

WORKSHOP TOPIC OVERVIEW

The Residential Existing Buildings program is made up of four core initiatives: Residential Coordinated Delivery (RCD), Residential Conservation Services, Residential Retail and Residential Behavior. These initiatives make up more than 90% of the Residential Sector electric and gas lifetime savings in the 2019-2021 Plan. This workshop focuses on three of many possible residential existing buildings topics: 1) heat pumps and electrification, 2) fossil fuel heating incentives, and 3) Residential Coordinated Delivery (RCD). This briefing document provides background, analysis and recommendations to further advance in the 2022-2024 Plan the PAs' strong foundational work in these areas.

OVERVIEW OF RECOMMENDATIONS FOR COUNCIL CONSIDERATION

TOPIC: HEAT PUMPS AND ELECTRIFICATION

1. **Establish separate, higher heat pump unit goals to reflect EEAC priorities. Goals should be broken out by all heat pumps, whole house conversions, partial displacement, and heat pump water heaters.**
2. **Bolster program support and market promotion of heat pump technologies for primary heating including the addition of incentives and HEAT Loan eligibility for ground-source heat pumps by January 2022:**
 - a. Enhance HVAC contractor technical competencies for heat pump system selection, design, installation and maintenance.
 - b. Co-deliver with other energy efficiency and active demand management measures.

TOPIC: FOSSIL FUEL HEATING INCENTIVES

3. **Limit fossil fuel space heating incentives only to technologies and installations where clear cost-effective savings remain.**
 - a. Incentivize only non-condensing to condensing fossil fuel systems by January 2022, using a phased approach if necessary to support an orderly market transition.
 - b. Cease support for oil-fired heating equipment as of January 2022; handle as custom measure, especially for multifamily buildings.
4. **Phase out fossil fuel water heating incentives.**
 - a. Cease incentives and HEAT Loans for oil and propane water heating equipment by January 2023, using a phased approach if necessary to support an orderly market transition.
 - b. Cease incentives and HEAT Loans for storage and indirect natural gas water heaters as of January 2022, but retain for more efficient tankless and condensing gas systems.

TOPIC: RESIDENTIAL COORDINATED DELIVERY (RCD)

5. **Supplement current RCD program with new, custom performance-based offer modeled after DOER's Home MVP pilot.**
6. **Implement state of art communication and data management practices to increase effectiveness of customer interactions, including but not limited to:**
 - Review/refresh Mass Save and PA websites

- Carry through updated messaging strategies to customer emails, social media, and other communication channels
- Improve the home energy audit report
- Improve behavior reports
- Enhance use of technology

RESIDENTIAL HEAT PUMPS AND ELECTRIFICATION

During the planning process for the 2019-2021 term there was a strong focus by the Consultants, Councilors, and stakeholders on opportunities to increase the emphasis on electrification of residential energy efficiency measures and approaches. The PAs responded to expressed Council priorities by advancing a strategy they termed “Energy Optimization,” an approach that the Plan indicates includes “providing fuel neutral educational materials and assistance on all options for heating and cooling. In some instances, for example, this may mean helping customers utilize energy more efficiently and reduce greenhouse gas emissions by increasing electric usage through the adoption of state-of-the-art cold climate air source heat pumps.”¹ The Term sheet also included specific heat pump unit goals for all three sectors which were supported, in part, by much higher incentives for the displacement of electric resistance, propane and oil heat.²

For the 2022-2024 Plan term, it is time to move beyond fuel neutrality to a stronger emphasis on electrification. This movement is supported by baseline conditions in the market, advances in technology, and by a need to accelerate actions required to meet the Commonwealth’s climate goals. In this section we focus on strategies to electrify space and water heating in residential existing buildings.

Background/Current Status

The PAs’ 2019-2021 Plan included Term Sheet goals of installing 37,993 market rate and 6,082 low income cold-climate heat pumps in Massachusetts homes. To support displacement of resistance space heat and fuel switching, the PAs introduced much higher incentives for these heat pump installations in early 2019. For example, in 2018 a qualifying typical/single head 1 ton heat pump unit displacing a delivered fuel would have earned an incentive of either \$100 or \$300 depending on the efficiency vs. \$1,250 in 2020. For the higher fuel switching incentives introduced in 2019, the PAs also require the installation of a program-approved integrated control unless the heat pump is displacing electric resistance space heat or fully displacing all of the oil or propane heat in a home.

However, the current Term Sheet goals do not distinguish between efficiency only upgrades, electric resistance displacement, and fuel switch installations. The majority of heat pumps installed to date in the current Plan have been efficiency upgrades (Table 1). In the next Plan, the PAs should have significantly higher heat pump unit goals than in 2019-2021 and have separate goals for each of these savings opportunities, further defined by building type. For heat pump water heaters, separate goals should be established for replacing an existing electric storage water heater and for replacing a fossil fuel-fired water heater.

¹ <https://ma-eeac.org/wp-content/uploads/Exh.-1-Final-Plan-10-31-18-With-Appendices-no-bulk.pdf>

² <https://ma-eeac.org/wp-content/uploads/Term-Sheet-10-19-18-Final.pdf>

Table 1. 2019 (Evaluated) and 2020 Q2 TYD Heat Pump Installation

Heat Pump Unit Type	Description	2019 Evaluated	2020 YTD
Residential			
Lost Opportunity	Efficiency upgrade of assumed baseline heat pump	8,276	2,346
Energy Optimization	Displacement of electric resistance space heat	1,001	581
Fuel Switching	Displacement of oil or propane	2,372	1,380
Total		11,649	4,307
Income Eligible			
Lost Opportunity	Efficiency upgrade of assumed baseline heat pump	0	0
Energy Optimization	Displacement of electric resistance space heat	658	42
Fuel Switching	Displacement of oil or propane	2	1
Total		660	43

The PAs have explicitly discouraged full replacement of existing fossil fuel heating systems. The PAs currently recommend that the existing fossil fuel heating equipment be retained to operate at lower temperatures where the heat pump economics may not be favorable and as a back-up. However, this approach fails to consider:

- ▶ The economics of cold climate heat pumps are favorable against propane heating across nearly all temperatures. Rather than maintain, and eventually replace, a propane furnace used in conjunction with a ducted heat pump, it is likely more cost efficient to remove the furnace and install some amount of supplementary resistance heat that would only operate on the coldest days.
- ▶ The cost-effectiveness and lifecycle costs of a whole house ducted heat pump solution vs. an oil furnace show more favorable economics for the heat pump.

In the 2022-2024 Plan (if not sooner), incentives should be expanded to include ground-source heat pumps (GSHPs) in addition to air-source heat pumps. GSHPs provide a highly efficient whole house, full replacement solution. GSHPs are being actively supported in New York, and Connecticut’s GSHP incentives increased significantly in 2020. The PAs should review and emulate best practices in the region to support the growth of ground source heat pumps. In addition, GSHPs should be eligible for HEAT Loans to assist customers with the high cost (estimated costs upwards of \$50,000) of installing these systems. Minimum eligibility criteria for qualifying GSHPs will need to be established consistent with the proposed incentives.

In the next Plan additional focus should be given to whole house ducted solutions, including GSHPs, to displace existing propane and oil furnaces. There should be separate goals established for heat pump whole house replacement and for heat pump partial displacement, with the existing fossil fuel space heating system retained in the latter cases.

To achieve this outcome, the PAs will need to work closely with contractors, distributors, and manufacturers to provide them with a level of comfort regarding whole house replacements. According to the US DOE, “traditional sizing, selection and installation practices are not always well-suited to cold climate [heat pumps] and have led to system inefficiencies and underperformance.”³ Largely in response to these market needs, the Northeast Energy Efficiency Partnerships’ (NEEP) has developed contractor guidance for system sizing and

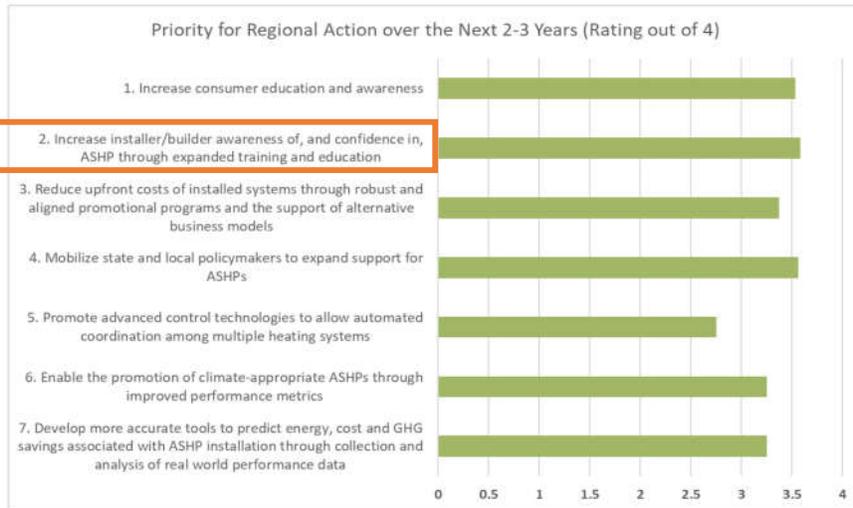
³ <https://rpsc.energy.gov/tech-solutions/hvac>

selection and a guide for installation, both of which could be leveraged for this purpose.⁴

Contractors, the salespeople and technicians, are a significant influencer for homeowner decisions in purchasing heating and cooling systems, according to NYSEDA research.⁵ Consequently, NYSEDA is

employing strategies in partnership with manufacturers and distributors for specific hands-on, “boot camp” trainings, demonstrations and outreach with contractors. These are actions the PAs should also employ to enhance HVAC contractor technical competencies and reinforce recommendations made in the Workforce Development Briefing Memo. Additionally, to verify installations, and offer a service differentiator, the PAs should leverage relationships and actions already established for measureQuick contractors, to develop and offer measureQuick workflow checklists and reports specific to cold climate heat pump commissioning.

NEEP ASHP Market Transformation Progress Report



<https://neep.org/ashp-market-transformation-progress-report>

The PAs will also need to consider means to minimize the sizing and operation of any resistance back up. This can be addressed, in part, by encouraging the co-delivery of envelope and distribution system improvements. For example, the PAs could encourage (and possibly require) both air and duct sealing prior to the sizing and installation of any whole house heat pump solution. In general, heat pumps function best and provide greater comfort in homes that have had their building envelopes and distribution systems addressed. While making insulation upgrades a requirement for heat pump electrification installations may not be feasible, such upgrades should be promoted.

Finally, the PAs should explore and implement accordingly any active demand management opportunities that can be co-delivered with efficient electric space and water heating equipment. Control of HPWHs can be pursued through add-on controllers or through the promotion of HPWHs that have built-in demand response capabilities.

Recommendations

1. **Establish separate, higher heat pump unit goals to reflect EEAC priorities.** Goals should be broken out by all heat pumps, whole house conversions, partial displacement, and heat pump water heaters.
2. Bolster program support and market promotion of heat pump technologies for primary heating including the addition of incentives and HEAT Loan eligibility for ground-source heat pumps by January 2022:

⁴ [Air Source Heat Pump Installer and Consumer Resources | Northeast Energy Efficiency Partnerships \(neep.org\)](https://neep.org/Air-Source-Heat-Pump-Installer-and-Consumer-Resources-Northeast-Energy-Efficiency-Partnerships)

⁵ <https://www.nyserda.ny.gov/Partners-and-Investors/Partner-With-NYSEDA/Residential-Market-Advisory-Group>

- a. Enhance HVAC contractor technical competencies for heat pump system selection, design, installation and maintenance
- b. Co-deliver with other energy efficiency and active demand management measures

FOSSIL FUEL HEATING INCENTIVES

The PAs' programs for residential space and water heating are mature, successful, and rely heavily on savings from fossil fuels including oil and propane through the electric PAs and natural gas from the gas PAs. For baseline and other reasons set forth below, the timing is ripe for a transition away from this historical reliance.

Space Heating

Background/Current Status

The PAs currently provide substantial incentives for a wide range of efficient fossil fuel-fired space heating equipment. While these incentives are the most comprehensive for natural gas equipment, several categories of propane and oil-fired equipment are also eligible for incentives. These fossil fuel HVAC incentives are provided through Residential Coordinated Services (RCD), the Income Eligible Services program, and through retail HVAC channels. RCD and Income Eligible efforts primarily focus on encouraging customers to accelerate the replacement of older, inefficient equipment while the Retail HVAC Initiative largely engages customers and contractors on replacement of existing equipment at or near the end of its useful life.

Table 2 below summarizes the currently available incentives for fossil fuel-fired space heating equipment and the minimum annual fuel utilization efficiency (AFUE) required for incentive eligibility. Also provided for reference are the corresponding Federal minimum equipment efficiency standards that will be in effect in 2021.

Table 2. 2020 Fossil Fuel Space Heating Equipment Incentives

		Natural Gas		Propane		Oil
Furnace	2021 Federal Std.	80%		80%		83%
	Program AFUE	≥95%	≥97%	≥95%		≥86%
	Incentive (\$)	\$1,000	\$1,250	\$1,000		\$650
Furnace w/On-Demand Hot Water	2021 Federal Std.	80%		N/A		N/A
	Program AFUE	≥97%				
	Incentive (\$)	\$950				
Boiler	2021 Federal Std.	84%		84%		86%
	Program AFUE	≥90%	≥95%	≥90%	≥95%	≥86%
	Incentive (\$)	\$2,000	\$2,750	\$1,500	\$2,300	\$800
Boiler w/On-Demand Hot Water	2021 Federal Std.	84%				N/A
	Program AFUE	≥95%		≥95%		
	Incentive (\$)	\$2,400		\$2,000		

Figures 1 and 2 below summarize the 2019 program supported fossil-fuel fired space heating units by fuel and equipment type. Of the 30,333 fossil-fuel fired space heating units incented in 2019, the large majority of units were gas fired (77% of units and 85% of lifetime MMBtu savings) and most were boilers (63% of units and lifetime MMBtu savings). Oil and propane space heating units constituted 23% of units and 15% of lifetime MMBtu savings. Note that for program supported gas and propane heating equipment, the PAs do not report out the efficiency of the replaced heating equipment; we do not know whether the replaced equipment was condensing or non-condensing.

Figure 1. 2019 Fossil-Fuel Fired Space Heating Unit Numbers by Fuel

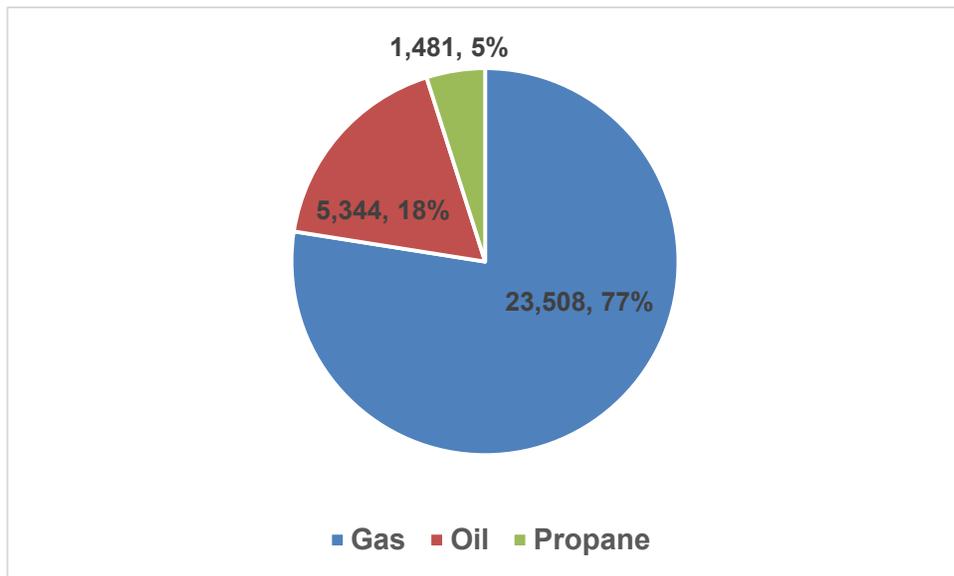
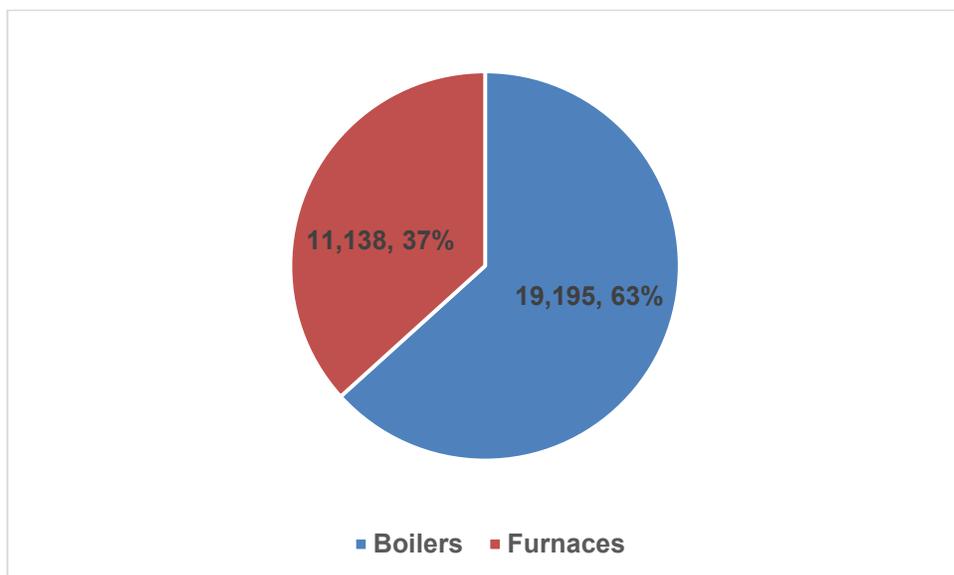


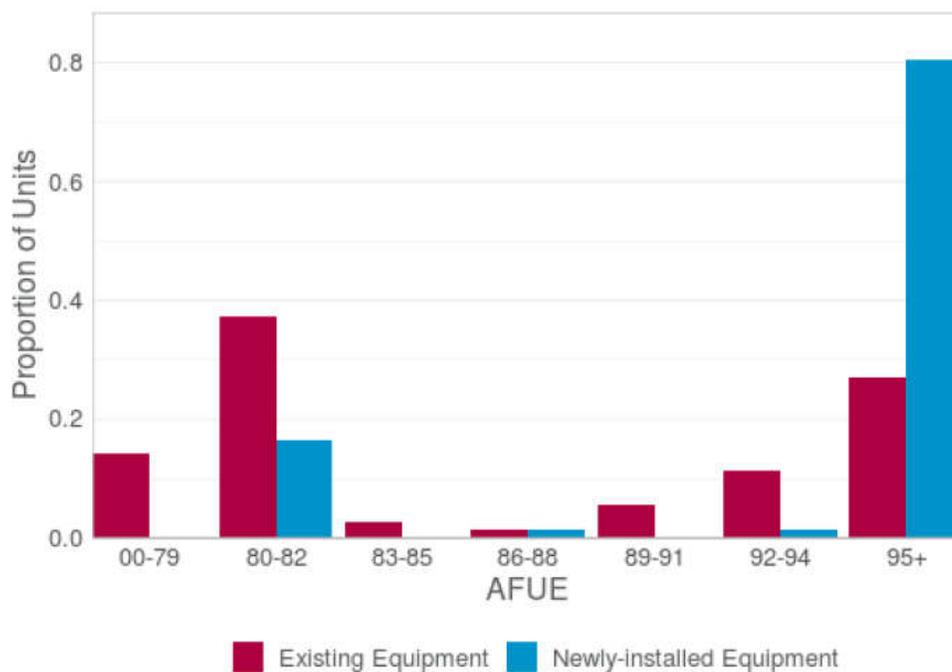
Figure 2. 2019 Fossil-Fuel Space Heating Unit Numbers by Equipment Type



Over the past several years, detailed data have been collected on the HVAC equipment and appliances in Massachusetts homes. These data include equipment saturations and, more recently, metered usage data. For certain equipment types, data on efficiency levels has also been collected. From this Baseline Study there are data that characterize both the current efficiency of in-place space heating equipment (saturation) and the efficiency of recent purchases. Unfortunately, due to sample size limitations space heating equipment efficiency data are only available for natural gas-fired equipment.⁶

Figure 3 below shows the distribution by AFUE efficiency range of both the total stock of natural gas furnaces, found in 24% of Massachusetts homes in 2019, and of natural gas furnace purchases in 2019. Of particular interest is that over 80% of recent natural gas furnace purchases are condensing furnaces (≥90% AFUE), with nearly all of these at or above the minimum program AFUE requirement for furnaces of 95% AFUE.

Figure 3. Natural Gas Furnace Efficiencies: Current Stock and Recent Purchases



Source: Guidehouse analysis

While Mass Save incentives may be one factor contributing to the preference for very efficient new natural gas furnace installations, it is worth noting that in mid-2017 only 20% of efficient furnace purchases in Massachusetts received program incentives.⁷ It appears that the Massachusetts natural gas furnace market is close to being transformed. Given the high level of recent 95+% AFUE natural gas furnace purchases, this market should be monitored to assess whether it has become sufficiently transformed to allow program

⁶ Massachusetts Residential Baseline Study. Guidehouse. March 31, 2020. [Residential Baseline Study \(ma-eeac.org\)](https://www.ma-eeac.org/residential-baseline-study)

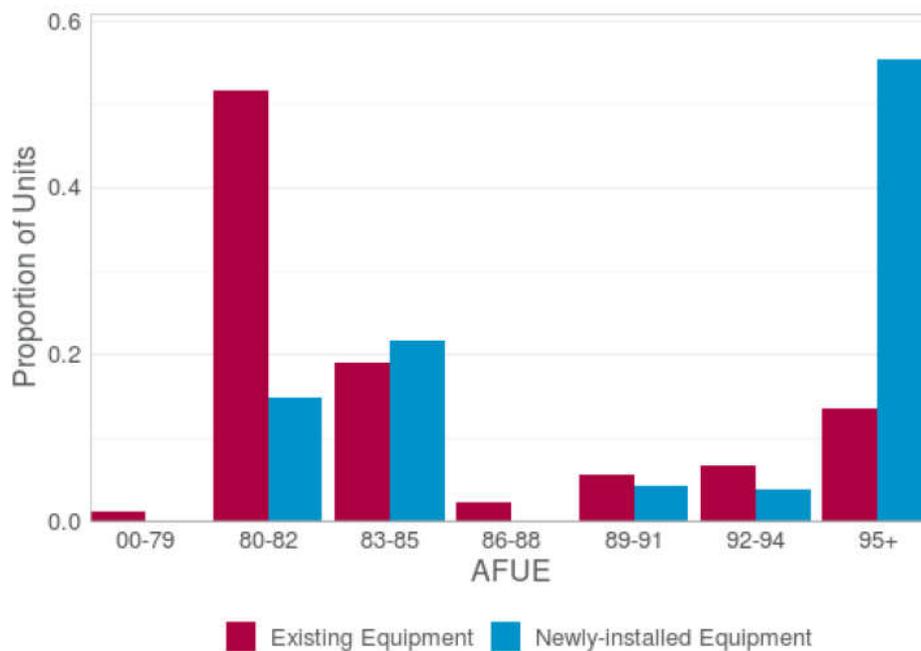
⁷ Analysis of Residential HVAC Sales Data from HARDI Distributors (TXC65). NMR Group, Inc. November 15, 2019. [TXC65 Analysis of Residential HVAC Sales Data from HARDI Distributors Memo \(ma-eeac.org\)](https://www.ma-eeac.org/txc65-analysis-of-residential-hvac-sales-data-from-hardi-distributors-memo)

support to be entirely withdrawn.

For natural gas boilers, which are found in 33% of Massachusetts homes, the proportion of new boiler purchases that are condensing is about 60% with the very large majority at an AFUE of 95% or higher (Figure 4). In mid-2017, a little less than half of efficient natural gas boiler sales in Massachusetts participated in the PAs’ programs.

The high percentage of new natural gas heating equipment purchases that are highly efficient supports a more nuanced and targeted approach to the PAs’ natural gas – and by extension to their propane – space heating equipment incentives. Incentives should be restricted to upgrades on non-condensing equipment.

Figure 4. Natural Gas Boiler Efficiencies: Current Stock and Recent Purchases



Source: Guidehouse analysis

Currently, the PA incentives make no distinction between homes that already have high efficiency ($\geq 90\%$ AFUE), i.e., condensing, equipment in place and those that do not. This is primarily a consideration for natural gas and propane heating equipment where there is significant product availability of very high efficiency equipment at or above AFUEs of 95%. For homes that have already switched to condensing equipment and have made the required changes to accommodate this equipment (e.g., sidewall venting, installation of a condensate pump and/or drain, addressing “orphaned” water heaters, etc.) it is expected that nearly all of these would be replaced with condensing equipment regardless of incentive availability. If incentives for these installations were continued, most of these installations would be program free-riders and not contribute to net savings.

While comparable efficiency saturation and recent sales data for propane space heating equipment are not available, it is assumed that propane sales would mirror those of natural gas. If anything, given the much higher cost of propane, propane space heating equipment efficiencies are likely to skew even higher compared to natural gas equipment.

Unlike natural gas and propane heating equipment, the efficiency range of the vast majority of oil-fired space heating equipment is much more limited, bounded by the federal minimum standards as a floor (86% AFUE for boilers and 83% AFUE for furnaces) and an effective ceiling of 88% AFUE. There are very few available oil furnaces or boilers with efficiencies at or above 88%, significantly limiting any possible efficiency gains in promoting efficient oil-fired heating equipment. Of the 392 listed ENERGY STAR oil furnaces, only 5 had AFUEs of 88% or higher.⁸ Of the 189 listed ENERGY STAR oil boilers, only 22 had AFUEs of 88% or higher with only 2 models attaining the highest oil boiler AFUE of 91%.⁹ Given this limited product availability, the very small national market for oil-fired heating equipment, and the 2021 AFUE federal standards, little savings opportunities remain for most oil-fired equipment installations. Continued support for oil-fired heating equipment is no longer warranted in most instances. For certain applications, e.g., multifamily buildings with very old and inefficient oil-fired heating systems, most often boilers, the ability to address these savings opportunities should be retained as a custom measure. Upgraded oil-fired heating equipment should only be supported if and when there is no heat pump solution that yields similar economic benefits to the customer.

Also note that continued support of propane and oil heating equipment with ratepayer funds sends mixed signals to customers and trade allies regarding the state's greenhouse gas reduction goals and Council priorities and the promotion of efficient heat pumps. In particular, continued PA support of the installation of efficient propane heating equipment represents a missed opportunity to move that customer to either full replacement (mostly likely when a propane furnace is currently in place) or partial displacement (when a propane boiler is currently in place). Given our recommendation below that oil space heating equipment incentives cease entirely in most applications in 2021, this may be less of an explicit concern for the next Plan, but does further support ending oil space heating equipment incentives as soon as feasible. For propane space heating equipment, in particular furnaces, thought should be given to phasing out incentives over the 2022-2024 Plan period as the PAs work to increase their cost-effective heat pump fuel switch installations.

Consistent with the approach put forward above, HEAT Loans should only be available when supporting upgrades from non-condensing to condensing natural gas and propane space heating equipment.¹⁰ Non-custom oil-fired space heating equipment measures would also be excluded from HEAT Loan eligibility.

The Consultants recognize that implementation of these changes and those recommended below to longstanding program practices will have impacts on program partners involved in the fossil-fuel heating equipment market. To minimize these impacts, an orderly market transition to phase out these incentives will need to be developed. Similarly, changes in Home Energy Assessment (HEA) recommendations provided to HEA participants would need to be made corresponding to an equipment phase-out schedule. In addition, support should be provided to transition program partners to play a more prominent role in supporting program measures and other offers that will continue to receive program support. For example, we note below that the PAs will need to work closely with contractors, distributors, and manufacturers to provide them with a level of comfort regarding whole house replacements using heat pump systems.

It is important to note that the discussion above and the recommendations below largely apply to all residential customers: market rate, moderate income, and low income. Additional discussions with LEAN and other stakeholders are warranted to assess whether any further adjustments are needed to properly address the

⁸ ENERGY STAR qualified boiler listed accessed on November 30, 2020. [ENERGY STAR Certified Furnaces | EPA ENERGY STAR.](#)

⁹ ENERGY STAR qualified boiler listed accessed on November 30, 2020. [ENERGY STAR Certified Boilers | EPA ENERGY STAR.](#)

¹⁰ In 2019 8,652 HEAT Loans for central heating equipment were made representing \$75.2M in loans for an average cost of. \$8,690 per loan.

distinct needs of the moderate- and low-income sectors.

Recommendations

3. **Limit fossil fuel space heating incentives only to technologies and installations where clear cost-effective savings remain.**
 - a. Incentivize only non-condensing to condensing fossil fuel systems by January 2022, using a phased approach if necessary to support an orderly market transition.
 - b. Cease support for oil-fired heating equipment as of January 2022; handle as custom measure, especially for multifamily buildings.

Water Heating

Background/Current Status

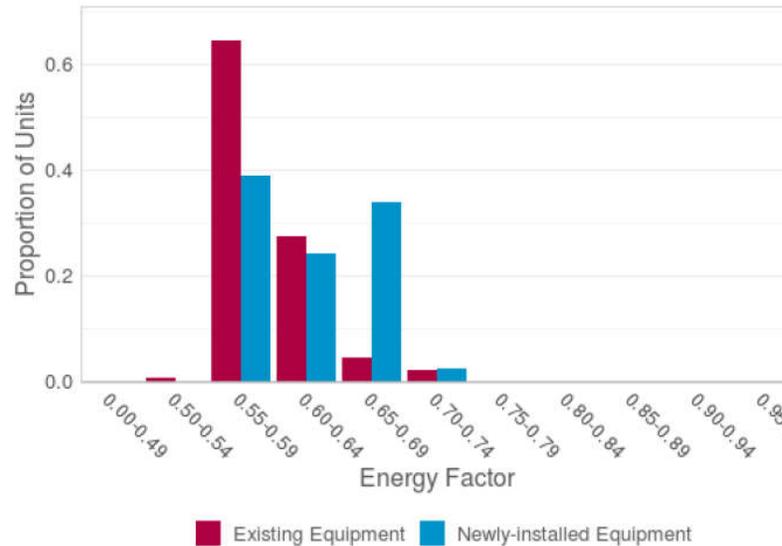
The PAs have long supported efficient fossil fuel and electric hot water heating technologies. These have included both stand-alone water heaters and indirect water heaters connected to a boiler. As with space heating equipment, the natural gas hot water incentives are the most comprehensive among fossil fuel-fired water heaters. Table 3 summarizes the PAs’ current fossil fuel water heater incentives. UEF refers to Uniform Energy Factor, the current federally prescribed efficiency descriptor for hot water heaters. Note that while federal efficiency standards for water heaters are in place, they are not included below as most of the minimum standards vary with the water heater’s storage volume.

Table 3. 2020 Fossil Fuel Water Heating Equipment Incentives

		Natural Gas		Propane	Oil
Storage	Program UEF (Medium draw/High draw)	≥0.64	≥0.68	N/A	N/A
	Incentive (\$)	\$100	\$100		
Condensing	Program UEF	≥0.80		N/A	N/A
	Incentive (\$)	\$500			
On-Demand Tankless	Program UEF	≥0.87	≥0.87	N/A	
	Incentive (\$)	\$700	\$800		
Indirect Water Heater Connect to a Hot Water Boiler	Program UEF	N/A	N/A	N/A	N/A
	Incentive (\$)	\$400	\$400	\$400	\$400

As with gas space heating equipment, data are available from the Baseline Study on the efficiency of the installed base of gas water heaters and for newly purchased equipment. While the data do show that recent purchases are more efficient than the installed base (Figure 5), the observed water heater energy factors (the prior federal water heater efficiency descriptor) indicate that nearly all of the recent water heater purchases are storage water heaters. As a result, these data indicate little penetration of more efficient tankless on-demand or condensing water heaters. The PAs’ efforts in the next Plan should target these highly efficient gas water heating technologies rather than incremental improvements in storage water heater efficiency.

Figure 5. Natural Gas Boiler Efficiencies: Current Stock and Recent Purchases



Source: Guidehouse analysis

The PAs also offer incentives for heat pump water heaters (HPWHs) which can be as much as four times as efficient as a conventional storage electric water heater, with UEF's as high as 4.0.

While the PAs have been offering heat pump incentives since early 2019 to promote space heating electrification and fossil fuel displacement, they only started to offer similar incentives for HPWHs in the second half of 2020. Until then, program supported HPWHs could only be installed to displace an electric storage water heater. Table 4 summarizes their current HPWH incentives.

Table 4. 2020 Heat Pump Water Heater Incentives

STANDARD HEAT PUMP WATER HEATER REBATES			
Equipment Type	Capacity	UEF ¹	Rebate Amount
Heat Pump Water Heater	> 55 gallons	≥ 2.7 (switching from electric heater)	\$150
	≤ 55 gallons	≥ 2.0 (switching from electric heater)	\$600
	≤ 55 gallons	≥ 2.0 (switching from oil heater)	\$600
	≤ 55 gallons	≥ 2.0 (switching from propane heater)	\$400

¹UEF - Uniform Energy Factor

Figures 6 and 7 below summarize the 2019 program supported fossil-fuel fired water heating units by fuel and equipment type. Of the 15,067 hot water heaters incented in 2019, the large majority of units were gas fired (76% of units and 88% of lifetime MMBtu savings) and most were indirect water heaters connected to a boiler (6,351 of units and 55% of lifetime MMBtu savings). Oil and propane water heating units constituted 13% of units and 6% of lifetime MMBtu savings while HPWHs constituted 9% of units and 3% of lifetime MMBtu savings.

Figure 6. 2019 Hot Water Heating Units by Fuel

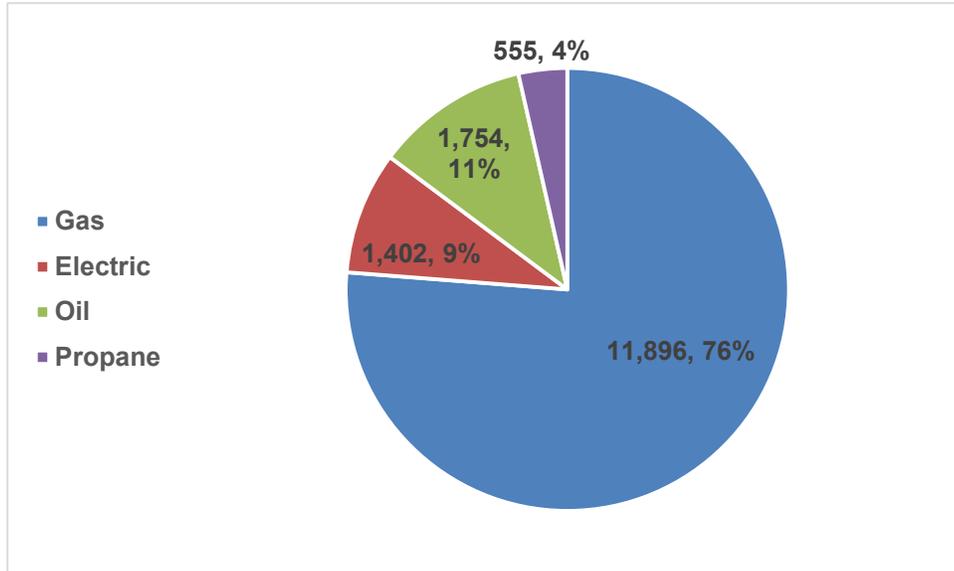
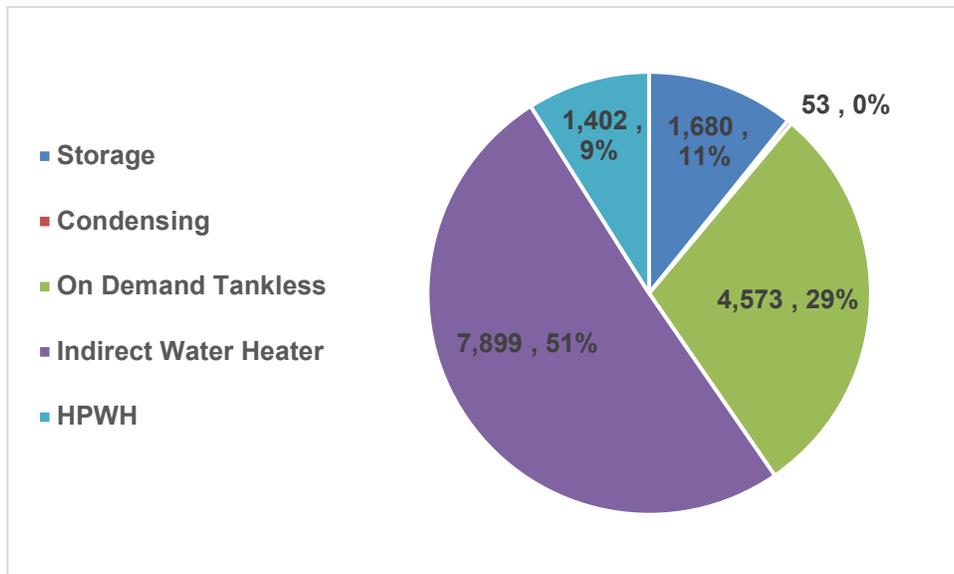


Figure 7. Hot Water Heating Units by Equipment Type



The 2022-2204 Plan water heater recommendations below were drafted with two objectives:

- ▶ Support and grow efforts to electrify this end use when cost effective and providing cost savings to customers. This effort should build on the PAs’ recently announced HPWH incentives to replace oil and propane hot water systems.

- ▶ Only continue to support fossil-fuel fired hot water heater measures where there is neither a HPWH alternative or, absent that, a fossil fuel-fired water heater alternative that yields a significant improvement in savings. This is the rationale for proposing that storage water heaters and indirect water heaters no longer be supported in the next Plan. Storage and indirect gas water heater technologies generally only provide small incremental improvements in efficiency relative to federal minimum standards and/or there are better efficiency alternatives available. Contractors and customers should be encouraged to install more efficient gas water heating technologies or HPWHs when the current hot water fuel is oil or propane.

HPWHs provide significant operating cost savings to consumers and much higher overall MMBtu savings relative to oil and propane hot water options, regardless of the efficiency of the fossil fuel-fired alternative. The HPWH alternative is also cost effective from a TRC perspective. In addition, as with space heating equipment, continuing to support oil and propane water heating sends mixed signals to contractors and customers regarding the state's efforts to electrify key residential end uses. Note that the customer and TRC economics of HPWHs vs. gas-fired on-demand tankless are not favorable.

To support hot water electrification will require the PAs to undertake increased outreach and training of contractors and distributors, as well as to work closely with manufacturers. The PAs will also need to be able to provide customers with the relative economics of different hot water fuel and equipment choices at the conclusion of an HEA. Similar tools should be provided to contractors. To allow for an orderly market transition, the PAs should consider a phased approach to these changes.

Recommendations

4. Phase out fossil fuel water heating incentives.

- a. **Cease incentives and HEAT Loans for oil and propane water heating equipment by January 2023, using a phased approach if necessary to support an orderly market transition.**
- b. **Cease incentives and HEAT Loans for storage and indirect natural gas water heaters as of January 2022, but retain for more efficient tankless and condensing gas systems.**

RESIDENTIAL COORDINATED DELIVERY (RCD)

As a whole-building approach to residential existing single- and multi-family buildings, the Residential Coordinated Delivery (RCD) initiative contains numerous elements and could support a lengthy analysis in a briefing document and discussion of many hours in a Council planning workshop. Given competing priorities for a limited amount of time, we have chosen to focus on two key opportunities we see for the 2022-2024 Plan term for this workshop—1) creating a custom pathway for participation and 2) improving marketing and communications. The focus on these two subjects is not intended to convey that these are the only opportunities for improvement in 2022-2024. Our expectation is that there will be additional opportunities over the course of the planning process to delve into other opportunities.

Background/Current Status

Mass Save RCD, as the primary service offering to residential customers, “facilitates comprehensive weatherization and home energy efficiency upgrades in existing homes in order to reduce whole-home energy.”¹¹ The objective, as laid out in the Plan, is to:

- ▶ Offer integrated program delivery, informed with data driven guidance to meet and optimize the specific transactional moment of the customer’s needs.
- ▶ Streamline the initiative and customer participation experience.
- ▶ Continue to increase depth of savings.

Prior to the 2020 pandemic, the PAs were making progress towards these goals, however, much opportunity remains to improve the customer experience and facilitate installation of deeper measures. Progress includes:

- ▶ Designing weatherization offerings by targeting by buildings type (e.g., single-family (1-4), attached low-rise, and attached high-rise).
- ▶ Offering one point of intake with an updated customer call system with prompts, offered in multiple language.
- ▶ Facilitation of specialized vendor services and access to the HEAT Loan to address pre-weatherization barriers, including knob and tube wiring and health and safety issues.



Massachusetts households spend 22% more on energy costs than the average US home; roughly \$2,500/year.¹² The majority of these costs (59%) are allocated to heating, making investments in weatherization and efficient heating systems a priority. Prior to the COVID-19 pandemic, the Mass Save RCD initiative reported roughly 80,000 home energy assessments in 2019. With average conversion rates of 35%, the PAs’ weatherization projects, primarily for air sealing and insulation, total just over 52,000. With roughly 2 million households in the state, the PAs are reaching approximately 3% of residences with weatherization services, one of the highest penetration rates in the nation.¹³

The PAs also have significantly higher program costs, incentive levels and program support infrastructure than most if not all other states. Looking at 2019 heating system rebates attributed to the RCD initiative, the reach of the program among Massachusetts households totals 6,900 installations.¹⁴ As noted by ACEEE’s Utility

¹¹ PAs’ 2019-2021 Plan

¹² EIA RECs

¹³ <https://www.energystar.gov/campaign/improvements/professionals/activity>

¹⁴ Heating system installations through RCD amount to approximately 20% of all Mass Save residential heating system installations, with the balance coming through the Retail Initiative/channel.

Energy Efficiency Scorecard, year-after-year, Massachusetts PAs rank number one, propelling them as national leaders and calling for nation-leading continued improvement and innovation. As called for in the Council’s 2018 Resolution, the RCD initiative needs to innovate to reach even more households and to facilitate installation of deeper energy saving measures. The Consultant Team has narrowed its focus on these primary issues with the understanding that they are inclusive of residential market challenges related to customer segmentation, reaching multifamily and renter markets and electrification.¹⁵

Custom Pathway for Deeper Energy Savings

In 2017, the Consultant Team recommended that the PAs include performance-based options for residential retrofit in the 2019-2021 term, and the Council’s February 2018 resolution asked the PAs to “provide a new, integrated residential program design that maintains strong savings and benefits for all residential homeowner and rental initiatives.”¹⁶ The PAs did not include such an approach in their 2019-21 Plan, however, DOER spent its own funds to pilot test the Home Energy Market Value Performance (Home MVP) approach. Home MVP is a custom residential program model that targets homes that have more varied needs than the standard RCD program offerings, and demand for the pilot suggests that there is a substantial market for a custom program. DOER collaborated with residential weatherization and home performance contractors to design the Home MVP pilot. DOER initially recruited only home performance and weatherization contractors but added outreach to air-source heat pump contractors 6 months into the pilot. After a slow start in 2017, 500 home retrofits are expected by the end of 2020 when the pilot ends. Of the 460 homes that had completed projects through November 2020, 290 (63%) were beneficial electrification conversions.

Home MVP Results to date:

- ▶ **Deeper savings:** With the incentivization to customers to combine weatherization and HVAC savings to maximize their rebate and get deep whole house projects, the pilot has consistently averaged around 50 MMBtus total saved/home/year, equivalent to 32% site energy savings. By comparison 15-20 MMBtus is the Mass Save average for weatherization-only projects, equivalent to approximately 13%.
- ▶ **High rate of electrification:** Home MVP contractors delivered deeper savings in large part due to high rates of electrification, with 63% of homes involving a fuel switch to heat pumps as well as

Home MVP as a custom program differs from the Mass Save RCD program design in several significant ways:

- ▶ **Performance-based, fuel-neutral savings** – contractors are paid an incentive based on modeled MMBtu energy savings vs. the existing home baseline
- ▶ **Actual usage from customer billing data** is used to calibrate modeled savings.
- ▶ **Open-market pricing** – Contractors have no fixed pricing on measures, so customers are encouraged to get multiple bids
- ▶ **Home energy scorecards** are integrated into the audit software to illustrate the savings and incentive levels available to customers
- ▶ **No limit on eligible measures** – e.g., foam, mineral wool, etc. are allowed
- ▶ **No lighting or other ISMs** – anticipating that these savings will be phased out
- ▶ **Expanded HEAT loan only for non-fossil fuel measures**, e.g., weatherization and heat pumps

¹⁵ The topics of better serving renters, as well as moderate income and limited English proficiency customers, will be addressed at the Council’s January 12 workshop.

¹⁶ <https://ma-eeac.org/wp-content/uploads/2019-2021-RECOMMENDATIONS-RESOLUTION-final-1.pdf>.

weatherization measures in most homes. Mass Save electrification rates are currently very low at under 5%.

- ▶ **Higher incentives per home:** Averaging \$6,250/home, plus \$250 to cover audit costs. This translates into \$131/MMBtu annual savings. DOER lowered incentive levels in February 2020 and believes they could be lowered further. Through a test and learn approach that seeks to scale contractor participation, the PAs could experiment with calibrating performance-based incentive levels.
- ▶ **Fuel types:** Oil heat and Muni Customers represent 63% of projects and gas heat customers 1/3rd.
- ▶ **Scorecards:** Were integrated into audit software and used to illustrate home savings potential, incentives earned and carbon reductions. Average homes used 154 MMBtus/year prior to improvements and 104 MMBtus/year on project completion.
- ▶ **Calibrated usage data:** Customers were willing to provide their fuel usage history to calibrate model savings, however, tracking ongoing usage is challenging for delivered fuels due to lack of meters for oil and propane customers.

The PAs should supplement current RCD program with new, custom performance-based offer modeled after DOER's Home MVP pilot with the objectives to achieve deeper fuel-neutral energy savings per project, increase rates of electrification in customers served, and to scale performance based contractor participation.

Improving Residential Marketing and Communications

Concurrent with redesigning the residential program to include a custom performance path is the need to simplify, clarify, and improve customer facing content and communication tools. Marketing and communication are used to educate, inform and persuade customers to take action – purchase projects, proceed with services and installations. Industry surveys consistently indicate information awareness and demand number among

"50% of American adults cannot read above an 8th grade level"

--The Literacy Project Foundation

the top barriers to advancing adoption of energy efficient products and services.¹⁷ The Mass Save brand has strong recognition and can be leveraged to increase residential customer's participation and engagement in online resources. The PAs should implement state of art communication and data management practices to increase effectiveness of customer interactions across the suite of outreach mechanisms, including the website, direct communications, behavior reports, and the home energy assessment audit

report. Increasing the effectiveness of communications and marketing will lead to both broader—e.g., historically underserved populations--and deeper participation.

Mass Save Website

The PAs are working on updates to the Mass Save website, such as adding customer toolkits and technology guidance, but an overarching consideration of customer-centric delivery of information and solutions that following the best practice aspects is lacking. Characteristics of websites that effectively communicate and deliver solutions for users include the following aspects:

- ▶ Streamlined navigation with easy, direct access to desired content.
- ▶ Messaging that underscores priorities (e.g., fuel optimization, all cost-effective energy saving

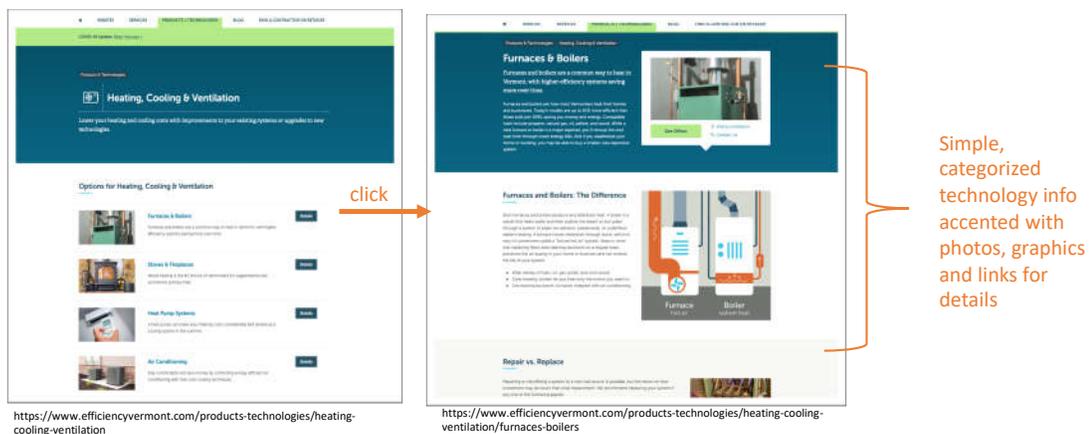
¹⁷ Over the last decade, numerous research reports indicate a knowledge gap is a significant barrier to pursuit of investment in energy efficient products and services. Two example reports are US DOE's "[Summary of Gaps and Barriers for Implementing Residential Building Energy Efficiency Strategies](#)" and the Shelton Group's [Eco Pulse report](#).

measures, etc.).

- ▶ Actionable information (e.g., taking the next step; push to project sale/installation).

A recent review of the Mass Save HVAC webpages found numerous opportunities to streamline content, simplify steps, and reduce text in favor of info-graphics and photos. By contrast, as shown by the Efficiency Vermont HVAC technology pages (see figure below), a homeowner is guided through simple, categorized technology information that is accented by photos, graphics and other links to provide additional detailed content.

Example: Efficiency Vermont HVAC Technology Pages



Direct Communications

Cultivating their role as a trusted advisor, the PAs need to carry through communications that are relevant, timely, and motivational for energy efficiency next step actions. Using data-driven solutions can help the PAs achieve more customer-centric messaging. Arizona Public Service (APS), for example, has been tapping their customer data to deliver prioritized measure opportunities with customized messaging that is specifically targeted and timed to meet their customer's needs. APS has used this model for several years and found it to be highly effective when customer inputs are coupled with actual customer energy consumption data, which helps generate a more accurate list of recommendations. APS's online tool for customer self-assessment automatically marries data from the online tool with the customer's consumption history (if they opt to input their account number) and provides a customized analysis and measure prioritization. APS then uses this profile information to provide hyper-targeted, strategically timed, customized marketing to customers.

Mass Save Home Energy Assessment (HEA) Audit Report

The March 2018 [Home Energy Services Process Evaluation \(RES 35\)](#) identified several recommendations that would improve the effectiveness of the HEA Audit process and report. These include:

- ▶ Offering multiple assessment paths, enabling effectiveness with a comprehensive option or a less intensive option. Recent advancements with the virtual HEAs could be leveraged to execute upon this recommendation.
- ▶ Offering specific guidance to support lead vendors and HPCs ability to prioritize options and customize HEAs based on each household's stated needs.



Following these recommendations in parallel with those identified in ACEEE's 2019 Report, "After the Audit: Improving Residential Energy Efficiency Assessment Reports," would further enhance the effectiveness of the Mass Save HEA Audit Report. ACEEE's report used a mix-method approach of expert interviews, eye-tracking studies, and customer surveys to examine readability of 45 different audit reports. Based on this comprehensive analysis, the authors identified key recommendations to motivate customer action based on audit report recommendations.

- ▶ Personalize text, specific to the customer's audit results and prioritized recommendations based on customer's needs.
- ▶ Use photographs, simple tables, and well-designed graphics.
- ▶ Provide the actionable prioritized information upfront with detailed material in the back of the report.
- ▶ Provide comparison information, such as current score compared to future home score with improvements.
- ▶ Use simple, relate-able text that presents the benefits of health, comfort and cost savings from recommended upgrades.

Presently, the PA's audit report, as shown with an Eversource sample, totals 8 pages. Individualized directed information only pertains to a table of information on direct install measures and a second table (see figure below) presenting estimated costs and savings for weatherization measures. More than 2 pages of stock language on "recommended" energy efficient technologies is offered, however it is not personalized to the homeowner's situation or set of current systems.

Recommended Improvement	Estimated Cost	Estimated Savings	Estimated Payback in Years	Estimated Program in Years
Replace Smoke Test Kit - 2" Thermal Seal	\$147.70	\$147.70	1.00	Immediate
Replace Smoke Test Kit	\$112.24	\$112.24	1.00	Immediate
Seal Energy Entry Gaps	\$200.00	\$200.00	1.00	Immediate
Seal Attic Air Leaking	\$1,112.00	\$1,112.00	1.00	Immediate
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00	Immediate
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00	Immediate
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00	Immediate
Subtotal	\$4,112.00	\$4,112.00	1.00	Immediate
Subtotal	\$4,112.00	\$4,112.00	1.00	Immediate

Your Recommended Improvements

The following table provides a summary of the recommended improvements. The table includes the estimated cost, estimated savings, and estimated payback in years for each improvement. The improvements are listed in descending order of estimated savings.

Recommended Improvement	Estimated Cost	Estimated Savings	Estimated Payback in Years
Seal Energy Entry Gaps	\$200.00	\$200.00	1.00
Seal Attic Air Leaking	\$1,112.00	\$1,112.00	1.00
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00
Seal Attic Air Leaking (Attic)	\$1,112.00	\$1,112.00	1.00
Subtotal	\$4,112.00	\$4,112.00	1.00

Your Recommended Improvements

The following table provides a summary of the recommended improvements. The table includes the estimated cost, estimated savings, and estimated payback in years for each improvement. The improvements are listed in descending order of estimated savings.

Seal Energy Entry Gaps

Sealing energy entry gaps is a simple and effective way to reduce energy loss. It can be done by caulking around windows, doors, and other openings. This can save up to 10% on energy bills.

Seal Attic Air Leaking

Sealing attic air leaks is a simple and effective way to reduce energy loss. It can be done by caulking around pipes, wires, and other openings. This can save up to 10% on energy bills.

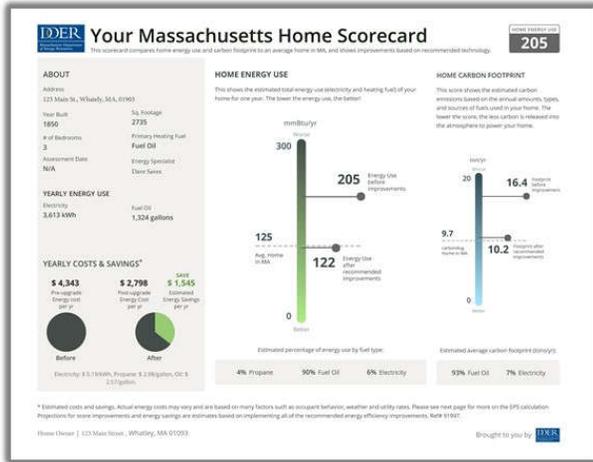
Seal Attic Air Leaking (Attic)

Sealing attic air leaks in the attic is a simple and effective way to reduce energy loss. It can be done by caulking around pipes, wires, and other openings. This can save up to 10% on energy bills.

Seal Attic Air Leaking (Attic)

Sealing attic air leaks in the attic is a simple and effective way to reduce energy loss. It can be done by caulking around pipes, wires, and other openings. This can save up to 10% on energy bills.

The PAs are working on IT programming tasks related to incorporating the Home Energy Score into the HEA report. They are also working on details of customer communications and reporting – looking to examples and lessons learned from other scorecard programs in other states. The proposed MA scorecard in Mass Save will use PA recommendations and will show total annual energy use (site MMBtus and GHG), based on the DOER Home Scorecard (see figure below) with the forthcoming addition of the Home Energy Score 1-10 score. This transition is behind schedule, but when fully complete during this plan cycle should improve their home audit reports.



The addition of the Home Energy Score to the HEA report affords a longer-term engagement strategy to drive deeper energy savings overtime. It also creates an opportunity to engage other market actors during various homeowner transaction points – such as the home sale or remodel. The PAs should harvest HEA and Home Energy Score reports for continued marketing and delivery of additional efficiency measures overtime.

With the multitude of data on customer behavior from the online assessments, in-home assessments, rebate redemption, and electric/gas usage, the PAs have the opportunity to develop a customer data integration strategy for enhanced customer engagement. Customer data integration (CDI) can empower the PAs’ program delivery

by providing a comprehensive single view of the customer, allowing insights into their digital footprint for personalization of messaging, services, and solutions. Working smarter, using data-driven strategies that mine data collected, the PAs can deliver custom narratives and solutions for improved customer engagement.

Behavior Reports

The primary behavior program model in Massachusetts—indeed across the United States—has been the Home Energy Report (HER) originally created by Opower, which was subsequently bought by Oracle. Currently, all PAs except Eversource (which now includes Columbia Gas, which never offered a behavior program to its customers) are claiming behavioral savings using Oracle’s HERs. In 2019, the PAs collectively communicated with more than 1.3 million electric customers and 900,000 gas customers in the form of paper or emailed Home Energy Reports (HERs), for which they claimed behavioral savings. Whether it be through continuing to build on the existing core HER offer or pursuing alternative savings models altogether like Eversource is undertaking, the PAs’ behavior programs in the 2022-2024 term should be more effectively leverage behavioral approaches as communication platforms to maintain if not increase claimable behavior savings. The PAs should also focus on better integrating behavior with other programs/offers to increase measure installations.

The Consultants note three main areas of innovation for the Massachusetts PAs’ behavior programs:

- ▶ Increase personalization of behavioral approaches, providing customers with information that is directly applicable to them and that addresses their individual circumstances and opportunities.
- ▶ Increase digital engagement, moving away from a sole reliance on paper or paper-like reports to engage with customers the way they are accustomed to in 2020—through devices using apps and other means.
- ▶ Integrate behavioral approaches into other customer engagements, including but not limited to online assessments, home energy scores provided at audits, the online marketplace, and PA customer engagement platforms.

Recommendations

5. Supplement current RCD program with new, custom performance-based offer modeled after DOER's Home MVP pilot.
6. Implement state of art communication and data management practices to increase effectiveness of customer interactions, including but not limited to:
 - Review/refresh Mass Save and PA websites
 - Carry through updated messaging strategies to customer emails, social media, and other communication channels
 - Improve the home energy audit report
 - Improve behavior reports
 - Enhance use of technology