Swimming to Midstream: New Residential HVAC Program Models and Tools

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ABSTRACT

As federal appliance standards continue to rise, energy efficiency program sponsors in some regions are finding themselves unable to offer cost-effective downstream HVAC incentives (i.e., consumer rebates) capable of inducing building owners or installers to purchase HVAC products that are significantly more efficient than the standard. One solution is to move further upstream and engage residential HVAC distributors. This paper will introduce programs that are pioneering new distributor-driven models or enhanced contractor-driven models for HVAC and similar types of products and assess program performance in light of a new source of full-category HVAC distributor benchmarking data. This new HVAC data has the potential to offer new opportunities for improvements and innovations while dramatically reducing evaluation risk.

Introduction

Residential HVAC is a major source of both summer and winter peak load and a large remaining source of reliable long-term residential energy savings, especially where the base code-compliant product is the dominant product (DOE 2011). Increased federal efficiency standards for HVAC and water heating products have eroded net savings and the corresponding allowed per-unit spending to meet required regulatory cost tests. For HVAC and plumbing products such as water heaters, mail-in rebates have been the standard program design. These programs are expensive to administer and often have low participation combined with high overhead and marketing costs (Buege et al. 2014). Midstream program designs, which have proven very effective for lighting products, have only recently begun for HVAC and plumbing products.

In a midstream program design, the primary points of market engagement are the midstream market actors: distributors and contractors. Efficiency Vermont, Energize Connecticut, and MassSave have all implemented midstream programs for HVAC and plumbing products that have generated dramatic increases in the number of incentivized sales. However, these programs suffer from a challenge facing most energy-efficient product programs – lack of geographically specific data on performance of the market as a whole, which prevents programs from easily detecting whether changes in the market share of efficient products correlate with their program activity.

To help remedy this deficit of critical data, D+R International has partnered with Heating, Air-conditioning & Refrigeration Distributors International (HARDI) to collect HVAC shipment data from more than 3,500 participating distributor branches across the United States. D+R's analysis of this data gives participating distributors information on their current and past performance in the HVAC market and provides timely insights on local HVAC market activity. This same information enables identification of communities with and without HVAC energy efficiency program opportunities. Not only can this data be leveraged to monitor the impact of utility incentive programs, but it can also be used to develop more effective designs in the future.

This paper provides an overview of the midstream program concept and their benefits in general, as well as the basic structure of these programs for a few representative product categories. In addition, this paper uses D+R's HARDI distributor market data and other sources of market data to assess program performance relative to the market as a whole and discusses how these data sources could enable the creation of even more successful midstream program designs, management, and evaluation approaches.

Table 1: Midstream Program Case Studies

Efficiency Program	Energize Connecticut	Mass Save	Vermont Energy Investment Corporation
Utilities	United Illuminating, Southern Connecticut Gas, and Connecticut Natural Gas	Blackstone Gas Company, Cape Light Compact, GasNetworks, Columbia Gas of Massachusetts, Eversource, Liberty Utilities, National Grid, Unitil	Efficiency Vermont
Incentivized Products (Incentive Amount)	• ENERGY STAR NG boilers 90%+ AFUE ($750) • ENERGY STAR NG furnaces 95%+ AFUE ($600) • ENERGY STAR heat pump water heaters ($400 or $300 instant + $100 mail-in at retailers)	• Ductless minisplit HPs SEER 16, 19, 23 (2013 $150, $300/$323, $500; 2014 –National Grid, unchanged, Eversource $300, $500, $625)	• Single zone mini-split heat pumps ($300) • Multi-zone mini-split heat pumps ($400) • Heat pump water heaters ($400) • High-performance circulator pumps ($50-$1200)
Incentive recipient	Participating distributors	Participating distributors	Participating distributors
Program dates	October 2013 (pilot) - 2018	2013-2015 (extended 2016-2018)	September 2013 - present

D+R approached these particular programs approached for collaboration on this paper for two reasons. D+R's analysis of HARDI distributor sales of ductless minisplit heat pumps

showed sales-weighted efficiency in the Northeast region to be two standard deviations above the national mean. Also, managers of these programs had implemented midstream designs and had previously indicated a willingness to share program data.

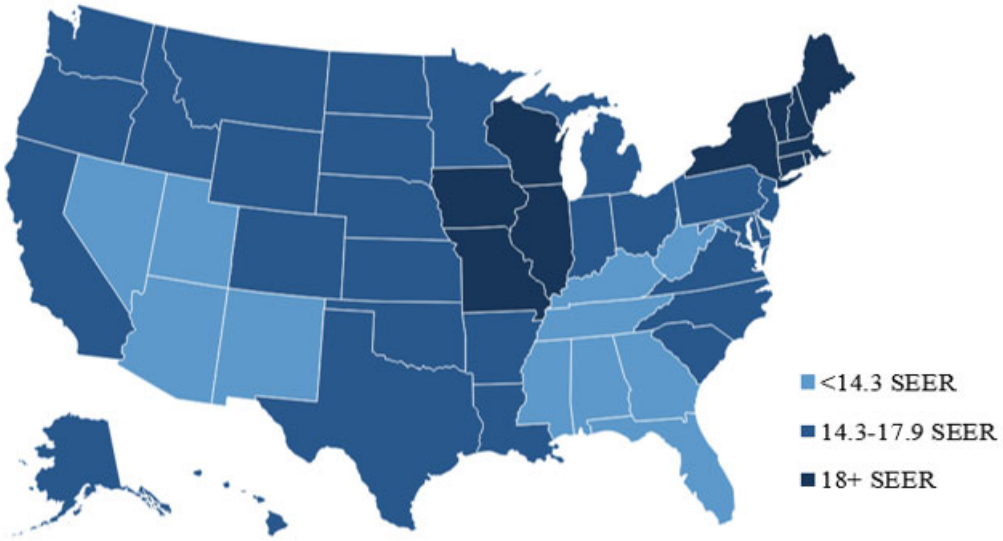

Figure 1. Ductless Minisplit Heat Pump Regional Weighted Efficiency Distribution. The light blue states are more than one standard deviation below the national average shipment-weighted efficiency (16.2 SEER); the dark blue states are more than one standard deviation above it. To ensure even coverage, states are grouped together based on similarities in market activity. The following state groupings were used to generate estimates for this heat map:: ID, OR, WA; CA, HI; AZ, NM, NV, UT; WY, NE, KS, CO; TX; AK, MT, MN, ND, SD; OK, AR, LA; WI, MO, IL, IA, IN, MI, OH; WV, TN, KY; NH, ME, MA, VT; RI, NY, CT; PA, NJ; DC, DE, MD, NC, SC, VA; GA, AL, MS; and FL. *Source*: D+R International 2016.

What is Midstream?

While midstream incentive programs for HVAC are a relatively new approach to increasing efficiency and reducing energy consumption, they are fast emerging as a potentially more effective and productive alternative to the more prevalent downstream incentive program (York et al. 2013). Incentive programs are classified based on where the incentive recipient is in the supply chain. The traditional downstream program design provides the incentive to the bottom of the supply chain – the end user. Upstream incentives are provided to the manufacturers – the top of the chain. Midstream incentive programs target the distributors and contractors who work between the manufacturers and end users.

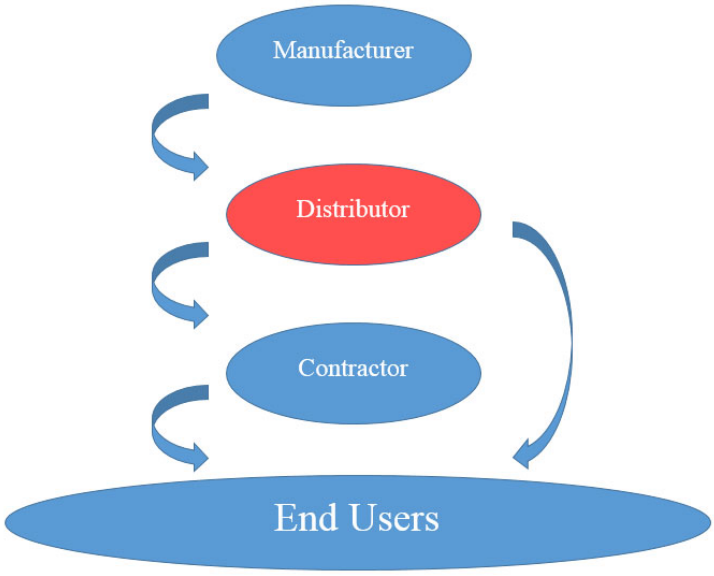

Figure 2. HVAC Market Flow. *Source*: D+R International 2016.

What Happens when a Program Shifts from Downstream to Midstream?

The success of the midstream program concept in commercial lighting is one of the factors that has generated interest in applying the approach to HVAC and plumbing products. For example, when Xcel Energy switched from a downstream incentive program to a midstream model, distributor support combined with increased customer engagement led to LED and linear fluorescent sales increasing by almost 150% (Buege et al. 2014). While the HVAC and lighting markets are quite different, the idea behind the midstream model is the same: increase the availability of more-efficient products and create a system where they are readily available for contractors and customers to purchase. Commercial lighting markets and residential HVAC markets are similarly structured in that they generally involve a level between the distributor and customer – the contractor.

Figure 3 and Figure 4 below illustrate the dramatic increase in incentivized sales that occur when a program shifts from downstream to midstream. In both programs, paperwork for the customer and contractor was reduced and the rebates were converted from mail-in to instant by having distributors serve as the program agent. Contractors pay for the product and are credited for the rebate when they provide a valid customer name and address.

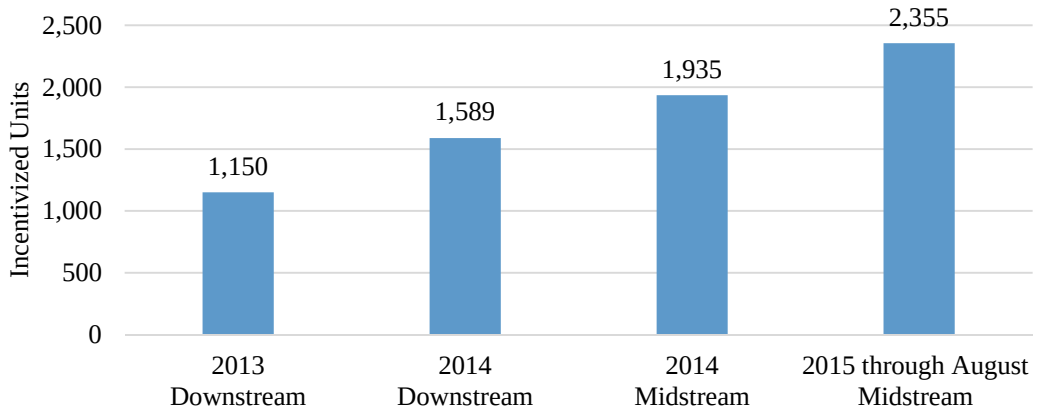

Figure 3. Energize Connecticut ENERGY STAR Natural Gas Boilers Downstream v. Midstream Results 2013-August 2015. *Source*: Energize Connecticut 2016.

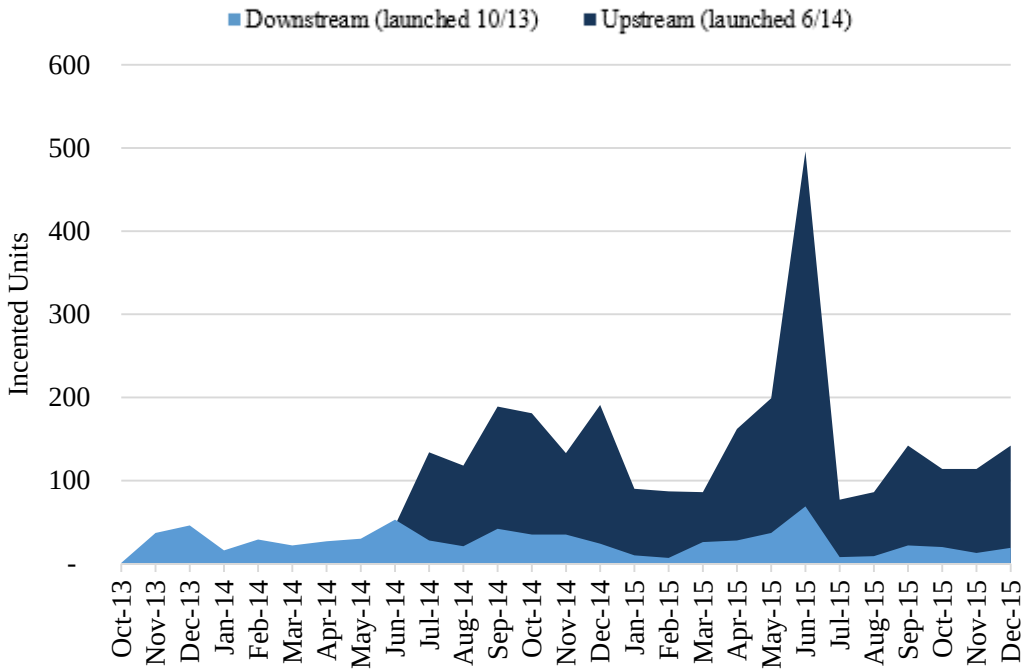

Figure 4. Vermont Upstream v. Downstream Heat Pump Water Heater Incentivized Units. *Source*: Efficiency Vermont.

Advantages of the Midstream Model

The midstream approach allows the end user to benefit from the financial and/or energy savings that a downstream program would provide, without investing the effort to claim a rebate or waiting a long time between filling out forms and receiving the rebate. The Connecticut program avoids burdening end users with the paperwork by engaging contractors. In this

program, contractors purchased equipment from distributors at full retail price, then receive a rebate from the distributor after providing installation details.

Midstream programs typically require little to no paperwork, allowing the distributor to pass the savings on to the customer immediately, which can have a positive effect on customer behavior and satisfaction but they do reduce customer awareness of the utility's role. Efficiency Vermont addressed this by developing materials such as a box sticker that says, "Special pricing brought to you by Efficiency Vermont."

One impetus for moving to the midstream model is the opportunity to magnify the impact of the program by using existing distributor relationships. Distributors are the gateway to contractors, and contractors are the gateway to consumers.

Midstream programs can be especially effective in increasing sales for efficient products that have little or no market share to begin with. Efficiency Vermont's midstream high-performance circulator pump (HPCP) and heat pump water heater programs fall into this category.

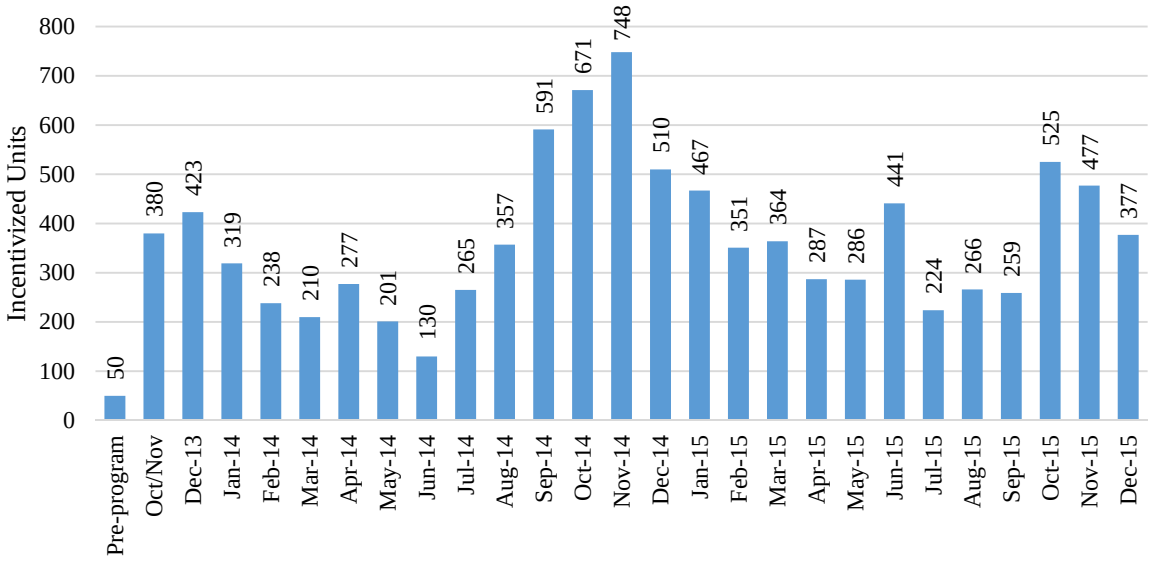

Figure 1. Efficiency Vermont High-Performance Circulator Pumps Unit Sales from Participating Distributors Sept. 2013- Dec. 2015. *Source*: Efficiency Vermont 2016.

Two of the main components of midstream programs are the changes in stocking practices (e.g., having HPCP stocked and readily available, rather than available only through special order) and the potential for greater influence on the final purchase decision. Customer behavior, specifically customer engagement, is one of the main reasons that downstream programs have not been as successful as midstream programs; accordingly, it is still an important factor to discuss (Buege et al. 2014). Social science research has consistently shown that person-to-person interactions tend to be more persuasive than printed messages (Cialdini 2009). By engaging distributors, who interact face-to-face with their contractors, and contractors, who speak directly to the final purchaser, midstream programs have much greater potential to influence the residential customer at or very near the critical moment in which the purchasing

choice is made, instead of at a time when they have no interest in the topic and will immediately forget it. Whether the potential is achieved is highly dependent on the structure and implementation of the midstream program.

By changing stocking practices – either through explicit stocking incentives or indirectly by enabling the efficient product to be cost competitive and therefore more likely in demand and worth stocking at a higher level – midstream programs offer an opportunity to influence the market on a larger scale without expending the resources needed to change customer behavior at an individual level. Another important factor that supports the importance of stocking is that “, 2 (Cornejo 2013, 2).” The replacement must be done quickly, typically using whatever product the contractor has available, and energy efficiency is often not considered in the purchase decision (Quaid and Geller 2016). Incentivizing distributors for selling more-efficient products encourages them to stock those products, potentially ordering them in larger volumes at a lower price. When properly paired with distributor-assisted contractor training and outreach, the change in stocking at a relatively small number of distributors can impact the energy consumption of an entire region or state with much less time, cost, and effort than a traditional downstream program.

Distributor Perspective on Midstream Programs

Although program administrators can learn important lessons from their experiences in developing, implementing, and evaluating midstream programs, the perspective of market players who receive the incentives is also extremely valuable. HARDI is the trade group for organizations in the HVAC market who “market, distribute, and support heating, air-conditioning, and refrigeration equipment, parts and supplies” in residential and commercial markets (HARDI 2016). HARDI distributors shared their experiences with residential HVAC efficiency programs as part of a 2011 study commissioned by the HARDI Foundation Center for Energy Efficiency Optimization and conducted by the Vermont Energy Investment Corporation (VEIC), which is used to inform the remainder of this section.

HARDI distributors are generally supportive of the intent of midstream programs, and they pointed out the strengths of such programs. Distributors approve of influencing stocking practices to move toward high-efficiency equipment because such equipment is typically associated with “higher price point[s] and higher margin[s].” Similarly, incentivizing distributors for sales of higher-efficiency equipment acknowledges that “stocking efficient equipment ties up more working capital than standard [-]efficiency equipment.” Distributors noted that the most successful programs “understand the supply chain and present many vehicles for contractors to use in becoming aware of the program.” Contractor education plays a pivotal role in program success, with some distributors integrating information about “available rebate programs in both sales and technical trainings, and [inviting] … representatives from efficiency programs to those events.”

Despite their positive experiences with midstream programs, HARDI distributors identified some weaknesses and recommended improvements for future midstream programs. As a starting point, distributors encouraged program administrators to “build HVAC industry knowledge and relationships” to tap into the network of organizations that are essential to program success. Developing such relationships will enable programs to understand distributor

motivations, including “increased sales of higher[-]margin products, increased contractor loyalty, [and] fewer warranty issues.” One way program administrators could strengthen relationships and preempt programmatic issues is by including distributors in the program development and design process from the start. An ENERGY STAR report found similar criticisms and noted that developing “a strategic relationship with retailers” is a key to successful midstream programs that prove satisfactory to distributors and their customers, while also producing significant energy savings.

Distributors also experienced a lack of program focus on the consumer, who is the ultimate decision maker for efficient products. Combining the contractor education discussed above with consumer marketing increases downstream demand for the high-efficiency products stocked by distributors. The Southern California Edison Lighting Innovation Midstream Pilot Trial Program found that customers preferred the midstream programs to downstream programs because participating is easy and does not require the time and paperwork of a downstream program. A downside of midstream programs for distributors is the paperwork and required data sharing that isn’t needed under downstream programs, in which the end user fills out the paperwork. Accordingly, distributors recommend that programs “streamline operations and reporting” to minimize distributors’ and contractors’ burden of compiling data and decrease incentive processing time for the program administrator.

Feedback from distributors about residential HVAC efficiency programs gives administrators a more complete understanding of past programs’ successes and shortcomings. Future programs should take the lessons learned from HARDI distributors into account when changing existing programs or developing new ones.

Market Intelligence

The case for transitioning HVAC incentive programs from downstream to midstream is well documented on a program-by-program basis. Nevertheless, to capture maximum energy savings, existing midstream HVAC programs must adapt to their markets, and new programs should be tailored to their markets. The Super-efficient Equipment and Appliance Deployment (SEAD) initiative found in its review of incentive programs that “[t]he key to successful program design and implementation is a thorough understanding of the market and effective identification of the most important local factors hindering the penetration of energy-efficient technologies (De La Rue Du Can et al. 2013).” Research and interviews confirm that understanding local factors is important in designing and implementing successful programs.

Program administrators have several pathways to understanding their respective HVAC markets, including developing relationships with distributors and contractors and making sure their strategies are aligned with the customer base. These approaches can certainly provide valuable information and feedback, but program administrators also need to understand sales trends in their service territories to establish appropriate incentive levels and accurately evaluate program impacts at a higher market level. The need for an understanding of the market and the market impacts of midstream programs is further supported by findings from Southern California Edison, which recommended developing an understanding of the market prior to instituting a program and tracking market indicators to assess the effectiveness of incentive programs once they begin (Evergreen Economics 2015).

Developing an understanding of the market, however, is easier said than done. For most product categories there is no reliable source of full-category sales data. When such data is

available from vendors such as Nielson or NPD, efficiency metrics are generally not reported nor is information available at regional, state, or service territory levels. Residential HVAC has now become one of the few product categories where highly granular and powerful data are available.

Since 2012, D+R International has collected monthly transaction-level HVAC sales data for more than 3,500 HARDI distributor member branch locations. Data is reported by model number, branch/delivery ZIP code, quantity, and price (for about 50% of units). D+R uses the model number to populate detailed product characteristic fields for air conditioning units (ducted and ductless), heat pumps (ducted and ductless), furnaces, and boilers, and employs advanced building stock replacement models to produce sales estimates.

As the starting point for this paper, D+R identified regions with unusually high sales-weighted efficiency for ductless heat pumps and then approached the program managers to better understand potential program contributions to these sources. Program data shared by the program sponsors shows significant increases in sales of incented units relative to previous downstream programs. Are these data also consistent with the broader market data?

D+R's initial analysis shows that the Northeast as a whole has been selling a much greater proportion of high-efficiency ductless heat pump products than most other regions of the country, and a state-by-state analysis reveals that, indeed, the sales of higher-efficiency products are concentrated in Connecticut, Massachusetts, Vermont, and Maine.

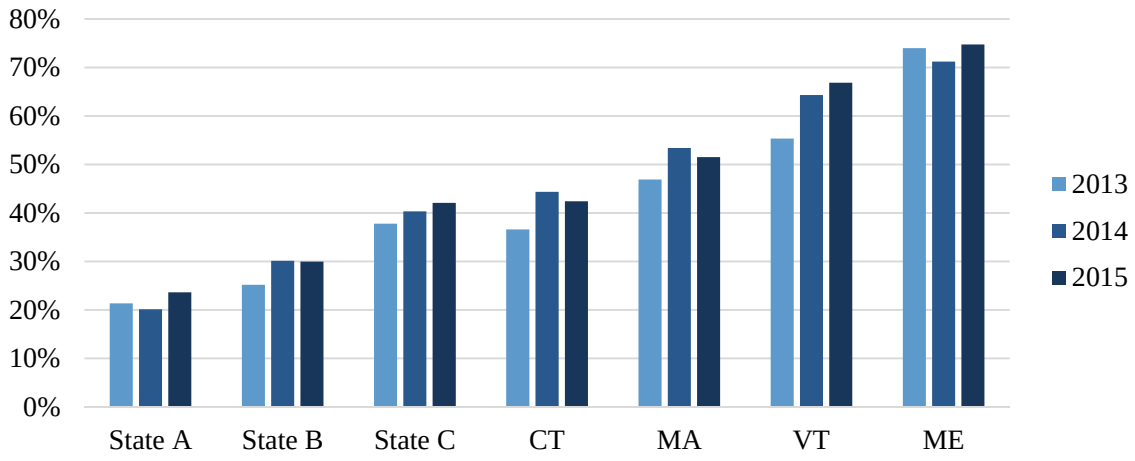

Figure 6: High-Efficiency (20+ SEER) Market Share of Ductless Heat Pumps in Northeast States. *Source*: D+R International 2016.

While the level of analysis conducted here cannot prove these results are attributable to the aforementioned programs, it can help determine the likelihood that this is the case. Unit sales incentivized by National Grid and NStar (part of Eversource Energy) who together serve 83% of Massachusetts electricity customers, are consistent with premise that there is a causal link between the high market share for high efficiency ductless heat pumps and program activity (Figure 7).

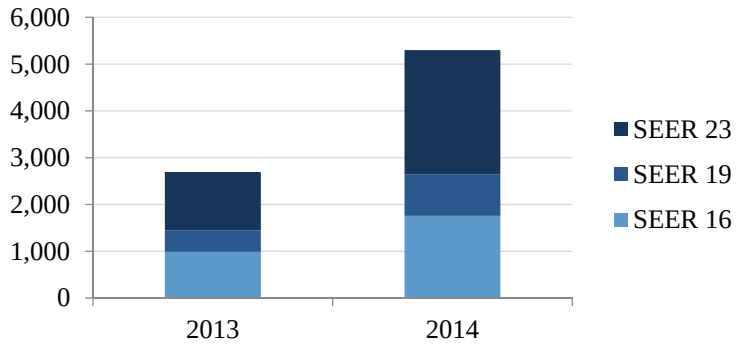

Figure 7. NSTAR and National Grid Ductless Heat Pump Incentivized Units by SEER. *Source*: MassSave 2016.

But what proportion of total sales to these incentivized units represent? Are they large enough to have a market impact?

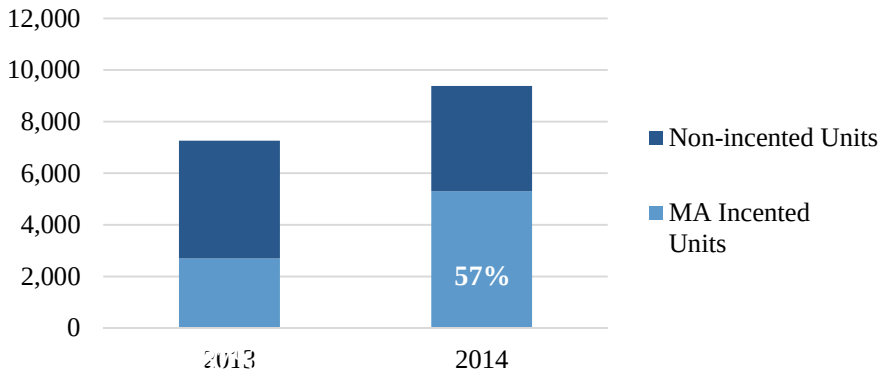

Figure 8. Incented Sales as a Share of Total Estimated Ductless Heat Pump Sales in NStar and National Grid Service Territories. *Source*: MassSave 2016.

D+R analysis shows that the Massachusetts utilities program incentivized sales represent an increasingly large share of the total market and that the increase in incentivized sales is proportional to the increase in total sales. There are several possible explanations for such a correlation, including coincidental growth in the size of the total market. The D+R HVAC market database could be used to rule in or rule out this possibility, but that is outside the scope of this paper. The above analysis illustrates that midstream programs can dramatically increase sales of high-efficiency products, but interpretation of the market impact of such programs is difficult without full-category sales data.

Market knowledge is essential for midstream programs, as it indicates what target product types will be most effective in increasing energy efficiency; planning and evaluation processes are best informed by multiple data sources. For evaluation, program data on incentivized sales can demonstrate the success of a midstream program compared to a downstream counterpart and regions or states without such programs. To get a fuller picture of market activity, administrators need full-category sales data to properly assess market potential before a program and market transformation when the program is over.

D+R's HVAC market intelligence database can be used to evaluate market share by nominal efficiency (SEER or AFUE), enabling programs to see their market prior to the start of the program and evaluate program results over time. The data includes sales price information that can be used to calculate the incremental cost of efficiency at the distributor level, which can inform incentive levels during the program design phase. Comparing data from states with midstream programs and neighboring states without such programs and having a market view beyond the localized area of an incentive program provides a much better perspective for assessment, which can aid in program design, changes, and evaluation.

Conclusion

As efficiency standards continue to rise and the pressure to save energy increases, midstream programs are emerging as a way to meet those challenges. While the basic structure of a midstream program has been established, the idea is still new enough to warrant more investigation and experimentation. The strengths of midstream programs are plentiful, and as this program model spreads, tracking the progress and effectiveness of these programs across the market will be increasingly important for distributors and utilities to evaluate them. Using the data collected by D+R and HARDI gives residential HVAC program managers an opportunity to gain market-level insights into the effects of these emerging midstream programs. Combining the power of distributor knowledge and customer relationships with data that can track progress of energy-efficient equipment in the market will create a stronger, more effective program model for efficiency programs.

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