2025	2030	2025	2030
Residential heating and cooling	15.3	10.8	7.8	29%	49%
Commercial and industrial heating and cooling	14.2	9.3	7.2	35%	49%
Transportation	30.2	24.9	19.8	18%	34%
Electric power	28.0	13.2	8.4	53%	70%
Natural gas distribution and service	2.3	0.4	0.4	82%	82%
Industrial processes	0.7	3.6	2.5	(449%)	(281%)
All others	3.4	1.0	0.9	70%	73%
Total	94.0	63.2	47.0	33%	50%

Source: Massachusetts Executive Office of Energy and Environmental Affairs

Reducing emissions from thermal sectors presents some challenges. However, it also presents new opportunities because clean heating options give the Commonwealth the chance to:

- Improve public health with cleaner air indoors and outdoors.
- Stimulate the economy with reduced expenditures on fossil fuels imported from other regions and overseas.
- Create new local industries and jobs.
- Make homes and businesses more comfortable year-round.

In September 2021, Governor Baker issued Executive Order #596, establishing the Commission on Clean Heat to advise on a framework for achieving long-term greenhouse gas emissions reductions from the heating sector. The commission has developed principles that are useful in thinking about the relevant challenges and opportunities and in developing programs and regulations in this area, including the Clean Heat Standard. Those principles are:⁹

- **Impact:** The regulatory approach and incentives are bold and strong enough to transform the market, the workforce and consumer demand, achieving required emissions reductions without negative economic consequences overall.
- **Simplicity:** The regulatory approach is simple, easy to use and transparent and has clear and broadly understood compliance requirements that are uniform across the state, minimizing the burden on regulated entities.

⁹ Massachusetts Commission on Clean Heat, in personal communication to the Regulatory Assistance Project, April 19, 2022.

- **Neutral accounting:** The regulatory approach scores emissions reductions in a fair and neutral manner, allowing the market to drive innovation and the most efficient and effective technologies to prevail.
- **Equity:** The regulatory approach is designed to avoid burdening low- and moderate-income residents and environmental justice communities, and it provides opportunities for them to lead.
- **Resourcing:** The regulatory approach is appropriately resourced to ensure it can be implemented effectively.
- **Revenue:** Revenue generated by the regulatory approach is directed in a fair and trusted manner to support compliance, promote equity and advance decarbonization efforts.
- **Timing:** The regulatory approach is implemented quickly, with compliance requirements coming online in a time frame that is realistic but sufficient to achieve emissions reduction mandates.
- **Public education:** The regulatory approach incorporates strong public and workforce education and transparency to obtain buy-in at scale and minimize the chances of backlash.

Technology Options for Clean Heat

As a priority, Massachusetts will need to deepen investments in weatherization and demand-side efficiency to reduce thermal needs regardless of the underlying heating technologies involved. Efficiency options include improved insulation, improved windows, air sealing and automated temperature controls. Demand-side management measures (such as controlling water heaters and air conditioning during peak demand) will be increasingly important as electrification of end uses expands in the Commonwealth, to better match thermal electric demands with the capacity and energy available from renewable electricity sources.

Typical fossil-fueled heating technologies have several elements in common. For space heating, the combustion process, regardless of whether the underlying fuel is natural gas, heating oil or propane, is utilized to heat air or water, and then that hot air or water is circulated throughout the building to heat individual rooms. If a fossil-fueled space heating unit circulates air, it is typically referred to as a furnace. If a space heating unit heats water, it is referred to as a boiler. For water heating, in many cases, the hot water is stored in an insulated tank, but tankless water heaters are increasingly common. For all these fossil-fueled heating technologies, more efficient versions have been developed over time, and these often require more complex controls and venting arrangements. Nearly every modern fossil-fueled heating unit requires electricity for some part of its operation, including ignition, control technologies, pumps to circulate water and fans to circulate air. As a result, losing electric service for any significant period will prevent the operation of the fossil-fueled heating system in most houses.

There are now a substantial number of heating technologies that are cleaner than fossil fuel technologies, with lower greenhouse gas emissions¹⁰ and no on-site combustion that affects indoor air quality or local air pollution. Chief among those are electric heating technologies, including:

- Electric resistance — Running an electric current through metal can be used to heat air or water. This is a relatively inefficient technology for space heating but is a common water heating technology.
- Air-source heat pumps — Typically using an outdoor compressor and an indoor unit, an air-source heat pump uses the inherent energy in the outdoor air with a refrigerant to either heat or cool the indoor air. Ductless indoor units directly heat or cool the room where they are located, but indoor units can also be connected to air ducts to transport the conditioned air, like a traditional furnace. Both ductless and central air-source heat pumps also provide cooling in summer.
- Heat pump water heaters — This technology is similar to an air-source heat pump with a simpler, single-unit arrangement, but it directly heats water instead of air. There is no outdoor condenser, as these units take heat from the air in the space where they are located, often a basement or cool storage space.¹¹
- Geothermal heat pumps — Also known as ground-source heat pumps, these use the consistent temperature of the earth (instead of ambient air) to provide very efficient heat or cooling to a building through a heat exchanger using loops of refrigerant-filled pipe buried in the ground.
- Geothermal district energy, using heat pumps within buildings — This uses a system of ground-source heat pumps to serve multiple homes or businesses at a time.

Other clean thermal supply alternatives:

- Solar thermal — Flat plates or evacuated tube collectors can be used to heat water, which can either be used for space heating or water heating.
- Clean district energy using zero-GHG inputs — This includes combined heat and power facilities that use renewable electricity sources to create steam, which can be distributed to heat one or more buildings.

There are a range of other heating fuels (solids, liquid and gases) that are not derived from fossil fuels and may have the potential to provide clean heat in the Commonwealth of Massachusetts. Importantly, there are many variations in how these fuels are created, collected or combusted, which leads to different kinds of upstream and downstream environmental impacts.

¹⁰ In a region dominated by high-emitting electric generation resources, such as coal, less efficient electric heating technologies (e.g., electric resistance space heating) can still be responsible for substantial greenhouse gas emissions. However, GHG emissions from the New England electricity grid have decreased significantly over the past two decades and are projected to continue decreasing in the coming decades.

¹¹ Although air-source heat pumps for domestic hot water are common, they are not often used in the United States for hydronic space heating systems (those relying on circulating fluids via radiators or baseboard pipes), which require higher-temperature fluids. This could change as heat pump technologies improve.

The primary alternatives for clean solid fuels are various forms of advanced wood heating, typically using wood pellets. Some sources of woody biomass could be considered to be zero- or low-GHG emitting when evaluated on a life cycle basis — for example, if pellets are made from sawmill residue or other waste products. Newer combustion technologies for wood fuels are much cleaner and more efficient than those of the past.

In addition, at least two different kinds of liquid fuels can substitute for fossil heating oil¹² as a blend or sometimes as a full replacement:

- Biodiesel — This can be derived from vegetable oils, soybeans or other food byproducts. Biodiesel can be used as a blend, but pure biodiesel is hard to store and may require modifications to typical heating equipment.
- Renewable diesel — Renewable diesel can be derived from the same feedstocks as biodiesel but is further refined into the same chemical form as fossil diesel fuel. As a result, renewable diesel can be used as a blend or a replacement for fossil heating oil.

Potentially cleaner forms of gaseous fuels are:

- Biomethane or renewable natural gas — There are several different collection sources for forms of methane that could be considered renewable. Potentially valuable sources include those that recapture methane that would otherwise be vented into the atmosphere. Those include collection at landfills, livestock operations, wastewater treatment plants and coal-mine mouths and anaerobic digestion, but not synthetic methane created from other fossil fuels. Most forms of biomethane contain contaminants that have health impacts and that interfere with combustion control technologies for reducing other pollutants, such as nitrogen oxides (NOx).
- Clean hydrogen — Today, nearly all hydrogen is created using steam-methane reforming, which typically has significant greenhouse gas emissions from the energy needed and the chemical process itself. This is known as gray hydrogen. However, green hydrogen, created from the electrolysis of a water molecule using zero-GHG electricity, has no GHG emissions associated directly with its production. Several other hydrogen creation methods are being explored across the globe, and each has its unique features. Although many analysts support the use of green hydrogen on a limited basis as a replacement for gray hydrogen and in high-temperature applications that are not easily electrified, a much wider use of hydrogen as a replacement for pipeline gas raises a number of issues. Hydrogen poses challenges for existing gas pipeline infrastructure because of its chemical and physical properties, and substantial investments to carry significant percentages of hydrogen would be needed. Combustion of hydrogen can also have significant nitrogen oxide emissions.

The Commonwealth of Massachusetts has some experience in making judgments about which of these fuels, and which specific versions of each, should be considered clean under the Alternative Energy Portfolio Standard run by the Department of Energy Resources. Under that program,¹³ biomass, biogas and liquid biofuels are eligible only if they meet

¹² Fossil heating oil is also known as distillate fuel oil and is chemically identical to stationary and mobile diesel fuel.

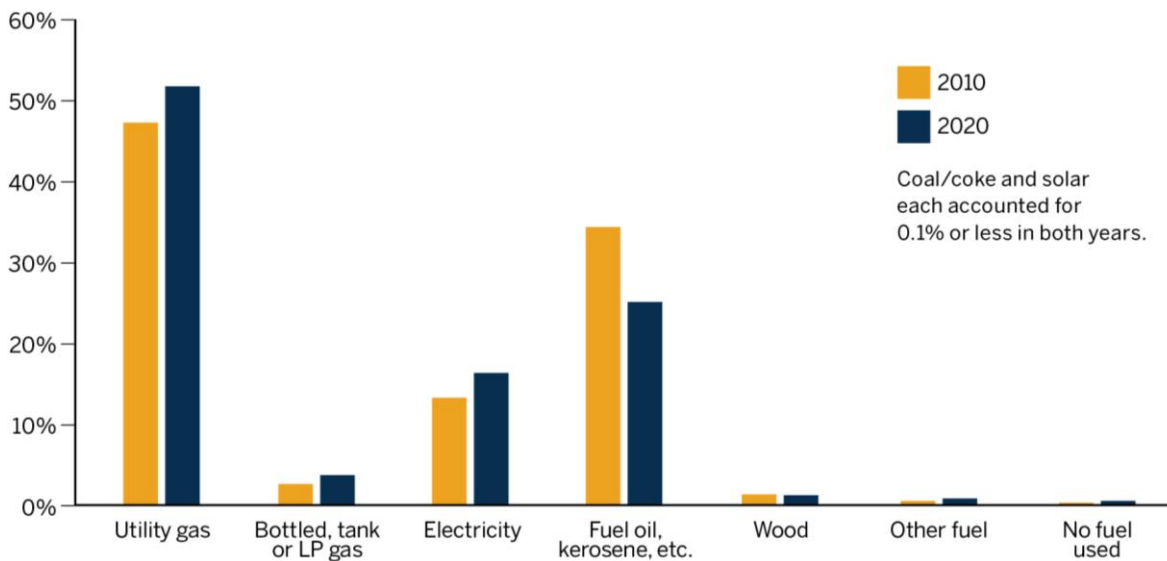
¹³ M.G.L. C. 25A, §11F1/2(b).

strict standards for conventional air pollutants and the use of low-greenhouse gas feedstocks such as wastes and residues. Furthermore, any forest-derived biomass must meet sustainable forestry practices. Similar judgments regarding whether these alternative gases, liquid fuels and solid fuels are worthy of public policy support can be made in a Clean Heat Standard, as discussed further below in the section titled “The Architecture of a Clean Heat Standard.”

The Current Thermal Sector in Massachusetts

There are approximately 2.7 million housing units in Massachusetts. As shown in Figure 2, roughly 85% of those homes were heated primarily by fossil fuels in 2010.¹⁴ That fell to approximately 81% in 2020, but this still represents a large majority of the residential building stock. In this time, there was a significant decline in the number of homes heated primarily by fuel oil, from 35% to 25%, but that came with a 4-percentage-point increase in the number of homes heated by gas from utilities and a smaller increase in propane usage. Over this period, there was a 3-percentage-point increase in the proportion of homes that reported electricity as their primary heating fuel and a small uptick in the number of homes heated by solar energy. The “wood” category held roughly steady. This shows that fuel switching has been occurring in Massachusetts homes, and that nearly one-fifth of Massachusetts homes are already heated without on-site combustion of fossil fuels, primarily by electricity.

Figure 2. Residential housing units by primary heating types

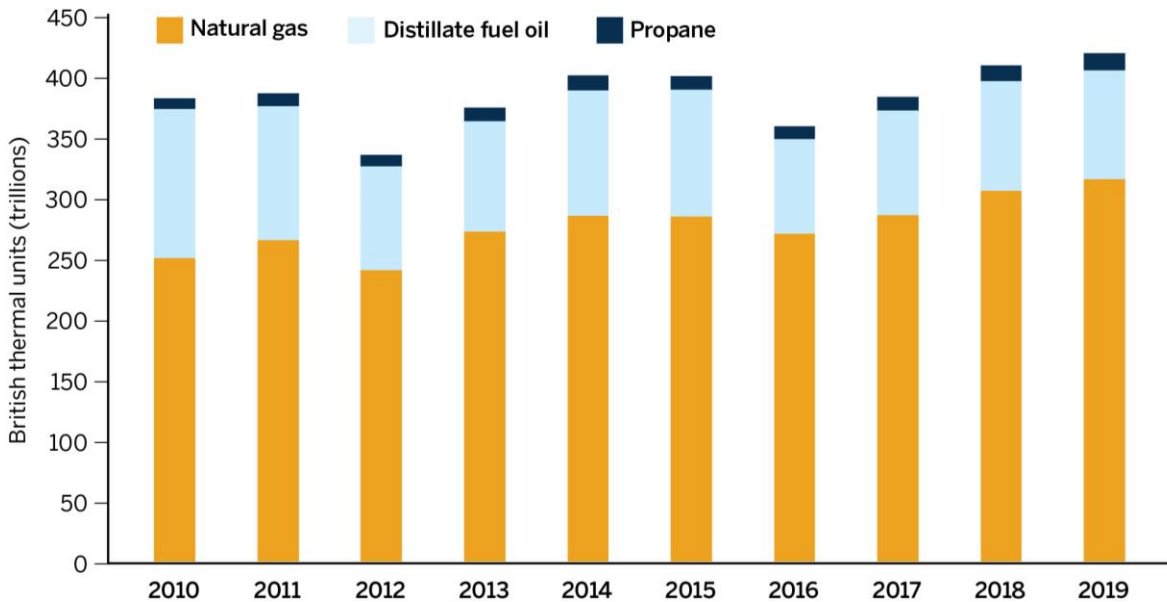


Data source: U.S. Census Bureau. (n.d.). *American Community Survey*

¹⁴ U.S. Census Bureau. (n.d.). *American Community Survey*. Selected housing characteristics for 2010 and 2020. <https://data.census.gov/cedsci/table?q=DP04&q=0400000US25&tid=ACSDP5Y2010.DP04>

Figure 3 shows thermal fossil fuel consumption by fuel from 2010 to 2019 for the residential, commercial and industrial sectors.¹⁵

Figure 3. Thermal fossil fuel consumption in Massachusetts for the residential, commercial and industrial sectors



Data source: U.S. Energy Information Agency State Energy Data System

While overall fossil fuel consumption in these sectors increased modestly from 2010 to 2019, natural gas combustion increased 25%, propane usage increased 54% and fuel oil usage declined 27%. Another consideration is that consumption can vary quite a bit from year to year. Weather is a significant variable (cold winters require more energy for space heating), but there are other reasons for annual variations as well.

Pathways for the Necessary Transformation

In an analysis by Evolved Energy Research for the 2025/2030 Clean Energy and Climate Plan (CECP), there are five different compliance scenarios in addition to the baseline. The 2025/2030 CECP has designated the “phased” scenario as the primary compliance scenario, although it is appropriate to recognize the uncertainties across many dimensions. As an indicative matter, the “phased” scenario contains the following projected changes to residential heating systems from 2020 to 2030 to achieve the required reductions:

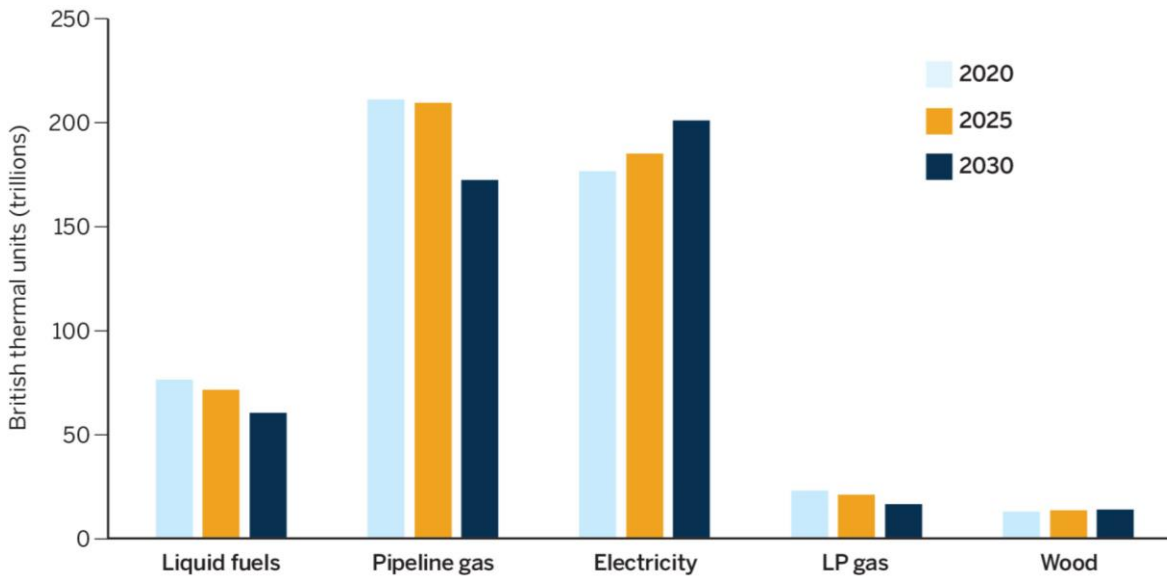
- Nearly 130,000 new whole-home air-source and ground-source heat pump systems.
- Over 380,000 air-source heat pumps added to fossil-fueled furnace systems in a partial building electrification setup.

¹⁵ Data compiled by the Massachusetts Executive Office of Energy and Environmental Affairs from the U.S. Energy Information Agency State Energy Data System. <https://www.eia.gov/state/seds/seds-data-complete.php>

- Approximately 660,000 fossil-fueled water heaters replaced with electric water heaters, either traditional resistance technology or heat pump water heaters.
- Approximately 230,000 buildings fully weatherized.

These changes in heating systems and the building stock, along with corresponding changes in the commercial and industrial sectors, would lead to significant changes in the combustion of thermal fuels by 2030, as shown in Figure 4.¹⁶

Figure 4. Final energy demand by fuel for the residential, commercial and industrial sectors in phased policy scenario



Data source: Massachusetts Executive Office of Energy and Environmental Affairs modeling

From 2020 to 2030, the phased policy scenario sees an 18.5% decrease in pipeline gas consumption, a 21.2% decrease in liquid fuels and a 28.9% decrease in liquid propane gas for these three sectors. Additional greenhouse gas emissions are achieved by replacing 5% of pipeline natural gas with renewable natural gas and 20% of liquid fuels with biofuels by 2030. Achieving these changes requires substantial deployment of clean heating technologies over the next eight years. It will require coordination with and action by many individual building owners and residents to help them make this a reality.

Furthermore, Massachusetts will need to build local industries and train employees. Massachusetts needs locally focused businesses with customer relationships and, literally, boots on the ground to deliver new technologies and help customers understand their functions and limitations and methods to optimize their use. The Commonwealth's economy contains an array of pipeline gas companies, weatherization providers, electric utilities, fuel suppliers, renewable energy companies and heating contractors who could, if refocused and provided incentives, do much of the needed work.

¹⁶ Modeling by the Massachusetts Executive Office of Energy and Environmental Affairs.

The Commission on Clean Heat has identified that Massachusetts needs a set of policy options, including the possibility of a Clean Heat Standard, that will support customers and suppliers and will ensure delivery of heating solutions at the scale needed to meet the Commonwealth's ambitious climate, equity and economic goals. The remainder of this paper focuses on the principal design options for a Clean Heat Standard to deliver essential emissions reductions from the thermal sector in Massachusetts. But a Clean Heat Standard is by no means the only policy option available to reduce thermal greenhouse gas emissions. In this rapidly advancing field, a clean energy performance standard on heat providers is a relatively new idea. Massachusetts will need to consider the associated opportunities, challenges and alternatives before moving forward.

Other policies can contribute significantly to thermal decarbonization, including cap-and-invest programs, fuel blending requirements, thermal energy efficiency that could include efforts in gas efficiency, building codes, heating equipment appliance standards and reliance on electric sector mandates. Each of these other policy options has merit, and each could be adopted to work in tandem with a Clean Heat Standard. To the degree that any of these parallel strategies lowers demand for fossil heat or lowers the cost of delivering clean heat solutions, they make it easier to deliver cleaner fuels and heating conversions, speeding up the transition to clean heat in Massachusetts. A Clean Heat Standard is an overarching strategy that can work with and tie together an array of complementary policies. The collective impact of the broad suite of programs can ensure an adequate rate of progress over time, while simultaneously advancing other policy goals.

There are many ways to approach the thermal decarbonization challenge, so it is vital to keep in mind a few guiding principles to test decision-making on various aspects of the Clean Heat Standard program. A successful set of policies will:¹⁷

- **Meet Massachusetts' climate goals** — reduce local air pollution and global greenhouse gases and be expected to meet the thermal sector's share of emissions reductions called for in the Global Warming Solutions Act.
- **Enhance social equity** — build social equity into the architecture of the program and, particularly, minimize adverse impacts on low-income households and those most burdened by high energy bills.
- **Secure physical delivery in Massachusetts** — provide real and verified emissions reductions, delivered via cleaner heating services at end-use locations in the state.
- **Provide customer flexibility** — give individual homeowners, building owners and other consumers a range of low-emissions heating choices, as well as the ability to decide whether and when to make changes in response to market offerings.
- **Promote supplier flexibility** — offer multiple pathways for obligated entities to meet their obligations under the standard.
- **Minimize cost** — provide flexibility to enable emissions reductions to be achieved at the lowest possible cost.

¹⁷ The principles developed by the Commission on Clean Heat overlap with a few of these but are different enough to merit including this list.

- **Maintain resource diversity** — retain Massachusetts’ ability to provide affordable heating services despite changing global energy prices and supply conditions.
- **Minimize negative side effects**, including exported environmental harms from cleaner heating choices in Massachusetts.
- **Scale over time** — grow in scale gradually to provide opportunities to benefit from new technology, capture economies of scale and provide certainty to market participants that the market for clean heat solutions will continue and grow.
- **Be as simple as possible** — minimize complexity of administration while maintaining enough regulatory rigor to ensure that emissions reductions are real and are consistent with state requirements.
- **Work well with other policies** — work well with, and be mutually reinforcing with, Massachusetts’ weatherization programs, utility efficiency and fossil fuel reduction programs and other greenhouse gas reduction initiatives. It should work with existing Massachusetts policies and institutions to boost progress, ensure consistency across policies and avoid re-creating the wheel.
- **Enhance economic development** — replace expensive and price-volatile fossil fuels with efficiency investments and cleaner and more affordable energy carriers. This conversion will support growth in the economy, including new jobs and job training opportunities, and fuel providers’ ability to transition to new and economically sustainable business models.

Building Blocks for a Clean Heat Standard

No single policy is likely to meet all the critical goals set out in the GWSA or the 2021 Climate Roadmap law. However, as RAP will show below, a performance standard for the delivery of clean heat measures to heat customers across the Commonwealth can do much to close the gap between the Commonwealth’s ambitions and the existing policy landscape. RAP calls this performance standard the Clean Heat Standard, requiring heating energy providers to deliver an increasing quantity of low-emissions heating services to Massachusetts customers.

This paper briefly describes the Clean Heat Standard and how it would work and shows how experience with existing policies can help policymakers and stakeholders understand and work through the design issues with this new idea. The paper then describes the initial decisions that must be made to set up a Clean Heat Standard and the major design elements, along with observations and options. Based on the analyses explained in subsequent sections, RAP draws two major conclusions:

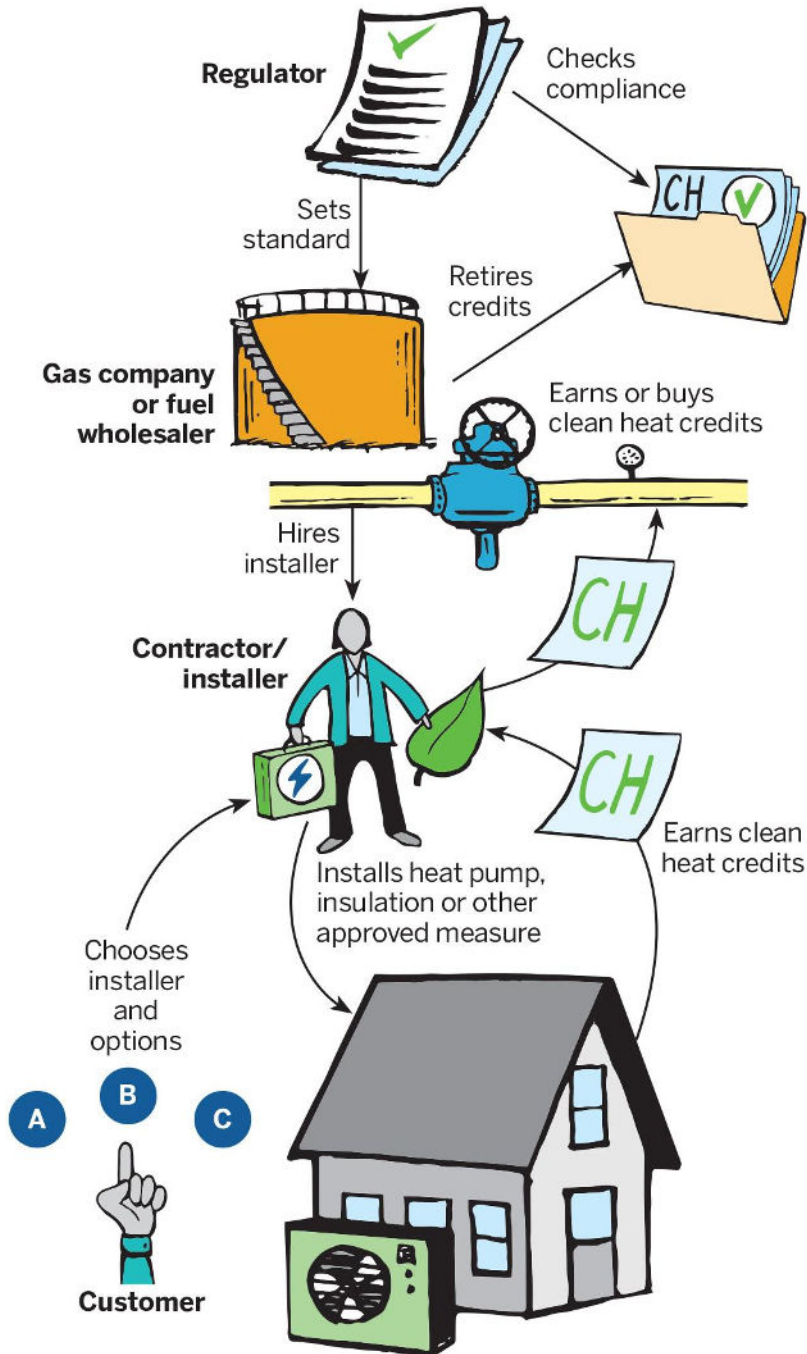
1. The Clean Heat Standard is a practical and cost-effective policy tool to meet emissions reduction goals for the thermal sector, and it could be implemented in a progressive, equitable manner consistent with the Commonwealth’s objectives for a timely and equitable transition.
2. The standard can be implemented to work in concert with other policy tools, and this could lower the cost and improve the benefits of the clean heat transition.

Fossil heating fuels reach customers in the Commonwealth in a variety of ways. To ensure complete and evenhanded coverage of the Clean Heat Standard, the performance obligation could be applied to all major suppliers of fossil heating fuels, including the “delivered fuels” (fuel oil, propane, kerosene and coal) and gaseous fuels delivered by pipelines and distribution networks (termed natural gas, fossil gas or pipeline gas.) The standard would apply to all substantial fossil fuel sales from any of these sources. Here are the key features of the standard:

- The Clean Heat Standard is akin to a renewable portfolio standard and to the low-carbon fuel standard in California. The targets for program administrators in the Massachusetts three-year energy efficiency plans required since the 2008 Green Communities Act can also be considered performance standards in that the overall standard and major milestones are set by the Clean Energy and Climate Plan emissions limit for the residential and commercial/industrial heating sectors, and a regulatory agency is authorized to supervise implementation. Massachusetts’ Clean Energy Standard is another example, notable for the fact that the percentage standard is established in a regulatory process, not legislation.
- Obligated fuel suppliers would be required to deliver clean heat solutions to Massachusetts customers on a percentage basis that rises over time. Although each year’s clean heat additions could be modest (perhaps 4% of delivered heating energy), clean heat additions would add up over time to help meet the thermal sector’s emissions reduction requirements.
- Obligated parties could meet their Clean Heat Standard obligation through a wide range of actions. Most importantly, working with families and businesses, they could help customers to improve the efficiency of their homes by installing low-emissions heating systems, such as cold-climate heat pumps, heat pump water heaters or advanced wood heating equipment, or by better insulating their buildings. Demonstrably cleaner fuels can be considered as well in the qualifying resources.
- Anyone delivering qualified clean heat solutions to Massachusetts homes and businesses could earn clean heat credits, which could then be sold to the obligated fossil fuel providers, who will need them to meet their annual performance obligations. Earning credits is not restricted to gas companies or obligated parties. RAP expects most of the customer-level work to be done in coordination with local enterprises, including obligated parties themselves, heating contractors, efficiency providers, existing weatherization programs and others.
- A critical feature of the Clean Heat Standard is customer choice. The standard 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 from 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. Experience has shown that these measures can accelerate the transition to cleaner and more efficient buildings across the state, providing lower-cost and more price-stable clean heating options and helping to reduce dependence on fossil fuels.

Figure 5 shows the actors that could be involved with a Clean Heat Standard and their potential roles.¹⁸

Figure 5. Clean Heat Standard sample processes



Source: Adapted from Cowart, R., & Neme, C. (2021). *The Clean Heat Standard*

¹⁸ Adapted from Cowart, R., & Neme, C. (2021). *The clean heat standard*. Energy Action Network. <https://www.eanvt.org/chs-whitepaper/>

Building on Experience: Performance Standards in Energy Sectors

The Clean Heat Standard would not be the first time that performance obligations have been placed on energy providers. In Massachusetts, 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 and suppliers of liquid fuels. What's unique about the Clean Heat Standard is that it would apply a performance standard to energy providers across both regulated and non-utility energy companies in the same program. At least four types of programs set up across the country provide potential lessons for the design of a Clean Heat Standard: (1) renewable portfolio standards, (2) low-carbon fuel standards, (3) energy efficiency obligations and (4) other states' clean heat policies.

Renewable Portfolio Standards

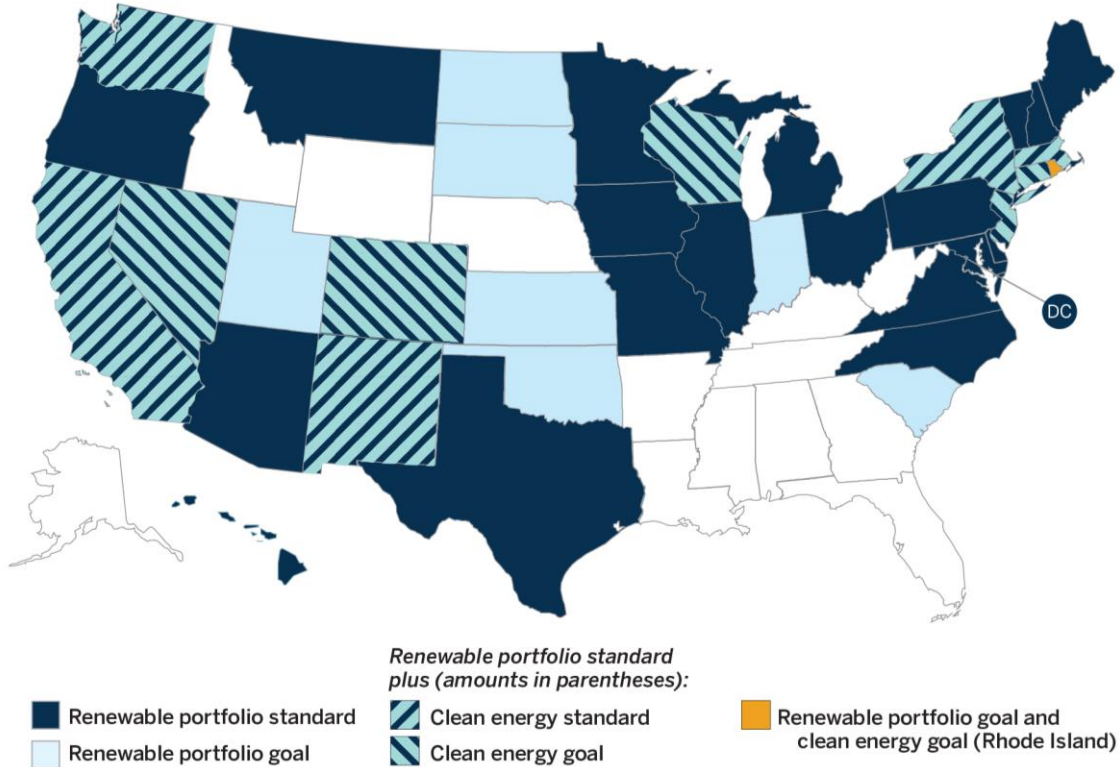
The most widely known examples of clean energy performance standards are the electric renewable portfolio standards in place in many jurisdictions to mandate continuing increases in renewable energy generation as part of utilities' portfolios of electric power provided to end-use customers. At least 30 U.S. states have electric portfolio standards in place. Five states have clean energy standards that include a broader range of eligible generator types (e.g., large hydro is excluded from Massachusetts' RPS but included in its clean energy standard). Figure 6 on the next page shows which states have standards or goals in place for renewable and clean energy.¹⁹

What's unique about the Clean Heat Standard is that it would apply a performance standard to energy providers across both regulated and non-utility energy companies in the same program.

¹⁹ Based on North Carolina Clean Energy Technology Center. (2020, September). *Renewable & clean energy standards*. Database of State Incentives for Renewables & Efficiency. <http://www.dsireusa.org/resources/detailed-summary-maps/>

Figure 6. State renewable and clean energy standards

30 states and Washington, D.C., have a renewable portfolio standard. Five states have a clean energy standard. Eight states have renewable portfolio goals, and five states have clean energy goals.



- Arizona:** 15% by 2025*
- California:** 60% by 2030 (100% by 2045)
- Colorado:** 30% by 2020 (IOUs)*† (100% by 2050)
- Connecticut:** 40% by 2030 (100% by 2040)
- Delaware:** 25% by 2026*
- Hawaii:** 100% by 2045
- Illinois:** 25% by 2026
- Indiana:** 10% by 2025†
- Iowa:** 105 MW
- Kansas:** 20% by 2020
- Maine:** 100% by 2050
- Maryland:** 50% by 2030
- Massachusetts:** 35% by 2030 and 1% each year thereafter (new resources); 6.7% by 2020 (existing resources) (80% by 2050)
- Michigan:** 15% by 2021*†
- Minnesota:** 26.5% by 2025 (IOUs) 31.5% by 2020 (Xcel)
- Missouri:** 15% by 2021
- Montana:** 15% by 2015
- Nevada:** 50% by 2030 (100% by 2050)
- New Hampshire:** 25.2% by 2025
- New Jersey:** 50% by 2030 (100% by 2050)
- New Mexico:** 80% by 2040 (IOUs) (100% by 2045 [IOUs])

- New York:** 70% by 2030 (100% by 2040)
- North Carolina:** 12.5% by 2021 (IOUs)
- North Dakota:** 10% by 2015
- Ohio:** 8.5% by 2026
- Oklahoma:** 15% by 2015
- Oregon:** 50% by 2040* (large utilities)
- Pennsylvania:** 18% by 2021†
- Rhode Island:** 38.5% by 2035 (100% by 2030 goal)
- South Carolina:** 2% by 2021
- South Dakota:** 10% by 2015
- Texas:** 5,880 MW by 2015*
- Utah:** 20% by 2025*†
- Vermont:** 75% by 2032
- Virginia:** 100% by 2045/2050
- Washington:** 15% by 2020* (100% by 2045)
- Washington, D.C.:** 100% by 2032
- Wisconsin:** 10% by 2015 (100% by 2050)

- U.S. territories**
- Puerto Rico: 100% by 2050
 - Guam: 25% by 2035
 - U.S. Virgin Islands: 30% by 2025
 - Northern Mariana Islands: 20% by 2016

IOUs = investor-owned utilities

* Extra credit for solar or customer-sited renewables

† Includes nonrenewable alternative resources

Source: Based on North Carolina Clean Energy Technology Center. (2020). *Renewable & Clean Energy Standards*

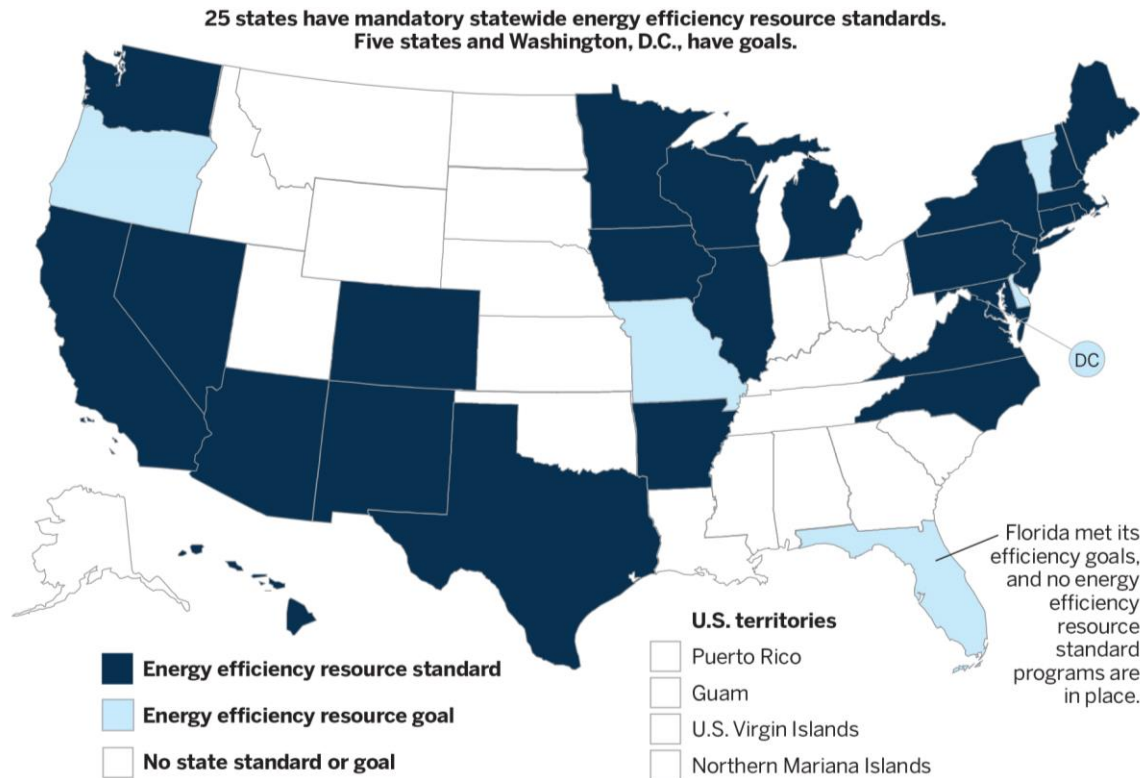
Low-Carbon Fuel Standards

The low-carbon fuel standards in California, Oregon, Washington and British Columbia are designed to decrease the carbon intensity of transportation fuels on a life cycle basis, using metric tons of greenhouse gas emissions. Although the transportation and thermal sectors are quite different, the California program has two aspects that could be useful in the design of a Clean Heat Standard. First, the low-carbon fuel standard includes electricity as a creditable resource in meeting the standard. Second, the program uses life cycle emissions across all eligible fuel types, providing good analytical examples that could be drawn on, or improved, for a Clean Heat Standard in Massachusetts.²⁰

Energy Efficiency Obligations

At least 31 states have an energy efficiency resource standard or similar obligations in place, requiring regulated utilities or retail electricity suppliers to deliver energy efficiency savings to and with their end-use customers (see Figure 7²¹). These too rely on performance standards to reduce consumption, total energy costs and emissions.

Figure 7. State energy efficiency resource standards and goals



Source: North Carolina Clean Energy Technology Center. (2021). *Energy Efficiency Resource Standards (and Goals)*

²⁰ The California Air Resources Board relies primarily on the GREET model, developed by Argonne National Laboratory, to compare the life cycle emissions of different transportation fuels and substitutes. Purdue's Global Trade Analysis Project (GTAP) model is also used to evaluate life cycle emissions of biofuels. To the degree that Massachusetts chooses to evaluate and compare heating options on the basis of life cycle greenhouse gas emissions, it could choose to rely on these or similar models to compare resource options within a Clean Heat Standard.

²¹ North Carolina Clean Energy Technology Center. (2021, September). *Energy efficiency resource standards (and goals)*. Database of State Incentives for Renewables & Efficiency. <http://www.dsireusa.org/resources/detailed-summary-maps/>

Important lessons can be taken from the experience gained by Massachusetts and other states in the delivery of end-use energy efficiency measures. First, although it is challenging to overcome the consumer barriers to efficiency, good program design can succeed in enrolling customers in changing the technologies they use in their homes and businesses. Second, there has been a great deal of experience in measuring and verifying consumption savings from long-lived measures. As this paper discusses later, these two topics are quite important in the design of a Clean Heat Standard, which relies in large measure on enrolling customers to change their heating systems and on measuring and crediting greenhouse gas savings from those systems over multiyear periods.

Other States' Experience With Clean Heat Policies

Two other states, Colorado and Vermont, can offer ideas for Massachusetts. In 2021, Colorado adopted legislation requiring its pipeline gas utilities to create clean heat plans that would reduce emissions by 22% by 2030.²² Gas distribution utilities can choose from a range of “clean heat resources” to meet the emissions reduction requirements, including electrification, efficiency, green hydrogen and a limited fraction of recovered methane and methane leakage reductions. In December 2021, the Vermont Climate Council recommended adopting a broader Clean Heat Standard for both pipeline and delivered fuels.²³ The General Assembly adopted detailed legislation to implement that recommendation, but the governor vetoed it at the end of the 2022 legislative session.²⁴ Decision-makers and stakeholders in Massachusetts will be able to learn from the legislative and regulatory processes in those states as they develop a Clean Heat Standard for the Commonwealth.

Threshold Issues for Implementing a Clean Heat Standard

Building in Equity

While equity and environmental justice have long been goals of Massachusetts energy and environmental policy, Massachusetts now has an explicit statutory requirement for greenhouse gas regulations to rigorously address these important issues. Equity has process and substance components.

As a matter of procedural equity, significant efforts must be undertaken in the initial program design stage to obtain input from low-income residents of the Commonwealth and from environmental justice communities. Input from housing agencies, weatherization and efficiency practitioners and finance experts should support this

²² Senate Bill 21-264, codified at Colorado Revised Statutes 40-3.2-108 (2021). See also Henchen, M., & Overturf, E. (2021, August 11). *Policy win: Colorado's innovative Clean Heat Standard will force gas utilities to clean up their act*. Canary Media. <https://www.canarymedia.com/articles/policy-regulation/policy-win-colorados-innovative-clean-heat-standard>

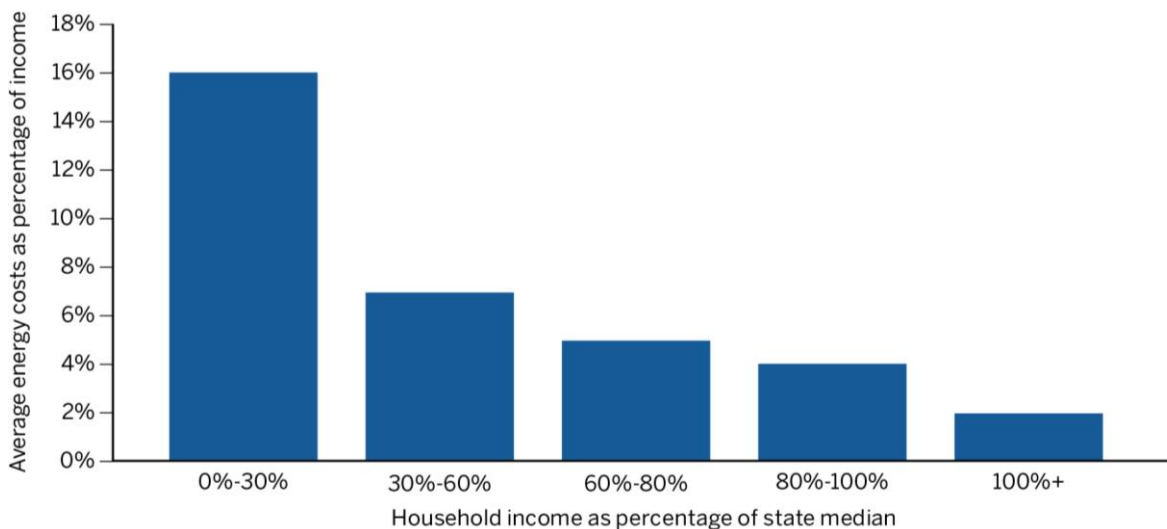
²³ Vermont Climate Council. (2021). *Initial Vermont Climate Action Plan*, pp. 97-101. <https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2021-12/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf>

²⁴ An Act Relating to the Clean Heat Standard. H.715, Vermont General Assembly. (2022). <https://legislature.vermont.gov/Documents/2022/Docs/BILLS/H-0715/H-0715%20As%20Passed%20by%20Both%20House%20and%20Senate%20Official.pdf>

engagement. The design process must be open to ideas from energy-burdened communities, housing providers and others with lived experience and professional expertise delivering weatherization and heating solutions. There are important roles for community organizations in this process.

Substantively, studies reveal that low-income populations spend a disproportionately high fraction of their income on household energy, despite consuming less energy overall. Figure 8 shows how energy burden is significantly higher for low-income residents of Massachusetts.²⁵

Figure 8. Energy burden in Massachusetts by percentages of state median income



Source: U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. (n.d.). *Low-Income Energy Affordability Data (LEAD) Tool*

There are several design elements of the Clean Heat Standard that should be shaped with equity in mind. For example, the standard could be developed with an equity carve-out requiring that a progressive fraction of clean heat credits be acquired from measures in low- and moderate-income households. Alternatively, regulated parties could be awarded a credit bonus, reducing their overall obligation, if a certain equity threshold were reached. In addition, the standard could cooperate with equity-focused goals in other programs, such as community outreach programs, means-tested energy rate tiers, and Mass Save® rebates dedicated to low- and moderate-income consumers.

Low-income households and environmental justice communities often have the highest-emitting building stock. Decarbonizing this fraction of the housing stock will make the greatest proportional contribution to reducing energy burdens, improving health outcomes and ensuring transitional equity. Building-shell improvements and heating conversions will be necessary to improve this fraction of the housing stock; since the financial resources of occupants are by definition limited, public policies are needed

²⁵ U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. (n.d.). *Low-Income Energy Affordability Data (LEAD) tool*. <https://www.energy.gov/eere/slsc/maps/lead-tool>

to make it happen. Those strategies should be built into the Clean Heat Standard program design from the beginning.²⁶ Some specific ideas are included in the next section, “The Architecture of a Clean Heat Standard.”

Interaction With Other Programs

Although a Clean Heat Standard is broadly compatible with a wide range of other policies, it is also important to consider more specific ways that these policies might interact, to understand the different impacts of this new policy.

First, the simplest way to construct a Clean Heat Standard is to allow any program-qualified action that reduces greenhouse gas emissions in the thermal sector to earn credits, whether or not the action was uniquely “caused” by the Clean Heat Standard program or by an obligated party (an “umbrella” approach). This allows greater competition among service providers and avoids requiring proof of specific attribution as a condition for earning clean heat credits. For example, installing clean electric heating and bringing insulation up to rigorous standards in existing housing should be able to generate credits regardless of who installed the measure or why. The Clean Heat Standard would just ask, “Is it a qualified clean heat measure?” and “How much will it reduce greenhouse gas emissions?” This way of constructing the program has financial implications, in most cases deliberately by design. Credits generated by upgrading buildings can be sold to obligated parties, thus defraying the cost to the builder or developer for meeting those requirements. In principle, it would be possible to develop a Clean Heat Standard that required direct attribution, but this is more administratively complex and would require a different approach for setting the standard.²⁷

Second, as a starting point it makes sense to name the owner of the property or business equipment being upgraded as the default owner of clean heat credits generated from on-site projects. Although in principle property owners could mint credits under the program and sell them to an obligated party or a broker, it is more likely that individual property owners would need support to do so or that automatic credit creation and exchange could be facilitated by other programs. For example, energy efficiency programs that support clean heat can provide for automatic acquisition of the clean heat credit and provide incremental incentive value in exchange, along with processes that automatically mint credits.

²⁶ There is, on the surface, tension in program design between dedicating efficiency and heat-switching resources to consumers with the highest energy burdens and maximizing early pollution reductions by focusing on the quickest reductions from anywhere. RAP recognizes that a just transition requires both justice and an effective transition, so multiple objectives must be served. At this point, RAP judges 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 Massachusetts, so almost everyone will ultimately be served. RAP believes it is 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.

²⁷ In an umbrella Clean Heat Standard, if the statewide emissions reduction target is 40%, the standard can be set at 40% and all qualified actions can earn credits. In an attribution-based system, regulators would need to estimate the reduction likely to result from other ongoing programs and market forces, (say 18%) and calculate the performance gap (in this example, 22%). The Clean Heat Standard could be set to deliver just the remaining “gap” amount of reduction (22%), but regulators would want to make sure that each clean heat credit claim was additional to what would have happened anyway. The umbrella Clean Heat Standard approach eliminates these administrative and measurement uncertainties.

In addition, other programs can be designed to be supportive of the Clean Heat Standard. Materials and websites for other programs should include the Clean Heat Standard as part of the menu of options for Massachusetts residents to consider.

These are simple examples of more specific ways that the Clean Heat Standard may interact with other energy and environmental policy efforts. Additional considerations may become clear during the regulatory process to develop the program specifics.

The Architecture of a Clean Heat Standard

Nature of the Obligation

The main advantage of the Clean Heat Standard is that it focuses on the delivery of concrete, delivered clean solutions to drive down consumption of fossil fuels. A key goal of the standard is to stimulate suppliers of clean heat alternatives to deliver clean heat solutions to their customers. However, a credit-based system must take care to measure the right accomplishments. For example, a Clean Heat Standard that requires installation of X number of heat pumps or weatherization of Y square feet of building space could be based on good estimates of the greenhouse gas results but would be measuring inputs rather than measuring the outputs (GHG reductions). A crediting system that focuses on counting tons of GHG reductions would ensure that emissions reductions are prioritized and quantified. Additional options include crediting based on heating energy provided (e.g., in therms).

Clean Heat Credits

The basic concept of a Clean Heat Standard is an earned-credit system, most analogous to the electric sector's RPS. Such a program would require obligated parties to deliver annually a gradually increasing quantity of heating services through approved clean heat measures and to retire the number of clean heat credits required in that year. As these measures replace fossil heat services, greenhouse gas emissions will decline in sync with the Commonwealth's climate mandates (see the following section on the pace of change). Like other performance standards, the Clean Heat Standard would provide a clear picture of the rate of change required. The program would create a commercial value for each heat pump installed, each customer served with an approved alternative, the square feet of homes weatherized and other complementary measures the Commonwealth wants to support.

That, in turn, could help fuel dealers, HVAC contractors, fuel producers and others to transition their businesses to selling such products and services.

The Common Denominator to Measure Credits Should Be CO₂e

In electricity performance standards, performance is normally counted in kWh. Since the principal goal of a Clean Heat Standard is to deliver the emissions reductions required by the GWSA and the 2021 Climate Roadmap law, credits could be measured in terms of CO₂ equivalents (CO₂e), which would give credit for the CO₂ emissions avoided by the addition

of a variety of clean heat solutions. Using CO₂e also allows a variety of clean heat options, from weatherization and heat pumps to approved clean fuels, to be compared on a quantitative basis.

Because the Clean Heat Standard would award credits for actions taken in the form of CO₂e avoided, it would be critical to establish standards to quantify the performance of different types of clean heat measures over time. This type of problem has been addressed in other performance-based systems, including energy efficiency programs and low-carbon fuel standards.

Energy efficiency programs have well-established protocols for quantifying the energy, capacity and environmental benefits of different types of efficiency measures, such as light bulbs, weatherization and appliance replacements. So-called deemed savings rates are based on field measurements and are updated over time. A Clean Heat Standard would require a similar manual and a process to create it and update it.²⁸

Size of the Annual Obligation

The size of the annual obligation for those covered by this program is a critical decision since it sets the pace and slope of the emissions reductions from a Clean Heat Standard. The regulating agency will need to determine (with public input) the glide path to a significant reduction in emissions, up to or beyond 85%. It must also set out the timeline for achieving that goal, including interim steps to be met in the CECP by 2025, 2030 and 2040.

The obligation for residential, commercial and industrial heating sectors would rise over time to meet the 2025/2030 CECP goals established by the Secretariat under the GWSA, along with other policies deemed appropriate, such as the three-year energy efficiency plans. These goals indicate a nearly 50% reduction from 1990 gross emissions in these sectors by 2030. As plans for 2040 and 2050 are developed, longer-term goals will be established.

Technology carve-outs are not necessarily needed but could be included in the Clean Heat Standard program, if desired for public policy reasons such as addressing the legislative requirement to track heat pump deployment. However, a key strength of the standard is that credits can be earned in multiple ways, allowing customer choices, provider choices and competition to deliver solutions. Therefore, RAP does not recommend including carve-outs for specific technologies, except where the public policy pathway is quite clear and barriers to that pathway may block progress. In such cases it may be important to promote certain clean solutions that are needed in the long term even where short-term solutions might otherwise prevail in the market. Giving extra credits for replacing fossil-fueled furnaces with heat pumps is one possible example. If the end goal is to reach net-zero emissions economywide and the pace of stock turnover presents only a few opportunities to replace heating systems in the next three decades, it may be important

²⁸ Life cycle CO₂e analysis would also be required if renewable fuels or biofuels were included in a Clean Heat Standard. There are scientifically determined values assessing the life cycle emissions of different types of fuel, differentiated by feedstock, location and other variables. Systems like the GREET and GTAP models used by the California Air Resources Board and the Environmental Protection Agency could help to assign life cycle emissions values for any fuels deemed creditable under a Clean Heat Standard in Massachusetts.

to encourage certain long-term solutions immediately even when lower cost near-term solutions are more readily available.

Ongoing and periodic program review will be necessary to consider potential regulatory amendments. For example, on evidence and after public hearings, it could be desirable to adjust the level of obligation on a forward-going basis: (a) upward, if credits are meaningfully oversupplied or (b) downward, subject to strict conditions, in response to serious, unavoidable technical problems, supply constraints and adverse market conditions.

The Obligation Rises Over Time in Sync With Climate Requirements

The essential idea of the Clean Heat Standard is to add clean heat resources to Massachusetts homes and businesses over time.

Heating, like electricity, is an essential service. Just as an RPS 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. However, continued investments in energy efficiency measures should help reduce the costs of clean heat solutions. Adding clean heat solutions in Massachusetts serves multiple purposes: lowering heating costs to residents, adding resilience to the heating sector,²⁹ supporting efficient cooling in low-income communities as the climate warms and extreme heat events become more common, promoting jobs in advanced heating technologies, improving indoor and outdoor air quality — and lowering greenhouse gas emissions. Lowering climate pollution is not the only reason to create a Clean Heat Standard.

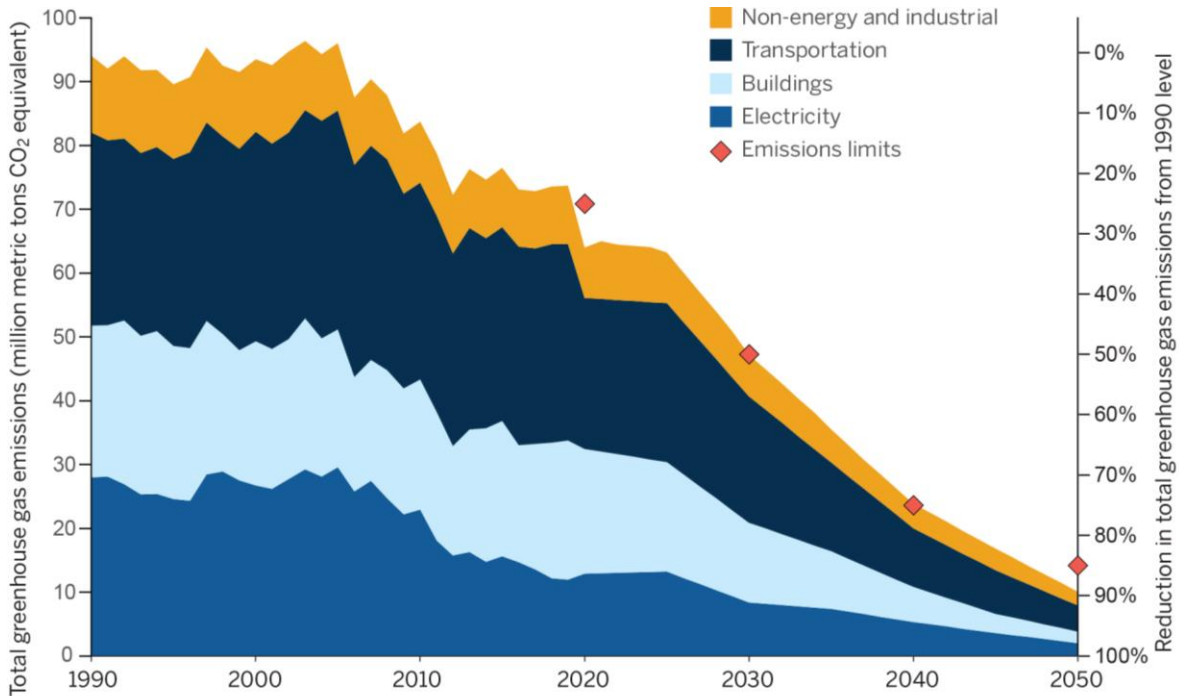
That said, as the supply of clean heat services in Massachusetts grows over time, greenhouse gas emissions from the thermal sector will naturally decline. The standard should be designed to sync with the state's overall climate requirements, recognizing as well that the Clean Heat Standard is not the only tool called upon to reduce emissions from the thermal sector.

Figure 9 on the next page shows how emissions from the thermal sector should decline in keeping with the GWSA requirements.³⁰ In very general terms, the rate of improvement set out in the law is roughly 4% per year until 2025, rising to just under 5% per year between 2025 and 2030, and then settling to a reduction in emissions of about 3% per year from 2030 to 2050.³¹

²⁹ Adopting a Clean Heat Standard now protects Massachusetts against the risk of supply disruptions and abrupt policy shifts that are likely to come later, as the climate crisis worsens and future governments impose policies to rapidly shift away from fossil heating fuels.

³⁰ Massachusetts Executive Office of Energy and Environmental Affairs.

³¹ Massachusetts measures greenhouse gas reductions from a 1990 baseline.

Figure 9. Sector greenhouse gas emissions as shares of Massachusetts economywide total

Note: 1990 through 2019 reflect full-year historical data.

Source: Massachusetts Executive Office of Energy and Environmental Affairs

The Standard Could Be Adjusted as Conditions Change

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 the expected growth in Massachusetts for installed heat pumps, a similar decrease in costs may occur over time, potentially including the cost of installation.³²

In addition, as equipment vendors, contractors and supply houses gain experience with these cleaner technologies, heating markets may gradually be transformed, as has happened with 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 Clean Heat Standard program for providers and consumers. Beyond that, with higher uptake and lower costs for the standard, decision-

³² The cost of delivering and installing clean heat solutions should drop with increased scale and experience in Massachusetts. If other states and nations adopt similar policies, the manufactured cost of clean heating equipment might decline, while equipment performance is likely to continue to improve. The cost of biofuels might rise due to potential supply limitations or might drop with technological improvement. Increased penetration of heat pumps could deliver positive benefits to the electric system if usage is managed over time through advanced rate designs, storage and demand management techniques.

makers might have the opportunity to increase the pace or ambition of the standard itself, which would deliver deeper greenhouse gas savings earlier in the program. This might be needed if climate progress in other sectors moves more slowly than expected or desired or if future CECPs require faster or deeper emissions reductions than currently outlined.

On the other hand, economic conditions might change dramatically to cause a shortage of clean heat opportunities, or supply chain disruptions could interfere with delivery of new equipment.³³ For all these reasons, the Clean Heat Standard program could build in 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 standard.

Obligated Parties

The obligation to lower the greenhouse gas emissions of fossil heating fuels could be applied on a competitively neutral basis across all fossil heating fuels, including gaseous fuels delivered by pipelines and distribution networks (termed natural gas, fossil gas or pipeline gas) and delivered fuels (fuel oil, propane, kerosene and coal). The standard would apply to all substantial fossil fuel sales from any of these sources.

Although coverage of the standard should be inclusive, the question remains: Who should be the “obligated parties” to ensure that this responsibility is carried out?

Massachusetts does not produce fossil fuels. The Commonwealth depends on imports of petroleum and diesel. Massachusetts residents and businesses spend about \$6 billion each year to import fuels to heat buildings and water, to cook and to run industrial processes.

A variety of enterprises are involved in this large, critical sector. Fossil fuels are delivered into the state to terminals in Chelsea, Boston and Springfield, and fuel is delivered via truck or rail from other terminals such as Albany, New York; Providence, Rhode Island; Portland, Maine; and New Haven, Connecticut. Liquefied natural gas arrives infrequently at a terminal in Boston, and pipelines deliver a large quantity of fossil gas. There are wholesale fuel suppliers operating out of terminals in Chelsea and Springfield. Massachusetts wholesalers and retailers also operate bulk storage facilities for distillate products and propane in the Commonwealth.

At the retail level, Massachusetts is served by many retail providers of fuel oil and propane and regulated and competitive suppliers of pipeline gas. These entities range in size from very large corporations to local, family-owned fuel dealers.

RAP sees the following options for obligated parties in Massachusetts:

- Regulated investor-owned gas utilities.
- Providers of delivered fuels, with the point of regulation applying either at the wholesale level or at the retail level.

³³ If Massachusetts launches a Clean Heat Standard program designed to achieve reductions in the next 25 years, it's impossible to anticipate events like the COVID-19 pandemic or the supply chain issues that have resulted. The program will need provisions that allow for adjustments over those 25 years, such as a required periodic review.

- Fossil heat providers that are not any of the above-named parties, including competitive gas suppliers.
- Electricity suppliers, either on their own or together with other heating suppliers.

Other categories that may warrant consideration include:

- Large commercial properties above a set threshold of fuel usage (to prevent individual homeowners from an individual obligation).
- Municipalities or municipal gas companies as obligated parties, perhaps with municipal electric companies having the option of creating and selling credits.
- Landlords with real estate above a set threshold of square footage.
- Other options that could be raised through public input.

As the list above reveals, a Clean Heat Standard in Massachusetts could be applied in many ways. At a very practical level, reducing building heat emissions requires building owners to decide to deploy clean heat solutions, such as a cold-climate air source heat pump, when replacing or augmenting their HVAC systems. RAP does not envision enacting a mandate directly on end users that would require individuals to replace their heating systems, so how can they be supported to make those changes? The principal reason to place a clean heat obligation on energy providers is that they have commercial relationships with end-use customers and thus can work with their customers on choices for heating that reduce emissions. In addition, in the long run, clean heat services will be a business opportunity in Massachusetts, and the state's economic goals are served by developing expertise in-house and in-state, as has been done for energy efficiency and solar power. Placing an obligation on existing heating providers on a competitively neutral basis might well provide a needed boost in that direction.

Obligations on Pipeline Gas Providers

With respect to pipeline gas, the obligation should cover all deliveries in Massachusetts. This can be accomplished by imposing the obligation on all pipeline gas retailers, regulated and competitive,³⁴ or on the natural gas local distribution companies that deliver the fuel. Due to more direct regulatory oversight, and for ease of administration, it is easier to apply the obligation on the regulated local distribution companies, but either choice could work.³⁵

Obligations on Delivered Fuel Providers

The discussion below touches on how the standard should be applied to delivered fuels, such as distillate heating oil and propane.

³⁴ For information on competitive gas suppliers, see Massachusetts Department of Public Utilities. (n.d.). *Competitive supply for natural gas*. <https://www.mass.gov/info-details/competitive-supply-for-natural-gas>

³⁵ Fossil heating fuels are delivered in a variety of ways, including directly from interstate pipelines to larger industrial users. Municipalities also deliver fossil gas to end users through public systems. As a general matter, RAP suggests including all thermal sales in the Clean Heat Standard to achieve the Commonwealth's climate goals and to avoid creating bypass incentives. However, decisions on scope involve other statewide public policy choices that decision-makers will need to weigh.

A basic question to address is: Should the Clean Heat Standard obligation for delivered fuels be implemented “downstream,” on retail delivery companies, or “upstream,” on wholesale providers?

As noted above, a major reason to assign the clean heat obligation to retail fossil fuel companies is their direct relationship with end-use customers. These companies employ technicians and delivery staff members who could be trained to work with customers on heat pump options and other cleaner-heating solutions. These companies could develop new business models to succeed under a clean heat mandate.

On the other hand, upstream wholesalers have greater financial and management capacity and are less numerous, 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.³⁶ 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 statewide delivery organizations. Finally, wholesale providers might wish to use this opportunity to build up a clean heat line of business, akin to the work that many traditional power 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. They could work with the wholesalers to identify customers who are good candidates for upgrades.

Legal research is required to determine the best way to apply an obligation at the wholesale level if some wholesale transactions occur outside of the Commonwealth (e.g., filling a tanker truck at a fuel storage depot in another state). At the wholesale level, the obligation to meet a Clean Heat Standard could be attached at the time a tanker truck is filled for sale, even if that happens out of state, if it is intended for sale in Massachusetts as per a bill of lading.³⁷

One key advantage of placing the Clean Heat Standard obligation onto delivered fuel wholesalers is that it creates opportunities for multiple categories of actors to perform work and earn credits. However, since either upstream or retailer obligations could work, the ultimate choice might well come down to the practical preferences of the Commonwealth and stakeholders including energy service providers. Whichever way the standard is designed, it should provide ample opportunity for regional and state-based fuel dealers and energy companies to develop new lines of business and to thrive in a low-carbon energy environment.

³⁶ Fossil fuel wholesalers include in-state and out-of-state entities, and out-of-state entities with in-state facilities and operations. Intermediate shipment points are also commonly used, as in the numerous bulk storage tanks that store fuel for later loading onto local delivery trucks. If the Clean Heat Standard obligation is not imposed at the retail level, RAP suggests that it be imposed on the first jurisdictional provider of fossil heating fuels destined for consumption in Massachusetts.

³⁷ A variety of legal options have been developed to ensure regulatory coverage of interstate fossil fuel sales. If obligations are placed on multistate wholesale operators, Massachusetts would need to evaluate how those methods could be applied to a Clean Heat Standard and how reliable the reporting and compliance pathways would be.

Obligations on Electricity Providers

Massachusetts is among a handful of states that have gotten a start on thermal efficiency and cleaner heat by extending electric utility energy efficiency or renewable energy programs to at least some fossil fuel uses. Under the Alternative Energy Portfolio Standard (APS), retail electricity suppliers (both regulated distribution utilities and competitive suppliers) are obliged to purchase alternative energy credits equal to a certain percentage of their retail sales in a given year. That percentage requirement, 5.5% in 2022, has been rising at the rate of 0.25 percentage point each year. Initially the program was designed to promote combined heat and power (CHP) installations, and over the years the largest fraction of the alternative energy credits has come from fossil gas-fired CHP operations. Much smaller fractions have been delivered by renewable thermal measures, including heat pumps, and by liquid biofuels and fuel cells.

The APS has been revised several times, enlarging the categories of technologies that can earn credits. Studies of the APS and stakeholder reviews of its implementation have crystallized a set of conclusions and recommendations that are relevant to the design of a Clean Heat Standard:

- The size of the APS obligation and its current rate of increase are small in comparison to the scale of clean heat deployment needed to reach statutory emissions limits.
- The APS has helped to drive innovation and deployment of some alternative energy solutions in Massachusetts.
- It has helped to add resilience and reliability to the power grid, especially via the operation of CHP units in critical facilities like hospitals.
- It has reduced emissions, but not at a rate sufficient to meet the goals set in the GWSA and the 2021 Climate Roadmap law.
- It has contributed to lower energy costs and diversification in the energy sector of the economy.
- Finally, and perhaps most importantly, Massachusetts' experience with the APS shows that a performance standard that permits a range of technologies to compete in lowering emissions can deliver cost savings and emissions reductions — if the credit system is set to reward sustainable, low-emissions energy options.

Notwithstanding those positive experiences, a thorough review of the APS by Daymark Energy Advisors for the Department of Energy Resources³⁸ found some challenges with the existing program.

- A major problem with the APS program has been a growing mismatch between demand and supply. The standard was initially set at a low level and grows slowly. Because natural gas-fired CHP is a well-developed and relatively low-cost generating technology, its inclusion in the program has crowded out other solutions.

³⁸ Daymark Energy Advisors. (2020). *Alternative Energy Portfolio Standard review*. <https://www.mass.gov/doc/alternative-energy-portfolio-standard-review/download>

- Moreover, the program’s energy-based credits are delivered on a MWh basis, much like an RPS, rather than measuring and rewarding greenhouse gas reductions. Renewable energy solutions that reduce emissions more than CHP has done are not rewarded in the alternative energy credit market sufficiently to truly provide the necessary incentives for broad adoption.

The Daymark report reveals that the APS program would require substantial modification if it were to be used as a vehicle to reduce emissions in the thermal sector. The report states that “in the cases modeled, CHP systems do not provide any emissions benefits.” Meanwhile, “small renewable thermal systems,” including heat pumps, biomass pellet boilers and solar thermal hot water, “achieve emissions reductions for the lowest cost compared to other renewable thermal and CHP systems.” However, those small renewable thermal systems do not receive the incentives they need to be deployed and play only a very small role in the APS program.

The Massachusetts APS program could be modified to change the incentive structure, remove fossil generation from the list of creditable measures and promote alternative technologies based on emissions reductions. The Department of Energy Resources is planning to launch a rulemaking to address some of these issues. But should the Commonwealth make all those changes, while keeping the obligation to perform at a much higher level on retail electricity suppliers?

Massachusetts could substantially increase the existing thermal obligation on electric utilities, or it could place the requirements on fossil fuel suppliers or on both fossil and electricity providers. The merits of these choices are sketched out below.

First, a leading factor in this choice is that electric utilities and electric rates are already bearing most of the cost of addressing climate change in energy in Massachusetts and the region. Electric rates have supported renewables additions, grid upgrades and electric efficiency programs. Carbon costs are also reflected to some degree in power costs through the Regional Greenhouse Gas Initiative (RGGI). Yet, clean and affordable electricity will be needed to help transform the other sectors of the economy, including heating. In contrast, natural gas utilities and their rates bear less cost for energy efficiency: They face no renewable fuels mandates and have no carbon reduction requirements. Delivered fuel companies and their customers have even lower climate obligations.

As a result, progress has been relatively slow in the thermal sector, and we have created a situation in which the cleanest energy source (electricity) is paying extra costs to address climate change, while the higher-emitting fossil fuels are paying much less. The resulting relative prices are sending the wrong signals to consumers and making it that much harder to clean up our energy mix. Putting a clean heat obligation on the fossil fuel suppliers helps to rebalance the scales so that a greater share of emissions reduction costs is reflected on consumers’ fossil heating fuel bills instead of their electric bills.³⁹

If we assume that Massachusetts does not plan to implement a clean heat obligation directly on end-use consumers, consumers will need to make heating choices on an

³⁹ The Daymark report points out that switching the obligation from retail electricity suppliers to natural gas local distribution companies is one option to address the structural problems of the APS program. Daymark Energy Advisors, 2020, p. 3 and elsewhere.

individual basis. Consumers naturally compare the total cost of heating with one system against the total cost with another system when they are renovating a building or replacing a failed furnace or boiler. Incentive awards can make a big difference at that time, but comparative fuel costs matter as well. So even if “all customers will pay” one way or another, it matters how they pay.

Second, a diversity of solutions to reduce emissions from the heating sector will be important to consider. For instance, fuel suppliers, electricity suppliers and a natural gas utility are likely to take different approaches to the solutions offered to customers and how they will be marketed. Electric utilities, for example, could focus on heat pumps. However, particularly in the short run, Massachusetts may need a combination of thermal solutions to meet its climate goals. Fossil fuel providers have proposed options to deliver cleaner heat solutions, and some of them might be needed to deliver near-term solutions, particularly in a transition period. In the longer run, a broad conversion away from pipeline gas will require either phased decommissioning of parts of the gas grid or planned provision of hybrid electric/gas heating or both. If gas utilities are involved, they can help to deliver heating system changes to customers in geographically targeted areas to avoid customer confusion and minimize the total cost of the system conversion.⁴⁰ And, particularly in rural areas served by delivered fuels, choice is important to consumers due to personal preferences and the nature of the building stock.⁴¹

Finally, if the clean heat obligation is placed on fossil fuel providers in proportion to their annual sales of fossil fuels, this creates a continuous incentive for those providers to reduce their fossil fuel sales every year. When each year’s clean heat obligations are keyed to current or recent fossil fuel sales, actions that reduce fossil fuel sales will both (a) earn clean heat credits in the present year and (b) reduce the size of the obligation in future years. This creates an incentive for continuous decarbonization by obligated fossil fuel providers.

To deliver the depth and pace of change required, it is at least useful, and probably necessary, to engage the existing fossil fuel industry in its own transition to a clean thermal sector. These factors counsel against placing the obligation entirely on electricity providers, particularly at the start of the program.

A Phased Approach

As the discussion above makes clear, there are several reasons to impose a Clean Heat Standard obligation on fossil fuel providers — and some potential to impose the obligation on electricity providers. A third option is to adopt a phased approach, including electricity suppliers as obligated entities in the standard over the longer term when Massachusetts

⁴⁰ Where parts of the gas grid are to be decommissioned, it will be essential to offer heat pumps, district heating services or other options to those customers on a geographically targeted basis. Gas utilities will have to be involved in this new type of planning process.

⁴¹ For example, some rural buildings may be ready for conversion to heat pumps almost immediately, but many will require efficiency renovations first. Some customers may be ready, willing and financially able to do those renovations, while others will want or need to wait.

expects to have largely reduced the use of fossil fuels for heating. Reasons for taking this phased approach include:

- Over time, as electrification proceeds in powering heating and transportation needs, electricity suppliers' financial strength is likely to increase along with their capacity to purchase compliance credits and hedge risks associated with weather and fuel price variability.
- Massachusetts Pathways analysis and the text of recent climate legislation identify electrification as a necessary component of decarbonization, and electric utilities are likely to be more supportive of electrification than other potential compliance entities.
- Electricity customers include virtually all residences and businesses in Massachusetts; thus, placing the obligation on electricity customers would spread the costs of the transition more broadly, particularly in later years when there are fewer and fewer customers of gas companies and delivered fuel suppliers.

Considering these factors, it would be useful to study how the mix of obligated parties might evolve over time. One option would be to assign clean heat obligations across both fossil fuel providers and electric utilities *in proportion to their sales for heat*. In 2022, a relatively small fraction (under 15%) of the total obligation would fall on electricity providers. But as the pace of electrification picks up, that fraction would grow. Decision-makers should examine whether the Massachusetts clean heat obligation should be designed to shift the compliance obligation across different heating providers over time. If the obligation were only on fossil fuel providers, it would be placed on a declining number of users, whereas if it were on electricity providers as well, all heat customers would be contributing to the transition.⁴² This design question will require substantial additional analysis and modeling before decisions can be made.

What Actions or Fuels Should Earn Clean Heat Credits?

The Program Is a Performance Standard, Not a Technology Mandate

One of the central ideas of the Clean Heat Standard is to enable a variety of pathways to decarbonize heating, instead of choosing winners by having regulators require certain heating choices rather than others. This is important for at least three reasons:

1. Ultimately, end-use customers need to install their own heating equipment and choose their energy suppliers. Buildings differ, consumer preferences differ, and even the same consumers will choose different heating systems as their budgets and preferences change over time.
2. A performance standard creates competitive pressure across technologies and fuels, which will lower the total costs of the heating transition and help to drive innovation, both in technology and in service delivery pathways.

⁴² Putting the obligation on providers with a shrinking quantity of fossil sales is difficult but achievable. If the annual obligation is proportional to an obligated party's fossil sales, as those sales go down, so does the obligation in quantitative terms.

3. The fundamental purpose of the Clean Heat Standard is to reduce emissions, not to promote certain technologies for extrinsic reasons. The standard needs to include guardrails to ensure that unsustainable or clearly undesirable choices are not rewarded, but within a range of solutions it should allow customers, providers and markets to choose clean heat paths.

In short, the standard should permit a range of technologies and fuels to compete for the ability to earn clean heat credits. The standard could be met in multiple ways, combining different numbers of weatherization jobs, heat pumps, district heating or advanced wood heat systems, and/or different blends of renewable pipeline gas, perhaps green hydrogen and approved biofuels. The evolution of technologies, their relative costs and market dynamics would ultimately drive what the mix of resources should be or will be.

One thing we do know, whatever the future clean heat mix will turn out to be, is that Massachusetts will need substantial increases in clean heat investments and fuels through a variety of means. And climate science tells us that early actions to reduce emissions are particularly valuable. In general, diversity in creditable clean heat measures will promote a quicker and less expensive transition.

The discussion below addresses some of the major policy choices regarding eligible clean heat options for Massachusetts, and, where appropriate, RAP's views regarding them. In summary:

- Only those measures that directly reduce combustion of fossil fuels in Massachusetts homes and businesses would be eligible for clean heat credits.
- Biofuels and renewable gases could be eligible for clean heat credits on a limited basis and only if delivered and used in Massachusetts.
- Clean heat credits need to account for life cycle greenhouse gas emissions of the fuel(s) used.
- Exclusions: Certain measures, including pure offsets, fossil fuel fugitive emissions reductions and fuel switching from one fossil fuel to another will not earn clean heat credits.

Direct Reductions in Fossil Fuel Combustion in Massachusetts Homes and Businesses

Although it would be possible to create a clean heat performance standard that could be satisfied by emissions offsets in any sector, anywhere in the world, such a standard would not satisfy the requirements of Massachusetts law, nor would it help deliver the physical changes needed in Massachusetts to transition away from reliance on fossil fuels. The GWSA and the 2021 Climate Roadmap law clearly articulate a preference for direct reductions in Massachusetts' gross greenhouse gas emissions. In addition, to reduce the Commonwealth's reliance on expensive and price-volatile fossil fuels, we need to focus on the direct delivery of building upgrades and clean heat solutions in Massachusetts homes and businesses.

Direct reductions from in-state homes and businesses are also much easier to document as being real (i.e., actually occurring) and legitimate (e.g., relative to an appropriate baseline) and not being double-counted (e.g., relative to emissions reduction requirements in other sectors or in other jurisdictions).⁴³ For example, it would be very challenging to verify whether investments in tree planting, especially in another country, effectively achieved the level of greenhouse gas emissions reduction assumed. Similarly, it would be challenging to determine whether GHG emissions reductions at an industrial facility in another state were both (a) attributable to the actions or payment of an obligated party in Massachusetts⁴⁴ and (b) not also being counted toward other emissions reduction requirements in the host state or even a third state.

Deliverability Requirement for Biofuels

A requirement that any biofuels substituted for fossil fuels be “delivered” to Massachusetts homes and businesses is consistent with the principle of focusing on curbing emissions within the Commonwealth. For biodiesel or other biofuels displacing fuel oil, propane or kerosene, this requirement means that clean heat credits can be earned only for biofuel physically delivered and used in Massachusetts. Biogas (biomethane) that is trucked to an in-state 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 North America or the United States — would overwhelm the Clean Heat Standard and undermine its fundamental goal to change the nature of heating in the Commonwealth. Put simply, the standard should be a clean heat program for Massachusetts, 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 and hydrogen because it is not possible to trace which molecules of methane or hydrogen are burned in which homes and businesses. Thus, for pipeline biogas, deliverability could be satisfied by purchase and sale of what gas utilities call a bundled product. Specifically, the obligated gas supplier must purchase the biogas itself (including its greenhouse gas emissions 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 a distribution system in Massachusetts.

This concept is also consistent with the way renewable energy credits are credited in the electric RPS, 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 Massachusetts. Renewable generation cannot earn RPS credits in Massachusetts when the generator is located on a remote power grid and sold in a remote power market (e.g., in California or Georgia) that does not deliver electricity in this region.

⁴³ As discussed in the section below on credit creation, a concern about offsets is the need to ensure that reductions occurred, proper baseline reductions are measured and the reductions are not credited for multiple purposes (or in multiple jurisdictions). Some of these concerns are applicable to biofuels. However, when and if biofuels are used in Massachusetts, their life cycle greenhouse gas emissions can be assessed and measured against the life cycle GHG emissions of the fossil fuels they displace in Massachusetts homes and businesses.

⁴⁴ Although it is not necessary to document attribution for direct reductions in Massachusetts emissions, it would make no sense to allow counting of any emissions offsets, especially outside of the state's borders, without requiring a demonstration of attribution.

Life Cycle Accounting for Clean Heat Credits

Discussions about complex comparisons in the energy world invariably end up in a discussion of “compared to what?” The combustion of biofuels typically produces the same amount of CO₂ emissions at the burner tip as combustion of the fossil fuels they are displacing. The difference is that biofuels can provide other greenhouse gas emissions reduction benefits — either eliminating emissions of other greenhouse gases or removing CO₂ from the atmosphere before they are burned. Massachusetts’ program should avoid giving excess credits for emissions impacts that are merely exported to another jurisdiction. Thus, clean heat credits for biofuels need to be based on their net effect on greenhouse gas emissions, including indirect effects. To estimate that net effect, one must compare the life cycle emissions of the fossil fuel avoided with the life cycle emissions of the cleaner fuel being used. The same logic can apply to the replacement of fossil fuel heat by electric heat pumps, using appropriate average emissions rates for the electricity that will be used to power the electric appliance. This logic applies to all creditable actions⁴⁵ but is most appropriate for measures based on fuel substitutions, such as biofuels, advanced wood heat and electricity-driven heat.

Exclusions

A comprehensive climate program will necessarily offer a world of opportunities to reduce emissions in different places and across many sectors. An economywide cap-and-trade program might try to cover them all. For reasons explained earlier in this paper, even though a Clean Heat Standard addresses a major portion of the Commonwealth’s emissions, it focuses on a narrower goal: decarbonizing heating operations at the end-user level in the Commonwealth. Awarding credits for actions not closely linked to that goal would undermine its effectiveness and slow the pace of the thermal energy transition we need.

For this reason, measures that do not reduce thermal fossil fuel emissions at customer locations in Massachusetts would not be eligible to earn clean heat credits. Pure emissions offsets (e.g., tree planting or reductions in fossil fuel combustion outside of the Massachusetts thermal sector) would not earn credits under the Clean Heat Standard program. Reductions in fugitive emissions upstream from homes and businesses, fossil fuel storage systems, natural gas distribution systems and shared propane facilities would not be eligible.

In addition, giving clean heat credits to actions that merely substitute one fossil fuel for another would be problematic, even if emissions are temporarily reduced by the switch. For example, hooking up a building that currently heats with fuel oil to the pipeline gas grid might reduce emissions somewhat in the short run. However, the goal of the clean heat program is to reduce emissions altogether, and that new pipeline connection both adds to the fixed costs of the pipeline grid and delays the ultimate conversion of the building away from fossil fuels.

⁴⁵ Complex life cycle analyses are typically and appropriately moderated by establishing “boundaries of analysis” that allow decision-makers to focus on the most important impacts and to avoid ever-deeper assessments of the remote impacts of the actions in question. Protocols for life cycle assessments reflect judgments about the appropriate boundaries in particular cases.

Finally, the regulatory agencies could establish a process to consider whether eligibility to earn clean heat credits should be further restricted to protect against secondary undesirable environmental and social impacts of switching thermal heat sources from fossil sources to alternatives. Some biofuels have been shown to have serious negative impacts and should not be awarded credits under the Clean Heat Standard, regardless of the calculated greenhouse gas savings (if any).

In addition, a threshold percentage standard of improvement might also be employed to discourage fuel substitutions that may only marginally improve emissions.⁴⁶ Moreover, it would also be possible to design upper limits on the total contribution that could be credited from particular clean heat fuels or technologies — for example, an upper limit on the total quantity or fraction of biofuels that meet the threshold set for their life cycle greenhouse gas emissions. It is also important to consider the long-term goals of decarbonizing heating when assessing the potential short-term costs of switching to one technology or fuel versus another.

Obviously, a Clean Heat Standard can be designed in many ways, and particular resource choices can be included, limited or required to meet the Commonwealth's policy goals. These choices deserve careful attention, because limiting options will reduce the range of market-based consumer choice, may raise overall compliance costs, and could slow the pace of greenhouse gas reductions. These trade-offs are issues that need to be handled carefully, but the public and regulatory processes available in Massachusetts can address them.

Creation, Ownership and Transfer of Clean Heat Credits

Causation Is Not Required to Acquire Credits

One of the most attractive features of the Clean Heat Standard 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 2021 Climate Roadmap law requires specific levels of emissions reduction at multiple points between today and 2050. A Clean Heat Standard is an overarching policy tool for ensuring that those reductions are achieved in the Commonwealth's thermal sector. Thus, what matters is whether emissions actually go down and the correct number of clean heat credits have been generated and retired.

It is important that programs and actors who deliver clean heat savings can be paid in credits for those actions. However, for the main purpose of the law, it does not matter who generates those credits or why they were generated. If many of the credits would have been generated through natural evolution of the market (e.g., customers buying heat pumps or weatherizing homes on their own, without any programmatic inducement), that would simply mean that the level of effort required by obligated parties to acquire the right number of credits — and the cost they would need to incur to do so — will be lower than if natural market forces would not produce much change on their own.

⁴⁶ For example, the APS statute requires at least a 50% improvement as a qualification condition for APS inclusion. Higher or lower thresholds could be set for different types of resources.

This is akin to how most electricity renewables mandates work. Electric utilities must show that a certain percentage of their electric portfolio each year comes 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, it can use them to demonstrate compliance with its RPS obligation.

Customers Own Their Clean Heat Credits

It is important to note that as a starting provision, ownership of clean heat credits should begin with the end-use customer⁴⁷ whose fossil heat consumption has been reduced. That customer can decide whether to transfer the credits to the contractor, installer or fuel supplier who provided the clean heat services, sell them in the market or hold them for future use. In many, if not most, cases we can expect the provider of the service to contract with the customer for ownership of any credits and most likely offer an incentive payment or discount on the service provided. There is a great deal of experience in marketing energy efficiency and other energy services to demonstrate that the flexible use of discounts and incentives can spur customer uptake of the measures in question.

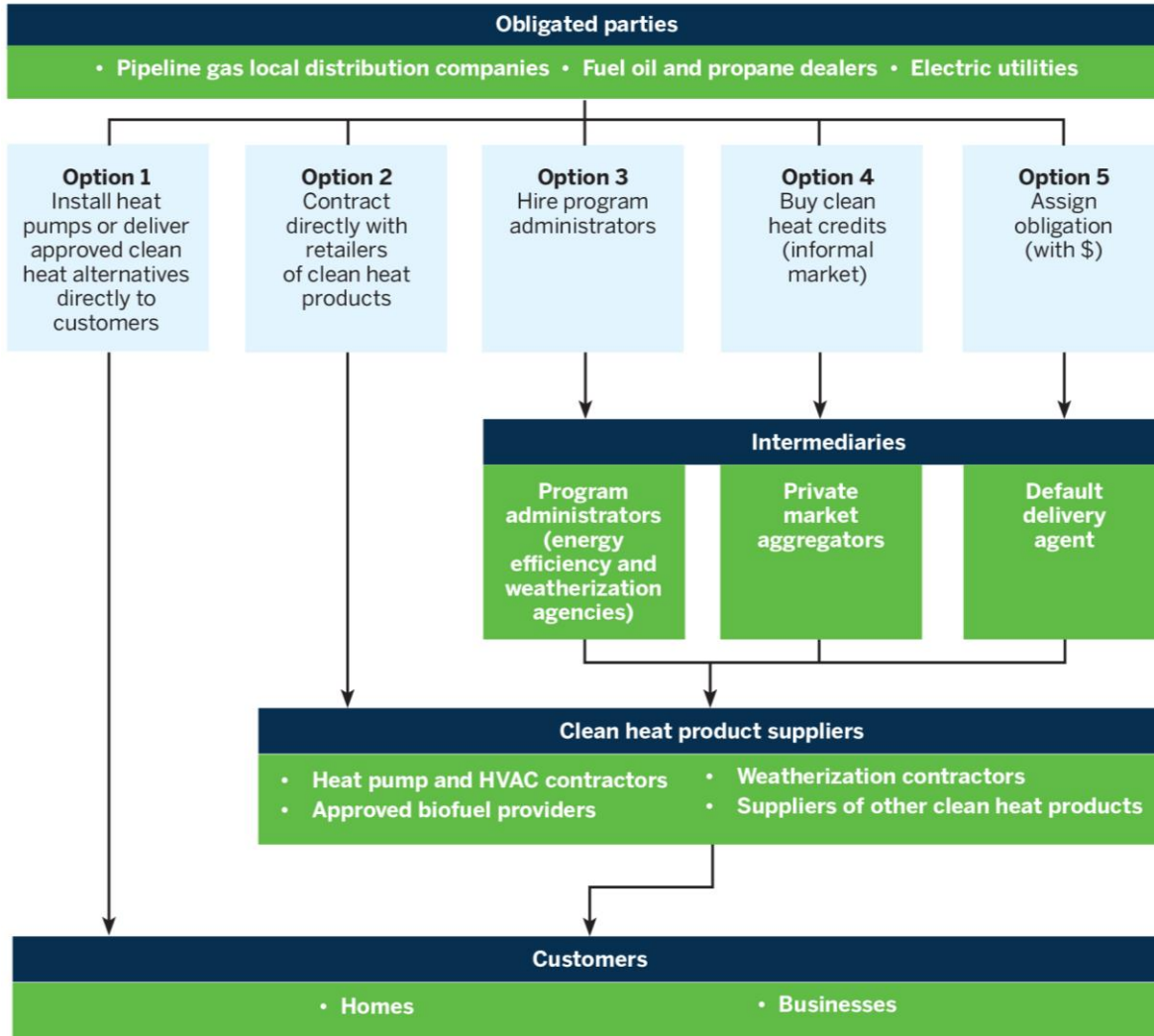
This customer flexibility will serve several purposes. It will broaden the range of options for obligated parties and create greater competition in the market, lowering the cost of compliance with the Clean Heat Standard. It should also make it easier for businesses selling clean heat products and services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

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 on the next page.⁴⁸

⁴⁷ Adjustments will be needed for landlord-tenant arrangements and related business arrangements where the occupier and operator of a building space is different from the owner of the property or the owner of the thermal equipment. For long-lived measures (e.g., new air-source heat pumps), RAP suggests that the person or entity that owns the newly installed equipment would be the initial owner of the clean heat credits.

⁴⁸ Adapted from Cowart & Neme, 2021.

Figure 10. Potential paths for earning clean heat credits

Source: Adapted from Cowart, R., & Neme, C. (2021). The Clean Heat Standard

1. Obligated parties should have the option to **generate credits directly**, by helping customers to install different emissions reduction measures (e.g., heat pumps and weatherization of buildings) or by purchasing and selling zero- to low-carbon fuels to customers, as this is the simplest way for them to comply with the Clean Heat Standard.
2. If an obligated party does not want to work with customers directly, it could **hire contractors to install** clean heat measures on its behalf. This is analogous to how many utility efficiency programs operate in Massachusetts and across the country.
3. 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.
4. 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, generating credits that could then be sold to any obligated party. When an obligated party buys those credits, it would defray the cost of making the heat pump sales, ultimately lowering costs to customers or increasing the profitability of the business selling the clean heat products.

5. The final option would be making a payment to assign emissions reduction obligations to a **“default delivery agent”** designated by the lead agency implementing the Clean Heat Standard. This could be an option of last resort, providing an out for any obligated party that prefers making a payment to having to deal with the planning and management of efforts to acquire credits in some other way. The default delivery agent would then be required to use the funds to deliver clean heat savings to consumers.

Another important aspect of flexibility is the ability of an obligated party to acquire clean heat credits not just from its own customers, but for measures installed in any Massachusetts home or business. That would include customers who buy fossil fuels from other obligated parties. For example, pipeline gas retailer A could acquire credits resulting from installing heat pumps in homes served by pipeline gas retailer B or by weatherizing a home. Or fuel oil company A could acquire credits from an HVAC company that originally came from the installation of a heat pump in a home that had bought fuel oil from provider B.

Regardless of which of these options or combinations of options are utilized, a mechanism would be needed to register credits when they are claimed and track them when they are sold, to create a strong credits market and to avoid double-counting of credits. This is not a new challenge. For example, it currently exists to a degree with regard to bidding of efficiency resources into the New England Independent System Operator’s capacity market and the attribution of renewable energy credits to obligated parties throughout the New England states.

Managing Credits From Long-Lived Measures

Some clean heat measures have a one-year life. For example, a gallon of zero- or low-emissions clean fuel reduces greenhouse gas emissions only in the year in which it is burned. Other clean heat measures, such as heat pumps and home weatherization projects, provide GHG emissions reductions for 15 years, 20 years or longer. The Clean Heat Standard needs to ensure that these long-lived measures are adequately supported, and it needs to assign emissions reduction credit values over the course of years. Such support is also appropriate because these measures cannot easily be reversed.

Long-Lived Measures Should Receive Lifetime Clean Heat Credits

There are, broadly, two ways to ensure that long-lived clean heat measures receive credits in proportion to the emissions they will avoid over their useful lives. One option is to credit a multiyear measure with its full lifetime emissions reductions in the year it is installed. For example, if a heat pump had a 15-year life and produced 10 clean heat credits per year, the regulatory agency could assign 150 credits to that heat pump in year 1. Thus, a heat pump installed in 2024 would provide 150 credits toward an obligated party’s 2024 credit

obligation (but no credits in subsequent years). The second option is to time-stamp a multiyear “strip” of credits for that measure. In this case, a heat pump installed in 2024 would earn 10 credits with a 2024 time stamp, another 10 credits with a 2025 time stamp, another 10 credits with a 2026 time stamp and so on through 2038 (the 15th year of its life). There may be other gradations of these two choices.

The first option of capturing the lifetime emissions reductions in the year a measure is installed is simpler and helps support installations by providing credits at the time that the investment expense is incurred. However, retiring a lifetime’s worth of credits in the first year is inconsistent with the statutory requirements to achieve defined levels of greenhouse gas emissions reductions in specific years. It would result in substantially lower levels of emissions reductions in any given target year than required by the GWSA and the 2021 Climate Roadmap law. In addition, fully accelerating lifetime emissions reductions into the early years of the Clean Heat Standard program would add substantially to the supply of credits in those years, reducing credit prices and weakening the price signal that the program is intended to deliver to ensure substantial reductions.⁴⁹

To illustrate this problem, consider a hypothetical situation in which obligated parties currently have 300 units of greenhouse gas emissions and face the statutory objective of a 40% reduction in current emissions by 2030 ($300 \times 40\% = 120$ units of GHG reductions by 2030). Assume each heat pump produces 1 unit of GHG reduction per year, and each heat pump lasts 15 years. If a heat pump’s lifetime emissions reductions can all be claimed in the year it is installed, the obligated party would need to install only 36 heat pumps by 2030. The 36 heat pumps are expected to deliver 120 units of reduction eventually but will deliver only 36 units of GHG reduction in 2030, or only a 12% reduction from current emissions — far short of the 40% required by statute.⁵⁰

Credits Awarded for Long-Lived Measures Should Be Protected

Regulatory agencies will, after appropriate public processes, establish clean heat credit values for a range of approved actions. These credit values will need to change over time as technologies and situations change and as everyone learns how particular measures work in practice. That is expected and necessary. However, it will be important to not alter the number of credits originally awarded at the time a long-lived measure was installed. For example, if in the fall of 2025 the regulatory agency approves an assumption that a 3-ton centrally ducted heat pump provides a defined stream of clean heat credits across the 15 years of its assumed life, any heat pump installed in 2026 would earn those credits in 2026 and each year thereafter through 2040 (its 15th year). Those credits would remain as assigned in 2026, even if a future evaluation suggests that such heat pumps produce more or less greenhouse gas emissions reduction than the quantity assigned in 2025.

This approach provides certainty for obligated parties regarding the number of credits they can earn for different measures. The market value of credits in each of those future

⁴⁹ This is akin to the problem faced in some greenhouse gas cap-and-trade programs, including the European Trading System, which created a large “overhang” of excess credits due to generous crediting of offsets and early actions. See Cowart, R., Buck, M., & Carp, S. (2017). *Aligning Europe’s policies for carbon, efficiency, and renewables*. Regulatory Assistance Project. <https://www.raonline.org/knowledge-center/aligning-europes-policies-for-carbon-efficiency-and-renewables-creating-a-virtuous-cycle-of-performance-and-emissions-reduction/>

⁵⁰ For a detailed explanation of this issue, see Cowart & Neme, 2021, pp. 50-52.

years, however, may be higher or lower than the market value of credits in the year the heat pump was installed. This result is similar to the risk that renewable energy providers face with respect to the value of renewable energy credits over the lifetime of a wind turbine or solar farm. It is also the primary reason that states have chosen to augment the broader RPS requirements with policies such as carve-outs and long-term contracting requirements. Therefore, decision-makers need to be conscious of the potential impact of price volatility on the ability of clean heat credits to attract sufficient clean heat investments. Options to address this issue are discussed in the next section.

Program Options to Encourage Investments in Long-Lived Measures

All policy options aimed at transforming the heating sector must overcome the slow turnover rates in buildings and heating systems and the high upfront costs of making long-term changes. The Clean Heat Standard is not unique in this regard, but it does offer some unique approaches to the problem. RAP recommends that policymakers consider a variety of options that could accelerate investments in long-lived measures under the standard, without undermining the emissions reduction goals the program needs to meet. These options are especially important to spur investments in weatherization (particularly low-income weatherization), heat pumps and renewable district heat systems. Among the options to consider are:

- Securitizing or contracting for the credits earned by long-lived measures. An alternative to putting a lifetime of credits into the market in year 1 of the measure's life is to securitize their value. Massachusetts could create or commission a patient lender or buyer of clean heat credits, which could pay for them at the time of installation and release them into the credit market in the years the measure is operating. This could be paid for in a number of ways, including green bonds, housing finance tools, loans secured by tariffed on-bill financing and other environmental finance tools.
- Carbon revenues could be used to finance clean heat investments, either as part of a securitization package or directly, as an element of a cap-and-invest program that could operate in tandem with the Clean Heat Standard.
- Utility regulation could support these outcomes. Regulated fossil gas utilities could be obliged, as part of their Clean Heat Standard obligation, to deliver a set fraction of clean heat credits from qualified long-lived measures. Alternatively, or in combination, regulated electric utilities could be directed to provide financial assurances that would encourage installation of qualified measures. In the case of weatherization, heat pumps and heat pump water heaters, financial tools such as tariffed on-bill financing could help to overcome the price barriers that customers face in installing the measures. The utility could purchase and hold the clean heat credits as part of that financing package.
- The Clean Heat Standard itself could be designed to ensure that an adequate fraction of all clean heat credits are derived from long-lived measures or those measures that are especially valued for public policy reasons (e.g., low-income weatherization, heat pumps, renewable district heating). This could be done through a credit carve-out or tiered credit system, as was done for solar electricity under various renewable portfolio

requirements. Carve-outs are similar to the time-stamped credit approach in that the energy is counted on par with other options in calculating compliance with the broader annual standard, but it is different in that it can be used to require (vs. encourage) particular project categories.

The list above is by no means exhaustive. Whatever path is chosen, policymakers need to consider the trade-offs between a Clean Heat Standard program that leaves the mix of qualified solutions to the market, as chosen by providers and customers, and one that affirmatively promotes selected solutions that may also advance other public policy objectives.

Credit Markets and Compliance Flexibility Mechanisms

Several compliance flexibility mechanisms are typically offered in programs of this type. It is not expected that each individual fossil fuel provider acquires sufficient credits directly in a given year to satisfy its compliance obligation. First, the most straightforward flexibility mechanism is credit transfer, which in most cases will be structured as a purchase and sale in exchange for other valuable consideration. This requires a system for credits to be transferred to other parties, and appropriate security measures are necessary to ensure that credits are not transferred without the proper permission from the current owner. With these basic administrative structures, an informal credit market could arise but there are also more formal markets and exchanges that could be set up by the state agency in charge.

Second, obligated parties may acquire more clean heat credits than they need to meet their obligation for a given year and may “bank” those credits for use in a later year. Some amount of excess acquisition is highly likely to occur in many years if obligated parties see the cost of modest overcompliance to be lower than the cost of falling short of their obligations and having to make a noncompliance payment (see the discussion below on noncompliance payments). Allowing any such excess credits to be applied to a future year’s obligation will lower the cost of meeting the state’s emissions reduction goals. It will also enhance the likelihood of meeting annual goals by lowering the cost of overcompliance (since, from the perspective of the obligated parties, the credits from overcompliance are still useful and not wasted). Regulators will need to establish a system for tracking banked credits, but that should be relatively easy to implement. Any minted credit that has not yet been retired should continue to be registered in the system and thus can be used for compliance in the future.

However, the reverse option, known as borrowing, can have significant downsides. Borrowing credits from planned clean heat actions is not consistent with the goals of the GWSA and the 2021 Climate Roadmap law to physically deliver defined emissions reductions in specific years. Borrowing creates the risk that the borrowing entity will fail to perform in the future or even go out of business. These are unacceptable risks in an essential emissions reduction program, particularly since climate science tells us that near-term reductions are especially important to forestall the worst impacts of climate change. However, while not recommending it, RAP acknowledges that limited borrowing might be an option for addressing short-term market volatility, such as might be caused by abnormal variations in the weather or relative fuel prices.

Instead of borrowing, an alternative compliance payment is a typical feature of renewable portfolio standards and can be determined in a Clean Heat Standard. This means that if an obligated party has not otherwise acquired sufficient credits to meet its obligation, then the party can pay a predetermined dollar amount per unit of undercompliance to satisfy the regulation. Of course, this does lead to physical undercompliance in a given year, but the alternative compliance payment should be set at a level high enough to pay for near-term delivery of savings by other means. A good alternative compliance payment can provide a level of cost certainty for obligated entities and can lower the downside scenarios of potential overall compliance costs.

Program Administration

There are several administrative functions that one of the EEA agencies (the Department of Environmental Protection or Department of Energy Resources, which this paper refers to collectively as the regulatory agencies) would need to perform to establish and operate a Clean Heat Standard, such as preparing and promulgating regulations. Per Massachusetts law, the implementing agency would need to seek stakeholder input and initiate a public comment process. These processes should emphasize input from environmental justice and overburdened communities. This would serve as the foundation for the systems that follow to administer the program. The principles noted earlier can serve as a starting point for considering the process and areas for focus as the regulatory agencies begin their work and as touchstones to ensuring that the program design will meet the aims of the Commonwealth.

Administrative functions include areas such as:

- **Minting credits.** This requires a system that provides for the serialization of unique credits that can be used in a data system to track who buys, sells or owns them. The system also needs a mechanism that allows for banking credits to use in the future and a function to retire credits that are used to meet compliance obligations.
- **Reporting by obligated entities, and amendment/revision processes.** The data system needs to have functions that enable the obligated entities to demonstrate how they have met their compliance obligations and provide the regulatory agencies with the ability to amend, review or update these parties on at least an annual basis or perhaps more frequently, or even on demand (as businesses are sold and ownership changes).
- **Enforcement, fines, penalties and corrective action.** The regulatory agencies need to have authority to enforce the program if obligated entities do not meet their obligations. This needs to include fines and penalties that promote compliance (i.e., are significant enough to be an incentive to comply), and the regulatory agencies need to be able to request any corrective action deemed necessary to discourage any noncompliance from being repeated. For example, in the RGGI program if the surrendered allowances are not sufficient to meet a compliance obligation, the offending party must then surrender three allowances for every allowance it did not submit (a 3:1 penalty). That is in addition to paying a monetary penalty.

- **Program reviews and updates.** A program review every few years (RGGI's requirement is every three years) can ensure that improvements are made in the program and its governing regulations over time as issues arise. It also provides an excellent mechanism for updating areas like:
 - What options are creditable for compliance and how various options are valued.
 - How life cycle emissions are calculated as the science evolves.
 - Whether the compliance obligation needs to be increased to ensure that the GWSA goals are being met.
- **Centralized procurement mechanisms or default delivery agent structures.** These concepts envision a mechanism (which doesn't have to be a regulatory provision of the agencies) where a fuel dealer association could serve as a joint purchasing agent of credits (or an agent for developing credits) on behalf of its members.

The regulatory agencies will need to evaluate whether to undertake the tasks noted above themselves or set up other mechanisms through contracts; for example, the analysis of life cycle emissions by one of the national laboratories or a company familiar with GREET.

Other administrative functions may arise as the public process of implementing the program begins to be developed. The list above is not intended to be exhaustive.

Conclusion: Performance Standards Can Drive Thermal Decarbonization

Renewable energy standards and other performance standards have worked well to drive change in the electricity sector. In some jurisdictions, performance standards also apply to the regulated pipeline gas utilities successfully.

National and local experience with these performance standards reveals five broad observations:

1. **Performance standards can achieve change at scale.** Renewable portfolio standards and energy efficiency resource standards are responsible for a large fraction of the renewable energy and energy efficiency services received by end-use customers in the states that have enacted them.
2. **Performance standards can keep costs lower.** These programs have delivered clean energy improvements largely in the absence of carbon taxes or cap-and-trade regimes. They can bring about systemic changes without relying on higher prices as the main tool to change consumer behavior. Carbon revenues can be quite helpful, but carbon taxes are not required to deliver renewable energy or energy efficiency to replace fossil energy.

3. **It's important to focus on adding “good” resources, not just on limiting “bad” resources.** In many states the renewable portfolio standard and efficiency mandates 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-emissions resources to energy systems, they have displaced higher-carbon energy sources and substantially reduced environmental harms, including greenhouse gases.
4. **Performance standards can elevate resources that are most needed and most desirable.** Many states have adopted portfolio standards with tiers or set-asides for resources that were especially desired or needed additional assistance, especially in the early years. Distributed resources, solar generation and other preferred resources can be called out in a performance standard to ensure delivery in the program. Efficiency programs have taken a similar approach, especially to ensure service delivery to low-income customers or in underserved communities.
5. **Regulators know how to administer them.** Performance standards require ways to measure and count performance, and states across the country have decades of successful experience. The details can be complicated, but across all these programs, utilities, governmental regulators and stakeholders have developed the procedures and verification methods to implement them successfully.

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 RPS 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.

Designing the Clean Heat Standard to focus on the delivery of resources that are perceived as good avoids arguments over whether and how to limit the use of fossil resources that most people and businesses have long relied upon. As with numerous energy efficiency programs, Clean Heat Standard success requires finding ways to work with both upstream vendors and end-use customers to deliver solutions in millions of distributed locations. Multiple competitors, including non-utility providers, will increase the range of consumer choices in a sector where consumer acceptance is crucial. The standard 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.

The Clean Heat Standard would be a performance-based obligation, without needing detailed prescriptions, imposed on fossil fuel sellers (or all heating energy providers) on a competitively neutral basis. Competition among obligated providers creates incentives for innovation and better customer service while lowering costs over time. However, as with

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.

RPS and energy efficiency programs, a Clean Heat Standard can be designed with special tiers or set-asides for minimum and maximum percentages of resources in order to meet public policy goals. This could include positive assurance percentages for desired resources (e.g., beneficial electrification, service to lower-income households and communities), and caps on those resources that are deemed less desirable in the long run. Also like the RPS and efficiency programs, the Clean Heat Standard is not a fee-based system or a tax. Its continued success does not depend on annual governmental appropriations.

Finally, renewable portfolio standards have guided numerous electricity providers to new business models that work sustainably in the emerging low-carbon economy. In like manner, the Clean Heat Standard would be designed to help Massachusetts' heating enterprises, fossil gas, delivered fuel and possibly electricity companies to become clean heat suppliers, while helping their customers switch to cleaner, sustainable heating choices. This type of transition has not yet occurred at scale and is unlikely to occur through the actions of a few early adopters and the public programs now operating in the Commonwealth. To meet Massachusetts' climate objectives, a much larger driver is required. A Clean Heat Standard, operating in combination with a strong suite of complementary policies, could provide that framework.



Energy Solutions for a Changing World

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