

Mass Save Program Enables Quality HVAC Installations and Tune-Ups Using Smart Diagnostic Tools

A Smart Tools for Efficient HVAC Performance Campaign Case Study

The U.S. Department of Energy (DOE) Smart Tools for Efficient HVAC Performance (STEP) Campaign supports the use of wirelessly connected smart diagnostic tools—a suite of digital probes that transmit key HVAC system measurements, such as refrigerant temperatures and pressures, to HVAC system diagnostic smartphone and tablet applications. These tools can help determine whether air source heat pumps (ASHPs) including central heat pumps and ductless mini-split heat pumps (DMSHPs), central air conditioners (CACs), and other residential HVAC equipment are installed or operating correctly.

This case study describes how Mass Save, a collaborative of Massachusetts' electric and natural gas utilities and energy-efficiency service providers, designed and implemented a novel residential heating and cooling program to incentivize adoption of smart diagnostic tools and contribute to HVAC workforce development. This program uses smart diagnostic tools to enable quality installation and tune-ups and reduce the energy use and peak demand of residential HVAC equipment.

Why?

Proper installation and maintenance practices are required to deliver a comfortable climate to households while sustaining efficient HVAC system operation. Improper installation of HVAC equipment is a widespread problem affecting homes nationwide. A recent study by DOE found that improper installation of HVAC equipment results in at least one fault in 70–90% of homes. When duct leakage is considered, this increases to 90–100% of homes (DOE 2018). Improper refrigerant charge and airflow are two of the most common faults in CACs and ASHPs. Researchers at the National Renewable Energy Laboratory estimate that these two faults alone lead to an average of 9% energy waste compared to baseline (no-fault) conditions.

To solve these problems in Massachusetts, the Sponsors of Mass Save worked with implementation vendor, ICF, to modify the Mass Save Residential Heating and Cooling Program, an effort to get smart diagnostic tools in the hands of as many contractors as possible in Massachusetts through no-cost technician training and homeowner incentives.



Photo of digital probes. Photo courtesy of ICF

The Challenge

Quality installation (QI) and quality maintenance (QM) programs are not new concepts. Different QI/QM programs have been implemented across the United States with varying degrees of success. Traditionally, these programs provide homeowner rebates based on readings from the HVAC system that are documented by the installer or technician and can be used to calculate system performance, capacity, and several common faults that might exist. But, without adequate digital measurement tools, these readings are difficult to document and even more challenging to independently verify. Another barrier to program participation and success is that manual data entry is cumbersome and costs contractors time and money.

Quality Installation Verification (QIV) programs that were developed in the early 2000s utilized third-party software to verify that HVAC systems were operating correctly. Some QIV programs required technicians to manually enter key measurements using hand-held computers, which then provided recommendations for adjustments or repairs. Other QIV programs required the technician to report the necessary data to a call center, which would then provide recommendations for corrections. Both methods still relied on the technician to provide accurately documented readings. For a utility or energy efficiency program that wants to verify quality installation or maintenance, could a method be developed that makes reporting easier for HVAC technicians?

A New Approach to Energy Efficiency Incentives

The Mass Save Residential Heating and Cooling Program utilizes **smart diagnostic tools** to streamline the process of verified QI/QM, which adds transparency to reporting and ultimately equips technicians with the tools and knowledge necessary to provide quality service to homeowners. From 2005 through 2019, Mass Save ran the COOL SMART Quality Installation Verification offer which encouraged HVAC technicians to verify refrigerant charge and air flow of their CAC systems using manually entered HVAC system data. In 2020, the Sponsors of Mass Save worked with ICF to launch a rebranded QI/QM program that required using a suite of smart diagnostic tools. The measureQuick smartphone app accepts Bluetooth-enabled probes that stream real-time data to the app, which detects and diagnoses faults in the HVAC system and suggests corrective actions to improve the system's efficiency. When the installation or maintenance is complete, data that would normally be manually entered by the technician and sent for verification under a traditional QIV program is instead digitally sent to Sponsors of Mass Save through measureQuick. The project data is geolocated to verify the work was performed at the address applying for program incentives.

Contractors also benefit from using smart diagnostic tools while installing or servicing equipment. When trained on smart diagnostic tools, contractors can provide their customers the assurance of knowing their heating and cooling system is installed or maintained to achieve high performance—with real system data as proof. The tools verify maximum efficiency, comfort, and savings for customers, which reduces call backs and increases customer satisfaction. Contractors can also add business value by using the application's reporting functions to confirm necessary equipment repairs or replacements.

Read the [STEP Contractor Case Study](#) to see how three HVAC contractors incorporated smart diagnostic tools into their businesses.



Smart diagnostic tools include a suite of digital probes paired with an HVAC diagnostic application on a smartphone or tablet.

Photo courtesy of ICF

Project Profile

Description

The Sponsors of Mass Save, with support from ICF, developed and implemented a new residential heating and cooling offer to improve the performance of residential HVAC systems and elevate the quality of contractor work in Massachusetts through training and promotion of smart diagnostic tools.

Team and Territory

Investor-owned, municipal utilities, energy efficiency service providers and customers served in Massachusetts:

- **Berkshire Gas** | 40,136 gas
- **Cape Light Compact** | 205,000
- **Eversource** | 635,000 gas + 1.4 million electric
- **Liberty** | 53,726
- **National Grid** | 900,000 gas + 1.2 million electric
- **Unitil** | 15,615 gas + 28,605 electric

Highlights

- No-cost virtual training on measureQuick
- Downsizing Incentive
- Duct Sealing Incentive
- QIV Rebate
- Tune-up Rebate
- Certified measureQuick Contractor Network
- Zero interest HEAT loan

Preliminary Outcomes (as of October 2021)

- 692 Trained Technicians
- 486 Companies
- QIV Applications
 - 370 CAC
 - 84 ASHP
 - 97 DMSHP
- Tune-up Applications
 - 21 CAC
 - 2 ASHP
 - 13 DMSHP

Program Details

The Mass Save QI/QM offer focuses on empowering contractors and providing them the tools and information necessary to provide quality installations and maintenance. By participating, contractors benefit from

- No-cost training
- Eligibility to provide homeowners quality installation and maintenance verification
- Partial reimbursement for the purchase of smart diagnostic tools.

Contractors receive \$130 for each passing measureQuick QIV/Tune-up submission, \$250 for equipment downsizing, and \$2 per cubic foot per minute of leakage reduced from duct sealing (up to a maximum of \$600).

Developing a Quality Workforce

Adoption of new technologies like smart diagnostic tools requires technicians to overcome a learning curve. With that in mind, the Sponsors of Mass Save partnered with measureQuick to develop a practical training program for contractors. This five-hour training is offered virtually and focuses on ensuring high-performance HVAC installation and tune-ups using the measureQuick app. Technicians can access it through a user-friendly web-based training portal. Once the contractor completes the training, they are eligible to perform tests and receive incentives. Contractors who perform three tests can receive a tool reimbursement of up to \$150.

Conclusion

The Mass Save Heating and Cooling program is showing early signs of success, despite being rolled out in a pandemic year. With many restrictions on businesses and travel in place, the virtual training platform enabled technicians to safely complete the training required for program participation.

587 measureQuick applications

have been verified and submitted for quality heat pump and AC tune-up/start-up incentives, resulting in...

112,000 kWh savings annually

40.90 kW winter peak + 29.15 kW summer peak demand savings

To Learn More, Visit the Smart Tools for Efficient HVAC Performance Campaign

The STEP Campaign serves as a national platform for sharing information and resources, and recognizing successes of key stakeholders, including HVAC contractors and installers, energy-efficiency programs, equipment developers, trainers, and others.

To participate, please email us at

techchallenge@pnnl.gov

To provide additional information, visit

<https://bit.ly/3I8sRMo>

To learn more about the STEP Campaign, visit

<https://bit.ly/3HdAUWR>

For more on the Mass Save program, visit

<https://www.masssave.com/>

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