Comments Received: Clean Heat Standard
February 10, 2024 – April 8, 2024

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February 16, 2024

via email

Massachusetts Department of Environmental Protection
100 Cambridge Street Suite 900
Boston, MA 02114

Re: Stakeholder input to inform the development of a Clean Heat Standard (CHS) Discussion Draft Regulation Voluntary Clean Heat Standard Early Registration Program

Dear Commissioner Heiple:

Acadia Center appreciates the opportunity to provide feedback on the Discussion Draft Regulation Voluntary Clean Heat Standard Early Registration Program ("Early Registration Program") provided by the Massachusetts Department of Environmental Protection (DEP) for a Clean Heat Standard (CHS). Moving quickly over the next several years to decarbonize the building sector through the deployment of heat pumps will be critical to achieving our Commonwealth's Net Zero Emissions requirements, and this Early Registration Program proposal represents an essential step forward. Acadia Center applauds DEP for its bold vision and for recognizing that the challenges posed by this transition are incredibly complex. In particular, the exclusion of liquid biofuels, RNG, and hydrogen from qualifying under this Early Registration Program demonstrates that the DEP has a strong grasp of the stakes involved.

These comments are narrowly focused on the Early Registration Program proposal. More extensive comments on the overall design of the CHS can be found in Acadia Center's December 21 CHS Draft Framework comments. We look forward to continuing to work with DEP and diving in more deeply to analyzing the potential impacts of the CHS in the future.

Make it Clear That Early Action Full Electrification Projects Are Eligible for Generation of Future Emissions Avoided Credits

The Voluntary Clean Heat Standard Early Registration Program document developed by DEP mentions that "[c]redits associated with the ongoing operation of a heating system are not included in the early action program, although projects that qualify in the early action program *may receive administrative benefits in generating credits associated with operation of a clean heat system once a Clean Heat Standard is established*." The phrasing of "may receive administrative benefits" is vague. **Acadia Center strongly urges that DEP develop Early Registration guidance that makes it clear that Early Registration full electrification projects will definitively generate emissions-avoided clean heat credits (CHCs) once the program officially kicks off in 2026, assuming they meet the compliance requirements demonstrating the system is actually operating in its intended capacity in, for example, 2026 – 2032.** Mechanisms for ensuring that installed heat pump systems are actually being used to provide space heating was discussed in great detail in Acadia Center's December comments. Making it clear that these Early Registration full electrification projects will be eligible for future emissions-avoided CHCs will send a strong market signal encouraging the deployment of full electrification projects prior to official launch of the CHS in 2030, and this strong market signal will likely be necessary to actually achieve the 2030 buildings subsector emissions target of 15.0 MMT CO_2e established in the Clean Energy and Climate Plan (CECP).

On the December 8th CHS webinar, DEP staff appeared to clarify that the intent was to communicate that Early Registration full electrification projects would be eligible for the generation of emissions avoided CHCs once the full

CHS program kicks off in 2026, but making the written language in the Early Registration Program Draft Regulation clearer on this point is of critical importance.

Maintain Focus of Early Registration Program on Heat Pump Deployment

The proposed Early Registration Program makes it clear that liquid biofuel, gaseous biofuel, and hydrogen heating projects are not eligible for "early action" CHCs. Acadia Center wholeheartedly agrees that the focus of the Early Registration Program should be on the deployment of air-source and ground-source heat pumps systems capable of meeting 100% of a residence's heating needs. As the 2050 Decarbonization Roadmap and CECPs articulated, heat pump deployment is a clear "no regrets" strategy as the Commonwealth moves towards achieving overarching building decarbonization targets, and thus makes sense for eligibility under the Early Registration Program. Conversely, Acadia Center has significant concerns with the benefits (or lack thereof) associated with building decarbonization strategies that rely on liquid biofuels, gaseous biofuels, and hydrogen, as discussed in more detail in Acadia Center's December 21 CHS Draft Framework comments.

DEP's proposed language to date has made it clear that gaseous biofuels and hydrogen will not be eligible for either the Early Registration Program or the fully implemented CHS. Acadia Center fully endorses this decision for reasons discussed in detail in our December comments. With regard to liquid biofuels, as discussed in our December comments, while it may make sense for certain forms of liquid biofuels derived from organic waste feedstocks and deemed eligible under the Alternative Portfolio Standard (APS) to receive *some level of credit* under the fully implemented CHS, **Acadia Center agrees with DEP that making liquid biofuels eligible under the Early Registration Program is inadvisable at this time.** There is too much uncertainty regarding the supply, costs, and true GHG reduction potential of liquid biofuels to deem these fuels eligible under the Early Registration Program. Further investigation by DEP and stakeholder engagement on this topic is needed to determine which, if any, liquid biofuels are eligible under the fully implemented CHS. This process will take time.

Expand the Early Registration Program to Include Heat Pump Water Heaters

As proposed, conversion of fossil fuel water heating systems to electric heat pump water heating systems is not eligible for the generation of CHCs under either the Draft Framework or the Early Registration Program. Acadia Center views this proposal as a significant missed opportunity to accelerate decarbonization of water heating in Massachusetts. This topic was addressed in detail in Acadia Center's December comments. While those comments focused on making heat pump water heating eligible for the generation of CHCs in the context of the Draft Framework, the same logic extends to Early Registration eligibility. **Like deployment of heat pumps for space heating, electrification of water heating via heat pumps is a clear "no regrets" building decarbonization strategy and heat pump water heaters should be deemed eligible for credit generation under the Early Registration Program.** Inclusion of heat pump water heaters in the Early Registration Program would send a clear market signal that could significantly accelerate deployment of this technology. Water heating represents 23% of building sector emissions in the state,[1] and a failure to make water heating electrification eligible under the CHS will make it impossible for the CHS to drive the achievement of "near zero" emissions levels in the building sector by 2050.

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[1] https://www.mass.gov/doc/buildings-sector-technical-report/download, at 9

Only Cold Climate Heat Pumps Should Be Eligible Under the Early Registration Program

The proposed Early Registration Program highlights the importance of a full electrification eligibility requirement whereby ASHPs "meet Cold Climate Air Source Heat Pump Specification Version 4.0 published by Northeast Energy Efficiency Partnerships effective January 1, 2023, or any version thereafter." Acadia Center wholeheartedly agrees with this requirement. It's critical that all heat pumps installed in New England be cold climate heat pumps – the marginal cost difference of installing cold vs. non-cold climate heat pumps is minimal. Further, while not directly relevant to full heating electrification projects, which is the focus of the Early Registration Program, deployment of cold climate ASHPs will better position hybrid buildings for 1) Eventual full electrification and/or 2) More flexibility in future adjustments to the "switch over" temperature of the hybrid system. Greater future flexibility to lower this switch over temperature, for example from 30F to 5F, comes with a multitude of potential benefits including reducing utility bill costs to consumers and reducing GHG emissions. This topic is addressed in more detail in Acadia Center's December 21 CHS Draft Framework comments.

Conclusion

In summary, Acadia Center appreciates the opportunity to comment in the early stages of this important CHS Early Registration Program Draft Regulation development. We commend DEP on several key elements of the proposed Early Registration Program, including with respect to the ineligibility of biofuels and hydrogen and the cold climate heat pump requirement. Despite this, we do raise several outstanding questions and concerns regarding other program elements and design proposals. Thank you in advance for the consideration and review of our input, and we look forward to engaging further with DEP in the months ahead to refine both the Early Registration Program and Draft Framework and move toward implementation. If you have any questions or concerns, please do not hesitate to reach out.

Sincerely,

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April 5, 2024

via email

Massachusetts Department of Environmental Protection
100 Cambridge Street Suite 900
Boston, MA 02114

Re: Stakeholder input to inform the development of a Clean Heat Standard (CHS) program

Dear Commissioner Heiple:

Acadia Center appreciates the opportunity to provide feedback to both 1) The March 2024 proposed potential changes to the Clean Heat Standard (CHS) Draft Framework ("Framework) as outlined in the updates to the CHS FAQ Question 0 and 2) The March 2024 CHS Non-Residential Building Crediting Discussion Document ("Non-Residential Discussion Document")provided by the Massachusetts Department of Environmental Protection (DEP). Decarbonizing the building sector equitably will be critical to achieving our Commonwealth's Net Zero Emissions requirements, and this proposal represents an essential step forward. Acadia Center applauds DEP for its bold vision and for recognizing that the challenges posed by this transition are incredibly complex. In particular, the exclusion of RNG and hydrogen from qualifying under this Framework, combined with the strict proposed blending limits on non-waste liquid biofuels, demonstrates that the DEP has a strong grasp of the stakes involved.

However, given the complexity of the proposed Framework and the lack of modeling and quantitative analysis provided by DEP underpinning many of the policy design elements proposed, it was challenging to fully evaluate the proposed changes to the Framework. These comments therefore represent *initial thoughts* from Acadia Center on a wide range of topics related to the proposed changes to the Framework. We look forward to working with DEP and diving in more deeply to analyzing the potential impacts of the CHS for the remainder of the year.

Overview of Initial Comments

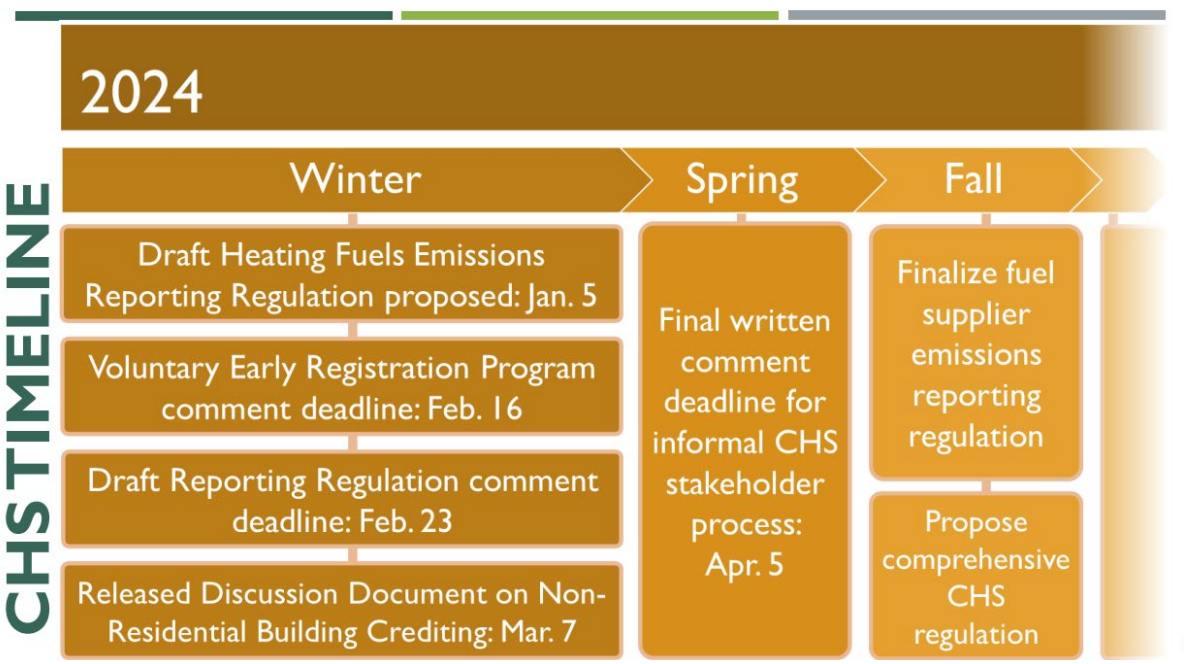
In the following sections, Acadia Center provides initial commentary and recommendations pertaining to: Stakeholder Process; Policy Design Changes proposed in the FAQ; and Hydrogen and Renewable Natural Gas in the Non-residential Building Sector. Acadia Center has also worked closely to coordinate with and contribute to a set of joint comments from environmental stakeholders, entitled "Joint Comments by Climate Advocates." We express our support as a signatory to those comments and take the opportunity to further elaborate on issues and recommendations in these standalone comments, which solely reflect the input of Acadia Center.

CHS Draft Framework Stakeholder Process

Since the beginning of the CHS program development process, when Acadia Center responded to the March 2023 MassDEP Stakeholder Discussion Document in May 2023 joint comments from environmental stakeholders, we have been stressing the need for modeling, quantitative analysis, and deep stakeholder engagement on a range of highly technical topics in order to inform sound CHS policy design. We echoed these calls for more detailed quantitative analysis and technical stakeholder engagement in our December 2023 comments in response to the release of the Framework. To date, we have still not seen modeling, quantitative analysis, and deep technical stakeholder engagement to policy design decisions within the Framework and proposed changes to the Framework.

This is highly concerning to Acadia Center given the wide range of highly complex nature and potentially wide-ranging economic impacts of the policy. Conducting and sharing technical analysis with stakeholders will enable stakeholders to understand and analyze the policy design and potential impacts of the policy design, which will, in turn, increase the quality and technical rigor of constructive feedback provided by stakeholders. While Acadia Center acknowledges that there is still time for this technical analysis to take place and be shared with stakeholders, the clock is ticking and sharing this analysis with stakeholders as early in the program design process as feasible will benefit the overall program design process. The most recent April 1st CHS Technical Session shared the 2024 program development timeline with stakeholders, but it's not clear what technical analysis or technical engagement with stakeholders will be taking place between the April 5th final written comment deadline for the information stakeholder process and the proposal of a comprehensive CHS regulation in the fall. In our comments below, we 1) Suggest specific areas of policy design that could benefit from rigorous modeling and quantitative analysis and 2) Repeat our suggestion that the process would benefit from the formation of a "Technical Working Group" of 8-12 technically-inclined stakeholders representing a wide variety of stakeholders.

CHS Program Development Timeline as of April 1, 2024



FAQ "Question 0" Potential Changes to Draft Framework

The CHS FAQ document, which has been updated continuously over the last several months by DEP, was updated in March 2024 to include a "Question 0" that proposed a number of significant potential changes to the Framework released in November 2023. Acadia Center's response to these proposed changes is presented in the subsections below.

FAQ Question 0, Bullet 1: Proposed Changes to Emissions Reduction Standard

The first bullet in FAQ Question 0 proposes lowering the CHS emissions reduction standard from 5 MMT in 2030 to 4 MMT in 2030 to *"better accommodate the possible inclusion of water heating"* and suggests *"leaving room for residential water heating crediting within the scheme".* The 25% reduction (5 MMT to 4 MMT) in the emissions reduction standard appears to be a reaction to the fact that approximately 25% of emissions in the building sector in the Commonwealth are estimated to come from sources other than space heating (primarily domestic water heating which makes up 23% of building sector emissions).[1] Although, it is a bit confusing as to how the 4 MMT figure was landed on.

The Non-Residential Discussion Document mentions that, for non-residential buildings, *"…emission reductions would be credited based on the full amount of emission reductions realized on site, including emission reductions resulting from weatherization measures and electrification of water heating."* In other words, as proposed, the CHS would include water heating electrification in non-residential buildings as an eligible clean heat measure but would not include water heating electrification in residential buildings as an eligible measure. To be clear, Acadia Center supports making water heating electrification an eligible measure across all buildings types, as we discussed in greater depth in our December comments. If we assume that non-space heating emissions make up 25% of total building sector emissions, some significant portion of that 25% comes from non-residential domestic hot water heating. As a result, Acadia Center would expect the proposed emission reduction standard to be higher than 4 MMT given the logic used by DEP in FAQ Question 0 bullet point 1. This is an example where seeing the underlying quantitative analysis informing policy design decisions would be beneficial to stakeholders and aid their ability to better understand the proposed changes to the Framework.

Perhaps more importantly, decreasing the annual emissions target from 5 MMT to 4 MMT was justified under the pretense of "leaving room" for residential water heating electrification, but residential water heating electrification is still proposed by DEP to be an ineligible clean heat measure under the current CHS proposal. This design decision significantly increases the risk of not reaching the overarching 2030 and 2050 building sector GHG sublimit. The proposal by DEP to not include residential water heating as an eligible clean heat measure in the Draft Framework is the source of this risk, and the proposal to lower the CHS emissions reduction target from 5 MMT to 4 MMT is essentially DEP's acknowledgement of the risk created by excluding residential water heating electrification from being an eligible measure under the program. This begs the obvious question – why not just include water heating electrification as an eligible clean heat measure under the CHS so the Commonwealth 1) Has assurance that a specific program (the CHS) is responsible for ensuring that water heating electrification occurs at the pace necessary to achieve the CECP building sector sublimit and 2) Is able to more fairly spread the cost of water heating electrification transition across all heating fuels, rather than placing the majority of the transition burden on electric rates as MassSave currently does?

DEP's rationale for this design decision seems to be based on limiting the administrative burden of the CHS. Question 23 of the FAQ states that "other (non-space heating) equipment types are not addressed to limit program complexity". Question 35 of the FAQ attempts to address this concern of not including residential water heating electrification in the CHS, stating, *"However, the CHS could still have an indirect impact on water heater emissions over time. This may occur because consumers who have made the decision to electrify their heating systems may be more likely to choose*

[1] https://www.mass.gov/doc/buildings-sector-technical-report/download, at 9

other electric appliances in the future for the simple reason that they will have gained experience and familiarity with general concept of electrification." The term "may be more likely" does not inspire a lot of confidence, particularly since no studies are cited and no quantitative analysis is provided supporting this line of thinking.

While Acadia Center acknowledges that expanding the CHS to cover residential water heating will present some level of additional administrative burden on DEP – the benefits of expanding the program to cover water heating far exceed the costs of this additional administrative burden. It also seems intuitive that if DEP is currently proposing to include non-residential water heating electrification as an eligible measure that this eligibility would be extended to cover residential water heating electrification. In terms of streamlining the residential water heating electrification verification process, it would be interesting, for example, for DEP to connect with the current MassSave program administrators to better understand how this verification currently works under the MassSave program and put some thought into how a similar process could be most efficiently implemented under the umbrella of the CHS. To date, it's not clear to stakeholders how much research and investigation DEP has done into this topic to assess the level of administrative burden and weigh the pros/cons of including/excluding water heating from the CHS. Given the magnitude of this policy design decision, water heating is an excellent example of a topic that could benefit from an in-depth Technical Working Group session (a concept previously proposed by Acadia Center).

FAQ Question 0, Bullet 2: Proposed Changes to Years of Emissions Reduction Credit Generation for Electrification Projects

The second bullet in FAQ Question 0 proposes limiting the emission reduction credit generation from heat pumps to no more than five years after initial installation/registration for any clean heat project. This is a significant departure from the original Draft Framework. The Draft Framework implied that a residential heat pump installed in, for example, 2026, would generate annual emissions reduction credits for every year a heat pump system remained operational at that home through 2050.[2] Although quantitative analysis on this topic was not provided by DEP, this potential change begs the question –how does this policy design pivot impact the total stream of credit values generated by a residential "full electrification" project in a given year? To help answer this question, Acadia Center calculated the projected total credit values (combing both the full electrification and annual emissions credit values) for a hypothetical residential non-low-income "full electrification" project in 2026 and 2030.[3]

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[2] The topic of what would happen if, for example, a full electrification heat pump system installed in 2026 reached end of life in 2040, was subsequently replaced in 2040 and then continued to operate through 2050, was not explicitly addressed in the Draft Framework, but the overall CHS emission obligation of 25 MMT CO_2 in 2050 implied a replacement system in the scenario outlined above would continue to produce emissions avoided credits, but would not generate a second full electrification credit.

[3] While the value of the credits will vary in the open market, the below analysis assumes the credit value is equal to the value of the equivalent alternative compliance payment. For example, the "full electrification" ACP value is proposed to start at $6,000 in 2026 and escalate to $10,000 in 2030, while the annual emissions avoided ACP value is set at a static level of $190/MT CO2.

Total Credit Value Generated by Residential Non-Low-Income "Full Electrification" Projects Completed in 2026 and 2030: Original Draft Framework vs. FAQ Proposed Changes

Original Draft Framework: 2026 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	$6,000
Annual Emissions Avoided (MT CO2)	5.0
Years Emissions Avoided Credits Generated	24
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	$22,800
Total Credit Value:	**$28,800**

Original Draft Framework: 2030 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	$10,000
Annual Emissions Avoided (MT CO2)	5.0
Years Emissions Avoided Credits Generated	20
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	$19,000
Total Credit Value:	**$29,000**

Revised Draft Framework: 2026 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	$6,000
Annual Emissions Avoided (MT CO2)	4.0
Years Emissions Avoided Credits Generated	5
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	$3,800
Total Credit Value:	**$9,800**
% Decrease Total Credit Value	**-66%**

Revised Draft Framework: 2030 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	$10,000
Annual Emissions Avoided (MT CO2)	4.0
Years Emissions Avoided Credits Generated	5
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	$3,800
Total Credit Value:	**$13,800**
% Decrease Total Credit Value	**-52%**

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As demonstrated in the tables above, the "five-year crediting" policy design decision decreases the total value of credits generated by a non-low-income full electrification project in 2026 by 66% and decrease the value of an equivalent project in 2030 by 52%, while the credit values generated by liquid biofuel blending remains unchanged from the original Draft Framework (biodiesel is typically purchased and consumed in same year so there is no "future stream of credits" to consider unlike heat pumps). This policy design decision significantly decreases the incentive for obligated parties to meet their obligations through the actual installation of heat pumps systems, opposed to meeting the obligation through liquid biofuels or ACPs. This impact is even more pronounced for fossil fuel obligated parties under the current proposal, as discussed in more detail later in the document, but it also appears to limit the motivation for all obligated parties, including electricity sellers, to pursue actual electrification projects.

Consider the case of an electricity seller (obligated party) deciding between pursuing a full electrification project versus ACPs in 2026. In the original Draft Framework, they would face a cumulative total of $28,800 in ACPs for every full electrification project they were obligated to achieve but failed to achieve. Under the changes proposed in the "five-year crediting" change, they would only face $9,800 in ACPs for every full electrification project they failed to achieve. This both 1) Dramatically lowers the level of incentives they are willing to provide to encourage full electrification projects and 2) Dramatically increases their odds of relying on ACPs as the primary compliance pathway. **This is the exact type of critical policy design decision that requires rigorous modeling and quantitative analysis to make an informed decision – to date that analysis has not been provided by DEP and stakeholders, like Acadia Center, are left trying to piece together the implications of these policy design decisions together without analysis to digest and react to.**

The second bullet point in FAQ Question 0 goes on to state: *"The draft framework creates the expectation that every heat pump in the Commonwealth will be eligible to earn CHCs in every year until 2050. **This is not likely to be necessary to ensure ongoing use of most heat pumps** and has the potential to lead to increasing program costs in the later years of program implementation. **If future program analysis suggests that a longer time period is desirable the five-year limit could be extended**."*

As currently constructed the CHS will be incentivizing both "full electric" residential heating systems (that can still retain a back-up fossil fuel heating system under the proposed definition) and "hybrid" residential heating systems that by definition retain a fossil fuel heating system. Hopefully, as Acadia Center suggested in our December comments, annual emission credits will be awarded to these projects based on electric billing data verifying the heat pumps are actually used to provide heating load during the winter. **The above quote from the FAQ suggests that, after the first five years of operation after install, it is "not likely to be necessary" to allow these systems to generate emission reduction credits to ensure that the heat pumps are actually used to provide heat in, for example, years 6 and beyond. However, it's not clear what this assumption by DEP is based on because no supporting analysis or discussion of literature reviews has been provided supporting this design decision.**

Take the case of a full electrification project completed in 2026. In the first five years of operation (2026-2031) there would be an incentive of up to $760/year (the equivalent ACP value[4]) for the customer's electricity seller to ensure the heat pump system is actually used for heating[5], but after year five that incentive would drop (and stay) at $0/year under the current DEP proposal. **In the case of a resident that has retained a back-up fossil fuel heating system, there's no incentive discouraging the resident from switching to 100% space heating reliance on that fossil heating system in years six and beyond. One could easily imagine this type of customer making a strictly financial decision based on which heating source (electricity vs. fossil fuel X) happens to be cheaper in a given winter.** This is a situation the Commonwealth should desperately be trying to avoid and is another key reason why the "five-year crediting" policy design decision is deeply flawed, particularly when the design decision is not backed up by any analysis of the relative impacts of the CHS on electricity versus fossil fuels rates.

Finally, in the quote highlighted above, DEP suggests that the program can extend the five-year crediting window down the road based on "future program analysis". It's not clear when this future analysis would be occurring, but presumably it would be associated with the proposed 2028 program review. The problem with this reactive approach is that obligated parties will be making decisions as soon as the program is launched (2026 or sooner to capitalize on Early Registration Program opportunities) on the levels of incentives they are willing to offer customers to install heat pumps and they will be basing the levels of incentives offered based on the projected future stream of emission reduction credits generated by the project. **If the policy design only provides credit generation certainty for the first five years of system operation, the obligated parties will react accordingly – they won't be banking on a policy design pivot X years in the future that increases the cumulative value of future credit flows they can expect from a project.** The number of years of emission reduction credit generation produced by heating electrification projects, the emission reduction ACP value, and the full electrification ACP value, the level of obligation on various energy suppliers, and a cap on the percentage of the total obligation that can be met via ACPs are all

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[4] 4 MT CO_2 avoided per year from full electrification project multiplied by an emission reduction ACP value of $190/MT CO_2

[5] As DEP suggests later in the FAQ default ownership of electrification emission reduction credits could be assigned to electricity sellers and this would *"...create an incentive for electricity sellers to encourage heat pump usage, possibly by offering discounts or other rewards to customers that utilize their heat pumps."*

complex, intertwined policy design decisions that need to be informed by modeling and quantitative analysis that has not been presented to stakeholders to date. Together, these policy design decisions should:

- 1) Send a strong signal to obligated parties that makes compliance via electrification more financially attractive than compliance via ACPs or liquid biofuel blend.
- 2) Ensure that the annual operating costs of heat pump heating systems for customers who have installed heat pumps are lower than the annual operating costs of fossil fuel heating equipment (that may or may not still be present in the building).
- 3) Ensure there is no "backsliding" of customers from reliance on heat pumps to provide all (full electrification) or the majority (hybrid) of space heating to demand to reliance on fossil fuel back-up systems due to an "emissions avoided credit generation cliff" (e.g., at the five-year mark as currently proposed).

FAQ Question 0, Bullet 3: Proposed Changes to Delay the Emission Reduction Credit Holding Requirement for Electricity Sellers

The third bullet in FAQ Question 0 proposes delaying the start date of the emissions reduction obligation on electricity sellers from 2031 to 2035. While this is generally a step in the right direction, no supporting analysis has been provided by DEP to address Acadia Center's concerns regarding the "potential regulatory burden on electricity sellers" that could disincentivize heating electrification via increased electricity rates, as discussed in more detail below. **The proposed change does not address our primary concern that the full electrification obligation placed on electricity sellers in the early year of the program will drive up electricity rates at a level that discourages both the installation and operation of heat pumps.**

For context, given future uncertainty surrounding a number of complex variables related to the building decarbonization transition in Massachusetts, Acadia Center is primarily evaluating the Draft Framework with an eye on the policy impacts over the first 5-6 year of the program (roughly 2026-2031). From a modeling perspective, it's easier to quantify potential impacts of the CHS over the next seven years than the next 26 years. Future program reviews will allow the framework to react and respond to future market conditions that are challenging to currently project. These future market conditions could and should influence certain aspects of future program designs changes.

As an example of Acadia Center's near-term focus, we proposed in our December Comments that, at a minimum, there should be no obligation of either type(full electrification or emissions) placed on electricity sellers in the early years of the program, until the current "price gap" between natural gas heating equipment operation and heat pump operation (on a $/btu of delivered useful heat to occupants) is closed to a level that makes heats pumps a clear winner over gas heating from a consumer annual operating cost perspective. Future program reviews could explore the question of placing *some level of obligation* on electricity sellers once this price gap is closed to a sufficient level, but any obligation on electricity sellers should not be considered until that point is reached. **This specific dynamic should be a top modeling priority of DEP to inform policy design.**

The context directly above is highly relevant to the proposal to delay the start date of emissions reduction credit obligation on electricity sellers from 2031 to 2035. The analysis below, conducted by Acadia Center, explores the total "avoided ACP value" obligation, in dollar terms, proposed to be placed on electricity sellers in the Original Draft Framework (top table) versus the proposed FAQ changes (bottom table).

CHS Obligation on Electricity Sellers: Original Draft Framework

	2026	2027	2028	2029	2030	2031	2032	2033	2034	First 6 Years: (2026-2031)	First 9 Years: (2026-2034)
Full Elec Obligation ($M)	$120	$193	$280	$383	$500	$575	$650	$725	$800	$2,050	$4,225
Emissions Obligation ($M)	$0	$0	$0	$0	$0	$285	$570	$855	$1,140	$285	$2,850
Total Obligation ($M)	$120	$193	$280	$383	$500	$860	$1,220	$1,580	$1,940	$2,335	$7,075

CHS Obligation on Electricity Sellers: Proposed FAQ Changes

	2026	2027	2028	2029	2030	2031	2032	2033	2034	First 6 Years: (2026-2031)	First 9 Years: (2026-2034)
Full Elec Obligation ($M)	$120	$193	$280	$383	$500	$575	$650	$725	$800	$2,050	$4,225
Emissions Obligation ($M)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Obligation ($M)	$120	$193	$280	$383	$500	$575	$650	$725	$800	$2,050	$4,225
% Change Total Obligation:										-12%	-40%

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As the top table demonstrates, in the original Draft Framework, the majority of the "obligation burden" placed on electricity sellers in the first six years and first nine years of the program came via the full electrification obligation. For example, in the first six years, this cumulative full electrification obligation ($2.1 billion) made up 88% of the total electricity seller obligation, and in the first 9 years the full electrification obligation made up $4.2 billion/60% of the total electricity seller obligation.

The bottom table demonstrates that pushing back the electricity seller emission obligation from 2031 to 2035 does nothing to alleviate the cumulative $2.1 billion full electrification obligation in the first six years of the CHS and only reduces the total obligation in the first six years (combined full electrification + emission reduction) burden on electricity sellers by 12% (from $2.3B to $2.1B). The impacts of pushing back the electricity sellers emission reduction obligation is more pronounced when the analysis is extended to the first 9 years of the program – it reduces the total obligation by 40% - but the core concern remains: **How will placing this $2.1 billion obligation burden on electricity sellers in the first six years of the CHS impact electricity rates, and, in turn, the relative operating costs of heat pump versus fossil fuel (and in particular natural gas) heating systems? This is an absolutely essential research topic that requires rigorous quantitative analysis to accurately inform policy design – to date, DEP has not provided any quantitative analysis on this topic. Acadia Center has been calling for this type of analysis since the Draft Framework was released in November 2023 and, to date, we have seen no analysis on this topic nor have we been giving a clear indication of when or if this analysis will take place.** If DEP acknowledges the need for and is planning on conducting this type of analysis in the coming months, it would be extremely valuable to clearly communicate this plan to concerned stakeholders.

In summary, the burden is on DEP to project, using rigorous modeling and quantitative analysis, what the currently proposed obligation on electricity sellers will do the annual operating cost of heat pumps relative to fossil fuel heating equipment. All modeling and quantitative contains uncertainty – this is okay. It's better to analyze these complex dynamics acknowledging the underlying levels of uncertainty across a set of variables than to not model the complex dynamic at all.

Given the information that has currently been provided to stakeholders, and preliminary analysis by Acadia Center, we are extremely concerned that the current proposed obligation on electricity sellers is too high to close the gas versus electricity annual operating heating equipment cost gap to the level necessary to instill consumer confidence in gas to electric heating conversions.

FAQ Question 0, Bullet 5: Eliminating Emission Reduction Credits for Non-waste Biodiesel Blends Above 20%

The fifth bullet in FAQ Question 0 proposes to *"…not allow emission reduction credit for renewable diesel or biodiesel blends above B20 unless they are derived from waste feedstocks."* **Overall, Acadia Center views this proposed change to the Framework as an extremely strong step in the right direction but urges DEP to go further by fully eliminating any crediting for any renewable diesel/biodiesel product that is not derived from waste feedstocks.** The topic of crediting non-waste liquid biofuels was discussed extensively in Acadia Center's December Comments and all our concerns regarding non-waste liquid biofuels articulated in those comments hold true. Primarily, based on review of existing literature (as discussed in detail in our previous comments), **Acadia Center is skeptical that liquid biofuels produced from energy crops provide any climate benefit. DEP has not provided any research or analysis to dissuade us from this opinion.**

Furthermore, as described in our December comments, Acadia Center withholds judgement on the eligibility of "eligible liquid biofuels" as defined under the Alternative Portfolio Standard. While the definition appears reassuring on paper - "A liquid fuel that is derived from organic waste feedstocks. Organic waste feedstock shall include, but not be limited to, waste vegetable oils, waste animal fats, or grease trap waste."[6] – the devil is often in the details when differentiating between waste-derived and energy crop biofuels. **For this reason, in our December comments, Acadia Center requested that DEP provide more information on the APS definition of "eligible liquid biofuels" and the verification process used to verify that fuels meet these criteria under the APS. Despite this request, to date, DEP has provided no additional information on this topic and has not held any technical stakeholder meetings focused on this critical topic. Further investigation by DEP and deeper engagement with stakeholders on this topic remains a priority for Acadia Center.**

FAQ Question 0, Bullet 6: Efforts to Align the CHS with Mass Save

The sixth bullet in FAQ Question 0 focuses on integration between the CHS and Mass Save, but several of the statements are vague and it's challenging as a stakeholder to interpret what they mean. The first potential change to the draft framework is *"Refining the full electrification crediting process for residents with access to Mass Save incentives."* It's not clear what this "refining" would entail, and it would be helpful if more details could be provided to stakeholders. The second statement of "Calibrating program stringency, ACP levels, and detailed requirements for full electrification with reference to the three-year plan process" is also vague. The general concept makes sense – Mass Save and the CHS are obviously highly intertwined and there should be close coordination between both programs to understand, for example, the projected combined impacts of both programs on the rates of different heating fuels and how incentive signals can be designed across the programs to achieve the overarching building decarbonization goals of the Commonwealth.

[6] https://www.mass.gov/doc/225-cmr-16-alternative-energy-portfolio-standard-aps/download

There is also a key question of program administration – how can program administration be streamlined across the CHS and Mass Save to minimizes administrative burden and make, for example, the verification process of installed measures as smooth as possible? Could DEP form some sort of administrative partnership with Mass Save and what would this look like? In the current CHS Framework, the is currently "measure overlap" between the two programs in the following categories: 1) Residential space heating electrification, 2) Non-residential space heating electrification, 3) Non-residential domestic water heating electrification, and 4) Non-residential insulation and weatherization for non-residential buildings that retain some level of fossil fuel heating system). How will incentive signals across the two programs be coordinated to ensure the most efficient use of ratepayer funds? Acadia Center doesn't have all the answers on this front, but we are hopeful that these are the types of questions DEP is currently investigating.

To date, it's not clear to stakeholders what level of coordination between the two programs is taking place - this is extremely concerning, particularly given that the Mass Save 2025-2027 draft Three-Year-Plan was just released on April 1st. Assuming the CHS launches in early 2026 (and CHS Early Action Crediting is available in 2025), there will be significant overlap from a timing perspective of the CHS and the Mass Save 2025-2027 Three-Year-Plan. Acadia Center urges DEP to coordinate more closely with DOER to ensure complimentary design of the two programs and share information regarding the details of this coordination process with DOER. Coordination with Mass Save would be an excellent topic for Technical Working Group sessions.

FAQ Question 0, Bullet 5: Eliminating Emission Reduction Credits for Non-waste Biodiesel Blends Above 20%

The fifth bullet in FAQ Question 0 proposes to, *"Consider assigning default ownership of emission reduction credits from operation of heat pumps to electricity suppliers instead of homeowners."* A major concern Acadia has had since the release of the original Framework is the percentage of overall obligations (both full electrification and emission reduction) on fossil fuel obligated parties would be met via the actual installation of electrification projects versus biodiesel and alternative compliance payments. This comes down to incentive signals for fossil fuel obligated parties – is it more cost-effective from a business bottom line perspective to purchase ACPs or actually install heat pumps? Imagine, for example, a fuel oil delivery company that has recently pivoted to installing heat pumps as a result of the CHS program (Company A).

If Company A installs a full electrification project in 2026, they capture one full electrification credit. This credit holds an "avoided ACP value" of $6,000. The full electrification credit also generates a future stream of emission reduction credits. Under the original Framework, these emission reduction credits would have provided $22,800[7] in terms of future streams of emission reduction credits. Under the changes outlined in the FAQ, the value of these future emission reduction credit streams decreases to $3,800.[8] **In either case, the core problem from the perspective of Company A is that they don't capture any of the value from the future emission reduction credits generated by the electrification project they completed. Their two paths to complying with their emission reduction obligation are 1) Buy ACPs or 2) Blend biodiesel. Additionally, in the case of a hybrid heat pumps system installed by Company A, they capture no credit value at all (there is no full electrification credit generated by the project and the electricity seller captures the future streams of emission avoided credits associated with operating the heat pumps).**

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[7] 24 years of operation from 2026-2050 x 5/MT CO2/year per full electrification project x $190/MT CO2 = $22,800

[8] 5 years of operation from 2026-2030 x 4 MT/CO2/year per full electrification project x $190/MT CO2 = $3,800

The "CHS compliance motivation" for Company A to complete full electrification projects ($6,000 if avoided ACP value) and hybrid electrification projects ($0 in avoided ACP) appears to Acadia Center to be significantly too low, in the case of full electrification projects, or nonexistent in the case of hybrid electrification projects. This is a core policy design concern. DEP needs to conduct modeling and quantitative analysis to "game out" these complex dynamics to assess the likelihood that fossil fuel obligated parties will meet 100% (or close to 100%) of their obligation via some combination of ACPs and liquid biofuel blending given the current policy design and alternative policy designs. If these scenarios unfold where 100% of their obligation is met via some combination of ACPs and liquid biofuel blending, what are the big-picture implications for the building electrification movement in the Commonwealth? Would the Commonwealth even have enough time to "course correct" the policy and stay on track for the target level of heat pump installations envisioned by the CECP? How can this type of scenario be safeguarded against with more sound policy design?

Acadia Center has not done the level of modeling and analysis to propose an optimal policy solution to this complex issue, but one could envision any number of policy design changes that could increase the motivation of fossil fuel obligated parties to install heat pumps: 1) Increase the full electrification credit value, 2) Create a "hybrid electrification credit value", 3) Give them a pathway to owning a portion of the emission reduction credits generated by the electrification projects they install, 4) Establish caps on the level of their obligations that can be met via ACPs or liquid biofuel blending. These are just some ideas in the universe of potential solutions – this topic requires significantly more research and analysis on the part of DEP to flesh out.

The fifth bullet in the FAQ goes on to state, *"The draft framework suggests that information in monthly electric bills may be used to verify reliance on heat pumps for heating. Because electricity sellers already have access to this information and have experience with crediting programs, assigning credits to electricity sellers could greatly simplify program administration."* As discussed in greater detail in our December Comments, Acadia Center supports the concept of awarding emission reduction credits from electrification projects based on an electric bill review process that ensures these heat pumps are actually being used to provide a substantial (in the case of hybrid) or all (in the case of full electrification) space heating to a home over the duration of the heating season. While we acknowledge that electricity sellers are obviously the best positioned at the current time to verify monthly changes in electricity consumption at an individual residential meter level, that alone should not be used as justification for assigning electricity sellers default ownership of all emission reduction credits generated by the operation of heat pumps. For example, one could envision a scenario where electricity sellers verify compliance, but emission reduction credits are assigned to either the customer or the company who completed installation of the heat pump project. One could also envision a scenario where electricity sellers are required to share electricity consumption data with a program administrator and that program administrator mints the credits and assigns them to the relevant parties. Ultimately, there are two completely separate questions that shouldn't be intertwined:

1) What is the optimal way to verify operation of heat pumps and generate emission reduction credits associated with that operation?

2) What is the optimal way to assign emission reduction credits (electricity sellers, customers, heat pump installer) to rapidly deploy heat pumps at scale, minimize the costs of the program, and send the right "market signal" to obligated parties to minimize their reliance on ACPs and biodiesel for compliance?

Question 2 is not an easy question to answer – rigorous modeling and scenario analysis is required to answer this question, and, to date, DEP has not demonstrated this type of analysis to stakeholders. The concept of electricity sellers being assigned default ownership of emission reduction credits generated by heat pump operation and this dynamic creating *"…an incentive for electricity sellers to encourage heat pump usage, possibly by offering discounts or other rewards to customers that utilize their heat pumps"* is an interesting topic for future research and analysis. It seems more intuitive to assign default ownership of the credits to the homeowners that have both 1) Installed heat pumps and 2) Demonstrated use of those systems via electricity bills. One could imagine a process by which these customers either sell the credits into a marketplace or sell them directly to the electricity seller – the funds generated by this sale could help offset both the installation and ongoing operational cost borne by the customer. D

Acadia Center has several concerns with assigning default ownership of emission reduction credits generated by heat pump operation to electricity sellers. Firstly, we are extremely concerned about what this proposal does to the motivation of fossil fuel obligated parties to actually install heat pumps, as discussed directly above. Secondly, we are concerned what percent of the emission reduction credit value will be "captured" by electricity sellers, rather than returned to heat pump customers in the form of reduced rates, etc. This risk is present in all cases, but is particularly troublesome for residential customers that install whole-home heat pump systems and remove all fossil fuel heating equipment - it wouldn't be necessary for electricity sellers to provide incentives to encourage heat pump use – these customers have no other option than relying 100% on their heat pump system to provide space heating. In these scenarios, would the electricity seller "capture" 100% of the emission reduction credit value? It's not clear what motivation electricity sellers would have to share some of the credit value with fully electric customers who don't retain a fossil fuel back-up system.

As laid out above -these interwoven policy dynamics are incredibly complicated. Modeling and quantitative analysis on these various scenarios needs to be provided by DEP before we can provide a more nuanced, detailed proposal on how to best design this specific aspect of the program. DEP should investigate multiple policy design scenarios and quantify the financial motivation of various obligated parties under different scenarios that, for example, explore the impacts of changes to default ownership of emission reduction credits generated by heat pump operation.

Crediting for Non-residential Buildings Stakeholder Discussion Document

Hydrogen and Renewable Natural Gas

The Crediting for Non-residential Buildings Stakeholder Discussion Document mentions that, *"In addition, MassDEP is considering whether to allow crediting for reductions in emissions from fossil fuel combustion resulting from the substitution of renewable natural gas and hydrogen produced using renewable electricity, as long as they are not blended with fossil fuels."*

The Framework stated that, *"The draft framework limits crediting to electricity and liquid biofuels at program startup."* Thus, the proposal to consider the substitution of RNG and hydrogen represents a fairly significant departure from the original Framework. Given that, it seems odd that DEP only mentioned this topic in a couple short sentences and didn't provide further information or analysis of the pros and cons of continuing to exclude these fuels versus including these fuels as eligible clean heat measures.

Referring to these fuels as "non-pipeline clean fuels" is also a bit confusing because both of these gaseous fuels are ultimately transported (whether it be short or long distances) via pipes. Acadia Center assumes that DEP is using the term to imply that these fuels would not be injected into the existing natural gas distribution system, but clarification on this topic would be useful to stakeholders. The text stating, "…as long as they are not blended with fossil fuels" seems to confirm this, but one could envision, for example, particular branches of the gas distribution system that are 100% RNG or, for example, an isolated 100% hydrogen gas delivery system serving multiple industrial customers in an industrial park.

Acadia Center is strongly opposed to the former example – a branch of the gas distribution system that is 100% RNG and technically not "blended with fossil fuels". In the case of hydrogen, Acadia Center acknowledges that the fuel may an important, niche decarbonization role to play in the building sector, particularly for certain industrial processes that are extremely technically challenging to electrify. However, the Inflation Reduction Act's (IRA's) Clean Hydrogen Production (45V) is already set to provide an extremely generous 10-year tax credit of up to $3 per kilogram of hydrogen produced[9] and it's not clear if additional state-level incentives (via a program like the CHS) would actually be needed to encourage investments in the infrastructure needed to support the limited appropriate use cases of hydrogen in the building sector in the state. **This is another topic that DEP should perform quantitative analysis on – what is the market signal/level of incentives provided by the IRA for hydrogen as a decarbonization strategy for certain industrial buildings and are additional state incentives actually justified?**

RNG is a broad term, and it refers to many different fuel production pathways, all of which have different lifecycle emissions associated with them. When analyzing the GHG impacts of RNG, it's important to consider the two general categories of RNG: 1) RNG derived from "intentionally produced" methane and 2) RNG derived from "waste methane". An example of "intentionally produced methane" is converting agricultural residues (e.g. corn stalks remaining after harvest) to methane through a process known as gasification, and an example of "waste methane" is methane released by a landfill as organic material decays. Intentionally produced methane should have absolutely no role in the building decarbonization strategy of the Commonwealth, even if it is not blended into the gas distribution system. As Dr. Emily Grubert, a professor of Environmental Engineering at Georgia Tech, points out in her research, we know that RNG systems leak methane, just like natural gas systems, only potentially at even higher rates. **When we *intentionally* produce methane, *any* methane leaks along the RNG supply chain result in a net increase in GHG emissions.**[10] In other words, if our goal is to minimize GHG emissions, we shouldn't be intentionally producing *any* methane that we know will leak.

For RNG produced using "waste methane", claims of GHG-neutrality are based on a flawed comparison against the worst possible alternative – that is, allowing methane released from sites like landfills to go directly into the atmosphere. That is unlikely to occur in a setting where GHG emissions are regulated, however, as the best option from a GHG perspective, by a wide margin, is to capture the biogas and combust it in a combined heat and power facility that produces both electricity and useful heat. This on-site combustion efficiently converts methane to CO_2 (a far less potent GHG), while simultaneously avoiding downstream methane emissions associated with upgrading, transporting, and distributing RNG. It also has the critical benefit of serving as a "firm" electricity generation resource to complement a future grid with a high penetration of intermittent renewable electricity resources.

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[9] https://www.federalregister.gov/documents/2023/12/26/2023-28359/section-45v-credit-for-production-of-clean-hydrogen-section-48a15-election-to-treat-clean-hydrogen

[10] Emily Grubert 2020 Environ. Res. Lett. 15 084041 https://iopscience.iop.org/article/10.1088/1748-9326/ab9335

If combined heat and power at a particular site is not a viable option, even just burning the methane on site (a process known as flaring) is better from a GHG perspective than RNG production because it avoids downstream methane leaks along the RNG supply chain, as research by Dr. Grubert highlights.[11] For RNG produced form waste methane to actually be beneficial from a GHG perspective, leak rates along the supply chain would need to be about 1%, but we know they're much higher than that – typically ranging from 2.8% to 4.8% but observed to be as high as 15.8%.[12]

RNG is upgraded biogas. There is no scenario in which Acadia Center would support including RNG as a clean heat measure under the CHS for the reasons outlined above. There are certain *niche scenarios* where Acadia Center would potentially consider the inclusion of true waste biogas that is not intentionally produced methane. For example, you can imagine capturing biogas from a closed landfill, combusting it on site in a CHP plant and delivering the waste heat from the CHP plant to a nearby warehouse facility to reduce that warehouse's reliance on fossil fuel combustion for space heating. However, like hydrogen, the IRA already offers significant incentives for many anerobic digestion projects, including the Investment Tax Credit (ITC) and the energy production tax credit (PTC). These incentives are significant – for example, the ITC allows taxpaying entities to deduct a percentage of the cost of biogas production equipment from their federal taxes, up to 50% or more.[13] Like hydrogen, it's not clear if additional state-level incentives (via a program like the CHS) would actually be needed to encourage investments in the infrastructure needed to support the limited appropriate use cases of biogas in the building sector in the state. **This is another topic that DEP should perform quantitative analysis on – what is the market signal/level of incentives provided by the IRA for biogas investments as a decarbonization strategy for certain buildings adjacent to sources of waste biogas (landfills, wastewater treatment plants, food compositing facilities) and are additional state incentives actually justified?**

Conclusion

In summary, Acadia Center appreciates the opportunity to comment in the early stages of this important CHS program design. We commend DEP on several key elements of the proposed Framework, including with respect to the ineligibility of gaseous biofuels and hydrogen blending, the relatively strict limits on non-waste liquid biofuels, as well as the strong equity provisions put forward. Despite this, we do raise a number of outstanding questions and concerns regarding other program elements and design proposals, and sharing greater quantitative analysis will help stakeholders provide more detailed commentary on these elements in question and on the program in its entirety. Thank you in advance for the consideration and review of our input, and we look forward to engaging further with DEP in the months ahead to refine the Framework and move toward implementation. If you have any questions or concerns, please do not hesitate to reach out.

Sincerely,

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[11] Ibid.

[12] Ibid.

[13] https://www.biocycle.net/the-ira-revolutionizes-ad-tax-credits/

MassDEP Clean Heat Standard

Carbon Score for Electricity

Technical Notes by Raymond J. Albrecht PE

Submitted on Behalf of the
Massachusetts Energy Marketers Association

April 5, 2024

Summary Biography for Raymond J. Albrecht PE

Consulting environmental engineer in the subject area of renewable heating technologies and power generation. Technical specialties have included electric and thermally driven heat pumps, solid biomass and liquid renewable fuel-fired thermal systems, and liquid renewable fuels for power generation. Have performed work for manufacturing companies, trade organizations and environmental agencies relating to equipment design, fuel utilization, regulatory permitting, emissions testing, and life-cycle analysis. Member of the ISO New England Planning Advisory Committee and active with the ISO New England Load Forecasting Committee. Spent 30 years as lead technical staff person for heating technology and fuels R&D at the New York State Energy Research and Development Authority (NYSERDA). NYSERDA work also included field testing of first ground-source heat pump installation in northeastern United States in the early 1980s. Principal of Raymond J. Albrecht LLC for the past 16 years.

Graduate of Cornell University with a Bachelor of Science degree in engineering and a Master of Science degree in Theoretical and Applied Mechanics. Life Member of the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) and past chairperson of ASHRAE Technical Committee 6.10 for Fuels and Combustion. Received the ASHRAE Distinguished Service Award in 2015. Licensed professional engineer (No. 056935) in New York. Served as a 1st Lt (Infantry) in the United States Army during 1970-80 including active plus reserve duty. Graduate of the US Army Infantry Officer School at Fort Benning, Georgia. Fulfilled my active reserve obligation in northeastern Kenya near the Somali border.

SUMMARY OF COMMENTS

MassDEP has committed a fundamental technical and policy error by stating that electricity will be assigned a carbon score of zero under the proposed Clean Heat Standard. The MassDEP position has recently been rebutted by a major ISO New England evaluation study of the grid impact by electric vehicles and heat pumps. The study has been performed under the Economic Planning for the Clean Energy Transition (EPCET) effort during the past year.

The ISO New England EPCET study and other analyses make several important points:

1) Essentially all electricity for EVs and heat pumps in New England during the next 10 years will come from fuel-fired generation units.

2) The ambitious build-out of wind and solar planned by the New England states for the next 10 years will only make partial progress toward offsetting existing grid loads.

3) Practically none of the additional generation needed during the next 10 years for EVs and heat pumps will be provided by solar PV or wind.

4) Looking further down the road, approximately 37,000 MW nameplate capacity of solar and wind resources (along with battery storage) will need to be constructed to meet just existing New England grid loads, prior to electrification of transportation and heating, during the winter months.

5) Meeting additional grid loads from EVs and heat pumps will require another 60,000 MW of solar and wind capacity, beyond the 37,000 MW figure for existing loads, for a total New England grid capacity of nearly 100,000 MW of solar and wind. This aligns with the widespread consensus that full electrification would require a tripling of the New England grid.

6) Since most electricity during the winter months will necessarily have to be generated by offshore wind, due to low output by solar, a huge area along the coast of New England would be required. Using the industry standard guide of 8 MW per square mile, a total of 10,000 square miles of coastal area would be required for the construction of 80,000 MW of offshore wind nameplate capacity.

7) If environmentally sensitive areas such as the Stellwagen Bank National Marine Sanctuary are protected, and major shipping channels into Boston, Portsmouth, Portland, and other coastal cities are not blocked, a significant fraction of the New England coast would be off limits to offshore wind farm construction. Perhaps 250 miles of the 400-mile New England coastline (from eastern CT to the Canadian border) might be available. With the added requirement that offshore wind farms be located at least 30 miles from the coastline to avoid visibility objections by property owners, a 40-mile width of ocean area, starting at 30 miles from the coastline, would be necessary. This would notably force the usage of floating type rather than fixed platforms, due to water depths greater than 60 meters, with significant cost implications.

8) Construction of at least 10,000 or 20,000 MW of additional offshore wind capacity, beyond the 37,000 MW referenced earlier, would be necessary to accomplish a meaningful start toward meeting EV and heat pump loads.

9) The construction of the resulting interim milestone of 50,000 to 60,000 MW of offshore wind capacity, to serve existing grid loads plus just a fraction of heat pump and EV loads, represents an enormous challenge, both logistically and economically. The goal of low-carbon electricity for EVs and heat pumps remains far off in the distance.

10) MassDEP staff working on the Clean Heat Standard have sidestepped questions from stakeholders about the feasibility of tripling the grid for the purpose of electrification. The staff have shifted responsibility by making public statements that other MassDEP and MADOER programs are instead responsible for addressing grid carbon intensity and capacity problems. MassDEP staff have not addressed these key issues in a forthcoming manner. The taxpayer and the industries impacted by the Clean Heat Standard deserve better.

11) Reducing carbon emissions now is more valuable than reducing the same emissions later. This is because earlier reductions limit the long-term climate impact caused by the accumulation of greenhouse gases. This significant and often overlooked principle is frequently absent from policy discussions, which, for example treat a reduction of CO_2 in 2023 with the same weight as a reduction in 2050. This is simply not accurate and skews the market to seek low-readiness technology options which may not be deployed for years or decades, if ever at all.

    Recently, The State University of New York (SUNY-ESF) published research highlighting the value of early GHG reduction, which can limit the cumulative heating impact of carbon emissions. This study compared the cumulative emissions reductions and associated societal value of using biodiesel today compared to waiting for a future, potentially lower carbon solution to be deployed later. These results demonstrated that when a technology with a low life-cycle GHG emission profile was deployed even five years later, it would generate less reduction in GHG emissions than a low life-cycle GHG technology deployed sooner. More simply, carbon reductions now are more important than carbon reductions later. The benefits accumulate, much like compound interest on a savings account.

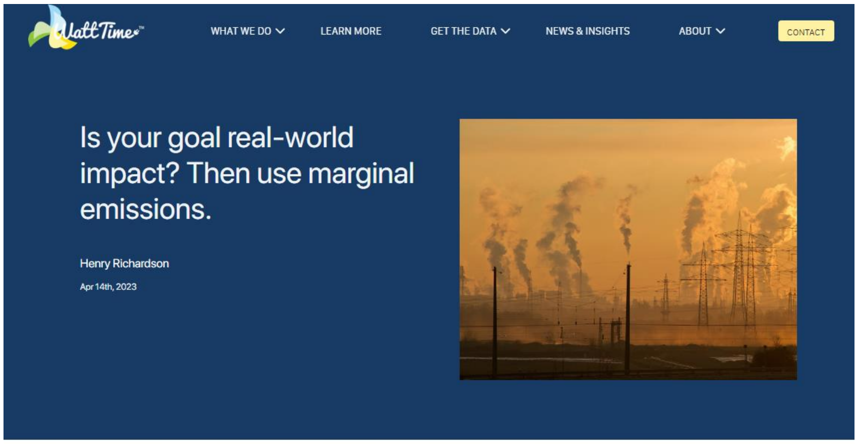
12) Carbon savings achieved by heat pumps during the next few decades will be limited to those which are achievable with natural gas-fired generation, until existing grid loads are fully met by renewable power generation, and further renewable capacity can then be dedicated to heat pump operation. There will thus be a significant time delay in the achievement of fully renewable electrification of thermal applications, which in turn impedes the accomplishment of our environmental goals, especially within the shorter timeframes that are becoming necessary to avoid catastrophic climate change.

ADDITIONAL TECHNICAL NOTES

The MassDEP position claiming zero carbon intensity for electricity is also in conflict with the USEPA AVoided Emissions and geneRation Tool (AVERT) methodology for the evaluation of grid emissions due to changes in load or renewable generation capacity. The AVERT model yields nearly identical results as the ISO New England EPCET study, in pointing to the continuing and almost exclusive use of fuel-fired power generation for EVs and heat pumps over the next 10 years.

Both the ISO New England EPCET study and the USEPA AVERT model support a science-based argument for using a carbon score of over 1,000 lbs CO2e per MWh for electricity under the proposed Massachusetts Clean Heat Standard.

MassDEP also needs to recognize the need for using marginal emission rates for electricity, rather than average grid mix figures. The *WattTime* organization, a subsidiary of the Rocky Mountain Institute (RMI), has established a nationwide program to support efforts by commercial, industrial, and institutional customers to undertake energy measures which are based on how the grid actually works.



Everyone knows you can't manage what you don't measure. Less often pointed out? You can't manage what you measure *incorrectly*.

Corporate net-zero targets are at an all-time high, per reporting from *The Economist*. In fact, fully 75% of the world's largest corporate greenhouse gas emitters have set net-zero by 2050 (or sooner) targets, as of an October 2022 benchmarking analysis by Climate Action 100. This is good news.

Or... it should be. Of course, these targets will only genuinely decarbonize the atmosphere if they measure the real thing. And, unfortunately, that's not always what happens.

See https://www.watttime.org/news/is-your-goal-real-world-impact-then-use-marginal-emissions/ for more information on the need for using marginal emission rates for electricity.

Electrification advocates routinely use average, annual grid mix values for electricity, rather than marginal emission rates, in the calculation of environmental benefits from heat pumps and EVs. The use of average grid mix hides the fact that intentional grid load increases in New England, including Massachusetts, are met almost entirely by fossil-fired generation, with only limited, net CO2 savings.

It is recommended that MassDEP perform hourly, marginal grid analyses, incorporating the principle of cause-and-effect logic, to better evaluate the impact of intentional grid load increases under the Clean Heat Standard. It is suggested that MassDEP staff consider the use of grid data that has become available from WattTime. It is further suggested that MassDEP staff review an educational document on the use of hourly marginal grid performance data vs. average grid mix figures, available on the WattTime website at https://www.watttime.org/app/uploads/2021/08/GHG-Frameworks-WhitePaper-Tomorrow-WattTime-202108.pdf, which explains the importance of looking at the cause-and-effect behavior of power grids, and thus the need for hourly performance analysis.

Some policymakers claim that fossil-based electricity will soon disappear, even with increased grid loads, and therefore heat pumps/EVs will be fully renewable and thus the sole pathway toward decarbonization. To the contrary, USEPA AVoided Emissions and geneRation Tool (AVERT) software shows that even if grid loads were to remain constant (i.e., no heat pump/EV market penetration), marginal ISO New England generation will remain nearly 100% fossil-based until at least 5000 MW of offshore wind power has become fully operational, at which point there will begin to occur some very occasional hours, mostly during April, when renewable electricity has indeed reached the margin of New England grid load.

The 5000 MW offshore generation level will only be reached if the entire slate of proposed Vineyard/Revolution/etc. offshore wind projects near Martha's Vineyard become fully operational, which in turn means that several interconnection/transmission challenges on Cape Cod would have to be successfully overcome. Recent ISO New England Planning Advisory Committee deliberations have been consumed by the technical challenges of integrating offshore wind into the southeast Massachusetts grid.

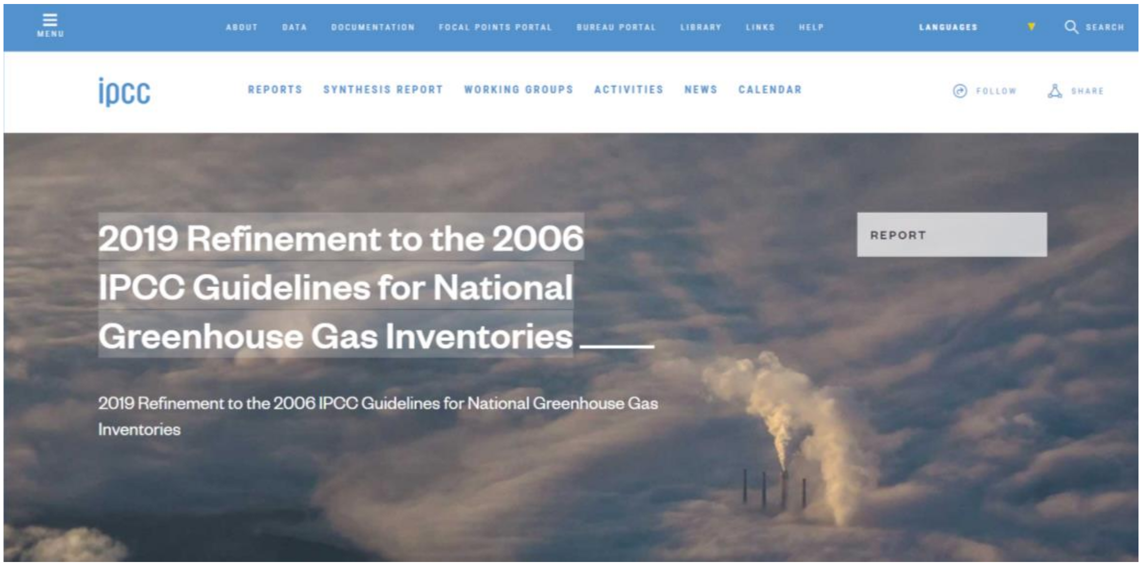
A recent publication by the Rocky Mountain Institute (RMI) states that a growing number of environmental organizations, when evaluating the emissions impacts of changes to grid loads or power production, "have been mis-applying average emissions factors to estimate the impact of environmental decisions. To protect against this mistake, the correct way to measure the impact of environmental decisions is to use *marginal* emissions factors. Marginal emissions factors measure the actual environmental consequences of taking different potential actions on the power grid."

See additional details in the informative RMI document entitled, On the Importance of Marginal Emissions Factors for Policy Analysis, which is available at https://rmi.org/combating-climate-change-measuring-carbon-emissions-correctly/ and also attached as an appendix at the end of this document.

See also https://www.watttime.org/app/uploads/2019/03/Automated-Emissions-Reduction-Primer_RMI-Validation_June2017.pdf and https://www.watttime.org/marginal-emissions-methodology/ for multiple additional references on the use of marginal emission rates for energy analysis. WattTime collects and disseminates hourly, real-world data on grid performance to enable environmentally responsible electricity choices by large customers.

An additional article on the need for using marginal emission rates, entitled, "*US Policy Action Necessary to Ensure Accurate Assessment of the Air Emission Reduction Benefits of Increased Use of Energy Efficiency and Renewable Energy Technologies*", published in the Journal of Energy & Environmental Law, can be found at https://gwjeel.com/wp-content/uploads/2013/07/1-1-jh.pdf . The article is based on research funded by the US Department of Energy's Office of Energy Efficiency and Renewable Energy through its Clean Energy/Air Quality Integration Initiative.

Finally, MassDEP is strongly encouraged to use life-cycle accounting (LCA) for all energy resources under the Clean Heat Standard. This should include being respectful of guidance by the United Nations Intergovernmental Panel for Climate Change (IPCC) for evaluating the upstream CO2 and methane emissions of all fuels used for generation of electricity. MassDEP needs to study the IPCC report entitled, *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.*



The UN IPCC is comprised of several thousand dedicated, respected scientists and engineers and is the premier organization for understanding and addressing climate change. It is understood that the UN IPCC 2019 guidelines are inconvenient to the MassDEP case for assigning a carbon intensity of zero to electricity used for heat pumps. But it is nevertheless incumbent on MassDEP to give due heed to the UN IPCC.

It is of critical importance to use life-cycle analysis for energy policymaking. Onsite-based emissions evaluations generally fail to address the real-world challenges of bringing renewable energy resources to the market.

Argonne National Laboratory has been the host administrator of the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model for many years. GREET is a highly respected tool for modeling the life-cycle characteristics of energy resources. Additionally, the United Nations Intergovernmental Panel on Climate Change (IPCC) has issued a series of updates to its comprehensive documentation relating to evaluation of energy resources.

The Argonne National Lab GREET 2021 model, as well as the recent United Nations Intergovernmental Panel on Climate Change (IPCC) Update Report, have correctly addressed the environmental characteristics of natural gas used for power generation. Both the GREET and IPCC references incorporate a methane leakage rate of approximately 0.7% of the volume of natural gas used for power generation. This accounts for methane loss during natural gas production and high-pressure transmission to power plants (but not through any local distribution piping).

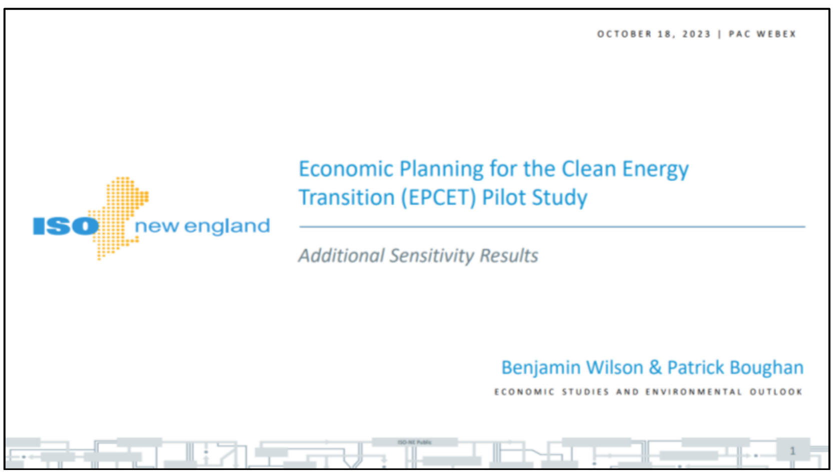
If a 100-year timeframe is used for analysis (GHG factor for NG = 25 compared to CO2), the 0.7% methane leakage rate results in about a 9 percent increase in the carbon intensity of natural gas that reaches the power plant. If a 20-year timeframe is used, however, for analysis (GHG factor for NG = 84 compared to CO2), the 0.7% methane leakage rate results in about a 25 to 30 percent increase in the carbon intensity. There is growing support for the use of 20-year greenhouse gas analysis since that reflects the timeframe that is now perceived as necessary for addressing climate change.

The inclusion of life cycle analysis for natural gas results in a likewise 25 to 30 percent increase in the effective, marginal CO2e emissions rate for electricity in ISO New England since most marginal generation there is gas-fired. This results in a further diminution of calculated energy and greenhouse gas savings, to the extent that only minimal, real savings are accomplished from the conversion of traditional oil-fired heating systems to electrically driven heat pumps.

Technical Notes on Individual ISO New England EPCET Presentation Slides

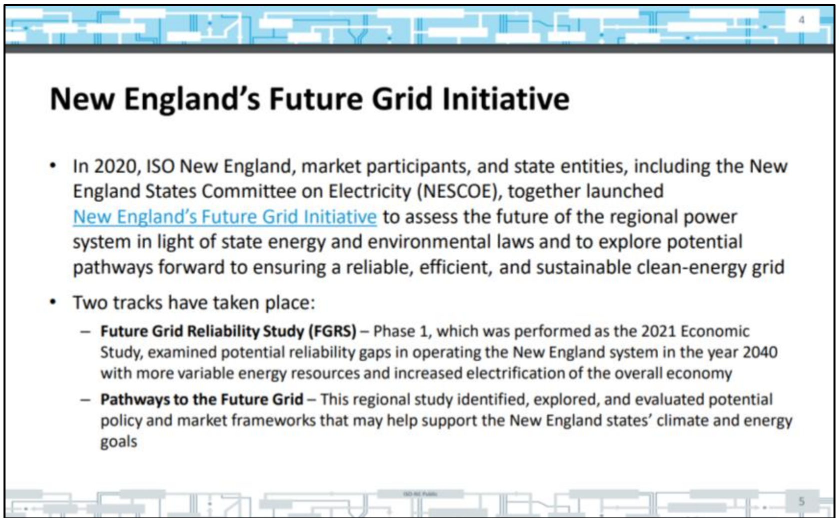
ISO New England recently posted a presentation showing the results of their analysis of grid impacts that will result from forecasted market growth by heat pumps and EVs through the year 2032 and beyond. The presentation entitled, Economic Planning for the Clean Energy Transition (EPCET), is available at https://www.iso-ne.com/static-assets/documents/100004/a06_2023_10_18_pac_epcet_additional_sensitivity_analysis_results.pdf.

The ISO New England EPCET work was requested by the New England States Committee on Electricity (NESCOE), which represents all six states in the region. ISO New England planning staff have been tasked with performing hourly analyses of grid loads and generation which could then be used to chart a course toward decarbonization across an expanded grid.

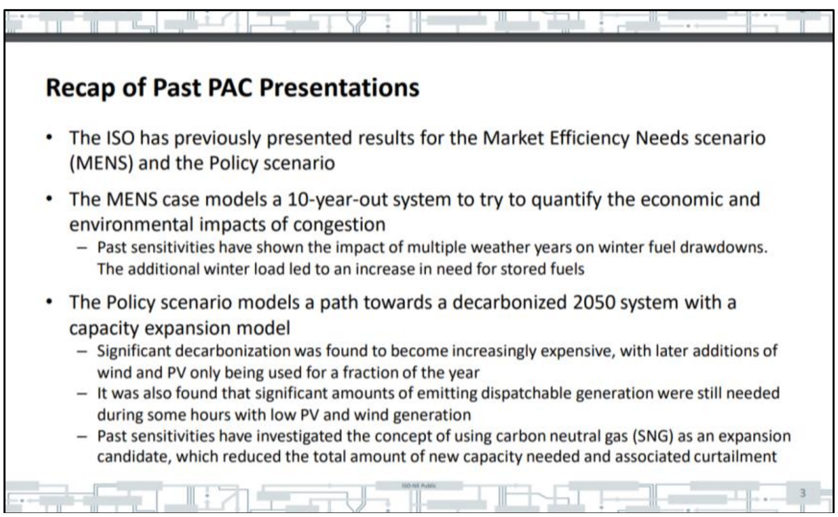


The EPCET work takes a very methodical and logical approach to analyzing the incremental effects of heat pump and EV loads on the grid. It is the first formal analysis published for New England to use such rigorous, hourly analysis to characterize power generation needed for heat pumps and EVs. These technical notes focus on the heat pump portion of the ISO New England EPCET presentation.

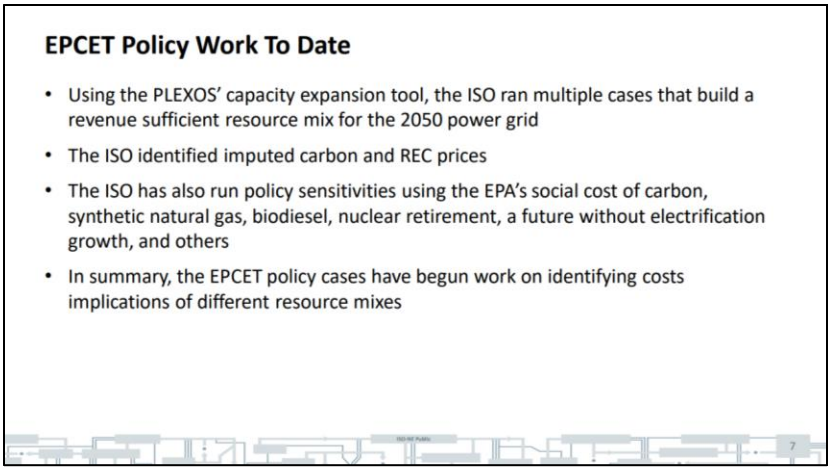
The next slide explains the context for the ISO New England EPCET analyses.



As described in the next slide, the ISO New England EPCET analyses have previously looked at the capital cost challenge of serving an expanded grid load entirely with solar, wind and battery storage. The analyses have more recently begun to consider the use of renewable fuels (hydrogen/synthetic natural gas/biodiesel) to fill in the gap when solar and wind outputs are low due to unfavorable weather.

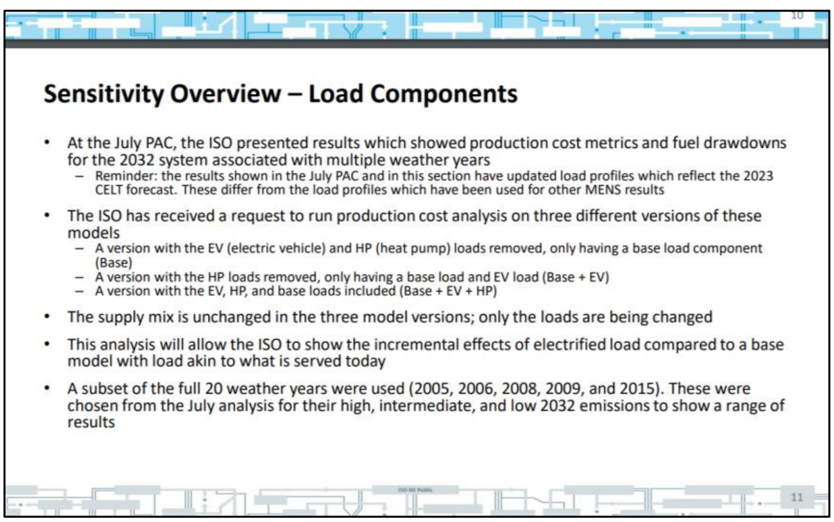


The analyses have looked at the impact of nuclear plant retirements through the year 2050. Nuclear plants generally run 24/7 when operational and thus present a significant challenge. The analyses have used rigorous logic in evaluating the expected trajectory of grid decarbonization without electrification.

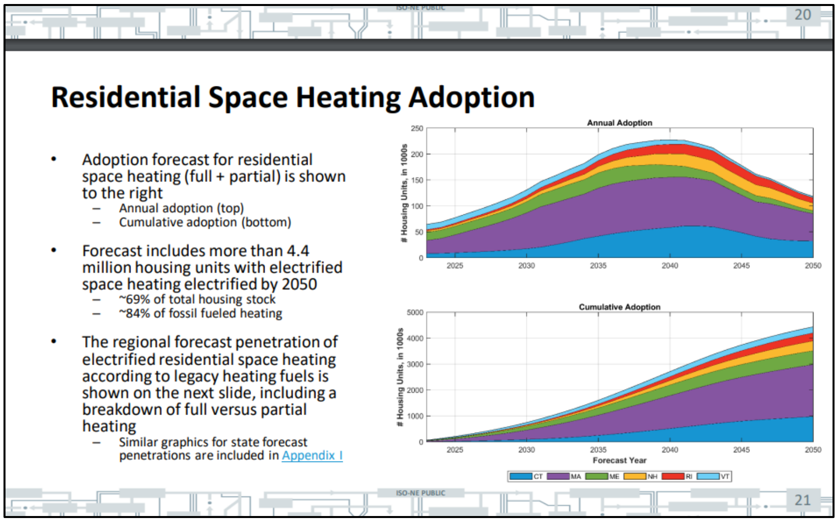


The referenced ISO New England EPCET presentation describes the logic used in evaluating the decarbonization of the existing grid then studying the incremental impacts of EVs and heat pumps. The EPCET analysis used five previous weather years to achieve a high/intermediate/low range of emissions results.

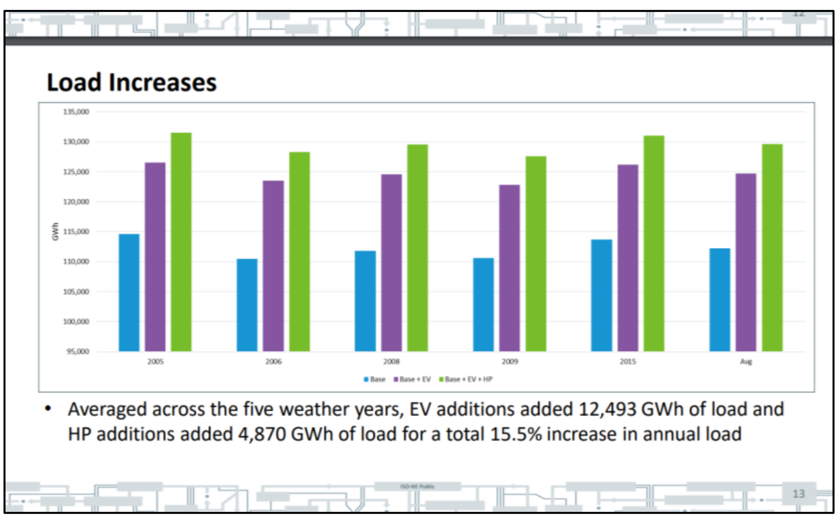
ISO New England had originally combined increasing grid loads and renewable generation into their hourly models, which then made it difficult to decipher the cause-and-effect attributes of individual actions. They then started to use discrete model shocks to analyze the separate impacts of increasing loads and generation capacity.



The graph below shows the individual state forecasts for heat pump implementation in New England. The ISO New England present addresses the grid impacts expected by 2032 resulting from just over one million homes in New England, which is something less than 20% of the residential housing stock, with about 30% of the heat pump installations expected to have full capacity, the remainder would be partial-capacity, single-head units.



The graph below shows the significant MWh grid load increases that will result from the first wave of EVs and heat pumps over the next 10 years. The base case of existing grid with no electrification is shown in blue, then base + EVs is shown in purple, then base case + EVs + heat pumps is shown in green. Since about 30% of the first million heat pump units would be of the full-capacity type, the heat pump numbers in the graph represent the equivalent of about 500,000 residential units with full-capacity heat pumps, out of a total residential building stock approaching 6 million units in New England.



The ISO New England presentation models the renewable grid capacity growth that would be necessary by the year 2050 to meet the loads incurred by the approximately 80 percent market share for heat pumps forecasted by ISO New England and the individual states. According to the presentation, about 37,000 MW of nameplate capacity of solar, wind and battery storage could meet nearly 100 percent of existing grid loads. By comparison, for the levels of EV and heat pump market growth forecasted by the year 2050, approximately 97,000 MW of nameplate capacity of renewable generation would be required. The ISO New England analysis uses partial shares of the renewable generation buildout for the 2032 portion of its work.

No Electrified Load Growth: Resource Buildout (MW)

	2050 Nameplate (No Electrified Load)	2050 Nameplate (Base Model)
PV	24,723	26,338
LBW	4,309	7,500
OSW	3,277	30,233
BESS	7,655	33,000
Total	39,314	97,071

- ~40,000 MW of new capacity was built to decarbonize without the electrified load. In the base model with electrified load (+87 TWh), almost ~100,000 MW of new capacity was built
- Smaller amounts of wind are built. The majority of new capacity is from PV and energy storage

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The table below shows the average generation by fuel type (GWh) for the three scenarios (base then add EVs then add heat pumps) for the year 2032. The table shows that the initial increment of renewable generation in place by 2032 would be fully used by just the existing grid. The table then shows that essentially all additional electricity loads, for EVs and heat pumps, will have to be met by natural gas, oil, and coal.

Average Generation by Fuel Type (GWh)

	ADR	COAL	OIL	MSW/LFG/ WOOD	NG	LNG	NUC	HYDRO	PV	LBW	OSW	TIE
Base (GWh)	1	167	11	6,133	12,302	1,185	29,600	6,192	14,323	3,932	13,236	25,636
Base + EV (GWh)	4	312	156	6,321	21,684	1,719	29,600	6,597	14,643	4,175	13,606	26,504
Base – Base + EV % Increase	259	86	1,287	3	76	45	0	6	2	6	3	3
Base + EV + HP (GWh)	7	493	834	6,461	24,668	2,366	29,600	6,592	14,614	4,164	13,525	26,859
Base + EV – Base + EV + HP % Increase	100	58	434	2	14	38	0	0	0	0	0	1

- These values represent the average of the five weather years simulated (2005, 2006, 2008, 2009, and 2015)
- The most significant increases in generation by fuel type are by expensive and/or emitting fuel sources (ADR, coal, oil, NG, and LNG)
- The most significant individual increase is in oil – while the Base case has minimal need for oil (11 GWh), the Base + EV + HP case has a ~7,300% increase in oil generation (834 GWh)

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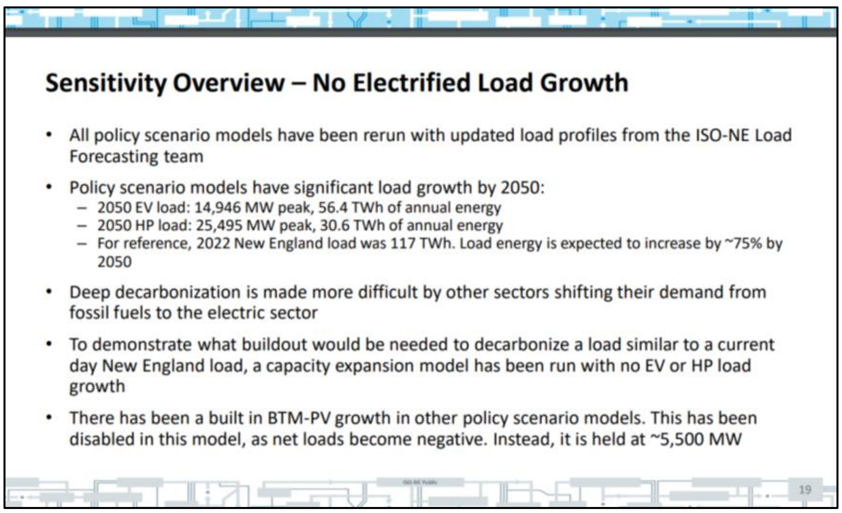
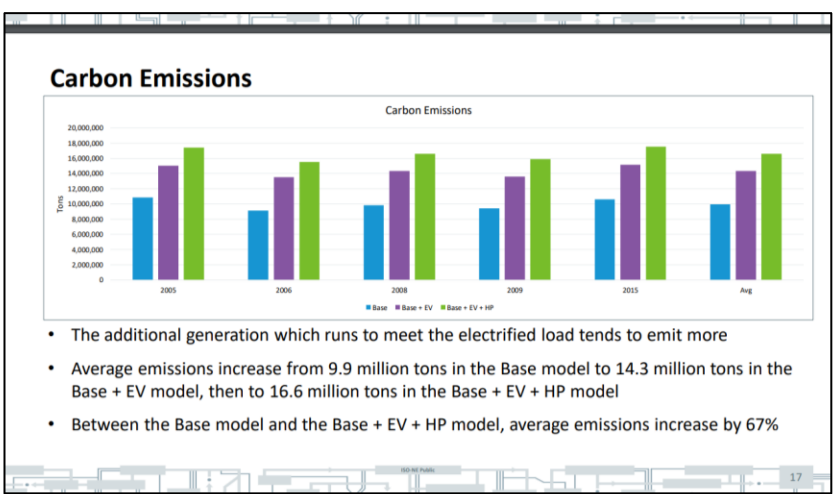
The next graph shows that CO2 emissions would be about 2.3 million tons per year for the roughly 500,000 equivalent full-capacity heat pumps installed over the next ten years. This aligns closely with other published analyses that show homes with full-capacity heat pumps causing about 5 tons of CO2 emissions per year based on the carbon intensity of electricity. The ISO New England forecast of something over 25,000 MW peak load for residential heat pumps is in close alignment with other published forecasts.

The graph below also highlights that EVs would produce lower MW peak loads but higher annual MWh consumption figures than forecasted for heat pumps. Heat pumps, compared to EV charging stations, have sharp load peaks during cold weather and result in lower MWh per year consumption per required MW of nameplate capacity.

Based on ISO New England figures, the annual load factor of the existing grid in New England is approximately 56 percent. The forecasted annual load factor for EVs would be approximately 43 percent, subject to management of charging activity during peak grid load hours. The forecasted annual load factor for heat pumps, by comparison, would be only 14 percent, which would likely lead to low technical and economic efficiency of capital-intensive renewable technologies such as solar and wind.



As shown in the next graph, ISO New England forecasts that the described 1 million heat pump units would increase electricity consumption by approximately 4870 GWh (or 4.8 million MWh) by 2032 and would result in increased direct CO_2 emissions of 2.3 million tons of CO_2. This is in close alignment with other published analyses showing that CO_2 emissions would be about 5 tons per year per full-capacity, residential heat pump.



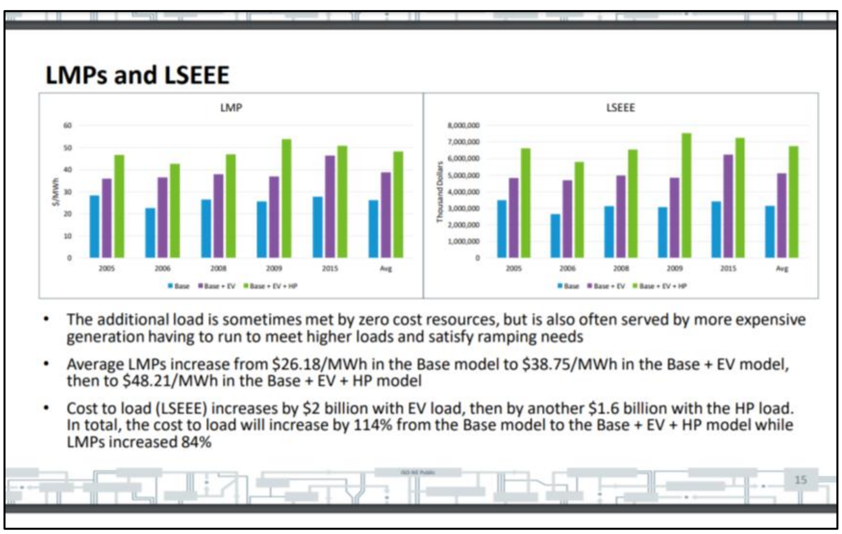
The CO2 emissions factor for the electricity produced for heat pumps would thus be 944 lbs. CO2 per MWh. The ISO New England figure aligns closely with the non-baseload factor of 900 lbs. CO2 per MWh for New England published by the US Environmental Protection Agency under the Emissions & Generation Resource Integrated Database (eGRID) program.

The ISO New England and EPA eGrid figures for CO2 emissions from electricity generation are onsite combustions only and do not account for upstream methane losses and CO2 emissions. Based on guidance provided by the Argonne National Laboratory GREET model and the UN Intergovernmental Panel on Climate Change (IPCC) 2019 guidelines, a full life-cycle analysis (LCA) for electricity typically yields an additional 15 to 30 percent higher factor for CO2e equivalent emissions depending on the timeframe (20 year vs. 100 year) used for methane emissions.

GREET and UN IPCC findings support a science-based argument for using a carbon score of over 1,000 lbs. CO2e per MWh for electricity under the proposed Massachusetts Clean Heat Standard.

The ISO New England presentation also forecasts that average annual wholesale electricity prices (LMPs) would increase substantially by the year 2032 due to the use of more expensive fuels (oil/coal) and lower efficiency generation units. While the grid MWh load growth from EVs and heat pump over the next 10 years will be only a modest 15% or so, the LMP would increase by 84%. The total annual cost for wholesale power supply for all customers in New England would increase from about $3 billion to $7 billion per year. All ratepayers in New England would collectively share the $4 billion per year jump in wholesale power cost resulting from forecasted heat pump implementation.

The left graph in the next slide shows the expected increases in wholesale power costs (LMP = $ per MWh) in New England for the base case of no electrification (blue), then base + EVs (purple), then base + EVs + heat pumps (green). The right graph shows the expected total wholesale power costs paid by utility customers (LSEE = $ billion per yr.).



The next and final slide shown here includes ISO New England commentary on the challenges of decarbonizing the grid when additional EV and heat pump loads are placed on top of the existing grid load profile.

No Electrified Load Growth: Takeaways

- Just as shown in the 2032 model, decarbonization would be a smaller lift without the added demand from the transportation and heating sectors
- While 40 GW of new capacity is still a massive undertaking, it is a much more feasible goal than almost 100 GW in the base model
- Without a large electrified peak load, significantly less emitting dispatchable generation is needed. New intermittent and energy limited resources could replace a moderate amount of emitting dispatchable generation if loads stay around their current level
- An issue, which is not examined in this analysis, is the management of low net loads. If growth of BTM-PV was included without load growth, net loads would eventually become negative and would require energy storage load or export capability

APPENDIX

NEED FOR USE OF MARGINAL EMISSIONS FACTORS FOR POWER GENERATION

On the Importance of Marginal Emissions Factors for Policy Analysis

Environmental nonprofits WattTime and Rocky Mountain Institute recommend marginal rather than average emissions factors be used for analysis of policies whose goal is to reduce carbon emissions. This primer explains why.

The purpose of average emissions factors is to apportion environmental responsibility.

A common technique in environmental analysis is to divide responsibility for cleaning up pollution equally between the different actors in a power grid on the basis of their relative power consumption. For example, if a given city consumes 5% of all the electricity produced in a given power grid, it is simple and intuitive to call it responsible for 5% of all the emissions in that grid.

The virtue of this technique is its simplicity. Each city or company on a power grid can simply calculate the average emissions per each kilowatt-hour on its local power grid; measure its own kilowatt-hours consumed; and multiply to determine its "share" of a given grid's pollution.[1]

Average emissions factors should *not* be used to measure environmental impact.

Historically, average emissions rates have been a convenient way to apportion "ownership" of different organizations' responsibility for emissions. Unfortunately, as momentum builds for institutions to more actively manage emissions, a worrisome trend is the growing number of organizations mis-applying average emissions factors to estimate the impact of environmental decisions. Yet this approach does not accurately measure environmental consequences. Returning to the previous example, it's entirely possible that the exact 5% of the grid's electricity that city is consuming comes predominantly from aging natural gas power plants, which would mean comparatively high emissions.

The correct way to measure environmental impact is using marginal emissions factors.

To protect against this mistake, the correct way to measure the impact of environmental decisions is to use *marginal* emissions factors.[2] Marginal emissions factors measure the actual environmental consequences of taking different potential actions on the power grid.

If the example city is evaluating an energy efficiency measure to conserve one megawatt-hour of electricity consumption, this program will reduce local emissions by reducing output at one or more power plants. But *which* power plants? Many sources of power, for example most solar panels, are designed to send all the energy they can to the power grid no matter the level of energy demand. Thus, they will be completely unaffected.

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[1] See, e.g. the GHG Protocol Corporate Standard.

[2] See, e.g. the GHG Protocol for Grid-Connected Electricity Projects.

Conserving energy only affects some power plants: those which can scale up or down in response, known as the "marginal" power plants. Marginal emissions measure the emissions per kilowatt-hour only from these power plants, thus accurately measuring real-world results.

Why using average emissions can lead to incorrect policy conclusions.

When a power grid experiences a change in energy demand—for example, adding electric vehicles, or installing new clean power—that changes the emissions from local power plants. But some power plants are completely unaffected, for example, most solar panels and nuclear plants.

Using average emissions factors to measure the effect of environmental decisions implicitly assumes that energy policy-making affects all power plants equally. This overestimates the effects on these unaffected plants, and underestimates the effects on the marginal plants which actually do change in response to policy. If these plants have different emissions rates, this can lead to incorrect measurement of policies.

This is a growing problem because the more "always-on" clean energy a region installs, the more inaccurate any analyses using average emissions factors become. For example, on Friday May 3rd, 2019 at 1:30 PM, the CAISO website reported the following data regarding real-time energy supply and emissions. CAISO was delivering 23, 690 MW of power at an emissions rate of 3,042 $mTCO_2$/hour. Nearly 50% of the total supply (12,086 MW), was from renewable sources. Using an approach of average emissions, one would say that the current emissions rate was 283lbs CO_2/MWh.[3]

However, the marginal emissions rate for the same time was much higher, at 927 lbs CO_2/MWh. Despite the high penetration of midday solar, if 1 MWh of load was added to the grid at this time, the solar plants would likely not be the type of fuel responding to the increased load. It is more likely that an inefficient gas generator would ramp to meet the increased load, thus creating an emissions impact of 927 lbs of CO_2.[4]

As seen here, true emissions rates can be up to four times higher than average emissions-based estimates would imply, with major consequences for policy evaluation.

If policymakers were to only allow technologies that were below the average emissions levels, they might inadvertently allow existing, inefficient generators to operate more than they intend. The result would be restricting projects are that good for the environment, instead of encouraging them.

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[3] California ISO real-time energy data.

[4] WattTime marginal emissions data.

Common situations in which marginal emissions is most important.

Marginal emission factors should nearly always be used in environmental impact analysis. Leading researchers apply them when measuring everything from renewable energy, to electric vehicles, to energy storage.[5] But they have particular importance for public policy whenever a policy measure is comparing different options, for example:

- *Comparing what times are best to use or store energy*. Marginal emissions should be used to select which times are cleanest, such as for energy storage.[6]
- *Comparing where is best to site a new energy asset*. Marginal emission rates should be used to measure the impact of new renewable energy, particularly in selecting locations.[7]
- *Evaluating electrification*. Marginal emissions rates should be used when evaluating the environmental impact of electrifying fossil fuel technologies such as vehicles, water heaters, and appliances. For example, in some coal-heavy regions, switching from a gasoline-powered car to an electric vehicle can actually increase, not decrease emissions.
- *Evaluating low-emissions energy sources*. Marginal emissions rates should be used to evaluate the environmental impact of low-pollution electricity generation technologies such as fuel cells and biomass. These technologies are sometimes mistakenly thought to increase emissions if they emit more than the local average emissions rate. But in reality they reduce emissions anywhere they less than the local marginal emissions rate.

For more information about average vs. marginal emissions, see this joint WattTime-RMI post.

How to properly design policy based on data-driven marginal emissions rates

Several large, influential public agencies (the CPUC), and private customers are committed to accurately reducing carbon emissions by using marginal emissions analysis. In December of 2018, the CPUC staff released a draft regulation directing the commission to require entities utilizing public incentives in the Self Generation Incentive Program (SGIP) to use marginal emissions rates to determine the net GHG impact of their project.[8]

Creating effective regulations and policy, as the CPUC has done, requires thorough data analysis and stakeholder engagement. As an independent, third-party non-profit, WattTime was founded to guide policy makers and regulators through this process to ensure that their efforts accurately reduce greenhouse gas emissions.

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[5] See, e.g. Hittinger and Azevedo (2015), Callaway et al (2017) or Fares and Weber (2017).

[6] E.g. the California Public Utilities Commission's decision to use marginal emissions in real time for energy storage.

[7] See, e.g. Boston University's recent decision to buy renewable energy outside Boston using marginal emissions.

MassDEP Clean Heat Standard

Cost of Renewable Electricity

Technical Notes by Raymond J. Albrecht PE

Submitted on Behalf of the
Massachusetts Energy Marketers Association

April 5, 2024

Summary Biography for Raymond J. Albrecht PE

Consulting environmental engineer in the subject area of renewable heating technologies and power generation. Technical specialties have included electric and thermally-driven heat pumps, solid biomass and liquid renewable fuel-fired thermal systems, and liquid renewable fuels for power generation. Have performed work for manufacturing companies, trade organizations and environmental agencies relating to equipment design, fuel utilization, regulatory permitting, emissions testing, and life-cycle analysis. Member of the ISO New England Planning Advisory Committee and active with the ISO New England Load Forecasting Committee. Spent 30 years as lead technical staff person for heating technology and fuels R&D at the New York State Energy Research and Development Authority (NYSERDA). NYSERDA work also included field testing of first ground-source heat pump installation in northeastern United States in the early 1980s. Principal of Raymond J. Albrecht LLC for the past 16 years.

Graduate of Cornell University with a Bachelor of Science degree in engineering and a Master of Science degree in Theoretical and Applied Mechanics. Life Member of the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) and past chairman of ASHRAE Technical Committee 6.10 for Fuels and Combustion. Received the ASHRAE Distinguished Service Award in 2015. Licensed professional engineer (No. 056935) in New York. Served as a 1st Lt (Infantry) in the United States Army during 1970-80 including active plus reserve duty. Graduate of the US Army Infantry Officer School at Fort Benning, Georgia. Fulfilled my active reserve obligation in northeastern Kenya near the Somali border.

SUMMARY COMMENTS

1) MassDEP should evaluate the capital expenses that would be necessary for expansion of generation, transmission, battery storage and distribution capacity of renewable electricity for residential and commercial heat pumps. While a moderate, initial increase in electricity consumption by heat pumps can be met by existing generation, transmission and distribution infrastructure in Massachusetts, the cost of a multi-fold expansion in grid loads will present an enormous economic and logistical challenge.

2) Analysis of long-term electricity costs included in this document indicates that the levelized capital cost of offshore wind generation-transmission-distribution infrastructure would be just over $1 per kWh. Utility costs for operations management, administration, insurance, taxes, etc., would be additional. The described capital cost estimates do not account for remediation measures in environmentally sensitive areas such as the Stellwagen Bank National Marine

Sanctuary. The estimates do not account for the use of floating platforms due to water depths of over 60 meters, which occur throughout most of the Gulf of Maine. The estimates do not account for options such as underground burial of transmission/distribution cable or alternate routing options, whose necessity could be triggered by Not-In-My-Backyard (NIMBY) opposition from residents subject to dislocation via eminent domain. The estimates also do not account for regional and national security concerns that may arise relating to protection of distant offshore infrastructure.

3) A recent ISO New England EPCET presentation forecasts that average, short-term, annual wholesale electricity prices (LMPs) would increase substantially by the year 2032 due to the use of more expensive fuels (oil/coal) and lower efficiency generation units while meeting increased grid loads. While the grid MWh load growth from EVs and heat pump over the next 10 years will be only a modest 15% approximately, the LMP would increase by 84%. The total annual cost for wholesale power supply for all customers in New England would increase from about $3 billion to $7 billion per year. All ratepayers in New England would collectively share the $4 billion per year jump in wholesale power cost resulting from forecasted heat pump implementation.

INTRODUCTION

Evaluations of capital expenses in these technical notes are based on several recently published reports, including the 2021 Avoided Energy Supply Component Update report prepared by Synapse Energy Economics for electric utilities and state regulatory agencies located in the ISO New England grid. Two reports from the National Renewable Energy Laboratory (NREL) were also used, including "Cost Projections for Utility-Scale Battery Storage 2021 Update" and "2020 Cost of Wind Energy Review". A report by the Brattle Group entitled, "Marginal Cost of Service Study", prepared for Con Edison, was also used.

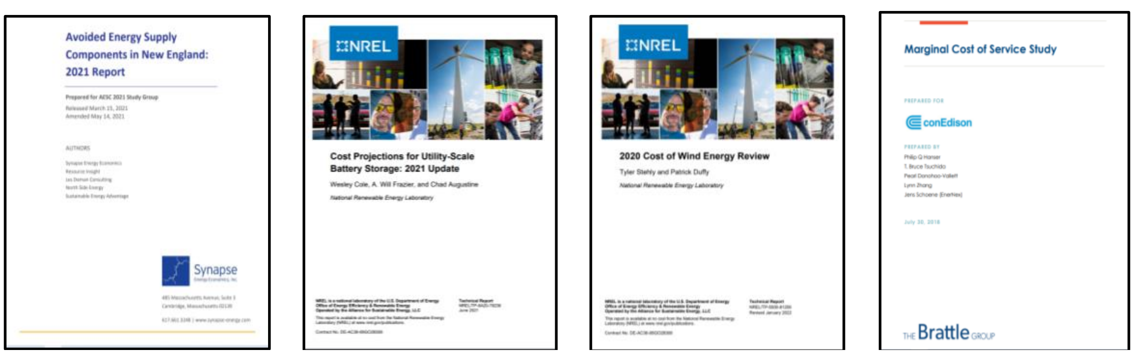


Figure 1. References Used in Capital Expense Evaluations

ACCOUNTING FOR TRANSMISSION AND DISTRIBUTION LINE LOSSES IN ANALYSIS OF GRID IMPACTS OF ELECTRIFICATION

When the electrical load increases in a building, the corresponding increase in necessary power generation will be greater due to line losses that occur between the powerplant and end-use sites. The average line loss in transmission and distribution networks will usually be somewhere in the range of 8 percent in the northeastern United States. This factor must be included in analyses of electrification and renewable power generation to maintain accuracy of results. The practical consideration is that the renewable power generation capacity necessary to serve an increased grid load will be measurably greater than the load itself. This effect can have a substantial impact on heat pump carbon intensity as well as capital costs for grid upgrades.

The EPA AVERT model incorporates an automatic, built-in calculation of approximately 8% average line losses for New England. It is noted here, however, that since line losses are an I^2R issue, with losses proportional to the square of the current flow rate, thus not just a linear relationship, the incremental loss for increased grid loads during peak periods will typically be in the mid-teen percentage range, with the exact figure defined as the calculus derivative of the governing, line-loss mathematical equation. The significant economic impact of line losses during peak grid load conditions, due to electrification, needs to be recognized and addressed by energy policymakers.

LONG-TERM CAPITAL COSTS OF ELECTRICITY GRID UPGRADES IN MASSACHUSETTS FOR IMPLEMENTATION OF RESIDENTIAL AND COMMERCIAL HEAT PUMPS

Wind and solar projects planned for the next 10 to 20 years in Massachusetts, even if fully developed, will make a good start toward eliminating fossil generation for existing grid loads, but will not provide the substantial growth in capacity necessary for full implementation of heat pumps in the residential and commercial building sectors. Substantial capital investments will be required beyond current plans for renewable power generation and battery storage to replace fossil-based generation that would be necessary to meet increased grid loads. Major investments will also be required for transmission and distribution networks to allow renewable electricity to reach end-use customers.

Approximately 15,000 MW of grid load growth in MA will result from operation of residential and commercial heat pumps during peak winter conditions. The data are based on the presumption that whole-house heat pumps would be used with no fuel-fired back-up. As stated earlier, such grid load growth would approximately triple the existing winter peak load in the MA zone of ISO New England.

An installed nameplate capacity of 10,000 MW of offshore wind plus 10,000 MW of solar PV power would approximately meet the needs of residential and commercial heat pumps in the MA zone of ISO New England during the coldest months of the heating season, assuming sufficient availability of battery storage. If it were possible to install the described 10,000 MW of offshore wind capacity at a cost of $5 million per MW, and the 10,000 MWh of solar PV capacity at a cost of $3 million per MW, the total capital expense would be approximately $80 billion. If floating-type offshore wind platforms are required, which is likely to be the case, due to water depths of greater than 60 meters, an upward revision to the wind turbine capital expense figure would become necessary.

For a MA peak grid load of about 15,000 MW for residential and commercial heat pumps, the required nominal, 48 hour, battery storage capacity, to enable continued operation during extended cold temperature and low windspeed conditions, with output of 20% of rated capacity, would be approximately 600,000 MWh.

If utility-scale battery storage were to cost $200,000 per MWh capacity, based on NREL mid-range cost projections for the year 2030, the initial capital expense for battery storage would be approximately $120 billion, to cover the 48 hour storage discharge needed during a wind drought. This figure may be subject to adjustment, however, based on battery material price increases/decreases which might occur as the wind and solar industries grow. Increased production volumes may contribute to economies of scale, which might provide downward pressure on costs. Increased volumes of mining/extraction of materials for batteries, on the other hand, could trigger higher prices due to supply shortages. Lithium and cobalt commodity prices have recently increased multifold with corresponding upward pressure on battery storage prices, although new, cheaper materials and battery designs are also under development. An expected service life of 10 years is used for analysis of battery costs.

Increased grid transmission capacity in Massachusetts would also be necessary to enable full implementation of residential and commercial heat pumps. While transmission upgrade costs will vary widely on a local basis depending on existing capacity and load characteristics, this analysis uses an average annual cost figure of $94 per kw-yr for New England, as developed in the 2021 Avoided Energy Supply Component Update report by Synapse Energy Economics for electric utilities and state regulatory agencies located in the ISO New England grid. The $94 figure represents a combination of construction and operating cost, e.g., labor, administration, insurance, and taxes. The corresponding, total combined capital and operating cost figure could have an order of magnitude value of $2000 per kw of increased transmission capacity, although actual cost figures are highly dependent on specific circumstances. Using the figure of $2000 per kW of increased transmission capacity, the corresponding cost for 15000 MW of transmission upgrades in Massachusetts could be approximately $30 billion.

Increased local electricity distribution capacity would also be necessary for implementation of residential and commercial heat pumps in Massachusetts. Synapse Energy Economics has identified a wide range of accounting practices used by electric utilities in New England, with corresponding cost figures that range from *de minimis* to over $200 per kW-yr. More consistent accounting practices used in other states, such as New York, have indicated distribution upgrade costs ranging from $50 to $250 per kW-yr, representing variations in cost and difficulty of distribution network construction which occur in rural through dense urban environments. A corresponding, total combined capital and operating cost figure of $3000 per kW is used for this analysis. The corresponding cost for 15000 MW of distribution upgrades would be approximately $44 billion.

The described capital cost estimates do not account for remediation measures in environmentally sensitive areas such as the Stellwagen Bank National Marine Sanctuary. The estimates do not account for the probable necessity for use of floating platforms due to water depths of over 60 meters, which occur throughout most of the Gulf of Maine and significant portions of the New England coast south of Cape Cod. The estimates do not account for options such as underground burial of transmission and distribution cable or alternate routing options, whose necessity could be triggered by Not-In-My-Backyard (NIMBY) opposition from local residents subject to dislocation via eminent domain. The estimates also do not account for regional and national security concerns that may arise relating to protection of distant offshore infrastructure.

Recent capital cost analyses for residential heat pumps have centered on an approximate figure of $20,000 per onsite installation. The corresponding capital cost for installation of 2.6 million residential heat pumps in Massachusetts would be approximately $52 billion. The commercial building sector uses about 50% as much heating equipment capacity and energy consumption as the residential sector. The total capital cost for installation of residential and commercial heat pumps in MA would thus be approximately $80 billion.

The following table presents the long-term capital cost figures estimated above for offshore wind and solar PV generation capacity, battery storage, transmission and distribution upgrades, as well as for onsite installation of residential heat pumps, for full implementation of residential and commercial heat pumps in Massachusetts.

Time Horizon	10 yrs	20 yrs	30 yrs
Wind and Solar PV Generation	$ 80 billion	$ 80 billion	$ 80 billion
Battery Storage	$ 120 billion	$ 240 billion	$ 360 billion
Transmission	$ 30 billion	$ 30 billion	$ 30 billion
Distribution	$ 44 billion	$ 44 billion	$ 44 billion
Onsite Heat Pump Installation	$ 80 billion	$ 120 billion	$ 160 billion
Total	$ 354 billion	$ 514 billion	$ 674 billion

Table 1. Summary of capital costs for full implementation of residential and commercial heat pumps in Massachusetts

The above table shows capital cost figures for three different time horizons. A service life of 30 years is used for the analysis of wind and solar PV generation, transmission and distribution systems. A service life of 10 years is used for battery storage systems, to reflect the limited lifetime of batteries used for daily charge/discharge cycles with depth of discharge (DOD) values in the range of 80 percent. Full battery replacement plus major maintenance/upgrades of charging controls and physical facilities have been presumed at the 10 and 20 year marks. Similarly, an initial service life of 10 years has been used for cold-climate heat pumps that are used for full heating season operation, with major (e.g., compressor/controls) component replacement required at the 10 and 20 year marks. The significant impact on long-term, total capital costs by short-lived equipment components can be seen in the table.

Approximately 22.2 million MWh of electricity would be generated per heating season by the described combination offshore wind plus solar PV system. A high fraction of the potential output of the dedicated wind/solar generation capacity necessary for winter heating would be foregone during the summer due to the high ratio of winter-to-summer peak load that would occur with electrification of heating. A total of approximately 660 million MWh would be produced over the course of 30 years.

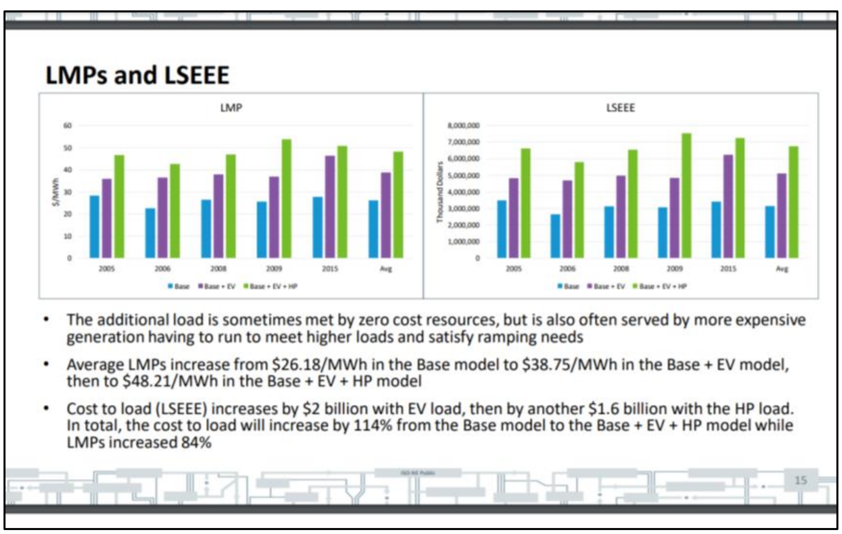
The total capital cost of the generation/transmission/battery storage/distribution cost components would be $674 billion over the described 30 year time horizon. The corresponding energy supply cost for the described wind/solar generation system can be calculated as the $674 billion total capital cost divided by the 660 million MWh of generation over the same 30 year time horizon. The resulting marginal cost of infrastructure for electricity generation/transmission/distribution would thus be approximately $1020 per MWh or $1.02 per kWh. Generation, battery storage and some of the transmission costs would be embedded in the supply charge portion of an electric bill. Additional transmission costs, plus costs for distribution infrastructure, administration, operations, taxes, etc., would be additional and embedded into the energy delivery portion of an electric bill.

There are two principles of significance to note in this analysis. First, battery storage is conspicuous as an expensive component of the total capital cost for a renewable power-heat pump concept for the residential and commercial building sectors. Battery storage systems are expensive, plus they do not have the same 30 year lifetimes as for generation/transmission/distribution equipment and thus need periodic replacement. Second, the capital cost of the renewable power-heat pump concept suffers from an overall low capacity factor due to the relatively high magnitude of peak loads compared to total annual energy consumption. Renewable fuels can therefore play a key role in maintaining acceptable cost effectiveness while achieving our environmental goals.

SHORT-TERM IMPACTS OF ELECTRIFICATION ON ELECTRICITY COSTS

The ISO New England presentation also forecasts that average annual wholesale electricity prices (LMPs) would increase substantially by the year 2032 due to the use of more expensive fuels (oil/coal) and low-efficiency generation units. While the grid load growth from EVs and heat pump over the next 10 years will be only a modest 15% or so, reflecting just early growth in heat pump market share, the LMP would increase by 84% due to the forecasted wholesale power auction response to higher grid load and fewer dispatchable generation resources. ISO New England forecasts that the total annual cost for wholesale power supply for all customers in New England would increase from about $3 billion to $7 billion per year. All ratepayers in New England would collectively share the $4 billion per year jump in wholesale power cost resulting from forecasted heat pump implementation. Again, this is just for a small percentage of market growth by heat pumps.

The left graph in the next slide shows the expected increases in wholesale power costs (LMP = $ per MWh) in New England for the base case of no electrification (blue), then base + EVs (purple), then base + EVs + heat pumps (green). The right graph shows the expected total wholesale power costs paid by utility customers (LSEE = $ billion per yr).



The next and final slide shown here includes ISO New England commentary on the challenges of decarbonizing the grid when additional EV and heat pump loads are placed on top of the existing grid load profile.

No Electrified Load Growth: Takeaways

- Just as shown in the 2032 model, decarbonization would be a smaller lift without the added demand from the transportation and heating sectors
- While 40 GW of new capacity is still a massive undertaking, it is a much more feasible goal than almost 100 GW in the base model
- Without a large electrified peak load, significantly less emitting dispatchable generation is needed. New intermittent and energy limited resources could replace a moderate amount of emitting dispatchable generation if loads stay around their current level
- An issue, which is not examined in this analysis, is the management of low net loads. If growth of BTM-PV was included without load growth, net loads would eventually become negative and would require energy storage load or export capability

MassDEP Clean Heat Standard

Grid Reliability Impacts

Technical Notes by Raymond J. Albrecht PE

Submitted on Behalf of the
Massachusetts Energy Marketers Association

April 5, 2024

Summary Biography for Raymond J. Albrecht PE

Consulting environmental engineer in the subject area of renewable heating technologies and power generation. Technical specialties have included electric and thermally-driven heat pumps, solid biomass and liquid renewable fuel-fired thermal systems, and liquid renewable fuels for power generation. Have performed work for manufacturing companies, trade organizations and environmental agencies relating to equipment design, fuel utilization, regulatory permitting, emissions testing, and life-cycle analysis. Member of the ISO New England Planning Advisory Committee and active with the ISO New England Load Forecasting Committee. Spent 30 years as lead technical staff person for heating technology and fuels R&D at the New York State Energy Research and Development Authority (NYSERDA). NYSERDA work also included field testing of first ground-source heat pump installation in northeastern United States in the early 1980s. Principal of Raymond J. Albrecht LLC for the past 16 years.

Graduate of Cornell University with a Bachelor of Science degree in engineering and a Master of Science degree in Theoretical and Applied Mechanics. Life Member of the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) and past chairman of ASHRAE Technical Committee 6.10 for Fuels and Combustion. Received the ASHRAE Distinguished Service Award in 2015. Licensed professional engineer (No. 056935) in New York. Served as a 1st Lt (Infantry) in the United States Army during 1970-80 including active plus reserve duty. Graduate of the US Army Infantry Officer School at Fort Benning, Georgia. Fulfilled my active reserve obligation in northeastern Kenya near the Somali border.

SUMMARY COMMENTS

1) MassDEP needs to address the grid reliability issues that would result from the widespread implementation of residential and commercial heat pumps under the proposed Clean Heat Standard. A moderate increase in electricity consumption by heat pumps in the short term can indeed be met by existing generation, transmission, and distribution infrastructure in Massachusetts. The rapidly expanding grid loads proposed by MassDEP would, however, be met by intermittent, inverter-based generation resources and would create multiple instances of capacity shortage as well as potential voltage and frequency instability.

2) A recent ISO New England publication entitled, “2021 Economic Study: Future Grid Reliability Study – Phase 1” describes a comprehensive evaluation of several scenarios of solar and wind generation and heat pump deployment over the next couple of decades through the year 2040.

The study evaluated how a 2040 grid could perform with the expected shift in generation resources and increased grid load that will occur under New England decarbonization efforts.

The principal focus of the study was to identify and evaluate gaps between generation capacity and heat pump-based grid loads that could result due to high thermal loads and low solar/wind output during unfavorable weather conditions. The ISO New England study included a detailed description of the analytical methodologies used and the key findings offered. Conclusions were made relating to energy adequacy, generation resource and grid load flexibility, and resource mix diversity. The ISO New England study is the basis for the principal conclusions offered in these technical notes.

Figure 1. References Used in Grid Reliability Technical Notes

3) The study concluded that the future grid will require a significant amount of dispatchable, fuel-fired generation to support intermittent, solar and wind generation resources during unfavorable weather conditions. While total hours of operation of fuel-fired generation would be less than occur today, the peak natural gas flows and necessary infrastructure for natural gas transport could be even greater than what is currently required by the existing grid. This result would occur because the net fuel-to-electric-to-heat efficiency of heat pumps would be less than the typical efficiency of fuel-fired heating systems.

4) The summary conclusion to be drawn from the ISO New England Future Grid Reliability Study is that the Clean Heat Standard needs to encourage, rather than limit, the use of renewable fuel-fired options for residential and commercial heating. More specifically, the Clean Heat Standard needs to build in a strong financial incentive for owners of residential and commercial buildings with heat pumps to maintain and use renewable fuel-fired systems when the grid is under stress or when grid carbon intensity is high.

TECHNICAL NOTES ON ISO NEW ENGLAND FUTURE GRID RELIABILITY STUDY

The following notes are drawn directly from the Future Grid Reliability Study originally published by ISO New England in July of 2022 with an Appendix C – Resource Adequacy Results later in 2023.

The resource adequacy analysis in the Future Grid Reliability Study simulated the reliability of a future renewable dominated grid using Resource Adequacy Screen (RAS) and Probabilistic Resource Availability Analysis (PRAA) methodologies. RAS and PRAA help analyze system reliability by considering the uncertainties associated with the output of intermittent renewable resources due to weather risks, interactions between different types of resources, and grid load conditions.

Resource Adequacy Screen (RAS) analysis examines the frequency and duration of reliability risk events, calculates loss-of-load probability, and identifies risk trends. It helps anticipate conditions under which there may not be sufficient resources to meet the reliability criterion, typically expressed as Loss of Load Expectation (LOLE), can predict when those conditions might occur, and assesses whether there may be a need for certain quantities and categories of resources to meet reliability criteria.

Probabilistic Resource Availability Analysis (PRAA) simulates scenarios by modeling hourly variations in wind and solar resources probabilistically according to years of historical weather conditions. The goal of PRAA was to analyze how modeling hourly output of solar and wind renewable resources may change overall system resource needs.

Battery storage can play a key role in filling gaps created by unfavorable weather conditions. But batteries can face a severe technical and economic challenge since they may frequently have to wait several days after discharge for favorable weather conditions that would allow them to recharge. The study found that long wait times for battery recharging could severely limit their effectiveness in meeting grid loads during subsequent drought conditions for solar and wind output. Battery recharging characteristics thus constitute a considerable risk to grid reliability.

Remaining nuclear power plants at Seabrook, NH and Millstone, CT are often presumed by energy policymakers to be viable until at least the year 2050. Recent forced outages, especially at Millstone 2 and 3, have begun to raise concerns about their remaining service life. Due to the 24/7 operating characteristics of nuclear power, the 2000 MW capacity at Millstone 2 and 3 provides the same annual MWh generation output as approximately 5000 MW nameplate capacity of offshore wind based on a net capacity factor of 40 percent. Energy policymakers need to consider the substantial risk to grid reliability presented by aging nuclear power plants in New England.

During periods of grid stress, whether due to peak weather conditions or rapid generation and load ramp-up cycles during the late afternoon, there can be a significant drop in the efficiency of power generation due to increased use of simple-cycle combustion turbines or steam-fired plants. To clarify, the fuel-to-electric generation efficiency during peak conditions can typically be 30 percent or less due to the use of older, simple-cycle combustion turbines or steam plants.

Likewise, the electric-to-heat efficiency of a heat pump will typically be in the range of 150 to perhaps 200 percent during cold weather. The net fuel-to-electric-to-heat efficiency of a heat pump would therefore be in the range of 45 to 60 percent, thus far below the typical 80 to 90 percent efficiency of fuel-fired heating systems. The noted losses of efficiency would cause significant stress on the natural gas system and power grid in New England.

The conversion of a liquid fuel-fired heating system to heat pump operation would add even greater load onto the New England natural gas infrastructure, with a potentially devastating impact on the grid, by forcing an even greater gap between natural gas availability and demand for power generation during peak periods.

It should be noted as well that the loss of efficiency by both power generation and heat pump operation would cause the carbon intensity of heating to rise substantially during peak load and rapid load ramp-up periods.

The intermittent resources in the future grid will lack controllability and predictability based on the natural variability of weather. This will trigger the need for far higher percentages of generation reserve capacity with attendant penalties in fuel consumption for maintaining hot spinning reserves.

There will be a growing demand for grid load flexibility to balance loads with available generation capacity. Many energy policymakers already recognize that solutions such as flexible EV charging can help smooth grid demand. During the winter, however, thermal loads will usually be greater than EV charging loads and there will be an even greater need for heat pump systems to incorporate a means for switching to a non-electric mode of operation.

Increased amounts of solar and wind generation will lead to an increased need for minute-to-minute voltage and frequency regulation, more usage of spinning reserves, and more frequent periods of reserve violations. Scenarios in the study which incorporated large amounts of dispatchable generation had fewer minutes of reserve violation. Scenarios with aggressive electrification and early retirement of dispatchable generation, on the other hand, saw increased minutes of reserve violation. The reserve margin used in grid operation will need to increase by an order of magnitude to account for the wide, unpredictable variation that can occur on a minute-by-minute basis with solar and wind energy.

The study explored four major scenarios for the future energy grid, including baseline decarbonization, moderate decarbonization, import-supported decarbonization and deep decarbonization. The deep decarbonization scenario met State environmental goals but did not meet grid reliability standards. An extremely high level of battery storage would be required to meet grid reliability standards. It was found, however, that even just 3,000 MW of dispatchable, fuel-fired generation, with lower capital costs than battery storage, could reduce the necessary solar and wind nameplate capacity by about 17,000 MW. This results from the simple math that 17,000 MW of wind or solar operating at 15% output due to unfavorable weather would yield the same 3,000 MW output as noted for the dispatchable system. ISO New England is therefore giving increased attention to the potential for renewable fuel-fired generation.

Reliance on imported electricity will become increasingly fraught with risk since neighboring regions are seeking to accomplish the same decarbonization goals as New England. An incident occurred during a cold spell this past winter in which Hydro Québec was unable to fulfill its contract obligation for supply of power to New England because of high demand and grid operating issues within its own territory. The loss of imported power from Hydro Québec nearly forced a grid collapse in New England. Energy policymakers need to recognize that inter-regional grid operation will sometimes deteriorate to an “every man for himself” mode during challenging circumstances.

CONCLUSION

Wind and solar projects planned for the next 10 to 20 years in Massachusetts, if fully developed, will make a good start toward eliminating fossil generation for existing grid loads, but will not provide the substantial growth in reliable generation capacity necessary for full implementation of heat pumps in residential and commercial buildings. The MassDEP Clean Heat Standard needs to incorporate strong incentives for the operation of renewable fuel-fired heating systems to help avoid grid reliability problems.

MassDEP Clean Heat Standard

Annual CO2e Emissions by Hybrid Biodiesel-fired/Heat-Pump Residential Heating Systems

Supplemental Technical Notes by Raymond J. Albrecht PE

Submitted on Behalf of the
Massachusetts Energy Marketers Association

April 5, 2024

Summary Biography for Raymond J. Albrecht PE

Consulting environmental engineer in the subject area of renewable heating technologies and power generation. Technical specialties have included electric and thermally-driven heat pumps, solid biomass and liquid renewable fuel-fired thermal systems, and liquid renewable fuels for power generation. Have performed work for manufacturing companies, trade organizations and environmental agencies relating to equipment design, fuel utilization, regulatory permitting, emissions testing, and life-cycle analysis. Member of the ISO New England Planning Advisory Committee and active with the ISO New England Load Forecasting Committee. Spent 30 years as lead technical staff person for heating technology and fuels R&D at the New York State Energy Research and Development Authority (NYSERDA). NYSERDA work also included field testing of first ground-source heat pump installation in northeastern United States in the early 1980s. Principal of Raymond J. Albrecht LLC for the past 16 years.

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SUPPLEMENTAL TECHNICAL NOTES

<u>Summary</u>

B50 biodiesel-fired boilers and cold-climate heat pumps, each capable of achieving, when operating by themselves, about 40% CO2e savings (compared to traditional heating oil) can achieve notably higher savings when they work in partnership as a hybrid heating system.

Both B50 UCO and B50 soy versions of the hybrid system achieve notable CO2e savings compared to the stand-alone, future generation air-to-air heat pump option, if component operation is based hourly on lowest, real-time carbon intensity in lbs CO2e per MMBtu of delivered heat.

The B50 soy version of the hybrid system achieves about 10% lower carbon intensity than a stand-alone heat pump, while the B50 UCO version achieves a carbon intensity reduction of about 18%.

There is thus an argument that forcing a customer to dismantle their fuel-fired boiler, or to relegate the boiler to only peak/emergency use, can result in harm to the environment.

The B50 (UCO) boiler in a hybrid system would always operate at temperatures equal to or below 30 deg F approximately. Above 30 deg F, the heat pump would run when the grid is more efficient, usually during mid-day and middle of the night, and the B50 (UCO) boiler would operate during morning/evening peak load periods when the grid is less efficient.

If B100 biodiesel is used, whether UCO or soy-based, there would be almost no hours of the heating season when heat pump operation would yield a lower carbon intensity than biodiesel, until roughly 20 to 30 thousand MW of offshore wind resources have been constructed to cover both existing grid loads as well as most thermal electrification loads.

Introduction

In the recent past, I have offered CO2e analyses of various fuel and heating system technologies for single family homes in Massachusetts. The analyses have shown calculated annual tons of CO2e emissions for individual, stand-alone technologies such as biodiesel-fired boilers using blends up to B50 and even B100, also natural gas and propane-fired boilers, and existing and future generations of air-to-air and air-to-water heat pumps. The analyses have shown especially that B50 biodiesel-fired heating systems, both soy and UCO versions, are approximately equal in annual performance to future generation, air-to-air heat pumps.

The following graph shows, however, that the general CO2e performance of heat pumps is sensitively dependent on outside temperature. The steady increase in carbon intensity shown at lower outdoor temperatures results from two independent factors: the drop in heat pump COP plus the drop in generation efficiency as simple-cycle power plants and higher carbon fuels are used more.

To note, the vertical data scatter shown for each temperature point is primarily the result of grid performance variations relating to hourly on/off-peak periods (morning and evening peaks vs. mid-day and nighttime), generation output ramp-up rate (simple cycle systems can ramp up faster than combined cycle), plus weekday/weekend differences in typical grid load profiles.

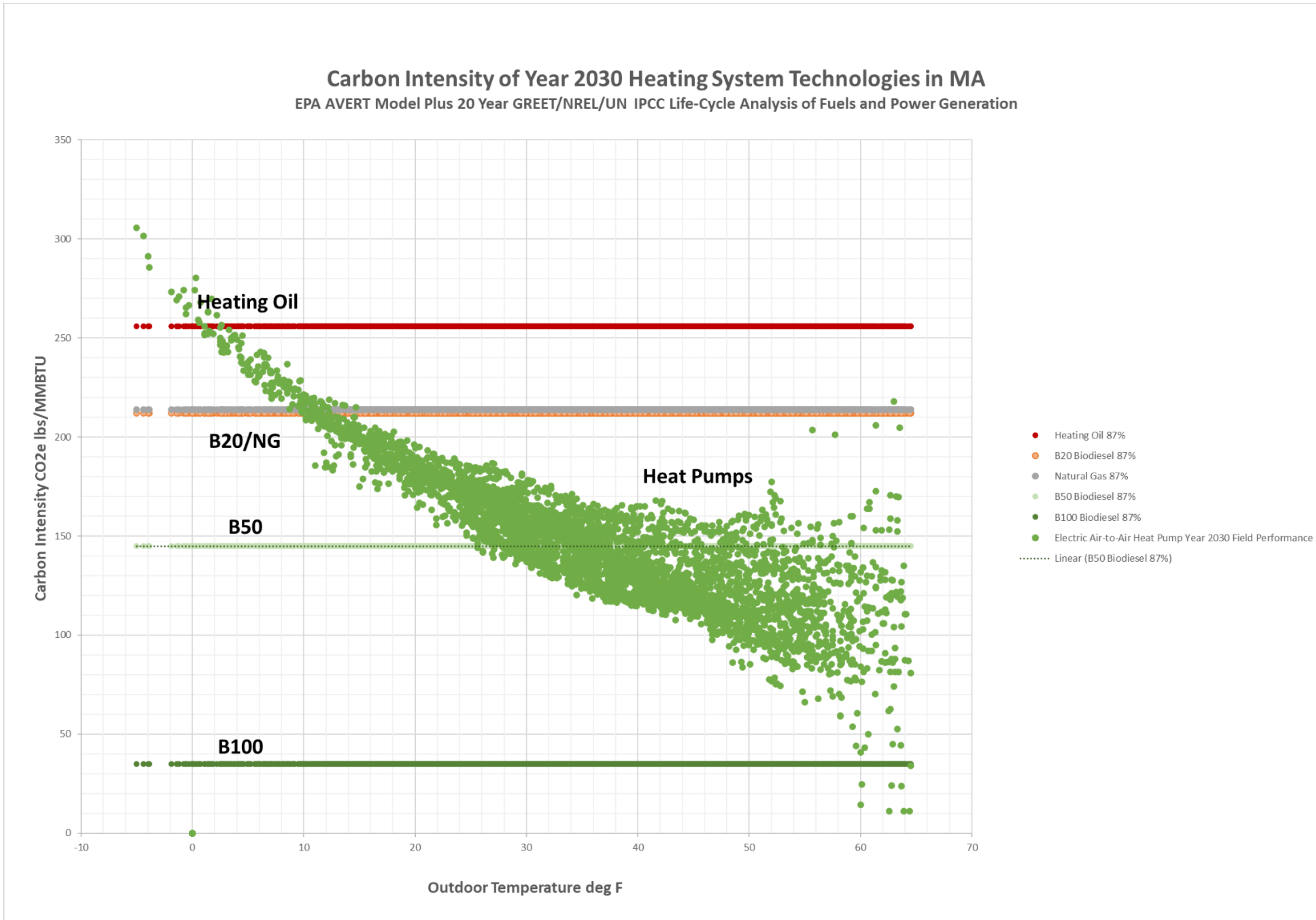


Figure A1. Carbon Intensity of Year 2030 Heating System Technologies vs. Outdoor Temperature

There have been many policy discussions recently relating to mandated conversion to heat pumps, e.g., the MassDEP Clean Heat Standard proposed annual requirement for converting 3% of the liquid fuel customer base to heat pumps, plus the question of whether customers should be allowed to still operate their fuel-fired heating systems after installation of a heat pump. There have also been increasing concerns about the impact of heat pump loads on an already stressed grid.

I decided to look at what would happen when a heat pump and biodiesel blend boiler are operated as a hybrid system, based solely on the question of which energy resource (electricity vs. biodiesel blend) would achieve the lowest carbon intensity in terms of lb CO2e per MMBtu of delivered heat during any particular hour of operation.

I modified my original Excel spreadsheet, used for past comments to MassDEP, to include an "IF" selector function for each hour of the heating season to choose which source (heat pump vs. boiler) would achieve the lowest carbon intensity.

Results

The following graph then shows a modified plot of carbon intensity at each outdoor temperature.

The data points in green indicate that a B50 (UCO) boiler would always operate at temperatures equal to or below about 30 deg F. Above 30 deg F, the heat pump would run when the grid is more efficient, usually during mid-day and middle of the night, and the B50 (UCO) boiler would operate during daily/hourly peak load periods when the grid is less efficient.

These results are fairly intuitive. To note, the corresponding graph for a hybrid, heat pump plus B50 (soy) boiler would be similar, but with a slight shift to the left due to the somewhat higher carbon intensity of soy-based B50.

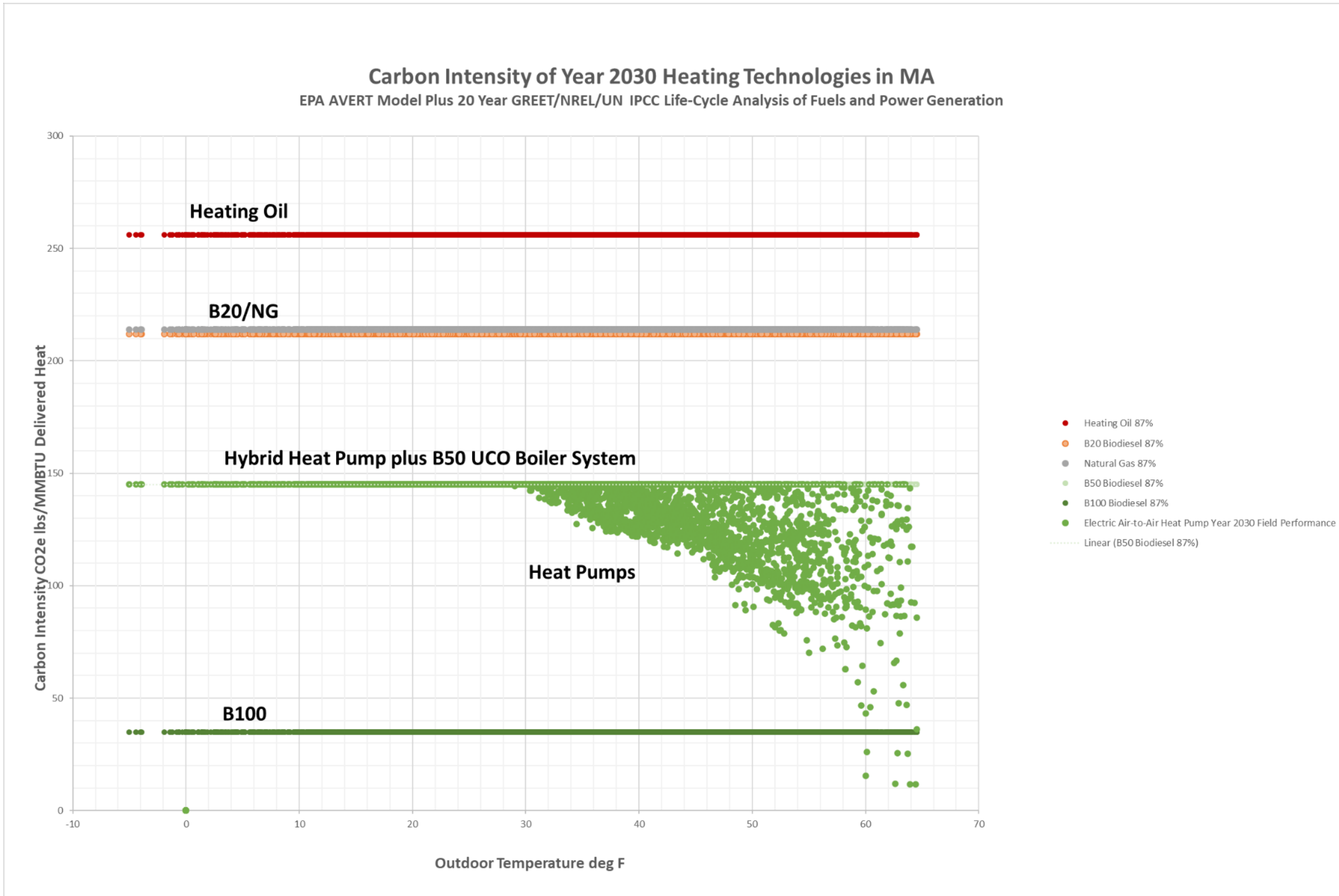


Figure A2. Carbon Intensity of Year 2030 Hybrid Biodiesel/Heat Pump Heating System Technologies vs. Outdoor Temperature

Then I analyzed the hourly energy consumption and CO2e emissions and put together a modified graph which shows annual CO2e emission figures for the original fuel and technology options that I had shown in previous documents plus two additional bars, just right of center, for hybrid biodiesel/heat pump systems using B50 (UCO) and B50 (soy) biodiesel blends.

The first conclusion is that both the B50 UCO and B50 soy versions of the hybrid system achieve notable CO2e savings compared to the stand-alone, future generation air-to-air heat pump option.

The B50 soy version of the hybrid system achieves CO2e savings of about 10% compared to the stand-alone heat pump, while the B50 UCO version achieves savings of about 18%.

Conclusions

The first conclusion is that two technologies, each capable of achieving about 40% CO2e savings when operating by themselves, can achieve notably higher savings of almost 50 percent when they work in partnership as a hybrid system.

For a B50 soy boiler scenario, the addition of a heat pump would decrease the CO2e emissions from 5.88 tons/yr to 5.46 tons/yr, for a savings of 0.42 tons/yr or 7%.

An additional conclusion is that if a customer does use B50 UCO in an 87% efficient boiler, that there are only very slim savings to be achieved by adding a future generation, air-to-air heat pump.

The actual numbers are 5.09 tons/yr CO2e for a stand-alone B50 UCO boiler, then 4.96 tons/yr CO2e for a hybrid heat pump plus B50 UCO boiler system, which amounts to only an approximate 2.5% reduction in CO2e emissions.

So there is an argument that forcing a customer to dismantle their fuel-fired boiler, or to relegate the boiler to only peak/emergency use, can result in harm to the environment.

The heat pump component of a hybrid system would operate most hours if B20 biodiesel were the alternate fuel option and if real-time carbon intensity were the only consideration. Generation and transmission capacity limits, however, would likely trigger the need for fuel-fired operation during cold weather.

But if B100 biodiesel is used, whether UCO or soy-based, there would be almost no hours of the heating season when heat pump operation would yield a lower carbon intensity than biodiesel, until roughly 20 to 30 thousand MW of offshore wind resources have been constructed off the coast of Massachusetts.

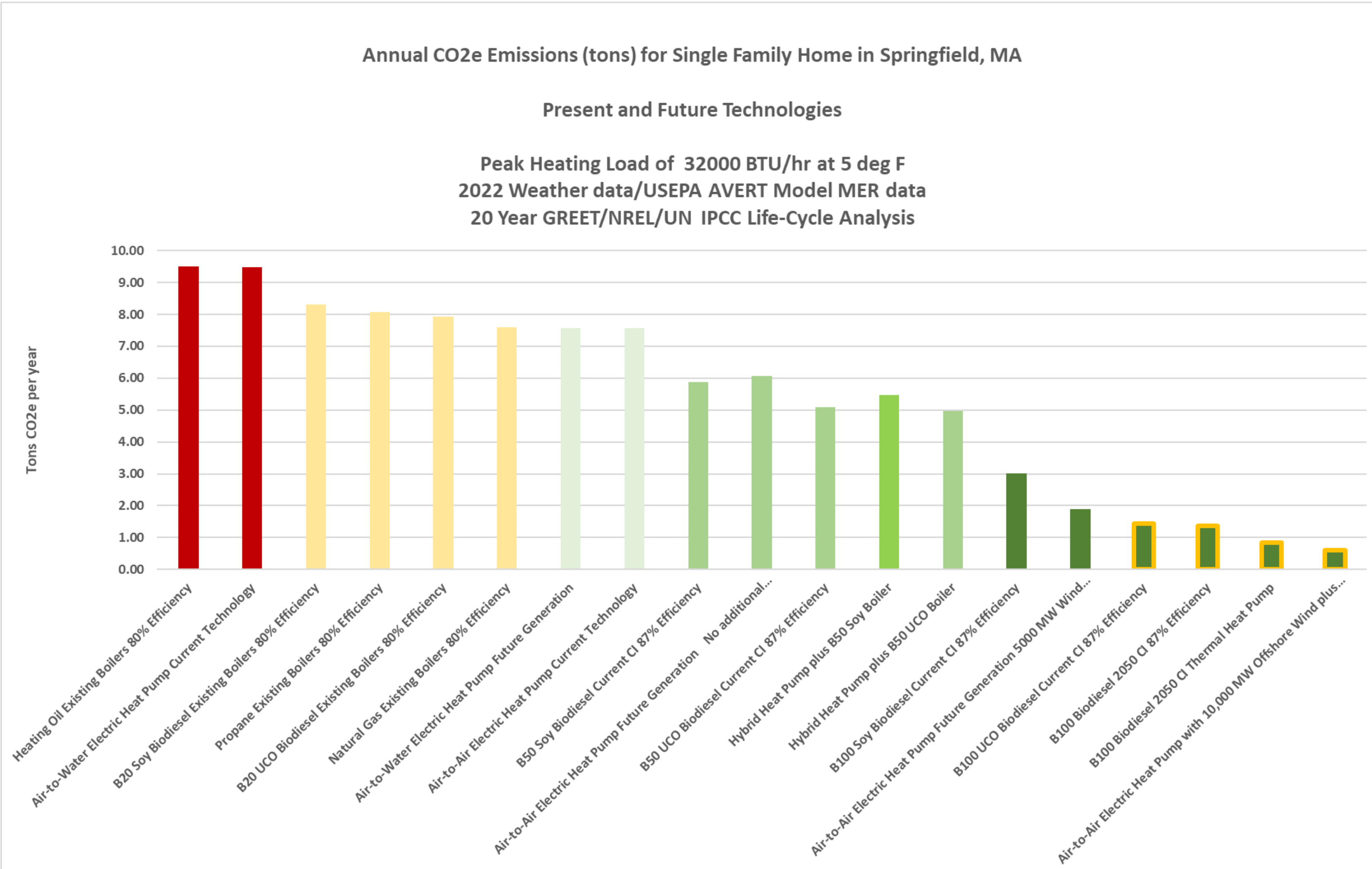


Figure A3. Annual CO2e Emissions for Single Family Home in Springfield, MA Including Hybrid Biodiesel/Heat Pump Heating System

For both the B50 UCO and B50 soy options, the funds for purchase and installation of a heat pump might be better directed to building envelope measures (insulation/windows/sealing/etc.) or to the purchase of highest possible efficiency boilers.

In terms of resulting impact on fuel and electricity consumption, my original analysis was based on a customer that would use approximately 625 gallons per year for space heating and 200 gallons per year for domestic hot water. Total fuel consumption would be about 800 to 850 gallons per year.

For the hybrid B50 UCO plus heat pump option, the annual fuel consumption would become approximately 700 gallons instead of 800 to 850 gallons.

For the hybrid B50 soy plus heat pump option, the annual fuel consumption would be less than 700 gallons depending on the carbon score of the biodiesel fuel.

For the hybrid B50 (UCO) plus heat pump option, electricity consumption would be approximately 1500 kWh per year. For the hybrid (soy) plus heat pump option, electricity consumption would be approximately 3000 kWh per year.

SUMMARY OF PAST TECHNICAL NOTES

These technical notes are based on an hourly, coincidental temporal analysis of heating loads and power grid performance. Digital weather data from Visual Crossing.com for Springfield, MA was used to model hourly heating loads in a representative single-family residential unit that would have a peak heating load of 32,000 Btu/hr at an outdoor temperature of 5 deg F. The described heating load formula is intended to be broadly representative for residential buildings located in New England.

I then used USEPA AVERT (AVoided Emissions and geneRation Tool) software to do an hourly analysis of grid impacts from residential and commercial heat pumps and to calculate required capacities of renewable power, including offshore wind, onshore wind, and utility-scale solar that would be necessary to meet expected Massachusetts heating loads using heat pumps.

USEPA's AVERT software performs deep analysis using marginal emission rates, rather than average grid mix values which are incorrectly used by many energy policymakers in the northeastern United States (see article by the Rocky Mountain Institute in the Appendix). AVERT analyzes how power plants would increase/decrease their output in response to grid load changes, and what the corresponding changes in fuel use and emissions would occur. AVERT software uses the EPA national air markets database, which incorporates hourly efficiency and emissions performance data for all power plants in the United States over 25 MW capacity.

AVERT software can calculate the hourly, regional marginal impact of reductions in grid load due to energy efficiency measures, as well as increases in grid load due to intentional load-building measures such as heat pumps and electric vehicles. AVERT software also can predict the hourly, marginal impact of renewable generation by resources such as solar PV and wind power, using hourly weather data. AVERT also predicts local changes in power generation output levels by individual generating plants within a specified region.

AVERT Model Results for Annual CO2e Emissions (US tons) by a Single-family Home in Massachusetts

Figure 1 below shows AVERT model-based results for annual CO2e emissions by a representative single-family home in Massachusetts under different fuel and technology options that are feasible by the years 2030 and 2050. Massachusetts has approximately 2.6 million residential units plus a broad array of commercial, industrial and institutional buildings. Traditional fuel options include heating oil, propane and natural gas. Renewable fuel options include biodiesel blends as well as B100 biodiesel. Heat pump options include current air-to-air technology plus improved, future generation technology, as well as air-to-water technology. The graph also includes scenarios for the existing grid plus options for partial and full-capacity renewable power generation for operation of heat pumps. It needs to be noted that the option for full-capacity renewable power generation, which is shown as a long-term goal, also presumes the availability of 720,000 MWh of battery storage to be sufficient for 48 hours of operation during periods of extreme cold temperature combined with low offshore wind and solar output.

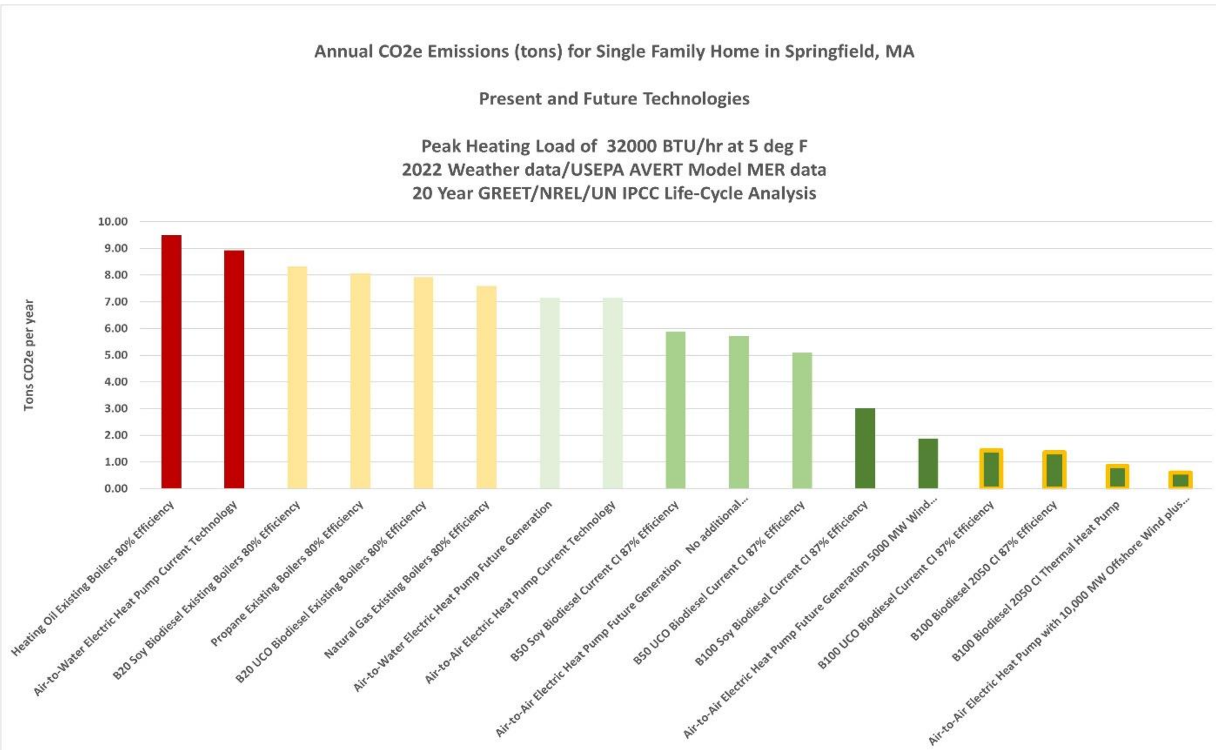


Figure 1. Annual CO2e Emissions (US tons) for a Representative Single Family Home in MA.

The two red-colored bars to the left in Figure 1 show traditional heating oil and current air-to-water heat pump technology as the highest emission options. The representative home would use approximately 600 gallons of oil for space heating plus an additional 200 gallons approximately for domestic hot water purposes. This analysis focuses, however, only on space heating. CO2e emissions for traditional heating oil would be something under 10 US tons (not metric tonnes) per year. Air-to-water heat pumps need to operate at higher supply temperatures than air-to-air heat pumps due to the requirements of hydronic distribution systems. They therefore experience approximately 20% lower efficiency than air-to-air heat pumps. This helps to explain why air-to-water heat pumps achieve only limited CO2e savings.

As illustrated by the four yellow-colored bars in the graph, CO2e savings in the range of 15 to 20 percent, compared to traditional heating oil, are achieved by propane, natural gas and B20 biodiesel blends, when life-cycle accounting is used for analysis.

Current air-to-air heat pump technology and future generation, improved air-to-water heat pump technology (see the light green bars in the middle of the graph) are shown as achieving 25 percent CO2e savings compared to traditional heating oil.

The options of B50 biodiesel blends and future air-to-air heat pump technology (see the medium green bars in the graph) are shown as achieving more significant CO2e savings in the range of 40 percent compared to traditional heating oil. The B50 soy-based option is somewhat higher in carbon intensity than the future generation air-to-air heat pump technology, while the B50 used-cooking oil (UCO) option is somewhat lower in carbon intensity. It is notable that the three options are closely similar in carbon intensity and are on a significantly faster trend toward carbon neutrality.

There is then a more substantial trend (see the dark green bars) toward declining CO2e emissions as biodiesel concentrations increase to the 100 percent level, and as dedicated, combined offshore wind plus utility-scale solar capacity growth to a total of 10,000 MW nameplate capacity is accomplished by Massachusetts, above and beyond the 40,000 MW nameplate capacity that is needed to decarbonize the existing New England grid. Dedicated offshore wind plus utility-scale solar capacity of 5,000 MW each, for a total of 10,000 MW, for Massachusetts, which represents about 50 percent of the 20,000 MW nameplate capacity ultimately needed for fully renewable heat pump operation, would achieve about 70 percent CO2e savings compared to heat pumps that use the existing grid.

The final four bars (dark green with gold borders) show a continuing downward trend in CO2e emissions as biodiesel achieves further improvements in feedstock production and processing (e.g., GPS-controlled planting and fertilizer application in agriculture, use of solar PV electricity in crushing operations, use of renewable methanol, etc.) as well as higher, end-use equipment efficiency (e.g., fuel-fired absorption heat pumps) for space heating in residential and commercial buildings. Absorption heat pumps can achieve efficiency levels of up to 140 percent, depending on manufacturing design and operating conditions. The final bar in the group shows estimated carbon intensity, based on data provided by the National Renewable Energy Laboratory (NREL), for heat pump operation when supplied with full capacity, solar and wind power.

Dedicated solar/wind power nameplate capacity of 20,000 MW for Massachusetts would provide for renewable heat pump utilization during the peak heating months of the winter but as previously described, would also require approximately 720,000 MWh of battery storage to maintain continued grid operation for up to 48 hours during cold weather combined with low wind and solar output conditions.

Alternatively, fully renewable heat pump operation could be accomplished in the near term through separate metering and billing for heat pumps, combined with power purchase agreements between electric utilities and solar/wind/battery projects which are dedicated exclusively to supply renewable electricity for space heating. Such bilateral agreements, if associated with renewable power generation capacity built above and beyond the requirements of MA RPS and Clean Energy Standard compliance obligations, could provide the additional benefit of reducing upward pricing pressure on wholesale electricity prices within the ISO New England market that would otherwise result from increased grid loads.

It should be noted that the previously described graph does not include possible hybrid heating systems consisting of renewable fuel-fired boilers and heat pumps. Smart controls for such hybrid systems could selectively operate individual components based on relative carbon intensity to achieve optimized environmental performance and to reduce grid load impacts. Smart controls could favor heat pump operation during mild weather and lower grid load periods (e.g., late evening, very early morning and mid-day hours) when heat pump and power generation efficiencies are higher. Likewise, smart controls could favor renewable fuel-fired boiler operation during cold weather, high grid load hours, and rapid, upward grid-load ramping periods (e.g., morning and late afternoon) when grid stability is under greatest stress. Smart controls could also base their decision making on relative carbon intensity of renewable fuels and grid electricity.

REFERENCES USED IN PREPARATION OF TECHNICAL NOTES

As the first step in preparation of these technical notes, I compiled and reviewed several key testing reports that have been published over the past six years relating to actual field performance of cold-climate heat pumps. The reports are listed below and represent the most frequently cited literature that has been published on field performance of cold-climate heat pumps.

1) Commonwealth Edison Company (2020). Cold Climate Ductless Heat Pump Pilot Executive Summary. Chicago, IL. https://www.comedemergingtech.com/images/documents/ComEd-Emerging-Technologies-Cold-Climate-Ductless-Heat-Pump.pdf

2) ISO New England (2020), Final 2020 Heating Electrification Forecast. Holyoke, MA. https://www.iso-ne.com/static-assets/documents/2020/04/final_2020_heat_elec_forecast.pdf

3) The Levy Partnership/NYSERDA (2019). Downstate (NY) Air Source Heat Pump Demonstration. Albany, NY. https://static1.squarespace.com/static/5a5518914c0dbf4226cd5a8e/t/5d963d39f515f87c7bafe3ff/1570127329734/TLP+ASHP+Demo+Presentation+9.26.19.pdf

4) slipstream/Michigan Electric Cooperative Association (2019). Dual Fuel Air-Source Heat Pump Monitoring Report. Grand Rapids, MI. https://slipstreaminc.org/sites/default/files/documents/research/dual-fuel-air-source-heat-pump-pilot.pdf

5) Center for Energy and Environment (2018). Case Study 1 – Field Test of Cold Climate Air Source Heat Pumps. St. Paul, MN. https://www.mncee.org/MNCEE/media/PDFs/ccashp-Study-1-Duplex.pdf

6) Center for Energy and Environment (2018). Case Study 2 – Field Test of Cold Climate Air Source Heat Pumps. Minneapolis, MN. https://www.mncee.org/MNCEE/media/PDFs/ccashp-Study-2-MPLS.pdf

7) Center for Energy and Environment/Minnesota Department of Commerce, Division of Energy Resources (2017). Cold Climate Air Source Heat Pump. Minneapolis, MN. https://www.mncee.org/MNCEE/media/PDFs/86417-Cold-Climate-Air-Source-Heat-Pump-(CARD-Final-Report-2018).pdf

8) The Cadmus Group/Vermont Public Service Department (2017). Evaluation of Cold Climate Heat Pumps in Vermont. Montpelier, VT. https://publicservice.vermont.gov/sites/dps/files/documents/Energy_Efficiency/Reports/Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.pdf

9) The Cadmus Group/Massachusetts and Rhode Island Electric and Gas Program Administrators (2016). Ductless Mini-Split Heat Pump Impact Evaluation. MA and RI. http://www.ripuc.ri.gov/eventsactions/docket/4755-TRM-DMSHP%20Evaluation%20Report%2012-30-2016.pdf

10) Center for Energy and Environment/American Council for an Energy-Efficient Economy/Minnesota Department of Commerce, Division of Energy Resources (2016). *Field Assessment of Cold Climate Air Source Heat Pumps*. 2016 ACEEE Summer Study on Energy Efficiency in Buildings. https://www.aceee.org/files/proceedings/2016/data/papers/1_700.pdf

11) Steven Winter Associates, Inc./National Renewable Energy Laboratory (2015). Field Performance of inverter-Driven Heat Pumps in Cold Climates. VT and MA. https://www.nrel.gov/docs/fy15osti/63913.pdf

12) The Levy Partnership and CDH Energy Corp./NYSERDA (2014). Measured Performance of Four Passive Houses on Three Sites in New York State. Albany, NY. https://static1.squarespace.com/static/5a5518914c0dbf4226cd5a8e/t/5ab273db562fa758761512bd/1521644514205/Measured-Performance-of-three-Passive-Houses+%283%29.pdf

Additional field studies of cold-climate heat pump performance are known to be currently underway in Massachusetts and New York, but no information has been published relating to their scope or results.

Briefly, the published field-testing reports show a significant drop in actual, cold-climate heat pump performance compared to manufacturer efficiency ratings. Many of the reports showed efficiencies that were 20 to 30 percent lower than manufacturer ratings. Identified causes included excessive compressor cycling under part-load conditions, sub-optimal defrost operation, and airflow restrictions in indoor units. Some of the efficiency differences can also be attributed to manufacturer ratings that are based on weather data for USDOE Climate Zone 4, which covers much of the warmer, mid-Atlantic region.

The analyses provided in this document include, however, the expectation that cold-climate heat pumps will achieve 25% improvements in COP performance by the year 2030, in response to the USDOE Heat Pump Challenge, stricter State mandates, and general product improvements by manufacturers.

These technical notes are also based on resources from Argonne National Laboratory (GREET model), the National Renewable Energy Laboratory (NREL), and the United Nations Intergovernmental Panel on Climate Change (UN IPCC) 2019 guidance update on life-cycle analysis of fuels and power generation.

EVALUATION OF RESULTS FROM FIELD TESTING OF COLD-CLIMATE AIR-TO-AIR HEAT PUMPS

The efficiency of cold-climate air-to-air heat pumps in the field has been documented as 20% to 30% below current manufacturer ratings. Based on the data included in the reports listed above, I have put together a series of graphs that illustrate heat pump performance and homeowner characteristics noted regarding utilization of their heat pumps.

Figure 2 below shows heat pump Coefficients of Performance (COPs) vs. outdoor temperature, as derived from the field-testing studies. The graph includes average manufacturer ratings of heat pumps (red data curve) used in the various field studies listed above. The graph also shows actual field-testing results published in the listed reports. The graph shows how heat pump COPs vary with outdoor temperature. It is also possible to see the trend of actual performance falling below manufacturer ratings for most studies.

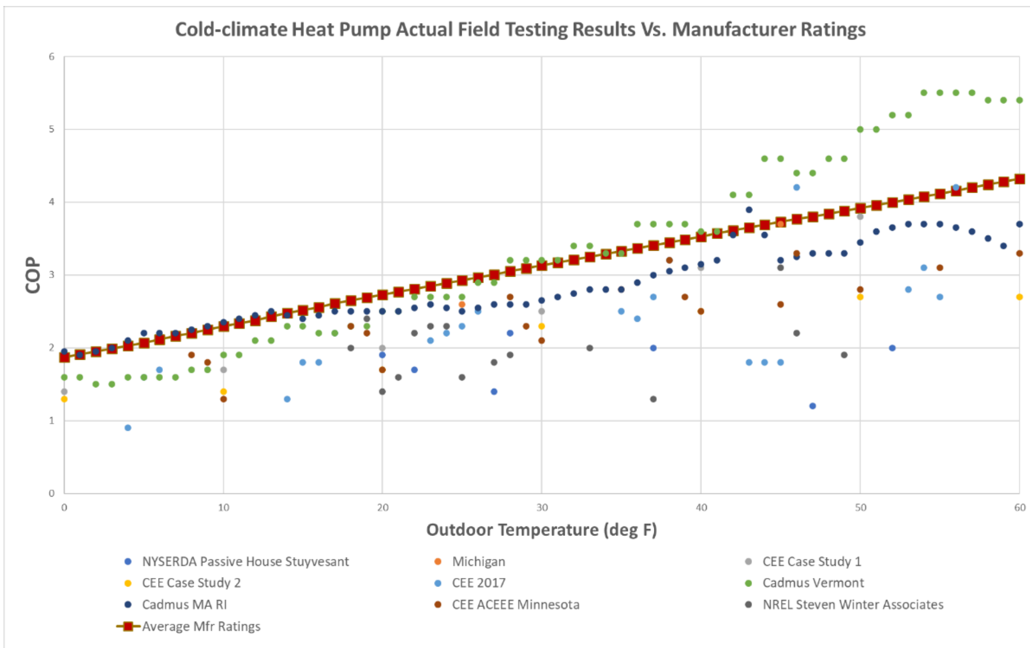


Figure 2. Cold-climate Heat Pump Actual Field-Testing Results vs. Manufacturer Ratings

Figure 3 following shows annual, cold-climate heat pump COP field data as published by the references used for these technical notes. Annual cold-climate heat pump COPs indicate much lower field efficiency than manufacturer ratings. Higher reported field efficiency by VT and MA/RI field testing was due to low utilization in colder weather, thus skewing the statistics. Power demand graphs in the cited references indicate that the drop-out rate increased as the outdoor temperature went down. As noted again, such homeowner behavior resulted in artificially high, measured annual COP values since the performance data was skewed toward warmer temperatures. The remaining studies generally entailed, by design or mandate, a high utilization factor through the winter, but then lower COP values.

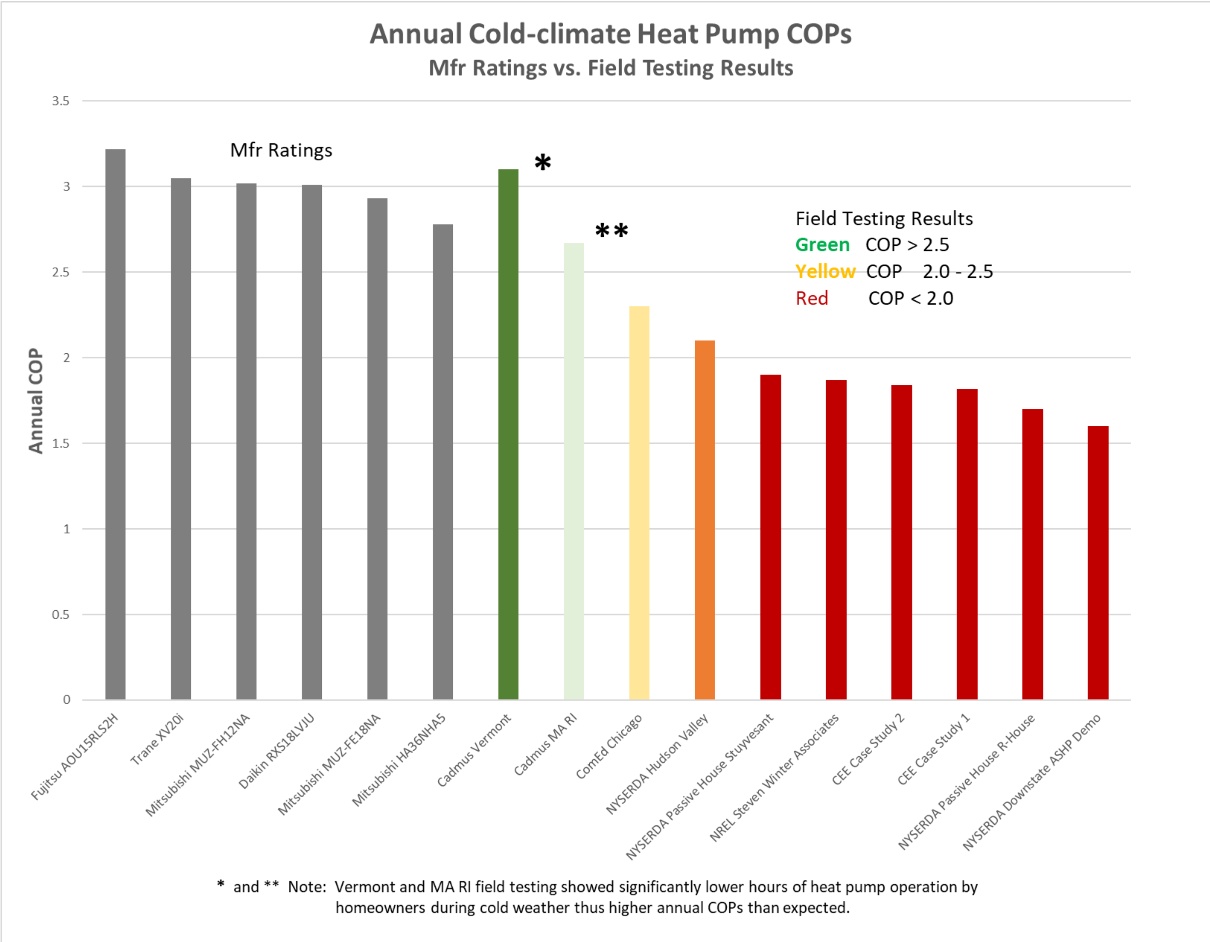


Figure 3. Annual Cold-climate Heat Pump COPs – Manufacturer Ratings vs. Field Testing Results

The manufacturer-rated seasonal COPs are generally around 3 or so, but the actual field-testing results show values in the range of about 1.6 to 2.3 (see color coding of graph bars), which translates into a loss of about 20 to 30% from the manufacturer-rated values.

USE OF LIFE-CYCLE ANALYSIS OF ENERGY RESOURCES

It is of critical importance to use life-cycle analysis for energy policymaking. Onsite-based emissions evaluations generally fail to realistically address the real-world performance of the power grid. Argonne National Laboratory has been the host administrator of the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model for many years. The GREET model is a highly respected tool for evaluating the life-cycle characteristics of energy resources. The United Nations Intergovernmental Panel on Climate Change (UN IPCC) has issued a series of updates to its comprehensive documentation relating to evaluation of energy resources.

Both GREET and UN IPCC provide clear guidance on the evaluation of upstream emissions of energy resources. Notably, both have recently addressed the problem of methane leakage in compounding the environmental impact of natural gas, including that used for power generation.

The two major reference sources for life-cycle analysis used in the preparation of these notes, including the Argonne National Laboratory GREET 2021 model, as well as the recent United Nations Intergovernmental Panel on Climate Change (IPCC) 2019 update report on guidance for life-cycle assessment protocols, have correctly addressed the environmental characteristics of natural gas used for power generation. Both the GREET and IPCC references incorporate a methane leakage rate of approximately 0.7% of the volume of natural gas used for power generation. This accounts for methane loss during natural gas production and high-pressure transmission directly to power plants, but not through any local distribution piping.

If a 100-year timeframe is used for analysis (GHG factor for NG = 25 compared to CO2), the 0.7% methane leakage rate results in about a 9 percent increase in the carbon intensity of natural gas that reaches the power plant. If a 20-year timeframe is used, however, for analysis (GHG factor for NG = 84 compared to CO2), the 0.7% methane leakage rate results in about a 20+ percent increase in the carbon intensity of natural gas used for power generation. There is growing support, and mandate in neighboring New York, for the use of 20-year greenhouse gas analysis since that reflects the timeframe that is now perceived as necessary for addressing climate change.

Combined with the impact of an approximate 10% increase in carbon intensity resulting from direct CO2 emissions during natural gas production and high-pressure transmission, the CO2e emissions characteristic of natural gas used for power generation is approximately 30% higher than the 117 lb/MMBTU onsite emissions figure frequently used, thus approximately 152 lb/MMBTU.

National Renewable Energy Laboratory (NREL) figures are used for evaluating renewable natural gas (RNG) and wind power. Carbon intensity data for RNG are sparse in availability but indicate that RNG can have approximately the same sustainability values as has been documented for biodiesel. NREL carbon intensity figures for offshore wind likewise are sparse but indicate significant carbon content for fabrication and construction steps.

ACCOUNTING FOR TRANSMISSION AND DISTRIBUTION LINE LOSSES IN ANALYSIS OF GRID IMPACTS OF ELECTRIFICATION

When the electrical load increases in a building, the corresponding increase in necessary power generation will be greater due to line losses that occur between the powerplant and end-use sites. The average line loss in transmission and distribution networks will usually be somewhere in the range of 8 percent here in the northeastern US. This factor must be included in analyses of electrification and renewable power generation to maintain accuracy of results. The practical consideration is that the MW amount of renewable power generation necessary to serve an increased grid load will be measurably greater than the load itself. The EPA AVERT model incorporates an automatic, built-in calculation of approximately 8% line losses. It is noted here, however, that since line losses are an I^2R issue, with losses proportional to the square of the current flow rate, thus not just a linear relationship, the incremental losses for increased grid loads during peak periods will typically be in the mid-teen percentage range, with the exact figure defined as the calculus derivative of the governing, line-loss mathematical equation. The significant policy impact of increased line losses during peak grid load conditions, due to electrification, needs to be recognized and addressed by energy policymakers.

POWER GRID ANALYSIS SOFTWARE

I used USEPA AVERT (AVoided Emissions and geneRation Tool) software to do an hourly analysis of grid impacts from residential and commercial heat pumps and to calculate required capacities of renewable power, including offshore wind, onshore wind, and utility-scale solar that would be necessary to meet expected Massachusetts heating loads using heat pumps.

See https://www.epa.gov/avert and https://www.epa.gov/avert/avert-overview-0 for more information about the AVERT program.

USEPA's AVERT software performs deep analysis using marginal emission rates, rather than average grid mix values which are incorrectly used by many energy policymakers in the northeastern United States (see article by the Rocky Mountain Institute in the Appendix). AVERT analyzes how power plants would increase/decrease their output in response to grid load changes, and what the corresponding changes in fuel use and emissions would occur. AVERT software uses the EPA national air markets database, which incorporates hourly efficiency and emissions performance data for all power plants in the United States over 25 MW capacity.

AVERT software can calculate the hourly, regional marginal impact of reductions in grid load due to energy efficiency measures, as well as increases in grid load due to intentional load-building measures such as heat pumps and electric vehicles. AVERT software also can predict the hourly, marginal impact of renewable generation by resources such as solar PV and wind power, using hourly weather data. AVERT also predicts local changes in power generation output levels by individual generating plants within a specified region.

The AVERT 4.1 software version released just recently also incorporates direct linkage with USEPA Co-Benefits Risk Assessment (COBRA) public health and Sparse Matrix Operator Kernel Emissions (SMOKE) air quality input software packages. This allows for direct modeling of public health and air quality impacts (NOx/SOx etc.) of changes in load or generation output within a regional grid. This enables the evaluation of air quality deterioration in environmental justice and LMI communities located adjacent to fossil-fired power plants as grid loads increase due to electrification.

AVERT spreadsheets are somewhat bulky, with typically close to 9,000 rows in height and many columns wide, but are nevertheless relatively user-friendly. Ancillary spreadsheet analysis of grid loads, using digital, hourly (8760 hours per year) weather data and heat pump performance formulas, can be easily copied into AVERT spreadsheets to yield highly informative, power generation and emissions outputs. MassDEP and MADOER energy policymakers are encouraged to use AVERT software if they are not already doing so.

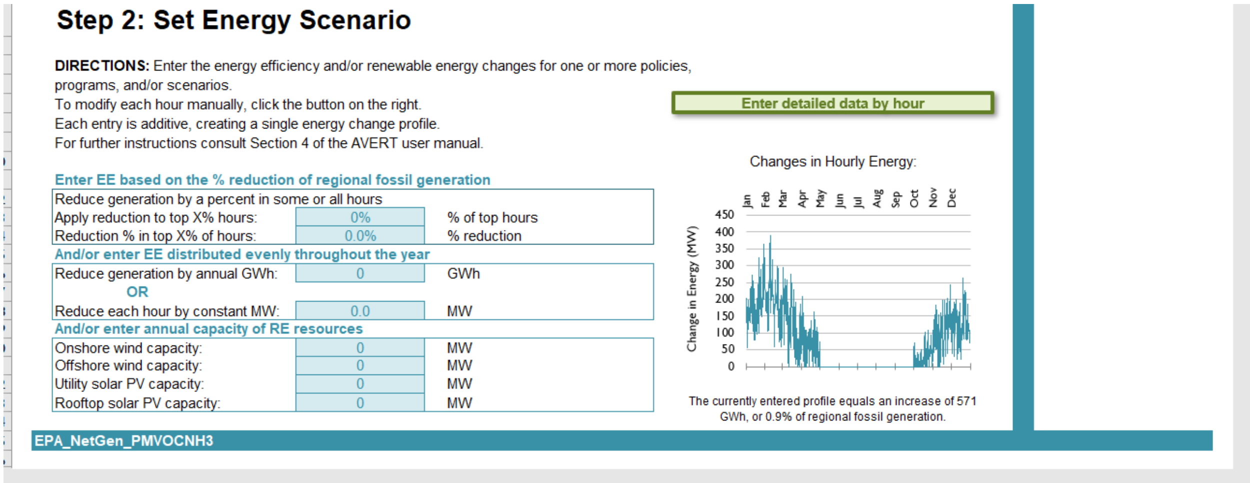
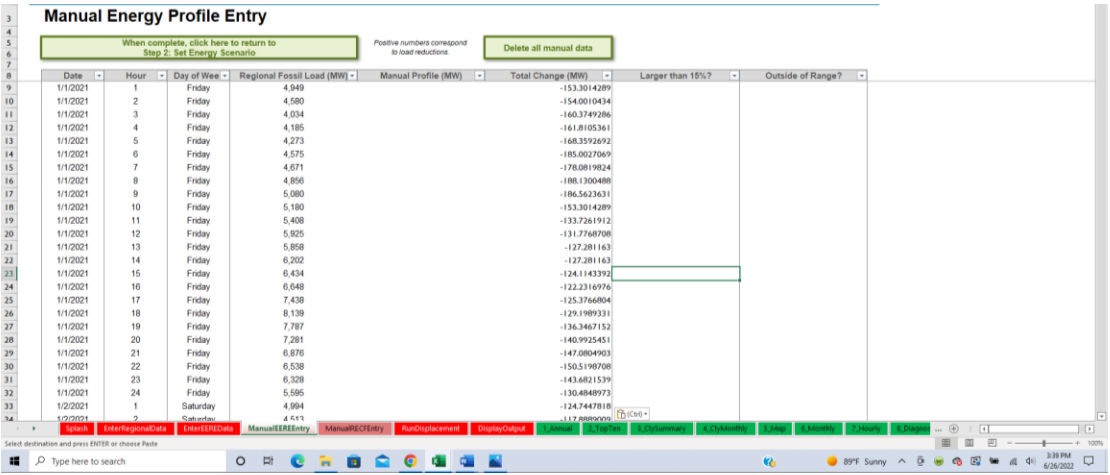


Figure 4. Example data input page for USEPA AVERT software

The screenshot shown above in Figure 4 shows an example graph of monthly grid loads that would be triggered by implementation of residential and commercial heat pumps. The AVERT program also allows for specification of renewable power capacities that might offset increasing grid loads.



Date	Hour	Day of Wee	Regional Fossil Load (MW)	Total Change (MW)
1/1/2021	1	Friday	4,949	-153.3014289
1/1/2021	2	Friday	4,580	-154.0010434
1/1/2021	3	Friday	4,034	-160.3749286
1/1/2021	4	Friday	4,185	-161.8105361
1/1/2021	5	Friday	4,273	-168.3592692
1/1/2021	6	Friday	4,575	-185.0027069
1/1/2021	7	Friday	4,671	-178.0819824
1/1/2021	8	Friday	4,856	-188.1300488
1/1/2021	9	Friday	5,080	-186.5623631
1/1/2021	10	Friday	5,180	-153.3014289
1/1/2021	11	Friday	5,408	-133.7261912
1/1/2021	12	Friday	5,925	-131.7768708
1/1/2021	13	Friday	5,858	-127.281163
1/1/2021	14	Friday	6,202	-127.281163
1/1/2021	15	Friday	6,434	-124.1143392
1/1/2021	16	Friday	6,648	-122.2316976
1/1/2021	17	Friday	7,438	-125.3766804
1/1/2021	18	Friday	8,139	-129.1989331
1/1/2021	19	Friday	7,787	-136.3467152
1/1/2021	20	Friday	7,281	-140.9925451
1/1/2021	21	Friday	6,876	-147.0804903
1/1/2021	22	Friday	6,538	-150.5198708
1/1/2021	23	Friday	6,328	-143.6821539
1/1/2021	24	Friday	5,595	-130.4848973
1/2/2021	1	Saturday	4,994	-124.7447818

Figure 5. Example screenshot of USEPA AVERT software – manual input of grid load data

The AVERT software incorporates the manual input of MW grid load values, as shown in Figure 5 above, based on calculated heating loads, heat pump COPs, and resulting site electrical load increases. The software then calculates impacts on power plant generation and CO2 emissions, as well as other pollutants such as NOx, SOx and PM2.5 particulates.

Output: Annual Regional Results

Click here to return to Step 4: Display Outputs

	Original	Post Change	Change
Generation (MWh)	61,220,480	61,791,760	571,280
Heat Input (MMBtu)	506,770,570	511,492,860	4,722,290
Total Emissions from Fossil Generation Fleet			
SO2 (lb)	3,060,270	3,103,060	42,790
NOx (lb)	15,529,130	15,711,810	182,680
Ozone season NO_x (lb)	8,314,720	8,314,720	—
CO_2 (tons)	30,295,030	30,577,870	282,840
PM2.5 (lb)	4,845,880	4,895,770	49,890
VOCs (lb)	1,961,390	1,983,790	22,400
NH3 (lb)	2,014,380	2,040,050	25,670
AVERT-derived Emission Rates:	Average Fossil		Marginal Fossil
SO2 (lb/MWh)	0.050		0.075
NOx (lb/MWh)	0.254		0.320
Ozone season NO_x (lb/MWh)	0.279		#VALUE!
CO_2 (tons/MWh)	0.495		0.495
PM2.5 (lb/MWh)	0.079		0.087
VOCs (lb/MWh)	0.032		0.039
NH3 (lb/MWh)	0.033		0.045

Ozone season is defined as May 1 - September 30. Ozone season emissions are a subset of annual emissions.
Negative numbers indicate displaced generation and emissions.
All results are rounded to the nearest ten. A dash ("—") indicates a result greater than zero, but lower than the level of reportable significance.
This region features one or more power plants with an infrequent SO2 emissions event. SO2 emissions changes from these plants are not included in this analysis. See Section 2 of the AVERT User Manual for more information.

Figure 6. Example screenshot of AVERT summary output page showing annual generation and emissions impacts.

As shown in Figure 6 above, AVERT software produces an array of output tables and graphs ranging from hourly to annual figures. The information can then be further processed to evaluate the environmental characteristics of changes to grid loads or generation outputs.

Generation (MW) New England (NE)

Click here to return to Step 4: Display Output

									ORSPL	58054	1595	55126	55126	55317	55149	56047	54907
									UNITID	ST01	4	CT01	CT02	11	LRG2	1	1
Hour	Year	Month	Regional L	Energy Ch	Load after Energy Ch	Timestamp	Orig Gen (	Post Chan	Sum: All U	Burgess Bic	Kendall Gr	Milford Pov	Milford Pov	Fore River	Lake Road (	CPV Towa	MIT Centr
1	2019	1	2259	1,652	3910.919	01/01/2019 00:00	2,252	3,932	1680.086	1.177	15.183	31.805	30.373	48.671	13.685	16.786	-0.897
2	2019	1	2288	1,652	3939.919	01/01/2019 01:00	2,281	3,953	1671.784	1.107	12.635	32.832	32.017	50.472	9.373	13.88	-1.166
3	2019	1	1944	1,498	3441.726	01/01/2019 02:00	1,938	3,445	1506.605	0.259	27.161	39.047	30.049	14.466	23.499	42.516	-2.135
4	2019	1	1879	1,448	3327.018	01/01/2019 03:00	1,874	3,320	1445.271	-1.702	30.659	34.215	35.429	5.892	28.018	47.653	-3.517
5	2019	1	1781	1,244	3024.919	01/01/2019 04:00	1,778	3,012	1233.478	-2.359	26.666	33.931	29.331	-14.675	35.82	51.917	-4.344
6	2019	1	1917	1,059	2976.402	01/01/2019 05:00	1,912	2,972	1059.843	-2.27	24.343	26.449	24.19	-6.853	26.897	38.558	-3.049
7	2019	1	2119	840	2959.374	01/01/2019 06:00	2,110	2,957	847.649	-2.337	16.266	19.244	14.552	-4.965	18.784	23.098	-1.841
8	2019	1	2201	812	3013.08	01/01/2019 07:00	2,193	3,002	809.47	-1.802	9.568	20.659	8.062	-6.425	19.769	22.993	-1.993
9	2019	1	2471	762	3232.892	01/01/2019 08:00	2,469	3,221	751.425	-2.262	12.232	17.54	11.142	23.524	9.864	17.605	-1.835
10	2019	1	2585	696	3281.418	01/01/2019 09:00	2,587	3,269	681.7	-4.347	8.473	16.756	8.087	11.175	13.911	19.563	-3.569
11	2019	1	2535	691	3226.034	01/01/2019 10:00	2,535	3,214	678.841	-3.715	10.385	17.41	11.112	14.819	12.411	16.443	-2.711
12	2019	1	2402	696	3098.418	01/01/2019 11:00	2,398	3,088	690.057	-0.462	10.929	17.98	8.341	24.219	8.756	12.084	-0.582
13	2019	1	2422	863	3285.225	01/01/2019 12:00	2,419	3,273	854.16	-0.596	13.278	17.522	8.945	32.854	7.434	20.611	-1.208

Figure 7. Example screenshot of AVERT output page showing hourly changes to individual power plant MW generation outputs

As shown in Figure 7 above, AVERT software yields estimates of hourly changes to generation output and emissions by individual power plants. This information helps to identify what environmental justice communities might be affected by increased emissions that result from grid load growth due to electrification programs, when not sufficiently offset by new, renewable power generation.

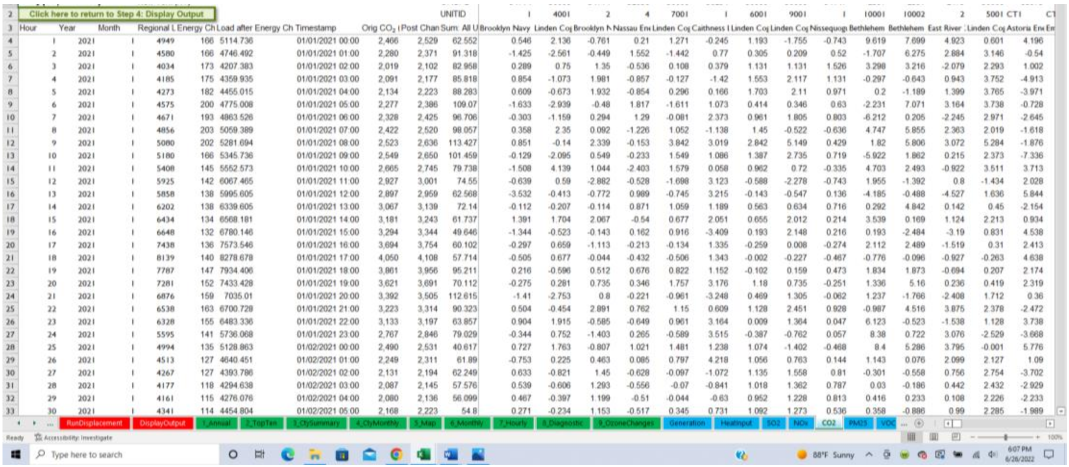


Figure 8. Example screenshot of AVERT output page showing hourly changes to individual power plant CO2 emission rates (lb/hr)

As shown in Figure 8 above, AVERT software also yields estimates of hourly changes to CO2 emissions from individual power plants. Such information is of key importance for the wholistic evaluation of environmental performance by a combined heating equipment-power grid system.

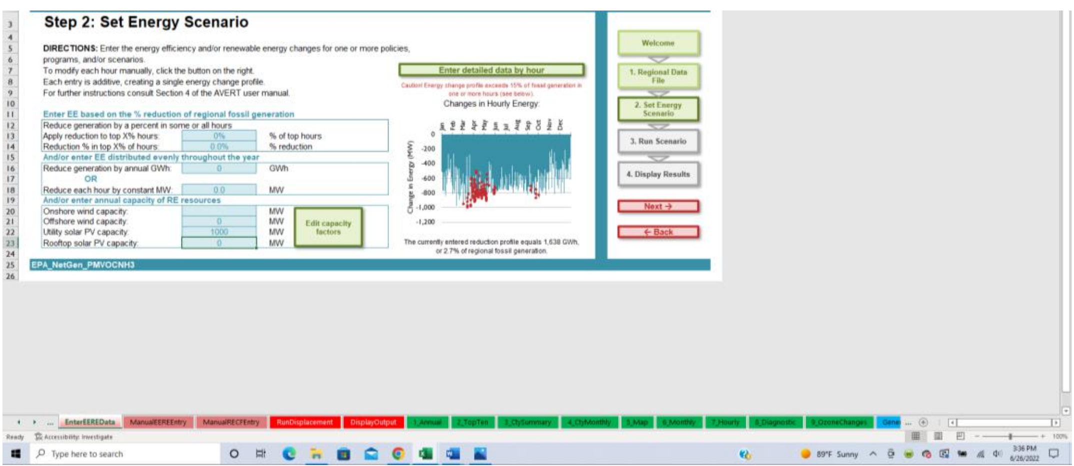


Figure 9. Example screenshot of AVERT input page showing MW quantities of renewable power generation capacity selected for analysis.

As shown in Figure 9 above, AVERT software also allows for the specification of amounts of wind and solar generation resources. The software then yields an hourly output table for the entire year, which can then be combined with grid load data to determine whether sufficient renewable power has been generated to meet the demand of electrification technologies, and if not, the quantity of fuel-based generation that must still be operated.

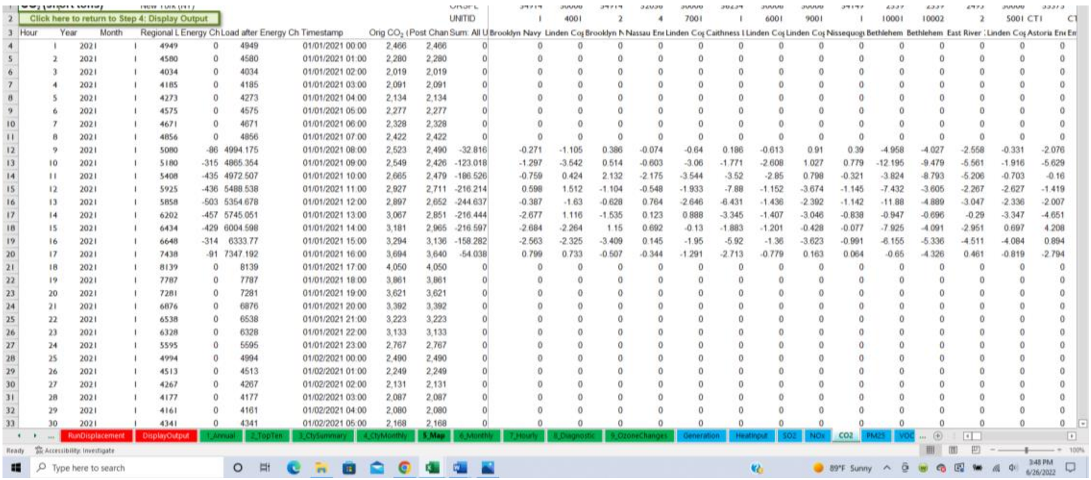


Figure 10. Example screenshot of AVERT output page showing hourly values of solar power output plus impact on individual power plants.

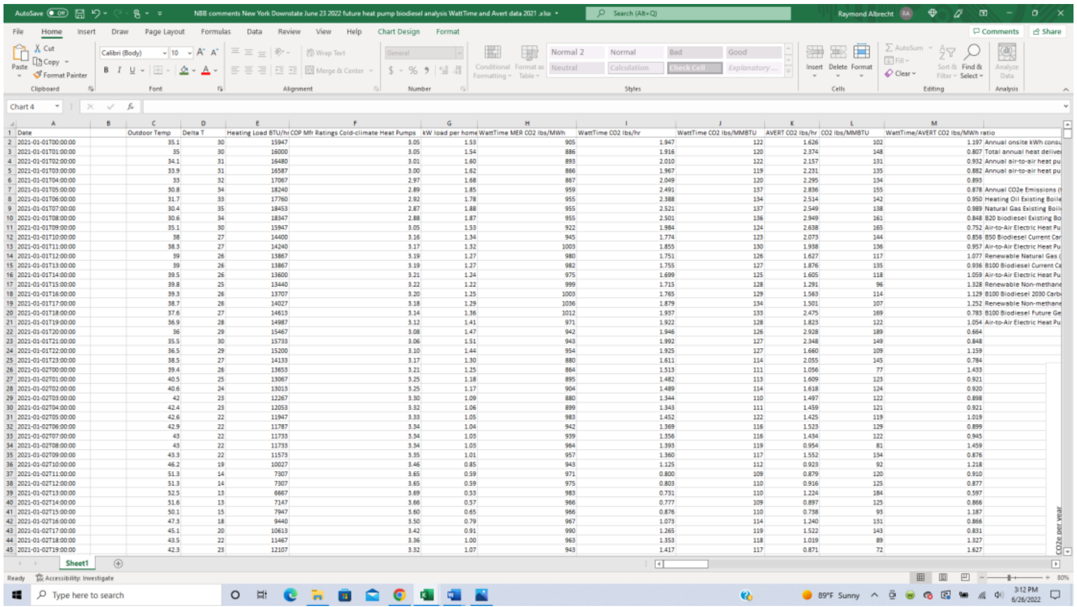
As shown in Figure 10 above, AVERT software calculates the hourly production of wind and solar power systems based on a typical year of weather data. The software then allocates reductions in generation output to individual power plants. The output data can then be combined with heating and grid load data to determine how much fuel-fired power generation might still be necessary if sufficient renewable power generation capacity has yet to be constructed.

METHODOLOGY FOR HOURLY EVALUATION OF COMBINED HEAT PUMP PERFORMANCE AND ISO NEW ENGLAND GRID CARBON INTENSITY FOR RESIDENTIAL AND COMMERCIAL HEATING

These technical notes are based on an hourly, coincidental temporal analysis of heating loads and power grid performance. Digital weather data from Visual Crossing.com for Springfield, MA was used to model hourly heating loads in a representative single-family residential unit that would have a peak heating load of 32,000 Btu/hr at an outdoor temperature of 5 deg F. The described heating load formula is intended to be broadly representative for residential buildings located in New England.

Temperature delta T values are determined using a base of 65 deg F as is customary for heating degree day analysis. Carbon intensities for common fuels including heating oil, natural gas, biodiesel and renewable natural gas are derived from the GREET 2022 model, as described earlier in this document. Heat pump COPs vs. outdoor temperature are determined through a formula based on the field test results included in the references described earlier.

Figure 11 below shows a screenshot of an Excel table that was created to perform the described hourly analysis of heating loads, grid performance, fuel/electricity input options, carbon intensities and resulting CO2 emission rates. The table includes input and output figures for the approximately 5000 hours that occur during the October through April heating season.



	Date	Outdoor Temp	Delta T	Heating Load BTU/hr	COP Mfr Ratings Cold-climate Heat Pumps	kW load per home	WattTime MER CO2 lbs/MWh	WattTime CO2 lbs/hr	WattTime CO2 lbs/MMBTU	AVERT CO2 lbs/hr	CO2 lbs/MMBTU	WattTime/AVERT CO2 lbs/MWh ratio	
2	2021-01-01T00:00:00	35.1	30	15947	3.05	1.53	905	1.947	122	1.626	102	1.197	Annual onsite kWh consu
3	2021-01-01T01:00:00	35	30	16000	3.05	1.54	886	1.916	120	2.374	148	0.807	Total annual heat delive
4	2021-01-01T02:00:00	34.1	31	16480	3.01	1.60	893	2.010	122	2.157	131	0.932	Annual air-to-air heat pu
5	2021-01-01T03:00:00	33.9	31	16587	3.00	1.62	866	1.967	119	2.231	135	0.882	Annual air-to-air heat pu
6	2021-01-01T04:00:00	33	32	17067	2.97	1.68	867	2.049	120	2.295	134	0.893	
7	2021-01-01T05:00:00	30.8	34	18240	2.89	1.85	959	2.491	137	2.836	155	0.878	Annual CO2e Emissions (
8	2021-01-01T06:00:00	31.7	33	17760	2.92	1.78	955	2.388	134	2.514	142	0.950	Heating Oil Existing Boile
9	2021-01-01T07:00:00	30.4	35	18453	2.87	1.88	955	2.521	137	2.549	138	0.989	Natural Gas Existing Boil
10	2021-01-01T08:00:00	30.6	34	18347	2.88	1.87	955	2.501	136	2.949	161	0.848	B20 biodiesel Existing Bo
11	2021-01-01T09:00:00	35.1	30	15947	3.05	1.53	922	1.984	124	2.638	165	0.752	Air-to-Air Electric Heat Pu
12	2021-01-01T10:00:00	38	27	14400	3.16	1.34	945	1.774	123	2.073	144	0.856	B50 Biodiesel Current Car
13	2021-01-01T11:00:00	38.3	27	14240	3.17	1.32	1003	1.855	130	1.938	136	0.957	Air-to-Air Electric Heat Pu
14	2021-01-01T12:00:00	39	26	13867	3.19	1.27	980	1.751	126	1.627	117	1.077	Renewable Natural Gas (
15	2021-01-01T13:00:00	39	26	13867	3.19	1.27	982	1.755	127	1.876	135	0.936	B100 Biodiesel Current Ca
16	2021-01-01T14:00:00	39.5	26	13600	3.21	1.24	975	1.699	125	1.605	118	1.059	Air-to-Air Electric Heat Pu
17	2021-01-01T15:00:00	39.8	25	13440	3.22	1.22	999	1.715	128	1.291	96	1.328	Renewable Non-methane
18	2021-01-01T16:00:00	39.3	26	13707	3.20	1.25	1003	1.765	129	1.563	114	1.129	B100 Biodiesel 2030 Carb
19	2021-01-01T17:00:00	38.7	26	14027	3.18	1.29	1036	1.879	134	1.501	107	1.252	Renewable Non-methane
20	2021-01-01T18:00:00	37.6	27	14613	3.14	1.36	1012	1.937	133	2.475	169	0.783	B100 Biodiesel Future Ge
21	2021-01-01T19:00:00	36.9	28	14987	3.12	1.41	971	1.922	128	1.823	122	1.054	Air-to-Air Electric Heat Pu
22	2021-01-01T20:00:00	36	29	15467	3.08	1.47	942	1.946	126	2.928	189	0.664	
23	2021-01-01T21:00:00	35.5	30	15733	3.06	1.51	943	1.992	127	2.348	149	0.848	
24	2021-01-01T22:00:00	36.5	29	15200	3.10	1.44	954	1.925	127	1.660	109	1.159	
25	2021-01-01T23:00:00	38.5	27	14133	3.17	1.30	880	1.611	114	2.055	145	0.784	
26	2021-01-02T00:00:00	39.4	26	13653	3.21	1.25	864	1.513	111	1.056	77	1.433	
27	2021-01-02T01:00:00	40.5	25	13067	3.25	1.18	895	1.482	113	1.609	123	0.921	
28	2021-01-02T02:00:00	40.6	24	13013	3.25	1.17	904	1.489	114	1.618	124	0.920	
29	2021-01-02T03:00:00	42	23	12267	3.30	1.09	880	1.344	110	1.497	122	0.898	
30	2021-01-02T04:00:00	42.4	23	12053	3.32	1.06	899	1.343	111	1.459	121	0.921	
31	2021-01-02T05:00:00	42.6	22	11947	3.33	1.05	983	1.452	122	1.425	119	1.019	
32	2021-01-02T06:00:00	42.9	22	11787	3.34	1.04	942	1.369	116	1.523	129	0.899	
33	2021-01-02T07:00:00	43	22	11733	3.34	1.03	939	1.356	116	1.434	122	0.945	
34	2021-01-02T08:00:00	43	22	11733	3.34	1.03	964	1.393	119	0.954	81	1.459	
35	2021-01-02T09:00:00	43.3	22	11573	3.35	1.01	957	1.360	117	1.552	134	0.876	
36	2021-01-02T10:00:00	46.2	19	10027	3.46	0.85	943	1.125	112	0.923	92	1.218	
37	2021-01-02T11:00:00	51.3	14	7307	3.65	0.59	971	0.800	109	0.879	120	0.910	
38	2021-01-02T12:00:00	51.3	14	7307	3.65	0.59	975	0.803	110	0.916	125	0.877	
39	2021-01-02T13:00:00	52.5	13	6667	3.69	0.53	983	0.731	110	1.224	184	0.597	
40	2021-01-02T14:00:00	51.6	13	7147	3.66	0.57	966	0.777	109	0.897	125	0.866	
41	2021-01-02T15:00:00	50.1	15	7947	3.60	0.65	966	0.876	110	0.738	93	1.187	
42	2021-01-02T16:00:00	47.3	18	9440	3.50	0.79	967	1.073	114	1.240	131	0.866	
43	2021-01-02T17:00:00	45.1	20	10613	3.42	0.91	990	1.265	119	1.522	143	0.831	
44	2021-01-02T18:00:00	43.5	22	11467	3.36	1.00	963	1.353	118	1.019	89	1.327	
45	2021-01-02T19:00:00	42.3	23	12107	3.32	1.07	943	1.417	117	0.871	72	1.627	

Figure 11. Screenshot of hourly heating system and power grid performance Excel analysis table.

After hourly heating loads and corresponding grid load increases have been determined, interim data from the Excel table are copied to the manual data input page of the AVERT software. The AVERT software then calculates generation and CO2 emissions changes, which are then transferred back to the Excel table to enable completion of the combined analysis.

WattTime hourly Marginal Emission Rates (MERs) in lbs CO2 per MWh for New England were also used in the Excel table to evaluate the grid impact of heat pumps. WattTime data does not provide for analysis of impacts on individual power plants but provides for a higher resolution analysis of geographical variations in carbon intensity between ISO New England zones.

ANALYTICAL RESULTS AND TECHNICAL COMMENTS

Annual CO2e Emissions for Single-family Homes in Massachusetts

Figure 12 below shows AVERT model results for annual CO2e emissions by a representative single-family home in Massachusetts under different fuel and technology options that are feasible by the years 2030 and 2050. Massachusetts has approximately 2.6 million residential units plus a broad array of commercial, industrial and institutional buildings. Traditional fuel options include heating oil, propane and natural gas. Renewable fuel options include biodiesel blends as well as B100 biodiesel. Heat pump options include current air-to-air technology plus improved, future generation technology as well as air-to-water technology. The graph also includes scenarios for the existing grid plus options for partial and full-capacity renewable power generation for operation of heat pumps. It needs to be noted that the option for full-capacity renewable power generation, which would be challenging to achieve by the year 2050, and which is shown as a long-term goal, also includes the requirement for 720,000 MWh of battery storage to be sufficient for 48 hours of operation during periods of extreme cold temperature with low offshore wind and solar output.

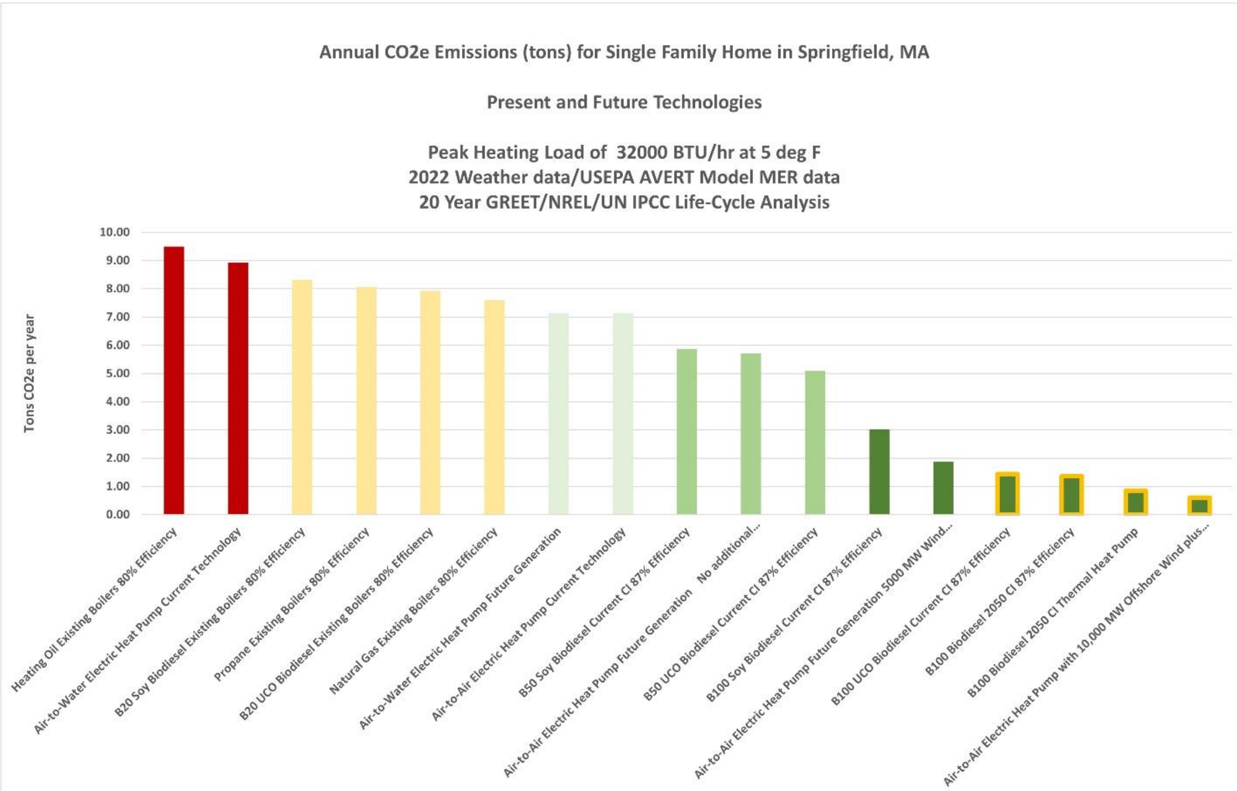


Figure 12. Annual CO2e Emissions for Single Family Homes in MA.

The two red-colored bars to the left in Figure 1 show traditional heating oil and current air-to-water heat pump technology as the highest emission options. The representative home would use approximately 600 gallons of oil for space heating plus an additional 200 gallons approximately for domestic hot water purposes. This analysis focuses, however, only on space heating. CO2e emissions for traditional heating oil would be something under 10 tons per year. Air-to-water heat pumps need to operate at higher supply temperatures than air-to-air heat pumps due to the requirements of hydronic distribution systems. They therefore experience approximately 25% lower efficiency than air-to-air heat pumps. This helps to explain why air-to-water heat pumps achieve only limited CO2e savings.

As illustrated by the four yellow-colored bars in the graph, CO2e savings in the range of 15 to 20 percent, compared to traditional heating oil, are achieved by propane and natural gas-fired boilers, current air-to-air heat pump technology and B20 biodiesel blends.

Current air-to-air heat pump technology and future generation, improved air-to-water heat pump technology (see the light green bars in the middle of the graph) are shown as achieving 25 percent CO2e savings compared to traditional heating oil.

The options of B50 biodiesel blends and future air-to-air heat pump technology (see the medium green bars in the graph) are shown as achieving more significant CO2e savings in the range of 40 percent compared to traditional heating oil. The B50 soy-based option is somewhat higher in carbon intensity than the future generation air-to-air heat pump technology while the B50 used-cooking oil (UCO) option is somewhat lower in carbon intensity. It is notable that the three options are closely similar in carbon intensity and are on a significantly more favorable trend toward carbon neutrality.

There is then a more substantial trend (see the dark green bars) toward declining CO2e emissions as biodiesel concentrations increase to the 100 percent level, and as dedicated, combined offshore wind plus utility-scale solar capacity growth to a total of 10,000 MW nameplate capacity is accomplished by Massachusetts, above and beyond the 40,000 MW nameplate capacity that is needed to decarbonize the existing New England grid. Dedicated offshore wind plus utility-scale solar capacity of 5,000 MW each, for a total of 10,000 MW, for Massachusetts, which represents about 50 percent of the 20,000 MW nameplate capacity ultimately needed for fully renewable heat pump operation, would achieve about 70 percent CO2e savings compared to heat pumps that use the existing grid.

The final four bars (dark green with gold borders) show a continuing downward trend in CO2e emissions as biodiesel achieves further improvements in feedstock production and processing (e.g., GPS-controlled planting and fertilizer application in agriculture, use of solar PV electricity in crushing operations, use of renewable methanol, etc.) as well as higher, end-use equipment efficiency (e.g., fuel-fired absorption heat pumps) for space heating in residential and commercial buildings. Absorption heat pumps can achieve efficiency levels of up to 140 percent, depending on manufacturing design and operating conditions. The final bar in the group shows estimated carbon intensity, based on data provided by the National Renewable Energy Laboratory (NREL), for heat pump operation when supplied with full capacity, solar and wind power.

Dedicated solar/wind power nameplate capacity of 20,000 MW for Massachusetts would provide for renewable heat pump utilization during the peak heating months of the winter but as previously described, would also require approximately 720,000 MWh of battery storage to maintain continued grid operation for up to 48 hours during cold weather combined with low wind and solar output conditions.

Alternatively, fully renewable heat pump operation could be accomplished in the near term through separate metering and billing for heat pumps, combined with power purchase agreements between electric utilities and solar/wind/battery projects which are dedicated exclusively to supply renewable electricity for space heating. Such bilateral agreements, if associated with renewable power generation capacity built above and beyond the requirements of MA RPS and Clean Energy Standard compliance obligations, could provide the additional benefit of reducing upward pricing pressure on wholesale electricity prices within the ISO New England market that would otherwise result from increased grid loads.

It should be noted that the previously described graph does not include possible hybrid heating systems consisting of renewable fuel-fired boilers and heat pumps. Smart controls for such hybrid systems could selectively operate individual components based on relative carbon intensity to achieve optimized environmental performance and to reduce grid load impacts. Smart controls could favor heat pump operation during mild weather and lower grid load periods (e.g., late evening, very early morning and mid-day hours) when heat pump and power generation efficiencies are higher. Likewise, smart controls could favor renewable fuel-fired boiler operation during cold weather, high grid load hours, and rapid, upward grid-load ramping periods (e.g., morning and late afternoon) when grid stability is under greatest stress. Smart controls could also base their decision making on relative carbon intensity of renewable fuels and grid electricity.

Carbon Intensities Vs. Outdoor Temperature for Single Family Homes in MA

The following graph shows carbon intensities (lbs CO2e per MMBTU of delivered heat) for the same options as shown in Figure 12 above. It can be seen that the carbon intensity of future generation, cold-climate heat pumps will be higher than for B50 biodiesel blends at temperatures below 32 degrees F. This illustrates the problem that cold-climate heat pumps, while having lower carbon intensities than traditional heating oil, B20 biodiesel blends, and natural gas, are nonetheless more carbon intensive than B50 and higher biodiesel blends during cold weather.

Figure 13 below also shows that the B100 option has lower carbon intensity than cold-climate heat pumps during all but 30 hours of the heating season, with such exceptions occurring exclusively during mild weather.

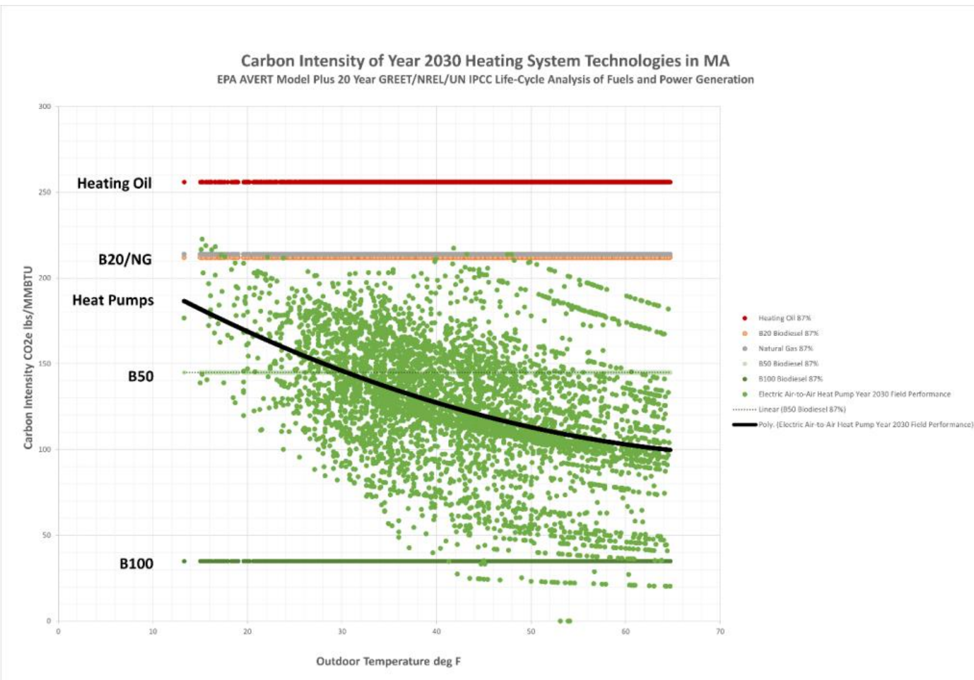


Figure 13. Carbon Intensity of Year 2030 Heating System Technologies vs. Outdoor Temperature

The graph in Figure 14 below indicates that an installed nameplate capacity of 10,000 MW of offshore wind plus 10,000 MW of solar PV power will approximately meet the needs of residential and commercial heat pumps in the MA zone of ISO New England during the coldest months of the heating season, assuming sufficient availability of battery storage.

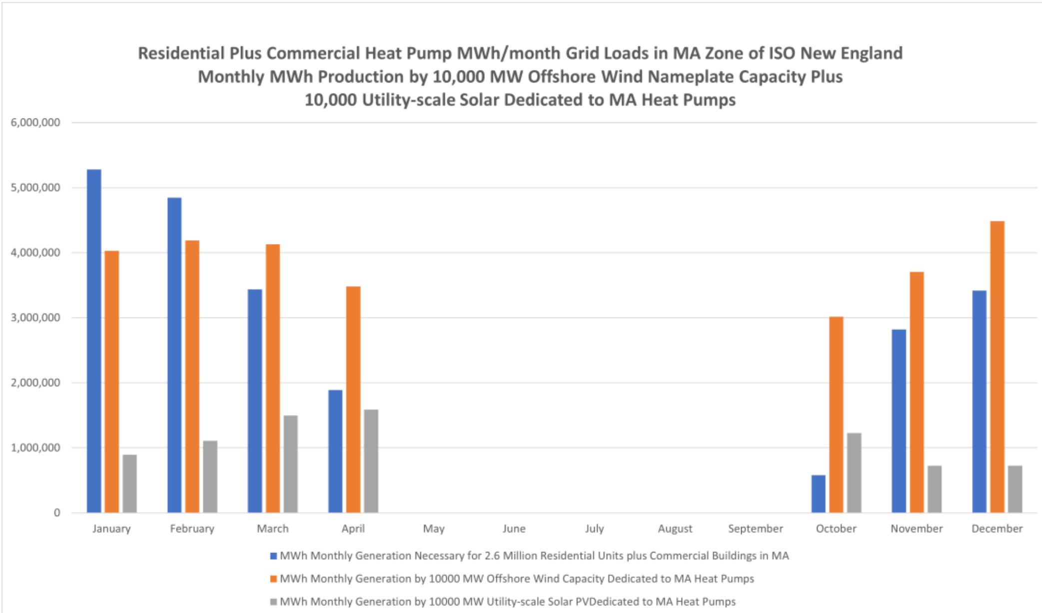


Figure 14. MA Monthly Grid Loads for Residential and Commercial Heat Pumps Plus 10,000 MW Wind Capacity Plus 10,000 MW Solar PV Nameplate Capacity

For a MA peak grid load of about 15,000 MW for residential and commercial heat pumps, the required nominal, 48 hour, battery storage capacity, to enable continued operation during extended cold temperature and low windspeed conditions, would be approximately 720,000 MWh.

PERFORMANCE OF COLD-CLIMATE AIR-TO-WATER HEAT PUMPS

Air-to-water heat pumps are gaining popularity in the hydronic heating sector. Air-to-water heat pumps are intended to replace fuel-fired hydronic boilers in residential and commercial buildings. Air-to-water heat pumps use refrigeration cycles that are similar to air-to-air heat pumps but face the challenge of having to produce higher temperature output due to the limitations of hydronic distribution systems.

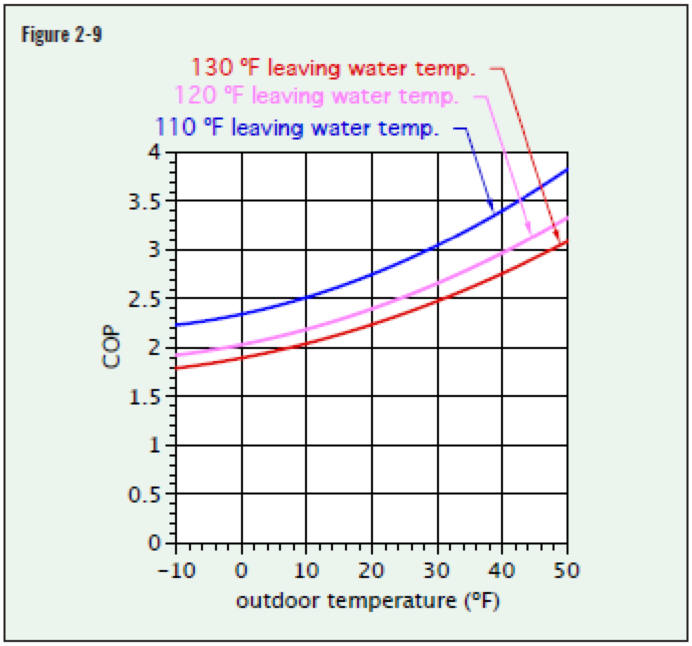


Figure 15. Example Manufacturer COP Rating Chart for Air-to-water Heat Pump

Figure 15 above shows an example COP rating chart from a leading manufacturer of air-to-water heat pumps. The chart shows, for an outdoor temperature of 30 deg F and supply water temperature of 130 deg F, a COP manufacturer rating of about 2.5, which is about 20 percent lower than shown previously for air-to-air heat pumps at the same outdoor temperature. Such difference in performance significantly impacts the ability of air-to-water heat pumps to accomplish our environmental goals.

Jim Blake
9 Hemlock St
Danvers, Ma 01923

April 5, 2024

Department of Environmental Protection
100 Cambridge Steet
Boston, MA 02114

Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK and FAQ Q.0

Comments, Concerns, and technically incomplete information in the draft framework

As a lifelong resident of Massachusetts and a member of the energy community for over 40 years, I would like to submit the following information regarding the Massachusetts Department of Environmental Protection's (DEP) draft framework and FAQ Q0. I have also included additional information to DEP about renewable propane and I urge DEP to include credits for International Sustainability Carbon Certificated (ISCC) renewable propane in the proposed rule this fall.

Propane is an alternative clean energy, and I share DEP's desire to reduce greenhouse gas (GHG) emissions and adopt a more carbon-friendly energy environment. The proposed CHS draft framework fundamentally alters the marketplace in which business operates, and intentionally creates barricades restricting consumer choice. I believe sustainable and cost-effective decarbonization is achieved by taking a holistic approach of consumer behavior and energy choices available now and in the future, such as propane, renewable propane, bio-heat, and electricity generated by cleaner sources. DEP must take into consideration the reliability and resilience of all potential energy options, and the aggregate costs passed along to all consumers and EJ communities after incentives have expired and the EJ communities become burdened with the true cost of their energy.

The current draft proposal treats all customers alike, which they are not. Unlike urban and suburban households, many residential customers live in rural and remote areas that are not well-served by the current electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. DEP and DOER have failed to acknowledge the diversity of housing across the commonwealth. Delivered fuel dealers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not the best solution for environmental justice communities, many of whom live in mobile homes. These types of buildings and families are better served by using affordable propane space heating and Biofuels that create warmer heat and prevent uninsulated pipes from freezing in the wintertime, unlike heat pumps. DEP must treat propane, Biofuel, and emerging energy technology differently than other combustible fuels.

Renewable Propane MA CHS Comments

The Department of Energy recognizes renewable propane as a drop-in replacement fuel for all propane applications. As with SAF and biodiesel, renewable propane is produced from natural fats (tallow), used cooking oils and other types of

grease. Biodiesel refineries can produce renewable propane from these fats and oils before they are used to produce biodiesel, giving materials once resigned to the landfill a new life.

Renewable propane has ultra-low carbon intensity, less than most other energy sources. At present, renewable propane is mostly produced and utilized on the West Coast to meet the California Low Carbon Fuel Standard and the Clean Fuel Standards in Washington and Oregon. The California Air Resources Board (CARB) calculates a carbon intensity (CI) score between 20.5 – 43.5 gCO2eq/MJ, depending on feedstock, compared to CIs of 130 for "average U.S. Electricity" and 91 for gasoline and diesel.

Every state in New England has had renewable propane delivered to it in 2023, and West Springfield, Massachusetts now has a dedicated terminal to an International Sustainability Carbon Certification (ISCC) certified renewable propane blend. This terminal obtains renewable propane from the Midwest, and it is not tied to transportation RINS, allowing it to be used for home heating and other applications. While renewable propane is a very new energy source, its production is growing, and it will continue to become more available as other renewable fuels grow. If DEP is going to realistically assume that Massachusetts will meet its clean electricity goals as part of the basis for their CHS design, DEP must also provide equal consideration that renewable propane propane blends, and Biofuels will be available in quantities that keep pace with or exceed Massachusetts's ability to regulate the utilities to produce cleaner electricity in Massachusetts. The expansion of biofuels and sustainable aviation fuels future the growth of renewable propane and it's no less tenuous than the future growth of wind and solar. In fact, there are production facilities for renewable propane growing all over the globe as illustrated on the WLGA map.[1]

Renewable propane and propane blends have the same great features as conventional propane — reliability, portability, power, and reduced carbon emissions — but with even lower carbon emissions when compared with other energy sources. This makes renewable propane and propane blends an ideal energy source for housing stock that is older and not suited to heat pumps, or for housing such as mobile homes. Renewable propane and propane blends also provide a cleaner future solution for locations without the need for costly infrastructure upgrades, because it is chemically identical to propane used today.[2] This means that it is a drop in fuel, working in existing propane boilers, furnaces, and heaters. The difference is that instead of being a by-product of natural gas production like conventional propane, renewable propane is a co-product of renewable diesel, sustainable aviation fuel, and other emerging technologies such as recycled plastics developed locally at MIT.

Innovation around renewable propane must be incentivized by the state. Renewable propane can also be made from plant stock and more and more renewable propane is being generated from the seed oil of the camelina plant.[3] Also known as camelina sativa or false flax, camelina is a member of the mustard family and a relative of cabbage, kale, and cauliflower, but is not a food crop nor does it compete with food production. Today, camelina is grown in cooler regions of the U.S. and will expand to the south as producers are experimenting with varieties that can thrive in warmer climates. Camelina is drought and pest tolerant and is a pollinator for bees.

This cover crop is completely waste-free as the seed produces 40% oil, twice the amount of soybean, the remaining meal is FDA approved for cow and chicken feed, and the husks are used for mulch. It is beneficial for farmers because it

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[1] https://www.worldliquidgas.org/key-focus-areas/renewable-liquid-gas/
[2] https://online.fliphtml5.com/addge/peyi/#p=1
[3] https://propane.com/about-propane/renewable-propane/

enriches the soil and prevents erosion when fields are fallow and provides additional income without the need for new equipment.

Comments on FAQ Q0:

Heat pump credits: 5 MMT is way too high of an emission reduction for residential heat pump credits. I encourage DEP to utilize the lifecycle analysis and GREET model to calculate the actual emissions cradle to grave for electricity. I am concerned that MA DEP is making a mistake by not incentivizing the usage of propane in the Commonwealth. Prioritizing electric heat pumps, over cleaner propane systems will increase emissions in our state. I urge DEP to consider providing credits for geologic propane and treating it in a similar manner as they do for renewable biomass. Propane is a beneficial by-product of natural gas processing and if it is not used it is wasted. As a waste product, it must be incentivized not only so that it will lower GHG emissions, but also so that it will be available as a reliable affordable energy source for energy security during times or emergencies.

The fundamental purpose of the Clean Heat Standard is to reduce emissions, not promote certain technologies for extrinsic reasons (CECP, Appendix B-3, page 61).[4] I believe propane must be an incentivized clean heat credit energy under the MA CHS. Today, geologic propane in MA has a carbon intensity of 77 which is less than the carbon intensity of electricity and heat pumps in MA which is 100 – 140 depending on how cold the winter is each year. Even if MA electricity will become cleaner, it still makes no sense to disincentivize propane systems as the propane industry will continue to lower its carbon intensity with the addition of renewable propane blends, and I anticipate propane in MA to always have a lower carbon intensity than MA electricity and heat pumps. If MA DEP is indeed trying to reduce carbon emissions today with a CHS, propane must be awarded clean heat credits.

Renewable propane must be incentivized in MA by DEP taking the lead to promote renewable propane development in the state. DEP could be leading the way and setting an example of how to reduce emissions while maintaining an equitable solution to energy security. MA must have backup energy for electricity outages and extreme weather events. Propane fills this role today as the backup fuel for generators across our state, and its use should be increased in the state to make sure we have environmental equity and affordability.

Electricity credit requirements: The delay of the emission reduction credit holding requirement for electricity sellers from 2031 until 2035, concerns me because it incentives electricity over all other energy sources and because DEP states that this change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers. This is disingenuous and shifts the burden on to small businesses and residential homeowners across the Commonwealth. I have been quite vocal about the burden these regulations will have on citizens of the commonwealth. Propane currently serves less than five percent of the thermal sector, it makes more sense for DEP to carve out propane or postpone any regulatory burdens on propane consumers. There is currently no net gain in carbon reduction by leaving propane out of the regulation, and by providing credits there is a potential reduction in carbon emissions within the commonwealth.

[4] Final Report: Commission on Clean Heat, November 30, 2022, Governor Baker's Commission on Clean Heat

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program must focus less on the type of energy to be delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with the commonwealth's targets, and less on marching towards the complete electrification of building stock. In short, the framework structure must focus on carbon reduction, not electrification.

DEP has set different timeframes for electricity and must consider the same approach for propane. Propane only accounts for 4.1 percent of the commonwealth's energy consumption. Until such time as the CI as defined under the EPA Greet standard, for electricity is lower than propane and propane blends, it makes absolutely no sense from an environmental or equity perspective to include propane in the CHS. Propane is a beneficial by-product of natural gas, yet more propane is wasted and simply burned off than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, not to mention natural gas is still part of the energy production of electricity in 2050, it makes no sense not to incentivize the use of more propane, if the Bay State is going to be a responsible steward of the climate and their energy requirements.

2022 Massachusetts (in state) Bulk Electric Generation Mix[5]

- Natural Gas – 77.8%
- Petroleum – 3.8%
- Hydroelectric – 4.5%
- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
- Others (e.g., tire-derived fuels, municipal solid waste) – 2.1

Scientific Analysis Requires Lifecycle Analysis

The Department of Environmental Protection needs to take a holistic view of energy consumption and evaluate the carbon footprint of all energy sources – and the appliances that are powered by them – fairly and accurately. This is best accomplished through a full fuel-cycle (FFC) analysis of energy consumption that utilizes source energy metrics. FFC includes the energy consumed onsite, but also incorporates applicable energy used in upstream processes, as well as the energy needed to convert a primary energy source into a secondary one and transport that energy to an end user. The use of FFC and source energy metrics has been endorsed by the National Academies and the Department of Energy's Office of Energy Efficiency and Renewable Energy.[6]

Propane has a source-site ratio of 1.01, compared to 2.80 for grid electricity.[7] This means, for electricity from the grid, it takes 2.80 units of energy to produce and delivery one unit of energy to a home, compared to only 1.01 for propane. For utility-scale electricity, more than 60% of energy is lost during the generation and conversion process, thereby drastically

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[5] *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

[6] *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

[7] *Source Energy Technical Reference*, Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

increasing emissions of GHGs and criteria pollutants.[8] The average efficiency of a natural gas plant is only 44 percent.[9] The average efficiency of a petroleum plant is 31%.[10] And an additional 5% of energy is lost during the transmission and distribution of electricity to an end user, further decreasing efficiencies and increasing CO_2 emissions.[11]

Energy Security and Reliability

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[12]

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[13]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

Environmental Justice and Equity Considerations

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[14]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[15] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[16] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[17] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup must be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system must be rejected. This requirement attempted in other states has shown to be unsafe, caused damage to homes, and ultimately rescinded primarily due to safety concerns as unqualified individuals and business have modified systems to eliminate fossil back ups.

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8 *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436

9 *Average Operating Heat Rate for Selected Energy Sources,* U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html

10 *Id.*

11 *How much electricity is lost in electricity transmission and distribution in the United States?,* U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

12 *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316

13 *Space heating and water heating account for nearly two thirds of U.S. home energy use,* U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433

14 *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf

15 *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector,* U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html

16 *Id.*

17 *Supra 16*

<u>If Propane is Not Exempted from CHS, Propane Must Generate Credits</u>

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, must generate clean heat credits. This must include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[18] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[19]

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[20] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[21] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the use of propane must generate CHS credits for both traditional and renewable propane.

Credit generation opportunities must include thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

Thank you for your consideration,

Jim Blake

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18 *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

19 *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

20 *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/

21 *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

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April 5, 2024

William Space
MassDEP
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Boston, MA 02108
climate.strategies@state.ma.us

Re: Clean Heat Standard

Dear Mr. Space:

The Boston Housing Authority looks forward to the Commonwealth of Massachusetts' adoption and implementation of a Clean Heat Standard. The BHA has a few additional comments regarding the standard and looks forward to MassDEP's further review.

Electrification is essential to decarbonization and BHA applauds the MassDEP's prioritization of electrification technologies. However, the approach is currently limited to heat pumps and does not include heat pump water heaters, induction stoves, or electric clothes dryers. At minimum, BHA suggest the MassDEP revisit the inclusion of domestic hot water electrification in the clean heat standard. Primarily, the BHA feels that space heating and hot water should each be eligible as an expenditure from the credits.

To the BHA's understanding, the MassDEP framework offers two types of clean heat credits: one would be provided at time of installation for installing a whole house heat pump and the other is based upon emission reduction over time. In their framework, residential customers would get both types of credits, but commercial and industrial buildings would only get the latter. It is critical that public housing receive credits at time of install in order to accelerate the decarbonization of low-moderate income multifamily buildings.

Perhaps most importantly, it is critical that the low-income rates are not the only means for determining income-qualification. The MassDEP has proposed a Justice40-style provision with 40% of benefits going to low-income customers. It is critical that this not be simply restricted to customers on the low-income discount rate but also available to low-income multifamily housing. A public housing authority that is master metered and pays for its tenants' utilities may not be on the discount rate. A master metered building should be included, and public housing should be prioritized, in the allocation of Clean Heat Credits. Failure to do this would have a perverse effect, because the BHA's master metering currently has the positive effect of shielding tenants from rate spikes or cost increase from electrification.

Finally, BHA applauds the MassDEP for amending the proposal to better coordinate with MassSave – understanding that MassSave itself needs to better coordinate with capital planning at housing authorities, this is a very positive development.

The BHA will seek to claim Clean Heat credits and is available to aggregate coordinated delivery of Clean Heat credit as a large property owner of electric resistance and gas heated properties.

Regards,

Joel Wool

Joel Wool
Deputy Administrator for Sustainability and Capital Transformation
Boston Housing Authority

City of Boston
Environment

February 22, 2024

Christine Kirby, Assistant Commissioner of the Bureau of Air and Waste
Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
Boston, MA 02114

By Electronic Submission to climate.strategies@mass.gov

Re: Early Action Credits in the Clean Heat Standard Program

Assistant Commissioner Kirby,

Thank you for the opportunity to provide input regarding the Department of Environmental Protection's (Department) proposals for crediting early action as part of the Clean Heat Standard ("CHS"). Given the amount of work and time needed to decarbonize our energy systems we support incentivizing early action. Crediting eligible electrification projects will also help avoid sinking costs into fossil fuel-dependent equipment like boilers. To advance efficacy and equity, the early action program should incorporate the following:

1. **Eligibility criteria** should be amended to (i) require that clean heat systems are installed in energy efficient buildings and (ii) require disconnection from or removal of gas infrastructure for the unit in which a clean heat system is added.

2. **Equitable access** to early action credits should be supported by allowing customers to pre-qualify for a CHS credit before investing in an electrification project.

3. **Consumer protection measures** should be developed, including (i) establishing a minimum price for early action credits, (ii) directing the monetary value of CHS credits to homeowners/tenants, and (iii) assisting customers in assessing the qualification and reliability of contractors.

I. ELIGIBILITY: Early Action Credits Should be Available to Electrification Projects in Weatherized Homes that Disconnect from or Remove Gas Systems & Infrastructure

The eligibility criteria in 310 CMR 7.77(4)(a) should be amended to require that clean heat systems are installed in energy efficient buildings.

Energy efficiency plays a critical role in our path to decarbonization, both at an individual level, *e.g.,* reducing utility bills and increasing in-home comfort, and at a system level, *e.g.,* reducing constraints on the grid.[1] As discussed in our January 17, 2022 comments, CHS credits for electrification should only be awarded for projects in weatherized buildings in order to encourage the pairing of heat pumps with energy-efficiency, thereby increasing the benefits to homeowners and reducing demand on the grid.

The Department should work with the Department of Energy Resources to set minimum weatherization standards, *e.g.,* minimum insulation requirements and blower door test results. An applicant for a CHS early action credit could then demonstrate that a building meets the required weatherization standards by submitting documentation, such as energy audit reports or proof of energy efficiency work, including via the Mass Save program. Required energy efficiency work could occur in tandem with installing a clean heat system.

Throughout the design and implementation of the CHS, the Department should coordinate closely with other state agencies and the administrators of the Mass Save program to ensure that the state's energy efficiency and weatherization programs align, are easy for residents to navigate, and do not inadvertently block individuals from obtaining benefits.

The eligibility criteria in 310 CMR 7.77(4)(a) should be amended to require the disconnection from or removal of gas infrastructure for the unit in which a clean heat system is added.

Electrification projects that disconnect heating systems and appliances from natural gas, or remove natural gas infrastructure, will help reduce the ongoing use of, and costs to maintain, the gas system. Because hybrid heating systems are expensive and, in many instances, unnecessary,[2] early action CHS credits should be limited to projects where full electrification is paired with disconnections from the gas system or removal of gas infrastructure. To ensure that tenants can benefit from the CHS program, disconnection from the gas system should be measured at the unit level in a multifamily building. While full disconnection from gas should be the norm for an early action CHS credit, exceptions should be available for gas stoves, water heaters or other appliances that have a significant amount of their useful life left, *e.g.,* are less than seventy-five percent (75%) through their useful life.

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[1] *See e.g.,* Wilson et al., "Heat Pumps for all? Distributions of the costs and benefits of residential air-source heat pumps in the United States," Joule, (2024), 5, 9, (calculating that, at a national level, heat pumps could cut home site energy use by 31% to 47% on average and 41% to 52% when combined with envelope upgrades; envelope upgrades could also save thousands of dollars in installation costs by reducing the size of required systems."); Mike Specian, "Weatherization is Key to Effective, Low-Cost Building Electrification," ACEEE, (2023) (finding that the average residential customer who weatherizes and electrifies can save between $500-$800 annually compared to one who only electrifies and that residential envelope improvements can reduce peak electrical load by 7 to 10%).

[2] DPU 20-80-B Order (2023), pg. 55, (DPU "is not persuaded that pursuit of a broad hybrid heating system strategy that would necessitate maintenance of the natural gas system to support heating systems is a viable path forward.")

Asking homeowners to attest to limited utilization of combustion equipment, as an alternative to disconnecting from or removing gas infrastructure, could be complicated, *e.g.,* calculating annual emission reduction credits and verifying attestations, and could result in disputes between homeowners and any installer or other party to whom homeowners have sold the CHS credits. For example, if a third-party has paid for the ongoing emission reduction credits but a homeowner then uses gas combustion beyond the allowable times, this could lead to disputes over who should pay for the "lost" credits. To avoid this confusion, 310 CMR 7.77(5)(7)(b) should be removed.

II. EQUITY: There Should be a System to Confirm Eligibility for CHS Credits Prior to Project Spending

Equitable access to the benefits of the CHS program can be supported by reducing the barrier to participation that up-front funding requirements can create for low-income households in particular. While a CHS credit is a useful incentive, if eligibility for the credit is not determined until *after* a project is completed, benefits can be skewed away from individuals or households most in need of financial assistance when there is a lag between a financial outlay and confirmation of outside funding. There are several ways to mitigate this risk.

One approach is to create a pre-qualification process to provide homeowners assurance before investing in a new heating system. Under this pathway, the proposed Clean Heat and Emissions Tracking System (CHETS) online portal could include a process where homeowners (or third-parties operating on their behalf) can input their project's information, *e.g.*, current heating system, planned upgrades, and low-income discount rate, to determine their eligibility for the full electrification or equity full electrification clean heat credits before making a financial commitment. The Department could create a process to issue pre-eligibility determinations and inform homeowners about the documentation required to confirm compliance at the end of a project. This work should occur early to support a widespread adoption of early action projects across all incomes.

A second approach is to model a system on the Mass Save program, which allows rebates to be deducted from the cost of a project conducted by a qualified contractor and then paid directly to the contractor at a later date. This approach may be less effective in the CHS program given that the price of CHS credits will be driven by market participants rather than "set" by the Department and that credit payments will not come from a single source. But if a minimum price were assigned to CHS early action credits (as discussed further in section III below), this approach could help ensure at least a minimum return to homeowners prior to the full implementation of the CHS program.

III. CONSUMER PROTECTION: The Program Should Integrate Measures to Help Consumers Recognize the Monetary Benefits of the CHS Program and Assess Contractors

The Department should explore and implement steps to advance consumer protection; this will be relevant for work subject to early action credits and during full implementation of the CHS. Ideas about how to support consumers, and the difficulties they might face, should be informed by experience with programs such as Mass Save, including its incentives for heat pumps.

Establish a Minimum Price for Early Action Credits

The financial value of early action credits would be uncertain in an unestablished CHS market. Some homeowners, especially those eligible for equity credits, may depend on the value of the credit to complete the project. The Department should set a minimum price homeowners would receive for early action credits – regardless of early market prices. For example, the value of early action credits could be the price, or a portion of the price, currently under consideration for alternative compliance payments or could be set at the level of the Mass Save heat pump incentives. If market prices are lower than the minimum once the CHS is up and running, the Department could use alternative compliance payments to ensure participants receive the full return on early action credits. Certainty around project costs will help incentivize early action.

Help Direct the Monetary Value of CHS Credits to Homeowners

Anecdotal evidence from the Mass Save program indicates that some contractors inflate the costs of their projects to offset the value of available incentive payments, thus depriving customers of the actual savings. Measures to address such concerns include: (i) requiring contractors to present the CHS credit as a separate line item on quotes and invoices to homeowners (ii) collecting and sharing information on project costs that homeowners can access when evaluating quotes; and (iii) auditing contractor pricing. This latter option could be linked to the creation of an “approved” or “certified” list of contractors.

Assist Homeowner in Assessing the Qualifications and Reliability of Contractors

The CHS program should explore creating and providing customers access to resources such as (i) lists of qualified HVAC companies, (ii) quotes/project costs by type of building and scope of work, and (iii) collected feedback on contractors. These resources could build off of, and integrate, data collected pursuant to the Mass Save program or other state initiatives. For example, the Mass Save program provides a list of contractors that “have provided proof of EPA [Environmental Protection Agency] certification and insurance in the state of Massachusetts and have completed heat pump installation training."[3] Such information could be part of a database, linked to the online CHETs platform, that allows homeowners to select contractors based on factors such as language preference, equipment type, and property type.[4] Over time, such a database could also provide a platform for homeowners to file complaints or reviews that others can view when selecting contractors.

* * *

A well designed system for early action credits can equitably support ongoing efforts to hasten decarbonization, avoid new investments in fossil fuel-related systems, and generate experiential data that can inform the design of the full CHS program. We appreciate the Department's ongoing efforts on this complex program and consideration of these comments. For questions, please contact Aladdine Joroff, Director of Climate Policy (aladdine.joroff@boston.gov; 617-635-3407).

Sincerely,

Chief Mariama White-Hammond
Environment, Energy and Open Space, City of Boston

[3] https://www.masssave.com/trade-partners/contractors/heat-pump-installers

[4] *See e.g., id.*; Clean Heat Rhode Island also has a searchable database for heat pump installers, *at* https://cleanheatri.com/resources/find-an-installer-dev-v2/?county=Newport&equipment=Ducted+Air+Source+Heat+Pumps&property=Small+to+Medium+Business&language=English&diversity=&company=

City of Boston
Environment

April 8, 2024

Christine Kirby, Assistant Commissioner of the Bureau of Air and Waste
Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
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By Electronic Submission to climate.strategies@mass.gov

Assistant Commissioner Kirby,

Thank you for the opportunity to provide feedback on the Department of Environmental Protection's (the Department) most recent ideas for the Clean Heat Standard (CHS). We recognize the need to balance moving forward quickly with decarbonization work and the time and research needed to develop this program. These goals can be supported by utilizing data and processes from other programs and building out the CHS program over time, starting with core components and integrating flexibility measures to support future revisions. These comments build on our prior input and reiterate (i) several key principles that should guide the development of the CHS and (ii) core elements (for both residential and non-residential buildings) that should be included in the first iteration of the CHS. We appreciate your continued consideration of our prior comments as well.

I. GUIDING PRINCIPLES FOR DEVELOPING THE CLEAN HEAT STANDARD

As with many initiatives relevant to decarbonizing the energy sector, program decisions should be guided by consideration of:

- **Equity**, including how the CHS can benefit or negatively impact consumers with high energy burdens and environmental justice communities. Low-income owners and tenants need access to decarbonization programs with protection from increases in energy costs.

- **Meaningful reduction of greenhouse gas emission that is additive to current efforts,** including aligning with and advancing current decarbonization efforts and assigning credit values that accurately reflect emission reductions.

- **Reduction of overall energy system costs,** including prioritizing full electrification investments that can reduce ongoing use and maintenance of the gas system, overall energy system costs, and individual customer costs.

II. KEY ELEMENTS TO ADDRESS IN THE FIRST ITERATION OF THE CLEAN HEAT STANDARD

The first iteration of the CHS should incorporate the following elements.

- **Holistically Engage Low-Income Homeowners and Tenants:** Continue to require a portion of credits to come from a low-income "carve out" and direct a significant portion of funds from Alternative Compliance Payments (ACPs) to support participation by low-income homeowners and tenants, including through paying for "pre-work," such as asbestos removal, and bill assistance. The Department should assess providing such assistance to certain moderate-income residents as well.

- **Support Energy Efficiency as Well as Electrification**: Energy efficiency is a fundamental building block to achieving net-zero carbon emissions in a cost effective manner. As discussed in our prior comments, the CHS should utilize credits to advance energy efficiency as well as electrification, including by: (i) awarding credits to new weatherization work, and (ii) requiring weatherization as a prerequisite to installation of a heat pump or awarding enhanced credits to electrification at buildings that have completed energy efficiency work. Credit for efficiency work should be available for work at both residential and non-residential buildings.

- **Create a Credit System that Incentivizes Energy Efficiency Work and Full Electrification:** As discussed in more detail in our prior comments, the CHS credit system should utilize "adders" to support electrification work that is paired with the addition of electric appliances and disconnections from the gas system. This would leave room for iterative action by building owners/residents and strategic electrification initiatives. The SMART program credit system could be a model for a CHS program that awards baseline credits with adders for additional work.[1] The emission reduction "value" of various adders could draw upon existing data sources, such as Mass Save.

- **Set Alternative Compliance Payments and Non-Compliance Penalties at a Level that Incentivize Implementing Clean Heat Measures:** To maximize the reduction of greenhouse gas emissions, the Department should set the price of ACPs at a level that incentivizes regulated entities to meet compliance through the direct generation or purchase of credits. An ACP price that is significantly lower than the cost of creating a credit will result in fewer emission reductions. (For context, Mass Save reports that the

[1] For example, under the SMART program solar projects can receive an "energy storage adder" (increasing the value of dollars per kilowatt hour) to incentivize the benefits of co-siting solar systems and batteries. 225 CMR 20:07(4)(c).

average installation cost for a whole-home air source heat pump is $22,000[2], but the draft CHS framework proposed a $6,000 ACP for full electrification credits in 2026.) ACP prices should be updated periodically to ensure alignment with market costs.

- **Include Electric Distribution Companies as Covered Entities Only if Modeling Demonstrates that Their Inclusion Would Not Negatively Affect Electricity Prices**: Regulating electric distribution companies (EDCs) pursuant to the CHS would be counter-intuitive to the goals of the program if it would increase electricity costs and disincentivize decarbonization. The Department should conduct economic modeling on this point before including EDCs as regulated entities for either the CHS' full electrification or emission reduction credits. The assessment regarding the role of EDCs can be revisited as part of future programmatic reviews, which will allow time to see how other policies will affect electric rates, including the open dockets at the Department of Public Utilities on electric sector modernization and energy burdens. In the meantime, EDCs will continue to reduce emissions through programs such as the Renewable Portfolio Standard.

- **Metrics for Measuring Emission Reductions:** The efficacy of the CHS will be strengthened by having tools to accurately calculate emission reductions that are also easy to use, *e.g.,* do not require excessive homeowner, third-party or agency time to measure on a case-by-case basis. Different measures will be needed to calculate credits associated with (i) installation of electrification or weatherization measures versus (ii) ongoing use of electrification measures. To-date, we have more experience with the former. The Department should draw from the Mass Save program to develop baselines and "size" credits for installation of electrification and weatherization measures. The credits awarded to such work should be the same for buildings that are subject to stricter building code standards or emission performance standards.

  As the Department noted, calculating changes in operational emissions based on a specific intervention, such as the installation of a heat pump, is difficult. Tracking utility bills at an individual building level is time-consuming and complicated, and emission reporting requirements for most larger buildings in the Commonwealth are not yet in effect. As such, we recommend that the initial CHS focus on credits for installation while the Department further researches metrics for measuring and crediting changes in operational emissions, including looking at existing building emissions performance standards as models. We would be happy to discuss the emissions-related data collected through Boston's Building Emissions Reduction and Disclosure Ordinance.

[2]https://www.masssave.com/residential/rebates-and-incentives/heating-and-cooling/heat-pumps/air-source-heat-pumps

- **Alignment with Existing Programs:** To cost-effectively maximize GHG emission reductions, the CHS should align with and build on current building decarbonization efforts across the Commonwealth. While the CHS should not allow “double counting” with other funding sources, it should allow building owners/residents to “stack” incentives. As noted in prior comments, we also encourage the Department to ensure that the design of the CHS does not inadvertently hinder or disadvantage municipal aggregation programs and their ability to deliver cost-effective green energy to residents.

* * *

We appreciate the continued efforts to develop this important program and would be happy to address any questions as the Department prepares the draft CHS regulations. Please direct any questions to Aladdine Joroff, Director of Climate Policy (aladdine.joroff@boston.gov).

Sincerely,

Chief Mariama White-Hammond
Environment, Energy and Open Space

Aladdine Joroff
Director of Climate Policy

CLEAN FUELS ALLIANCE AMERICA COMMENTS ON MADEP'S CLEAN HEAT STANDARD DRAFT FRAMEWORK AND Q AND A
April 5, 2024
Submitted by Stephen Dodge, Director of State Regulatory Affairs, Clean Fuels Alliance America

Thank you for the opportunity to offer comments on the MaDEP Clean Heat Standard Draft Framework and recently updated Q&A.

Clean Fuels Alliance of America (Clean Fuels) is the industry's primary organization for technical, environmental, and quality assurance programs for biomass-based diesel (BMBD), and is the strongest voice for its advocacy, communications, and market development. Clean Fuels represents the farmers, producers, distributors, and end-users of BMBD including biodiesel, Bioheat ® fuel, renewable diesel, and sustainable aviation fuel. Clean Fuels has been actively engaged with legislators and regulators in all the states that have LCFS-type programs already in place which include California, Oregon, Washington and New Mexico (recently passed), as well as those states such as Vermont, New York, Rhode Island, Pennsylvania and Maryland which are actively considering LCFS-like programs for either the transportation or heating sectors, or both.

We wish to address several issues that have been referenced in the Q&A document, the draft framework, previously filed comments and on the webinars that DEP has conducted on this matter.

BIODIESEL AND RENEWABLE DIESEL CREDITING

We are concerned that DEP's latest proposal to differentiate between crop-based and waste-based feedstocks - limiting credits to crop-based biodiesel blends to B20 and under and excluding crop-based RD - will increase the cost of compliance for the CHS without commensurate emissions benefits because non-waste-based RD can provide additional GHG reductions through 2030 and beyond at no additional cost. As we commented back in April, no other jurisdiction that either implements an LCFS-type program, or is considering one for either transportation or heating, entirely eliminates credits for higher blends.

Massachusetts should take a technology-neutral approach to any CHS program. BMBD feedstocks that achieve lifecycle greenhouse gas (GHG) emissions reductions relative to petroleum should be allowed in the CHS. The market, through science-based metrics, should be able to determine the feedstocks and fuels that provide GHG emissions reductions – including

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significant indirect emissions – at the lowest cost to society. Setting wholesale limits or caps on biodiesel feedstocks will arbitrarily restrict the state from achieving GHG emissions reductions at the lowest possible cost while maximizing total benefits. Concerns of indirect impacts of BMBD use in the state should be addressed through market-based and science-based mechanisms to incentivize behavior that reduces GHG emissions. The U.S. Renewable Fuel Standard (RFS), which sets the volume of biomass-based diesel used in the United States, already has requirements for feedstocks to meet a 50% emissions reduction threshold and ensure that land use is not expanding.

The Massachusetts 2050 Climate Action Plan makes the case for using fact-based science in determining greenhouse gas reduction methodologies instead of arbitrary limits on crop-based biodiesel and renewable diesel. The Action Plan clearly states: *"Over the next 28 years, Massachusetts' clean energy programs must evolve with changes in science, technology, and costs. Massachusetts must achieve Net Zero in 2050 while recognizing inevitable changes in the future. One of the areas of evolving scientific understanding centers on GHG fluxes and, as more accurate and precise data become available over time, policy makers in Massachusetts must pivot and adapt to using the best available information."* The Plan further states: *"To ensure accuracy and credibility, Massachusetts must continue to use transparent methods to track and report GHG emissions reductions and carbon sequestration. Using reporting and accounting approaches that are compatible with other jurisdictions will decrease the chances of double-counting and allow Massachusetts to truly contribute toward global GHG reductions."*

Allowing for all eligible feedstocks will help ensure that supplies of biomass-based diesel are sufficient to not only meet the needs of the program, but to immediately reduce carbon emissions – an urgent need cited by the most recent United Nations IPCC reports. In addition, limiting feedstocks has an adverse effect on the communities that DEP wants to protect the most – disadvantaged EJ and LMI communities - because such limitations restrict competition, leading to higher product prices. As has historically been the case in California, Massachusetts would be much better served, from a markets standpoint, to use a credit-based system that incentivizes all feedstocks that fit market conditions within the state, as producers and distributors will respond to price signals to meet CHS requirements using lower CI feedstocks.

Limiting eligible feedstocks is short-sighted. Massachusetts will not be setting the overall production of biofuels in the marketplace with any new rule as the RFS (Renewable Fuel Standard) is the overall driver of production in the US. By banning crop-based biofuels from eligibility, the state would simply be limiting the options for biofuels within the state, driving up fuel costs and/or leading to a lack of supply of biofuels within the state. The end result would be higher costs for all consumers which disproportionately burdens lower income households while perpetuating the use of fossil fuels and environmental injustice.

DEP appears to be curiously overconcerned about stranded investments for RD, particularly in light of the proposed 2028 review. This concern is unfounded. RD capacity is ramping up in the billions of gallons, mostly due to West Coast policies. Massachusetts perceived demand – or lack of it – will not have an effect upon those investments. Furthermore, RD can use the same distribution tanks, rail and pipelines as fossil diesel. So not crediting RD because of concerns about stranded assets makes little sense. There will always be a market for excess West Coast consumption, whether it be in Massachusetts or elsewhere, without undue impacts to infrastructure investments. In fact, if anything, the massive investment in ramping up heat pump production and installations, along with generating green electricity generation and distributing that extra capacity, is much more of an investment risk than crediting for higher BMBD blends. While electrification is an important pathway to decarbonization of the building sector, BMBD is here now and is ramping up quickly while deep deployment of green-electric heat pumps is years and many investment dollars away.

Again, reference to the Massachusetts 2050 Climate Action Plan is appropriate here: *"Like current fossil fuel markets, the markets for alternative fuels are likely to be national or global in scope, and Massachusetts' supply, demand, and policies will not likely be a major driver of these markets…"*

There additionally seems to be some concerns expressed by DEP regarding the production and processing of renewable diesel. Clean Fuels has regularly and vociferously been opposed to the co-processing of RD (i.e. allowing fossil-diesel to be blended with renewable diesel in the RD refining process). Co-processed renewable diesel should not be a credit generator under the proposed program. Only fully renewable RD should be treated the same as biodiesel. The operational details for each refinery are unique making it difficult, if not impossible, to track the renewable feedstocks through to specific volumes in finished fuels. As such, it is necessary to measure the actual biogenic content of fuels that result from co-processing via ASTM D6866 – a test applied in other jurisdictions. In states that allow co-processed BMBD, this test is used to determine the percentage of fossil diesel versus renewable diesel. The test can also be used to enforce a co-processing prohibition against any proposed credit generations. Additionally, other jurisdictions also require third party verification of BMBD's feedstock pathways and reports, adding additional assurance that the accounting is accurate. It should also be noted that this accounting method is not different from what is required for neat biodiesel or renewable diesel production using multiple feedstocks in jurisdictions where suppliers have to adhere to specific approved pathways.

LIFE-CYCLE CARBON ANALYSIS

DEP and others have expressed concerns about the lifecycle impacts of BMBD feedstocks. To be clear:

(a) the only ILUC model recognized by CARB and hardwired into the LCFS is GTAP-BIO (created and updated by Purdue University),

(b) the ILUC estimates for soy have been greatly overestimated since 2009, when it was assessed at over 300 CI (in at least one paper), to 60 in 2011 (in the CA LCFS reg), to 29.1 in 2015 (in the CA LCFS reg), and now 9.7 (June 2023 Purdue GTAP paper). It's important to note that the June 2023 GTAP paper arrived at an ILUC estimate for soy of 9.7 CI, which is 67% less than the current regulatory value and 84% less than the 2011 value, using an assumed volume of 3.2 billion gallons of soy-based BMBD, which is 4 times the volume CARB assumed when it assigned the much higher ILUC score of 29.1.

(c) other papers cited by opponents of biofuels in support of constraining BMBD have not gone through the public regulatory vetting and have NOT been incorporated into the LCFS or other carbon policies on the west coast, so relying on those papers to nullify a regulatory provision that's been in place for over a decade and make future programming decisions makes little sense.

The limits or prohibition on crop-based biofuels are based on conjecture and unfounded fears. The evolving science in the ILUC models underlying such concerns in LCFS programs is showing substantial declines in the estimated ILUC impacts from even a few years ago.

As mentioned above (as well as in the Massachusetts 2050 Climate Action Plan), it is vitally important that any CHS/LCFS-type program base its regulatory framework on widely accepted, established and peer-reviewed science. Some commenters have questioned EPA's research on "amortizing" emissions over a 30-year time horizon. To be clear, EPA chose a 30-year time horizon for quantifying the total emissions benefits of a scenario involving an increase in land use to meet the RFS volumes. 30-year amortization is common practice in the U.S. across industries to assess returns on investment and reflects the assumed lifetime of a biofuel facility. The 30-year timeframe allows the agency to quantify the total emission reductions over a 30-year period that could be expected after an initial pulse of GHG increases from new land being converted to energy crop production. If EPA had chosen a much shorter timeframe like 3-5 years, it likely would have masked the true emission benefits because biofuel facilities can operate for multiple decades[1] and skewed the GHG estimates into much lower reductions or even increases.

BMBD PROVIDES CARBON REDUCTION BENFITS IMMEDIATELY

While the goal of the Clean Heat Standard is to provide measurable, verifiable and substantive reductions in carbon emissions in the thermal heat sector to help the state achieve its GHG reduction mandates, considerable and appropriate attention is given in the draft plan to EJ communities and the disproportional adverse effects that current fossil fuel sources are having in these communities – resulting in increased asthma cases, lost workdays and premature deaths. But what is critically missing from DEP's extensive background documents and Q&A is a reference to the time value of carbon emissions as well as the co-pollutant benefits that drop-in liquid biofuels can provide, irrespective of their feedstock source.

It is disingenuous for any carbon reduction program to not take into consideration the co-benefits of low-carbon liquid fuels – whether it be in the transportation sector or the thermal heat sector. These are shorter term, but nonetheless important benefits that cannot be

[1] 2022 Draft Regulatory Impacts Analysis for the RFS (2023-2025)

immediately achieved by slower-paced electrification. This is particularly true in the thermal heat sector, where building owners are more reluctant to spend significant amounts of money to replace their current fossil-fuel based heating systems unless that replacement is significantly subsidized or needs immediate replacement.

Some make the argument that a CHS program that does not aggressively eliminate liquid fuels perpetuates the use of fossil-diesel infrastructure. In fact, such programs perpetuate the use of low-carbon, non-fossil liquid fuel in sectors that cannot realistically electrify in the near-term. BD and RD blends as a drop-in heating fossil-oil replacement have proven to be the most cost-effective way to reduce carbon emissions immediately. As we know the United Nations has repeatedly warned of the need to reduce carbon emissions in a timely manner. The IPCC has provided us with a stark warning: "It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred." Furthermore, their report states, "From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO_2 emissions, reaching at least net zero CO_2 emissions, along with strong reductions in other greenhouse gas emissions."

Simply put, reducing carbon emissions now, is more valuable than reducing the same amount of emissions later. It's the same principle we learned in high school: a dollar invested now is worth more than a dollar invested 20 years from now. This is because earlier reductions limit the long-term climate impact caused by the accumulation of greenhouse gases. This significant and often overlooked principle is frequently absent from policy discussions, which, for example, treat a reduction of CO_2 in 2024 with the same weight as a reduction in 2050. This is simply not accurate and skews the market to seek low-technology readiness options which may not be deployed for years or decades, if ever at all. From a climate standpoint, making things worse upfront is clearly not an appropriate strategy, especially when there are drop-in decarbonization strategies that can be coupled with increasing electrification at the same time to ensure continual GHG and co-pollutant reductions.

For every five years we wait to take action we must reduce GHG emissions by 13 times as much to have the same climate impact. MaDEP should not arbitrarily limit emission reductions in the short term based on false assumptions about RD investments and poorly understood and diminishing risks that might be associated with crop-based fuels. We cannot afford to wait for perfection.

The phase-out of fossil heating oil is happening now. The largest liquid heating appliance equipment manufacturers for all different sizes and equipment applications have worked with Underwriters Laboratories (UL) on B100 UL-rated heating appliance protocols, which were recently approved for home heating appliances[2]. Their efforts are leading to the production of B100 UL-rated components this year that can be put immediately into use throughout the marketplace. Indeed, manufactures such as the Beckett Corporation and Carlin have already

[2] See UL296, Nov. 14, 2022 Update to Include Biodiesel Blends Up to B100, NORAweb.org.

begun producing B100-compatible burner equipment.[3] Thus, a 100% renewable liquid fuel for thermal heat in both home and commercial applications that can save upwards of 80% carbon emissions is here and ready to use now.

Regarding co-pollutants, Clean Fuels groundbreaking Trinity Study[4] conducted in phases and covering some 40 communities over the past several years, further solidifies the mounting evidence that BMBD can have immediate and positive effects on the health of residents in EJ communities. Results from the study are impressive, showing that 100 percent biodiesel (in both home heating and transportation sectors) result in more than 457,000 fewer asthma cases, 177,000 few sick days, 1100 fewer deaths (over a lifetime) and 10,000 fewer cases of cancer. The results can be extrapolated for lowers blends showing that even limiting blends to B20 will leave many beneficial outcomes on the table at low cost. Results for renewable diesel are similar.

BMBD SUPPLIES

In Q0 of DEP's most recent Q&A, the agency seriously questions the availability of RD supplies citing the lack of current supply. That assumption is off base. Market demands will bring product to the Northeast as has been the case in the West. The U.S. biodiesel and renewable diesel production capacity is currently over 4 billion gallons, with 6 billion gallons projected by 2030 (and probably years before then) and, with further investments in crush and production, up to 15 billion gallons by 2050.

Biodiesel imports have increased over the past few years, with European plants returning from turndowns associated with the spike in natural gas prices in the EU that occurred at the end of 2021 and then was extended due to the start of the Russia-Ukraine conflict in early 2022. Renewable diesel imports have remained relatively constant over the past three years. In addition, BMBD consumption continues to grow, with consumption in 2023 far surpassing full-year 2022 to set a new annual record. Renewable heating oil consumption continues to grow. RD is now available in markets as close as Providence, Rhode Island, and the City of New York's entire off and on-road diesel fleet is now using a blend of R99/B1, weaning itself entirely off fossil diesel.

FOOD VERSUS FUEL

DEP'S Q&A references the Massachusetts Clean Energy and Climate Plan for 2050, quoting (in footnote 10) that *"crop-based biofuels can compete directly with food production and contribute to deforestation."* The footnotes cited in the Plan do not reflect this assumption. Of the four footnotes associated with this statement in the Climate Plan only one mentions the food-fuel conflict, but only in passing. The food v. fuel debate misunderstands the economics of

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[3] Production began the week of Jan. 30, 2023. See Beckett announcement at https://www.beckettcorp.com/product-announcements/r-w-beckett-oil-burners-approved-for-b100-r100-blends/.
[4]https://cleanfuels.org/sustainable-impact/health-benefits-study/

agriculture and commodity markets. As cited above, the Clean Energy and Climate Plan for 2050 calls for science-based policies, saying: *"policy makers in Massachusetts must pivot and adapt to using the best available information."* DEP cannot justifiably wholly write-off crop-based fuels based on one passing statement that is not supported in the Commonwealth's record to date without more study or explanation at a minimum[42]. As currently stated in the Q&A, the bias against crop-based BMBD appears to be arbitrary and disingenuous without further exploration of the topic. In fact, replacing domestic petroleum diesel consumption with domestically produced BMBD for heating applications not only reduces GHG emissions by up to 76%, but doing so is one of one the most sustainable actions available to Massachusetts and other states concerned with addressing climate change effectively.

The following additional points should also be taken into consideration:

- BMBD is the most diverse fuel available, made from a wide variety of waste and by-product feedstocks such as used cooking oil, rendered animal tallow, recycled grease, and agricultural byproducts from canola, soybean, and other plant oils.
- BMBD is nontoxic and biodegradable, and its production reduces wastewater by 79% and hazardous waste by 96%.
- The largest feedstock for crop-based is soy oil. Its use decreases soybean meal prices by $20-$40 per ton, saving livestock producers $5B in reduced soymeal cost and reducing food costs for consumers.
- The U.S. BMBD industry supports more than 60,000 jobs, generates $11B for the U.S. economy (rather than on foreign oil), and recycles atmospheric CO_2 into valuable fuel that enables progressive states to keep climate-worsening crude oil (the burning of which produces new, not recycled sources of carbon) in the ground.
- The claims of some appear to conflate palm oil production with soybean oil production. Palm oil production, conducted in tropical countries outside the U.S., often involves destructive practices, but those practices do not occur in domestic production of soybean or other plant-based biodiesel feedstocks.
- Indeed, BMBD use in climate progressive states like California and Oregon has increased many-fold under their innovative low carbon fuel programs. For example, because of their positive attributes, biodiesel and renewable diesel in 2023 are projected to have grown 150-fold in California since the start of its Low Carbon Fuel Standard program in 2011, now comprising 60% of the total diesel fuel pool in the state.
- Such rapid growth has taken place due to substantial increases in agricultural yield, efficiency gains in the processing and production of BMBD, and other improvements that have enabled the increase in production without the adverse land and soil carbon impacts noted by some environmental groups. It is inconceivable that California and Oregon would allow the use of such biofuels, much less the phenomenal growth these fuels have had, if the types of adverse consequences were actually being caused by these fuels.

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[4]https://onlinelibrary.wiley.com/doi/10.1002/bbb.2124

In conclusion, Clean Fuels believes a properly constructed, feedstock agnostic program will be the largest arrow in the state's quiver to reduce carbon emissions from the thermal heat sector in a technology-neutral and environmental outcomes-based approach, especially in the near-term where carbon reductions are inarguably the most important. Clean Fuels looks forward to continuing to work to DEP and fellow stakeholders, as we have done in Vermont which is on a parallel course, in drafting regulations that take into consideration the widest possible pathways for all low-carbon liquid fuels. While electrification is an important pathway to reducing carbon emissions, it cannot be the only pathway. A Clean Heat Standard that promotes the full use of all compliant biomass-based diesel will allow for the state to achieve its greenhouse gas reduction goals in a manner that is cost-effective, practical and affordable for all of its businesses and citizens, particularly those in disadvantaged communities.

Sincerely,

Stephen C. Dodge

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April 5, 2024

Via Electronic Mail to climate.strategies@mass.gov

Bonnie Heiple, Commissioner
Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: MassDEP Clean Heat Standard Framework, Joint Comments of Climate Advocates

Dear Commissioner Heiple,

Below, please find comments regarding the March 2024 revisions to Massachusetts Department of Environmental Protection's ("the Department's") Clean Heat Standard ("CHS") Framework from environmental and climate organizations dedicated to achieving Massachusetts' climate policy in an equitable and efficient manner.

The proposed CHS is a potentially vital tool to aid in attainment of the Commonwealth's mandate to achieve net-zero greenhouse gas (GHG) emissions by 2050, as required by the 2021 Roadmap Law. As Massachusetts' 2025, 2030, and 2050 Clean Energy and Climate Plans concluded, electrification is the best option for building heating that meets Massachusetts' climate mandates in a cost-effective manner. We appreciate DEP's emphasis on electrification in its design of the CHS and the iterative process that design of this standard has taken. We are particularly encouraged by the current proposal for the treatment of biodiesel. But as these comments lay out, significant amounts of analysis are still needed to inform the development of the CHS. As this process moves forward from a framework into a draft standard, we encourage DEP to imagine how different customers and obligated entities would interact with the standard and strive to make it easy for those involved to understand and use.

Issues raised by March 2024 proposed amendments

In the Q0 section of the March and April 2024 updates to the FAQ document, DEP proposes certain changes to the draft framework. We have a number of questions regarding these changes and comments on whether the proposed changes should be adopted as well as some comments on program design features that are in the proposal from before these updates were made.

A. Why assign ownership of credits to anyone besides consumers?

The Department says it is considering assigning default ownership of emissions reduction credits (ERC) from the operation of heat pumps to electricity suppliers instead of homeowners. We strongly oppose this change unless significant changes to the structure of this proposal are made and absent quantitative analysis. As the original Draft Framework proposed, the bulk of the money generated from one full electrification comes from the ERC.[1] Full electrification customers who have removed their fossil fuel systems should be assigned the full value of their ERC for the amount of time that DEP determines best incentivizes this desired outcome. Given that the consumer has already completed the desired behavior of fully electrifying, they should reap the full benefits of that decision.

A properly structured incentive program where credits are assigned to an obligated entity on the basis of actual heat pump usage could be appropriate in the case of a partial electrification, if sufficient quantitative analysis supports this structure. However, DEP should not consider assigning the ERC to any party other than the consumer unless analysis indicates that consumers would still capture the value of the credits through reduced rates, rebates, or other incentives. Experience with Mass Save enhanced rebates indicates that heat pump installers will increase charges to capture the value of the rebate for themselves without careful program administration.

DEP should also analyze what this shift would do to the motivation of fossil fuel sellers to pursue electrification projects, as part of its analysis into setting the ACP values. Assigning a valuable credit to electric suppliers is not necessary to simplify program administration - rather, they can be required to provide data to regulators, regardless of whether they have a financial interest in doing so. Electric distribution utilities do it all the time by sharing metering data with electric suppliers. If the proposal to include electric companies as obligated under the CHS was motivated by concern for electricity rates or other burdens on consumers, a far more logical and effective solution would be to eliminate electricity sellers as obligated entities for at least the early years of the program until DEP can demonstrate that the annual cost of operation of heat pumps is significantly lower than the operation of natural gas heating equipment.

B. Why lower the annual emissions reduction target from 5 MMT CO2/year to 4?

The Department proposes to reduce the rate of increase of the emissions reduction standard so that it reaches 4 MMT by 2030 (rather than 5). The FAQ indicates that this change is in response to stakeholders' comments that the CHS does not address all sources of emissions from residences, "leaving room" for residential water heating crediting within the scheme. This is the opposite of how this stakeholder observation should be addressed in program design. Rather than reducing the stringency by 20%, DEP should set the standard at the level that the 2030 emissions target demands (apparently, 5 MMT) and allow electrified appliances and weatherization to generate credits. The objective is not to save space for heat pump water heaters to contribute to our climate goals, too - but rather to incentivize the use of them, just like the standard incentivizes heat pumps. Electrified appliances are part of the Mass Save program and should be similarly integrated into a CHS.

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[1] Using the figures proposed in the original Draft Framework, a full electrification credit would generate $6,000 of value, but the 15 years of emissions reductions credits (15 years x 4 MT/project x $190MT CO2) would generate $11,400 (or $3,800 if lifetime is reduced to 5 years as suggested in the FAQ).

C. Why shorten years and reduce the crediting rate for emissions reductions credits for heat pumps?

The Department also proposes to shorten the timeline over which a heat pump can generate ERCs from the lifetime operation of the heat pump (26 years for heat pumps installed in 2026, for example) to 5 years, and reduce the per-residence credit for heat pumps from 5 to 4 MT for full electrification (or 2.5 to 2 for hybrid heat pump systems). This changes the market signal provided by this credit significantly. In the below chart, the left column represents 2026 and the right represents 2030. Playing out this example, the value of an electrification project would decline by 66% in 2026 and 52% in 2030. Putting it another way, not doing a full electrification project in 2026 (and instead paying alternative compliance payments) would cost a gas company $6,000 under the new credit values, rather than $28,800 as originally proposed.

Original Draft Framework: 2026 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	**$6,000**
Annual Emissions Avoided (MT CO2)	5.0
Years Emissions Avoided Credits Generated	24
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	**$22,800**
Total Credit Value:	**$28,800**

Original Draft Framework: 2030 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	**$10,000**
Annual Emissions Avoided (MT CO2)	5.0
Years Emissions Avoided Credits Generated	20
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	**$19,000**
Total Credit Value:	**$29,000**

Revised Draft Framework: 2026 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	**$6,000**
Annual Emissions Avoided (MT CO2)	4.0
Years Emissions Avoided Credits Generated	5
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	**$3,800**
Total Credit Value:	**$9,800**

Revised Draft Framework: 2030 Residential (non-LI) "Full Electrification" Project	
Full Electrification Credit Value	**$10,000**
Annual Emissions Avoided (MT CO2)	4.0
Years Emissions Avoided Credits Generated	5
Emissions Avoided Credit Value ($/MT CO2)	$190
Cumulative Emissions Avoided Credit Value ($)	**$3,800**
Total Credit Value:	**$13,800**

% Decrease Total Credit Value	**-66%**

% Decrease Total Credit Value	**-52%**

Acadia Center

The Department's comment that the five-year time limit could be extended "if future program analysis suggests that a longer time period is desirable" gets the sequence of events entirely backwards. The obligated parties will be making decisions in 2026 based on the anticipated future cost of alternative compliance payments. If DEP sets up the program to only award 5 years of credits for each install, that is the amount on which they will base their program - not just the early years of the program, but the entire design of the program. No business decisions will be made based on the hope that the Department's 2028 review returns a different structure. The Department should take the time it needs to conduct the analysis necessary to create incentives to drive the outcomes it seeks starting with the commencement of the CHS.

Prior to reducing the timeline for heat pumps to generate ERCs from the usable life of the equipment, DEP needs to 1) Do rigorous modeling and quantitative analysis to inform the appropriate value of both the full electrification ERCs and the future emission reduction ERCs generated by electrification projects that will actually motivate fossil fuel obligated parties to complete electrification projects, opposed to meeting 100% of compliance via ACPs and liquid biofuel blending (to date, we have not seen any analysis on this topic from DEP); and 2) Set some sort of limit on the percent of the total obligation that can be met via ACPs and conduct quantitative analysis and modeling to investigate and inform this critical policy design decision. Under the current proposal, fossil fuel obligated parties could meet 100% of their obligation via ACPs–a design that potentially puts the entire effectiveness of the policy at risk. The Commonwealth needs to actually install heat pumps at scale in the 2026-2030 time window (and beyond), not just collect ACPs. DEP has provided no quantitative analysis assessing the likelihood of 100% of fossil fuel obligated compliance being met via ACPs despite multiple requests from stakeholders.

D. Commercial Building Electrification Should be Incentivized in a CHS.

Unlike the residential sector proposal, the commercial and industrial/non-residential sector proposal does not adequately incentivize electrification with minimums. Absent policy directing at least a minimum level of electrification of the commercial building sector, it is possible these property owners and developers will rely too heavily on alternate compliance payments and false climate "solutions" such as biodiesel or hydrogen. Further, any consideration of hydrogen should be removed from the first phase of the program and referred to MassCEC and DOER and the Hydrogen Advisory Group they have convened.

E. The CHS must be based on quantitative analysis to be viable.

The CHS is ultimately a system of incentives and corresponding disincentives or costs. To set the appropriate value of a credit, mechanisms by which a credit is generated, lifetime of emissions reductions that are credited, and even which entities are obligated or awarded credits, one must first know the intended policy effects and how changes in each variable impact behavior, substitution of fuels, use of alternative compliance mechanisms, and the overall outcome. Such analysis should also show how the CHS will correspond to the CECP goals and drive toward the 2050 net zero requirement. No in-depth analysis on any of these topics has been presented to stakeholders to date. In particular, the analysis we wish to see includes:

- Specific to electric seller obligation: impacts on electric/gas/oil/propane rates under various scenarios (high vs. low reliance on ACPs to meet obligation, high vs. low reliance on biodiesel to meet obligation)
- Generally, impact on rates under various scenarios (low vs high ACP compliance, low vs high biodiesel compliance)
- Breakdown of water heating emissions by building type and how this impacts GHG reduction obligations proposed
- GHG/cost impacts of crediting all housing units at 4 MT avoided vs. linking full electrification projects to actual emissions avoided
- Impacts of ACP compliance caps at various levels (e.g. 0%, 50%, 100%)

- Eligibility of biofuels (lifecycle emissions, how APS standards verification would translate to CHS)

We would encourage interactive expert technical sessions on each of these topics.

This analytical review should be iterative. We appreciate the Department's openness to feedback and encourage additional processes moving forward, including analysis of rate impacts, technical working groups, and providing draft analysis for comments.
Electricity sellers should not be obligated entities in the early years of the program (at a minimum). Once electrification has become a clear winner from the perspective of consumers' operating costs, it may be appropriate to place some CHS obligation on electricity sellers, particularly to fund a continued Just Transition Charge or other equity-focused framework. But such a change should only be made after thoughtful, in-depth quantitative analysis informing such a proposal, particularly in light of other decarbonization costs (including the cost to decarbonize the electric sector) placed on electric bills.

F. Inclusion of Electric Providers as Obligated Parties Will Result in Inequities and Hamper Progress Toward Massachusetts' Climate Goals

As RAP stated in its July 2022 white paper supporting the 2025 and 2030 Clean Energy and Climate Plan, "[E]lectric rates are already bearing most of the cost of addressing climate change in energy in Massachusetts", and "[Inclusion of electricity providers] will require substantial additional analysis and modeling before decisions can be made".[2]

As Massachusetts works toward its electrified future in pursuit of eliminating GHG emissions, it is vital to ensure the energy transition happens in an equitable manner. Practically, this means that electricity needs to remain affordable. As Synapse noted in its analysis for the Department last spring, "The CHS will favor broad electrification of heating and a reduction in the use of fossil fuels. From this perspective, an ideal policy would lower (or not increase) electricity prices and raise (or not lower) fossil prices. Higher electricity prices degrade the economics of switching to heat pumps, requiring higher incentives to persuade customers to switch."[3] While Synapse did not rule out the inclusion of electricity suppliers in CHS program design, it certainly cautioned that careful analysis and design would be necessary to overcome the "systemic negative feedback loop" that adding costs on electric bills would create: "[H]igher prices resulting from a CHC obligation make electrification less attractive, requiring higher incentives (and CHC prices) to incentivize electrification, further driving up electricity prices."[4]

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[2] Regulatory Assistance Project, "A Clean Heat Standard for Massachusetts" at 58-60 (July 2022), https://www.mass.gov/doc/appendices-to-the-clean-energy-and-climate-plan-for-2025-and-2030/download.
[3] Synapse Energy Economics, Inc. "Options for Role of Electric Distribution Companies (EDCs), Obligated Fuels, and Obligated Entities" at 5 (May 2023), https://www.synapse-energy.com/sites/default/files/23-009%20Memo%203.pdf.
[4] Id.

G. All Home Heating Appliances Which Can Provide Necessary GHG Emissions Reductions Benefits Should be Included

A Clean Heat Standard for Massachusetts must include as many aspects of home heating – including heating water, using stoves, and drying clothes and linens – as possible. Data from the U.S. Energy Information Administration shows that heating water using gas has about 40% of the climate impacts that heating space by gas does,[5] and Massachusetts' own Roadmap notes that heating water makes up almost one-quarter of direct GHG emissions from the building sector in the Commonwealth.[6] If the Commonwealth only focuses on heat pumps, we will not achieve the necessary reductions of GHG emissions. If 100,000 of each – stoves, dryers, and water heaters – are included in CHS programming, Massachusetts can increase its anticipated reduction of GHG emissions by up to 1 MMT/year for water heaters and 200,000 MT/year for stoves and dryers. MassSave already includes heat pump water heaters, induction stoves, and dryers; perhaps the rebate/credit amounts for each of these should be proportional to their potential for GHG reduction, with their dollar amount corresponding to the amount of GHG emissions avoided. MassSave has already calculated the potential GHG reductions associated with electrifying these appliances, which will save time in integrating this concept into the CHS. As further discussed below, collaboration between CHS and MassSave will be vital to developing and implementing a successful CHS. Additional funding is available via the Inflation Reduction Act, and Massachusetts should work to take advantage of that funding where possible.

Inter-Agency Collaboration Will Facilitate Process and Encourage Participation

As noted above, elements of MassSave programming can help to set the stage for development of an effective CHS in Massachusetts. Coordination between the CHS and MassSave should yield program design that will lead to achievement of Massachusetts' goal to reduce GHG emissions to 50% of 1990 levels by 2030.[7] In addition, because of the significant overlap between the work of the DEP in development and implementation of a CHS and the work of DOER and the DPU in achievement of Massachusetts' climate goals, interagency collaboration is vital to ensuring the effective sharing of information, data, and communications which would foster innovation.

[5] U.S. Energy Information Administration "Detailed household natural gas and propane end-use consumption—averages, 2020", (Mar. 2024), https://www.eia.gov/consumption/residential/data/2020/c&e/pdf/ce5.4.pdf.
[6] Buildings Sector Report: A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study at 9 (Dec. 2020), https://www.mass.gov/doc/buildings-sector-technical-report/download.
[7] For elaboration on this point see Chretien, Larry, "Coordinating Mass Save with the Clean Heat Standard is Essential" (Mar. 2024), https://blog.greenenergyconsumers.org/blog/coordinating-mass-save-with-the-clean-heat-standard-is-essential.

Coordination with MassSave will be vital to the success of a CHS. A formal partnership between DEP and MassSave would help to streamline process and communications, which in turn will increase program enrollment and participation. Point of sale rebates for heat pumps, dryers, induction stoves, and heat pump water heaters will also encourage participation and enrollment. As described above, MassSave has already performed necessary analysis and review of the values associated with various technologies, so coordination between the entities will provide efficiency in processes and enable necessary communication. While the full value of credits should primarily be directed to customers to incentivize behavior change, as discussed above, customers should experience the CHS as painlessly as possible. For example, the program "storefront" could essentially be styled as an enhancement to Mass Save. This outcome will require careful coordination with Mass Save, potentially through the buildings decarbonization clearinghouse effort.

There Remains a Need for Additional Technical Sessions

There remain some outstanding questions which would be best suited for addressing at technical sessions rather than in back and forth correspondence. For example, the CHS design must ensure avoidance of energy crop feedstocks. We have heard that DEP anticipates working with DOER to verify feedstocks to support crediting the use of waste feedstocks but believe this could use additional development. Options for regulating woody biofuel heating is another good topic for discussion at a technical session.

Conclusion

A Clean Heat Standard for Massachusetts has significant potential to help advance Massachusetts' efforts to eliminate GHG emissions to combat climate change. As we move toward our clean energy future, DEP must prioritize equity and ensure that electrification remains a cost-effective choice. As such, the costs of emissions should be borne by those continuing to burn fossil fuels – not those attempting to clean up their carbon footprints. Finally, cooperation among agencies is essential for coordinating data and analysis and helping to promote efficiency in implementing a CHS and encouraging consumers to participate in our clean energy transition. DEP should continue to work on development of the CHS, and the undersigned are eager to continue to help with this effort.

Respectfully Submitted,

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Ben Butterworth, Acadia Center
Amy Boyd Rabin, Environmental League of Massachusetts
Larry Chretien, Green Energy Consumers Alliance
Cathy Kristofferson, Pipe Line Awareness Network for the Northeast

April 4th, 2024

To the MassDEP:

On behalf of Dandelion Energy and Carbon Solutions Group, we write in strong support of a Clean Heat Standard (CHS) in Massachusetts. We applaud the significant resources, time, and patience your organization has allotted to diligent policymaking, as well as to the extensive stakeholder consultation process that aims to ensure an equitable and effective program. Innovative concepts, such as those addressing weather normalization, indicate that the Massachusetts CHS will be a beacon for future heat standards around the country.

By way of background, Dandelion Energy is a leading residential geothermal heating and cooling company. Dandelion has installed systems for over 100 Massachusetts households since opening in the Commonwealth in 2022 and is contracted to install systems in an additional 150 Massachusetts homes in 2024. Carbon Solutions Group (CSG) is a clean energy developer and aggregator of environmental attributes. CSG streamlines the monetization of residential environmental attributes on behalf of property owners, resulting in over $160M paid to consumers to date. CSG services 30,000 customers across twenty states in the U.S. As of January 2024, CSG began contracting with residences in the Commonwealth.

Our respective companies believe that geothermal Ground-Source Heat Pumps (GSHP) represent an immensely impactful technology when it comes to U.S. grid resiliency and economic prosperity, as well as decarbonizing the building sector. A recent Department of Energy (DOE) study came to similar findings:

> "The analysis finds that, coupled with building envelope improvements, retrofitting around 70% of U.S. buildings with GHPs [geothermal heat pumps] could reduce electricity demand by as much as 13% by 2050 versus decarbonizing without GHPs. This reduction in demand would avoid as much as 24,500 miles of new grid transmission lines by 2050—enough to cross the continental United States eight times. Most GHP equipment for the U.S. market is manufactured domestically, so increasing GHP deployment can also expand domestic industry and create local jobs to install and maintain the systems."[1]

Specifically, the DOE study concluded that GHP deployment at the national scale could result in $1 trillion in cumulative savings for electricity grid services and $19 billion *per year* in consumer

[1] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. "U.S. Department of Energy Analysis Highlights Geothermal Heat Pumps as a Pathway to a Decarbonized Energy Future." December 6th, 2023. Accessed via: <https://www.energy.gov/eere/articles/us-department-energy-analysis-highlights-geothermal-heat-pumps-pathway-decarbonized>

heating bill savings.[2] Even at the reduced scale of a single state, such as Massachusetts, these savings are potentially tremendous.

That said, the implementation of GSHPs at the household level can be a costly and logistically complicated endeavor. GSHP conversion is a multi-step process that requires borehole drilling and trenching to the home—in addition to multi-stage permitting—all before the actual GSHP installation can even truly begin. Many projects span calendar years and come at a significant cost to the homeowner, in the range of $20,000 - $30,000 or higher for a 2,500-sf home, after MassSave rebates and tax credits. Even with relatively high incentives, homeowners and commercial building owners are the primary financial risk takers for GSHP installations. Most GSHP customers finance their project to pay install costs over time with their energy bill savings.

As such, Dandelion and CSG believe that a policy-based economic incentives program, such as the Clean Heat Standard, will be crucial in driving transformational efficiencies in Massachusetts' building sector. That said, we respectfully appeal for reconsideration on one crucial element of the proposed guidance and wish to highlight three other areas that may merit further consideration. In summary:

> I. In regard to qualifying Clean Heat Credit (CHC) generation, we respectfully request that MassDEP retain its previous language—as per the November 2023 draft framework—allowing for homeowners, in tandem with installers and aggregators, to participate in the CHS program. Should the final language exclude the primary financial risk takers in GSHP installation from program incentives, we believe the program will be rendered into a utility rebate structure that will not effectively achieve its goals. In short, the ineffectiveness would be premised on a misalignment between risk taker and awardee.
>
> II. We request further clarification regarding the interoperability of the CHS with other compliance programs, namely the geothermal APS pathway.
>
> III. Limiting the credit generation period to 5 years will likely not provide the needed financial incentive to spur development at scale. Most residential installations in the Commonwealth today have a payback period of 7+ years for customers transitioning off heating oil and 15+ years for customers transitioning off utility gas heating.
>
> IV. We recommend utilizing/amending a preexistent tracking system framework in order to ensure timely deployment of the program.

These points are examined in greater detail as follows.

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[2] [DOE, Oak Ridge National Laboratory:] Liu, Xiaobing, Ho, Jonathan, Winick, Jeff, Porse, Sean, Lian, Jamie, Wang, Xiaofei, Liu, Weijia, Malhotra, Mini, Li, Yanfei, and Anand, Jyothis. *Grid Cost and Total Emissions Reductions Through Mass Deployment of Geothermal Heat Pumps for Building Heating and Cooling Electrification in the United States*. United States, 2023. pp. xii-xiii, Web. doi:10.2172/2224191. Accessed via: <https://info.ornl.gov/sites/publications/Files/Pub196793.pdf>

I. Regarding Default Ownership of CHCs

Item Q0. in the FAQ Document (Versions 1.3 and 1.4) states that consideration is being given to assigning "default ownership of emission reduction credits from operation of heat pumps to electricity suppliers instead of homeowners."[3] The FAQ document highlights two main issues in defense of this position: 1) default utility crediting would allegedly create an incentive for utilities/electricity sellers to encourage GSHP usage via discounts, and 2) program simplification to ease the risk of administrative overburdening.

We believe that defaulting Clean Heat Credits (CHCs) to utilities would undermine the success of the CHS program. Should CHCs default to utilities, homeowners would likely be left with recourse to a utility-managed rebate system. However, a rebate is unlikely to a) put the full cash value of a GSHP install back in the hand of the homeowner; and b) achieve that payback+ in a timely fashion. In precarious economic times like our own, such a structure will likely result in many homeowners opting to save their cash or pay down debt, rather than take on greater financial risk by investing in new, clean technology.

A clean heat incentives program will be most effective if it rewards the primary financial risk taker in clean heat installation—that is, the property owner paying for the installation. As noted in the November 2023 draft framework, this financial risk can be spread to installers and aggregators while still maintaining a direct incentive for the homeowner via actual CHC revenue or significantly reduced installation costs.

Incentivizing the primary risk takers in GSHP installation is all the more important if the CHS program is to address low-income and moderate-income equity concerns, where the payback time and payback amount are eminently critical. Rebates and ACPs are unlikely to move the needle when it comes to low-to-moderate income GSHP adoption, especially because the uncapped federal tax credit for residential GSHP installations is non-refundable and therefore of limited value for households with a low federal income tax liability.

MassDEP's previous language in Section III.H(1) of the November 2023 draft framework would better reflect the necessary incentives required to ensure a scale of GSHP adoption concomitant with a successful program. Specifically, we believe the following proposed language better established long-term program success:

> "For electrification projects, ownership of credits would reside with the property owner unless and until re-assigned by the property owner to another owner. For example, MassDEP expects that property owners would normally assign full electrification credits to heat pump installers or other intermediaries and that these entities would reflect the value of the credits in prices offered for their services."[4]

[3] MassDEP. *Clean Heat Standard (CHS) Stakeholder Process—Frequently Asked Questions (FAQ) Version 1.3*. March 2024. p. 4.
[4] Mass DEP. *Clean Heat Standard—Draft Framework for Stakeholder Comment Only*. November 2023. p. 6.

This original concept was reiterated in the December 2023 technical session deck, which explained: "Regulated energy suppliers would create/obtain CHCs by 1. Implementing clean heat themselves, or 2. Purchasing credits from third parties, such as heat pump installers."[5]

If subsequent rulemaking eliminates the ability of a third-party homeowner/installer/aggregator to participate in CHCs, then the Clean Heat Standard would, therefore, essentially become a utility rebate program. Such as it is, a CHS that defaults credits to utilities would also then potentially create a partial redundancy with MassSave, in which utilities already claim default ownership of environmental attributes—often likely unknown to the rebate applicants who have not read the fine print nor understand environmental markets.[6]

With all this in mind, however, the straightforward concern of administrative overburdening is well-justified any time a novel compliance framework is being developed. That is, if every homeowner became a CHS account holder, the administrative capacity would likely be overwhelmed in short order. However, this overload issue can be easily evaded. We believe that creating credit volume floors and an "approved vendor" process can incentivize aggregation and limit the potential for any account creation overload that might overwhelm a regulatory agency.

Such an approach would be similar to many existent APS/RPS programs, which delegate account creation to approved installers/aggregators that bundle home system-generated credits, while still passing on the actual credit earnings that are required to incentivize clean energy adoption. Again, the November 2023 draft framework, has already suggested a structure along these lines.[7]

That said, it would make sense that, should a homeowner/installer/aggregator opt-out of CHC generation, a utility could claim those credits as a second-tier option.

Economy-wide benefits would also likely occur in concert with a CHS that welcomes a variety of market participants. An analogue can perhaps be seen in states with open REC markets. In such cases, dynamic market activity has spurred innovation and greater large-scale investment in clean energy projects, as well as enhanced grid reliability and expanded the labor pool. Whereas, if utilities become the sole, or primary, claimant to CHCs, we fear GSHP adoption will stagnate considerably. Stagnation will also likely negatively affect CHC pricing, which in turn creates endemic problems for any market-based compliance mechanism.

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[5] Mass DEP. *Massachusetts Clean Heat Standard—Technical Session: Draft Framework Review*. December 7th, 2023. p. 27.
[6] Mass DEP. *Massachusetts Clean Heat Standard—Technical Session: Draft Framework Review*. December 7th, 2023. p. 31.
[7] Mass DEP. *Clean Heat Standard—Draft Framework for Stakeholder Comment Only*. November 2023. p. 6.

II. Regarding Inclusivity of Other Clean Heat Programs

According to the December 7th, 2023, "Technical Session: Draft Framework Review," the Clean Heat Standard would "be inclusive of clean heat supported by other programs," including the Alternative Portfolio Standard (APS).[8]

We respectfully request further clarification as to the interoperability of various crediting pathways within Massachusetts-based GSHP development.

III. Regarding the Proposed 5-Year Credit Generation Timeline

According to the March 2024 FAQ and deck, MassDEP is deliberating a limit on "credit generation to no more than 5 years after initial registration for any clean heat system."[9]

Considering the relatively low price of carbon at present, and the marginal amount of total potential credits available per system per year, we are concerned that a five-year cap on credit generation may not provide enough of a financial incentive for installers to market and develop GSHPs within the CHS market. While some timeline cap on credit generation makes sense, considering the projected increase in program costs in later years, we argue that five years is too short of a runway to justify major capital deployment statewide. For example, the APS geothermal pathway for AECs usually covers a 10-year value span.[10]

Likewise, as other stakeholders have noted, a quantitative study could help clarify the best approach regarding benchmark increases to the standard versus remaining static after 2030.

IV. Regarding the Proposed Implementation of a Novel Tracking System

As opposed to the suggested language of Section III.J., which notes the creation of a new "Clean Heat and Emissions Tracking System," we argue that, if at all possible, creating a pathway within a larger existing tracking system will lead to much quicker program implementation and, thus, success. Creating a completely new tracking system may lead to program delays and unnecessarily create redundancies with other systems.

Utilizing a preexisting tracking system would also feasibly minimize administrative burden. Efficient system registration and credit generation takes significant time to optimize and operate. Additionally, installers and aggregators are often already integrated with existing tracking systems, therefore further limiting administrative stress vis-a-vis account creation. More so, considering the residential focus of the Clean Heat Standard, it is important to make this process as friendly as possible for household generation registration. In short, we believe the labor required to recreate this process anew would be sizable.

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[8] Mass DEP. *Massachusetts Clean Heat Standard—Technical Session: Draft Framework Review*. December 7th, 2023. p. 17.
[9] MassDEP. *Massachusetts Clean Heat Standard—Virtual Community Meeting: Fall and Winter Comments*. March 7th, 2024. p. 26.
[10] MassDOER. *Small Ground Source Heat Pumps in the Massachusetts Alternative Portfolio Standard*. February 2018.

We appreciate your efforts to institute the Clean Heat Standard. We believe that, with the proper level of participation, this program stands to be a historic achievement that will instigate similar programs around the country. Thank you for your diligence and vision.

Best Regards,

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Diversified Energy Specialists (DES) Comments on the Massachusetts Department of Environmental Protection Clean Heat Standard Draft Framework & FAQ Document

April 5, 2024

The following comments are written by Joe Uglietto, President of DES.

Background

Diversified Energy Specialists (DES) is a renewable energy consulting and environmental markets trading company. DES trades in thermal energy portfolio standards in the northeast and is an aggregation in the Massachusetts Alternative Energy Portfolio Standard, representing clients across renewable thermal technologies. DES has been working with associations throughout the Northeast and Mid-Atlantic on market-based decarbonization policy in the thermal sector, with a specific focus on Portfolio Standards, Clean Heat Standards, Low-Carbon Fuel Standards, and Cap-and-Trade programs.

Summary of Recommended Changes to the CHS by DES

1. Allow all Federal Renewable Fuel Standard eligible biodiesel and Renewable diesel blends to generate credits in the Emission Reduction Standard without limitation and without a cap. This would include all crop-based and waste-based feedstocks that qualify for the Federal Renewable Fuel Standard.
2. Create an Equity Carve Out for the Emission Reduction Standard.
3. Create a credit banking mechanism for the Emission Reduction Standard.
4. Assign credit ownership to the “decision maker” in both the Emission Reduction Standard and Full Electrification Standard. For delivered fuels, including biodiesel and renewable diesel, this would be the retailer that delivers the fuel to the end user. For installed measures, including air-source heat pumps and ground-source heat pumps, this would be the homeowner or building owner. The electric and natural gas utilities contributing to Mass Save should not receive any credits. Additionally, the installers of clean heat measures should not receive any credits.
5. Impose an Emission Reduction Standard obligation to the sellers of electricity in 2031. Do not delay the obligation until 2035.
6. Impose the Full Electrification Standard obligation solely on the sellers of electricity. Remove the obligation from natural gas utilities, propane retailers, and heating oil retailers.
7. Remove the “Just Transition Fee” from the Full Electrification Standard.
8. Allow early action credits to be generated by both delivered fuels and installed clean heat measures. This will allow early action credits to be generated as “one-time” credits in the first compliance period in both the Emission Reduction Standard and the Full Electrification Standard.
9. Weather normalizing credits and credit multipliers should be added across all eligible technologies in the Emission Reduction Standard, not assigned to only heat pump installations.

Comments on the Clean Heat Standard Draft Framework & FAQ Document

The MassDEP Clean Heat Standard Draft Framework document improved the design of the CHS in many ways, while providing necessary details on the DEP's design process. DES commends MassDEP on their hard work. DES believes that several of the proposed market mechanisms in the Draft Framework need to be altered to create a successful standard for the heating sector in Massachusetts.

Draft Framework: "To ensure equitable access to affordable clean heat, the regulations would include an "**equity carve out**" requirement that 25% of the Full Electrification Standard be met by projects that serve customers who are eligible for low-income discount electricity rates." DES agrees that creating an equity carve out for the Full Electrification Standard is the correct design and will help to ensure that equity is a part of the Full Electrification Standard and that low-income residents will receive a higher incentive for their heat pump installations. In the Emission Reduction Standard, MassDEP failed to create an "equity carve out" to protect low-income residents from the additional cost of heating fuels that would result from a Clean Heat Standard. Environmental Justice communities are disproportionately impacted by climate change and the greenhouse gas emissions that result from combusting fossil fuels for heating. It is the responsibility of MassDEP when creating a Clean Heat Standard to ensure that the costs of all heating technologies are not increased for the low-income and EJ population. While an equity carve out in the Full Electrification Standard is a small part of the solution, MassDEP must consider the cost of fully electrifying all homes and buildings within Massachusetts. Even with the additional incentive provided by the equity carve out in the Full Electrification Standard, many homes and buildings in Massachusetts will not be able to afford a whole-home heat pump conversion, especially in low-income and EJ communities. Greenhouse gas emissions must be reduced in low-income and EJ communities, and those emission reductions must occur at the lowest cost to the end user. Creating an equity carve out in the Emission Reduction Standard will ensure that the low-income and EJ communities will have access to renewable fuels that will reduce emissions from heating and will not add any additional cost to their heating bill from the Clean Heat Standard. It is imperative that MassDEP creates an equity carve out in both the Full Electrification Standard and the Emission Reduction Standard to ensure that the Clean Heat Standard is designed with equity in mind and doesn't increase heating costs for the low-income and EJ residents in Massachusetts.

Draft Framework: "**Banking** of full electrification credits for use in future compliance years would be allowed without limit… this would ensure adequate supply of credits in the early years of the program and support development of a durable and liquid market for credits." DES agrees and supports creating a banking mechanism for the full electrification standard. Similar to the California Low Carbon Fuel Standard, banking without limit is the correct choice and would ensure adequate supply of credits as the market reacts to the regulations. In the Emission Reduction Standard, MassDEP failed to create a banking mechanism for credits. The failure to create a credit banking mechanism in the Emission Reduction Standard will ensure the program will not succeed. While credit banking can ensure an adequate supply of credits in the early years of the program, the most important aspect of credit banking is to protect the value of credits when the Standard becomes oversupplied. The purpose of implementing a Clean Heat Standard is to incentivize the Massachusetts thermal markets to reduce emissions in buildings over time. Success of the program will be achieved when building emissions have been reduced to, or above the obligated levels set by MassDEP. If the Emission Reduction Standard sets

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an obligation of 4 MMT of carbon dioxide equivalent emissions by 2030 and the Massachusetts market reduces emissions by more than 4 MMT, the program would be considered successful. There would be more than 4 MM Emission Reduction Credits generated and an obligation of 4 MM Emission Reduction Credits. If no banking mechanism were in place, the value of these credits would fall to nearly $0 and any surplus credits generated above the obligation would not be sold. This would create a situation that the success of the program would ensure the failure of the program and generators of credits would have no incentive to reduce emissions in future years, knowing that the value of the credits they generate would be nearly $0. All market-based decarbonization programs, from all sectors (electricity, transportation, and buildings) have banking mechanisms in place for all credits. All Low Carbon Fuel Standards for the transportation sector allow banking without limit, like the design of the Full Electrification Standard by MassDEP. All RPS programs, across all States, have banking mechanisms in place. Additionally, the MA APS and other thermal programs have banking mechanisms in place. A banking rule which may be considered for the Emission Reduction Standard is how the MA DOER allows banking in the MA APS. Obligated parties can bank up to 30% more than their obligated number of credits each year and will be able to use those banked credits to meet compliance for up to two years after they are banked. The banking rule that MassDEP chooses for the Emission Reduction Standard is less important than the fact that they chose a banking mechanism. Not only is credit banking a "best practice" of all market-based decarbonization programs, it's also a necessity to ensure the market does not fail when the program becomes successful and achieves its stated goal.

Credit ownership is an important design component of all market-based decarbonization programs. The "best practice" for credit ownership is to assign the credits to the decision maker. For example, if I install an air-source heat pump system in my home then I am the decision maker. I, as the homeowner, should receive the credit for making that decision to install a clean heat measure in my home. The air-source heat pump installation company did not make that decision, the electric utility did not make that decision, I did. The incentive from the Clean Heat Standard needs to incentivize the decision maker to chose clean heat options that benefit the environment. If the credit were given to the installer of a clean heat measure, that wouldn't move the needle for the homeowner deciding whether to install the heat pump system. If the electric utility were given the credit, a third-party that has nothing to do with the decision or even the installation of the system wouldn't incentivize the homeowner to make that capital investment. Similarly, if the contributors to Mass Save, the electric and natural gas utilities, were to receive the credit, the home or building owner would have no additional incentive to decide to install a heat pump system at their home or building. For delivered fuels, like biodiesel and renewable diesel, the decision maker is the retailer that delivers the fuel to the end user. The retailer that delivers the renewable fuel to an end user in MA should be the entity that receives the credits. In this case, if the homeowner were to receive the credit, the retailer would have no additional incentive to blend renewable fuels into their heating oil. In the Draft Framework and the FAQ document, MassDEP suggests that credit ownership for full electrification projects could be assigned to Mass Save contributors, the electric utilities, or the installers of clean heat measures. All of these options will not create an incentive for the decision maker and will not facilitate any additional heat pump installations. The only heat pump installations that will occur would have taken place without the clean heat standard. The incentive will be provided to a third-party and the homeowner will not receive any of the benefit. The Clean Heat Standard needs to be designed to incentivize investment into clean heat technologies that wouldn't have occurred if the Clean Heat Standard weren't implemented. In order facilitate capital investment into clean heat measures, delivered clean heat measures must be credited at the retailer level and installed clean heat measures must be credited at the end user level. The decision maker is the only party that should receive benefits within a Clean Heat Standard or any other market-based decarbonization program.

MassDEP has indicated that **early action credits** will be provided to homeowners that install air-source heat pumps or ground-source heat pumps after January 1, 2024. DES supports early action crediting for clean heat measures and believes it will help provide additional incentive for decision makers prior to the implementation of the Clean Heat Standard. The Clean Heat Standard incentivizes biodiesel, renewable diesel, air-source heat pumps, and ground-source heat pumps, but the early action crediting is only available to the heat pumps. Early action credits should be available in both the Emission Reduction Standard and the Full Electrification Standard for all eligible technologies within the Clean Heat Standard. Only allowing early action credits for a specific technology does not create a program that incentivizes emission reduction and instead favors a certain technology. Creating an early action crediting system for all eligible technologies will incentivize all credit generating entities to begin reducing emissions in buildings in Massachusetts now, creating a greater probability of success for the Clean Heat Standard. All technologies must have the opportunity to receive one-time early action credits in both the Full Electrification Standard and the Emission Reduction Standard. For example, if a heat pump were installed on January 1, 2024, that system should receive 1 Full Electrification Credit when the CHS is implemented in 2026 and additionally receive 8 Emission Reduction Credits for the 4 MT carbon dioxide equivalent emissions that it reduced for the two years leading up to the implementation of the CHS. In the case of biodiesel and renewable diesel, all BD and RD eligible sales from January 1, 2024, until the CHS is implemented in 2026 should receive one-time Emission Reduction Credits for those deliveries. It is important that MassDEP can claim all emission reductions that occur because of the implementation of the CHS, which includes all technologies receiving Early Action Credits.

Draft Framework: "A **just transition fee** of 10% of the annual full electrification credit ACP value would be required for the first transfer of each full electrification credit that is not eligible for the equity carve out, with funds assisting low-income consumers during the clean heat transition." FAQ Document: "Refine the applicability of the just transition fee. This change could help to address stakeholder comments regarding the use of geographic identifiers and the treatment of moderate-income households. For example, exempting smaller homes (based on real estate records) or homes located in disadvantaged communities could be a way to better target collection of the fee toward energy consumers who are most able to contribute to assistance to low-income households during the clean heat transition." DES strongly opposes any form of a just transition fee in the Clean Heat Standard. MassDEP wants to implement a just transition fee to generate funds to assist low-income households in the costly transition to clean heat measures. A just transition fee is unnecessary and redundant based on current program design. The equity carve out of the Full Electrification Standard accounts for the additional burden that is placed on low-income residents in the Clean Heat Standard. In fact, the equity carve out of the Full Electrification Standard values Full Electrification Credits as 2x the value as other Full Electrification Credits. The ACP of the Full Electrification Standard equity carve out begins at $12,000, while regular Full Electrification Credits have an ACP of $6,000. The ACP of the equity carve out increases by twice the amount annually as regular Full Electrification Credits and is the ACP price is set at $20,000 in 2030 for the equity carve out versus an ACP of $10,000 for the regular Full Electrification Credits. This accounts for equity in the Full Electrification Standard. Additionally, DES anticipates that many obligated parties will be required to pay the ACP to meet compliance in the Full Electrification

Standard. MassDEP has indicated in the FAQ Document (Q. 32) that the ACP payment revenue from the low-income carve out will be dedicated towards future low-income full electrification credits. In addition, DES supports an equity carve out in the Emission Reduction Standard. If MassDEP creates an equity carve out in the Emission Reduction Standard, ACP revenue from the equity carve out in the Emission Reduction Standard could be used to fund additional low-income clean heat measures. When analyzing the applicability of the just transition fee, the revenue will come out of the pocket of homeowners who made the decision to install clean heat measures (specifically whole-home heat pumps). These homeowners have been properly incentivized by the Clean Heat Standard and have been influenced to make the decision that the Clean Heat Standard aims to accomplish. Charging this homeowner 10% of the value of their incentive for installing whole-home heat pump system is punishing a homeowner for making the decision that the Clean Heat Standard incentivizes them to make. When looking at program design, it makes more sense to use ACP revenue from the equity carve out than to use a just transition fee to generate this revenue. Due to current program design of the Clean Heat Standard, a just transition fee is unnecessary and repetitive. DES strongly recommends eliminating any form of a just transition fee.

While the Draft Framework places a compliance obligation on electricity sellers in the Emission Reduction Standard in 2031, the FAQ Document proposed **delaying the "emission reduction credit holding requirement for electricity sellers from 2031 until 2035**. This change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers." DES believes delaying the emission reduction credit holding requirement on electricity sellers from 2031 until 2035 would be a mistake and have severe implications on the success of the Emission Reduction Standard. The goal of the Emission Reduction Standard is to reduce emissions through the delivery of BD and RD, and through the installation of heat pumps, both hybrid and whole-home systems. A successful CHS will transition the building sector in MA, through both the Emission Reduction Standard and the Full Electrification Standard, to electric heating from natural gas, propane, and heating oil. Over time, this shift in market share of building stock will lower the compliance obligation on natural gas utilities, and heating oil and propane retailers. To ensure a successful program, an obligation must be placed on electricity sellers in Massachusetts as their market share of heating technologies in buildings increases throughout the State. Any delay in the emission reduction credit holding requirement for electricity sellers will ensure that the obligation will decrease while the generation increases and an oversupply in the Emission Reduction Standard credit marketplace will lead to a price crash and the incentive decline for reducing emissions. In the FAQ Document, MassDEP states that this change would address the potential regulatory burden on electricity sellers. DES finds this statement confusing for many reasons. Electricity sellers are currently facing compliance obligations in many different market-based decarbonization programs in Massachusetts (RPS Class I, RPS Class II, APS, CPS, etc.). Electricity sellers in MA are uniquely positioned to handle regulatory burdens and have teams in place dedicated to meeting compliance programs. This statement would be more accurate when describing the regulatory burden placed on heating oil and propane retailers within the Clean Heat Standard. Unlike electricity suppliers, heating oil and propane retailers are typically small, family-owned businesses. Heating oil and propane retailers do not face any regulatory burdens and are not obligated parties in any current market-based decarbonization programs in Massachusetts and do not face a compliance obligation in any current program. These small companies are ill-equipped to handle the reporting and compliance obligation that will be placed upon them in a Clean Heat Standard and may need to hire additional employees just to comply with the CHS. Electricity sellers will simply add the CHS to a list of many compliance programs that they are currently required to participate in and the transition into the CHS will be seamless for them. DES believes that the electricity suppliers in Massachusetts should face a compliance obligation in the Emission Reduction program in proportion with the market share of building stock using electric heating equipment in the first year that the CHS is implemented.

Draft Framework: "The regulation would establish a process for **weather normalizing annual emission reduction credit values for electrification projects**… To provide compliance flexibility in years when colder weather drives significantly higher emissions, a credit multiplier would be used in assessing compliance obligations after particularly cold winters. In other words, the value of annual emission reduction credits resulting from electrification projects would be weather normalized in advance of the relevant compliance deadline to reflect the fact that electrification avoids more emissions during colder winters." DES opposes this viewpoint and believes that all eligible technologies that reduce emissions in the Emission Reduction Standard (biodiesel, renewable diesel, air-source heat pumps, and ground-source heat pumps) should receive a credit multiplier after particularly cold winters. During a particularly cold winter, the value of heating technologies that reduce emissions increases. One technology doesn't increase in value more than another and their value should be measured on greenhouse gas emissions avoided. In especially cold winters, the efficiency of cold-climate air-source heat pumps declines. In fact, the value of cold-climate air-source heat pumps are higher in warmer winters, when we see higher COPs from heat pumps in field studies. During colder winters, when the performance and efficiency of heat pump systems decline, the value of biodiesel and renewable diesel compared to heat pumps increases and more value should be added to these renewable fuels, rather than to heat pump systems. If credit multipliers are added after cold winters in the Emission Reduction Standard, they must be applied across all eligible technologies. In the Emission Reduction Standard, the FAQ Document proposes that each whole-home air-source heat pump and ground-source heat pump should receive 4 Emission Reduction Credits per home. This is based on an average thermal carbon footprint of each home as 5 MT of carbon dioxide equivalent emissions per year. The 1 MT that is remaining will be used to incentivize the use to heat pump water heaters in future years. Adding a credit multiplier to these homes would assume that these homes reduced more than the average household emissions in a year, despite the efficiency of their heat pump system declining in colder winters and the average carbon intensity of electricity increasing significantly in colder winters. The rate at which emissions are increased from households that use heat pumps in colder winters far outpaces all other renewable thermal technologies and they should not be further incentivized and awarded for that increase in emissions and decrease in efficiency. Hybrid homes, which have installed a heat pump system and retained their legacy fossil fuel heating system, receive 2 Emission Reduction Credits per year. In a cold winter, that household will rely on their legacy fossil heating system for a greater percentage of their annual heat load due to the lower efficiency and performance of their heat pumps in colder winter. Adding a multiplier to those hybrid credits in colder winters is rewarding the use of their legacy fossil fuel heating system. While a mechanism needs to be in place for weather normalization, a credit multiplier should only be applied if it is equally applied across all eligible technologies in the Emission Reduction Standard.

MassDEP assigns a compliance obligation in the Full Electrification Standard to natural gas utilities, and heating oil and propane retailers. This obligation begins at the implementation of the Clean Heat Standard and increases each year until 2030, when the obligation starts to shift towards the electricity sellers. **DES believes that the Full Electrification Standard should place a compliance obligation solely**

on the retail sellers of electricity in Massachusetts and should not place any obligation on natural gas utilities, and heating oil or propane retailers. MassDEP believes that heating oil, propane, and natural gas customers should pay for the conversion of homes to heat pumps. This thought process is in opposition of all heat pump incentive programs that currently exist. All RPS programs across the country place a compliance obligation on electricity sellers. The APS program in Massachusetts places a compliance obligation on electricity sellers in MA and incentivizes heat pump conversions. By placing a compliance obligation on heating oil and propane retailers, and natural gas utilities, the MassDEP is requiring that companies convert their customers to competing technology or pay a fine, increasing the cost of their fuel, to convert customers to their competitors. A heating oil, propane, or natural gas company that converts a customer to electricity loses that household as a customer forever. Penalizing a company for not converting their customer base to a competing technology, ensuring the end of their business, is not an effective policy tool to ensure the outcome desired. If you look at other RPS programs, like the Vermont RPS Tier III program, electricity sellers are required to convert a certain number of homes per year to heat pumps. Placing the obligation on electricity sellers makes the most sense, since electricity sellers will directly benefit from the conversion of homes to heat pumps. All programs, like the VT Tier III program and the MA APS program, which incentivize heat pump conversions, place the compliance obligation on the electricity sellers within the State. Natural gas, propane, and heating oil companies will not benefit from converting homes to heat pumps. The electricity sellers in MA should be the only entities that face a compliance obligation in the Full Electrification Standard of the MA CHS. The Emission Reduction Standard requires that all heating technologies reduce the carbon footprint of the building stock in Massachusetts. Under the Emission Reduction Standard, it makes sense to obligate all heating technologies based on number of customers and carbon intensity of the fuel that is sold.

Delivered fuels reporting – 310 CMR 7.71. DES believes that the reporting obligation on heating fuel sellers in Massachusetts should be kept confidential. While this reporting is imperative to MassDEP's ability to implement and manage the CHS, the value of these companies is based on the fuel they sell, where they purchase their fuel, and the end users that they sell the fuel to. To not risk the value of delivered fuels businesses in Massachusetts, it is important that there are mechanisms in place to keep all reporting through 310 CMR 7.71 completely confidential and any attempt to acquire any reporting information should be denied, whether that is through a Freedom of Information Act or otherwise.

MassDEP proposed many changes in Q.0 of the FAQ Document that DES supports. DES supports adjusting the annual rate of increase of the Emission Reduction Standard so that it **reaches 4 MMT by 2030 instead of 5 MMT by 2030**. DES also supports reducing the per-residence crediting rate for heat pumps from **5.0 MT to 4.0 MT for full electrification projects and 2.5 MT to 2.0 MT for other heat pumps** to accommodate the possible inclusion of water heating crediting. **DES strongly supports holding the annual Emission Reduction Standard constant at 4.0 MMT after 2030.** DES agrees with MassDEP that the high compliance obligation in the Full Electrification Standard, combined with the 4 MMT obligation in the Emission Reduction Standard will ensure that Massachusetts meets its 2030 and 2050 goal cited in the CECP while not placing a substantial tax burden of significantly higher fuel costs on consumers in MA. While fuel costs will increase significantly, capping the Emission Reduction Standard obligation at 4 MMT in 2030 and beyond will help to ensure that the low- and middle-income homeowners in MA do not experience an unbearable cost from the CHS. **DES commends MassDEP on separating the CHS into two separate standards**, the Full Electrification Standard and the Emission

Reduction Standard, and believes this design will ensure success of the program while also being able to accurately account for progress in climate goals in the State.

DES believes that MassDEP provided criteria for biodiesel and renewable diesel feedstocks that would be agreeable to most stakeholders in the Draft Framework: "Documented delivery of eligible liquid biofuels would earn annual emission reduction credits toward compliance obligations of heating oil suppliers… Eligible waste-based liquid biofuels would be credited based on the assumed avoidance of all emissions from the combustion of an equivalent quantity of heating oil. Other liquid biofuels eligible for the Federal Renewable Fuel Standard would receive half credit through 2030 only." While DES believes that most Federal RFS eligible biofuels and renewable diesel provide an avoidance of emissions greater than 50% from the combustion of an equivalent quantity of heating oil, allowing credit generation from all RFS qualified fuels was the correct decision. All other transportation and heating programs across the country, coupled with blending mandates in many Northeast States accept all Federal RFS biofuels to qualify. Unfortunately, DES believes that the proposed changes to the Draft Framework in Q.0 of the FAQ by the MassDEP rolls back the important rules set forth in the Draft Framework. Q.0 proposes limiting crediting for biodiesel blends above a B20 from crop-based biofuels and not allowing any crediting for crop-based renewable diesel. No other program in the United States, whether it is for heating, transportation, or a mandated blend level limits or caps the use of biodiesel or renewable diesel based on a specific feedstock. Crop-based biodiesel provides significant emissions reductions versus heating oil (>50%) and does so immediately and at little-to-no cost to the end user. Crop-based biodiesel is domestically produced and commercially available across Massachusetts and the entire Northeast. Crop-based biodiesel meets the eligibility of the fuel mandates currently set in New York, Pennsylvania, Rhode Island, and Connecticut. In the Low-Carbon Fuel Standard in California, biomass-based diesel is the largest producer of credits and eliminates emissions across the transportation sector at scale. This market for crop-based biodiesel is mature and MassDEP's decision to limit or exclude certain blends will not impact that domestic production or supply, with demand across the country. MassDEP fails to cite any science when choosing to restrict blend levels above a B20 and appears to only have political bias when proposing this change. MassDEP cites concerns about investments in equipment adjustments and new transportation and storage pathways for higher blends of biodiesel and renewable diesel from crop-based biodiesel. Private sector investments should not be a concern to MassDEP, and those investments have already been made at scale across the United States. Additionally, any concern about equipment adjustments or storage pathways is unfounded. Renewable diesel handles like heating oil and no equipment adjustments are needed. B100 heating equipment is commercially available and being installed in Massachusetts homes every day. Crop-based biodiesel is commercially available, the necessary infrastructure and equipment is already in place, and can be delivered to all Massachusetts home's, reducing emissions immediately and at scale for a little-to-no cost to the homeowner. While heat pumps are not limited or regulated in the MA CHS, despite the large capital investment necessary to retrofit a home, biodiesel should not be capped or limited, especially when there is no scientific argument for its limitation, when it can reduce emission at scale for the lowest cost to a homeowner. DES urges MassDEP to allow all Federal RFS eligible biodiesel and renewable diesel to generate credits in the Emission Reduction Standard of the CHS and not limit the credits generated by capping it at any blend level.

Parnay, Angela L (DEP)

From: Michael Duclos <mduclos1@icloud.com>
Sent: Saturday, February 10, 2024 11:51 AM
To: Strategies, Climate (DEP)
Cc: Michael Duclos
Subject: Clean Heat Standard - Comments

Comments on CHS Early Registration

Michael Duclos – 2/10/2024

Thank you for all of your efforts on a Clean Heat Standard, this is a complex undertaking, involving the public in the development will certainly result in a much better final standard, and is well worth the additional effort. Thank you also for the initiative on the Early Registration Program, we have a long way to go and 2030 is just down the road, we need to get started as soon as possible.

It appears to me that there is a strong inclination to promote ‘full electrification’ with comparatively little incentive for ‘partial electrification’ and that this may be due to a lack of appreciation for some real world issues with heat pumps, some of which experienced heat pump installers are well aware.

I urge you to discuss this with some experienced heat pump installers, because in my discussions with them, in my work as a residential energy consultant, and experience in my own home, there are issues. HVAC installers are the ones who have to deal with the issues that occur, and I think it would be valuable for you to solicit their thoughts.

One experienced installer (e.g. Joel Boucher, https://boucherenergy.com) I think would be willing to help, I can find others if you wish. I’ll give you my perspective here.

Unlike fossil fuel equipment, for ASHP there must be an outdoor unit exposed to the elements, which, if it fails during severe cold weather, must be serviced outdoors, and this presents technical challenges. Many ‘fully electrified’ homeowners have a single outdoor unit, so if that fails they may have nothing for back up while the heat pump is being repaired, unless they have a fossil fuel system. Repair may include ordering, receiving and installing parts, or even an entire new outdoor unit. Or worse, for an obsolete / no longer manufactured system (note the upcoming mandatory refrigerant change next year!) an entirely new system may have to be installed. In some situations it can be many days before a failed heat pump is again in service.

For ducted ASHP systems, it is possible to include electric resistance heat to deal with very cold temperatures, and this is in fact common practice. The electric resistance heat can be used in event the outdoor unit fails, so this has a substantial advantage in redundancy, and disadvantage in peak load impact.

For the very popular ductless ASHP systems, incorporating electric resistance heat is not an option. Given that design temperature can be significantly higher than the outdoor temperatures experienced during a sustained polar vortex event, absent some sort of backup heat such as an existing fossil fuel system there can be issues with sufficient heat. It seems to me that for reasons of redundancy and for resiliency in what may be unprecedented cold weather, allowing the retention of an operating fossil fuel system to be used only for **both** very low temperature back up and ASHP service outage would be prudent.

The current MassSave practice of using an outdoor switchover temperature for a hybrid FF / HP system should be reconsidered in terms of a 'droop' switchover (inability of the HP to service the entire heating load) to maximize the GHG reduction potential of hybrid FF / HP systems.

A hybrid system with fuel stored on site (oil, propane) can facilitate heating a home during a grid outage (which are becoming more frequent and of longer duration) because stored fuel is much more energy dense, and a tank to contain it is orders of magnitude less expensive than a battery. So a home with a small battery can provide the small amount of electricity necessary to run the fossil fuel heating equipment fueled by very high energy density fossil fuel to deliver the large amount of heat most homes require.

If the home has a PV system to charge a battery, fairly long grid outages can be bridged using fossil fuel stored on site for heating. Given that EVs are present now and will be present in greater numbers in the future, the availability of their very large batteries can make limited 'off grid' operation possible for a much lower cost, since the homeowner already owns the most expensive component – the battery. We should be thinking about these critical issues, and planning for them now.

One should consider the option of installing a modest propane tank on site, and simply switching the natural gas orifice for a propane orifice in an existing natural gas boiler or furnace as an approach to 'prune houses off the gas grid' as directed by DPU 20-80 while retaining the existing fossil fuel equipment for peak load use only.

From what I understand DCR is not concerning itself with peak grid loads. Clearly someone should. I think we should be careful about adopting a 'siloed approach' to a complex system like the electricity grid. Looking down the road, if electrification is as successful as expected, during very cold nights there will be very substantial grid peaks that will mean building and sustaining very expensive peak load generation, since the amount of battery storage needed would be wildly impractical – unless there are other options.

These grid peaks could be mitigated by allowing fossil fuel systems to be used by the grid management to displace heat pump electricity. Grid management could simply send a signal to switch off the heat pump and use the fossil fuel heating until the grid peak passed. Burning oil or natural gas for heat directly is more efficient in terms of cost and GHG generation than using oil or natural gas to generate electricity in peaker plants used when both the outdoor temperature is low, as well as the COP of ASHP. This could be a powerful tool in minimizing construction of 'peaker plants' likely fueled by fossil gas, by effectively realizing 'dispatchable load shedding' and reduce the stress on the local distribution network as well.

In terms of 'bang for the buck,' providing incentives for small, single zone ductless ASHP can provide compelling results. For a very modest cost, I installed a 9 KBtu/hr ductless ASHP that adequately heats my home when it is over 20F outdoors, reducing my oil use by about 80%. I expect to add more ASHP later, but this strategy provides an immediate high CO2 reduction w/r/t installation cost to obtain a years old CO2 reduction we need so badly at this time. This strategy allows people to become familiar with ASHP technology before asking them to invest a large amount of money in ASHP for all their heat, and to trust their comfort to an all ASHP system.

Finally, the Passive House Standard is the only building standard specifically created to address Climate Change via emissions reduction due to buildings. What it does, better than any other building standard, is to dramatically reduce space heating demand. Since the focus of the Clean Heat Standard is emissions reduction from space heating, I believe Certified Passive House buildings should be included in the Clean Heat Standard – the least expensive, least polluting energy is that which is not used. Additionally these buildings have greatly reduced peak grid impact, and can sustain reasonable temperatures during grid failures passively.

In summary:

1. Regulators should realize they may not appreciate the complexity and all the details of the wide scale application of ASHP for 100% electrification, and so should consult with HVAC installers with decades of in-field experience to be sure they are not needlessly creating issues down the road.

2. Hybrid fossil fueled / heat pump systems with fuel stored on site can be compatible with fossil gas grid pruning, and eventually decommissioning, and can provide resilient heating in the event of heat pump failure, can provide very low temperature heating while reducing grid peak load impact, and in conjunction with a small battery, provide heat during grid outages.

3. Certified Passive House buildings should be part of the Clean Heat Standard.

Thank you for the opportunity to provide comment.

Best Regards,

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Draft Clean Heat Standard Comments

Michael Duclos – 03/07/2024

Thank you for the opportunity to provide comment on the current draft proposal for the Mass. Clean Heat Standard, hopefully you will find some of these comments helpful.

I attended the 3 PM CHS meeting on 3/7/2024, and reviewed the FAQ updated for March 2024.

I see the Draft CHS remains entirely focused on the 'supply side' of space heating in spite of the comments I made previously. So I'd like to try again here, a bit differently.

I see the problem the Clean Heat Standard proposes to address is that many decades of low fossil fuel prices have created a building infrastructure that wastes a very large amount of heat, and so a very large amount of so called 'clean heat' must be supplied to balance the demand side of this equation.

Another way to balance this equation is to make buildings (new or existing) require very little heat. Note this does not mean 'weatherization' which seems to be the catch phrase of the day.

The Passive House standard is the only building standard in the world conceived by a physicist to address climate change by nearly eliminating space heating demand as a requirement for certification.

As an example, the owner of the first Certified Passive House I helped design did not use it's heating system at all the first year of occupancy.

As a second example, the owner of the second Certified Passive House I helped design did not use the heating system at all the first three years of occupancy.

It will be some time before the Mass electricity grid can achieve a similar ratio of emissions reduction that a Certified Passive House realizes as soon as it is completed.

Moreover, Passive House Certified buildings are resilient against power outages, grid failures or peak grid loads because they require little, if any, heat.

So it is my opinion that the Clean Heat Standard should address both the supply and demand sides of the equation by acknowledging the remarkable reduction of space heat demand by a realizing **a new, or retrofit**, building Certified as a Passive House with appropriate credits.

Back about a decade ago three of us worked with Ian Finlayson of DOER to get Passive House certification written into the building code as an alternate compliance path. This was done to 'begin the conversation' about the kinds of buildings we should be creating. Now we have progressed to Passive House Certification mandated by the Specialized Stretch Code for multi-family buildings over 12,000 sf.

I'm asking you to help 'continue the conversation' by putting Passive House Certification, in some form. In the Clean Heat Standard.

I think we should strive for an alignment between the messaging of the Clean Heat Standard, the underpinning requirements of the TBD regulation and the MassSave program which is all in on Passive House:

MassSave Passive House Training
https://www.masssave.com/residential/rebates-and-incentives/passive-house-training

MassSave Passive House Incentives
https://www.masssave.com/residential/rebates-and-incentives/passive-house-incentives

It has taken Mass far too long to align with Passive House, it is my opinion we should accelerate adoption of Passive House so we avoid the many potential pitfalls of a 'Zero Net Energy mindset' which does not have the underpinning rigorous building science review and inspection requirements of Passive House.

It appears the feedback loop to verification of the realized effects of CHS to actual emissions reduction could be very long. Would it still be about 18 months between the end of an accounting period and when the amount of GHG reduction is known ? Would it be longer ? Would such a lengthy feedback time critically impair the operation of the Clean Heat Standard, e.g. in the 2028 review timeframe ? Given a long feedback time it might be desirable to do annual 'coarse reviews' so that the trend and magnitude of change is seen sooner.

I did not see an answer in the March FAQ update, on the question of if a house has partial 'clean heat' via an ASHP and completes the process, does that completion count as a 'full electrification' for crediting purposes ?

Thank you for the opportunity to provide comment, please contact me if any questions.

Best Regards, Michael Duclos
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February 21, 2024

Massachusetts Department of Environmental Protection
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Re: Massachusetts Clean Heat Standard Stakeholder Comment Request

Dear Commissioner Heiple,

Thank you for the opportunity to provide these comments regarding MassDEP's draft regulation for a voluntary early registration program for the state's Clean Heat Standard (CHS), presented to stakeholders via a technical session on February 8, 2024.

We strongly support the development of a voluntary early registration program for a couple of related reasons. First, the magnitude of the greenhouse gas (GHG) emission reduction that the state must achieve to meet its near-term (e.g., 2030) decarbonization goals is substantial. Thus, rewarding early efforts to promote electrification should reduce the burden for reducing emissions that will be imposed on obligated parties once the Clean Heat Standard's requirements go into effect in 2026. In addition, from a climate perspective, the earlier emissions reductions are achieved, the better.

We are also generally very supportive of the draft requirements for early registration that MassDEP has proposed. What follows are our responses to the specific questions posed by MassDEP to stakeholders regarding the draft regulations it has proposed, as well as some suggestions for potentially improving the effectiveness of the proposed regulations.

MassDEP Questions for Stakeholders

On slide 32 of its February 8th Technical Session, MassDEP identified three specific questions on which it was seeking feedback from stakeholders:

- "*Are there other eligibility requirements that MassDEP should consider for early registration?*
- *What types of projects should be ineligible for early registration?*
  - *Mass Save?*
  - *Un-weatherized homes?*
  - *Non-equity projects?*
- *How can MassDEP minimize administrative barriers to participation?*"

Are There Other Eligibility Requirements MassDEP Should Adopt?

In our view, MassDEP's proposed eligibility requirements already address all of the key issues that we believe it is important to address for residential electrification measures. We are particularly supportive of the requirements that heat pumps be sized to the heating load of the house; that the heat pumps be both Energy Star certified and meet "cold climate" standards; that credits be available for both existing homes and new construction; that credits be available for any type of residence, whether single family or multi-family; and that heat pump installations be performed by licensed contractors. These requirements will all help drive the much-needed development of a market for heat pumps that is necessary to meet the state's near-term and long-term emission reduction goals. Though we have some suggestions – provided below – related to some of these criteria for residential electrification measures, we do not think any additional criteria would be necessary or helpful.

Our one suggestion for modifying MassDEP's proposed eligibility requirements is to allow for credits for heat pump installations in businesses, particularly small businesses, as well as at residences. It is important to note that MassDEP's proposed Clean Heat Standard has two components: (1) a residential electrification obligation; and (2) a GHG emission reduction obligation. The GHG emission reduction obligation cannot be met by residential electrification alone. Substantial additional emission reductions from commercial will be required. To that end, we think that it is important to start to promote electrification of business customers. In many cases, the heat pumps that would be installed to electrify space heating of small businesses are identical to those that will be installed in residences. Also, many HVAC contractors serve both types of customers. Thus, allowing for early registration credits from business customers will not only support achievement of the state's GHG emission reduction goals, but will help support the development of the residential heat pump market.

We appreciate that there is value to simplicity in the early registration process. However, MassDEP could adopt a relatively simple way of providing early registration credits for electrification of space heating of businesses. For example, the state could provide one home's worth of emission reduction credits for every 3 or 4 tons of heating capacity (or whatever MassDEP determines to be the average needed for full electrification of a single-family home) installed in commercial buildings.

What Types of Projects Should be Ineligible for Early Registration Credits?

We recommend that MassDEP not restrict eligibility in any of the three ways it has proposed for stakeholder feedback.

First, we do not see why electrification accomplished through the Mass Save program should be treated any differently than electrification accomplished in any other way. The emission reductions are the same. Any emission reductions accomplished through Mass Save will contribute just as much to the state's GHG emission reduction goals. Further, there are advantages to leveraging existing programs such as Mass Save to support achievement of Clean Heat Standard requirements. If electrification projects supported by Mass Save are not allowed to earn early action credits, the result will be confusion in the market with customers having to decide which initiative to use and which not to use. We need "all oars rowing together in the same direction" if we are to economically reach our goals.

We also recommend against adopting requirements that homes be weatherized in order to be eligible to earn early action credits. We appreciate that heat pumps perform better and will have greater customer acceptance if installed in weatherized homes. However, we are concerned that it may not be possible to meet Massachusetts' aggressive (and necessary) near-term electrification and emission reduction goals if heat pump installations are limited to such homes. We say this for a couple of reasons. First, it may be likely that relatively few HVAC contractors who sell heat pumps are interested in – or engage in – assessing the efficiency of building envelopes. Second, the most logical time for most customers to consider installation of a heat pump is when their existing furnace or central air conditioner needs to be replaced. In many cases, this will typically not allow for weatherization before a new heating system is installed. Thus, we suggest that MassDEP explore ways to educate customers about the importance of weatherization and to provide incentives for weatherization – either before, at the same time as or after installation of a heat pump – rather than making weatherization a requirement.

We also recommend against limiting early action credits to low-income installation of heat pumps. Massachusetts needs to quickly accelerate adoption of heat pumps by all segments of the market – low-income and non-low-income. Further, if non-low-income installations are not allowed to earn early action credits, we will simply force them to be installed in a more compressed time horizon once the Clean Heat Standard goes into effect. The fact that low-income installations can earn equity credits under MassDEP's proposal should be sufficient incentive to drive early investment in such installations.

How Can MassDEP Minimize Administrative Barriers to Participation

We have several suggestions for enhancements to the MassDEP proposal that, among other things, should help reduce administrative barriers. Those suggestions are provided below.

Other Feedback on MassDEP Proposal

In this section we provide feedback on other aspects of MassDEP's proposal.

Consider Alternatives for Low-Income Eligibility for Equity Credit Requirements

It is critical to include consideration of low-income customers in the voluntary early registration program, and we agree that assigning an equity designation to clean heat credits (CHCs) generated by a system installed in a low-income household is a good approach to addressing equity considerations. MassDEP's has proposed that equity credits be provided when heat pumps are installed in homes of customers who are eligible for a low-income discounted rate from their electric utility. While that may be a reasonable approach conceptually, we are concerned that many low-income customers who are eligible for discounted electric rates do not get those rates. As National Grid recently stated: "we absolutely believe there are thousands of people out there who might be eligible but either aren't aware they are eligible or don't know a discount program exists."[1] Thus, we suggest that MassDEP adopt a range of potential ways in which eligibility for equity credits could be demonstrated, with documentation of discount electric rates being just one of those options. This issue is sometimes addressed through efficiency programs targeted to low-income households. For example, Illinois utilities have a number of options to qualify a customer as income eligible.[2] One of those options is customer participation in Low Income Home Energy Assistance Program (LIHEAP), Percentage of Income Payment Plan (PIPP), and/or other discount utility rate offerings. However, there are a variety of other options as well. For single family homes they include:

1. Participation in a weatherization assistance program with like eligibility.

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[1] https://www.wbur.org/news/2023/11/17/national-grid-electricity-discount-rate-low-income-massachusetts.

[2] *Illinois Energy Efficiency Policy Manual Version 3.0, A Manual Guiding the Operation of Illinois Energy Efficiency Programs*, Effective Date: January 1, 2024, pages 22-24.

2. Participation in other state, federal, or local income eligible programs with like income eligibility (e.g., Supplemental Nutrition Assistance Program (SNAP), Medicaid).
3. Location in a census tract identified by the U.S. Department of Housing and Urban Development (HUD) as a Low-Income Housing Tax Credit (LIHTC) Qualified Census Tract, which must have 50% of households with incomes below 60% of Area Median Income or areas with a poverty rate of 25% or more.

For multi-family housing, criteria include:

1. Participation in a federal, state or local affordable housing programs, including LIHTC, state housing finance agency programs, local tax abatements for low-income properties, etc.
2. Participation in weatherization assistance programs
3. Location in a HUD LIHTC qualified census tract
4. Rent roll documentation that the median rents charged for a property are at or below 80% of "Fair Market Rent" as published annually by HUD.
5. Tenant income information showing that at least 50% of units are rented to households at or below either 200% of federal poverty level or 80% of area median income.

The multi-family criteria are a little different based on the conclusions in Illinois (and many other states' efficiency programs) that the focus should be on the building, not on individual tenants. Because there is a lot of tenant turnover, it doesn't matter so much whether the current occupant of an apartment is low-income as they may be gone in a year or two, especially when making decisions about qualification for measures that last 15-30 years or more. What matters is whether the apartment building is likely to have a large percentage of low-income customers from year to year.

We strongly encourage MassDEP to consider adopting a broad range of options for qualifying homes for equity credits, particularly for multi-family buildings. The criteria used by Illinois utilities' efficiency programs are good examples. To the extent that the Mass Save program has additional or different criteria, those would also be worth considering.

Provide a Publicly Available List of Licensed Contractors

The proposed requirement that the heat pump be installed by a licensed contractor is conceptually a good idea. However, we are concerned with the ability of a customer to know whether a contractor is licensed or not. There is potential for some customer dissatisfaction if they get a heat pump installed by an uncertified contractor only to discover after the fact that they are not eligible for a clean heat credit. One potential solution would be for MassDEP to provide a publicly available, searchable list of qualified contractors for customers to be able to verify whether the contractor is licensed and meets state requirements.

Commit to On-Site Assessments of a Sample of Participants

We support MassDEP's inclusion of inspection and monitoring in the early registration program process. We suggest that it will be important that MassDEP clearly commit to conducting a certain number of on-site inspections (a statistically reasonable sample) to catch any fraud trends during the early registration program. Such a public commitment may help discourage any fraudulent applications.

Assess Compliance with Sizing Requirements

MassDEP has proposed a requirement that heat pumps be sized to meet 90-120% of total heating load, estimated using ACCA Manual J. However, it has not suggested whether or how it plans to enforce this requirement. Sizing with ACCA Manual J is a good practice. In fact, it should be standard practice. However, experience from efficiency programs across the country has demonstrated that many HVAC contractors do not actually understand, let alone routinely use Manual J. Thus, we are not suggesting that MassDEP require submittal of Manual J sizing calculations to qualify for an early action credit. The fact that MassDEP is also requiring that the existing fossil fuel heating system be removed (or the customer attest that it will only use it in emergency situations) addresses the ultimate objective of ensuring full heating decarbonization. However, we would suggest that MassDEP endeavor to educate customers on the value of proper sizing using Manual J (something customers can ask of their HVAC contractor) and that it use its on-site inspections, in part, to assess the extent to which heat pumps were properly sized. To the extent that it discovers any common problems with sizing, it could consider additional requirements for adoption in the future (under the full Clean Heat Standard requirements).

Limiting Customer Attestation of Full Electrification Just to Early Application Credits

The proposed program does not require the removal of the existing fossil fuel system if the customer attests that the fossil fuel system will not be used other than during repair or replacement of the heat pump. We are concerned that if there is no requirement to remove the existing fossil fuel system, some customers will continue to use the system in situations outside of just heat pump repair or replacement. This could jeopardize achievement of the climate goals of the CHS. On the other hand, we appreciate that forcing customers to completely get rid of their fossil fuel heating system may prevent some risk averse customers from installing heat pumps. If MassDEP proceeds with the approach of allowing for fossil fuel systems to remain (with customer attestation that they won't be used), we suggest that this approach only be adopted for the early registration program, while the consumer market is becoming more familiar with heat pumps, and not be locked in as a strategy for the long-term. After the early registration program, we suggest requiring the removal of fossil fuel systems in order to generate a full clean heat credit.

Thank you again for the opportunity to provide these comments. Please feel free to contact me if I can provide any additional information regarding our recommendations.

Respectfully submitted,

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Dir. & Sr. Attorney, Equitable Regulatory Solutions

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EDF.org | A vital Earth. For everyone.

Environmental Defense Fund

Environmental Defense Fund

April 3, 2024

Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
Boston, MA 02114
climate.strategies@mass.gov

Re: Massachusetts Clean Heat Standard Stakeholder Comment Request

Dear Commissioner Heiple,

Thank you for the opportunity to provide these comments regarding MassDEP's draft changes to the state's Clean Heat Standard (CHS), presented to stakeholders via a technical session on March 7, 2024, and found in Q0 of the MassDEP Clean Heat Standard (CHS) Stakeholder Process Frequently Asked Questions (FAQ) document.[1]

We are supportive of efforts to refine the draft framework to effectively construct a CHS in Massachusetts and we appreciate MassDEP's openness to revise the framework based on stakeholder feedback. Specifically, we are supportive of the following:

- Proposed revisions to assign clean heat credits more accurately, though we oppose reducing the annual emissions rate requirement as a result.
- Delaying the emission reduction credit holding requirement for electric utilities, though we question the need to obligate electric utilities in the first place.
- Efforts to refine the just transition fee and alignment with Mass Save, though more details surrounding these changes are required.

What follows are our responses to the specific proposed changes posed by MassDEP to stakeholders, as well as some suggestions for potentially improving the effectiveness of the proposed regulations.

[1] https://www.mass.gov/doc/chs-faq/download

MassDEP Proposed Changes to the CHS Framework

Adjusting credit generation for heat pumps

MassDEP proposes adjusting the credits assigned to heat pumps per fully electrified residence from 5 metric tons (MT) to 4 MT to acknowledge that the CHS does not address all sources of emissions from buildings. We agree with this adjustment as it better reflects the reality that a heat pump installation does not result in fully electrifying a home and therefore does not fully eliminate greenhouse gas (GHG) emissions associated with fossil fuel burning in homes.

While we agree with the concept of reducing heat pump credits in recognition that there are emissions from water heating and other end uses, this reduction may not actually go far enough. There is evidence to suggest that average residential households may use less than 80% of fossil fuels used at the homes for heating, especially in multifamily buildings. For example, data from the U.S. Energy Information Administration (EIA) 2020 Residential Energy Consumption Survey (RECS) suggests that New England homes use 69% of natural gas, 59% of propane and 80% of fuel oil for space heating; most (but not all) of the rest is used for water heating.[2] These data suggest that it may be appropriate to reduce the assumed emission reduction from full electrification of heating to 3.5 MT instead of 4.0 MT (i.e., an average of 70% instead of 80% of total residential thermal emissions). That said, the EIA data we reference are for New England as a whole. If MassDEP has Massachusetts-specific data that justify a different adjustment to heat pump credits, those should be used instead.

MassDEP also proposes to change the annual rate of growth in GHG emissions reduction requirements for the years 2026 through 2030 from 1 million metric tons (MMT) per year to 0.8 MMT, presumably to reflect the lower emission reduction credit values assumed to heat pumps. We do not support this change to the framework. While the change to credits assigned to heat pumps is intended to more accurately account for how much of the goal can be met with heat pumps, this does not mean that the overall goal should change. This change should just reflect that obligated parties have to invest more in other measures.

Hold annual emission reduction standard constant at 4 MMT after 2030 and limit emission reduction credit from heat pumps to no more than 5 years

We are confused by the rationale offered for this proposal and think it would create a couple of major problems.

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[2] U.S. Energy Information Administration, Table CE4.2 Annual household site end-use consumption by fuel in the Northeast—totals, 2020

First, and most importantly, we think the proposal will result in fewer total emission reductions than required by the state to meet its climate goals. The combination of (A) limiting the life of a heat pump credits to five-years; and (B) eliminating growth in required emission credits after five years would result in the same emission reduction as under MassDEP's original proposal *only if all of the emission reductions were expected to come from heat pumps*. But that is not the case. The total emission reduction credits required by the state will have to be met through a mix of measures rather than just with heat pumps. That will include biofuels whose emission reductions have just a one-year life (per unit of fuel consumed). If any such shorter-lived measures are used to meet emission reduction credit requirements under MassDEP's proposed changes to emission reduction credit requirements, the result will be achieving less emission reduction than required by the state.

This is illustrated in the two tables below. The first table is consistent with MassDEP's original proposal, with emission reduction credit requirements growing by 1 MMT every year through 2050 and heat pumps, once installed, earning credits every year through 2050. In this hypothetical scenario, 50% of the required credits are earned through heat pump installations (growing at 125,000 installations per year at 4 tons of credit per heat pump per the MassDEP's most recent proposal) and 50% earned through biofuels. Biofuel sales would start at 6.75 TBtu in 2026 and grow by that amount every year to ensure that half of the growing emission reduction requirement is met. The second table is consistent with what we interpret MassDEP's possible alternative proposal to be – with heat pumps earning credits only for five years after installation but with the total emission reduction credit requirements growing to 4 MMT by 2030 and then remaining constant at that level. As the table shows, if the same number of heat pump installations are assumed to take place each year (i.e., 125,000 per year), biofuel sales would only have to grow for three years (and then stay flat) to achieve the 4 MMT credit requirement for each year after 2030. As the last line of the table shows, the result will be a total of just 14 MMT of emission reduction by 2050 rather than the 25 MMT reduction required to meet state goals. In other words, under this hypothetical, the state would achieve only 56% of its emission reduction target.

MA DEP December 2023 Policy Proposal

GHG credits for Heat Pumps All Last through 2050
GHG credit requirements grow by 1 MMT/year through 2050

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2045	2050
Heat Pumps																	
GHG Credits/Home 4.0																	
Thousands of Installs/Year	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
GHG Credits	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**10.0**	**12.5**
GHG Reductions	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**10.0**	**12.5**
Biofuels																	
GHG Credits/MMBtu 0.074																	
TBtu Sold Each Year	6.8	13.5	20.3	27.0	33.8	40.5	47.3	54.0	60.8	67.5	74.3	81.0	87.8	94.5	101.3	135.0	168.8
GHG Credits	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**10.0**	**12.5**
GHG Reductions	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**10.0**	**12.5**
Total Across Measures																	
GHG Credits	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**7.0**	**8.0**	**9.0**	**10.0**	**11.0**	**12.0**	**13.0**	**14.0**	**15.0**	**20.0**	**25.0**
GHG Reductions	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**7.0**	**8.0**	**9.0**	**10.0**	**11.0**	**12.0**	**13.0**	**14.0**	**15.0**	**20.0**	**25.0**

MA DEP March 2024 Policy Revision Under Consideration

GHG credits for Heat Pumps All Last 5 Years
GHG credit requirements max out at 4 MMT in 2030 and stay flat thereafter

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2045	2050
Heat Pumps																	
GHG Credits/Home 4.0																	
Thousands of Installs/Year	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
GHG Credits	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
GHG Reductions	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**10.0**	**12.5**
Biofuels																	
GHG Credits/MMBtu 0.074																	
TBtu Sold Each Year	6.8	13.5	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3
GHG Credits	**0.5**	**1.0**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
GHG Reductions	**0.5**	**1.0**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Total Across Measures																	
GHG Credits	**1.0**	**2.0**	**3.0**	**3.5**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**
GHG Reductions	**1.0**	**2.0**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**11.5**	**14.0**

A second related concern is that limiting the number of credits that a heat pump can earn to 5 years distorts the value of heat pumps vis-à-vis shorter-lived measures like biofuels. A heat pump installed in 2026 can be expected to provide 25 years' worth of emission reductions whereas a biofuel burned in 2025 will provide only one year of reductions. In other words, putting aside discounting to address the time value of money, a heat pump installed in 2026 is worth 25 times as much as a biofuel burned the same year. Artificially constraining the number of years that a heat pump provides clean heat credits to just five years reduces its relative value by a factor of five (again, putting discounting aside).[3] That is a major distortion of the relative market value of each resource. That distortion could inappropriately skew decisions by obligated parties regarding which emission reduction measures merit investment.

We are also unclear about the purpose of the proposed change. The MassDEP FAQ response suggests that it would "better target incentives in each year to support operation of newer

[3] A five-year constraint still results in a major reduction in the value of heat pumps, relative to biofuels, under any reasonable assumption about discount rates.

installations." We do not understand why that would be the case. If an obligated party causes a heat pump to be installed in a given year, it should acquire the rights to the credits that heat pump will provide in every year through 2050. Even if some market actors acquire a multi-year stream of credits associated with a heat pump installation and sell them to obligated parties only in short-term increments (e.g., one year at a time), that won't change the impetus for new heat pump installations because of the growing number of emission reduction credits required each year under the MassDEP's original policy proposal.

The bottom line is that under a mechanism that allows many different measures with different emission reduction lives to contribute to growing annual emission reduction goals, artificially constraining how many credits a measure can earn over time will create significant problems.

Delay emission reduction credit holding requirement for electric utilities from 2031 to 2035

We support delaying the emission reduction credit holding requirement for electricity sellers from 2031 until 2035. As EDF has noted in previous comments, we are concerned that MassDEP's December proposal – which would make electricity suppliers responsible for more than half of all emission reduction requirements by 2033, 70% by 2035 and 100% by 2040 – would impose significant costs on electric utilities, adversely affecting the customer economics of electrification and therefore undermining electrification goals. Starting the emission reduction credit obligation on electricity supplier five years later may mitigate – though not eliminate – this concern. However, there are more details needed regarding this potential change. If the emissions reduction credit holding requirement is delayed for electricity sellers, would fossil fuel providers pick up the extra reductions required during the 2031–2035-timeframe to meet the overall emissions reductions goal? We would support this reallocation of reduction of credit requirements to fossil fuel providers during this time period as we would see this as necessary to meeting the overall emission reduction goals. We would not want a delay in the requirement for electricity sellers to reduce the overall emission reduction goal.

That said, we continue to question the need to obligate the electric utilities during the early stages of implementing a CHS. The underlying premise for beginning to shift emission reduction obligations from fossil fuel providers to electricity providers appears to be that the combination of growing emission reduction costs and a shrinking customer base would make it challenging to impose all of the obligation on fossil fuel providers. However, we are unaware of analyses suggesting such effects would be untenable, especially before we get to even 60% total emission reduction levels in 2040. MassDEP notes that the proposed 2035-timeframe would allow for two program reviews in 2028 and 2033 to reconsider the advantages and disadvantages of requiring electricity sellers to hold emission reduction credits. While we support the idea of the program reviews, we suggest it would be better to maintain the full emission reduction obligation on fossil fuel providers – at least through 2040 – and allowing these program reviews to identify whether there is a need for an earlier shift of portions of the obligation to the electric utilities. In other words, it would be more appropriate to make no electric obligations until 2040 the default assumption, with program reviews offering opportunities to revisit that default assumption, rather than having the default being that electric obligations start in 2035 with program reviews offering opportunities to push back that starting date. Such a change in the "default assumption" is in line with the polluter pays principle, in which it is the polluter who should be responsible for reducing pollution, unless there is a compelling economic or equity reason to change responsibilities.

Refining applicability of just transition fee

We support refinements to the applicability of the just transition fee, as long as it maximizes the benefits to those who it seeks to serve. While it is not clear exactly what the proposed refinements are, we conceptually support better targeting of the fee to those who are most able to afford it. Developing thoughtful criteria for accurate and innovative ways to exempt households from the fee will be an important part of the just transition fee.

Better align CHS with Mass Save

We would support refinements to the proposed CHS to better align it with the Mass Save program. That includes crediting electrification projects that receive Mass Save incentives, as well as aligning CHS electrification requirements with Mass Save program requirements. Such refinements will support consistent messaging and reduce administrative burdens on customers and trade allies.

Consider assigning default ownership of emission reduction credits from heat pumps to electricity suppliers instead of homeowners

We have concerns about this proposal. First, shifting default ownership of emission reduction credits from heat pumps to electricity suppliers will have the effect of removing direct market incentives to HVAC contractors to promote and sell heat pumps because they would no longer have the ability to sell emission reduction credits assigned to them by their customers.[4] That, in turn, would mean that HVAC contractors would have less of an incentive to reduce the cost of heat pumps they sell. While the electricity suppliers might provide an incentive equal to the value of emission reduction credits, that might not happen for at least the first five years of the program – and possibly the first 10 years – in which the electricity suppliers do not face an emission reduction obligation.

Second, shifting default ownership of emission reduction credits to electricity providers could distort market demand for heat pumps relative to other measures. As we understand the proposal put forward for consideration, even if a gas utility or fuel dealer helps a residential customer to install a heat pump and the electric utility played no role in causing that installation to take place, the electric utility would own the emission reduction credits associated with that heat pump. While the gas utility or fuel dealer could then buy the emission reduction credits from the electricity supplier, that would be an extra cost to them. That could skew their investment decisions to measures for which they get the full emission reduction value associated with those investments.

Finally, we do not understand the articulated purpose of this possible change. MassDEP has suggested that it could simplify program administration because electric utilities have direct access to billing data that could be used to "verify reliance on heat pumps for heating." We are confused

[4] Under MassDEP's original draft proposal credits would be owned by customers installing heat pumps, but those customers could assign the credits to the HVAC contractor who sells them the heat pump. We would expect that to be happen often, with HVAC contractors then selling the credits to gas utilities, electric utilities, fuel dealers or other fossil fuel suppliers.

by that statement. It was our understanding that heat pumps would be assigned a deemed emission reduction value of 5 metric tons per year (or 4 tons, if MassDEP's most recent proposal is adopted instead) and would not have to be verified by annual reviews of billing data. Based on MassDEP's proposal for early registration, those "full electrification" values would be earned as long the customer attests that all combustion heating equipment has been removed from the home or the fossil heating system remains but will only be used when the heat pump was being repaired or serviced. In this context, it is not clear how electric utilities' access to customer billing data would enhance program administration.

Thank you again for the opportunity to provide these comments. Please feel free to contact me if I can provide any additional information regarding our recommendations.

Respectfully submitted,
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Environmental Defense Fund

EVERSOURCE

April 5, 2024

VIA EMAIL

Massachusetts Department of Environmental Protection
ATTN: Commissioner Bonnie Heiple
100 Cambridge St, Suite 900
Boston, MA

Re: Clean Heat Standard Final Informal Comments

Dear Commissioner Heiple:

Eversource Energy ("Eversource") appreciates the Massachusetts Department of Environmental Protection ("MassDEP") focus on the future of clean heat in the Commonwealth of Massachusetts. Eversource continues to appreciate the opportunity to submit comments throughout the stakeholder process. In response to MassDEP's request of commenters to avoid repeating previously submitted feedback in their final comments, Eversource offers these brief additional considerations as MassDEP concludes the informal Clean Heat Standard ("the Standard") stakeholder process.

Eversource agrees with the position expressed by many commenters throughout the stakeholder process that for the Commonwealth to reach its important emission reduction goals, MassDEP should embrace innovation through frequent review and inclusion of available emission reduction opportunities in the Standard, as well as employing a technology agnostic approach. In addition to casting a wide net as it relates to opportunities for carbon reduction and clean heat credit generation, it is imperative that the Standard include an accurate accounting of achieved emission reductions. Emission reduction calculations and associated credits should clearly correlate to the technologies, methods and fuel(s) utilized.

The Standard, as currently contemplated, does not always clearly calculate and attribute emission reductions and resulting credits specific to the technology or low carbon fuels deployed. As an example, a heat pump utilized as part of a networked geothermal system is more than twice as efficient and reduces emissions significantly more than an air source heat pump operating with electricity as its source energy in low ambient air temperatures. Currently, the Standard makes no distinction in emission reductions or credits produced by these vastly different technology applications. Additionally, the Standard does not consider the substantial emission reduction benefits and significant renewable energy production offered through the lifetime of geothermal borefield(s) and the associated network.

Accounting for emission reductions and the production of clean heat credits through the use of alternative low-carbon fuels also remains unclear. In its March stakeholder discussion document regarding crediting of non-residential buildings, MassDEP recognizes that emission reductions can be attributed to electrification, as well as renewably produced hydrogen and renewable natural gas. Eversource appreciates MassDEP continuing to consider multiple complementary approaches to address the challenges of decarbonizing the building sector including emission reductions produced through alternative fuels. The Massachusetts Department of Public Utilities' Order on the future of natural gas in D.P.U. 20-80 also considers low carbon fuels by contemplating the possibility of voluntary "opt-in sales tariff[s]" and "pilot programs" for alternative fuels.[1] The Commonwealth's energy customers require various options to reduce emissions and earn clean heat credits; with the use of renewable low carbon fuels providing one potential pathway.

Eversource appreciates the opportunity to continue to provide input as MassDEP refines the Standard and develops draft regulations. The Company renews its support in aligning the Standard with Mass Save® and believes that such alignment will mitigate market confusion, while capitalizing on lessons learned through robust verification processes and a proven history of highly successful stakeholder engagement. Implementing a clean heat policy that is easily understood by obligated parties, contractors and customers will be also play a critical role in its successful adoption. The Company is compelled to conclude its comment by reaffirming that ensuring affordability and equity as part of a clean heat transition must remain central to every aspect of the Standard. Eversource remains committed to collaborating with stakeholders and MassDEP throughout the continued development and rollout of clean heat initiatives.

Sincerely,

Nikki L. Bruno

Nikki Bruno
Vice President, Clean Technologies

[1] Investigation by the Department of Public Utilities on its own Motion into the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals, D.P.U. 20-80-B, at 71 (December 6, 2023), https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/18297602.

Parnay, Angela L (DEP)

From: Conor Galligan <conor.galligan@gmail.com>
Sent: Sunday, March 17, 2024 9:26 PM
To: Strategies, Climate (DEP)
Subject: Clean Heat Standard

To whom it may concern:

I wanted to write to you in full support of the Clean Heat Standard in MA; I'm very excited to see progress on sustainability at a state level. This standard looks to balance how expensive owning and heating a home in the Boston area is with the stark reality that we need to reduce dependence on fossil fuels immediately to mitigate climate change. We are looking to move off of oil as our backup heat, but are having a hard time affording the transition. The more legislation such as this that is enacted, the better people of all income levels should be able to afford fighting greenhouse gas emissions.

Best,
Conor Galligan
17 Beverly Rd, Natick, MA 01760
9145880760

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www.globalp.com

February 16, 2024

Bonnie Heiple, Commissioner
Massachusetts Department of Environmental Protection (DEP)
100 Cambridge St #900
Boston, MA 02114

Subject: Comments on Voluntary Early Registration Program Discussion Draft

Dear Commissioner Heiple,

Global Partners LP (Global) appreciates the opportunity to present comments on the Massachusetts Clean Heat Standard's (CHS) Draft Program. As one of the Northeast's largest independent suppliers and operators of liquid energy terminals, retail fuel stations, and convenience stores, reliability and quality service are key to everythingwe do. We are proud to support the communities in which we live, work, and contribute. Our efforts to be a good neighbor began more than 75 years ago, when our company began delivering home heating oil – door to door – in the neighborhoods around Greater Boston.

We are proud to serve the energy needs of people and businesses within the Commonwealth through our terminal locations in Sandwich, Chelsea, and Revere and at our retail locations, consisting of over 400 owned and supplied fuel stations throughout the Commonwealth. We are headquartered in Waltham and proudly employ over 1,500 workers in the state. Through our existing energy infrastructure, we are able to deliver vital liquid fuel to meet the energy needs of almost seven million residents in the state. At the same time, we are committed to improving sustainability and reliability across the value chain of our business operations. As such, we believe Global is uniquely positioned to provide commentary concerning Massachusetts energy policy and help the state meet its climate goals.

Global generally supports the principles of the Global Warming Solutions Act of 2008, which requires a 25% reduction in greenhouse gas (GHG) emissions from all sectors of the economy below the 1990 baseline emission level in 2020 and at least an 80% reduction in 2050.[1] As part of this pursuit, Global is also invested in meeting state greenhouse gas emissions reductions in a way that is consistent with the Massachusetts Clean Energy and Climate Plan (CECP) for 2025 and 2030.[2] Through this framework, Massachusetts has an opportunity to make early contributions to decarbonization efforts and minimize costs to residents through smart policy design. Early contributions to decarbonization are also critical because of the concept of the Time Value of Carbon (TVC).[3] Due to the cumulative effects of carbon, emissions reductions today are a better mitigation tool than addressing concerns in the future.

Our comprehensive view is that the design of the Voluntary Early Registration Program must be technology-neutral to best promote emissions reduction in the Commonwealth. The Voluntary Early Registration Program only considers credits generated by full electrification projects and ignores actions from emissions reduction projects. By focusing on the installation of heat pumps and excluding the contributions of biofuels, the program misses out on the substantial contributions of drop-in renewable fuels in terms of cost and emissions reductions. In addition, it brings about the possibility of retail heating oil

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[1] Department of Environmental Protection. An Act Establishing the Global Warming Solutions Act. Massachusetts Legislature, https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298. 193rd General Court of the Commonwealth of Massachusetts, Chapter 298, Acts (2008), approved August 7, 2008.
[2] Executive Office of Energy and Environmental Affairs. Massachusetts Clean Energy and Climate Plan for 2025 and 2030, June 30, 2022, https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download
[3] Marshall, Liz, and Alexia Kelly. The Time Value of Carbon and Carbon Storage: Clarifying the Terms and Policy Implications of the Debate. World Resources Institute, Oct. 2010, https://files.wri.org/d8/s3fspublic/time_value_of_carbon_and_carbon_storage.pdf.

companies delaying selling blended bioheat fuels until the program begins, further hindering the overall goals of the Massachusetts CECP. In conclusion, the Massachusetts Clean Heat Standard was designed with two standards: the emissions reduction standard and the full electrification standard. It does not make sense to overlook the contributions of one of these standards to incent consumer behavior when favoring one pathway will drastically alter the success of the other.

Additionally, although the discussion draft includes a provision for equity credits, the draft language does not adequately consider the cost implications of fully electrifying households. This Voluntary Early Registration Program document requires the displacement of existing combustion heating, causing households to fully outfit their home heating systems to install air and ground-source heat pumps. This is extremely hard for low- and moderate-income (LMI) households to not only afford, but also coordinate. Additionally, MassDEP may request audit documentation or equipment, and records must be retained for five years, further straining LMI households with administrative and cost burdens. Equity must be prioritized and not just acknowledged in program design, and mandating the installation of heat pumps contributes to income inequality between socioeconomic classes.

Thank you again for considering our views and experience. If you have any questions, please do not hesitate to contact me directly at Drew.Carlson@globalp.com.

Sincerely,

Drew Carlson
Vice President of Government and Community Affairs
Global Partners LP

April 5, 2024

Bonnie Heiple, Commissioner
Massachusetts Department of Environmental Protection (DEP)
100 Cambridge St #900
Boston, MA 02114

Subject: Comments on Massachusetts Clean Heat Standard FAQ Document

Dear Commissioner Heiple,

Global Partners LP (Global) appreciates the opportunity to present comments on the Massachusetts Clean Heat Standard (CHS). As one of the Northeast's largest independent suppliers and operators of liquid energy terminals, retail fuel stations, and convenience stores, reliability and quality service are key to everything we do. We are proud to support the communities in which we live, work, and contribute. Our efforts to be a good neighbor began more than 75 years ago, when our company began delivering home heating oil – door to door – in the neighborhoods around Greater Boston.

We are proud to serve the energy needs of people and businesses within the Commonwealth through our terminal locations in Sandwich, Chelsea, and Revere and at our retail locations, consisting of over 400 owned and supplied fuel stations throughout the Commonwealth. We are headquartered in Waltham and proudly employ over 1,500 workers in the state. Through our existing energy infrastructure, we are able to deliver vital liquid fuel to meet the energy needs of almost seven million residents in the state. At the same time, we are committed to improving sustainability and reliability across the value chain of our business operations. As such, we believe Global is uniquely positioned to provide commentary concerning Massachusetts energy policy and help the state meet its climate goals.

Global is generally supportive of the principles outlined in the Global Warming Solutions Act (GWSA) of 2008, which mandates a 25% reduction in greenhouse gas (GHG) emissions across all sectors of the economy by 2020, relative to the 1990 baseline emission level, with a long-term target of achieving at least an 80% reduction by 2050.[1] As part of this pursuit, Global is also invested in meeting state greenhouse gas emissions reductions in a way that is consistent with the Massachusetts Clean Energy and Climate Plan (CECP) for 2025 and 2030.[2] Through this framework, Massachusetts has an opportunity to make early contributions to decarbonization efforts and minimize costs to residents through smart policy design. Early contributions to decarbonization are also critical because of the concept of the Time Value of Carbon (TVC).[3] Due to the cumulative effects of carbon, emissions reductions today are a better mitigation tool than addressing concerns in the future.

We would first like to show our support for certain areas of this draft document. In this regard, MassDEP rightly recognizes the contributions of waste-based fuels such as biodiesel (aligned with the Alternative Energy Portfolio Standard) and now, despite some past opposition, renewable diesel (RD). Additionally, for the first time since the passage of the 2008 Clean Biofuels mandate,

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[1] "An Act Establishing the Global Warming Solutions Act." Department of Environmental Protection, Massachusetts Legislature, Chapter 298, Acts (2008), approved August 7, 2008. https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298.
[2] "Massachusetts Clean Energy and Climate Plan for 2025 and 2030." Executive Office of Energy and Environmental Affairs, June 30, 2022. https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download.
[3] Marshall, Liz, and Alexia Kelly. "The Time Value of Carbon and Carbon Storage." World Resources Institute, January 11, 2010. https://www.wri.org/research/time-value-carbon-and-carbon-storage.

there is an allowance for crop-feedstock biodiesel up to B20, which we are very supportive of as a cost-effective low-carbon fuel. These fuels have been well studied and utilized in programs like the Low Carbon Fuel Standard in California, which directly aligns with the Environmental Protection Agency.

Most of our concern surrounds several potential changes under **Q0. Is MassDEP considering any particular changes to the draft framework for potential inclusion in proposed Clean Heat Standard (CHS) regulations?** One potential change reads…

> Do not allow emission reduction credit for renewable diesel or biodiesel blends above B20 unless they are derived from waste feedstocks. Biofuel blends up to B20 are in widespread use in Massachusetts, but higher blends and renewable diesel are not and could require investments in equipment adjustments, new transportation and storage pathways, etc. Because only wastebased biofuels will be credited after 2030, this change will help direct any capital investments related to biofuels toward options that can contribute to CHS compliance in the long term. This change would also help address stakeholder concerns regarding the lifecycle emissions impacts of biofuels without unduly interfering with existing industry efforts to reduce emissions from heating oil combustion.

There are several dangerous and factually inaccurate statements in this paragraph. The first is the statement that "Biofuel blends up to B20 are in widespread use in Massachusetts, but higher blends and renewable diesel are not." In contrast, higher blends and RD have seen increasing supply growth across the continental United States as public policy has developed to incentivize emissions reductions. Overall, biodiesel production capacity reached 2.1 billion gallons per year in January 2023,[4] while RD supply has grown rapidly since 2019, doubling from 800 million gallons to 2.6 billion gallons as of March 2023.[5] Renewable diesel is also projected to exceed biodiesel supply in the near and long term, increasing to 145,000 b/d in 2050.[6] While America experiences this growth of a domestic low-carbon energy source and other states such as New York take advantage of these benefits,[7] misguided policy design and omission of these fuels will hamper the state's accomplishment of its climate goals. This statement also ignores the development of Low Carbon Fuel Standards across the country and in the Northeast,[8] which will bring a more readily available supply of these fuels to market.

Second, RD meets the ASTM D975 specification for petroleum diesel and can be seamlessly blended, transported, and even co-processed with petroleum diesel, making it an immediate drop-in fuel solution.[9] The concept paper's assertion that its usage "could require investments in equipment adjustments, new transportation and storage pathways…" is an incorrect argument utilized for the purpose of justifying electrification. The attractiveness of RD is that it does not require any modifications to existing infrastructure, which saves costs and enables other investments necessary for the energy transition. Existing infrastructure for petroleum-based diesel production and distribution is well-established and interconnected, spanning refineries, pipelines, storage facilities,

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[4] "In 2023, U.S. Renewable Diesel Production Capacity Surpassed Biodiesel Production Capacity." U.S. Energy Information Administration (EIA), Today in Energy, September 5, 2023. https://www.eia.gov/todayinenergy/detail.php?id=60281#:~:text=Biodiesel%20now%20accounts%20for%20the,January%202022%20to%20January%202023.

[5] Klein, Tammy. *The Benefits of Renewable Bio-Based Diesel Fuels*, October 2023. https://enginetechforum.egnyte.com/dl/QADLBsYufi/ETF_Renewable_Diesel_HVO_White_Paper_by_Transport_Energy_Strategies_October_2023.pdf_.

[6] Smiddy, Andrew, Will Sommer, and Estella Shi. "EIA projects U.S. renewable diesel supply to surpass biodiesel in AEO2022". U.S. Energy Information Administration (EIA), March 24, 2022. https://www.eia.gov/todayinenergy/detail.php?id=51778.

[7] Bates, Michael. "NYC to Transition Heavy-Duty Fleet to Renewable Fuel." NGT News, November 29, 2023. https://ngtnews.com/nyc-to-transition-heavy-duty-fleet-to-renewable-fuel.

[8] Mills, Ryan. "How States Can Use Low-Carbon Fuel Standards to Incentivize Clean Hydrogen-Derived Fuels." RMI, February 12, 2024. https://rmi.org/how-states-can-use-low-carbon-fuel-standards-to-incentivize-clean-hydrogen-derived-fuels/.

[9] "Biodiesel and Renewable Diesel." Department of Energy. https://www.energy.gov/energysaver/biodiesel-and-renewable-diesel.

and fueling stations that can be used immediately to deliver these low-carbon fuel alternatives. This is as compared to the multitude of costs and time required to not only install air- or ground-source heat pumps but also to permit and build out the clean energy generation, transmission, and distribution needed to connect to our already faltering electrical grid.

Finally, there is an oversight with the assertion that "this change will help direct any capital investments related to biofuels toward options that can contribute to CHS compliance in the long term." Some added context also comes from public conversations with MassDEP, who referenced capital expenditure invested into terminals to retrofit them to handle RD as wasted, purely for the fact that this funding is not going directly to electrification.

This proposed change cites **Q25. Why does the draft framework provide "half credit" to biofuels that are eligible for the Federal Renewable Fuel Standard (RFS) but not for the Massachusetts Alternative Portfolio Standard (APS)** in its rational, which is pasted below…

> Fuels eligible for the RFS program include fuels that have been evaluated by the United States Environmental Protection Agency and determined to result in emission reductions of at least 50%. In other words, the fuels have been determined to reduce emissions by at least half relative to similar petroleum-based fuels. Other programs, such as California's Low Carbon Fuel Standard, utilize more detailed analysis, but they reach the same general conclusion that these fuels reduce emissions moderately. The approach of providing "half credit" to all fuels in this category is intended to strike a balance between appropriately crediting biofuels and limiting program complexity. Please note that the draft framework only includes crediting for these fuels through 2030, and that the 2028 program review will provide an opportunity to revisit the topic of biofuel crediting. Heating fuel supplier reporting regulations will allow MassDEP to monitor biofuel use for space heating in Massachusetts over time and provide data that can be considered during the 2028 program review.

The proposed changes arbitrarily restrict crop-based biodiesel blends above B20 and crop-based RD, which are proven fuels utilized in other Low Carbon Fuel Standards across the country to deliver emissions reductions and fulfill energy requirements. Limiting crop-based biofuel up to B20, and at a 50% credit amount, has no scientific basis if program design end goals are to "reduce greenhouse gas emissions from fossil heating fuels."[10] Higher blends of fuel have greater emissions and co-pollutant reductions, improving public health and the environment in all areas they are utilized. Life cycle analysis completed by Argonne National Laboratory finds that B100 use reduces carbon dioxide emissions by 74% compared with petroleum diesel,[11] with similar values reported by the California Air Resources Board.[12] Massachusetts must ensure that the program prioritizes feedstock neutrality and utilizes all available renewable fuels or all blending amounts. This includes allowing all types of waste-based feedstock besides used cooking oil, including animal fats and other organic materials. Utilizing all forms of waste-based feedstocks allows for the efficient use of resources that might otherwise be discarded in landfills or waste streams. Including diverse feedstocks can also stimulate economic growth and create employment opportunities in feedstock collection, processing facilities, transportation, and distribution, particularly in underserved areas where waste materials are oftentimes abundant. This comment also addresses our opposition to the leaning that "only wastebased biofuels will be credited after 2030," which we continue to maintain.

Throughout this Clean Heat Standard process, we've consistently raised concerns about an aspect of the program's design that seems to have been overlooked. Specifically, there's an issue with how electricity emissions are being scored and the lack of recognition for the role biofuels can play in reducing emissions. We believe that for the program to effectively tackle emissions, it needs to consider carbon emissions from all sectors, including electricity generation. Failing to do so will

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[10] "Massachusetts Clean Heat Standard." Mass.gov, https://www.mass.gov/massachusetts-clean-heat-standard.
[11] "Life-Cycle Assessment of Energy and Greenhouse Gas Effects." https://greet.es.anl.gov/files/e5b5zeb7.
[12] https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/peerreview/050515staffreport_ca-greet.pdf

inadequately address emissions releases in the state, as natural gas is the most common electricity generation source in the state, fueling almost one-half of our current production.[13] Why does electrification continue to get preferential treatment despite its tangible emissions profile? The GWSA, which serves as the basis for this rulemaking, emphasizes the importance of counting all the carbon, including those from electricity generation. However, the current approach seems to prioritize electricity over other alternatives, such as biofuels, which can also contribute to emission reductions. This leaning document attempts to score this grid on future projections by assuming carbon neutrality, but scores crop-based biofuels on analysis from over a decade ago. This method seemingly ignores delayed timelines for renewable energy buildout seen across the country and overlooks technological efficiencies in the agricultural sector that generate more emissions reduced. Fairness to deliver GHG reductions is all we ask under the Clean Heat Standard.

Thank you again for considering our views and experience. If you have any questions, please do not hesitate to contact me directly at Drew.Carlson@globalp.com.

Sincerely,

Drew Carlson
Vice President of Government and Community Affairs
Global Partners LP

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[13] "Massachusetts State Energy Profile." U.S. Energy Information Administration https://www.eia.gov/state/print.php?sid=MA

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COORDINATING MASS SAVE WITH THE CLEAN HEAT STANDARD IS ESSENTIAL

Larry Chretien | March 27, 2024

This year, Massachusetts government agencies are working on major aspects of building decarbonization in three different arenas: Mass Save, the “Future of Gas” proceeding, and the Clean Heat Standard. The Commonwealth must coordinate these efforts to find the optimum set of policy solutions. This blog outlines our view on how state agencies should be coordinating these processes.

Start with the Goal

As we often state, Massachusetts law requires that economy-wide greenhouse gas (GHG) emissions be reduced 50% below 1990 levels by 2030 and to net-zero emissions by 2050. F the building sector, the specific requirement is **49% reduction by 2030**. Current policies on the books will not get us there. We need new and bigger interventions.

The Role of Mass Save

For a long time, the Commonwealth's primary workhorse for building decarbonization has been the efficiency program known as **Mass Save**. It's required by law and overseen by the Massachusetts Department of Public Utilities (DPU). Investor-owned gas and electric utilities like National Grid and Eversource (and the Cape Light Compact) submit three-year plans for Mass Save to the **Energy Efficiency Advisory Council (EEAC)** before going to the DPU for final approval.

Mass Save is a major program by any definition. It spends over a billion dollars per year of ratepayer money. Still, its benefits far outweigh its costs because efficiency costs less than buying supply and it reduces emissions that cause global warming and health care costs.

Although Mass Save does contribute to GHG emission reductions, it doesn't go far enough. In 2023, investor-owned gas utilities sold 2.6 *billion* therms of methane and **claimed savings** through efficiency of 23 *million* therms. At that rate, it would take over 100 years to reach net-zero emissions. We don't have a century (and actually, it would take longer if gas utilities were allowed to increase gas sales through new customers or general economic growth). Methane consumption must be eliminated in 26 years to reach net-zero emissions by 2050. So, basically, Mass Save, using *gas* ratepayer money, has been reducing gas usage by just a fourth of what's necessary.

Mass Save also uses *electric* ratepayer money to reduce oil and propane usage (through insulation and conversions to heat pumps). There are 729,000 oil and propane customers in the Commonwealth. Using electric ratepayer funds for this purpose is not sustainable. Electric rates charged by Eversource, National Grid, and Unitil are already too high, and those utilities are asking for rate increases related to grid modernization. If we want consumers to adopt heat pumps and electric vehicles, we must contain the cost of electricity. There's also the issue of fairness. Gas ratepayers pay into Mass Save twice, once for gas and once for electricity. There is no efficiency charge on oil and propane.

According to the **Commonwealth's Clean Energy and Climate Plan**, we need to ramp up to 100,000 heat pumps per year statewide as soon as possible. In 2023, there were a total of

28,000 heat pump installations (in oil, propane, gas, and electric resistance-heated homes). Most of those were the 22,000 oil and propane conversions funded by the surcharge on electricity bills.

On March 1, Rebecca Tepper, Secretary of Energy and Environment, reiterated the point that Mass Save program administrators should significantly increase the number of residential and commercial buildings retrofitted with heat pumps and weatherized each year, with a focus on buildings served by delivered fuels, to set the Commonwealth on a path to installing efficient electric space heating in 500,000 homes and 300-400 million square feet of commercial buildings *this decade (emphasis added).*

Order 20-80: The “Future of Gas”

To hammer the point home ever harder, on December 6, 2023, the Mass. Department of Public Utilities issued an **order, 20-80**, announcing a new regulatory strategy for natural gas in the Commonwealth. This new strategy reflects DPU’s focus on helping the Commonwealth achieve its greenhouse gas (GHG) emissions reduction requirements through decarbonization, electrification, and the adoption of pilot programs for new technologies while minimizing additional investment and costs to protect ratepayers. In the words of DPU Chair James Van Nostrand, “As Massachusetts moves towards net zero emissions by 2050, the DPU must develop a regulatory structure for the gas sector befitting that requirement.”

The Reality Gap

Order 20-80 certainly indicates that the DPU is expecting gas utilities to reduce gas emissions through electrification and efficiency (not renewable natural gas and hydrogen, thankfully). However, a real question is whether the Mass Save program administrators, the Energy Efficiency Advisory Council, and the DPU are ready to quadruple Mass Save’s commitment to decarbonization this year. The program administrators will submit a draft plan to the EEAC in April and a final plan for EEAC approval in October, before going to the DPU for approval for the Three-Year Plan for 2025-2027.

Where the Clean Heat Standard Comes In

While Mass Save and the DPU are doing their things, the Mass. Department of Environmental Protection is developing a regulation called the **Clean Heat Standard** (CHS) as another way to reduce emissions in the building sector. A CHS would require heating energy suppliers to replace fossil heating fuels with clean heat over time by implementing clean heat or purchasing credits. The main purpose of the CHS is to enable customers to electrify through weatherization, air-source heat pumps, ground-source heat pumps or networked geothermal). These same measures are what Mass Save does, but not at the scale we need.

Kudos to the Healey administration and the DEP for bringing this policy forward. A CHS can fill the gap between what Mass Save can do on its own and what the Commonwealth needs to meet its climate law requirements. DEP hopes to finalize the regulation by the end of 2024.

Improving Program Coordination

As a close observer of all three of the arenas mentioned above – Mass Save, DPU with Order 20-80, and DEP's Clean Heat Standard – I would like to see better coordination among the three. Here are some suggestions for the powers that be:

- **The Energy Efficiency Advisory Council and DEP need to come up with a joint management plan.** A heat pump installation, for example, would earn clean heat credits through DEP and also receive a Mass Save rebate. Contractors and customers should be able to go to one window for service and be subject to one system for verification and quality control, not two. No one should have to receive two checks. Let's not emulate the American health care "system".

- The EEAC meets monthly. At each meeting, the Council should have a public dialogue with the DEP on progress towards the CHS. This would inform the EEAC's work on the Three-Year Plan.
- Together, Mass Save and the Clean Heat Standard should result in reducing emissions 50% by 2030 compared to 1990. As stated above, that calls for over 400,000 more heat pumps in homes by 2030 and in 300 to 400 million square feet of commercial space. Stringency is the key word; any CHS must meet the required emissions reductions by 2030 and 2050.
- The entities obligated to earn clean heat credits should be gas utilities (including municipally-owned gas utilities), heating oil suppliers, and propane suppliers. Electricity suppliers should be exempt. **The object of the game is to phase out fossil fuels through electrification. So don't raise the price of electricity. Put the cost of decarbonization onto the fuels that emit carbon.** An appropriately stringent Clean Heat Standard could enable a reduction in the surcharge that Mass Save puts on electricity ratepayers.
- The Clean Heat Standard ought to bestow clean heat credits onto heat pumps (air-source, ground-source, and networked geothermal), as well as heat pump water heaters, induction stoves, and electric clothes dryers. DEP's current framework would allow heat pumps and biodiesel to earn clean heat credits, but not heat pump water heaters, stoves, and dryers. The latter three appliances are all currently eligible for Mass Save incentives, but larger incentives are needed to drive sufficient adoption. By electrifying those items, we can further reduce GHG, save consumers money, improve indoor air quality, and diversify the supply chains.
- Municipal utilities are not required to participate in the Mass Save program, but municipal gas utilities would be obligated to earn clean heat credits in DEP's draft framework. That makes perfect sense.

Justice 40 – Last But Not Least

Mass. DEP's draft framework for the CHS has a requirement that 40% of clean heat credits benefit low- and moderate-income households. In terms of equity, this would be the most redistributive clean energy policy that Massachusetts has ever had, and it would be a big improvement over what Mass Save has been able to accomplish. It should be noted that Mass Save's enabling statute focuses on cost-effectiveness, which limits how far it can go to ensure that benefits and costs are allocated fairly.

Public Comments

We've written this blogpost as an open letter to the state agencies working on these policies. But you can get involved too!

- MassDEP is accepting comments on the CHS in writing and at a virtual community meeting on April 4 at 6 pm. You can register for that meeting here and learn more about the Clean Heat Standard stakeholder process **here**.
- The Energy Efficiency Advisory Council is holding a public listening session on April 17 from 10 am to 12 pm. You can learn more here and register **here**.

TAGS:

ENERGY POLICY & ADVOCACY, MASSACHUSETTS, ENERGY EFFICIENCY, HEATING

Comments

Perry Grossman 4/1/2024, 11:24:25 AM

Yes, we need a coordinated plan. Time is running short.

Reply to*Perry Grossman*

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GREEN ENERGY CONSUMERS ALLIANCE

April 5, 2024

Massachusetts Department of Environmental Protection
100 Cambridge St, Suite 900
Boston, MA 02114
United States

Email: climate.strategies@mass.gov

RE: Irving Oil Terminals Inc. ("Irving Oil") Response – MassDEP Clean Heat Standard Draft Program Framework and Crediting for Non-residential Buildings Discussion Document

Dear Massachusetts Department of Environmental Protection,

Introduction

As a follow up to our submission to the Massachusetts Department of Environmental Protection ("MassDEP") on the Stakeholder Discussion Document: Clean Heat Standard Program Design (May 5th, 2023), we are pleased to provide our comments on the proposed Clean Heat Standard ("CHS") Draft Program Framework and the Crediting for Non-residential Buildings Discussion document as well as other key policy design topics. We appreciate the opportunity to participate in the development of the regulations through the stakeholder consultation process. The proposed CHS is a challenging and highly complex policy with considerable potential for unintended and substantial impacts – primarily related to energy cost and supply security — to New England consumers. As such, we have provided a summary of key policy issues and recommendations below.

About Irving Oil

Irving Oil has been active in the United States ("US") energy market since 1972, providing a suite of energy products including gasoline, diesel, home heating oil, propane, marine and aviation fuels and asphalt. We are proud of our history of serving the Northeastern US, and we are confident in our ability to continue to supply quality products to meet the region's current and future energy needs. Our Saint John, New Brunswick, refinery produces over 300,000 barrels of petroleum products per day, of which over 80% is exported to the United States market. Named one of Canada's Top 100 Employers for eight consecutive years, we employ over 650 employees in New England. We are proud of our team and our longstanding commitment to our customers and our communities.

Irving Oil's largest (by volume) marine terminal within its New England network is located in Revere, Massachusetts (MA). Irving Oil's Revere Terminal receives and distributes gasoline (typically blended with ethanol) and distillate fuels, such as heating oil and diesel. This terminal supports Irving Oil's retail businesses and serves hundreds of additional wholesale customers, who in turn serve the Massachusetts market. It is important to note the state is supplied with fuels from neighboring states and through imports from other countries. The supply chain is not state-specific, rather supplied more broadly by region.

Energy Transition at Irving Oil

We are on a continuous journey of sustainable development, working to reduce our environmental footprint while continuing to provide safe, compliant, and reliable energy to our customers. We have set a 30% greenhouse gas ("GHG") emission reduction goal by 2030, with an aspiration to achieve net-zero by 2050. As part of our energy transition strategy, we are exploring and investing in various decarbonization projects including low carbon electrification, cogeneration, renewable electricity solutions, hydrogen, renewable gas, biofuels, Carbon Capture Utilization and Sequestration ("CCUS"), and investments in electric vehicle charging infrastructure. The targets outlined in our most recent Report on Sustainability[1] have been carefully considered as part of our overall decarbonization efforts.

Timing and Implementation

Due to the complex nature of the proposed CHS, our view is that the timing of the CHS should be staged and paced to mitigate the risk of avoidable impacts to consumers. The current regulatory timeline for the CHS contemplates implementation by 2026. We understand that this date has been extended, however, based on several key policy design elements that are yet to be determined, we feel that this timeline is too compressed and ultimately impractical. Low-carbon fuel policies are amongst the most complex environmental policies in the world as they impact and interact with so many different sectors and regions. The CHS should be staged and paced to

[1] https://www.irvingoil.com/en-CA/irving-values/sustainability-report-esg

allow fuel suppliers in the region to make the investments required to maintain security of supply and offer lower-emission products for retailers obligated by the standard.

Cost to Industry and Consumers

Based on our experience with other similar climate policies, renewable fuel regulations, and low-carbon fuel regulations (Canada Clean Fuel Regulations, Quebec Integration of Low-carbon-Intensity Fuel Content into Gasoline and Diesel Fuel Regulation, Quebec Cap and Trade Regulations, Europe Renewable Energy Directive, etc.), the compliance, reporting and electronic trading platforms, abatement, and overall program costs can be substantial. Therefore, we recommend that detailed economic modelling be conducted to determine the cost benefit analysis of the program and to fully understand the economic impact of this policy on energy security/supply, industry, businesses, and consumers (including cents per gallon impact) as well as any unintended consequences.

The CHS material presented to date has limited information on the financial impacts to both industries and the consumer for the implementation of this standard. One key area of the CHS that requires further analysis is the proposed target of 20,000 residences in 2026, increasing by 20,000 per year to reach 100,000 in 2030 and every later year. If this magnitude of uptake is required to meet targets, we ask that MassDEP take into consideration the supply and availability of heat pumps, qualified contractors, the consumer choice of adopting these technologies and provide analyses to determine if these targets are feasible.

Rather than picking technological winners and losers, the government should allow for consumer choice that provides incentives for low-carbon alternative technologies and avoids significant cost impacts to consumers. The potential cumulative cost impacts of the proposed CHS to households would be significant, whether based on the increased fuel prices or for the upgrades to electrify homes. It should also be considered that not every house will be easily converted from a heating oil furnace/ boiler system to an air source heat pump, with a year-round back up and there may be many customers that are unable to afford the initial capital investment to convert to a heat pump.

Use of Clean Heat Measures (Biofuels)

We recommend that MassDEP consider all biofuel supply and availability in Massachusetts and allow for full biofuels credits (both waste-based and crop-based feedstocks) and not limit credit generation based on certain blend levels (i.e., B20) as biofuel blending will be a vital compliance pathway for heating oil retailers to meet the annual emission reduction targets. According to the Draft Program Framework released in November 2023, MassDEP is proposing that eligible liquid biofuels (waste-based) would be credited based on the equivalent quantity of heating oil emissions avoided from combustion, whereas other liquid crop-based biofuels eligible under the US RFS would receive half credit through 2030. This approach is not based on a scientific carbon intensity ("CI") based calculation and therefore dismisses the full life cycle emission reductions. Further clarification is required for how the credits will be determined for mixtures of waste-based and crop-based feedstocks.

Generating credits by blending biofuels will be a primary means of meeting compliance for obligated heating fuel suppliers. Biofuels provide near-term emission reductions and significant future decarbonization opportunities as technologies advance and new low CI fuel pathways are developed. Eligible biofuels should include biodiesel and renewable diesel of any blend percentage (i.e., higher than B20), and the treatment of feedstocks should be on an equal and level playing field. Renewable diesel is a drop-in fuel that can be readily added to the existing infrastructure already in place and provide actual emission reductions. In addition to renewable diesel being an important compliance pathway, its prioritization under the proposed CHS would lay the foundation for biofuel supply that not only supports the CHS, but allows for expansion into future, broader low-carbon fuel opportunities.

The CHS Frequently Asked Questions ("FAQ") document that states that MassDEP is considering not allowing emission reduction credits for renewable diesel or biodiesel blends above B20 unless they are derived from waste feedstocks. It is also understood that MassDEP intends on only crediting waste-based biofuels after 2030.

Restricting biofuels credit creation may have unintended negative consequences on the decarbonization of other sectors that also utilize renewable fuel blending (e.g., rail, road, marine, aviation). Focusing on only waste-based biofuels will result in more expensive feedstock options and increased costs to the end consumer (waste-based feedstocks, a food industry derivative, are of fixed supply). By restricting biofuel credit eligibility to only waste-based biofuels after 2030, the Commonwealth may fail to benefit from the full emission reductions of all biofuel feedstock pathways which could jeopardize achieving its climate goals.

We understand that MassDEP will consider reviewing the types of eligible biofuels pathways including advanced biofuels in 2028. We recommend expanding eligible biofuel clean heat measures to include crop-based feedstock sooner than 2028, as there are crop-based biofuels that have a lower CI than waste-based biofuels due to investments in CCUS, advanced farming practices, and adherence to sustainable land use and biodiversity criteria.

It is understood that MassDEP does not intend on using a CI lifecycle-based approach for determining credits for clean heat measures. Other similar programs such as the California Low Carbon Fuel Standard utilize life cycle emission modelling and assign each low carbon fuel its own CI score. This provides a technically sound and fair mechanism which drives low carbon fuel suppliers to further reduce the CI of their fuels and would make the CHS technologically neutral (not inadvertently picking winners and losers). The proposed CHS should also include the carbon intensity of the electricity grid when determining total emission reductions made from electrification projects.

It is unclear how the credits for biofuels will be determined if not based on a CI score. It is understood that MassDEP will determine this based on the criteria of “clean” versus “not clean”, and the credits would be based on volume or energy content. It is recommended that clarification on the credit methodology be provided, including the calculation for biofuel credits (based on the equivalent volume or energy content).

Other Low-Carbon Fuels (Renewable Natural Gas and Hydrogen)

It is understood that MassDEP is considering allowing credit creation for renewable natural gas (“RNG”) and hydrogen produced from renewable sources that are not blended into fossil fuels for non-pipe heating customers. We support RNG and hydrogen being included in the CHS as eligible clean heat measures. Further clarification is recommended on the quantification of credits for RNG and hydrogen.

Other low carbon alternatives that should be considered as part of the CHS to generate credits include renewable propane, biogas, as well as other low-carbon fuel alternatives such as solar, wind, and energy efficiency measure as these would result in emission reductions and would be lower cost options.

Point of Credit Creation

It is unclear in the Draft Program Framework which entity creates the credit for supplying eligible biofuels. We believe the entity making the investments to blend biofuels or importing liquid biofuels should be the default credit creator for credits generated from these emission reductions. We recommend that the CHS allow for credit creation to be transferred from one entity to another based on a contractual agreement. This could relieve some of the administrative burden the CHS will have on smaller retail companies.

Clean Heat and Emissions Tracking System (CHETS)

Irving Oil has extensive experience participating in the regulatory development and implementation of Canada's Clean Fuel Regulations as well as other carbon market programs. Creating a carbon market platform for a credit trading system is a complex, multi-year undertaking. Environmental credits are financial instruments that are traded similar to other commodities. MassDEP must ensure that there is governance, oversight, and security to protect the integrity of the system from financial fraud.

An added level of complexity in the Massachusetts CHS is the standard for Emission Reduction Credits and the standard for Full Electrification Credits. Further clarification is required to understand if the CHETS will include both types of credits to be traded interchangeably and at an equal value.

Proposed GHG Reporting Amendments to 310 CMR 7.71

In January 2024, MassDEP proposed revisions to the Greenhouse Gas Reporting regulation (310 CMR 7.71). Our concerns with the proposed amendments include: 1) ensuring the confidentiality of competitively-sensitive information, 2) challenges with customer information and customer fuel use, and 3) the significant administrative burden to collect and report this information by December 2024. Additional details on this are provided in the attached Appendix.

Closing

Irving Oil appreciates MassDEP's commitment to engaging industry for input into the development of a transparent and effective Clean Heat Standard that is based on sound science and economics. Irving Oil will continue to be an active stakeholder in this process as Massachusetts moves forward with the development of the program. We are available to discuss this submission at your convenience and look forward to continued collaboration with the Department.

Sincerely,

Joe Harriman
Director, Environmental and Regulatory Strategy
Irving Oil

IRVING

Appendix – Comments on Proposed GHG Reporting Amendments to 310 CMR 7.71

Ensuring the Protection of Data Confidentiality	Competitively-sensitive business information (e.g., supplier/customer names, sales volumes) required to be reported by the Reporting Amendments should be afforded the protections from public disclosure to the extent permitted by Massachusetts law. Protection from disclosure of such information is necessary to prevent unfair business advantages in a highly competitive marketplace; disclosure of this information would give competitors an unfair business advantage and cause harm to registering entities. We request written confirmation from MassDEP that such information will be kept confidential and not be made public.
Challenges with Customer Information/ Fuel Usage	For reporting on fuels other than heating oil (i.e., propane, kerosene, and diesel), it is very difficult for a fuel supplier to determine what a customer intends on using the product for and how the fuel is tracked to identify when the product is used. This will be especially complex for buildings that use fuels for various applications, such as restaurants or laundromats. In the amendments it states fuels that can be used by customers for heating, cooking, water heating, small appliance, or lighting purposes, would be defaulted to be categorized and obligated as heating fuels. This should be removed from the reporting requirements. Propane and Kerosene are two examples that can be used for any of those purposes. Customers are under no obligation to tell their supplier how they use the product and once title passes from a supplier to a customer, the supplier has no responsibility or authority for following up with them.
Significant Administrative Burden/ High Level of Complexity	The requirements for reporting as laid out in the amendments are a significant administrative burden and some systems are not set up to pull this data in the way it is being requested under this reporting requirement. The fuel should only be tracked once, at the single point of obligation. The proposed reporting amendments are very onerous and will result in the same gallons of fuel being counted more than once. The requirement for fuel storage suppliers being required to submit reports monthly is additional administrative work for non-obligated entities. Not all the data may be available in fuel systems. Storage facilities may not have data on other suppliers' information including Name and Identification Number of any other heating fuel supplier(s) listed on the shipping document.

JAYSAN GAS SERVICE, INC.

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April 5, 2024

Department of Environmental Protection
100 Cambridge Steet
Boston, MA 02114

Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK and FAQ Q.0

COMMENTS OF THE PROPANE GAS ASSOCIATION OF NEW ENGLAND

On behalf of the Propane Gas Association of New England (PGANE), which represents propane marketers, suppliers and equipment manufacturers across Massachusetts, we appreciate the opportunity to provide comment regarding the Massachusetts Department of Environmental Protection's (DEP) draft framework and FAQ Q0. We also would like to provide additional information to DEP about renewable propane and we urge DEP to include credits for International Sustainability Carbon Certificated (ISCC) renewable propane in the proposed rule this fall.

Propane is an alternative clean energy, and we share DEP's desire to reduce greenhouse gas (GHG) emissions and promote a more carbon-friendly energy sector. However, the proposed CHS draft framework would fundamentally alter the marketplace in which our members seek to operate and conduct business. To be clear, sustainable and cost-effective decarbonization is best achieved through a multi-pronged approach that includes clean and efficient energy molecules, such as propane, in addition to bulk electricity generated from cleaner sources than today. DEP's approach should take into consideration the reliability and resilience of various energy options, as well as the aggregate costs passed along to energy consumers and commercial businesses.

Unfortunately, the current draft framework proposal treats all energy customers alike, which they are not. Unlike urban and suburban households, many residential propane customers live in rural and remote areas that are not well-served by the bulk electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. State officials have also failed to acknowledge the diversity of housing stock across the commonwealth. Propane marketers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not the best solution for environmental justice communities, many of whom live in mobile homes. These types of buildings are better served by affordable propane space heating which keeps uninsulated pipes from freezing in the wintertime, unlike heat pumps. This is yet another crucial reason we urge the DEP to treat propane differently than other combustion fuels.

Renewable Propane MA CHS Comments

The Department of Energy recognizes renewable propane as a drop-in replacement fuel for all propane applications. As with biodiesel, renewable propane is produced from natural fats (tallow), used cooking oils and other types of grease. Biodiesel refineries can produce renewable propane from these fats and oils before they are used to produce biodiesel, giving materials once resigned to the landfill a new life.

Renewable propane has an ultra-low carbon intensity, less than most other energy sources. At present, renewable propane is mostly produced and utilized on the West Coast to meet the California Low Carbon Fuel Standard and the Clean Fuel Standards in Washington and Oregon. The California Air Resources Board (CARB) calculates a carbon intensity

(CI) score between 20.5 – 43.5 gCO2eq/MJ, depending on feedstock, compared to CIs of 130 for "average U.S. Electricity" and 91 for gasoline and diesel.

However, every state in New England has had renewable propane delivered to it in 2023, and Springfield, Massachusetts now has the only terminal dedicated to an International Sustainability Carbon Certification (ISCC) certified renewable propane blend. This terminal obtains renewable propane from the Midwest, and it is not tied to transportation RINS, allowing it to be used for home heating and other applications. While renewable propane is a very new energy source, its production is growing, and it will continue to become more available as other renewable fuels grow. If DEP is going to realistically assume that Massachusetts will meet its clean electricity goals as part of the basis for their CHS design, DEP must also assume that renewable propane will be available in future quantities to continue to keep propane cleaner than electricity in Massachusetts. With the expansion of biofuels and sustainable aviation fuels the future growth of renewable propane is no less tenuous than the future growth of wind and solar. Indeed, there are production facilities for renewable propane growing all over the globe as illustrated on the WLGA map.[1]

Renewable propane has the same great features as conventional propane — reliability, portability, power, and reduced carbon emissions — but with even lower carbon emissions when compared with other energy sources. This makes renewable propane an ideal energy source for housing stock that is older and not suited to heat pumps, or for housing such as mobile homes. Renewable propane also provides a cleaner future solution for these locations without the need for costly infrastructure upgrades, because it is chemically identical to propane used today.[2] This means that it is a drop in fuel, working in existing propane boilers, furnaces, and heaters. The difference is that instead of being a by-product of natural gas production like conventional propane, renewable propane is a co-product of renewable diesel and sustainable aviation fuel.

Innovation around renewable propane should be incentivized by the state. Renewable propane can also be made from plant stock and more and more renewable propane is being generated from the seed oil of the camelina plant.[3] Also known as camelina sativa or false flax, camelina is a member of the mustard family and a relative of cabbage, kale, and cauliflower, but is not a food crop nor does it compete with food production. Today, camelina is grown in cooler regions of the U.S. and will expand to the south as producers are experimenting with varieties that can thrive in warmer climates. Camelina is drought and pest tolerant and is a pollinator for bees.

This cover crop is completely waste-free as the seed produces 40% oil, twice the amount of soybean, the remaining meal is FDA approved for cow and chicken feed, and the husks are used for mulch. It is beneficial for farmers because it enriches the soil and prevents erosion when fields are fallow and provides additional income without the need for new equipment.

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[1] *https://www.worldliquidgas.org/key-focus-areas/renewable-liquid-gas/*
[2] *https://online.fliphtml5.com/addge/peyi/#p=1*
[3] *https://propane.com/about-propane/renewable-propane/*

Comments on FAQ Q0:

Heat pump credits: We agree with DEP that 5 MMT is way too high of an emission reduction for residential heat pump credits. We encourage DEP to utilize the lifecycle analysis and GREET model to calculate the actual emissions cradle to grave for electricity. We are concerned that MA DEP is making a mistake by not incentivizing the usage of propane in the Commonwealth. Prioritizing electric heat pumps, over cleaner propane systems will increase emissions in our state. We urge DEP to consider providing credits for geologic propane and treating it in the same manner as DEP already applies to renewable biomass. Propane is a beneficial by-product of natural gas processing and if it is not used it is wasted. As a waste product, it should be incentivized not only so that it will lower GHG emissions, but also so that it will be available as a reliable affordable energy source for energy security during times or emergencies.

The fundamental purpose of the Clean Heat Standard is to reduce emissions, not promote certain technologies for extrinsic reasons (CECP, Appendix B-3, page 61).[4] We wish to stress that we believe propane should be an incentivized clean heat credit energy under the MA CHS. Today, geologic propane in MA has a carbon intensity of 77 which is less than the carbon intensity of electricity and heat pumps in MA which is 100 – 140 depending on how cold the winter is each year. Even if MA electricity will become cleaner, it still makes no sense to disincentivize propane systems as the propane industry will continue to lower its carbon intensity with the addition of renewable propane blends, and we anticipate propane in MA to always have a lower carbon intensity than MA electricity and heat pumps. Thus, if MA DEP Is indeed trying to reduce carbon emissions today with a CHS, propane should be awarded clean heat credits.

Renewable propane should be incentivized in MA by DEP taking the lead to promote renewable propane development in the state. DEP could be leading the way and setting an example of how to reduce emissions while maintaining an equitable solution to energy security. MA must have a backup energy for electricity outages and extreme weather events. Propane fills this role today as the backup fuel for generators across our state, and its use should be increased in the state to make sure we have environmental equity and affordability.

Electricity credit requirements: The delay of the emission reduction credit holding requirement for electricity sellers from 2031 until 2035, concerns our industry as it incentives electricity over propane and because DEP states that this change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers. Our industry is made up of over 70 small businesses across the Commonwealth and we have been quite vocal about the burden these regulations will have on our members. With less than five percent of the thermal sector, it makes more sense for DEP to carve out propane or postpone any regulatory burdens on our industry.

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program should focus less on the type of energy to be delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with commonwealth targets, and less on marching towards the complete electrification of building stock. In short, the framework structure should focus on carbon.

DEP has set different timeframes for electricity and should consider the same approach for propane. Propane only accounts for 4.1 percent blurb. Until such time as the CI as defined under the EPA Greet standard, for electricity is lower than propane and propane blends, it makes absolutely no sense from an environmental or equity perspective to include propane in the CHS. Propane is a beneficial by-product of natural gas, yet more propane is wasted and simply burned off

[4] Final Report: Commission on Clean Heat, November 30, 2022, Governor Baker's Commission on Clean Heat

than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, it makes no sense not to incentivize more use of propane if the Bay State is going to be a responsible steward of their energy beneficial by products.

2022 Massachusetts (in state) Bulk Electric Generation Mix[5]

- Natural Gas – 77.8%
- Petroleum – 3.8%
- Hydroelectric – 4.5%
- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
- Others (e.g., tire-derived fuels, municipal solid waste) – 2.1

Scientific Analysis Requires Lifecycle Analysis

The Department of Environmental Protection needs to take a holistic view of energy consumption and evaluate the carbon footprint of all energy sources – and the appliances that are powered by them – fairly and accurately. This is best accomplished through a full fuel-cycle (FFC) analysis of energy consumption the utilizes source energy metrics. FFC includes the energy consumed onsite, but also incorporates applicable energy used in upstream processes, as well as the energy needed to convert a primary energy source into a secondary one and transport that energy to an end user. The use of FFC and source energy metrics has been endorsed by the National Academies and the Department of Energy's Office of Energy Efficiency and Renewable Energy.[6]

Propane has a source-site ratio of 1.01, compared to 2.80 for grid electricity.[7] This means, for electricity from the grid, it takes 2.80 units of energy to produce and delivery one unit of energy to a home, compared to only 1.01 for propane. For utility-scale electricity, more than 60% of energy is lost during the generation and conversion process, thereby drastically increasing emissions of GHGs and criteria pollutants.[8] The average efficiency of a natural gas plant is only 44 percent.[9] The average efficiency of a petroleum plant is 31%.[10] And an additional 5% of energy is lost during the transmission and distribution of electricity to an end user, further decreasing efficiencies and increasing CO_2 emissions.[11]

Energy Security and Reliability

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[12]

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5 *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

6 *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

7 *Source Energy Technical Reference,* Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

8 *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436

9 *Average Operating Heat Rate for Selected Energy Sources*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html

10 *Id.*

11 *How much electricity is lost in electricity transmission and distribution in the United States?*, U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

12 *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[13]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

Environmental Justice and Equity Considerations

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[14]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[15] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[16] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[17] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup should be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system should be rejected.

If Propane is Not Exempted from CHS, Propane Should Generate Credits

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, should generate clean heat credits. This should include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[18] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[19]

[13] *Space heating and water heating account for nearly two thirds of U.S. home energy use*, U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433

[14] *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf

[15] *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector*, U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html

[16] *Id.*

[17] *Supra 16*

[18] *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

[19] *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[20] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[21] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the delivery of propane should generate CHS credits for both traditional and renewable propane.

Credit generation opportunities should be extended to thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

Thank you for your consideration.

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[20] *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/
[21] *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

April 5, 2024

Department of Environmental Protection
100 Cambridge Steet
Boston, MA 02114

Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK and FAQ Q.0

Comments, Concerns, and technically incomplete information in the draft framework

As a lifelong resident of Massachusetts and a member of the energy community for over 40 years, I would like to submit the following information regarding the Massachusetts Department of Environmental Protection's (DEP) draft framework and FAQ Q0. I have also included additional information to DEP about renewable propane and I urge DEP to include credits for International Sustainability Carbon Certificated (ISCC) renewable propane in the proposed rule this fall.

Propane is an alternative clean energy, and I share DEP's desire to reduce greenhouse gas (GHG) emissions and adopt a more carbon-friendly energy environment. The proposed CHS draft framework fundamentally alters the marketplace in which business operates, and intentionally creates barricades restricting consumer choice. I believe sustainable and cost-effective decarbonization is achieved by taking a holistic approach of consumer behavior and energy choices available now and in the future, such as propane, renewable propane, bio-heat, and electricity generated by cleaner sources. DEP must take into consideration the reliability and resilience of all potential energy options, and the aggregate costs passed along to all consumers and EJ communities after incentives have expired and the EJ communities become burdened with the true cost of their energy.

The current draft proposal treats all customers alike, which they are not. Unlike urban and suburban households, many residential customers live in rural and remote areas that are not well-served by the current electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. DEP and DOER have failed to acknowledge the diversity of housing across the commonwealth. Delivered fuel dealers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not the best solution for environmental justice communities, many of whom live in mobile homes. These types of buildings and families are better served by using affordable propane space heating and Biofuels that create warmer heat and prevent uninsulated pipes from freezing in the wintertime, unlike heat pumps. DEP must treat propane, Biofuel, and emerging energy technology differently than other combustible fuels.

Renewable Propane MA CHS Comments

The Department of Energy recognizes renewable propane as a drop-in replacement fuel for all propane applications. As with SAF and biodiesel, renewable propane is produced from natural fats (tallow), used cooking oils and other types of

grease. Biodiesel refineries can produce renewable propane from these fats and oils before they are used to produce biodiesel, giving materials once resigned to the landfill a new life.

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Every state in New England has had renewable propane delivered to it in 2023, and West Springfield, Massachusetts now has a dedicated terminal to an International Sustainability Carbon Certification (ISCC) certified renewable propane blend. This terminal obtains renewable propane from the Midwest, and it is not tied to transportation RINS, allowing it to be used for home heating and other applications. While renewable propane is a very new energy source, its production is growing, and it will continue to become more available as other renewable fuels grow. If DEP is going to realistically assume that Massachusetts will meet its clean electricity goals as part of the basis for their CHS design, DEP must also provide equal consideration that renewable propane propane blends, and Biofuels will be available in quantities that keep pace with or exceed Massachusetts's ability to regulate the utilities to produce cleaner electricity in Massachusetts. The expansion of biofuels and sustainable aviation fuels future the growth of renewable propane and it's no less tenuous than the future growth of wind and solar. In fact, there are production facilities for renewable propane growing all over the globe as illustrated on the WLGA map.[1]

Renewable propane and propane blends have the same great features as conventional propane — reliability, portability, power, and reduced carbon emissions — but with even lower carbon emissions when compared with other energy sources. This makes renewable propane and propane blends an ideal energy source for housing stock that is older and not suited to heat pumps, or for housing such as mobile homes. Renewable propane and propane blends also provide a cleaner future solution for locations without the need for costly infrastructure upgrades, because it is chemically identical to propane used today.[2] This means that it is a drop in fuel, working in existing propane boilers, furnaces, and heaters. The difference is that instead of being a by-product of natural gas production like conventional propane, renewable propane is a co-product of renewable diesel, sustainable aviation fuel, and other emerging technologies such as recycled plastics developed locally at MIT.

Innovation around renewable propane must be incentivized by the state. Renewable propane can also be made from plant stock and more and more renewable propane is being generated from the seed oil of the camelina plant.[3] Also known as camelina sativa or false flax, camelina is a member of the mustard family and a relative of cabbage, kale, and cauliflower, but is not a food crop nor does it compete with food production. Today, camelina is grown in cooler regions of the U.S. and will expand to the south as producers are experimenting with varieties that can thrive in warmer climates. Camelina is drought and pest tolerant and is a pollinator for bees.

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[1] https://www.worldliquidgas.org/key-focus-areas/renewable-liquid-gas/
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[3] https://propane.com/about-propane/renewable-propane/

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Comments on FAQ Q0:

Heat pump credits: 5 MMT is way too high of an emission reduction for residential heat pump credits. I encourage DEP to utilize the lifecycle analysis and GREET model to calculate the actual emissions cradle to grave for electricity. I am concerned that MA DEP is making a mistake by not incentivizing the usage of propane in the Commonwealth. Prioritizing electric heat pumps, over cleaner propane systems will increase emissions in our state. I urge DEP to consider providing credits for geologic propane and treating it in a similar manner as they do for renewable biomass. Propane is a beneficial by-product of natural gas processing and if it is not used it is wasted. As a waste product, it must be incentivized not only so that it will lower GHG emissions, but also so that it will be available as a reliable affordable energy source for energy security during times or emergencies.

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Renewable propane must be incentivized in MA by DEP taking the lead to promote renewable propane development in the state. DEP could be leading the way and setting an example of how to reduce emissions while maintaining an equitable solution to energy security. MA must have backup energy for electricity outages and extreme weather events. Propane fills this role today as the backup fuel for generators across our state, and its use should be increased in the state to make sure we have environmental equity and affordability.

Electricity credit requirements: The delay of the emission reduction credit holding requirement for electricity sellers from 2031 until 2035, concerns me because it incentives electricity over all other energy sources and because DEP states that this change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers. This is disingenuous and shifts the burden on to small businesses and residential homeowners across the Commonwealth. I have been quite vocal about the burden these regulations will have on citizens of the commonwealth. Propane currently serves less than five percent of the thermal sector, it makes more sense for DEP to carve out propane or postpone any regulatory burdens on propane consumers. There is currently no net gain in carbon reduction by leaving propane out of the regulation, and by providing credits there is a potential reduction in carbon emissions within the commonwealth.

[4] Final Report: Commission on Clean Heat, November 30, 2022, Governor Baker's Commission on Clean Heat

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program must focus less on the type of energy to be delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with the commonwealth's targets, and less on marching towards the complete electrification of building stock. In short, the framework structure must focus on carbon reduction, not electrification.

DEP has set different timeframes for electricity and must consider the same approach for propane. Propane only accounts for 4.1 percent of the commonwealth's energy consumption. Until such time as the CI as defined under the EPA Greet standard, for electricity is lower than propane and propane blends, it makes absolutely no sense from an environmental or equity perspective to include propane in the CHS. Propane is a beneficial by-product of natural gas, yet more propane is wasted and simply burned off than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, not to mention natural gas is still part of the energy production of electricity in 2050, it makes no sense not to incentivize the use of more propane, if the Bay State is going to be a responsible steward of the climate and their energy requirements.

2022 Massachusetts (in state) Bulk Electric Generation Mix[5]

- Natural Gas – 77.8%
- Petroleum – 3.8%
- Hydroelectric – 4.5%
- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
- Others (e.g., tire-derived fuels, municipal solid waste) – 2.1

Scientific Analysis Requires Lifecycle Analysis

The Department of Environmental Protection needs to take a holistic view of energy consumption and evaluate the carbon footprint of all energy sources – and the appliances that are powered by them – fairly and accurately. This is best accomplished through a full fuel-cycle (FFC) analysis of energy consumption that utilizes source energy metrics. FFC includes the energy consumed onsite, but also incorporates applicable energy used in upstream processes, as well as the energy needed to convert a primary energy source into a secondary one and transport that energy to an end user. The use of FFC and source energy metrics has been endorsed by the National Academies and the Department of Energy's Office of Energy Efficiency and Renewable Energy.[6]

Propane has a source-site ratio of 1.01, compared to 2.80 for grid electricity.[7] This means, for electricity from the grid, it takes 2.80 units of energy to produce and delivery one unit of energy to a home, compared to only 1.01 for propane. For utility-scale electricity, more than 60% of energy is lost during the generation and conversion process, thereby drastically

[5] *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

[6] *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

[7] *Source Energy Technical Reference,* Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

increasing emissions of GHGs and criteria pollutants.[8] The average efficiency of a natural gas plant is only 44 percent.[9] The average efficiency of a petroleum plant is 31%.[10] And an additional 5% of energy is lost during the transmission and distribution of electricity to an end user, further decreasing efficiencies and increasing CO_2 emissions.[11]

<u>Energy Security and Reliability</u>

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[12]

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[13]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

<u>Environmental Justice and Equity Considerations</u>

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[14]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[15] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[16] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[17] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup must be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system must be rejected. This requirement attempted in other states has shown to be unsafe, caused damage to homes, and ultimately rescinded primarily due to safety concerns as unqualified individuals and business have modified systems to eliminate fossil back ups.

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[8] *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436
[9] *Average Operating Heat Rate for Selected Energy Sources*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html
[10] *Id.*
[11] *How much electricity is lost in electricity transmission and distribution in the United States?*, U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3
[12] *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316
[13] *Space heating and water heating account for nearly two thirds of U.S. home energy use*, U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433
[14] *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf
[15] *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector*, U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html
[16] *Id.*
[17] *Supra 16*

If Propane is Not Exempted from CHS, Propane Must Generate Credits

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, must generate clean heat credits. This must include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[18] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[19]

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[20] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[21] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the use of propane must generate CHS credits for both traditional and renewable propane.

Credit generation opportunities must include thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

Thank you for your consideration,

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[18] *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

[19] *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

[20] *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/

[21] *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

A. **Special characteristics of implementing heat pumps for decarbonization:**

1. Resource limitations: decarbonization replacing oil and gas heating systems with heat pumps is a major undertaking. During the recent European crisis estimates were that a tenfold increase in engineering staff was required to meet decarbonization goals. The changes from gas heat to electric power are potentially complex: e.g. changing a hydronic system from 180F oil to use of heat pumps that lose a lot of efficiency and capacity at such temperatures may require a complete redesign. While large building owners often have the engineering support and data from building management systems, needed to support such a transition, many owners and operators of smaller buildings do not. And their consultants are not prepared for such transitions.
2. Many buildings have dual systems to cover requirements for heating cooling and ventilation. Trying to replace these dual systems with a single heating/cooling solution like a ground source heat pump can be very complex and require one-off solutions with limited options for more cost-effective standard systems.
3. Decarbonization is encouraged by utilities and government/state incentives as part of a systematic approach to reducing carbon usage AND electricity consumption. Significant incentives exist, but tend to also require and reward an integrated approach involving insulation of the envelop, changes in loads/lighting, new controls, energy recovery etc. =
4. Tighter buildings as a result of (2) requires optimization of ventilation loads for health, building quality and energy efficiency for health and building safety.
5. Many buildings and homes are maintained and supported with minimal resources. Systems tend to be replaced when they break down leaving no time for review of options or managing details Key question is what measures can be taken to successfully transition either in preparation of a replacement or during a breakdown.
6. In general current solutions tend to replace a mix of air con systems and carbon based heating systems with a mix of ventilation and sensible systems.
    - Central system sized for (equivalent) outside air requirements, humidity control, demand control and energy recovery
    - zone based systems using sensible only heat pumps to provide additional cooling and/or heating.

Starting with installing sensible only heating capacity can significantly reduce requirements for the central system, especially if combined with changes in the envelop, the use of exhaust air and in controls that significantly reduce loads. Developing a plan for that requires an iterative approach.

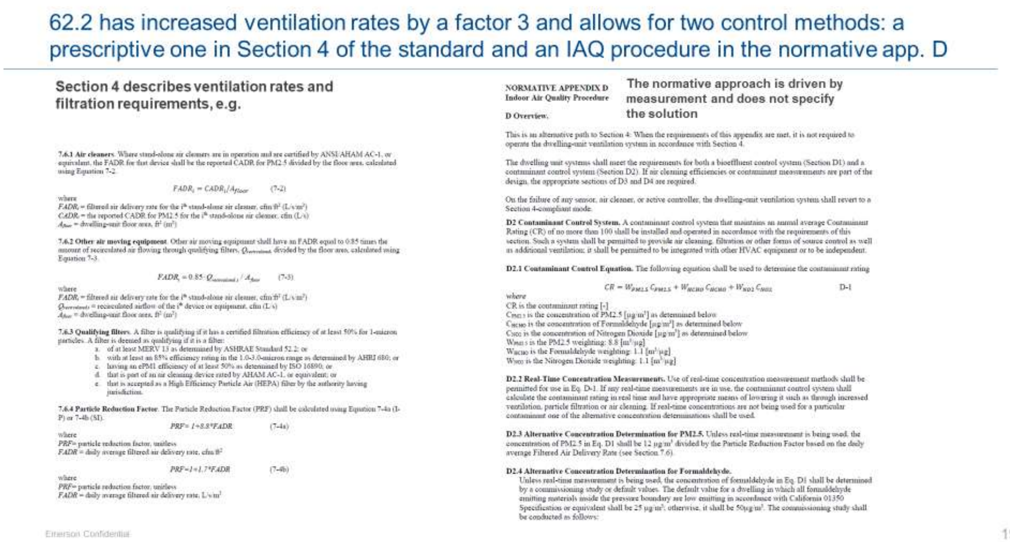
Things to do:

1. For smaller buildings and homes focus binary solutions Use off the shelf solutions where possible to reduce engineering and other costs esp. in smaller buildings and homes. A mix of a smart central DOAS heat pump with decentral sensible heat pumps and/or cooling units tends to be very efficient and cost effective. The central air system can focus on (equivalent) outside air requirements, proper filtration, humidity management, occupancy control etc. Such a smart central system can manage its own exhaust if the ducting system is used to deliver it to the unit. Hydronic systems can be optimized for heat pump temperatures with additional VRF/split units handling the additional heating and cooling requirements. Separating air quality/ventilation/humidity control from sensible control also allows for some staging of loads e.g., by delivering central air at conditions that still require some sensible heating or cooling. This optimizes central system capacity and overall system

efficiency. Existing heating systems can be used temporarily for peak demand while their replacement is being planned. In high humidity zones (4a and higher) doas systems can meet new active ventilation requirements, equivalent ventilation/filtration needs and humidity control requirements for.

2. Optimize use of existing ducts to maximize availability of exhaust air to make ventilation more efficient.
   Add where possible demand control to only ventilate when necessary. Ensure effective dehumidification during unoccupied periods which means that DOAS systems will need to have the ability to recirculate “exhaust air” when ventilation air is not needed. Use natural ventilation either by using an economizer or by using windows.
3. Manage humidity: decarbonization strategies tend to significantly reduce sensible loads causing the share of latent loads to increase, as they result from ventilation, occupants. Plants and wet spaces can also drive humidity generation esp in greenhouses and pools. Humidity control is a primary issue during cooling, but can also be a significant problems during heating season in unheated basements and technical spaces.
   Humidity control not only increasingly drives energy consumption of cooling systems and needs for ventilation. More importantly it can significantly impact absenteeism, occupant performance and building health /sick building syndrome and should be addressed during decarbonization with appropriate ventilation solution, including the use of DOAS systems (see doas design guide).

4. Manage demand as well as energy recovery.



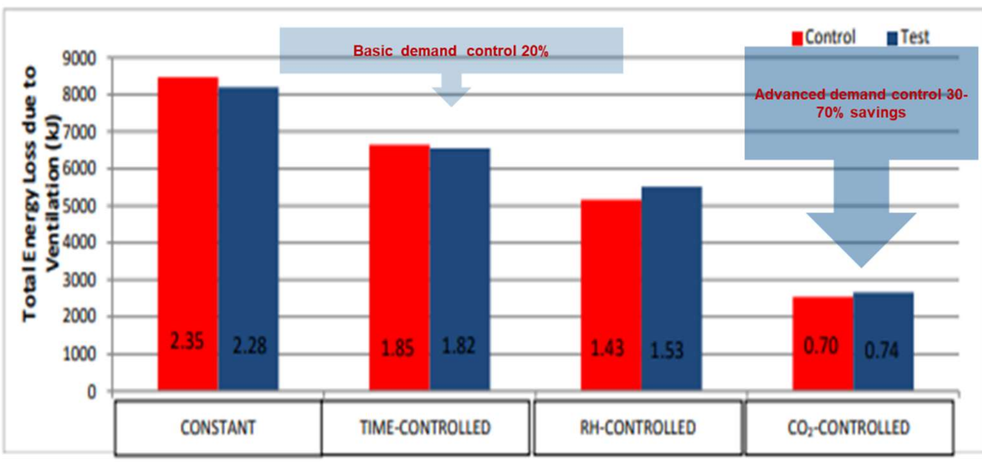
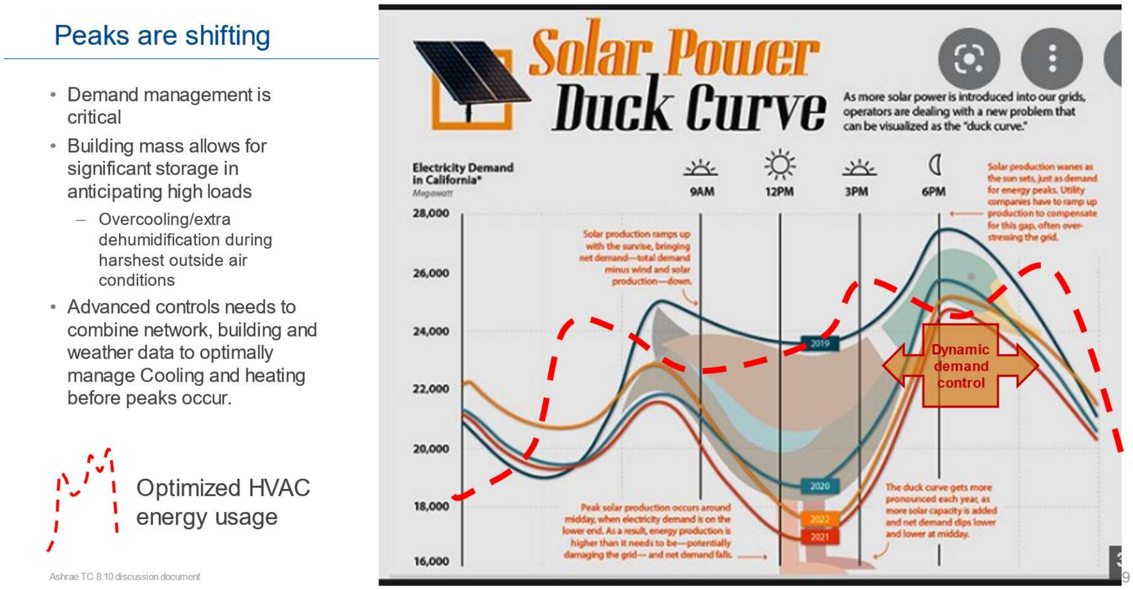


Figure 13. Total energy loss (heating and cooling) due to ventilation for a duration of 28 hours under test cases. Values each bar are energy loss in kilowatt-hours.

5. Use legacy systems for peak heating requirements
6. Buy systems with smart sensors and communication capabilities.
7. Incorporate annualized and peak power usage optimization, with options for shifting peaks as well as use of solar power to reduce daytime demand. .



What not to do;

1. Do not oversize heat pump systems. Use variable or staged compressors. A recent NYSERDA/Oil heating research institute study showed a 40% reduction in annualized efficiency in heat pumps due to rapid defrost cycling with cycles occurring up to 3 times per hour (2.5.3 +} Many contractors will oversize airflow and compressor capacity "to be on the safe side" under sizing with peak demand covered by decentral solutions or even resistance heat can be more energy efficiency when considering annualized kWh use.
2. Avoid unbalanced ventilation: relying on infiltration for air replacement is inefficient and potentially risky. Relying on infiltration and exhaust only systems for ventilation. Infiltration is potentially risky for the building high humidity in certain areas and brings in more outside conditions, including pollen, pollution 2.5micron and below
   Ventilation air should be centrally treated and exhaust air should be used to minimize losses. Existing ducting systems can be repurposed if recirc air is done with split/local zone systems. Reduced ducted air flows also allow buildings to match requirements for 240 equivalent outside air by highly filtrating sufficient air to meet target requirements. Especially important in schools, retirement homes, hospitals.
3. Replace existing ducting systems to accommodate the higher heating loads in zone 5 and higher.
4. Work from a single set of assumptions esp. on fuel/power pricing. Recent developments show how power and fuel prices can rapidly and unexpectedly change in a major way. Negative electricity prices during sunny days, NG prices that gas prices that increased more than tenfold from 5-20Euro/KWH to more than 150Euro/KWH are some recent examples *. Future options compared to current cost and typical contract durations (from spot to multiyear) will influence choices significantly. HP transition can be quite robust under a variety of pricing scenario's.

Emerging cost effective solutions:

a. Smart HVAC management systems: cheaper and simpler sensors, smart thermostats and smart ventilation units that enable advanced occupancy control using combinations of traditional CO_2 monitoring with WIFI data, entry and security data and improved air quality measurement air particles and VOC can support improved ventilation rates linked to actual requirements. Remote monitoring and optimization of actual usage of systems allows for control optimization, allowing utilities to load shift, using available solar power, using storage etc.
b. Innovative approaches to building management including BACnet, OEM systems as well as new players like Amazon, Apple and Alphabet.
c. Reusing central ducting systems for exhaust air and ERV as well as to support occupancy-based control of ventilation, air quality and humidity control.
d. Humidity management using absorption-based solution rather than condensation.

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CLEAN HEAT COMMENTS – SUMMARY

The Massachusetts Clean Heat program seeks to accelerate the adoption of alternatives to oil and gas heating and to make sure that these new solutions are also used. As a result, the program emphasizes full replacement of existing heating systems. To simplify administration, incentives are not linked to the actual performance of the system but instead linked to an assumed reduction in CO2 by 5Tons. The objective is to start with 10.000 homes and to gradually increase that total to 100,000 homes per year.

One of the key drivers for this approach seems to be a concern that without taking out the existing system building operators could switch back to fossil fuels when gas prices are low. And that the heat pump would only be used for additional cooling in summer. As a co-founder of a clean energy startup – 7AC Technologies in Woburn and Beverly in Massachusetts I remain strongly committed to the shift towards sustainable heating solutions Massachusetts is seeking.

A key characteristic of de-carbonization is the need to offer easy to implement quick solutions existing systems tend to break down unexpectedly after years of limited attention being paid. If major repairs are needed, a reliable solution needs to be available without further planning or in-depth study and optimization of solutions. Since the expense is unexpected, cash funding may be limited.

Unintended consequences

Rapid electrification is an effective solution for reducing reliance on fossil fuels for heating. However major swings in prices for gas and electric can easily lead to ineffective use of the new heat pumps – a significant concern given the need to quickly reduce reliance upon fossil fuels. Full electrification can however also lead to several unintended consequences:

- Escalating costs of heat pumps. Already costs in Massachusetts are several times higher than elsewhere, based on recent bids for single and dual head heat pumps of $8000 to $24000 rather then $2000-8000 which are typically paid for the equipment and basic installation elsewhere. There are too few qualified installers and contractors to handle the work.
- Replacing a hydronic or duct-based heater with a heat pump requires adjustments for the lower operating temperatures of typical heat pumps and climate conditions tend to require high temperature and/or cold climate solutions. Replacing ducts or pumps can further increase cost and complexity of the work required. Time for additional insulation may be lacking.
- Increased peak demand for electricity can increase storage requirements in the network as during the coldest days heat pump capacity is reduced and resistance heat tends to be used as backup. This will slow down decarbonization of the network and can significantly increase costs.
- Lowest cost equipment is significantly less efficient than high end solutions with demand control features, variable compressors and fans. Lab based testing may give a skewed picture of

installed demand especially if higher capacity fixed compressor systems with low efficiency fans are being used. Noise levels also tend to be higher esp. for outside units. And heat pumps differ significantly in actual reliability, with some units operating for years without need for adjustments while others may require significant work.

- A fixed incentive for 100% electrification does not encourage use of higher end solutions with variable fans, modulated compressors, high efficiency quiet outdoor units and high reliability.
- 100% replacement tends to involve several days of work in the home not counting for the preparation, including careful estimates of actual heating loads, to avoid rooms getting insufficient heat during cold periods.
- As a result initial plans start with replacing existing heating in 10,000 homes per year.

Alternative approach

A different approach will accelerate decarbonization beyond the current objectives, achieving much quicker decarbonization of heating in homes using preselected "80% solutions", encourages training of new technical staff using existing electricians, plumbers and IT staff. Success does require properly monitored and installed smart controllers, which can also prepare the way for significant improvements in indoor air quality that has become a growing concern in ASHRAE.

1. During the first few years of the program install large numbers of supplementary heat pumps with smart controls that ensure that fossil heaters are only turned on when heat pump capacity is insufficient. Use connected units that report actual usage of the heat pump allowing for incentives to be linked to high efficiency. Supplementary heat pumps can typically offer 60-80% of the heating requirements.
2. Preselection of the supplementary heat pumps can be done based on competitive bidding for units with demonstrated high efficiency, very high reliability, low service call and low noise levels. The cost for a single 1-ton unit including installation should not exceed $2000 to 2500 assuming multiyear programs of many 10ths of thousands of units. A service contract for a minimum of 3-5 years should be added. A range of 1-, 2- and 3-ton split units for in duct installation and split systems should be offered.
3. Suppliers should offer multiyear installations in packages of 10000 per year each against a fixed rate with a fixed requirement, while training sufficient staff to do the installations. Electricity suppliers can also agree to lower charges when the efficient heat pumps are used. Consumers interested in modifications can ask for those at additional costs.
4. Bids can come from non for profits, current heating suppliers and should include the training of additional staff to do the installations. By providing electricians and plumbers with one or a few weeks of training to install a specific heat pump or small range of heat pumps and a specific connected smart controller or small range of sensors/controllers, , additional resources are created and existing shortages in contracting supplies are not acerbated.
5. Low cost and public housing users can be offered such a service at no cost to the end-users. Other homeowners get access to high quality supplementary systems at a cost will below 50% of current market prices.
6. Smart monitors should not only measure operating conditions (Temp/RH, hours of usage of the back up system) but also indoor air quality measures including CO_2, PM2.5 and 10, RH. This

will provide crucial information needed to plan a final solution for the home or commercial building that meets all annual requirements AND improves indoor air quality through appropriate ventilation, filtration of air and humidity management. This is not only critical during epidemics like Covid (see the new ASHRAE standard 241), but can also significantly reduce healthy years lost (DALY) through indoor pollution, which in typical US homes is still close to that of the risk of smoking (2200 DALY's per 10,000)

After 3-5 years the program will have provided reduced building and home usage of heating by 60-80%. Meanwhile new programs can be developed to combine one hundred percent heat pump heating with significant improvements in occupant health through proper selection of fans and filters, air treatment, RH management in summer and winter with controls that monitor actual occupancy and air quality performance as required under the latest 62.2 and 62.1 indoor ventilation standards for homes and commercial buildings. The smart controls networks will provide owners and their network operators with the information needed to accelerate decarbonizing electricity distribution and generation networks through a combination of demand control, decentralized solar and storage and new incentives. This can include adding improved insulation, energy recovery for ventilated air, demand ventilation, high efficiency solutions including geothermal and local storage solutions.

This approach also supports the critical expansion of technical resources needed to meet the demand for 100% electrification with a mix of high efficiency solutions. Fresh air ventilation should be controlled based on actual air quality measurements (CO_2, PM2.5) and information on occupancy. Existing ducting can be used to manage energy recovery solutions. Combining lower temperature heat pump capacity on hydronics systems with ducted heating/cooling can be used to balance year-round requirements without major changes to the distribution systems. Cold spots can be managed using small split or multi head systems. Geothermal solutions can be included after appropriate checking of the impact on ground water systems.

By using the relatively simple supplementary systems to develop additional technical resources, a supply sector can be developed that can be used to handle the more complex issues of meeting peak demand with a variety of heating systems. As described in the enclosed document that should often result in separate solutions for high quality ventilation and air quality management and for sensible temperature control. This can be done using both the ducted and hydronic systems in a building. Or by adding geothermal heat and other heat network solutions.

Related ASHRAE initiatives

As chair of an ASHRAE technical committee and coauthor of ASHRAE guides on decarbonizing heating, ventilation systems and humidity control, I would be pleased to help out in thinking through the alternatives for Massachusetts. I was involved in similar programs in my country of origin the Netherlands, where an exchange of experience may be useful. I'm vice chair of ASHRAE's new task for on decarbonization with utilities that seeks to optimize HVAC efficiency and flexibility to reduce requirements for additional capacity and is working on a number of heating and energy recovery programs.

Following the acquisition of 7AC Technologies by Emerson Climate Systems (now Copeland) I was asked to continue working with the team on our Liquid Desiccant Dedicated Outside Air Systems (DOAS) where I'm now responsible for Advanced Technology Solutions.

Enclosed is my input to the latest ASHRAE guide on decarbonization of heating, which is currently being prepared by NREL, which covers some of the same materials covered in this note.

While my experience informed my views, these comments are my personal views and do not represent those of ASHRAE or Copeland

ADDITIONAL DISCUSSION

A. Technical expertise with contractors is the main barrier to success and can further overheat markets.

At the same time, design and installation of heat pump systems requires specific training. Among others because of the handling of refrigerants to avoid losses during replacement or charging of the systems. The rapid growth of demand has led to major shortages in these skills in many markets like Massachusetts which has resulted in sharp and major increases in the cost of systems.

Optimal implementation needs to consider fundamental differences between heat pumps and fossil fuel heaters. To do that well requires time and expertise among contractors, engineers and building/homeowners.

B. Focus on speed and high efficiency, rather than completeness and pulling out existing infra early on.

The sustainable heating program should focus on accelerate overall usage of heat pump systems to decarbonize heating. Rather than maximizing electric heating by building, heating should be accelerated across the housing stock, using relatively standard, off the shelf 60-80% solutions that are easy and cost effective to implement and can achieve larger short-term savings than a more complex full transformation (see A) Work by our helix center at the university of Dayton has shown that relatively small split systems can cover 60-80% of the annual heating requirements while avoiding the losses associated from rapid defrost cycling. This includes using existing heating systems when they are available as back up for extremely cold conditions and doing that in a combination with a smart thermostat to ensure usage and compliance with program requirements.

C. Modulation of the compressor and the fan are critical.

System efficiency and capacity drops at temperatures below 20F and at high humidity if this causes frequent cycling to eliminate icing/frost forming on the outside unit. Low-temperature heat pumps and geothermal can operate at lower temperatures while modulation of compressors can maintain significantly higher efficiency, especially at the very frequent partial load conditions.

Lab test results can differ very substantially from field results by as much as a factor 2. This is among others due to the impact of part load performance and in the heating season to the high frequency of defrost cycling of a unit when sensible loads are relatively low, and humidity is high. A recent study showed a 40% reduction in actual performance by some systems that don't have the ability to effectively modulate their capacity. Modulation can be done in a variety of ways, including using tandem compressors, techno systems and variable compressor.

D. **Offset cost of high efficiency systems with potential network savings to minimize costs to consumers/ratepayers.**

System efficiency has a major impact on the sustainability and capacity requirements in electricity networks. Typically, the cost differential between high end efficient and adjustable systems and the lowest cost systems are more than offset by the impact on the cost and reliability of networks. E.g., Typical systems vary in cost between a few hundred dollars per KW energy requirements to several thousand dollars. Peak heating systems relying on resistant heat strips with a COP well below 2 may cost even less, but require networks to increase peak capacity at a cost of 2-4000 per peak kW and

Incentives should reflect the benefits of high efficiency heat pump systems especially in reducing electricity generation and distribution network investments, which can range from 2000- 4000 dollar per kW. A low efficiency system using that much power has a similar cost, while a high efficiency system can produce the same heating or cooling while using as much as half of the required electricity, justifying a cost that is several thousands of dollars per Ton higher. As a result, high efficiency, flexible solutions tend to be significantly cheaper for both customers and rate payers than low-cost systems. As a regulator, Massachusetts can reduce its overall cost by offsetting the cost of high-end systems using the avoided costs in the network through a program like Mass Save.

E. **Longer Term Full Electric Systems Should Maximize Climate Impact As Well As Health And Comfort Benefits For Building Occupants.**

Efficient whole electric systems should incorporate changes in the envelop and heat distribution systems as well as the replacement of the heater itself. This will improve comfort and reduce electricity usage.

Heat pumps typically operate at temperatures around 120-130F and down to temperatures between 0 and 20F depending on design. This strongly impacts heat distribution as more air or water is needed to distribute the same amount of energy. Rather than spend tens of thousands of dollars on such changes, much smaller investments in complementary equipment can ensure that capacity requirements are met by using local zone-based solutions like VRF.

The full switch towards electric systems should focus on final replacement of existing systems and should be optimized for the existing energy infrastructure in the building. I.e. rather than investing in new ducting or new water systems or complex high/low temperature units, users should be encouraged to continue to use separate networks for sensible heating /cooling and for ventilation/humidity control. The former can use existing hydronic systems at lower heating temperatures or use a combination of split systems. The latter can often use existing ducting systems. Where necessary in extremely cold zones additional local heat can be added, e.g., using chilled beams or VRF.

A lot of work is currently being done on optimal ventilation and incorporating the latest solutions is likely to improve health and comfort of occupants. Ventilation systems are undergoing rapid development among others by

- Being performance or demand driven rather than operating under set schedules
- Enable maintaining maximum humidity levels during unoccupied periods to maintain building health and fight mold.

- Incorporate filtration/airtreatment steps to reduce transmission of airborne decease like the flue and to reduce potential pathogens like PM 2.5 which have now been shown to cause significant health risks

A well designed final solution can have major additional benefits from a global warming perspective. Several manufacturers now offer refrigerant solutions with extremely low GWP including 290 or propane. While not yet approved for the use in the US recent approvals in Europe are likely to accelerate adoption of these solutions in safe and effective ways. Timing of full electrification can therefore

F. Ensure Connectivity And Performance Measurement For The End user, The Program And The Utilities With Participation Voluntary But Linked To Incentives

Smart HVAC and home controls are now available and allow for remote monitoring of usage and performance as well as allowing for two-way communication with the HVAC system similar to what is being done in solar and other connected systems. They can also monitor health related indices like pm2.5 and PM10, CO_2, absolute and relative humidity and VOCs providing consumers with additional benefits that can support the program.

G. Go Beyond Financial Incentives To Reduce Costs.

Offer training to electricians and other technicians that can be taught rapidly how to install basic systems.

Prepare user guides for contractors, for home/small building owners and for regulators to identify workable solutions, gather field data and ensure learning. Make these available online, together with project data bases linked to incentives.

Maintenance and support requirements differ significantly between brands. Regulators and utilities can ensure that customer feedback over their system is easily accessible while selecting system alternatives. Service records like those available for cars can be maintained by consumer organizations, ASHRAE and/or state intermediaries. Actual contract pricing data by supplier combined with such data can help provide a growth path for the most effective suppliers.

Maintenance costs are a major factor and increase costs. Providing “service vouchers” can reduce customer concerns about “lifetime guarantees” in a technology that is new and unfamiliar.

Incentives should focus on reducing actual cost of solutions to building owners and users rather than adding to further costs increases. This can be done by improving supply, large scale procurement of approved systems which can be delivered through various organizations ranging from low cost housing associations to utilities supported non for profits. The proposed approach that reduces time required for implementation also provides an ability to move more equipment with much less cost in the limited available technical resources.

H. Exclude High Noise Systems

Noise: Optimal fan and airflow design can reduce noise levels especially of the outside units from about 70DB to 40-50DB. Users may be tempted to minimize their own cost at the expensive of broader support. Incorporating noise limits is likely to help in maintaining public support.

I. Offer Geothermal As A District Solution

Geothermal systems are among the most efficient in the industry but require significant investments as well as preparation. A staged /phased approach provides time to prepare for this and minimizes the sizing requirements of such a system.

I. Demonstrate Integrated Solar PV And Electric Heating Solutions

Solar combi's: Combining solar and heat pump projects can add additional network benefits especially in areas where distribution networks are constrained. The combination can not only reduce peak demand during the afternoon, but also extend the capacity of the network to accept additional solar capacity.

By email to: climate.strategies@mass.gov

February 21, 2024

Bonnie Heiple, Commissioner
100 Cambridge Street
Suite 900
Boston, MA 02114

RE: Comments to Department of Environmental Protection Clean Heat Standard Draft Program Framework

Dear Commissioner Heiple:

On behalf of our members, the Mass Coalition for Sustainable Energy (MCSE) is pleased to submit comments relative to the Department of Environmental Protection (DEP) Clean Heat Standard (CHS) draft program framework ("the draft framework") released November 16th, 2023. Comments are due by February 21, 2024.

With 19 members in the employer, business, labor, commercial development and homebuilding communities, representing many of the Commonwealth's largest and most important business associations - including seven statewide business organizations, nine regional chambers of commerce and several of the largest labor unions in Massachusetts - our coalition is committed to addressing the climate crisis and aspire to be a valuable and engaged partner as the Commonwealth transitions to clean energy in order to meet its 2050 carbon emission goals. A properly designed CHS could contribute to meeting that goal.

The CHS will require heating energy suppliers (oil, propane, natural gas, and electricity) to reduce their GHG emissions over time by gradually increasing the percentage of "clean heat services" they supply to customers. Suppliers would demonstrate emissions reductions through "clean heat credits," created either by the suppliers themselves or through purchase of credits from third parties, such as heat pump installers. The draft framework envisions near universal deployment of heat pumps across Massachusetts - an estimated 1.8 million units - to reach a zero-emission goal in the residential sector. Alternative compliance payments (ACPs) may be assessed if clean heat credits are not available.

Due to the impact of this draft proposal on various segments of our membership, MCSE engaged Concentric Energy Advisors ("Concentric") to review and analyze the cost of implementing this draft proposal in terms of needed additional electrical infrastructure and equipment.

The Concentric Report, *Cost Analysis of the Proposed Massachusetts Department of Environmental Protection Clean Heat Standard*, is attached for your review.

Among Concentrics's findings:

- **$60 Billion in Electric Infrastructure Costs:** Additional infrastructure for generation, transmission and distribution will be necessary to account for additional heating load from the 1.8 million heat pumps identified in the draft proposal. Concentric estimates that in the winter of 2023, additional electric load associated with serving these new heat pumps would have increased the winter peak electric demand to 20,223 MW, a 129 percent increase as compared to actual loads during that time.

  The estimated cost of building the infrastructure necessary to meet this new peak demand would be $60.6 billion dollars.

- **Up to $40,475 in Household Equipment Costs:** Utilizing data from Mass Save, the Commonwealth's energy efficiency program, the cost of the heat pumps and associated wiring would be $44.8 billion dollars - between $16,675 - $40,475 per household, depending on the type of heat pump installed.

  Federal tax credits may defray some of the cost in the near term, but their availability long-term is uncertain. Additionally, while Mass Save offers rebates for heat pump conversions, these rebates do not lower the overall cost of implementation. That is because the rebate costs are passed to consumers in the form of higher electric rates - essentially being paid by the same person in a different way.

In total, Concentric estimates the total cost to fully implement the CHS as proposed would be $105.4 billion dollars not counting carrying costs needed to finance these investments.

That is a staggering cost, even when considered over the time period anticipated for full implementation. As such, we urge the Department to evaluate the economic impact these types of increases will have on the Commonwealth's existing households, new housing starts, and businesses who invest and operate in Massachusetts. The Coalition urges that the Department be transparent regarding the costs of this proposal, so as to fully engage all stakeholders in its development. At the same time this proposal is being developed, the Local Distribution Companies (LDCs) are in the process of developing their Electric Sector Modernization Plans (ESMPs) with the D.P.U. Therefore, more granular data should be available soon. *D.P.U. 24-10, 24-11, 24-12.*

In developing the CHS, the Coalition believes that the Department should look for ways to significantly mitigate the cost impact of this proposal. Fortunately, there are ways to alleviate some of the costs. The Concentric report identified two approaches.

Hybrid Fuel. First, the Department could support a hybrid fuel approach to net-zero, rather than transforming the entire heating sector to electric heat pumps. Under the hybrid approach, the existing fuel infrastructure would mitigate the need for extensive upgrades to the electric infrastructure by taking pressure off the electric system during periods of high electric needs.

Zero-Carbon Emitting Alternatives. Second, the Department could immediately allow zero-carbon emitting alternative fuels such as biogas or hydrogen to count as part of eligible technologies. In the current proposal, these fuels would not be considered until 2028, too late for the research and development required to make them viable. Allowing the use of biogas and hydrogen from the beginning will utilize the capacity of existing infrastructure, saving money for consumers by not straining the electric grid. In addition to lower costs, decarbonization through the enhanced use of biogas and hydrogen provides the Commonwealth with both greater energy security and affordability.

Although it was not analyzed in the Concentric report, other zero-carbon emitting technologies, such as geothermal, could also play a role in mitigating the cost of CHS compliance.

These options should be considered as part of a broad analysis of implementing the clean heat standard affordably.

Lastly, we are deeply concerned that the CHS program relies on meeting the targets through a zero-emissions building sector in the Commonwealth by 2050, rather than achieving the goal set under Massachusetts law which is to reduce emissions to "net-zero" as compared to 1990 levels. Setting an unachievable objective will not create momentum for climate action but rather the potential for widespread opposition and controversy, hindering meaningful and achievable emissions reductions and slowing progress at a moment when we can least afford it.

To be clear: the MCSE stands with Massachusetts in advocating for a transition to zero emissions consistent with the goals of the Commonwealth. But reaching our emissions reductions goals cannot be an "either or" situation, where all efforts are put into a single solution - in this case heat pumps - or contain unattainable goals that fail to account for the long-term reliability and impacts of this technology or the state and quality of New England's built environment. To reduce emissions and reverse the effects of climate change, we should use all the technologies available and marshal to action as many stakeholders as possible.

We look forward to continuing the discussion with the Department and would be happy to have our consultant present this data in person or expand on any issues as the discussion continues.

Thank you for your consideration of these concerns.

Respectfully,

cc: Edward M. Augustus, Secretary, Executive Office of Housing and Livable Communities
Rebecca Tepper, Secretary, Executive Office of Energy and Environmental Affairs
Yvonne Hao, Secretary, Executive Office of Housing and Economic Development

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COST ANALYSIS OF THE PROPOSED MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION CLEAN HEAT STANDARD

PREPARED FOR: MASSACHUSETTS COALITION FOR SUSTAINABLE ENERGY

FEBRUARY 20, 2024

Concentric Energy Advisors

ceadvisors.com

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TABLES AND FIGURES

SECTION 1: INTRODUCTION

The Massachusetts Department of Environmental Protection ("MassDEP") proposed a Draft Clean Heat Standard Framework ("CHS Framework") in November of 2023 which seeks to install heat pumps in 1.8 million Massachusetts homes by 2045. Under the CHS Framework, these homes would be fully converted to electric heat pump heat and away from their existing heating source. Concentric was asked by the Massachusetts Coalition for Sustainable Energy ("MCSE") to review the structure of this CHS Framework and develop an estimate of the cost of full residential heating electrification ("full electrification") under a scenario in which the CHS Framework was implemented immediately (i.e., on an "overnight" cost basis). Concentric's calculation of the cost of full electrification as requested by MCSE includes costs associated new power generation, transmission and distribution infrastructure and the cost of installing new electric heat pumps within the 1.8 million homes specified in the CHS Framework. This analysis does not consider potential additional fuel costs nor any required return on invested capital associated with the CHS framework.

SECTION 2:
HEATING LOAD

The 2.8 million households in Massachusetts use a variety of fuels for space heating, consuming an estimated 228,745,468 MMBtu (62.4 million MWh) annually across a variety of fuels including natural gas, propane, fuel oil, electricity and other fuels.[1] The number of households consuming each type of fuel and the estimated quantity of fuel used for space heating by each fuel type are shown below in Table 1.

Table 1: Massachusetts Household Space Heating by Fuel Type as of 2022

Fuel Type	# of Households	Percent of Total	Heating MMBTU
Utility gas	1,411,895	51%	117,176,268
Fuel oil, kerosene	649,036	24%	53,782,076
Electricity	492,336	18%	40,737,062
Bottled, tank, LP	129,599	5%	10,756,415
Wood	30,651	1%	2,517,459
Other fuel	21,455	1%	1,830,879
Solar	5,807	0%	457,720
Coal or coke	1,320	0%	114,430
No fuel	16,919	1%	1,373,159
Total	**2,759,018**	**100%**	**228,745,469**

Source: Energy Information Administration

1 See https://www.eia.gov/dnav/ng/NG_CONS_SUM_DCU_SMA_A.htm.

SECTION 3:
CLEAN HEAT STANDARD ELECTRIC DEMAND & REQUIRED CAPACITY

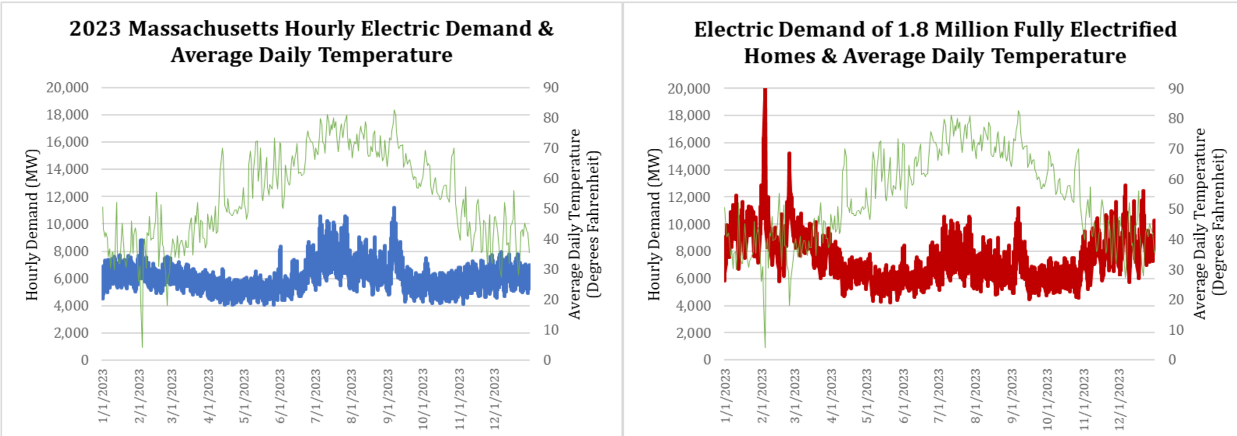
Heat pumps function by mechanically extracting heat from the outside atmosphere and transferring this heat into the home. As outside temperatures decline, the operation of the heat pump becomes less efficient at extracting heat from the atmosphere. The efficiency of heat pumps at various temperatures is a key consideration in evaluating how the CHS Framework would impact electricity demand in Massachusetts.[2]

The efficiency of a heat pump is measured by the coefficient of performance ("COP") which is calculated as the ratio of the amount of thermal energy that the heat pump generates as compared to the energy content consumed. On average, heat pumps can operate at a COP of 2.34 during winter months in Massachusetts.[3] The heat pump COP can decline to 1.5 when outdoor temperatures approach zero degrees Fahrenheit. As the COP declines, heating requirements may exceed the heat pump's output capacity, requiring supplemental electric resistance heating which has a COP of 1.0 (i.e., energy output is equal to energy input). The decline in COP that occurs with a decline in temperature means that providing heating during extreme cold can require two to three times more power generation infrastructure than required at average temperatures. This infrastructure may then remain idle during other times of the year when electric demand is lower.

As of 2023, the winter peak electricity demand in Massachusetts was 8,819 MW. If the CHS Framework had been in place in 2023, the additional electric load associated with serving new heat pumps coupled with the declining efficiency of heat pumps during very cold winter days would have increased the winter peak electric demand to 20,222 MW, a 129 percent increase as compared to 2023. This new electrical load would also move Massachusetts from having an electric peak demand that occurs in the summer to one that occurs in the winter as shown in Figure 1, below.

2 Heat pump efficiency also declines with altitude.
3 Residential ccASHP Building Electrification Study, April 2022, Cadmus.

Figure 2: Massachusetts Hourly Electric Demand[4]



Serving this new load would require significant new dispatchable generation, much of which would likely need to be fired by natural gas, given a variety of factors including the fact that certain renewable generation resources (i.e., solar) are often less productive in the winter than the summer. The CHS Framework would also increase electricity consumption in the Commonwealth by 12 million MWh, a 24 percent increase over 2023 levels. These CHS Framework impacts are based on 2023 actual temperatures including February 4, 2023, when the average temperature dipped to 4 degrees Fahrenheit. However, the more extreme temperatures observed during past winters would lead to an even greater increase in the winter peak electric demand and greater consumption than estimated above.

4 Incremental heat pump load was calculated using 2023 heating degree data. Using 835 therms of annual natural gas heating load for the average Massachusetts customer and calendar year 2023 heating degree days ("HDD") of 4,895, an average heating rate of 0.17 therms was derived. Next heat pump COP was assumed to decrease linearly from 4.0 at 50 degrees to 2.0 at 10 degrees Fahrenheit. Finally heat pump Btu consumption was converted to electric consumption using the ratio of 0.03412 kWh/therm.

In fact, the Massachusetts natural gas utilities plan for far colder temperatures using a "design day" criteria which ensures that their systems can meet heating load when average daily temperatures are between 13- and 15-degrees Fahrenheit below zero.[5] Under these extreme, yet possible, conditions the requirements on the electric grid from full electrification would be even greater than as described above.

When temperatures decline to these design day levels, the heat pump COP would decline to 1.5 and it is possible that installed heat pump capacity alone could be insufficient to provide customers necessary heating, requiring the use of supplemental electric resistance heating.[6] At these design day temperatures, the heat pump capacity specified by the CHS Framework would result in a doubling of Massachusetts' peak day electric consumption, increasing from 223,295 MWh to 670,000 MWh per day and the new peak electric demand associated with the heat pumps mandated under the CHS Framework would be 19,875 MW and the new total winter peak demand would be 28,694 MW.[7]

This additional winter electricity demand would be served by a combination of existing power generation, transmission and distribution capacity used to serve the 2023 summer peak electric demand, plus new capacity required to serve the new higher winter peak demand. To determine the net new quantity of additional capacity required to serve the CHS Framework heat pump load, Concentric calculated the electric capacity required to serve the net heat pump demand of 17,520 MW using the power generation reserve margin and transmission line losses set by the Independent System Operator of New England (ISONE) and distribution line losses set by the various distribution utilities. The calculation of the resulting total net new generating capacity of 21,559 MW is shown in Table 2, below.[8]

---

5 *See* Forecast & Supply Plans for National Grid, Eversource, and Berkshire: Berkshire Docket 22-148, National Grid Docket 22-149, and Eversource Docket 23-125.

6 *See* Residential ccASHP Building Electrification Study, April 2022, Cadmus.

7 Calculation assumes generator capacity accreditation does not vary by season.

8 *See* 2021 Economic Study: Future Grid Reliability Study Phase 1 2021_economic_study_future_grid_reliability_study_phase_1_report.pdf (iso-ne.com) National Grid Supplier Load Estimation Allocation of Losses to Suppliers (nationalgridus.com).

Table 2: Net New Capacity Required to Serve Massachusetts Heat Pump Load

Period	MW	Calculation
2023 Winter Peak Demand	8,819	a
2023 Summer Peak Demand	11,174	b
Heat Pump Demand at -15 degrees & 1.5 COP	19,876	c
New Winter Peak Demand	28,694	d=a+c
Incremental Peak Demand in Excess of Summer Demand	17,520	e=d-b
ISONE Reserve Margin	15%	f
Secondary Line Losses	7%	g
Total Generation Capacity Requirement	21,559	h=e*(1+f)*(1+g)
Total Trans. & Dist. Capacity Requirement	18,747	i=e*(1+g)

This incremental load would be served by new generation, transmission and distribution infrastructure. The calculation of the overnight cost of this infrastructure is described in the following section of this report.

SECTION 4:
ELECTRIC INFRASTRUCTURE COSTS

Concentric has developed an estimate of the cost of the incremental generation capacity based on the Cost of New Entry ("CONE") used by ISONE, which represents the estimated cost to construct a new natural gas turbine in New England. This value is used as a benchmark within the ISONE Forward Capacity Market and is reviewed and approved by the Federal Energy Regulatory Commission ("FERC"). The most recent CONE value was set in 2019 at $777/kW. This value has been escalated by an inflation factor to obtain an expected generation construction cost in 2024 of $1,194/kW. When multiplied by the required net new generation capacity of 21,559 MW, total overnight cost for new capacity is $25.7 billion.

The cost of transmission and distribution capacity is based on the New England Avoided Energy Supply Component Study, which estimates the projected unit construction cost of these assets within New England.[9] These values are often used to evaluate the economic benefits of energy conservation programs that reduce energy consumption and can also be used to estimate the cost associated with serving additional peak demand. Using the most recent values available (2021) and escalating by an inflation factor to 2024, the cost of pooled transmission resources is $754/kW, the cost of non-pooled transmission resources is $908/kW, and the cost of electric distribution is $199/kW. When multiplied by the required net new distribution and transmission capacity of 18,747 MW, total overnight cost for new transmission and distribution capacity is $34.9 billion.

Using these costs, Concentric has calculated the investment required to meet the incremental peak demand associated with the CHS Framework at $60.6 billion as shown below in Table 3.

Table 3: Incremental Cost of Electric Capacity Required to Serve Electric Heat Pump Load

Infrastructure	Incremental Cost ($/kW)	Incremental Capacity Requirement (MW)	Total Cost ($ billions)
Generation	$1,194	21,559	$25.7
Pooled Transmission	754	18,747	14.1
Non-Pooled Transmission	908	18,747	17.0
Distribution	$199	18,747	$3.7
Total			**$60.6**

9 *See* Avoided Energy Supply Components in New England: 2021 Report available at: https://www.synapse-energy.com/sites/default/files/AESC%202021.pdf

SECTION 5:
HEAT PUMP EQUIPMENT COSTS

The full electrification specified under the proposed CHS framework would require installation of new heat pump capacity capable of serving each home's peak heating demand. This equipment cost will include new heat pump units and, in some cases, utility service upgrades to handle the additional heat pump load. In many cases, these upgrades would be eligible for the $2,000 rebate available through the Federal Government's Inflation Reduction Act ("IRA").[10]

The median home in Massachusetts is estimated to require 5 tons of heat pump capacity to fully meet its heating needs.[11] This requirement will result in average per home costs ranging from $16,675 to $40,475 depending on equipment configuration as shown in Table 4, below.

Table 4: Heat Pump Equipment Costs

Heat Pump Type[12]	Home Count	Average Equipment & Installation Cost[13]	Service Panel Upgrade[14]	Average Cost per Home	Total Cost ($ billions)
Mini-Split Heat Pump	1,179,310	$15,800	$3,500	$16,675	$19.7
Ducted Air Source Heat Pump	620,690	$39,600	$3,500	$40,475	$25.1
Total	**1,800,000**				**$44.8**

10 Additional state-level heat pump incentives would be funded by state tax revenue and thus would not reduce the cost of CHS Framework to state taxpayers.

11 Average peak heating demand 0.57 therms = 56,515 Btu ÷ 12,000 Btu per ton = 4.7 tons

12 Allocation between heat pump types based on Massachusetts Residential Baseline Study. 2019 Navigant. *See* https://ma-eeac.org/wp-content/uploads/RES-1-Residential-Baseline-Study-Comprehensive-Report-2019-04-30.pdf

13 Heat pump costs from Mass Save: Heating Comparison Calculator available at: https://www.masssave.com/residential/heating-comparison-calculator. Mass Save Mini-Split Heat Pump installation cost of $17,800 less IRA tax credit of $2,000. Mass Save Ducted Air Source Heat Pump installation cost of $41,600 less IRA tax credit of $2,000.

14 Concentric estimates that a service panel upgrade is required at 25% of the homes.

SECTION 6:
CONCLUSION

Combining the total electrical infrastructure costs of $60.6 billion and heat pump infrastructure costs of $44.8 billion yields a total overnight cost of the CHS Framework of $105.4 billion. This cost represents a per household cost of $38,202, if allocated equally across all 2.8 million households in the Commonwealth. As an overnight cost estimate, this cost does not include carrying costs that would be associated with financing these investments. These carrying costs would be incurred for all electrical infrastructure investment and many of the heat pump installations. This cost analysis also does not include potential differences in fuel costs between existing heating fuels and the fuels used to generate additional required electricity.

These stated overnight costs can be significantly reduced through a series of heating fuel supply and heat pump configurations strategies. In particular, permitting MA gas utilities to deliver a blend of renewable natural gas and hydrogen and for heating fuel suppliers to advance the delivery of low carbon home heating fuels will provide emissions reductions without incurring these electric infrastructure and heat pump equipment costs. In addition, sizing of heat pump capacity installed at each home to serve average home heating load and not total home heating load, will reduce the total cost of required electric infrastructure and heat pump equipment costs. This strategy is particularly attractive as it avoids the challenges created by the declining efficiency of heat pumps at very low temperatures, while leveraging the ability of heat pumps to efficiently generate heat at average temperatures and take advantage of renewable generation when available. Each of these strategies should be further evaluated to ensure the objectives of the proposed CHS Framework are achieved at the lowest possible cost.

MASS COALITION for sustainable energy

By email to: climate.strategies@mass.gov

April 5, 2024

Climate Strategies
MassDEP
100 Cambridge Street
Boston, MA 02114

RE: Comments to Department of Environmental Protection *Stakeholder Discussion Document relative to the Clean Heat Standard - Crediting for Non-residential Buildings*

On behalf of our members, the Mass Coalition for Sustainable Energy (MCSE) is pleased to submit comments to the Department of Environmental Protection (MassDEP) *Stakeholder Discussion Document relative to the Clean Heat Standard - Crediting for Non-residential Buildings* released March 2024 ("Stakeholder Document"). Comments are due by April 5, 2024.

With 19 members in the employer, business, labor, commercial development and homebuilding communities, representing many of the Commonwealth's largest and most important business associations - including seven statewide business organizations, nine regional chambers of commerce and several of the largest labor unions in Massachusetts - our coalition is committed to addressing the climate crisis and aspire to be a valuable and engaged partner as the Commonwealth transitions to clean energy in order to meet its 2050 carbon emission goals.

MCSE has been following the development of the Clean Heat Standard since it was first proposed. On February 21, 2024, the Coalition submitted comments pertaining to the original Clean Heat Standard Draft Program Framework.

The stated purpose of this Stakeholder Document is to elaborate on the concepts in the draft framework with respect to clean heat credit generation for non-residential (i.e., commercial, and industrial) buildings and solicit feedback. MassDEP is considering two potential mechanisms for emission reduction credit generation in non-residential buildings: 1) electrification, and 2) certain non-pipeline clean fuels (i.e., fuels that are not delivered using the existing natural gas infrastructure).

Our concern is related to Item 2 – *Emission credit generation in non-residential buildings for certain non-pipeline fuels.* The MassDEP is considering crediting emissions reductions for the substitution of renewable natural gas ("RNG or Biogas") and hydrogen produced using renewable electricity ("Green Hydrogen"). Unfortunately, the Stakeholder Document contemplates only crediting the emissions reductions from RNG, biogas and Green Hydrogen *as long as they are not blended with fossil fuels* [Emphasis added] (Stakeholder Document, Page 3).

We appreciate that MassDEP has recognized that RNG, biogas and green hydrogen can be valuable sources of non-carbon emitting fuels when they are substituted for fossil fuels. This is consistent with scientific and technical research which shows that both fuels, sourced properly, can be effective tools to lower greenhouse gas emissions.

MassDEP's view is also consistent with conclusions of the recent Department of Public Utilities (D.P.U.) investigation into the role of local gas distribution companies (LDCs) relative to the Commonwealth's 2050 climate goals[1]: "*In summary, subject to the conditions above* [primarily regarding cost sharing] *we will allow the option for consumers to purchase RNG from an LDC or a third-party supplier."* (Order, page 71). As such, there is no technical or legal impediment to using these fuels as substitutes for fossil fuels in non-residential applications.

Despite this broad agreement, the Stakeholder Document disqualifies the use of RNG, biogas or green hydrogen in any application if they are blended with fossil fuels. That is perplexing as blending these fuels with natural gas is consistent with national trends and industry standards and is in fact, the most economical and efficient way to use them.

RNG and biogas are chemically indistinguishable from pipeline natural gas. As RNG and biogas generating facilities are built around the country, the fuels will be injected at various points into the same system that delivers natural gas to the Northeast. As such, it will be impossible for LDCs to identify whether natural gas contains RNG or biogas and even if they could distinguish it, there would be no way to separate the fuels – resulting in scarcity or higher prices.

Utilizing RNG and biogas to the fullest extent possible also provides Massachusetts with a double benefit. Multiple Commonwealth businesses are poised to produce RNG and biogas from landfills or anaerobic digestion of unusable food waste that would otherwise emit greenhouse gases into the atmosphere.

But under the scenario outlined in the Stakeholder Document, instead of injecting these fuels safely into the existing distribution system, RNG and biogas would need to be transported to an end user by truck - similar to the way propane and fuel oil are used now - a very inefficient way to transport fuels that would likely outweigh their environmental benefit.

A similar challenge exists for green hydrogen. While the production of green hydrogen is a little further behind RNG and biogas, a modest amount (up to about 20%) could be added to the existing natural gas system with no impact on safety or function.

With recent federal and state investments in RNG, biogas and green hydrogen coming to Massachusetts and supported by our elected officials, MassDEP would be cutting off a source of innovation, funding, and jobs if they restrict the use of these fuels to dedicated pipelines - likely a decade or more away.

Massachusetts needs all the clean energy it can get – and soon. With climate deadlines looming, costs rising and renewables coming online more slowly than anticipated, we are in no position to be excluding technologies from our clean energy portfolio that could immediately begin lowering emissions for larger commercial ratepayers. These include some of the largest consumers of energy in the Commonwealth.

---

[1] D.P.U. 20-80-B Investigation by the Department of Public Utilities on its own Motion into the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals. December 6, 2023

MassDEP should look at exploring any and all methods to reduce carbon emissions. Restricting the use of these fuels at this time to only dedicated systems is shortsighted and will have significant economic and environmental repercussions. A far better way for MassDEP to proceed would be to remove this comingling prohibition and utilize the existing reliable natural gas system which has served well for decades. This will result in continued innovation and ultimately lower emissions.

Thank you for allowing us to make these comments. We look forward to continuing the discussion with the Department.

Respectfully,

MASS COALITION for sustainable energy

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MASSACHUSETTS ENERGY MARKETERS ASSOCIATION

April 5, 2024

Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: Draft Framework – Clean Heat Standard
Submitted via: climate.strategies@mass.gov

On behalf of the Board of Directors and members of the Massachusetts Energy Marketers Association (MEMA or association) I respectfully submit the following comments to the Massachusetts Department of Environmental Protection (Mass DEP or Department) related to the Department's ongoing regulatory activity to develop a Clean Heat Standard (CHS). These comments relate to the draft framework for the CHS, and the FAQ document, Version 1.4 issued by Mass DEP in April 2024.

Please note that in addition to these comments submitted by the association, comments have also been submitted to Mass DEP on our behalf by Diversified Energy Specialists and Raymond Albrecht PE. Our association also supports comments submitted by the Clean Fuels Alliance America.

Association Profile

The Massachusetts Energy Marketers Association, established in 1955, is the trade association representing the heating oil and renewable biofuel/biodiesel industry in Massachusetts. Our membership includes retail and wholesale heating oil, diesel fuel and renewable biofuel/diesel companies who are the bedrock for the industry in the Commonwealth. Our membership also includes major U.S. producers/suppliers of renewable liquid heating fuels produced using various feedstocks that are recognized by the U.S. Environmental Protection Agency under the Renewable Fuel Standard as "approved" pathways for renewable fuel. (Please refer to the link below.)

https://www.epa.gov/renewable-fuel-standard-program/approved-pathways-renewable-fuel

The association's membership also includes major national manufacturers and distributors of both residential and commercial heating equipment. It is important to note that many of our retail heating oil members also sell propane and sell and install electric heat pumps.

Emission Reductions and Biofuel Blending Under the Clean Heat Standard

Our association fully supports Mass DEP in recognizing the importance of including renewable liquid biofuels/biodiesel as a credit-generating technology in the draft CHS framework. According to Q0 in the referenced FAQ document, the Department is currently:

1. Allowing all waste-based feedstock biodiesel to be eligible.
2. Allowing crop-based feedstock biodiesel to be eligible up to a B20.
3. Allowing all waste-feedstock renewable diesel to be eligible.

This approach by Mass DEP within the draft framework for the CHS coincides with the support of liquid biofuels by the Commonwealth with its Alternative Energy Portfolio Standard (APS), and the recognition by the Massachusetts Department of Energy Resources (Mass DOER) that liquid biofuels "contribute to the Commonwealth's clean energy goals by increasing energy efficiency and reducing the need for conventional fossil fuel-based power generation."

However, MEMA is very concerned about and opposes Mass DEP 's consideration of not allowing any crop-based feedstock for renewable diesel. We urge the Department to consider the comments provided by Diversified Energy Specialists and the Clean Fuels Alliance of America in eliminating this potential element of the CHS program.

Additionally, in its final report, the Massachusetts Commission on Clean Heat stated, "the Clean Heat Standard can be a powerful tool for creating a new market for clean heating solutions," and "minimize transition costs to homeowners by leveraging the power of market competition." For more information on this, please refer to the link below.

https://www.mass.gov/doc/massachusetts-commission-on-clean-heat-final-report-november-30-2022/download

These "new" markets include renewable diesel, and the major northeast suppliers of this fuel, other renewable liquid fuels and traditional heating and diesel fuel, are already offering renewable diesel as a pathway to reduce emissions. These companies, who represent the essence of "market competition" have responded to their customers' demands for renewable diesel and other renewable fuels. These companies are also working to help achieve the biofuel mandate requirements in New York, Connecticut, Rhode Island, and Pennsylvania.

The Commission on Clean Heat also stated, "The CHS must be designed to include and protect LMI and EJ populations from the outset." Last year, the heating oil industry in Massachusetts served 37,000 customers who qualified for the Low-Income Heating Energy Assistance Program (LIHEAP).

Allowing the heating oil and renewable fuels industry in Massachusetts to incorporate the use of all available liquid fuels that reduce greenhouse gas emissions will enable heating oil retailers to include the supplies provided to LIHEAP customers for greater and immediate climate change mitigation and would address the fact that LIHEAP customers, or their lessors, are unlikely to be able to afford the significant relative costs of electric heats pumps.

In this regard, given Governor Healey's recent announcement urging regulatory amendments to improve air quality in or near environmental justice (EJ) communities (see the link below), the final CHS regulations should be as comprehensive as possible in allowing the broadest array of renewable biofuels/biodiesel and feedstocks in order to assist low-income households and EJ communities with affordable energy that improves air quality and reduces GHG emissions.

https://www.mass.gov/news/massachusetts-becomes-first-state-to-require-analysis-of-cumulative-impacts-for-air-quality-permits-near-environmental-justice-populations

MEMA believes that Mass DEP's statement in Q0 of the FAQ document that biofuel blends above B20 "could require investments in equipment adjustments" is unsupported and inaccurate. Our concern is that this statement will only further encourage those who oppose biofuels in general, and the blending of these renewable fuels in home heating oil as an effective way to reduce carbon emissions in Massachusetts.

MEMA recognizes that biofuel blending specifications established by the American Society of Testing and Materials (ASTM) do not currently exceed B20. However, this ASTM specification did not deter the Mass DOER from promulgating 255 CMR 16:00 – Alternative Energy Portfolio Standard (APS) in 2018.

This regulation allows for "eligible" liquid biofuels to be blended with home heating oil starting at B10 but with no specific upper limit on blend percentage. Currently there are retail heating oil companies who participate in the APS program that are successfully, and consistently delivering blends as high as B50. "Investments in equipment adjustments" by consumers receiving these higher blends have been minimal to non-existent.

Furthermore, the three leading heating oil burner manufacturers in the U.S. – Beckett, Carlin, and Riello – have all introduced B100 equipment that is now readily available in Massachusetts. See links below.

https://www.beckettcorp.com/product-announcements/r-w-beckett-oil-burners-approved-for-b100-r100-blends/

https://carlincombustion.com/b100/

https://www.riello.com/international/news/gulliver-b100-series

The National Oilheat Research Alliance (NORA) has conducted and continues to conduct extensive research on higher blends of biofuel in new and existing heating equipment. Higher fuel blends have proven to not only work well, but also can result in helping homeowners achieve a zero-carbon home. (See link below.)

https://noraweb.org/2022/10/zero-carbon-home/

In a related matter, the association also wants to reiterate our main concerns that were submitted to the Department on February 23, 2024, relating to **310 CMR 7.71 – Reporting of Greenhouse Gas Emissions.**

The association believes the information that its members would be required to submit under the proposed regulations constitutes confidential competitive information relating to their businesses and potentially private data relating to their customers. Even if the scope of the information provided is reduced, MassDEP must include provisions to ensure that business information provided to the Department is protected from public disclosures.

Our association supports the following position as stated by one of our wholesale members. "We would not want any of this information (company names, sales volumes, customer information, etc.) to be made public as this is confidential business information. This reporting information, if made public, would pose a risk of negatively impacting industry competitiveness and therefore should not be published. The content of this information is commercially sensitive in nature, considered confidential, and the disclosure thereof could cause economic loss and prejudice to the competitive position of the entity as this data is not otherwise publicly available."

In its *Background Information and Technical Support Document*, Mass DEP states: "No significant economic impacts are anticipated from the implementation of reporting requirements on heating fuel suppliers, but minor administrative costs are anticipated."

The association believes this is a mistaken conclusion. The reporting requirements as currently drafted will impose significant economic impacts on all our members. Many of the association's members are small family businesses, with limited staff and resources. Complying with the requirements of 310 CMR 7.71 will be a major burden for these companies, particularly during the heating season. The Department needs to conduct a thorough analysis of that burden and modify the proposed rules to avoid undue economic impacts.

The association maintains that the costs of compliance with 310 CMR 7.71 will result in higher fuel costs for every home and business using heating oil or propane. Low-and moderate-income residents, including EJ communities and those receiving fuel assistance through LIHEAP, will be especially hard hit.

Thank you for the opportunity to provide written comments to the Department.

Michael Ferrante | President

CC: Board of Directors, Massachusetts Energy Marketers Association

Jim Blake, Eastern Oil & Propane, Danvers
Will Beck, Sprague Energy, Portsmouth, NH
Mark Brideau, Brideau Energy, Fitchburg
Scott Bouvier, Global Partners, Waltham
Laura Carbone, Alvin Hollis, Weymouth
Art Chaves, Coan Heating & Cooling, Natick
Andrew Davison, Cape Cod Biofuels, Sandwich
Robert Duffy, Devaney Energy, Newton
Ben Fawcett, Fawcett Energy Partners, Kingston
Erik Geckler, Mirabito Energy Products, Binghamton, NY
Doug Goodman, Dead River Company, South Portland, ME
Russ Freeman, Energy North Group/Haffner's, Lawrence
Tim Kasieck, Petro Home Services, Peabody
Michael Lamparelli, Frank Lamparelli Oil, Canton
Chris LeBoeuf, Falmouth Energy, Falmouth
Scott E. MacFarlane, MacFarlane Energy, Dedham
Paul Nazzaro, Advanced Fuel Solutions, Andover
Michael Niccoli, Niccoli Energy, Brockton
Ted Noonan, Noonan Energy, Noonan Energy
Jacob Nogueira, Atlantic-Pratt Energy, Braintree
Dennis O'Brien, Sail Energy, Portsmouth, NH
Steve Sack, Sack Energy, West Hartford, CT
Danny Silverman, Angus Energy, Fort Lauderdale, FL
Michael Trask, Hall-Trask Equipment, Braintree
Courtney Townsend, Townsend Energy, Danvers
Charlie Ueglietto, Cubby Oil & Energy, Wilmington
Gavin Williams, Williams Energy, Braintree
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Parnay, Angela L (DEP)

From:	sendtim@protonmail.com
Sent:	Thursday, February 29, 2024 11:08 AM
To:	Strategies, Climate (DEP)
Cc:	Space, William (DEP)
Subject:	Clean Heat Standard Limitations

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Hi friends,

As I consider a heat pump, some of the limitations required by the state in order to get the rebate are keeping me from implementing this in my home. Some of the restrictions placed on financial support for the project make so little sense that I believe I am better off sticking with wood and oil instead of switching to a heat pump.

Right now I heat with a mix of oil and wood. My house was built around 1850, and is 2,980 sq ft. I burn about 3 cords of wood each year and use 170 to 700 gallons of oil. Most of my first floor has forced hot air through a heat exchanger, while the upstairs has baseboard hot water. Since I mostly just open doors to let heat up the stairway and into the upstairs rooms as they are used, I actually almost never us the baseboard heating at all. Using a heat pump for the first floor, combined with wood heat, would have covered all of my needs.

Just about the only time the boiler kicks on was at night anyway. Realizing that would often be too cold outside for a air source heat pump to be effective, I called in Dandelion Energy to look at installing a geothermal unit for this night time use, and for when I am away.

What made me decide I could be better off without a heat pump at all is that I would be forced to remove the air exchanger on my oil boiler to get the rebates. Now what person in his or her right mind would use an oil boiler when you have cheaper and cleaner heat coming from the heat pump? Nobody. So no reason to remove a good backup/suplemental source. However, with the boiler and heat pump hooked up through an air handler something like an ADP model BVRMB9737S4N3 Air Handler 3 Ton Multi R-410A I could have a backup heat source that could be powered off a few small batteries or plugged into a car.

That's not allowed however. Instead, I have to rip out an existing system that wouldn't be used until our next hurricane anyway, then put in a huge, expensive generator and add another tank to hold its fossil fuel, decreasing reliability and adding unnecessary complexity while increasing environmental impact. Then I find out that the system I would be forced to buy has a (backup) electric heating coil in it just to be able to keep up with demands, adding even more costs!

At this point it seems that by far the most economical, environmental, and reasonable thing to do is just keep the fossil fuel system I have rather than install another system that doesn't work and relies on fossil fuels anyway.

Tim

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nationalgrid

Bonnie Heiple, Commissioner
Department of Environmental Protection
100 Cambridge St Suite 900
Boston, MA 02114

April 5, 2024

Dear Commissioner Heiple,

Thank you for the opportunity to provide additional comments on the Clean Heat Standard (CHS). National Grid supports the development and implementation of a CHS that will enable effective, affordable, and equitable decarbonization of heat in Massachusetts. We appreciate MassDEP's hard work on this important program, and look forward to continuing to work together toward our shared climate action and decarbonization goals.

Our comments today are intended to supplement National Grid's previous comments filed in August, September, and December of 2023, and focus on emerging issues that were not addressed in previous comments.

First, we would like to address the discussion from the March 7th virtual community meeting related to the Department of Public Utilities (DPU) "future of gas" order in docket D.P.U. 20-80. Making renewable natural gas (RNG) and clean hydrogen eligible to generate credits under the CHS is consistent with the DPU's 20-80 order, which calls for gas utilities (referred to as Local Distribution Companies, or LDCs) to "investigate all options that will lead to a reduction in their GHG footprint."[1] The order states that it will be "necessary to make RNG and/or hydrogen available" through LDC delivery infrastructure in "circumstances where electrification is not feasible for all natural gas applications,"[2] and authorizes gas utilities to propose RNG and hydrogen pilots.[3] **Most importantly, the order states that the DPU "support[s] customer choice as it relates to RNG,"[4]** and "will allow the option for consumers to purchase RNG from an LDC or a third-party supplier."[5] The DPU has clearly articulated a future for gas utilities that includes delivering RNG and potentially clean hydrogen to enable decarbonization of difficult-to-electrify applications. RNG and clean hydrogen delivered to customers by gas utilities should therefore be eligible to generate credits through the CHS, and the CHS should include a process for establishing and verifying the lifecycle carbon intensity of utility-delivered alternative fuels.

Second, we applaud MassDEP for including consideration of RNG and clean hydrogen eligibility within the discussion document on "Crediting for Non-residential Buildings" released in March 2024. This recognition of the GHG emissions reduction potential of these alternative fuels is an important step toward maximizing emissions reductions through the CHS. However, the discussion document proposes to exclude pipeline-delivered alternative fuels. We strongly urge MassDEP to include pipeline-delivered RNG and clean hydrogen as credit-generating technologies in the CHS, consistent with the conditions of the DPU's order in the 20-80 docket. The DPU makes clear in the 20-80 order that alternative fuels delivered by gas utilities will be necessary to provide clean energy for hard-to-

[1] MA Department of Public Utilities, Order on Regulatory Principles and Framework, DPU 20-80-B, December 6, 2023., p. 69
[2] Id., p. 70
[3] Id., p. 71
[4] Id., p. 70
[5] Id., p. 71

electrify customers. The DPU is unambiguous that alternative fuels will flow through existing gas utility distribution networks to meet those customers' needs.[6] Excluding pipeline-delivered alternative fuels will severely constrain difficult-to-electrify customers' ability to access alternative fuels, and is not consistent with the 20-80 order. Making RNG and clean hydrogen delivered by gas utilities eligible to generate CHS credits will make clean heat accessible to any customer connected to the gas system, eliminating barriers to adoption and reducing more emissions sooner. Delivering alternative fuels through the existing gas network will maximize emissions reductions by allowing producers to capture more waste methane than they may consume themselves, and by empowering customers for whom it is infeasible to host RNG production to eliminate fossil fuels. Additionally, excluding pipeline-delivered alternative fuels may require construction of new dedicated RNG distribution pipelines and will add significant costs and unnecessary impacts that would be avoided if existing gas distribution infrastructure is used to deliver alternative fuels.

Finally, we applaud the many organizations and individuals who provided comments to MassDEP calling for the CHS to use lifecycle assessment of GHG emissions, and for the CHS to be technology-inclusive. There is broad consensus among stakeholders that lifecycle assessment is an essential tool for ensuring real, verifiable emissions reductions and avoiding GHG "leakage." Further, the public comments demonstrate significant support for allowing utility-delivered alternative fuels to generate CHS credits. We urge MassDEP to incorporate these key principles into the CHS to ensure the program is effective, affordable, and equitable.

We look forward to continuing to work closely with MassDEP and other stakeholders on this important effort.

Sincerely,

Huck Montgomery
Director, US Policy & Regulatory Strategy
National Grid

[6] Id., see first paragraph of p. 70

February 16, 2024

Commissioner Bonnie Heiple
Massachusetts Department of Environmental Protection 100
Cambridge Street, Suite 900
Boston, Massachusetts 02114

Re: The MassDEP Clean Heat Standard – Stakeholder Comments

Dear Commissioner Heiple:

The Northeast Chapter of the Combined Heat and Power Alliance (the "Northeast Chapter") welcomes this opportunity to provide comments regarding the MassDEP Clean Heat Standard ("CHS") Draft Framework as presented at the Technical Session held on February 8, 2024. The Northeast Chapter is the successor organization to the Northeast Clean Heat and Power Initiative, which submitted several prior comments during the MA Clean Heat Standard and Alternative Energy Portfolio Standard proceedings.

The Northeast Chapter is a group of manufacturers, system developers, engineers, and end-user representatives with the common goal of reducing energy costs and carbon emissions using the highly efficient and reliable technology of combined heat and power ("CHP"). Many of its members are located in Massachusetts and/or develop and operate projects therein. The Northeast Chapter strongly believes that CHP must play a crucial role in reducing marginal grid emissions in the near-term while assisting Massachusetts efforts for a fully electrified grid. The United States Department of Energy shares this sentiment in stating that "[i]ndustrial CHP can provide significant greenhouse gas emissions reductions in the near- to mid-term as marginal grid emissions continue to be based on a mix of fossil fuels."[1] Ignoring CHP at this critical moment is fundamentally inconsistent with the express goals of the MassDEP's CHS.

In furtherance of such goals, we are pleased to submit the following comments emphasizing the need to include CHP technologies in MassDEP's comprehensive decarbonization strategy, specifically regarding the CHS.

1. The Northeast Chapter strongly encourages MassDEP to adopt a standard that is: (i) based on overall greenhouse gas reductions; (ii) expressed in relation to such reductions; and (iii) technologically agnostic regarding the method of achieving such reductions.

The expressed purpose of MassDEP's Clean Heat Standard is to reduce climate pollution. The Northeast Chapter shares the desire to reduce such pollution, which is why CHP must be included in the CHS. The inclusion of "full electrification" as a requirement to receive credits ignores CHP, which currently results in lower greenhouse

[1] US Department of Energy, Industrial Decarbonization Roadmap, Sep. 2022 at 14, https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf

gas emissions than the grid:[2]

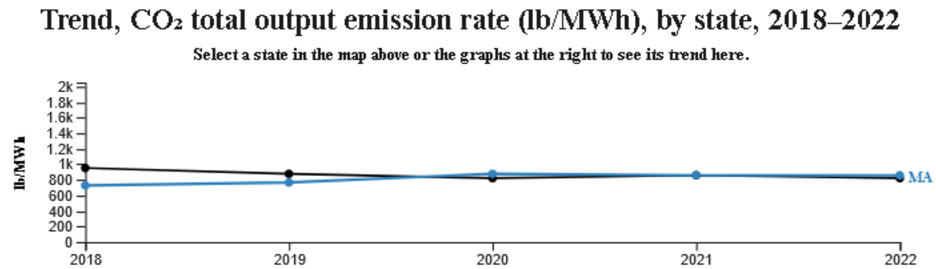

Figure A: MA Average Grid Emissions increased from 727.58 lb / MWh in 2018 to 851.74 lb CO2/MWH in 2022 (higher than the national average of 823.15 lb CO2/MWh).

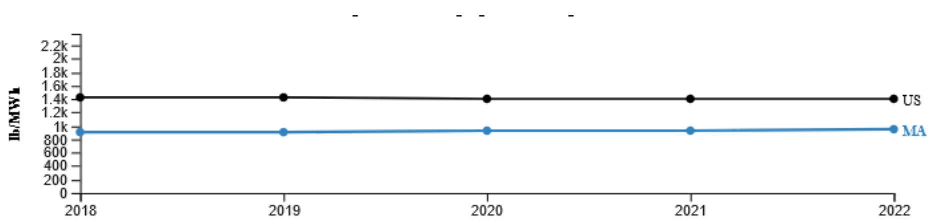

Figure B: MA Non-Baseload Grid Emissions increased slightly from 910.58 lb / MWh in 2018 to 944.55 lb CO2/MWH in 2022.

The CHS must take a technologically agnostic approach that prioritizes actual greenhouse gas reductions over select technologies that are not currently delivering similar reductions. Such an approach will result in lower carbon emissions *now* while supporting the transition to full electrification. Additionally, this technologically agnostic approach will ensure that the Commonwealth remains at the cutting edge of innovation throughout the energy transition by not foreclosing the possibility that other technologies may reduce emissions further than is currently contemplated. Finally, a technologically agnostic approach will give the Commonwealth's citizens a level of consumer choice that is likely to incentivize them to shift away from current fossil fuel sources in a timelier manner.

One of CHP's greatest strengths is that it is not a "technology lock in," but rather operates as a fuel-flexible system capable of using both low-carbon and zero-carbon fuels.[3] As such, it can serve as a both a transitional technology, bridging the gap as Massachusetts moves to electrification and can fill the gaps by addressing difficult to decarbonize sectors. CHP is an established, high-efficiency technology reducing marginal grid emissions today by displacing dirtier grid resource carbon emissions, as demonstrated in Figure C:

Renewable and Net-Zero Carbon Fuels Maintain CHP's Advantage

[2] *See* United States Environmental Protection Agency, eGrid with 2022 Data, Summary Data. https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf; *see infra* Figure A.
[3] Today's existing and newly installed CHP systems can use a substantial blend of clean hydrogen – ranging from 20-100%, according to equipment manufacturers. CHP Alliance. "Clean Hydrogen and CHP: A Roadmap for Industrial and Commercial Decarbonization." March 2022. https://chpalliance.org/wp-content/uploads/2019/08/CHP-Hydrogen-Roadmap-2.pdf

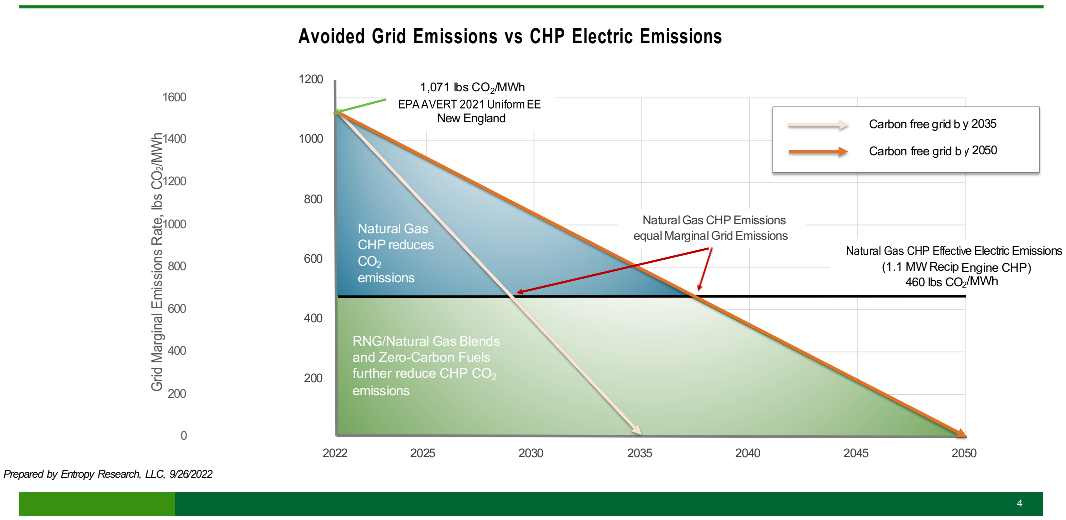

Figure C: In conjunction with Figures A and B, the reduction in difficult to ameliorate marginal grid emissions can be affected via Combined Heat and Power technology.

Furthermore, Figure C illustrates that as zero carbon fuels become available for use in CHP systems, they can maintain carbon advantage over the grid for a considerable period into the future. If, as some studies have suggested, net-zero carbon fuels are in limited supply and/or expensive, using these relatively scarce and costly fuels in high-efficiency CHP systems will ensure they are used in the most productive manner.

The Carbon Leadership Forum has noted that, "[b]ecause emissions are cumulative and because we have a limited amount of time to reduce them, carbon reductions now have more value than carbon reductions in the future. The next couple of decades are critical."[4] CHP is the precise type of technology that results in less carbon produced *now*. Accordingly, the MassDEP must adopt a technologically agnostic approach considering the critical nature of this moment in time. The consequences of ignoring in the near to medium term better performing technologies, such as CHP, could have significantly increased transition costs while increasing CO2 emissions outcomes fundamentally inconsistent with the express environmental and affordability goals of the MassDEP's CHS.

2. The Northeast Chapter urges that MassDEP include CHP as part of its commitment to equity, in its push to decarbonize and electrify the grid.

CHP can provide crucial assistance in the equity space, a priority the MassDEP highlighted in its recap of Initial Stakeholder Comments from the May-August 2023 comment period. CHP is presently being used to control costs and provide reliability within existing public housing infrastructure and healthcare facilities.[5] The Northeast Chapter is committed to environmental justice and applauds the MassDEP's commitment to equity concerns, which it has highlighted in its own presentations, and which concerns have been shared by a variety of its stakeholders throughout the comments period. A proven driver of

[4] Larry Strain. The Time Value of Carbon, Carbon Leadership Forum, University of Washington, May 10, 2017. https://carbonleadershipforum.org/download/35419/?tmstv=1696538222
[5] MassDEP. "Clean Heat Standard, 2023 Initial Stakeholder Comments." May-August 2023. https://www.mass.gov/doc/chs-summer-2023-comment-summary/download

environmental equity, such as CHP, must be considered as part of the MassDEP's CHS. Ignoring CHP would be a disservice to certain of Massachusetts' most vulnerable communities.

3. The CHS should provide full credit for renewable natural gas ("RNG"), biofuels, and hydrogen, immediately and in perpetuity.

The Northeast Chapter strongly believes that all clean energy sources, including RNG, biofuels, and hydrogen should be eligible for credits immediately and that the proposed 2028 study to consider such other fuels be eliminated. In the alternative, the proposed study must be expedited so as to be considered during the 2024-2025 timeframe. As noted by other stakeholder comments, excluding other clean fuels until further study discourages their use, impedes investment in and stifles development of clean energy resource options, narrowing the set of alternatives at this critical moment for the environment. As noted by Eversource, significant electrical infrastructure improvements are required to enable the clean energy objectives of the Commonwealth reliably and safely.[6] As those improvements are likely to take significant time to implement, decarbonized RNG and biofuels provide a viable solution while the Commonwealth constructs the infrastructure necessary to meet its climate goals. Disincentivizing the use of these energy sources during the energy transition puts the Commonwealth at risk of failing to meet its climate goals.

Hydrogen must be given full credit immediately and in perpetuity. National Grid agrees that alternate fuels like RNG and hydrogen are valuable decarbonization resources and therefore should be included in the CHS.[7] In its submission dated September 1, 2023, the Northeast Chapter highlighted the benefits of the proposed Northeast Regional Hydrogen Hub, which was supported by seven regional states, including Massachusetts. Given the Commonwealth's prior support for hydrogen, it should be included along with other clean fuels in the MassDEP's CHS.[8] Similarly, the United States Department of Energy believes that the use of "renewable and synthetic fuels, and clean sources of energy as the prime movers for CHP systems can avoid the use of fossil fuels, which will support the integration of CHP into a fully decarbonized energy economy."[9] Accordingly, RNG, biofuels, and hydrogen must be given full credit immediately, and in perpetuity under the CHS.

Several states, including California, Oregon, Washington, Vermont, and Colorado, allow for use of alternative fuels in their transportation sector Low Carbon Fuels Standard or CHS. The Commonwealth ought to look to the experiences of Colorado's investor-owned gas utilities in meeting that state's Clean Heat Standard. According to a recent article in S&P Global, gas utilities Atmos and Black Hills are relying heavily on energy efficiency and renewable natural gas (later, in 2030, hydrogen) to meet the CHS mandates and stay under the cost cap:

> In assessing different clean heat portfolios, the companies {Atmos, Black Hills} ran into a dilemma similar to the one their larger peer, Xcel Energy Inc., encountered when it filed the state's first clean heat plan in August 2023. Achieving the full 22% reduction by 2030 would require far outspending

[6] *See Id.* at p 26.
[7] *See Id.* at p 64.
[8] *See Id.* at p 72.
[9] US Department of Energy, *Industrial Decarbonization Roadmap*, Sep. 2022 at 14, https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf.

the cost cap imposed on clean heat plans by legislators, or 2.5% of annual retail sales. [10]

We urge that all viable options for meeting our shared concerns, be kept open. Pre-selecting a subset of technologies and systems, while ruling out other alternative fuels as eligible measures in the CHS is not in line with a goal of maximizing emissions reductions and ensuring affordability for customers.

<u>Conclusion</u>

The MassDEP's proposed CHS is not in alignment with its stated mission to reduce climate pollution.[11] In order to remain truly committed to this mission, all credits given to energy sources and technologies should be linked to the life cycle reduction in greenhouse gas emissions that these solutions provide. Accordingly, the CHS must be technology agnostic and provide full credits to a broader spectrum of energy sources, such combined heat and power technology and low carbon/zero carbon fuels such as hydrogen and RNG, provided that they deliver greenhouse reductions relative to fossil fuels.

Respectfully,

The Northeast Chapter of the Combined Heat and Power Alliance

[10] Tom DiChristopher, Atmos, Black Hills Rely on Energy Efficiency, RNG in Colo. Clean Heat Plans, January 17, 2024. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/atmos-black-hills-rely-on-energy-efficiency-rng-in-colo-clean-heat-plans-80068913

[11] Regulatory Assistance Project. "A Clean Heat Standard for Massachusetts." June 2022. www.mass.gov/doc/clean-heat-standard-2-page-summary/download

April 5, 2024

Commissioner Bonnie Heiple
Massachusetts Department of Environmental Protection 100
Cambridge Street, Suite 900
Boston, Massachusetts 02114

Re: The MassDEP Clean Heat Standard – Stakeholder Comments

Dear Commissioner Heiple:

The Northeast Chapter of the Combined Heat and Power Alliance (the "Northeast Chapter") submits this letter as a supplement to its comments regarding the MassDEP Clean Heat Standard ("CHS") Draft Framework dated February 16, 2024. As a reminder, the Northeast Chapter is the successor organization to the Northeast Clean Heat and Power Initiative, which submitted several prior comments during the MA Clean Heat Standard and Alternative Energy Portfolio Standard proceedings.

The Northeast Chapter is a group of manufacturers, system developers, engineers, and end-user representatives with the common goal of reducing energy costs and carbon emissions using the highly efficient and reliable technology of combined heat and power ("CHP"). Many of its members are located in Massachusetts and/or develop and operate projects therein. As previously stated, the Northeast Chapter strongly believes that CHP must play a crucial role in reducing marginal grid emissions in the near-term while assisting Massachusetts efforts for a fully electrified grid. The United States Department of Energy shares this sentiment, stating that "[i]ndustrial CHP can provide significant greenhouse gas emissions reductions in the near- to mid-term as marginal grid emissions continue to be based on a mix of fossil fuels."[1] Ignoring CHP at this critical moment is fundamentally inconsistent with the express goals of the MassDEP's CHS.

In furtherance of such goals, we are pleased to supplement our prior comments, emphasizing the need to include CHP technologies in MassDEP's comprehensive decarbonization strategy, specifically regarding the CHS.

1. The CHS should provide full credit for renewable natural gas ("RNG"), biofuels, and hydrogen, immediately and in perpetuity. Additionally, credits should be awarded for the use of any alternate fuel, or process, that results in reductions in emissions from fossil fuel combustion.

While we are encouraged by the MassDEP's consideration of "potential mechanisms for emission reduction credits generation in non-residential buildings" related to "non-pipeline clean fuels," noted in its

[1] US Department of Energy, Industrial Decarbonization Roadmap, Sep. 2022 at 14, https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf

Stakeholder Discussion Document dated March 2024, the Northeast Chapter continues to strongly believe that hydrogen must be given full credit immediately and in perpetuity, regardless of whether the building is residential or not. Additionally, we support allowing crediting for reductions in emissions, compared to fossil fuel combustion, resulting from the substitution of renewable natural gas and hydrogen. Consistent with the MassDEP's stated goal of reducing climate pollution, such credit for reductions should be awarded for the use of any alternative fuel, or process such as CHP, that results in reductions in emissions from fossil fuel combustion. The degree of credit, of course, could vary based on the degree of emissions reduction, but the MassDEP should reward **all** verifiable means of carbon reduction. The MassDEP must not let perfect be the enemy of good.

As noted in point "3" of our comments dated February 16, 2024, the Northeast Chapter strongly believes that all clean energy sources, including RNG, biofuels, and hydrogen should be eligible for credits immediately and that the proposed 2028 study to consider such other fuels be eliminated. In the alternative, the proposed study must be expedited so as to be considered during the 2024-2025 timeframe. As noted by other stakeholder comments, excluding other clean fuels until after further study discourages their use, impedes investment in and stifles development of clean energy resource options, narrowing the set of alternatives at this critical moment for the environment. As noted by Eversource, significant electrical infrastructure improvements are required to enable the clean energy objectives of the Commonwealth reliably and safely.[2] As those improvements are likely to take significant time to implement, decarbonized RNG and biofuels provide a viable solution while the Commonwealth constructs the infrastructure necessary to meet its climate goals. Disincentivizing the use of these energy sources during the energy transition puts the Commonwealth at risk of failing to meet its climate goals.

RNG and biofuels are already being utilized to reduce greenhouse gas emissions in Massachusetts. The MassDEP has highlighted the benefits of such use in wastewater treatment operations.[3] Additionally, the Commonwealth has noted that RNG and biofuels are actively being utilized in agricultural and industrial settings.[4] It would be counterintuitive, and contrary to the MassDEP's express goals, to disincentivize the use of RNG and biofuels, particularly when the Commonwealth and MassDEP are promoting their use and benefits. Accordingly, RNG, biofuels, and hydrogen should be eligible for credits immediately as a proven method of greenhouse gas emissions and climate pollution reductions.

National Grid agrees that alternate fuels like RNG and hydrogen are valuable decarbonization resources and therefore should be included in the CHS.[5] In its submission dated September 1, 2023, the Northeast Chapter highlighted the benefits of the proposed Northeast Regional Hydrogen Hub, which was supported by seven regional states, including Massachusetts. Given the Commonwealth's prior support for hydrogen, it should be included along with other clean fuels in the MassDEP's CHS. [6] Similarly, the United States Department of Energy believes that the use of "renewable and synthetic fuels, and clean sources of energy as the prime

[2] *See Id.* at p 26.
[3] *See* Shutsu Chai Wong, Tapping the Energy Potential of Municipal Wastewater Treatment: Anaerobic Digestion and Combined Heat and Power in Massachusetts, Mass DEP, July 2011, https://www.mass.gov/doc/tapping-the-energy-potential-of-municipal-wastewater-treatment-anaerobic-digestion-and-0/download
[4] *See* Anaerobic Digestion Case Studies, Commonwealth of Massachusetts, 2024, https://www.mass.gov/info-details/anaerobic-digestion-case-studies
[5] *See* US Department of Energy, Industrial Decarbonization Roadmap, Sep. 2022 at p 64.
[6] *See Id.* at p 72.

movers for CHP systems can avoid the use of fossil fuels, which will support the integration of CHP into a fully decarbonized energy economy."[7] Accordingly, RNG, biofuels, and hydrogen must be given full credit immediately, and in perpetuity under the CHS.

Several states, including California, Oregon, Washington, Vermont, and Colorado, allow for use of alternative fuels in their transportation sector Low Carbon Fuels Standard or CHS. The Commonwealth ought to look to the experiences of Colorado's investor-owned gas utilities in meeting that state's Clean Heat Standard. According to a recent article in S&P Global, gas utilities Atmos and Black Hills are relying heavily on energy efficiency and renewable natural gas (later, in 2030, hydrogen) to meet the CHS mandates and stay under the cost cap:

> In assessing different clean heat portfolios, the companies {Atmos, Black Hills} ran into a dilemma similar to the one their larger peer, Xcel Energy Inc., encountered when it filed the state's first clean heat plan in August 2023. Achieving the full 22% reduction by 2030 would require far outspending the cost cap imposed on clean heat plans by legislators, or 2.5% of annual retail sales. [8]

We urge that all viable options for meeting our shared concerns, be kept open. Pre-selecting a subset of technologies and systems, while ruling out other alternative fuels as eligible measures in the CHS is not in line with a goal of maximizing emissions reductions and ensuring affordability for customers.

Conclusion

The MassDEP's proposed CHS is not in alignment with its stated mission to reduce climate pollution.[9] In order to remain truly committed to this mission, all credits given to energy sources and technologies should be linked to the life cycle reduction in greenhouse gas emissions that these solutions provide. Accordingly, the CHS must be technology agnostic and provide full credits to a broader spectrum of energy sources, such as CHP technology and low carbon/zero carbon fuels such as hydrogen and RNG, provided that they deliver greenhouse reductions relative to fossil fuels. Finally, credits should be awarded for the use of any alternate fuel, or process, that results in reductions in emissions from fossil fuel combustion.

Respectfully,

The Northeast Chapter of the Combined Heat and Power Alliance

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[7] US Department of Energy, *Industrial Decarbonization Roadmap*, Sep. 2022 at 14, https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf.

[8] Tom DiChristopher, Atmos, Black Hills Rely on Energy Efficiency, RNG in Colo. Clean Heat Plans, January 17, 2024. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/atmos-black-hills-rely-on-energy-efficiency-rng-in-colo-clean-heat-plans-80068913

[9] Regulatory Assistance Project. "A Clean Heat Standard for Massachusetts." June 2022. www.mass.gov/doc/clean-heat-standard-2-page-summary/download

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Feb 23, 2024

Department of Environmental Protection
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Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK

COMMENTS OF THE PROPANE GAS ASSOCIATION OF NEW ENGLAND

On behalf of the Propane Gas Association of New England (PGANE), which represents propane marketers, suppliers and equipment manufacturers across Massachusetts, we appreciate the opportunity to provide comment regarding the Massachusetts Department of Environmental Protection's (DEP) proposed Clean Heat Standard (CHS) regulation.

The Commonwealth of Massachusetts boasts a robust propane market, having nearly 250,000 retail accounts and 92,000 primary home heating customers.[1] Massachusetts' propane industry provides good-paying jobs and generates more than $615 million in economic activity annually.[2]

The proposed CHS regulation would fundamentally alter the marketplace in which our members seek to operate and conduct business. To be clear, we share DEP's desire to reduce greenhouse gas (GHG) emissions and promote a more carbon-friendly energy sector. Sustainable and cost-effective decarbonization is best achieved through a multi-pronged approach that includes clean and efficient energy molecules, such as propane, in addition to bulk electricity generated from cleaner sources than today. Such an approach would take into consideration the reliability and resilience of various energy options, as well as the aggregate costs passed along to energy consumers and commercial businesses.

Unfortunately, the current draft framework proposal treats all energy customers alike, which they are not. Unlike urban and suburban households, many residential propane customers live in rural and remote areas that are not well-served by the bulk electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. State officials have also failed to acknowledge the diversity of housing stock across the commonwealth. Propane marketers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not a solution for environmental justice communities, many of whom live in mobile homes. These types of buildings are better served by propane space heating which keeps uninsulated pipes from freezing in the wintertime, unlike heat pumps. This is yet another crucial reason we urge the DEP to treat propane differently than other combustion fuels.

Reducing Greenhouse Gases

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program should focus less on the type of energy to delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than

[1] *Propane's Impact on Economy: 2018 Massachusetts,* National Propane Gas Association, https://www.npga.org/wp-content/uploads/2020/06/Massachusetts_Propane-1-Pager_2020.pdf
[2] *Id.*

decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with commonwealth targets, and less on marching towards the complete electrification of building stock. In short, the framework structure should focus on carbon.

Scientific Analysis Requires Lifecycle Analysis

The Department of Environmental Protection needs to take a holistic view of energy consumption and evaluate the carbon footprint of all energy sources – and the appliances that are powered by them – fairly and accurately. This is best accomplished through a full fuel-cycle (FFC) analysis of energy consumption the utilizes source energy metrics. FFC includes the energy consumed onsite, but also incorporates applicable energy used in upstream processes, as well as the energy needed to convert a primary energy source into a secondary one and transport that energy to an end user. The use of FFC and source energy metrics has been endorsed by the National Academies and the Department of Energy's Office of Energy Efficiency and Renewable Energy.[3]

Propane has a source-site ratio of 1.01, compared to 2.80 for grid electricity.[4] This means, for electricity from the grid, it takes 2.80 units of energy to produce and delivery one unit of energy to a home, compared to only 1.01 for propane. For utility-scale electricity, more than 60% of energy is lost during the generation and conversion process, thereby drastically increasing emissions of GHGs and criteria pollutants.[5] The average efficiency of a natural gas plant is only 44 percent.[6] The average efficiency of a petroleum plant is 31%.[7] And an additional 5% of energy is lost during the transmission and distribution of electricity to an end user, further decreasing efficiencies and increasing CO_2 emissions.[8]

Exempt Propane from the CHS or Delay Implementation of Propane Systems

DEP has set different timeframes for electricity and should consider the same approach for propane. Propane only accounts for 4.1 percent blurb. Until such time as the CI as defined under the EPA Greet standard, for electricity is lower than propane and propane blends, it makes absolutely no sense from an environmental or equity perspective to include propane in the CHS. Propane is a beneficial by-product of natural gas, yet more propane is wasted and simply burned off than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, it makes no sense not to incentivize more use of propane if the Bay State is going to be a responsible steward of their energy beneficial by products.

2022 Massachusetts (in state) Bulk Electric Generation Mix[9]

- Natural Gas – 77.8%
- Petroleum – 3.8%
- Hydroelectric – 4.5%

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[3] *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

[4] *Source Energy Technical Reference,* Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

[5] *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436

[6] *Average Operating Heat Rate for Selected Energy Sources*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html

[7] *Id.*

[8] *How much electricity is lost in electricity transmission and distribution in the United States?*, U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

[9] *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
- Others (e.g., tire-derived fuels, municipal solid waste) – 2.1

Energy Security and Reliability

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[10]

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[11]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

Environmental Justice and Equity Considerations

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[12]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[13] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[14] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[15] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup should be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system should be rejected.

If Propane is Not Exempted from CHS, Propane Should Generate Credits

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, should generate clean heat credits. This should include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and

[10] *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316
[11] *Space heating and water heating account for nearly two thirds of U.S. home energy use*, U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433
[12] *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf
[13] *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector*, U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html
[14] *Id.*
[15] *Supra 16*

improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[16] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[17]

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[18] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[19] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the delivery of propane should generate CHS credits for both traditional and renewable propane.

Credit generation opportunities should be extended to thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

<u>Renewable Propane</u>

The delivery of renewable propane and renewable propane blends should generate clean heat credits in all circumstances. Renewable propane should be explicitly designated as a qualifying biofuel. In order to incentivize innovation and increase the displacement of non-renewable thermal fuels, the definition of renewable fuels should be broadly defined and not narrowly tailored. Because renewable propane is such a new and rapidly emerging energy source, DEP should qualify any renewable propane certified by the International Sustainability Carbon Certification (ISCC) as renewable as qualifying for CHS Clean Heat Credits. This is especially important given that EPA RINS currently tie renewable propane usage to Autogas transportation usage only, and we want to incentivize the usage of renewable propane for home heating. ISCC is the international standard and utilizing this certification would increase innovation in renewable energy. As a drop in heating fuel, propane minimizes the financial impact to environmental justice communities and furthers the state's environmental equity goals.

Renewable propane is a by-product of renewable diesel production and can be derived from a variety of sustainable sources, such as biomass, animal fats, and vegetable oils.[20] At the point of combustion, renewable propane is carbon neutral because it's not releasing new carbon into the atmosphere.

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[16] *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

[17] *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

[18] *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/

[19] *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

[20] *Propane Production and Distribution*, Alternative Fuels Data Center, U.S. Department of Energy, https://afdc.energy.gov/fuels/propane_production.html

Renewable propane currently being used in California has a CI score as low as 21.[21] This renewable propane is produced from non-rendered, used domestic cooking oil.

It's important to ensure DEP recognizes blends (i.e., mixture of renewable and conventional LPG) of renewable propane as full credit generation opportunities, as opposed to simply gallons composed of 100% renewable fuel.

Technologies for renewable propane production include:[22] Hydro processed Esters and Fatty Acids (HEFA), Cool LPG, Methanol-to-Olefine (MTS) with hydrogenation of olefins, and catalytic conversions of sugars. Renewable propane feedstocks include:[23] FOGs (fats, oils, greases), forest resources, waste, and agricultural residue. Per the proposed standard framework, the final regulation would include a requirement to consider expanding eligibility to other fuels in a required 2028 program review. Fuels would be evaluated based on availability, life-cycle GHG emissions, and local air pollution. The Bay State has an opportunity to further environmental justice while encouraging innovation in renewable energy by incentivizing renewable energy blends in liquid biofuels. The state should incentivize these immediately and for clean heat credits early registration rather than waiting to 2028.

Thank you for allowing more time for us to submit these formal written comments on the Clean Heat Standard Draft Framework. This is our busiest time of the season and we have limited resources as a small business association.

Sincerely,

Leslie Anderson
President
Propane Gas Association of New England

[21] *Staff Summary, Renewable Naphtha and Renewable Propane from Distillers' Corn Oil, Used Cooking Oil, and Rendered Animal Fat*, California Air Resources Board (April 30, 2021), https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/comments/tier2/b0189_summary.pdf

[22] Baldwin, R., Nimlos, M., and Zhang, Y., *Techno-Economic, Feasability, and Life Cycle Analysis of Renewable Propane*, National Renewable Energy Laboratory, https://www.nrel.gov/docs/fy23osti/83755.pdf

[23] *Id.*

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April 5, 2024

Department of Environmental Protection
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Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK and FAQ Q.0

COMMENTS OF THE PROPANE GAS ASSOCIATION OF NEW ENGLAND

On behalf of the Propane Gas Association of New England (PGANE), which represents propane marketers, suppliers and equipment manufacturers across Massachusetts, we appreciate the opportunity to provide comment regarding the Massachusetts Department of Environmental Protection's (DEP) draft framework and FAQ Q0. We also would like to provide additional information to DEP about renewable propane and we urge DEP to include credits for International Sustainability Carbon Certificated (ISCC) renewable propane in the proposed rule this fall.

Propane is an alternative clean energy, and we share DEP's desire to reduce greenhouse gas (GHG) emissions and promote a more carbon-friendly energy sector. However, the proposed CHS draft framework would fundamentally alter the marketplace in which our members seek to operate and conduct business. To be clear, sustainable and cost-effective decarbonization is best achieved through a multi-pronged approach that includes clean and efficient energy molecules, such as propane, in addition to bulk electricity generated from cleaner sources than today. DEP's approach should take into consideration the reliability and resilience of various energy options, as well as the aggregate costs passed along to energy consumers and commercial businesses.

Unfortunately, the current draft framework proposal treats all energy customers alike, which they are not. Unlike urban and suburban households, many residential propane customers live in rural and remote areas that are not well-served by the bulk electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. State officials have also failed to acknowledge the diversity of housing stock across the commonwealth. Propane marketers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not the best solution for environmental justice communities, many of whom live in mobile homes. These types of buildings are better served by affordable propane space heating which keeps uninsulated pipes from freezing in the wintertime, unlike heat pumps. This is yet another crucial reason we urge the DEP to treat propane differently than other combustion fuels.

Renewable Propane MA CHS Comments

The Department of Energy recognizes renewable propane as a drop-in replacement fuel for all propane applications. As with biodiesel, renewable propane is produced from natural fats (tallow), used cooking oils and other types of grease. Biodiesel refineries can produce renewable propane from these fats and oils before they are used to produce biodiesel, giving materials once resigned to the landfill a new life.

Renewable propane has an ultra-low carbon intensity, less than most other energy sources. At present, renewable propane is mostly produced and utilized on the West Coast to meet the California Low Carbon Fuel Standard and the

Clean Fuel Standards in Washington and Oregon. The California Air Resources Board (CARB) calculates a carbon intensity (CI) score between 20.5 – 43.5 gCO_2eq/MJ, depending on feedstock, compared to CIs of 130 for "average U.S. Electricity" and 91 for gasoline and diesel.

However, every state in New England has had renewable propane delivered to it in 2023, and Springfield, Massachusetts now has the only terminal dedicated to an International Sustainability Carbon Certification (ISCC) certified renewable propane blend. This terminal obtains renewable propane from the Midwest, and it is not tied to transportation RINS, allowing it to be used for home heating and other applications. While renewable propane is a very new energy source, its production is growing, and it will continue to become more available as other renewable fuels grow. If DEP is going to realistically assume that Massachusetts will meet its clean electricity goals as part of the basis for their CHS design, DEP must also assume that renewable propane will be available in future quantities to continue to keep propane cleaner than electricity in Massachusetts. With the expansion of biofuels and sustainable aviation fuels the future growth of renewable propane is no less tenuous than the future growth of wind and solar. Indeed, there are production facilities for renewable propane growing all over the globe as illustrated on the WLGA map.[1]

Renewable propane has the same great features as conventional propane — reliability, portability, power, and reduced carbon emissions — but with even lower carbon emissions when compared with other energy sources. This makes renewable propane an ideal energy source for housing stock that is older and not suited to heat pumps, or for housing such as mobile homes. Renewable propane also provides a cleaner future solution for these locations without the need for costly infrastructure upgrades, because it is chemically identical to propane used today.[2] This means that it is a drop in fuel, working in existing propane boilers, furnaces, and heaters. The difference is that instead of being a by-product of natural gas production like conventional propane, renewable propane is a co-product of renewable diesel and sustainable aviation fuel.

Innovation around renewable propane should be incentivized by the state. Renewable propane can also be made from plant stock and more and more renewable propane is being generated from the seed oil of the camelina plant.[3] Also known as camelina sativa or false flax, camelina is a member of the mustard family and a relative of cabbage, kale, and cauliflower, but is not a food crop nor does it compete with food production. Today, camelina is grown in cooler regions of the U.S. and will expand to the south as producers are experimenting with varieties that can thrive in warmer climates. Camelina is drought and pest tolerant and is a pollinator for bees.

This cover crop is completely waste-free as the seed produces 40% oil, twice the amount of soybean, the remaining meal is FDA approved for cow and chicken feed, and the husks are used for mulch. It is beneficial for farmers because it enriches the soil and prevents erosion when fields are fallow and provides additional income without the need for new equipment.

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[1] https://www.worldliquidgas.org/key-focus-areas/renewable-liquid-gas/
[2] https://online.fliphtml5.com/addge/peyi/#p=1
[3] https://propane.com/about-propane/renewable-propane/

Comments on FAQ Q0:

Heat pump credits: We agree with DEP that 5 MMT is way too high of an emission reduction for residential heat pump credits. We encourage DEP to utilize the lifecycle analysis and GREET model to calculate the actual emissions cradle to grave for electricity. We are concerned that MA DEP is making a mistake by not incentivizing the usage of propane in the Commonwealth. Prioritizing electric heat pumps, over cleaner propane systems will increase emissions in our state. We urge DEP to consider providing credits for geologic propane and treating it in the same manner as DEP already applies to renewable biomass. Propane is a beneficial by-product of natural gas processing and if it is not used it is wasted. As a waste product, it should be incentivized not only so that it will lower GHG emissions, but also so that it will be available as a reliable affordable energy source for energy security during times or emergencies.

The fundamental purpose of the Clean Heat Standard is to reduce emissions, not promote certain technologies for extrinsic reasons (CECP, Appendix B-3, page 61).[4] We wish to stress that we believe propane should be an incentivized clean heat credit energy under the MA CHS. Today, geologic propane in MA has a carbon intensity of 77 which is less than the carbon intensity of electricity and heat pumps in MA which is 100 – 140 depending on how cold the winter is each year. Even if MA electricity will become cleaner, it still makes no sense to disincentivize propane systems as the propane industry will continue to lower its carbon intensity with the addition of renewable propane blends, and we anticipate propane in MA to always have a lower carbon intensity than MA electricity and heat pumps. Thus, if MA DEP Is indeed trying to reduce carbon emissions today with a CHS, propane should be awarded clean heat credits.

Renewable propane should be incentivized in MA by DEP taking the lead to promote renewable propane development in the state. DEP could be leading the way and setting an example of how to reduce emissions while maintaining an equitable solution to energy security. MA must have a backup energy for electricity outages and extreme weather events. Propane fills this role today as the backup fuel for generators across our state, and its use should be increased in the state to make sure we have environmental equity and affordability.

Electricity credit requirements: The delay of the emission reduction credit holding requirement for electricity sellers from 2031 until 2035, concerns our industry as it incentives electricity over propane and because DEP states that this change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers. Our industry is made up of over 70 small businesses across the Commonwealth and we have been quite vocal about the burden these regulations will have on our members. With less than five percent of the thermal sector, it makes more sense for DEP to carve out propane or postpone any regulatory burdens on our industry.

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program should focus less on the type of energy to be delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with commonwealth targets, and less on marching towards the complete electrification of building stock. In short, the framework structure should focus on carbon.

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[4] Final Report: Commission on Clean Heat, November 30, 2022, Governor Baker's Commission on Clean Heat

than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, it makes no sense not to incentivize more use of propane if the Bay State is going to be a responsible steward of their energy beneficial by products.

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- Natural Gas – 77.8%
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- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
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Energy Security and Reliability

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[12]

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5 *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

6 *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

7 *Source Energy Technical Reference,* Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

8 *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436

9 *Average Operating Heat Rate for Selected Energy Sources*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html

10 *Id.*

11 *How much electricity is lost in electricity transmission and distribution in the United States?*, U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

12 *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[13]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

Environmental Justice and Equity Considerations

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[14]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[15] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[16] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[17] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup should be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system should be rejected.

If Propane is Not Exempted from CHS, Propane Should Generate Credits

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, should generate clean heat credits. This should include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[18] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[19]

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13 *Space heating and water heating account for nearly two thirds of U.S. home energy use*, U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433

14 *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf

15 *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector*, U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html

16 *Id.*

17 *Supra 16*

18 *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

19 *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[20] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[21] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the delivery of propane should generate CHS credits for both traditional and renewable propane.

Credit generation opportunities should be extended to thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

Thank you for your consideration.

Sincerely,

Leslie Anderson
President
Propane Gas Association of New England

[20] *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/
[21] *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

April 4, 2024

Ms. Bonnie Heiple, Commissioner
Massachusetts Department of Environmental Protection
100 Cambridge Street
Suite 900
Boston, MA 02114

Dear Commissioner Heiple:

Thank you for the opportunity to comment on the Clean Heat Standard (CHS). We appreciate the Massachusetts Department of Environmental Protection's (MassDEP) robust approach to the public comment process. We write on behalf of Rewiring America, the leading electrification nonprofit working to help families and communities achieve energy efficiency, protect human health, and save money while reducing pollution. We offer the following recommendations for your consideration.

Recommendation 1: Include more eligible appliances in the CHS program, most importantly heat pump water heaters

The CHS program should extend emission reduction credits beyond space heating technologies to other residential technologies, including: heat pump water heaters, insulation and air sealing, induction stoves, and heat pump clothes dryers. The CHS is a vital tool for decarbonizing Massachusetts's buildings. Any appliance that *significantly* reduces thermal sector fossil fuel consumption and reliance on gas infrastructure should be eligible for credits.

Households that switch to a heat pump water heater are virtually guaranteed bill savings. We estimate that 98% of Massachusetts households that install a heat pump water heater would lower their energy bills, with an average savings of $241 annually. Basic insulation also virtually guarantees bill savings for Massachusetts residents across all fuel types by an average of $835 per year and enhanced insulation an average of $974 per year.

Water heaters and insulation are the most important additions to deploy in residential buildings through the CHS in terms of reducing climate pollution and increasing energy efficiency and bill savings. The universal adoption of heat pump water heaters would lower Massachusetts's pollution by 2.2 million metric tons annually.

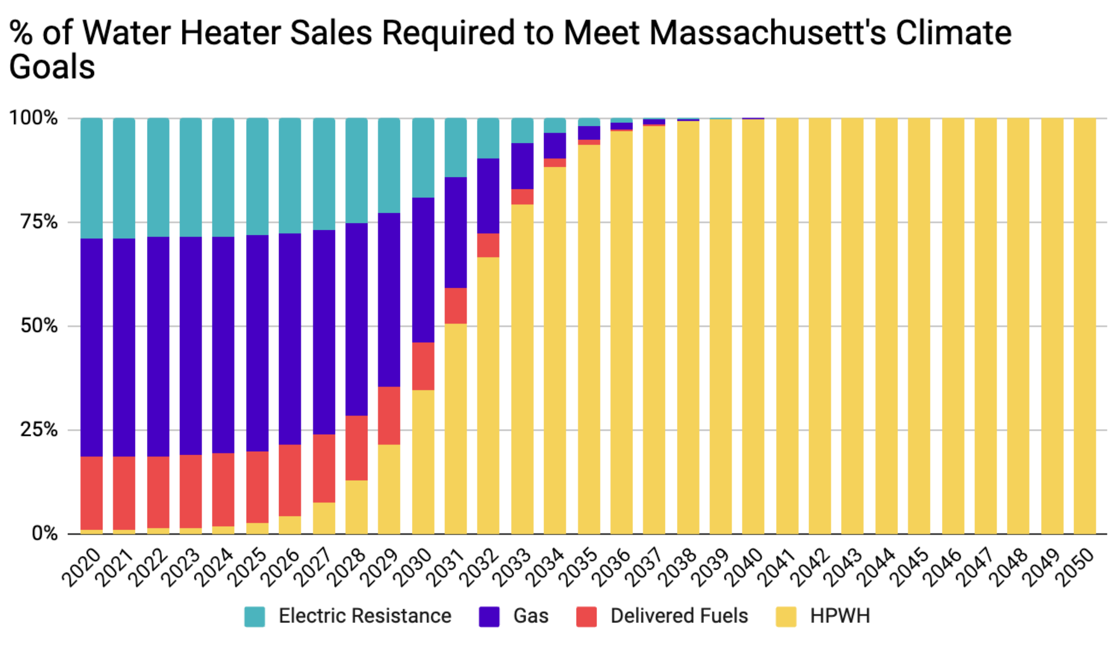


Figure 1. The pace of Massachusetts heat pump water heater sales necessary to achieve net zero carbon pollution by 2050

Excluding other carbon-slashing appliance installations from eligibility in *residential buildings* is a missed opportunity. It locks households into using gas appliances and their associated pipelines for longer. The CHS draft framework states that 40% of clean heat credits must benefit low- and moderate-income households. To provide ample flexibility and less costly options for CHS projects, at a minimum heat pump water heaters, induction stoves, and heat pump dryers should be eligible for clean heat credits.

Allowing a broader range of efficient electric appliances also spreads out demand across different products, reducing the risk of shortages or delays in obtaining heat pump space heaters. Relying solely on one technology could strain the supply chain, leading to shortages or inflated prices.

Recommendation 2: Integrate the CHS with Mass Save Incentives

We recommend that MassDEP integrate the CHS with Mass Save incentives to create a “one-stop shop.” Already, the technologies listed above are eligible under the Mass Save program. Integrating the two programs would increase clarity for building owners, and increase uptake in participation for both programs.

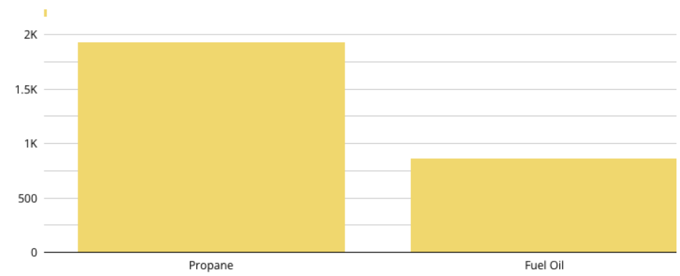
Recommendation 3: Target Households Using Propane and Fuel Oil for Electrification using Heat Pump Space and Water Heaters and Insulation

Around 725,000 Massachusetts households are currently using delivered fuels like propane and fuel oil. If these households electrify, they are all but certain to save money on their energy bills — on average $1,928 annual savings for households switching from propane and $868 for households switching from fuel oil (see Figure 2). We urge MassDEP to work with utilities and other agencies to identify households using these fuels and targeting them early in the program.

Upgrade Option: Max Efficiency Heat Pump

Average Bill Savings	$964	**Number of Households**	724,064
Average kgCO2e Savings	8,288	**Number of Households w/ Bill Savings**	643,478
Average kWh Savings	25,203	**Average Bill Savings for Households that Save**	$1,196

Average Bill Savings by Baseline Fuel:



Upgrade Option: Medium Efficiency Heat Pump + Basic Insulation

Average Bill Savings	$529	**Number of Households**	2,096,446
Average kgCO2e Savings	6,134	**Number of Households w/ Bill Savings**	1,533,796
Average kWh Savings	22,960	**Average Bill Savings for Households that Save**	$928

Average Bill Savings by Baseline Fuel:

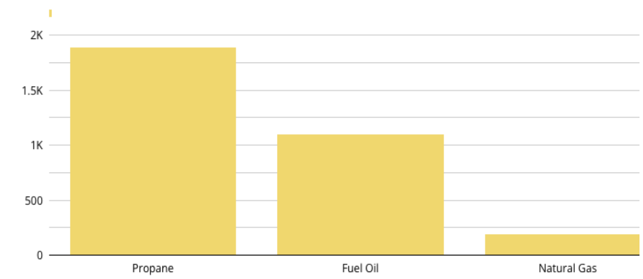


Figure 2. Annual savings for Massachusetts households switching to heat pumps

Particularly for households upgrading from natural gas space heating to a heat pump, it will be important to simultaneously help them improve insulation. Installing a heat pump in a drafty house could increase energy burdens for some households. However, most Massachusetts households will save money on their energy bills with a heat pump plus insulation, no matter the fuel type they are switching from (Figure 3).

Recommendation 4: Exclude Electricity Suppliers from Being Implicated Under the CHS

Massachusetts's electricity bills are among the highest in the nation. We implore MassDEP to ensure that electricity suppliers' obligations do not translate into higher electricity rates for households — which more than likely means relieving electricity suppliers of obligation under the CHS altogether.

Electricity rates can make or break the incentive for household electrification. For this reason, it is critical to ensure this program does not put upward pressure on rates, or else it will unintentionally undermine its electrification goals. Lowering, or at least maintaining, electricity prices is arguably more important than the long-term viability of the CHS. Rewiring America's analysis shows that a $0.01 reduction in electricity rates can reduce the operating cost of heat pump space heaters by $1,445 over their average lifespan.

Increasing the price of electricity, especially when it is progressively becoming less carbon-intensive, goes against the goal of encouraging the transition from combustion towards electrification. Moreover, the carbon intensity of the electric system is already accounted for through the Renewable Portfolio Standard and the Clean Energy Standard. Imposing charges on electric customers under the CHS would be unnecessary and detrimental to our objectives.

Thank you for considering our comments. We appreciate all the work that has gone into the Clean Heat Standard design process so far. We look forward to continued engagement.

Sincerely,

Leah Stokes and Amanda Sachs
Rewiring America

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Massachusetts Department of Environmental Protection
100 Cambridge Street,
Suite 900 Boston, MA 02114

Re: Massachusetts Clean Heat Standard Stakeholder Input April 5, 2024

Commissioner Heiple,

Thank you for the opportunity to provide comments on the Clean Heat Standard. Since its founding in 1870, Sprague has been actively supplying customers in Massachusetts with the energy product it needs. Today, we supply refined products to resellers and commercial end users in Massachusetts and throughout the northeast. Sprague is also one of the largest Natural Gas distributors in the Commonwealth. Finally, starting in 2007 Sprague has been a leading supplier of renewable fuels in this market. We supply renewable fuels throughout our terminal network including all three of our terminals located in Massachusetts. We continue to grow our biodiesel and renewable diesel product offerings along with our activity in both the solar and wind markets. As a participant in the Clean Heat Standard discussions since they were initiated, Sprague has had the opportunity articulate its position on the topics of program design, cost mitigation, implementation structure, and reporting capabilities. We appreciate the feedback that Massachusetts DEP has provided to date and look forward to continuing that dialogue on these important topics. The comments herein are on two specific items which have arisen out of the draft proposal of the Clean Heat Standard.

- The CHS draft plan to score electricity as having zero CO2 emissions until an estimated 2031.
- The draft Clean Heat Standard position on Renewable Diesel and crop based renewable fuels.

<u>Emissions Scoring of Electricity</u>

It is challenging to find a scientific rationale to count emissions that are generated through electricity heating system as zero as proposed in the draft Clean Heat Standard. We can find no comparable example in emissions reporting policies on the state or federal level in the U.S. Even more puzzling is that the CO2 emissions in the production of electricity are known. ISO New England annually reports and publishes the CO2 emissions. Massachusetts is obviously part of ISO New England, and which makes this emissions data readily available **(1).** This can also be easily seen on ISO New England that utilizes the EPA's eGrid methodology **(2)**

Table 1-1
2020 and 2021 ISO New England Average Emissions (ktons) and Emission Rates (lbs/MWh)

Annual Average Emissions and Emission Rates						
	2020 Emissions (ktons)	2021 Emissions (ktons)	Total Emissions % Change	2020 Emission Rate (lbs/MWh)	2021 Emission Rate (lbs/MWh)	Emission Rate % Change
Native Generation						
NO_X	12.09	12.44	2.9	0.25	0.24	-4.0
SO_2	1.88	2.11	12.2	0.04	0.04	0.0
CO_2	31,028	33,439	7.8	654	658	0.6
Native Generation Plus Imports						
CO_2	33,168	34,555	4.2	560	574	2.4

By scoring electricity generated heat in the CHS as zero this program is electing not to account for emissions that are occurring. Ignoring emissions from some technologies, while counting others, leads to an inaccurate Green House Gas accounting and misrepresents the progress that the state is making in any reports that it publishes. It also leads to inequitable outcomes as per this example: Under the proposal, a 5,000 square foot home in Brookline MA that is using heat pump electricity for heating purposes does not have to pay the clean heat tax, even though approximately 50% of the power used in that electricity was generated by natural gas (**3**). However, an 800 square foot apartment in Boston utilizing that exact same natural gas for heating purposes is required to pay the clean heat tax. The end user with the much lower total carbon footprint is paying the MA clean heat tax and the user with a significantly larger carbon footprint does not. It's challenging to see how this is equitable.

(**1**) https://www.iso-ne.com/static-assets/documents/2023/04/2021-air-emissions-report.pdf
(3)https://www.iso-ne.com/about/regional-electricity-outlook

Advocates for not counting emissions from electricity heating have often cited the Regional Greenhouse Gas Initiative as having already addressed these emissions regulations. However, the Massachusetts Clean Heat Standard is unique and a new tax that will be paid by all end users of heating products in the state. Nowhere in the "Global Warming Solutions Act" or the "Next Generation Roadmap for Massachusetts Climate Policy" does it say that Massachusetts should cede its taxing authority to the Cooperative of an eleven-state coalition in RGGI for the purpose of regulating heating emissions in the Commonwealth. The two acts from which the Clean Heat Standard derive its authority clearly state a number times that a full accounting of electric emissions should take place.

(4) AN ACT ESTABLISHING THE GLOBAL WARMING SOLUTIONS ACT.

-Indirect emissions", emissions associated with the consumption of purchased electricity, steam and heating or cooling by an entity or facility.
-Statewide greenhouse gas emissions", the total annual emissions of greenhouse gases in the commonwealth, including all emissions of greenhouse gases from the generation of electricity delivered to and consumed in the commonwealth, accounting for transmission and distribution line losses, whether the electricity is generated in the commonwealth or imported
-(d) The department shall promulgate regulations establishing a desired level of declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions.
-Section 4. (a) The secretary shall consult with all state agencies and regional authorities with jurisdiction over sources of greenhouse gases on all elements of the emissions limit and plan that pertain to energy-related matters including, but not limited to, electrical generation, load based-standards or requirements,

(5) AN ACT CREATING A NEXT-GENERATION ROADMAP FOR MASSACHUSETTS CLIMATE POLICY. *Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:*

-SECTION 2. Said section 1 of said chapter 21N, as so appearing, is hereby further amended by striking out the definition of "Greenhouse gas emissions source" and inserting in place thereof the following definition:--"Greenhouse gas emissions source", a source, or category of sources, of greenhouse gas emissions, including but not limited to greenhouse gas emissions from transportation fuels, heating fuels, or electricity that are used, distributed, consumed, combusted, or sold into the commonwealth,

- greenhouse gas emissions from the use, distribution, consumption, combustion, or sale of such fuels or electricity.

SECTION 3. -"Indirect emissions", emissions associated with the consumption of any purchased electricity, fuel, steam and heating or cooling by a person, an entity or a facility in the commonwealth.

Finally, there is an assumption made in scoring electricity that the grid will be composed of low emissions electricity by 2031 as per the MA Clean Heat Standard draft. However, recent events in the East Coast wind market and subsequent project cancellations demonstrate the timeline for lower emissions electricity expansion is uncertain at best. Last month, ISO New England published its 2024 Regional Electricity Outlook (**6**). In this release ISO New England is quoted "*Over the next 15 years, the region needs to add almost twice as much new generation as it added in the last 25 years. By the early 2030s, the annual energy needed to heat buildings and charge electric vehicles is expected to grow to about 20 times the forecast for 2024."*

The conclusion is that it's not possible to accurately predict the growth rate of low emission power generation, the grid infrastructure build out timeline, or the associated ratepayer cost that could slow adoption rates. Given these facts, it calls into question the 2031 proxy date for the CHS emissions reporting. In the interim, years of emissions from electricity generation for heating applications will go uncounted by the Clean Heat Standard. We recommend that the DEP revisit this position as guided by Massachusetts legislative directives and common sense.

(4) Department of Environmental Protection. An Act Establishing the Global Warming Solutions Act. Massachusetts Legislature, https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298.
(5)193rd General Court of the Commonwealth of Massachusetts, Chapter 298, Acts (2008), Executive Office of Energy and Environmental Affairs. Massachusetts Clean Energy Climate Plan for 2025 and 2030, June 30, 2022 , https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download

Draft Clean Heat Standard position on Renewable Diesel and Crop based renewable fuels.

We will leave the comments detailing the science of emission reductions from renewable fuels to the experts on this topic that are submitting comments. However, Sprague will make this point. Massachusetts appears to be leaning towards making policy that limits biofuels emissions reduction by citing several different studies. However, none of the studies sighted are in line with actual adopted emissions laws at the federal or state level. The emission accounting conclusions in these sighted studies are in conflict with: The Renewable Fuels Standard as determined by United States Environmental Protection Agency, The California Low Carbon Fuel Standard from the California Air Resource Board, and The Canadian Fuel Standard. In addition, the States of New York, Rhode Island, and Connecticut all have active bioheat mandates sighting the emission reductions benefit of both crop and non-crop-based biofuels. We believe it unlikely that all of these state and federal analysis that went into the laws are inaccurate and Massachusetts third party cited studies are correct.

The comments on the latest CHS draft also point to a study by Argonne GREET utilizing a 30-year lifecycle analysis for purposes of emission reductions **(7)**. This raises the question of how can Massachusetts utilize the 100-year EPA CO2 emissions standard for its GHG accounting, and at the same time utilize a 30-year standard for IDLU renewable fuel calculations? If the 30-year cycle is going to be utilized, then doesn't that require a 30-year cycle for all accounting? As Massachusetts is aware, going to a shorter term for analyzing emissions will drive the cost of the Clean Heat Standard materially higher. However, it is unclear how to reconcile differing terms for measuring emissions as suggested.

Also, based on the CHS referenced study, there seems to be confusion in mixing up the Indirect Land Use Calculations for that of ethanol and for biodiesel. Clearly the emission reductions are different (as defined in the Renewable Fuel Standard), and we have seen no advocacy for ethanol as a participant in the Clean Heat Standard.

7)Carbon Calculator for Land Use and Land Management Change from Biofuels Production (CCLUB) https://publications.anl.gov/anlpubs/2021/10/171711.pdf, In advocating for excluding crop-based byproduct fuels, several stakeholders have raised the argument of food vs. fuel during this process. On this point, soybeans are grown for the meal which represents 80% of the beans during production. This meal goes primarily to animal feed at levels 95% and above. The approximately 20% byproduct of meal production is bean oil. This byproduct has now found a higher value for the farmer in the reduction of CO2 emissions through biodiesel and renewable diesel than being used for frying foods and making salad dressing. The data on this is so abundantly clear that we do not believe this is the actual objection. The actual argument behind stakeholders opposed to crop-based fuels appears to be: *Farmers are utilizing land to grow a protein source for animal feed when crop lands should be utilized to move to a more vegetarian diet to help reduce emissions*. This is the major policy conflict point and Sprague will not offer a position on the debate of creating policies suggesting Massachusetts residents should move away from meat consumption to a more vegetarian based diet.

Renewable Diesel Infrastructure.

The following was sighted in the CHS Q&A: *Biofuel blends up to B20 are in widespread use in 3 Massachusetts,1 but higher blends and renewable diesel are not and could require investments in equipment adjustments, new transportation and storage pathways, etc. Because only waste-based biofuels will be credited after 2030, this change will help direct any capital investments related to biofuels toward options that can contribute to CHS compliance in the long term. This change would also help address stakeholder concerns regarding the lifecycle emissions impacts of biofuels without unduly interfering with existing industry efforts to reduce emissions from heating oil combustion.* ***(8)***

Renewable Diesel capital investments required by wholesalers like Sprague are minimal. The drop in nature of the fuel means that the product can utilize the current storage and transportation infrastructure already in place and does not require the investment suggested. We believe other wholesalers would also attest to the same in

(8) MassDEP Clean Heat Standard (CHS) Stakeholder Process Frequently Asked Questions (FAQ) Version 1.4 (April 2024) //efaidnbmnnnibpcajpcglclefindmkaj/https://www.mass.gov/doc/chs-faq/download adding Renewable Diesel to their Massachusetts terminals. The growth of Renewable Diesel production in the United States is now making this fuel available in the Northeast. Massachusetts should encourage policies which can materially reduce emissions with minimal cost to the end user or supplier. In regards to biodiesel, the investment in infrastructure at Sprague's three Massachusetts based terminals has already been completed and currently serve the Massachusetts market with biodiesel blends for both heat and transportation usage. Sprague's terminals located in Albany, Providence, and Newington NH also supply Massachusetts end users and are also capable of providing biodiesel blends. Other wholesalers that service Massachusetts also have the same capabilities. This makes it possible that the CHS policy could utilize existing infrastructure for the immediate reduction of emissions through renewable fuels. We believe all stakeholders can agree that immediate CO_2 reductions are a positive and worthy goal.

Thank you for your time and consideration and please do not hesitate to reach out to us with any questions.

Best regards,

Kevin Grant
Director of Renewable Fuels
Sprague Energy
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Sprague
Our Energy Makes the Difference™

February 14, 2024
Submitted via email to climate.strategies@mass.gov

Massachusetts Department of Environmental Protection
100 Cambridge Street Suite 900
Boston, MA 02114

RE: SRECTrade Comments on Voluntary Early Registration Program Discussion Draft Regulation

Dear Massachusetts Department of Environmental Protection Clean Heat Standard Team,

Thank you for the opportunity to provide feedback on the Discussion Draft Regulation for the Voluntary Early Registration Program for the Clean Heat Standard (CHS).

SRECTrade recommends the following to encourage greater program participation:

1. <u>Enable Authorized Agents to manage multiple projects in a single Clean Heat and Emissions Tracking System (CHETS) account.</u> Authorized Agents reduce the administrative burden of participating in the program and provide greater incentive and credit market access to Owners. CHETS should be designed in a manner where Authorized Agents can operate a single "aggregator account" to manage multiple projects at once. This will also reduce the number of CHETS accounts that need to be created and maintained.
2. <u>Strategies for streamlining the application process:</u>
    - Consider utility permission to operate (PTO), inspection reports, operating data, and other forms of documentation that demonstrate proof of installation.
    - Contractor licenses should not be required in the qualification application. This may place an undue burden on applicants who may not have access to contractor licensing information. The authority having jurisdiction is best positioned to vet the competency of the installer, not MassDEP.
3. <u>Allow third parties to develop software tools that can integrate with CHETS using application programming interfaces (APIs).</u> APIs have been effectively used within environmental credit trading programs to streamline administrative and user functions such as submitting and reviewing project applications. This feature will be critical for aggregators, regulatory staff, and other program participants managing hundreds or thousands of applications.

SRECTrade appreciates the opportunity to provide feedback on the CHS and looks forward to continued engagement with MassDEP.

Sincerely,

Evan Rosenberg
Director, Strategy and Business Development
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Evan.Rosenberg@SRECTrade.com

About SRECTrade

SRECTrade provides management and transaction solutions for renewable energy and clean fuel programs across North America. SRECTrade's parent company, Xpansiv, provides market infrastructure to rapidly scale the world's energy transition. Xpansiv operates CBL, the largest spot exchange for environmental commodities, including carbon credits and renewable energy certificates.

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April 5, 2024

Department of Environmental Protection
100 Cambridge Steet
Boston, MA 02114

Re: Massachusetts Clean Heat Standard DRAFT FRAMEWORK and FAQ Q.0

Comments, Concerns, and technically incomplete information in the draft framework

As a lifelong resident of Massachusetts and a member of the energy community for over 40 years, I would like to submit the following information regarding the Massachusetts Department of Environmental Protection's (DEP) draft framework and FAQ Q0. I have also included additional information to DEP about renewable propane and I urge DEP to include credits for International Sustainability Carbon Certificated (ISCC) renewable propane in the proposed rule this fall.

Propane is an alternative clean energy, and I share DEP's desire to reduce greenhouse gas (GHG) emissions and adopt a more carbon-friendly energy environment. The proposed CHS draft framework fundamentally alters the marketplace in which business operates, and intentionally creates barricades restricting consumer choice. I believe sustainable and cost-effective decarbonization is achieved by taking a holistic approach of consumer behavior and energy choices available now and in the future, such as propane, renewable propane, bio-heat, and electricity generated by cleaner sources. DEP must take into consideration the reliability and resilience of all potential energy options, and the aggregate costs passed along to all consumers and EJ communities after incentives have expired and the EJ communities become burdened with the true cost of their energy.

The current draft proposal treats all customers alike, which they are not. Unlike urban and suburban households, many residential customers live in rural and remote areas that are not well-served by the current electric grid. This is due in part to geographic barriers and limitations of the requisite utility infrastructure. DEP and DOER have failed to acknowledge the diversity of housing across the commonwealth. Delivered fuel dealers, for example, serve many customers in manufactured housing and mobile homes that have unique energy needs that would be adversely impacted by DEP's actions. Heat pumps are not the best solution for environmental justice communities, many of whom live in mobile homes. These types of buildings and families are better served by using affordable propane space heating and Biofuels that create warmer heat and prevent uninsulated pipes from freezing in the wintertime, unlike heat pumps. DEP must treat propane, Biofuel, and emerging energy technology differently than other combustible fuels.

Renewable Propane MA CHS Comments

The Department of Energy recognizes renewable propane as a drop-in replacement fuel for all propane applications. As with SAF and biodiesel, renewable propane is produced from natural fats (tallow), used cooking oils and other types of

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grease. Biodiesel refineries can produce renewable propane from these fats and oils before they are used to produce biodiesel, giving materials once resigned to the landfill a new life.

Renewable propane has ultra-low carbon intensity, less than most other energy sources. At present, renewable propane is mostly produced and utilized on the West Coast to meet the California Low Carbon Fuel Standard and the Clean Fuel Standards in Washington and Oregon. The California Air Resources Board (CARB) calculates a carbon intensity (CI) score between 20.5 – 43.5 gCO2eq/MJ, depending on feedstock, compared to CIs of 130 for "average U.S. Electricity" and 91 for gasoline and diesel.

Every state in New England has had renewable propane delivered to it in 2023, and West Springfield, Massachusetts now has a dedicated terminal to an International Sustainability Carbon Certification (ISCC) certified renewable propane blend. This terminal obtains renewable propane from the Midwest, and it is not tied to transportation RINS, allowing it to be used for home heating and other applications. While renewable propane is a very new energy source, its production is growing, and it will continue to become more available as other renewable fuels grow. If DEP is going to realistically assume that Massachusetts will meet its clean electricity goals as part of the basis for their CHS design, DEP must also provide equal consideration that renewable propane propane blends, and Biofuels will be available in quantities that keep pace with or exceed Massachusetts's ability to regulate the utilities to produce cleaner electricity in Massachusetts. The expansion of biofuels and sustainable aviation fuels future the growth of renewable propane and it's no less tenuous than the future growth of wind and solar. In fact, there are production facilities for renewable propane growing all over the globe as illustrated on the WLGA map.[1]

Renewable propane and propane blends have the same great features as conventional propane — reliability, portability, power, and reduced carbon emissions — but with even lower carbon emissions when compared with other energy sources. This makes renewable propane and propane blends an ideal energy source for housing stock that is older and not suited to heat pumps, or for housing such as mobile homes. Renewable propane and propane blends also provide a cleaner future solution for locations without the need for costly infrastructure upgrades, because it is chemically identical to propane used today.[2] This means that it is a drop in fuel, working in existing propane boilers, furnaces, and heaters. The difference is that instead of being a by-product of natural gas production like conventional propane, renewable propane is a co-product of renewable diesel, sustainable aviation fuel, and other emerging technologies such as recycled plastics developed locally at MIT.

Innovation around renewable propane must be incentivized by the state. Renewable propane can also be made from plant stock and more and more renewable propane is being generated from the seed oil of the camelina plant.[3] Also known as camelina sativa or false flax, camelina is a member of the mustard family and a relative of cabbage, kale, and cauliflower, but is not a food crop nor does it compete with food production. Today, camelina is grown in cooler regions of the U.S. and will expand to the south as producers are experimenting with varieties that can thrive in warmer climates. Camelina is drought and pest tolerant and is a pollinator for bees.

This cover crop is completely waste-free as the seed produces 40% oil, twice the amount of soybean, the remaining meal is FDA approved for cow and chicken feed, and the husks are used for mulch. It is beneficial for farmers because it

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1 https://www.worldliquidgas.org/key-focus-areas/renewable-liquid-gas/
2 https://online.fliphtml5.com/addge/peyi/#p=1
3 https://propane.com/about-propane/renewable-propane/

enriches the soil and prevents erosion when fields are fallow and provides additional income without the need for new equipment.

Comments on FAQ Q0:

Heat pump credits: 5 MMT is way too high of an emission reduction for residential heat pump credits. I encourage DEP to utilize the lifecycle analysis and GREET model to calculate the actual emissions cradle to grave for electricity. I am concerned that MA DEP is making a mistake by not incentivizing the usage of propane in the Commonwealth. Prioritizing electric heat pumps, over cleaner propane systems will increase emissions in our state. I urge DEP to consider providing credits for geologic propane and treating it in a similar manner as they do for renewable biomass. Propane is a beneficial by-product of natural gas processing and if it is not used it is wasted. As a waste product, it must be incentivized not only so that it will lower GHG emissions, but also so that it will be available as a reliable affordable energy source for energy security during times or emergencies.

The fundamental purpose of the Clean Heat Standard is to reduce emissions, not promote certain technologies for extrinsic reasons (CECP, Appendix B-3, page 61).[4] I believe propane must be an incentivized clean heat credit energy under the MA CHS. Today, geologic propane in MA has a carbon intensity of 77 which is less than the carbon intensity of electricity and heat pumps in MA which is 100 – 140 depending on how cold the winter is each year. Even if MA electricity will become cleaner, it still makes no sense to disincentivize propane systems as the propane industry will continue to lower its carbon intensity with the addition of renewable propane blends, and I anticipate propane in MA to always have a lower carbon intensity than MA electricity and heat pumps. If MA DEP is indeed trying to reduce carbon emissions today with a CHS, propane must be awarded clean heat credits.

Renewable propane must be incentivized in MA by DEP taking the lead to promote renewable propane development in the state. DEP could be leading the way and setting an example of how to reduce emissions while maintaining an equitable solution to energy security. MA must have backup energy for electricity outages and extreme weather events. Propane fills this role today as the backup fuel for generators across our state, and its use should be increased in the state to make sure we have environmental equity and affordability.

Electricity credit requirements: The delay of the emission reduction credit holding requirement for electricity sellers from 2031 until 2035, concerns me because it incentives electricity over all other energy sources and because DEP states that this change would be responsive to stakeholder comments addressing the potential regulatory burden on electricity sellers. This is disingenuous and shifts the burden on to small businesses and residential homeowners across the Commonwealth. I have been quite vocal about the burden these regulations will have on citizens of the commonwealth. Propane currently serves less than five percent of the thermal sector, it makes more sense for DEP to carve out propane or postpone any regulatory burdens on propane consumers. There is currently no net gain in carbon reduction by leaving propane out of the regulation, and by providing credits there is a potential reduction in carbon emissions within the commonwealth.

[4] Final Report: Commission on Clean Heat, November 30, 2022, Governor Baker's Commission on Clean Heat

The underlying premise of any CHS is to reduce greenhouse gas (GHG) emissions. As such, the program must focus less on the type of energy to be delivered – molecules or electrons – and more on the ability of any technology to immediately reduce GHG emissions from thermal applications. The current standards focus too much on electrification rather than decarbonization. A better framework would put more emphasis on obtaining year-over-year emission reductions, consistent with the commonwealth's targets, and less on marching towards the complete electrification of building stock. In short, the framework structure must focus on carbon reduction, not electrification.

DEP has set different timeframes for electricity and must consider the same approach for propane. Propane only accounts for 4.1 percent of the commonwealth's energy consumption. Until such time as the CI as defined under the EPA Greet standard, for electricity is lower than propane and propane blends, it makes absolutely no sense from an environmental or equity perspective to include propane in the CHS. Propane is a beneficial by-product of natural gas, yet more propane is wasted and simply burned off than used as an energy source every year across the globe. Considering the volume of natural gas Massachusetts is going to be using through 2028 simply for electricity alone, not to mention natural gas is still part of the energy production of electricity in 2050, it makes no sense not to incentivize the use of more propane, if the Bay State is going to be a responsible steward of the climate and their energy requirements.

2022 Massachusetts (in state) Bulk Electric Generation Mix[5]

- Natural Gas – 77.8%
- Petroleum – 3.8%
- Hydroelectric – 4.5%
- Non-hydro renewables (e.g., biomass, wind, utility-scale solar) – 13.5%
- Others (e.g., tire-derived fuels, municipal solid waste) – 2.1

Scientific Analysis Requires Lifecycle Analysis

The Department of Environmental Protection needs to take a holistic view of energy consumption and evaluate the carbon footprint of all energy sources – and the appliances that are powered by them – fairly and accurately. This is best accomplished through a full fuel-cycle (FFC) analysis of energy consumption that utilizes source energy metrics. FFC includes the energy consumed onsite, but also incorporates applicable energy used in upstream processes, as well as the energy needed to convert a primary energy source into a secondary one and transport that energy to an end user. The use of FFC and source energy metrics has been endorsed by the National Academies and the Department of Energy's Office of Energy Efficiency and Renewable Energy.[6]

Propane has a source-site ratio of 1.01, compared to 2.80 for grid electricity.[7] This means, for electricity from the grid, it takes 2.80 units of energy to produce and delivery one unit of energy to a home, compared to only 1.01 for propane. For utility-scale electricity, more than 60% of energy is lost during the generation and conversion process, thereby drastically

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5 *Electricity Data Brower Massachusetts 2022*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=002&sec=008&freq=A&start=2021&end=2022&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

6 *Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Statement of Policy for Adopting Full-Fuel-Cycle Analyses of Energy Conservation Standards Programs*, Federal Register, Volume 76, No. 160, (August 18, 2011), https://www.govinfo.gov/content/pkg/FR-2011-08-18/pdf/2011-21078.pdf

7 *Source Energy Technical Reference,* Energy Star Portfolio Manager, U.S. Environmental Protection Agency, (August 2023), https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

increasing emissions of GHGs and criteria pollutants.[8] The average efficiency of a natural gas plant is only 44 percent.[9] The average efficiency of a petroleum plant is 31%.[10] And an additional 5% of energy is lost during the transmission and distribution of electricity to an end user, further decreasing efficiencies and increasing CO_2 emissions.[11]

Energy Security and Reliability

Electrification efforts, as proposed in the framework, will put additional stress on the electric grid. This is noteworthy because across the U.S., the average duration of total power interruptions roughly doubled between 2013- 2020.[12]

The current CHS framework, which is primarily focused on fuel-switching and thermal electrification efforts, will add a massive new load to an electrical network that is already strained and badly in need of maintenance. Using propane as a primary household heating fuel reduces stress on the electric grid and helps it cope with peak demand. This is because space heating is the most energy intensive application in a typical home and accounts for most of the energy consumption.[13]

The installation of electric resistance heating, as either a primary or backup fuel source, should not generate credits. Electric resistance heating is extremely energy intensive and puts a great deal of stress on the electric grid. Traditional electric resistance heating also has a huge carbon footprint, given the amount of energy used both onsite and upstream.

Environmental Justice and Equity Considerations

In the U.S., per unit of energy, propane is 1.7 time more affordable than grid electricity.[14]

- 2022 Massachusetts residential electric rates = 25.97 cents per Kwh.[15] This is 10.93 cents more than the national average.
- 2022 Massachusetts commercial electric rates = 18.68 cents per Kwh.[16] This is 6.27 cents more than the national average.
- 2022 Massachusetts industrial electric rates = 17.06 cents per Kwh.[17] This is 8.74 cents more than the national average.

As proposed, hybrid heating systems that retain a fossil backup must be eligible to earn annual emission reduction credits. This carveout is important. Any effort to require that credits may only be generated upon retirement of a supplemental propane heating system must be rejected. This requirement attempted in other states has shown to be unsafe, caused damage to homes, and ultimately rescinded primarily due to safety concerns as unqualified individuals and business have modified systems to eliminate fossil back ups.

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[8] *More than 60% of energy used for electricity generation is lost in conversion,* U.S. Energy Information Administration, (July 21, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44436
[9] *Average Operating Heat Rate for Selected Energy Sources*, U.S. Energy Information Administration, (2022), https://www.eia.gov/electricity/annual/html/epa_08_01.html
[10] *Id.*
[11] *How much electricity is lost in electricity transmission and distribution in the United States?*, U.S. Energy Information Administration, (November 7, 2023), https://www.eia.gov/tools/faqs/faq.php?id=105&t=3
[12] *U.S. electricity customers experienced eight hours of power interruptions in 2020,* U.S. Energy Information Administration, (November 10, 2021), https://www.eia.gov/todayinenergy/detail.php?id=50316
[13] *Space heating and water heating account for nearly two thirds of U.S. home energy use*, U.S. Energy Information Administration, (November 7, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37433
[14] *Energy Conservation Program for Consumer Products: Representative Average Unit Costs of Energy,* Office of Energy Efficiency and Renewable Energy, Department of Energy, Federal Register, Volume 87, No. 44, (March 7, 2022), https://www.govinfo.gov/content/pkg/FR-2022-03-07/pdf/2022-04765.pdf
[15] *Table 2.10 Average Price of Electricity to Ultimate Customers by End-Use Sector*, U.S. Energy Information Administration, https://www.eia.gov/electricity/annual/html/epa_02_10.html
[16] *Id.*
[17] *Supra 16*

If Propane is Not Exempted from CHS, Propane Must Generate Credits

Beyond electrification and the delivery of qualifying biofuels, the delivery of conventional propane, in certain situations, must generate clean heat credits. This must include the conversion of households that previously relied on fuel, kerosene, or coal. Retiring these thermal sources in favor of propane would immediately reduce carbon emissions and improve local air quality. The CHS must recognize that different combustion fuels have different properties and environmental impacts.

In Massachusetts, more than 650,000 households use fuel oil, kerosene, or coal as their primary space heating fuel.[18] Propane has a CO_2 coefficient, per million Btu of energy, that is 16% lower than fuel oil, 15% lower than kerosene, and 41% lower than coal.[19]

In 2022, fossil fuels generated 81.6% of the commonwealth's bulk electricity. Massachusetts' electric sector produced 952 pounds of CO_2 emissions per megawatt hour generated.[20] Except for Rhode Island, Massachusetts' power sector is the most carbon intensive in New England. In 2019, grid electricity across ISO-New England, which includes Massachusetts, was 400 kg/MWh, which equates to 111.11 grams of carbon dioxide equivalent per megajoule (gCO2e/MJ). This is a carbon intensity (CI) score of 111.11.[21] According to Argonne National Lab's GREET model, propane has a CI score (US average) of 78.7 gCO2e/MJ. In Massachusetts, propane's CI score is lower, at 77, due to more product being derived from natural gas processing. If propane is not exempted from the CHS at this time, then the use of propane must generate CHS credits for both traditional and renewable propane.

Credit generation opportunities must include thermal applications that can prove an immediate reduction in aggregate GHG emissions. This is a better approach than simply transferring emissions from the buildings sector to the electric power sector without proving a reduction in aggregate emissions.

Thank you for your consideration,

Susan Sumner
Owner

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[18] *Selected Housing Characteristics – Household Heating Fuel*, American Community Survey, U.S. Census Bureau, (2022), https://data.census.gov/table/ACSDP5Y2022.DP04?g=040XX00US25

[19] *Carbon Dioxide Emissions Coefficients*, U.S. Energy Information Administration, (September 7, 2023), https://www.eia.gov/environment/emissions/co2_vol_mass.php

[20] *Massachusetts Electricity Profile 2022*, U.S. Energy Information Administration, (November 2, 2023), https://www.eia.gov/electricity/state/massachusetts/

[21] *Difference in carbon intensity between grid electricity and propane for heating*, (October 28, 2022), https://public.tableau.com/app/profile/grace.willis/viz/Differenceincarbonintensitybetweengridelectricityandpropaneforheating/Differenceincarbonintensitybetweengridelectricityandpropaneforheating

Parnay, Angela L (DEP)

From: A Dylan Vizy <vizystudio@icloud.com>
Sent: Thursday, April 4, 2024 1:09 PM
To: Strategies, Climate (DEP)
Subject: MA Clean Heat Standard

Good day,
To whom it may concern,

I am writing as a concerned citizen, and also a volunteer of two Sustainability groups in town,
Regarding the hopeful execution and adoption of a Clean Heat Standard.

Living in a coastal town, its quite apparent that the sea levels are rising, and the storms are getting strong,
Due to human influenced climate change… and whatever we can do to decarbonize as quickly as possible,
Would be imperitive… there's no more denying it – we are doing this to the planet, and we need to stop.
There is just too many sources of GHGs, and we need to curb our polluting ways…
A regulated standard would help – as there are so many out there, just simply not paying attention to the direness
Of this very serious and existential situation.

Therefore – I highly recommend and endorse the adoption of the MA Clean Heat Standard.

I think that the only immediate matter that I cannot agree with – is to make Electrical Utilities as part of the obligated suppliers.

We must have the fossil fuel industry take responsibility for their actions, and they can help with paying for incentives.
Therefore – please make natural gas, oil, and propane suppliers the obligated ones,
And as their costs rise, it will help make it easier for the citizens to electrify via the incentives and electricity being more affordable.
Please, don't ask the electrical suppliers to have to be obligated,
As – if the electrical prices rise, then we are losing some of the incentives of the concept of electrification.

For incentives – I agree that all the non-fossil fuel options/actions should qualify – including weatherization and the potential of network geothermal.

At the same time – I would not allow Bio-fuels to qualify as a solution, or to be incentivized – as
A – they still pollute and create carbon in the atmosphere,
B – there is potential that crop based bio fuels are actually causing deforestation, and /or effecting the food industry.
We don't want to lose forests or land designated already for food production, when we have other better solutions,
In hydro, wind, solar, geothermal and nuclear for electricity creation.

Very much hoping that the MASSDEP will approve a stringent set of standards soon,
That really helps us all to decarbonize while also electrifying our homes and businesses in a fair and equitable manner.

Thank you for your consideration…
Sincerely,

Anthony Dylan Vizy
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