

2019

# HVAC MARKET CHARACTERIZATION

RESIDENTIAL BUILDING  
STOCK ASSESSMENT

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# NYSERDA Record of Revision

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Additionally, we thank the contractors and market actors who participated in this research, all of whom provided critical insights into the New York residential HVAC and water heating market.

# Acronyms and Abbreviations

AFUE	Annual Fuel Utilization Efficiency
CEER	Combined Energy Efficiency Ratio
DPS	Department of Public Service
D+R	D+R International, LTD
EER	Energy Efficiency Ratio
EF	Energy Factor
HARDI	Heating, Air-conditioning, and Refrigeration Distributors International
HSPF	Heating Seasonal Performance Factor
HVAC	Heating, Ventilation, and Air-Conditioning
NYSERDA	New York State Energy Research and Development Authority
RBSA	Residential Building Stock Assessment
RH&C	Renewable Heating & Cooling
RSBS	Residential Statewide Baseline Study
SEER	Seasonal Energy Efficiency Ratio
UEF	Uniform Energy Factor

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# Executive Summary

## BACKGROUND AND STUDY OBJECTIVES

As part of NYSERDA's 2019 Residential Building Stock Assessment (RBSA), Cadmus conducted an HVAC market assessment. The 2019 RBSA provides the first update to the 2015 Residential Statewide Baseline Study (RSBS) of New York State.<sup>1</sup> The 2015 RSBS and the 2019 RBSA characterized single-family homes throughout the state, with a single-family home defined as a residential structure containing one to four living units. The primary objectives of the RBSA were to provide a profile of new and existing homes in the state based on data from a representative sample of homes and to determine changes in building and equipment stock since the 2015 RSBS, including changes in the saturation of energy-consuming equipment (electric, natural gas, and other fuels), building characteristics, and energy management practices.

The 2015 RSBS also included an assessment of the HVAC market. This study assessed baseline conditions for HVAC and water heating equipment in the state and characterized the equipment sold (including the percentage of equipment that was high-efficiency). To assess how the HVAC market has changed since the baseline study, the 2019 RBSA HVAC Market Assessment addressed two primary research objectives:

- **Update baseline conditions for sales of high-efficiency equipment installations for the state:** Cadmus conducted research to update the baseline conditions for sales of high-efficiency HVAC equipment installations (i.e., market penetration of HVAC technologies and tiers of efficiency levels). Cadmus used New York State-specific Heating, Air-conditioning, and Refrigeration Distributors International (HARDI) sales data aggregated and reported by D+R International (D+R) to calculate statewide equipment sales, by efficiency tier, for furnaces, boilers, central air conditioners, and air-source heat pumps. For water heaters and renewable heating and cooling technologies, Cadmus estimated the market penetration of equipment types through online customer surveys and on-site inspections conducted as part of the RBSA study.
- **Determine common practices in the residential HVAC and water heater market:** Cadmus conducted contractor surveys (in partnership with APPRISE) and interviews with HVAC market actors (distributors, manufacturers, and trade associations) to explore common practices in the residential HVAC and water heater market.

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<sup>1</sup> NYSERDA. July 2015. *Residential Statewide Baseline Study, Volume 3: HVAC Market Assessment*. Prepared by Tetra Tech, GDS Associates, and PSD.

This report presents the findings of the HVAC market assessment. Separate reports document the methodologies and findings for the building assessment and potential study components of the RBSA. Information provided by these studies will be used by NYSEERDA, the New York State Department of Public Service (DPS), energy efficiency program administrators throughout the state, and others for a variety of purposes, such as informing program planning and setting baselines for savings calculations. HVAC and water heating market actors may also utilize this information and the results of this report.

## OVERVIEW OF METHODOLOGY

### Approach to Update Baseline Conditions for Equipment

Cadmus gathered primary and secondary data to update the baseline conditions for HVAC and water heating equipment sales and efficiency levels.<sup>2</sup> These data sources and data collection activities are outlined Table 1.

**TABLE 1. DATA SOURCES AND DATA COLLECTION ACTIVITIES TO UPDATE BASELINE CONDITIONS FOR HVAC EQUIPMENT**

Data Collection Activity	Data Source	Type of Data Available	Technologies Represented	Number of Completes/ Data Points
HVAC Sales Data	D+R International (aggregated from HARDI members)	HVAC sales and efficiency tiers since 2013	<ul style="list-style-type: none"> <li>Natural gas furnace and boilers</li> <li>Oil-fired furnaces and boilers</li> <li>Central air conditioners</li> <li>Air-source heat pumps</li> </ul>	The number of participants who provide data varies from year to year; at least 23 distributors reported at least one unit sales in New York State for all reporting years, which D+R estimates represents 5% to 25% of products sold in the state.
RBSA Residential Home On-Site Inspections	Cadmus	Type of equipment, age, and efficiency currently installed in existing and new homes	<ul style="list-style-type: none"> <li>Natural gas furnace and boilers</li> <li>Oil-fired furnaces and boilers</li> <li>Central air conditioners</li> <li>Air-source heat pumps</li> <li>Water heaters</li> <li>Ground-source heat pumps</li> <li>Solar thermal hot water</li> </ul>	361 existing homes (built before 2015) and 95 new construction homes

<sup>2</sup> This study updates the baseline conditions from the 2015 RSBS HVAC Market Assessment; however, the methodologies differ between the two studies. The 2015 RSBS HVAC Market Assessment relied on contractor self-reported installation data and triangulated findings with HARDI sales data and RSBS residential home on-site inspections. In addition to the methodological differences, the 2019 RBSA HVAC Market Assessment assessed additional renewable heating and cooling technologies not covered in the 2015 RSBS study (ground-source heat pumps, biomass systems, and solar thermal hot water systems).



Data Collection Activity	Data Source	Type of Data Available	Technologies Represented	Number of Completes/ Data Points
RBSA Residential Customer Online and Telephone Surveys	Cadmus	Type of equipment currently installed in existing and new homes	<ul style="list-style-type: none"> <li>Natural gas furnace and boilers</li> <li>Oil-fired furnaces and boilers</li> <li>Central air conditioners</li> <li>Air-source heat pumps</li> <li>Water heaters</li> <li>Ground-source heat pumps</li> <li>Solar thermal hot water</li> </ul>	1,835 existing homes (built before 2015) and 584 new construction homes

### *Secondary Data: HARDI HVAC Sales Data*

D+R has an exclusive license with HARDI that authorizes D+R to collect data from HARDI members and to aggregate member data to produce analysis and reports. The estimates of annual market size are based on a stock-replacement model. D+R developed the model using existing HVAC equipment stock data from the Energy Information Administration’s 2009 Residential Energy Consumption Survey. The estimates of equipment sales are calculated by dividing the total stock by average lifetimes of equipment to determine the number of probable replacements in a given year. HVAC equipment in new housing is estimated from U.S. Census data. D+R also developed a heat pump adjustment factor to account for heat pumps replacing some air conditioners, particularly in the cooling-dominated regions.

Cadmus used HARDI distributor sales data to quantify HVAC equipment sales by efficiency level for these technologies for which D+R aggregates sales data:

- Natural gas furnace and boilers
- Oil-fired furnaces and boilers
- Central air conditioners
- Central and ductless air-source heat pumps

### *Primary Data: RBSA On-site Inspections and Customer Surveys*

For technologies where HARDI data do not provide adequate coverage (i.e., water heaters, ground-source heat pumps, solar thermal hot water, and biomass heating), Cadmus estimated the market penetration of equipment types through online customer surveys and on-site inspections conducted as part of the RBSA study.

### *Approach to Assess Common Practices in the HVAC and Water Heater Market*

To assess common installation practices in the New York State HVAC market, Cadmus conducted a survey of HVAC contractors and in-depth interviews with HVAC market actors.

## General Population HVAC Contractor Survey

Cadmus conducted a telephone survey of HVAC contractors to address the following research objectives:

- Understand HVAC contractor recommendations and sales practices regarding high-efficiency and RH&C equipment
- Explore HVAC contractor barriers and opportunities to installing high-efficiency and renewable heating & cooling (RH&C) equipment
- Gauge HVAC contractor and manufacturer training and certification practices
- Assess HVAC contractor experience with aspects of quality design
- Gauge HVAC contractor familiarity with and use of HVAC incentive programs in the state
- Understand the early replacement/early equipment retirement in the HVAC market

### Sample Development and Design

Cadmus surveyed representative sample of 72 HVAC contractors in New York State using the InfoGroup database. The sample included businesses identified as plumbing, heating, and cooling contractors (Table 2). To align with the baseline study approach, Cadmus stratified the sample by contractor size—small (1-9 employees) and large (more than 10 employees)—to ensure comparability across studies. Of the population of 5,285 contractors, 84% were small and the remaining 16% were large. To ensure representation across the state (including representation from harder-to-reach contractors in climate zone 4), Cadmus also established quotas by climate zone.<sup>3</sup> Of the 72 HVAC contractors, eleven participated in NYSERDA’s programs (ten air-source heat pump contractors and one ground-source heat pump contractor). The survey instrument is included in *Appendix A. NYSERDA RBSA HVAC Assessment Contractor Survey*.

TABLE 2. HVAC CONTRACTOR SURVEY SAMPLE DESIGN

Climate Zone	Estimated Population*	Total		Small Contractors (<10 Employees)		Large Contractors (≥10 Employees)	
		Target	Completes	Target	Completes	Target	Completes
4	3,282	34	35	19	18	15	17
5	1,558	28	28	16	14	12	14
6	445	8	9	5	5	3	4
<b>Total</b>	<b>5,285</b>	<b>70</b>	<b>72</b>	<b>40</b>	<b>37</b>	<b>30</b>	<b>35</b>

\* Population size estimated from businesses in the InfoGroup database identified as plumbing, heating, and cooling contractors.

<sup>3</sup> An initial analysis of the population of contractors from the InfoGroup sample frame found that 62% of contractors were located in Zone 4, 29% were located in Zone 5, and 8% were located in Zone 6. However, to be eligible for the survey, contractors had to sell or install heating, cooling, or water heating equipment in residential, one- to four-unit homes. Using data from the U.S. Census’ American Community Survey, APPRISE estimated the share of households that reside in one- to four-unit residences for each climate zone. The contractor population for each climate zone was then adjusted by the proportion of households residing in one- to four-unit residences to estimate the contractor population that is likely to work in residential one- to four-unit residences.

Of the contractors surveyed, only one large and one small contractor reported that they sell water heaters but do not sell any of the HVAC equipment listed in Table 1. Of the contractors who sell HVAC equipment, most (84% statewide) reported that they also sell at least one type of water heater.

### **Weighting the Survey Results**

In certain cases, Cadmus decided to apply statistical weights to the survey results by contractor company size (large or small) since the population sizes of contractors by company size was known. The company size weights were applied only to survey questions that were asked of all 72 respondents, and Cadmus reported the weighted results for the combined respondents only.

Cadmus did not weight the survey results when comparing responses by large vs. small company size and if the survey questions were not asked to all 72 respondents. This is because question skip logics were associated with the specific equipment technology that respondents did or did not install, and the population sizes of large and small contractor company sizes by each equipment technology were not known. Figures and tables showing the HVAC contractor survey results note whether the results were weighted.

### *Supply Chain Market Actor Interviews*

To provide additional insight into how or whether the HVAC market is changing, Cadmus conducted six supplemental qualitative interviews with supply chain actors (manufacturers, distributors, and trade associations). Through these interviews, Cadmus addressed the following research objectives:

- Document current HVAC equipment sales
- Identify changes/anticipated changes in HVAC and RH&C equipment sales and market share
- Gauge HVAC contractor and manufacturer training and certification practices
- Understand market actor promotion and sales practices regarding high-efficiency HVAC equipment and RH&C technologies
- Identify barriers and opportunities to increased sales and installation of high-efficiency HVAC equipment and RH&C technologies
- Understand the RH&C supply chain and distribution channels

### **Sample Design and Development**

Cadmus interviewed six HVAC market actors—including supply chain actors and trade associations—representing HVAC technologies. Table 3 lists Cadmus’ sample design.

**TABLE 3. HVAC MARKET ACTOR SAMPLE DESIGN**

Market Actor Group	Number of Completed Interviews
Distributors	2
Manufacturers	3
Trade Associations	1
<b>Total</b>	<b>6</b>

## SUMMARY OF KEY FINDINGS AND MARKET TRENDS

This section provides a summary of key findings and trends identified in the HVAC market.

### Equipment-Specific Market Trends

#### *Furnaces and Boilers*

- **Natural gas furnaces and boilers continue to dominate the market.** According to HARDI data, between 2013 and 2017, just under half of the residential heating systems sold were natural gas furnaces and about a third were natural gas boilers. According to the HVAC contractor survey, most HVAC and water heating contractors in the state sold or installed natural gas-based technologies. Of 72 respondents, most reported selling or installing natural gas boilers (80%) and natural gas furnaces (75%). The RBSA found that 49% of existing homes use a central forced-air furnace and 42% use a central boiler as the primary heating equipment. Furthermore, 90% of the small contractors (n=40) who said they encourage early replacement of older, but still functioning, natural gas boiler or furnaces said they recommend replacing the system with another natural gas boiler or furnace.
- **The market is moving away from heating with oil.** HARDI data showed that fewer oil-fired furnaces and boilers were sold each year between 2014 and 2017, and sales of high-efficiency oil-fired heating equipment remains low. The HARDI data correlate with RBSA primary heating fuel findings. The RBSA found that natural gas remains the predominant statewide fuel for primary heating and appears to have increased its share; currently, an estimated 65% of homes statewide use natural gas for primary heating. Fuel oil remains the second most common primary heating fuel type, but its share has decreased from 25% in the 2015 RSBS to 19% in the 2019 RBSA. In interviews, two manufacturers and a distributor acknowledged that the market is shifting away from oil heat. Most surveyed contractors (n=60) also reported having customers who switched from oil heat to a different heat source in the past year (on average, 22% of their customers). Contractor respondents (n=52) most frequently recommended a natural gas furnace or boiler (48%), propane system (42%), ductless heat pump (42%), and central air-source heat pump (37%) to customers who wanted to stop using oil heat. Installers who were asked about oil boilers and furnaces said they *very frequently, frequently, or occasionally* recommended early replacement (n=10), and nearly all said they recommended replacing the old oil unit with something other than an oil system (six installers recommended a natural gas boiler or furnace, and three recommended a central air-source heat pump).
- **Nearly all oil-fired furnaces and boilers sold are lower efficiency, and contractors infrequently recommend high-efficiency units.** Six of 11 contractors said that when they recommended an oil boiler or furnace, they *rarely or never* recommended a condensing model. According to HARDI data, 15% of oil furnaces and 21% of oil boilers sold in 2017 were high-efficiency compared to 7% of furnaces and 14% of boilers in 2013. Although sales of high-efficiency units has increased, standard efficiency oil systems continue to dominate the market.

### Air-Source Heat Pumps

- **The air-source heat pump market is growing.** Sales of ducted and ductless air-source heat pumps are increasing. In 2017, twice the number of ducted and ductless heat pumps were sold compared to 2013 sales for each technology, with a sharp decrease in sales of low-efficiency ducted and ductless heat pumps (heating seasonal performance factor [HSPF] 7.70-8.19). The majority of surveyed contractors said they installed ducted (74% of large and 49% of small contractors) and ductless (89% of large and 54% of small contractors) heat pumps. In line with these findings, most of the interviewed market actors (two manufacturers and two distributors) also said that air-source heat pumps—in particular, ductless heat pumps—was one of the fastest growing markets in the state.
- **Workforce challenges, such as finding trained installers and a lack of customer understanding and/or confidence are substantial challenges for air-source heat pump installers.** Air-source heat pump installers identified workforce challenges as the top barrier to successful operation of this business, with 75% (n=52) reporting this was a *somewhat significant* or *very significant* challenge. Lack of customer understanding of and confidence in the technology was the second most common challenge, with 67% of respondents rating this challenge as *somewhat significant* or *very significant*.
  - **Program Implication:** Allocation of additional resources to further support installers in ASHP workforce training and customer education may be warranted.

### Central Air Conditioners

- **Central air conditioners are more prevalent and more efficient. However, less efficient units still account for the majority of central air-conditioner sales.** HARDI data showed that each year more air conditioners were sold. The RBSA found that 90% of homes throughout the state use air conditioning, up from 85% in the 2015 RSBS. HARDI data also showed that the proportion of high-efficiency central air conditioners has increased. High-efficiency central air conditioners, or those with an efficiency greater than the 2015 federal standard, made up 38% of sales in 2017, compared to 14% of sales in 2013. Despite this increase, less-efficient units (i.e., those that meet the 2015 standard) still accounted for 62% of central air conditioner sales in 2017.
  - **Program Implication:** Given that most central air-conditioner sales are in units that meet, but do not exceed the standard, opportunities remain for increasing sales of high-efficiency units to assist in alleviating the growing summer peak-demand.

### Water Heaters

- **Standard efficiency water heaters are the norm.** The federal efficiency standard for water heaters changed in 2015, requiring much higher efficiency for storage water heaters with more than 55 gallons capacity. However, this change had little impact on the efficiency of the market in New York State, primarily because only 7% of all storage water heaters have a capacity greater than 55 gallons so most households are unaffected by the new standard.
- **Contractors infrequently recommend heat pump water heaters, and the prevalence of this technology remains low.** The 2019 RBSA found that only 0.4% of existing homes and 7.5% of new homes have a heat pump water heater. In addition, although 38% of surveyed contractors

(n=58) said they installed heat pump water heaters, 70% said they *rarely* or *never* recommend one to customers because of higher consumer costs, the contractor's lack of familiarity with the technology, and contractor perception of poorer performance in cold climates compared to a conventional water heater.

- **Program Implication:** Given that higher efficiency standards do not apply to most households in New York, market penetration of heat pump water heaters is low, and contractors infrequently recommend the technology, substantial additional market intervention is likely required to support the increased adoption of heat pump water heaters.

### Renewable Heating and Cooling

- **Few contractors reported selling and installing renewable heating and cooling technologies.** According to the survey, most HVAC and water heating contractors in the state sold or installed natural gas-based technologies. According to the survey results, most contractors (n=72) reported selling or installing natural gas water heaters (84%), natural gas boilers (80%), and natural gas furnaces (75%). A majority reported selling or installing central air conditioners (67%), electric resistance water heaters (61%), and central ducted air-source heat pumps (53%). Very few contractors reported selling or installing renewable technologies.
- **HVAC and water heating installers are more likely to install and consider installing ground-source heat pumps and solar hot water systems than biomass systems.** Of 72 surveyed contractors, 22% reported they installed ground-source heat pumps, 12% installed solar thermal hot water systems, 3% sold and installed pellet stoves, and 3% sold and installed biomass boilers. Among contractors who did not sell these renewable heating and cooling technologies, 18% reported considering ground-source heat pumps (n=51), 13% reported considering solar hot water systems (n=61), 7% reported considering biomass boilers (n=70), and 1% considered installing pellet stoves (n=70). The two distributors Cadmus interviewed said they did not usually sell biomass systems and that this equipment was more likely to be sold through hearth/fireplace businesses or hardware stores that source the equipment outside of the typical distribution models rather than through traditional HVAC contractors.

### Supply Chain Insights

- **Contractors commonly recommend early replacement of furnaces, boilers, and water heaters.** Of the 47 surveyed contractors who installed natural gas boilers and furnaces, 63% said they *very frequently* or *frequently* recommend early replacement of older, but still functioning, equipment prior to failure. Seven out of 11 surveyed contractors who installed oil boilers and furnaces said they *very frequently* or *frequently* recommend early replacement. Of the 58 surveyed contractors who installed water heaters, 59% said they *very frequently* or *frequently* recommend early replacement.
- **Large contractors are more likely than small contractors to require industry training and certification on energy efficiency and quality maintenance/installation.** A significantly higher proportion of large contractors (82%, n=34) said their companies require technicians to attend training on energy efficiency, quality maintenance, or quality installation compared to small contractors (56%, n=36). Similarly, a significantly higher proportion of large contractors (76%)

than small contractors (36%) require their technicians to obtain certification. Although the 2015 RSBS study found that, on average, a large contractor installs four times as many heating systems annually than a small contractor, the vast majority of HVAC and water heating contractors in the state (84%) are small.

- **Program implication.** Opportunities remain for engaging this critical group of small contractors in training and certification to increase the installation of high-efficiency equipment and ensure quality maintenance and installation. In line with these findings, although sample sizes were small, surveyed small contractors reported that their sales of cold-climate air-source heat pumps made up just 33% of their overall air-source heat pump sales compared to 60% of sales for large contractors, which suggests an opportunity for specific training or resources for small contractors on cold-climate heat pump specifications and benefits.
- **Improperly designed ducts, oversized equipment, and duct leakage are common quality installation issues encountered by contractors.** Of 63 surveyed contractors, 49% said they *very frequently* or *frequently* encountered ducts that were not properly designed, 46% said they *very frequently* or *frequently* encountered equipment that was oversized, and 44% said they *very frequently* or *frequently* encountered duct leakage.

# Detailed Findings by Residential HVAC Technology

This section presents a discussion of the trends in the HVAC and water heater market along with information on HVAC market share and a detailed analysis of sales and efficiency data organized by technology type. The results from the contractor survey are also organized by technology type.

Cadmus used HARDI sales data to quantify market share, total sales, and efficiency data for each technology for which D+R aggregates sales data. For technologies where HARDI data do not provide adequate coverage (water heaters and renewable heating and cooling technologies), Cadmus used RBSA data and contractor survey results.

Throughout this section, equipment sales are shown by efficiency tier. The efficiency of equipment is dictated by codes and federal standards, and changes to these affect customers' energy-consumption patterns and behaviors. *Appendix B. Codes and Standards* lists the current or baseline standard for single-family residential equipment and if there is a pending equipment standard change.

The RBSA presents HVAC and water heating equipment and fuel type separately by home vintage. Although HVAC and water heating systems installed in newly constructed homes represent only about 1% of the equipment throughout the state, the comparison is useful for different reasons. Examples include the following:

- The new construction home date range (2014 to 2018) aligns with the range for HARDI sales data, which allows for direct comparison of the data sources.
- Construction design impacts the technical feasibility of future equipment replacements. For example, new home builders are more likely to install central ducted systems, which makes zonal heating (possible with hydronic boilers) less common in new homes.
- The new home construction phase offers an opportunity for the most cost-effective installation of alternate technology like ground-source heat pumps.

The following sections include some of the key differences in HVAC and water heating equipment and fuel types between new and existing homes.

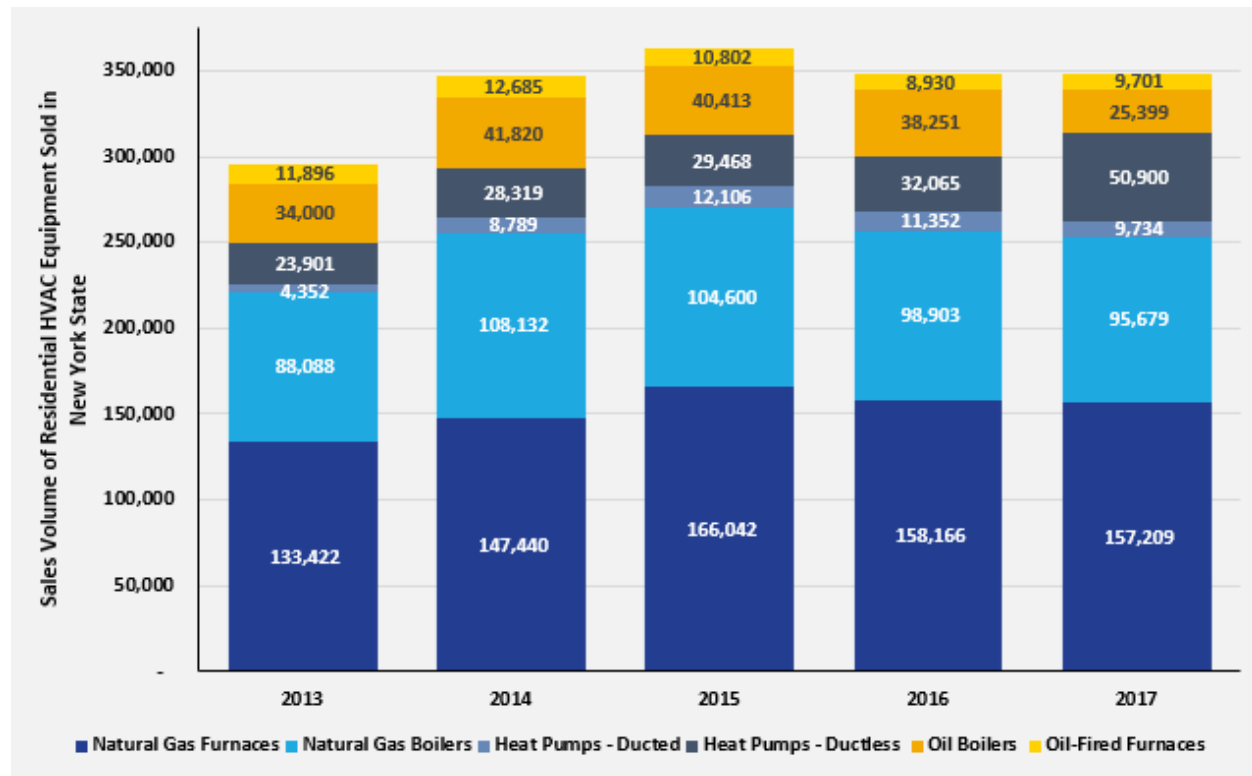
## MARKET SHARE BY RESIDENTIAL HVAC TECHNOLOGY

To provide the overall context for the HVAC market between 2013 and 2017, Cadmus compared residential HVAC sales in the state for natural gas furnaces and boilers, heat pumps (ducted and ductless), and oil-fired furnaces and boilers, as reported by D+R HARDI (Figure 1). The proportion of natural gas furnaces in the overall mix of sales has remained steady, while the proportion of natural gas boilers has decreased slightly. Sales of oil-fired boilers has decreased, while sales of oil-fired furnaces



has dipped only slightly. The sales of ductless and ducted air-source heat pumps has increased each year, from 10% in 2013 to 17% in 2017, and each year more ductless than ducted air source heat pumps have been sold.

FIGURE 1. RESIDENTIAL HVAC SALES IN THE STATE BETWEEN 2013 AND 2017



Source: D+R HARDI data

### HVAC Contractor Sales and Installations

Cadmus surveyed a diverse mix of active HVAC companies across the state. This section includes a high-level overview of the technologies that contractors reported installing. The technology-specific sections that follow include detailed findings from the contractor surveys by technology type.

As shown in Table 4, most surveyed HVAC and water heating contractors reported selling or installing natural gas-based technologies. According to the results of the HVAC contractor survey (n=72), most contractors reported selling or installing natural gas water heaters (84%), natural gas boilers (80%), and natural gas furnaces (75%). A majority reported selling or installing central air conditioners (67%), electric resistance water heaters (61%), and central ducted air-source heat pumps (53%). Very few reported selling or installing renewable technologies.

The technologies sold or installed were mostly the same between large and small contractors with one exception. A significantly higher proportion of large contractors than small contractors reported selling or installing central ducted air-source heat pumps, ductless mini-split heat pumps, and ground-source heat pumps.

TABLE 4. EQUIPMENT HVAC CONTRACTORS REPORTED SELLING OR INSTALLING

Equipment Category	Technology	Percentage of Respondents Who Sell/Install Technology		
		Combined (n=72)	Large Contractors (n=35)	Small Contractors (n=37)
Boilers	Natural Gas Boilers	80%	74%	81%
	Oil Boilers	46%	46%	46%
Furnaces	Natural Gas Furnaces	75%	86%	73%
	Oil-Fired Furnaces	40%	51%	38%
	Electric Furnaces	32%	43%	30%
Central Air Conditioners	Central Air Conditioners	67%	80%	65%
Heat Pumps	Central Ducted Air-Source Heat Pumps	53%	74%*	49%
	Ductless Mini-Split Heat Pumps	59%	89%*	54%
Water Heaters	Natural Gas Water Heaters	84%	74%	86%
	Oil Water Heaters	41%	43%	41%
	Electric Resistance Water Heaters	61%	57%	62%
	Heat Pump Water Heaters	38%	37%	38%
Renewable Heating and Cooling	Ground-Source Heat Pumps	22%	40%*	19%
	Pellet Stoves	3%	3%	3%
	Biomass Boilers	3%	3%	3%
	Solar Thermal Hot Water Systems	12%	20%	11%

**Note:** The combined respondent column shows weighted percentages by contractor company size (large and small). The percentages shown in the large and small contractor columns are not weighted. An asterisk (\*) denotes that the difference between large and small contractors is significant at the 90% level (p<0.10).

**Source:** HVAC contractor survey. Question, "I'd like you to tell me which of the following types of HVAC and water heating equipment your company sells or installs in single-family (1 to 4 unit) homes in New York state?"

Of the contractors surveyed, only one large and one small contractor reported that they sell water heaters but do not sell any of the other equipment (generally referred to as “HVAC equipment”) listed in Table 4. Of the contractors who sell HVAC equipment, most (84% statewide) reported they also sell at least one type of water heater.

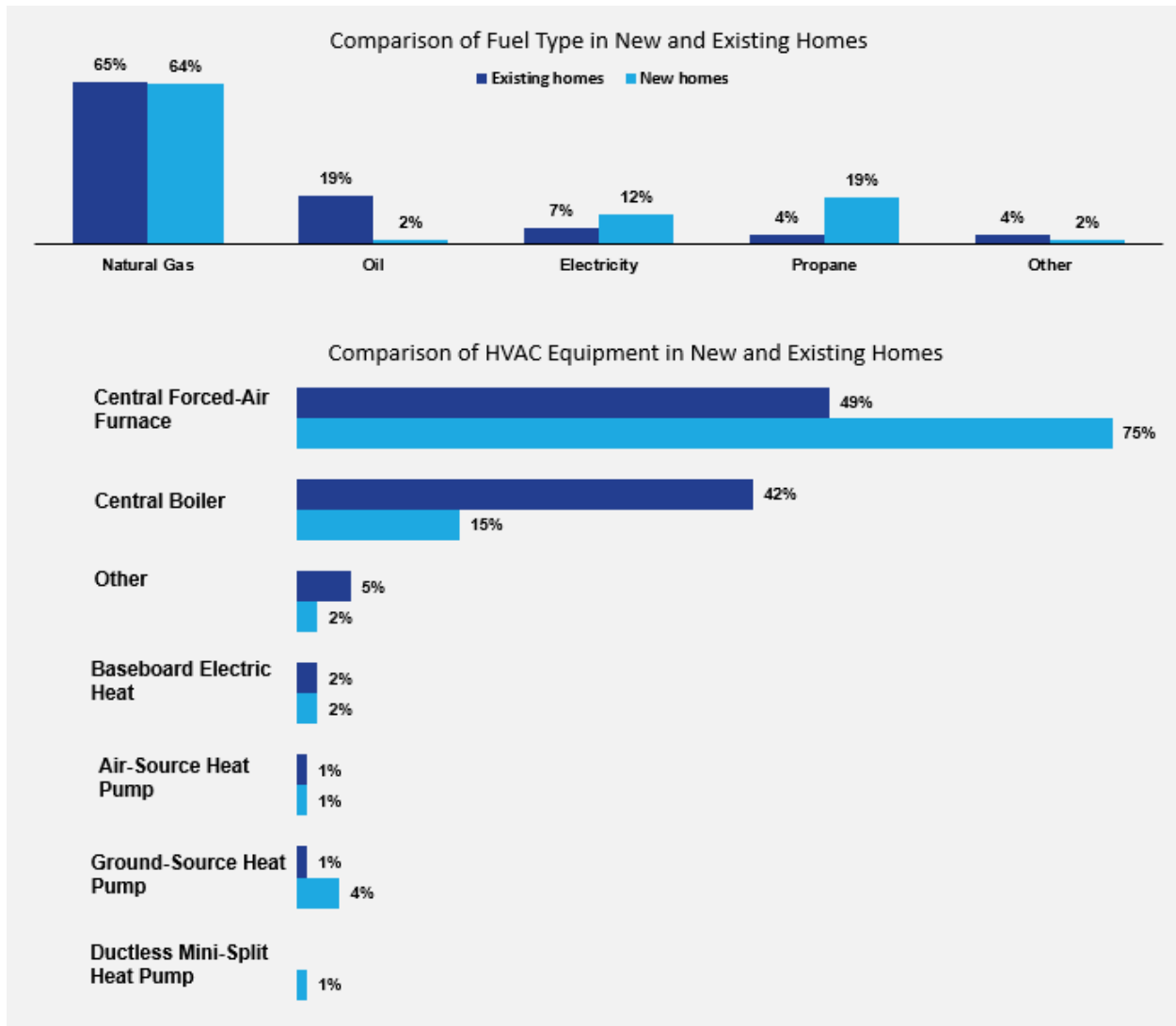
The majority of contractors surveyed (51 out of 72) were primarily in the business of servicing existing construction, indicating that 80% to 100% of their business was in existing homes. Only three said that most of their business (90% or more) was in new construction.

## FURNACES AND BOILERS

Figure 2 compares the heating equipment type and fuel type between new and existing homes. The predominant fuel type was natural gas (65% in existing homes and 64% in new homes). Fuel oil was the second most common fuel type in existing homes (19%). However, only about 2% of new homes heated with fuel oil. New homes were more likely to use propane (19%) or some type of electric heat (12%) than were existing homes (4% used propane and 7% used some type of electric heat). For both existing

and new homes, the predominant equipment types were forced air furnaces, followed by central boilers.

**FIGURE 2. COMPARING HVAC EQUIPMENT AND FUEL TYPE IN NEW AND EXISTING HOMES**



Source: 2019 RBSA

The next sections summarize and compare sales and efficiency levels from D+R HARDI data for the predominate heating equipment and fuel types: natural gas and oil-fired furnaces and boilers. D+R HARDI data provide estimated total sales of residential furnaces and boilers in the state by year. The sections summarize contractor survey findings pertaining to furnaces and boilers. Relevant findings from market actor interviews are also included.

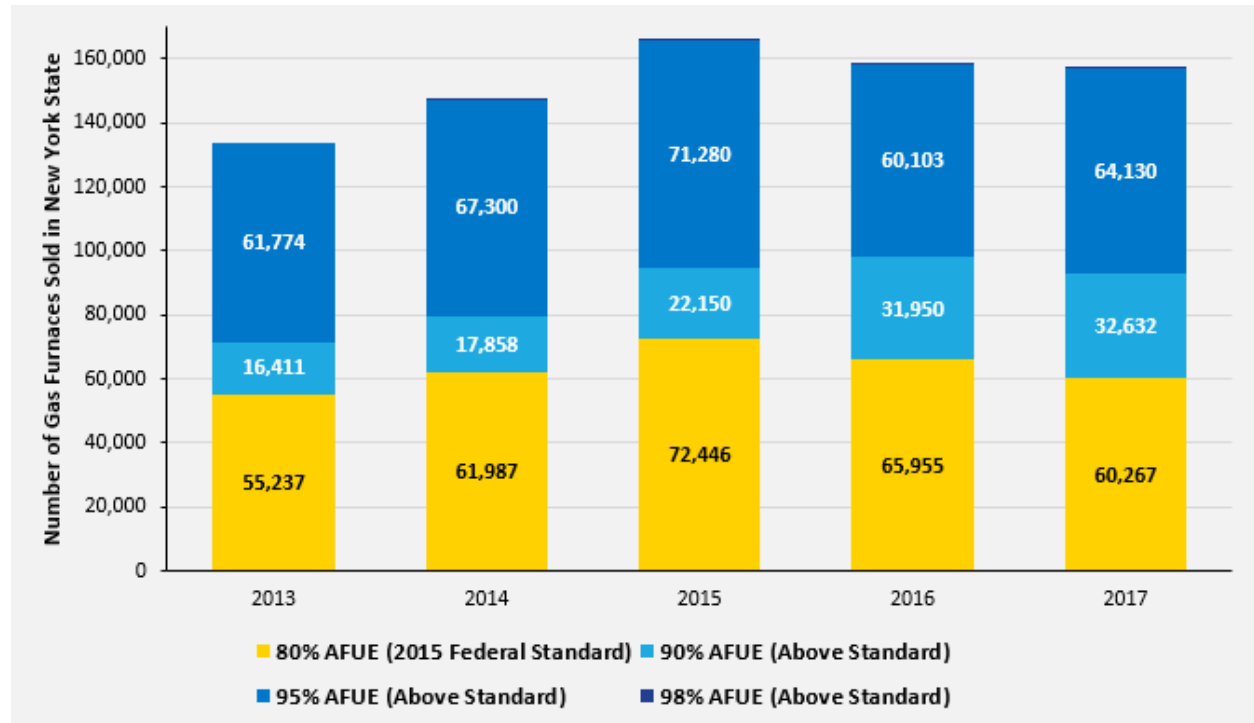
### Natural Gas Furnaces and Boilers

This section includes the market size estimates and market penetration data of natural gas furnaces and boilers by efficiency tier, based on D+R HARDI, followed by the contractor survey findings.

### Natural Gas Furnace and Boiler Sales and Efficiency Data

Between 2013 and 2017, a total of 762,279 natural gas furnaces were sold in the state. The highest sales were in 2015, and although fewer natural gas furnaces were sold in 2016 and 2017, the volume of sales has remained higher than 2013 (Figure 3).

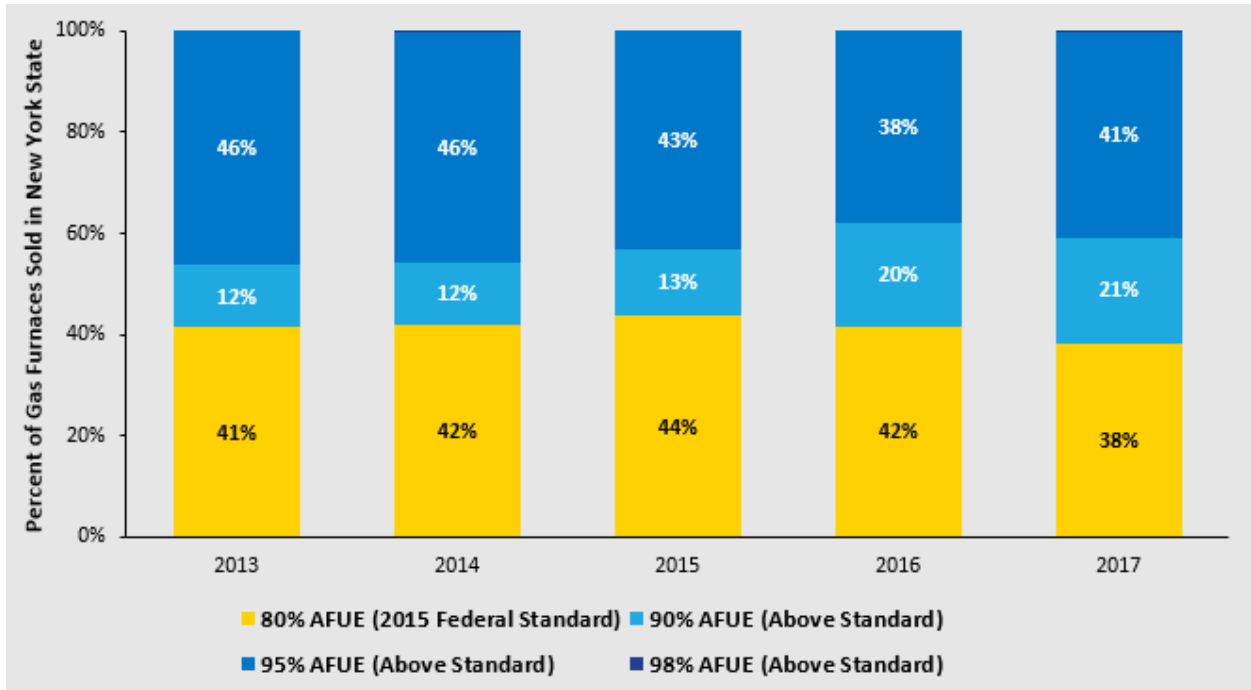
FIGURE 3. NUMBER OF NATURAL GAS FURNACES SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



Source: D+R HARDI Data

The proportion of natural gas furnaces sold by efficiency tier has remained relatively consistent over the five-year period (Figure 4). Forty-one percent of natural gas furnaces sold met the 2015 natural gas furnace federal standard of 80% AFUE. The remaining 58% were high-efficiency furnaces: 16% were 90% AFUE and 43% were 95% AFUE.

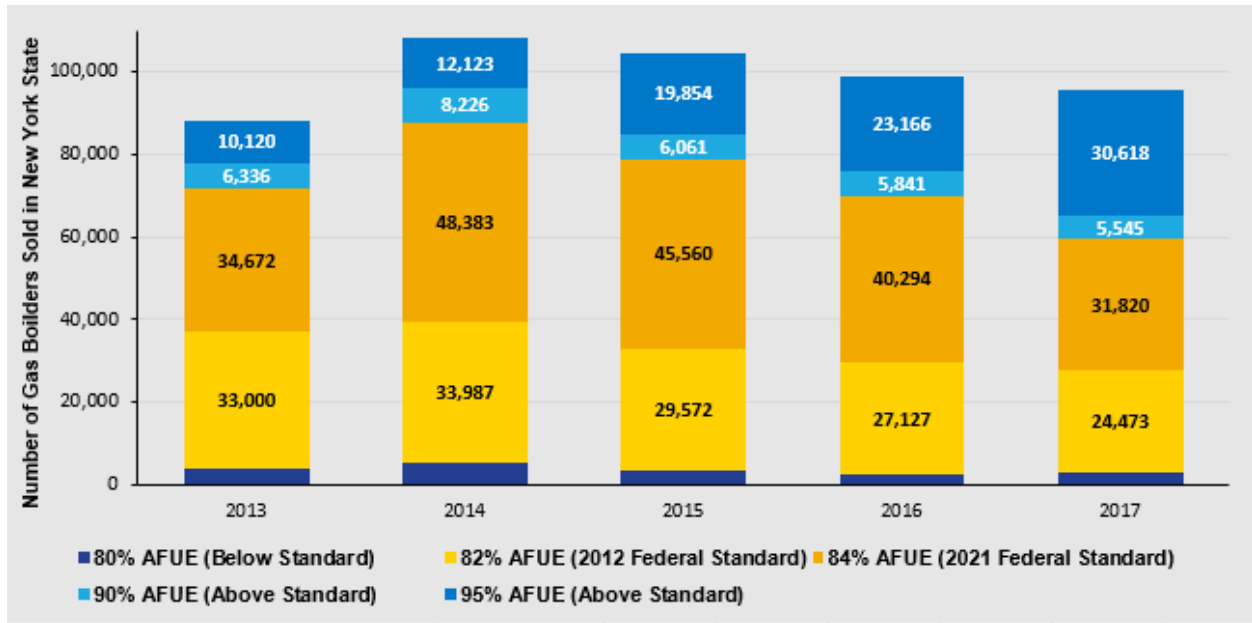
FIGURE 4. PERCENTAGE OF NATURAL GAS FURNACES SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



Source: D+R HARDI Data

Between 2013 and 2017, a total of 495,402 natural gas boilers were sold in the state. Natural gas boilers follow a similar trend to gas furnaces. The majority of natural gas boilers were sold in 2014, and although fewer were sold between 2015 and 2017, the volume of sales remained higher than 2013 (Figure 5).

FIGURE 5. NUMBER OF NATURAL GAS BOILERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017

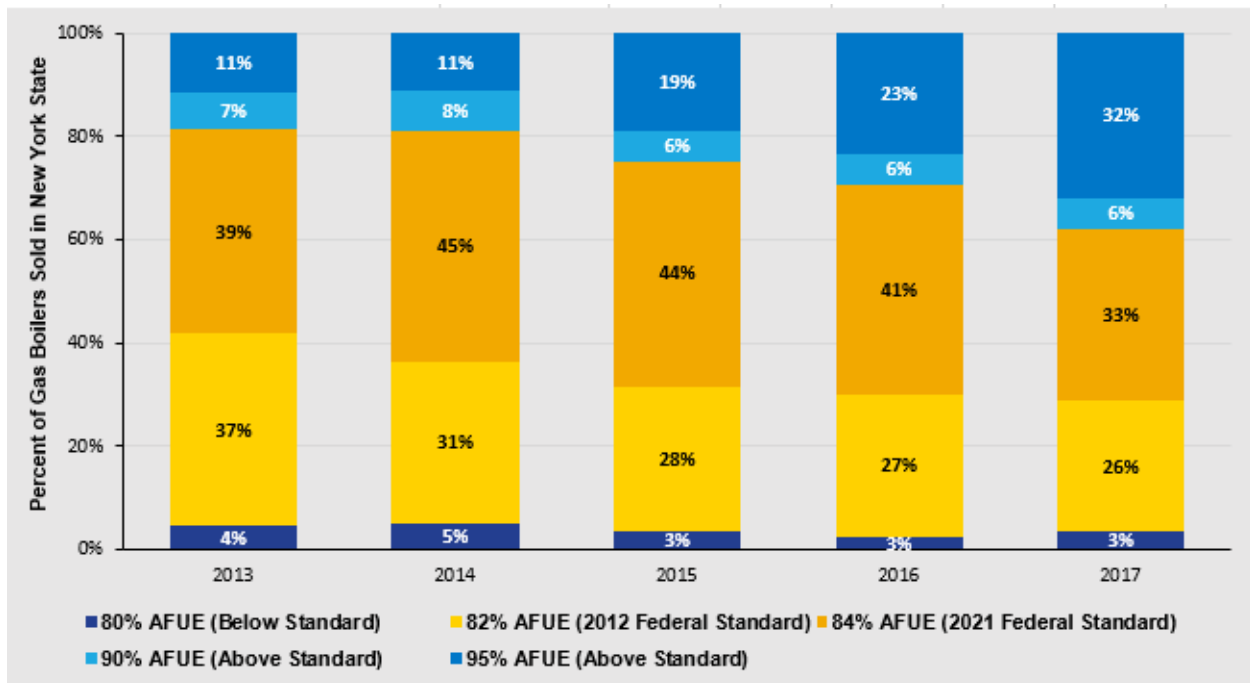


**Note:** The efficiency standard in the chart represents the standard for gas-fired hot water boilers (82% AFUE) which is the most common equipment. D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as gas-fired steam boilers, which has a standard of 80% AFUE. Relevant codes and standards are included in *Appendix B. Codes and Standards*.

**Source:** D+R HARDI Data

The proportion of high-efficiency natural gas boilers (95% AFUE) sold in the state has increased each year (Figure 6). In 2013, high-efficiency boilers made up only 11% of total sales. By 2017, high-efficiency boilers accounted for just over a third of sales. Of the 495,402 natural gas boilers sold in the past five years, only 4% were below federal standards. Thirty percent met the 2012 federal standard, and 41% of met the upcoming 2021 federal standard of 84% AFUE. Twenty-six percent of natural gas boilers sold superseded the federal standards: 6% were 90% AFUE and 19% were 95% AFUE.

FIGURE 6. PERCENTAGE OF NATURAL GAS BOILERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



**Note:** The efficiency standard in the chart represents the standard for gas-fired hot water boilers (82% AFUE) which is the most common equipment. D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as gas-fired steam boilers, which has a standard of 80% AFUE. Relevant codes and standards are included in *Appendix B. Codes and Standards*.

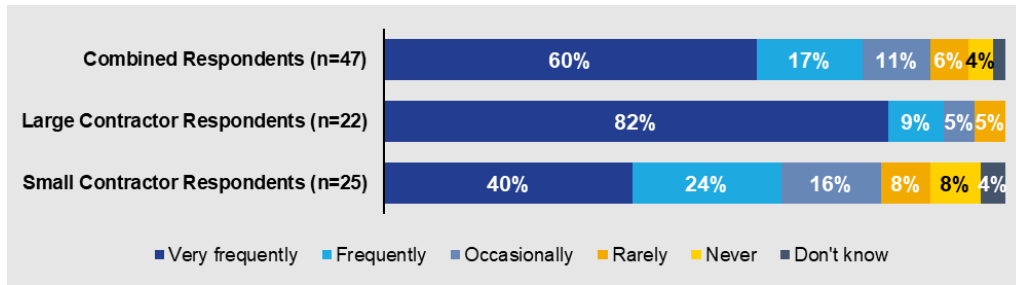
**Source:** D+R HARDI Data

### Contractor Survey Findings on Natural Gas Furnaces and Boilers

#### Technology Recommendations

Most of the surveyed contractors who installed natural gas boilers and furnaces recommended a condensing system to customers needing a new heating unit. As shown in Figure 7, 77% of respondents said they *very frequently* or *frequently* recommended a condensing unit, with 60% reporting that they *very frequently* recommended it. Large contractors tended to recommend a condensing unit more often (91%) than small contractors (64%), although sample sizes were too small to confirm the difference through statistical significance testing.

FIGURE 7. HOW OFTEN CONTRACTORS RECOMMEND A CONDENSING NATURAL GAS BOILER OR FURNACE TO CUSTOMERS



Note: percentages shown are not weighted.

Source: HVAC contractor survey. Question, "When recommending natural gas boilers and furnaces to your customers in need of a new heating system, how often do you recommend a condensing model?"

The five contractor respondents who said they *rarely* or *never* recommend a condensing unit gave the following reasons: the installation job requires more work than a noncondensing unit, the unit is more difficult to service, or their customers do not want to change from what they are already using (Table 5). Some respondents also mentioned repair costs and the lifespan of a condensing unit. None mentioned high upfront cost, long payback period, or availability of unit.

TABLE 5. WHY CONTRACTORS OFTEN DO NOT RECOMMEND A CONDENSING NATURAL GAS BOILER OR FURNACE

Reason	Combined Respondents (n=5)	Large Contractor Respondents (n=1)	Small Contractor Respondents (n=4)
Installation requires more work for a condensing unit than a noncondensing unit	2	1	1
More difficult to service or work with	2	1	1
Customer does not want to change from what they already use	2	0	2
Repair costs	1	0	1
Noncondensing systems outlast condensing systems	1	0	1

Note: Multiple answers were allowed. Counts shown are not weighted.

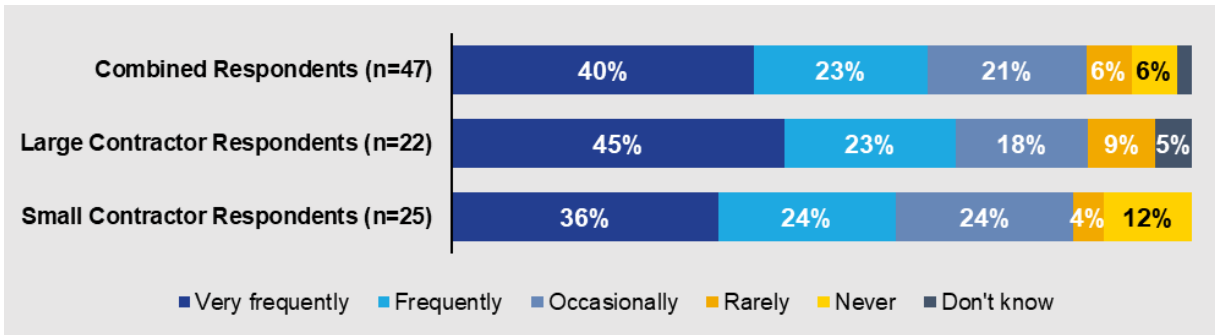
Source: HVAC contractor survey. Question, "What are the main reasons you rarely or never recommend condensing natural gas boilers and furnaces?"

### Early Replacement

Half of the surveyed contractors who installed natural gas boilers and furnaces said they often recommend a condensing unit to customers with an old but still functioning unit prior to failure. As shown in Figure 8, 63% of respondents said they *very frequently* or *frequently* recommend an early replacement, with 40% reporting that they *very frequently* recommend it. Large and small contractors tended to recommend an early replacement at similar frequencies. Of the respondents who said *very frequently*, *frequently*, or *occasionally* (n=40), 90% recommended replacing the old unit with another natural gas boiler or furnace, 13% recommended a higher-efficiency boiler or furnace (fuel type unspecified), 2% recommended a central air-source heat pump, and 2% recommended a ductless heat pump.



FIGURE 8. HOW OFTEN CONTRACTORS RECOMMEND NATURAL GAS BOILER OR FURNACE REPLACEMENT PRIOR TO FAILURE TO CUSTOMERS



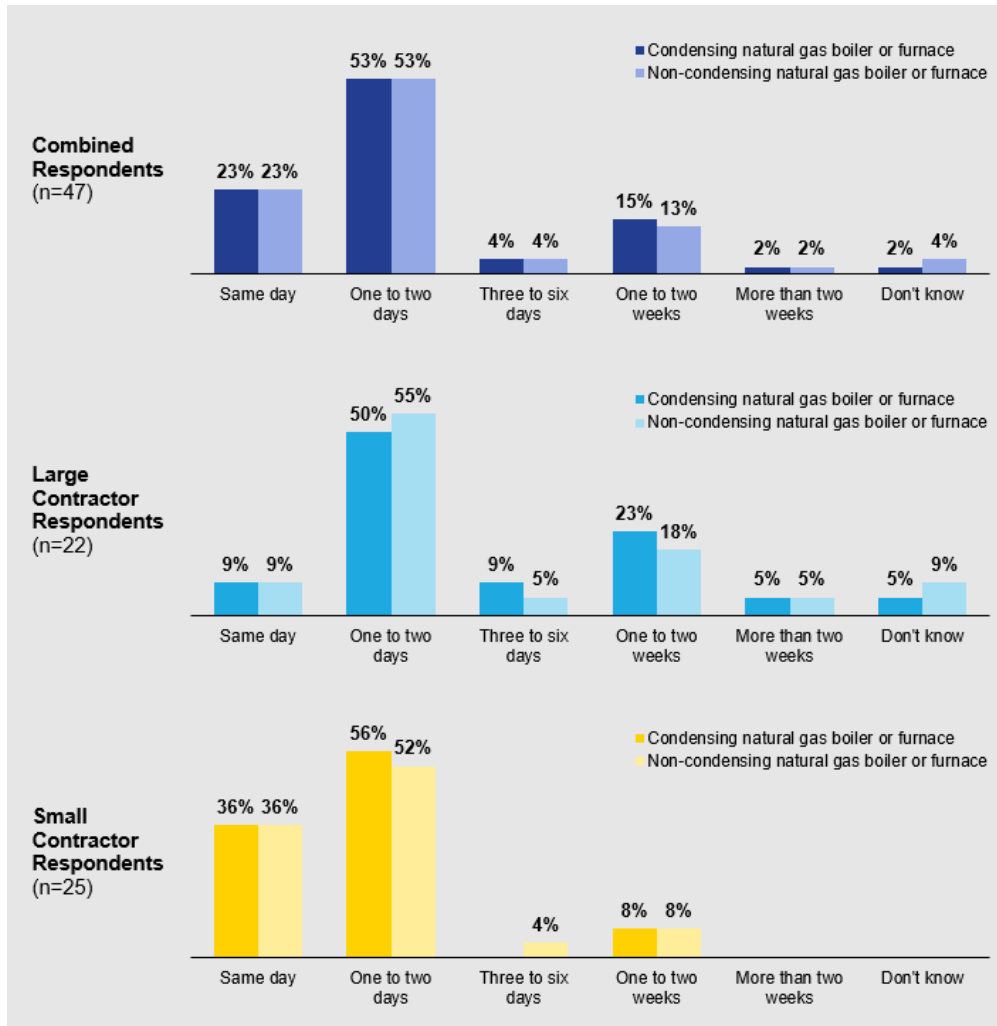
**Note:** Percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning natural gas boiler or furnace replace their existing system prior to failure??"

### Delivery Time of Technology

As shown in Figure 9, customer delivery times between a condensing and noncondensing natural gas boiler/furnace do not differ. Most respondents reported that equipment typically arrives to customers within two days, with 23% reporting same day delivery and 53% reporting one- to two-day delivery. Large and small contractors reported similar delivery timeframes for condensing and noncondensing units.

FIGURE 9. TIME IT TAKES TO DELIVER NATURAL GAS BOILERS AND FURNACES TO CUSTOMERS



Note: percentages shown are not weighted.

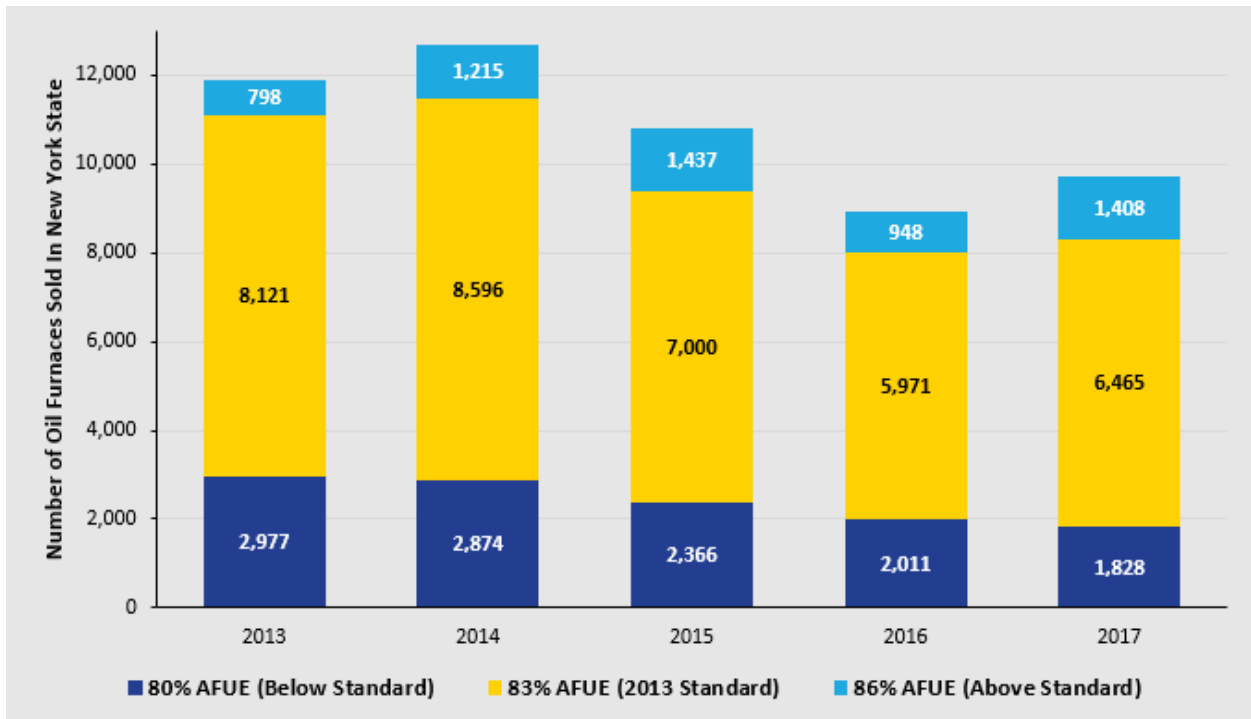
Source: HVAC contractor survey. Question, "How long would you say it typically takes to have a condensing/noncondensing natural gas boiler or furnace delivered to the customer?"

## Oil-Fired Furnaces and Boilers

This section presents market size estimates and market penetration from D+R HARDI data of oil-fired furnaces and boilers by efficiency tier, followed by the contractor survey findings.

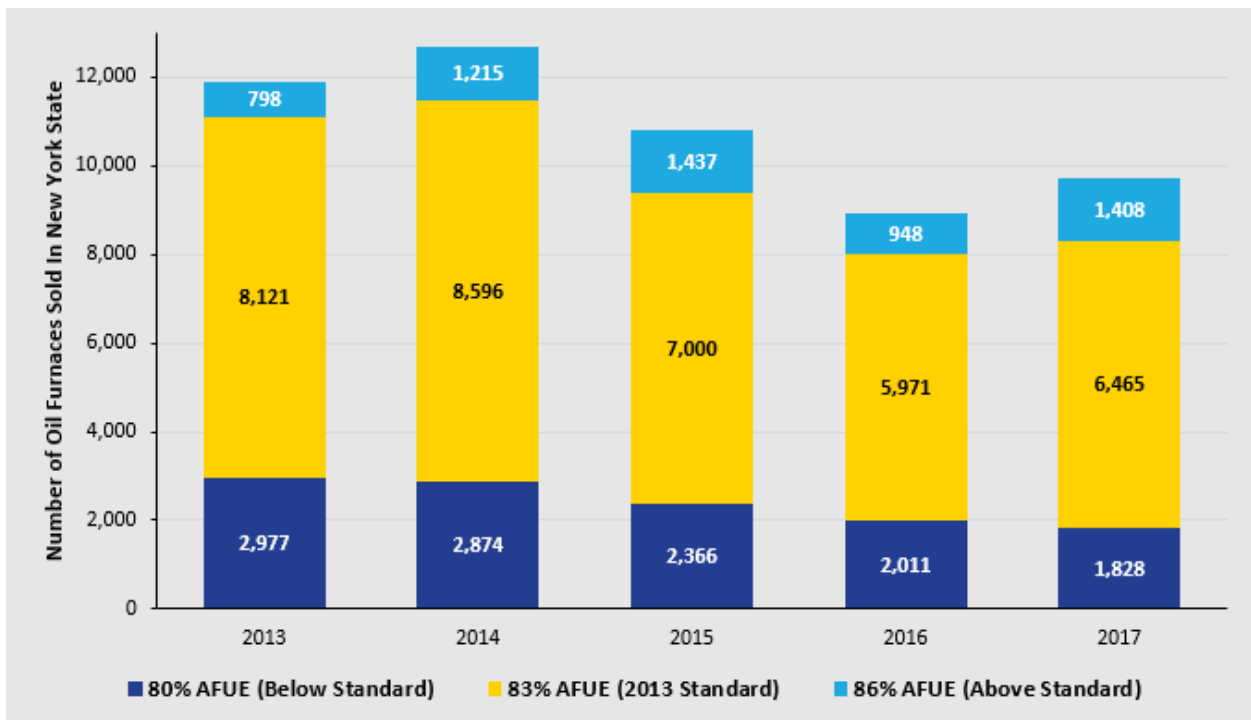
### Oil-Fired Furnace and Boiler Sales and Efficiency Data

Between the years of 2013 and 2017, a total of 54,014 oil-fired furnaces were sold in the state. Oil-fired furnace sales peaked in 2014 (Figure 10. Number of Oil-Fired Furnaces Sold by Efficiency Tier between 2013 and 2017



).

FIGURE 10. NUMBER OF OIL-FIRED FURNACES SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017

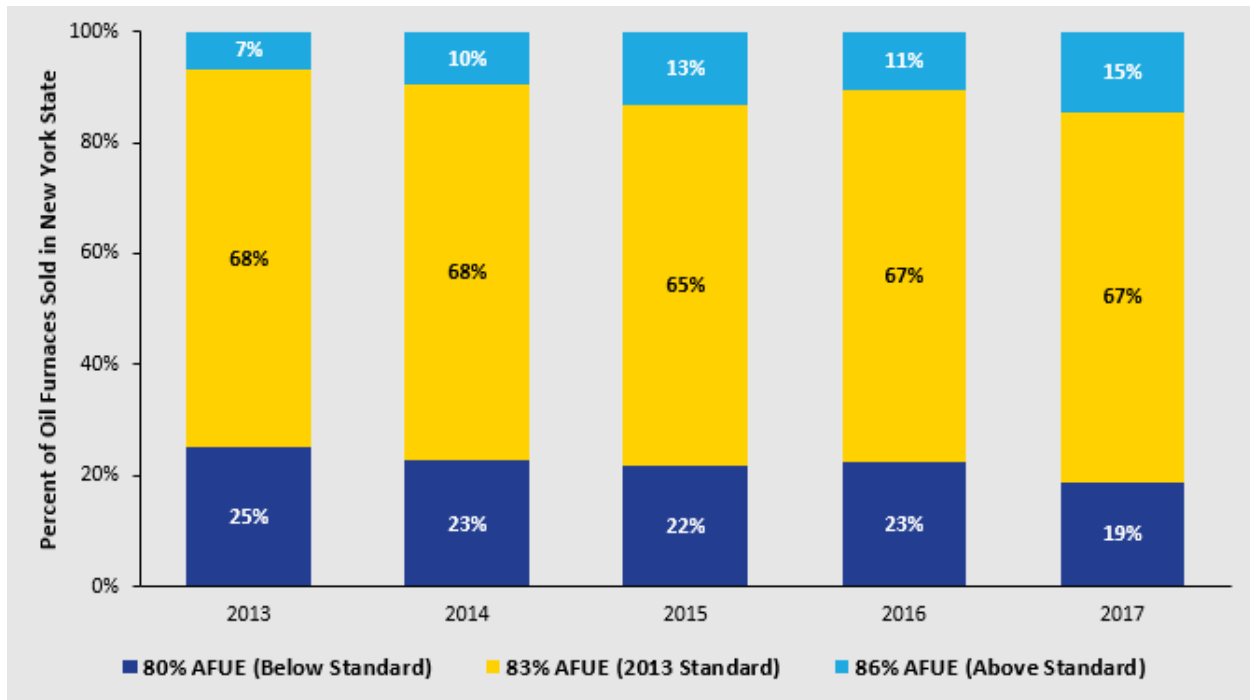


**Note:** The efficiency standard in the chart represents the standard for non-weatherized oil furnaces (83% AFUE), which is the most common equipment. D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as weatherized oil-fired furnaces (78% AFUE) and mobile home oil-fired furnaces (75% AFUE).

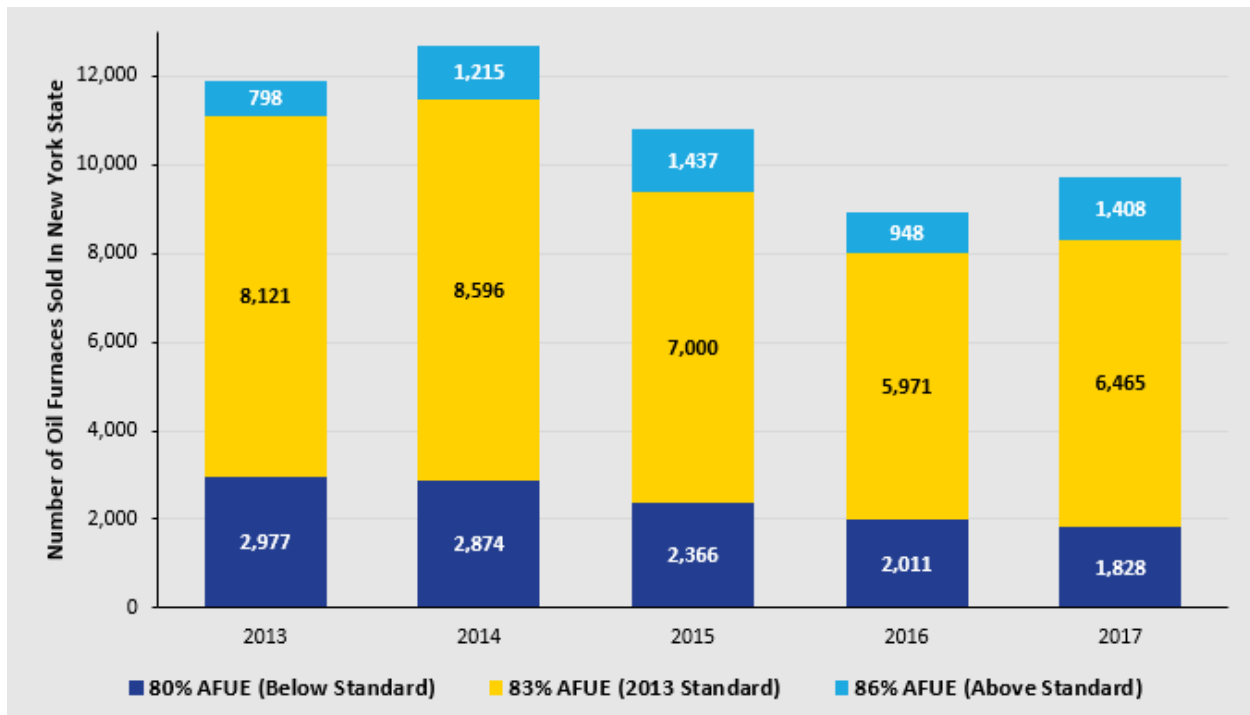
Relevant codes and standards are included in *Appendix B. Codes and Standards*.

Source: D+R HARDI Data

The proportion of oil-fired furnaces sold by efficiency tier has remained relatively consistent over the five-year period (Figure 11. Percentage of Oil-Fired Furnaces Sold by Efficiency Tier between 2013 and 2017

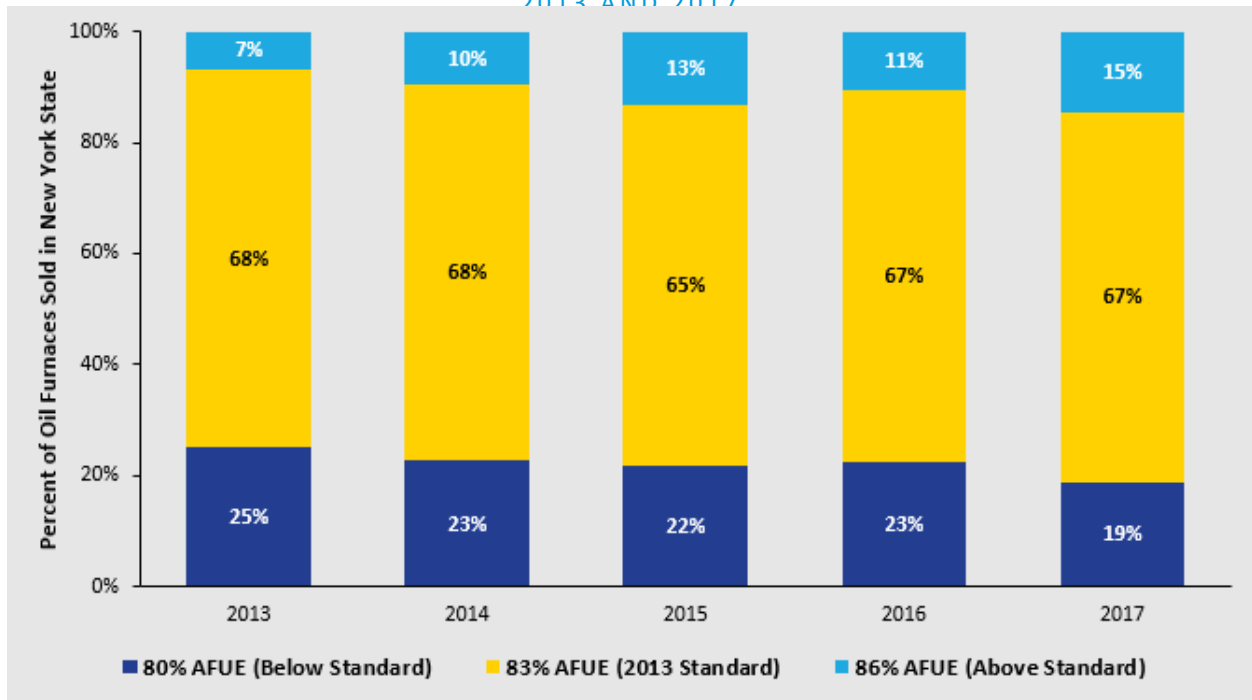


). Nearly all of the oil-fired furnaces sold were at or below standard efficiency for non-weatherized oil-fired furnaces (see note in Figure 10. Number of Oil-Fired Furnaces Sold by Efficiency Tier between 2013 and 2017



). Of the 54,014 oil-fired furnaces sold over the five-year period, 21% were below the 2013 federal standard, 66% met the 2013 federal standard, and 13% were above standard. However, the proportion of high-efficiency equipment did increase from 7% above standard in 2013 to 15% in 2017.

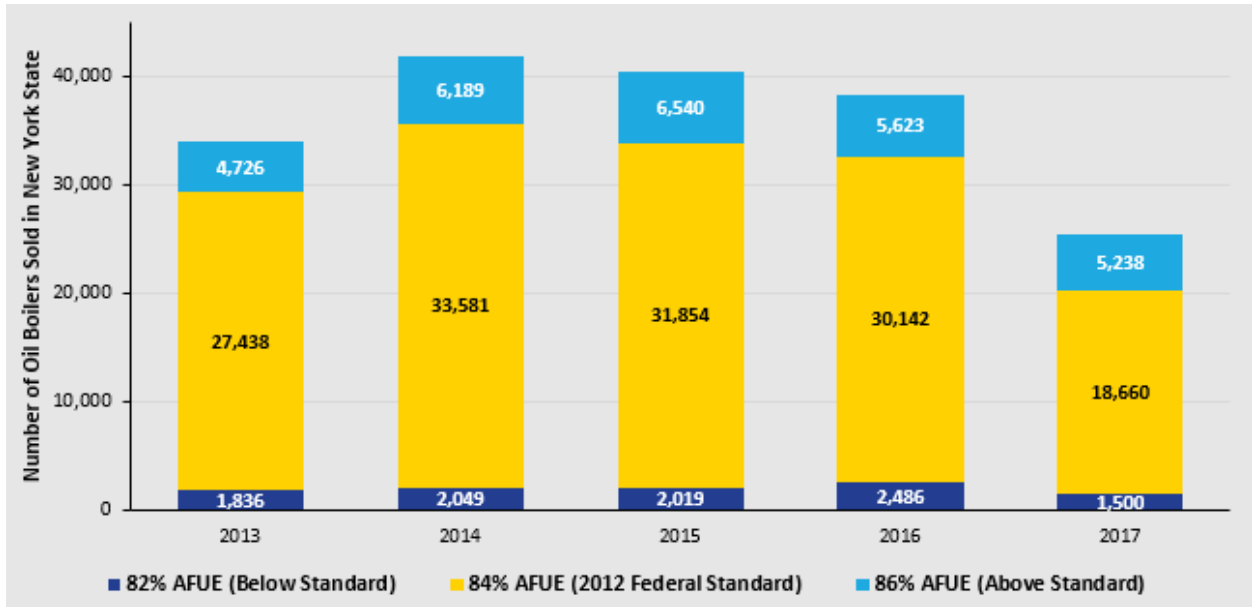
FIGURE 11. PERCENTAGE OF OIL-FIRED FURNACES SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



**Note:** The efficiency standard in the chart represents the standard for non-weatherized oil furnaces (83% AFUE), which is the most common equipment. D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as weatherized oil-fired furnaces (78% AFUE) and mobile home oil-fired furnaces (75% AFUE). Relevant codes and standards are included in *Appendix B. Codes and Standards*.

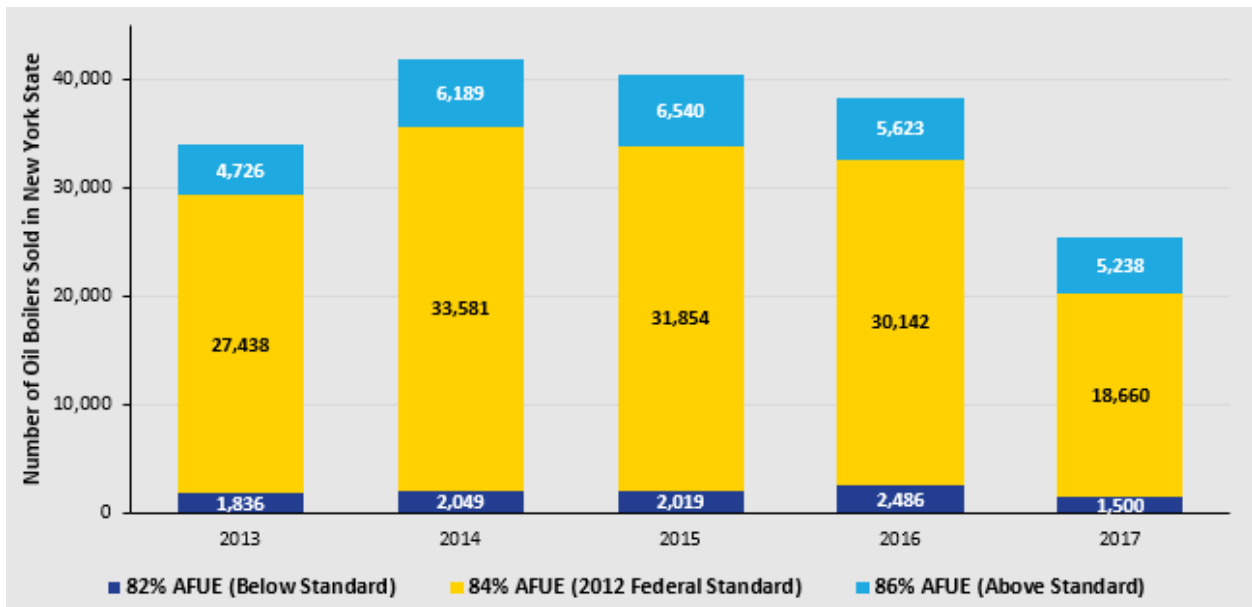
**Source:** D+R HARDI Data

Between the years of 2013 and 2017, a total of 179,883 oil-fired boilers were sold in the state. Oil-fired furnace sales peaked in 2014 (Figure 12. Number of Oil-Fired Boilers Sold by Efficiency Tier between 2013 and 2017



). This trend is similar to oil-fired furnaces.

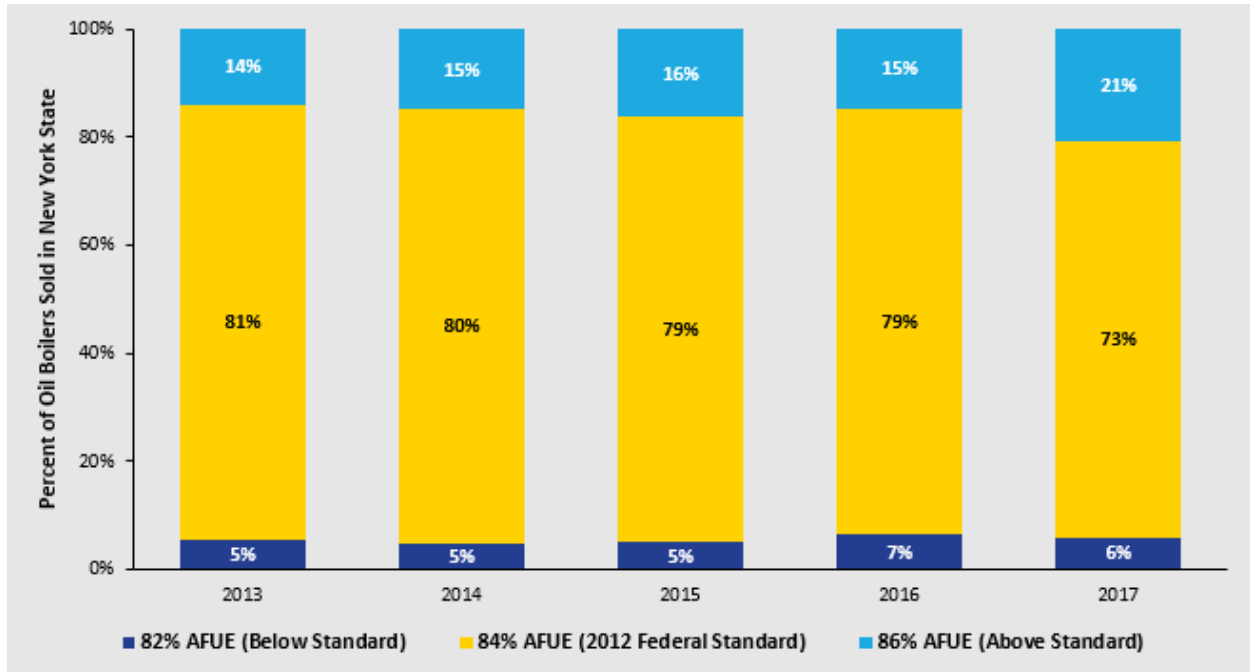
FIGURE 12. NUMBER OF OIL-FIRED BOILERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



**Note:** The efficiency standard in the chart represents the standard for oil-fired hot water boilers (84% AFUE, which is the most common equipment). D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as oil-fired steam boilers (82% AFUE). Relevant codes and standards are included in *Appendix B. Codes and Standards*.

**Source:** D+R HARDI Data

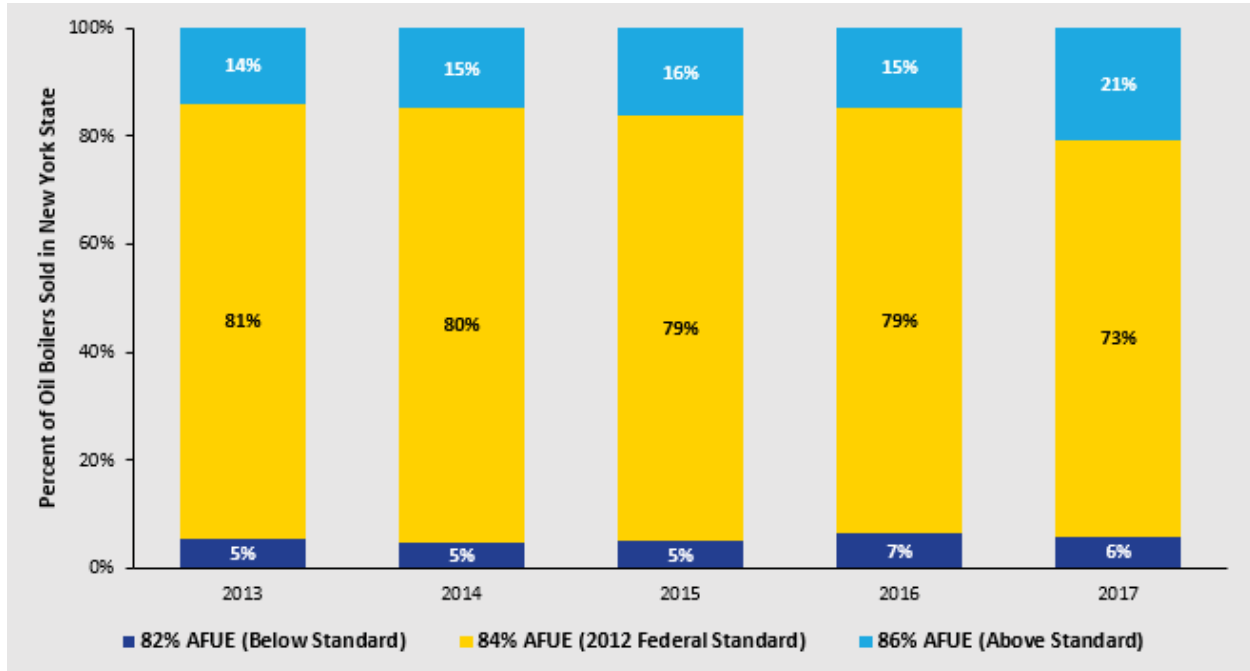
Similar to oil-fired furnaces, most oil-fired boilers sold were at or below the 2012 efficiency standard.<sup>4</sup> Nevertheless, the proportion of high-efficiency oil-fired boilers (86% AFUE) sold in the state increased each year between 2013 and 2017 (Figure 13. Percentage of Oil-Fired Boilers Sold by Efficiency Tier between 2013 and 2017



). In 2013, high-efficiency boilers made up 14% of total sales, and by 2017, high-efficiency boilers accounted for just over 21% of sales. Of the 104,063 oil-fired boilers sold in the past five years, only 6% were below the 2012 federal standard, 78% met the standard, and the remaining 17% were above standard.

<sup>4</sup> Minimum standard AFUE shown is based on the efficiency standard for non-weatherized oil-fired boilers. The minimum rating for weatherized oil-fired boilers is 82% AFUE.

FIGURE 13. PERCENTAGE OF OIL-FIRED BOILERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



**Note:** The efficiency standard in the chart represents the standard for oil-fired hot water boilers (84% AFUE) which is the most common equipment. D+R HARDI reports do not include the equipment classifications needed to determine all applicable standards. The “below standard” units are likely made up of less common equipment, such as oil-fired steam boilers (82% AFUE). Relevant codes and standards are included in *Appendix B. Codes and Standards*.

**Source:** D+R HARDI Data

### Contractor Survey Findings on Oil Furnaces and Boilers

#### Oil to a Different Heat Source Conversion

Of all surveyed contractors (n=72), 87% reported having customers with oil heat who switched to a different heat source within the past year.<sup>5</sup> Respondents reported (n=60), on average, that 22% of their customers who had oil heat switched to a different heat source. Large and small contractors reported a statistically similar proportion of customers switching (large 24%, n=27; small 21%, n=33).<sup>6</sup> In the market actor interviews, two manufacturers and a distributor noted the market is shifting away from delivered fuels, like oil, for heating.

#### Technology Recommendations for Switching Away from Oil

As shown in Figure 14, contractor respondents most frequently reported recommending a natural gas furnace or boiler (48%), propane system (42%), ductless heat pump (42%), and central air-source heat pump (37%) to customers who wanted to stop using oil heat. Large contractors tended to recommend ductless heat pumps and central air-source heat pumps more frequently than did small contractors, although sample sizes were too small to confirm the difference through statistical significance testing. Small contractors tended to recommend natural gas furnaces or boilers more frequently than did large

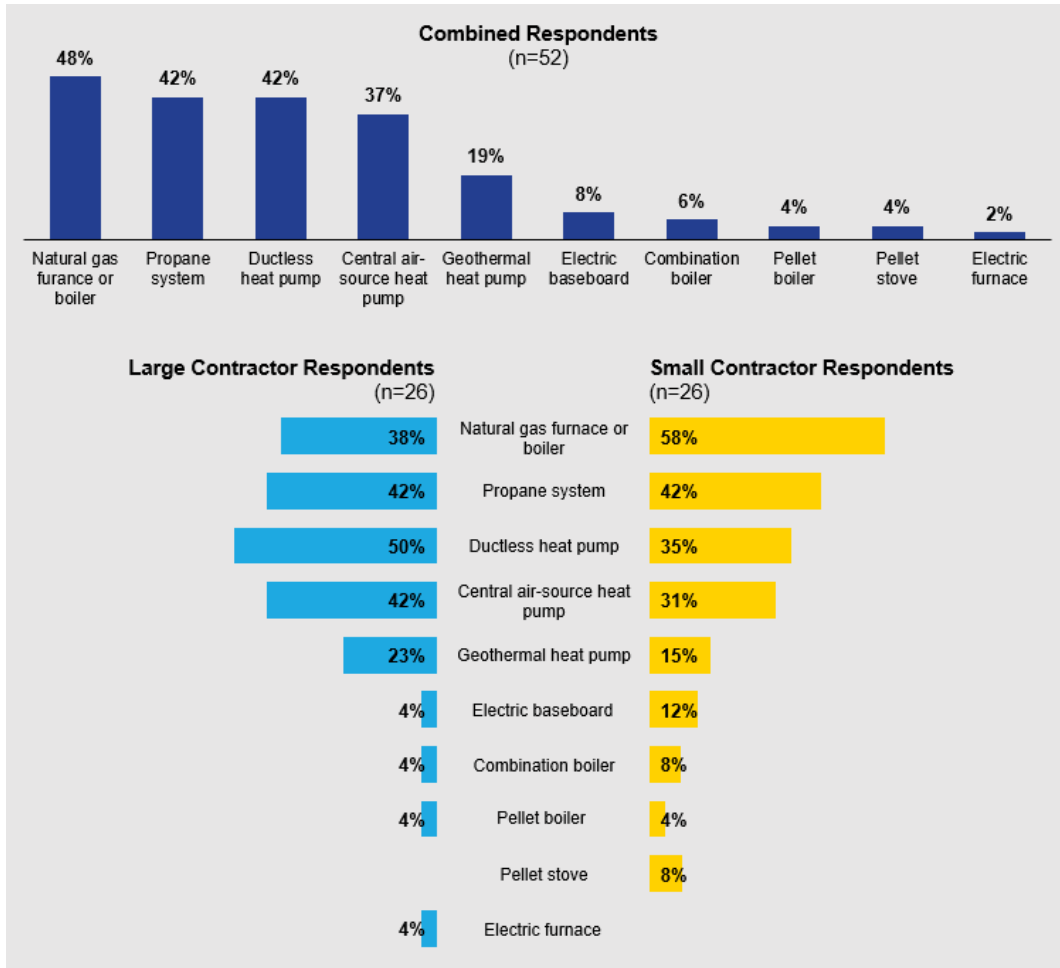
<sup>5</sup> This percentage is weighted by contractor company size.

<sup>6</sup> The percentages reported by large and small contractors are not weighted.



contractors, although sample sizes were too small confirm the difference through statistical significance testing.

**FIGURE 14. EQUIPMENT CONTRACTORS RECOMMENDED TO CUSTOMERS WHO WANTED TO STOP USING OIL HEAT**



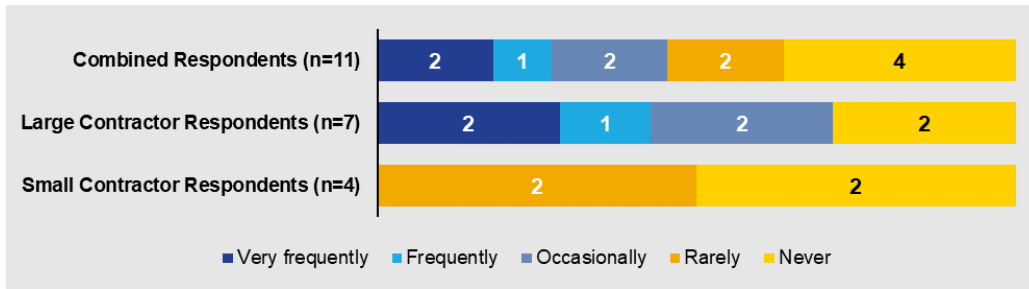
**Note:** Multiple answers were allowed. Percentages may add up to more than 100%. Percentages shown are not weighted.

**Source:** HVAC contractor survey. Questions, "For a customer who wants to stop using oil heat, which of the following equipment types do you most commonly recommend?"

### Oil Boiler and Furnace Recommendations

Most of the surveyed contractors who installed oil boilers and furnaces usually did not recommend a condensing unit to customers needing a new heating system. Figure 15 shows that three of 11 respondents said they *very frequently* or *frequently* recommended a condensing oil boiler or furnace. All three were large contractors. None of the small contractors said they *very frequently* or *frequently* recommended a condensing unit.

FIGURE 15. HOW OFTEN CONTRACTORS RECOMMEND A CONDENSING OIL BOILER OR FURNACE TO CUSTOMERS



Note: Counts shown are not weighted.

Source: HVAC contractor survey. Question, "When recommending oil boilers and furnaces to your customers in need of a new heating system, how often do you recommend a condensing model?"

The six contractor respondents who said they *rarely* or *never* recommended a condensing unit gave the following reasons: high upfront cost, unit lifespan, and unit availability (Table 6). Some respondents also mentioned availability of servicing and parts and customer maintenance issues.

TABLE 6. WHY CONTRACTORS OFTEN DO NOT RECOMMEND A CONDENSING OIL BOILER OR FURNACE

Reason	Combined Respondents (n=6)	Large Contractor Respondents (n=2)	Small Contractor Respondents (n=4)
High upfront cost	2	1	1
Noncondensing systems outlast condensing systems	2	0	2
Condensing systems are not as readily available as noncondensing systems	2	2	0
Servicing and parts availability	1	0	1
Customers do not want to deal with maintenance	1	0	1

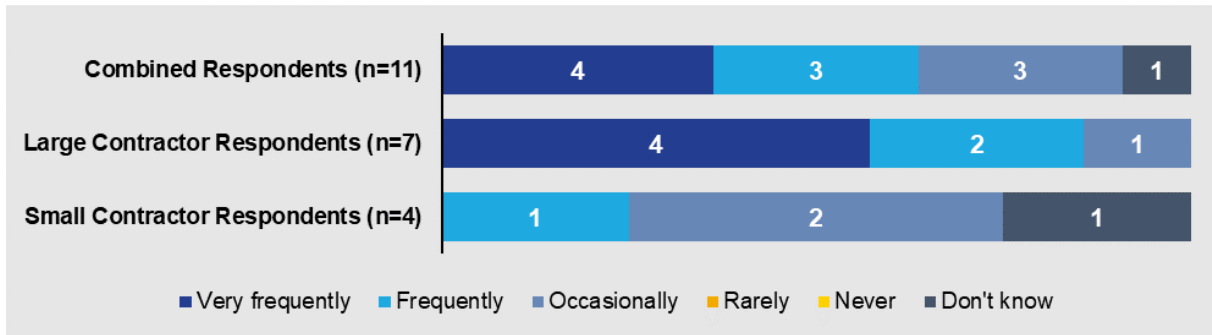
Note: Multiple answers were allowed. Counts shown are not weighted.

Source: HVAC contractor survey. Question, "What are the main reasons you rarely or never recommend condensing oil boilers and furnaces?"

### Early Replacement

Slightly more than half of the surveyed contractors who installed oil boilers and furnaces reported they often recommended a natural gas boiler or furnace to customers with an old but still functioning unit prior to failure. As shown in Figure 16, seven of 11 respondents said they *very frequently* or *frequently* recommended an early replacement. Large contractors tended to recommend an early replacement more often than did small contractors, although sample sizes were too small to confirm the difference through statistical significance testing. Of the 10 respondents who said *very frequently*, *frequently*, or *occasionally*, six recommended replacing the old oil boiler or furnace unit with a natural gas boiler or furnace. Three recommended replacing it with a central air-source heat pump. One respondent said, "It varies and depends on what the customer is interested in."

FIGURE 16. HOW OFTEN CONTRACTORS RECOMMEND OIL BOILER OR FURNACE REPLACEMENT PRIOR TO FAILURE TO CUSTOMERS



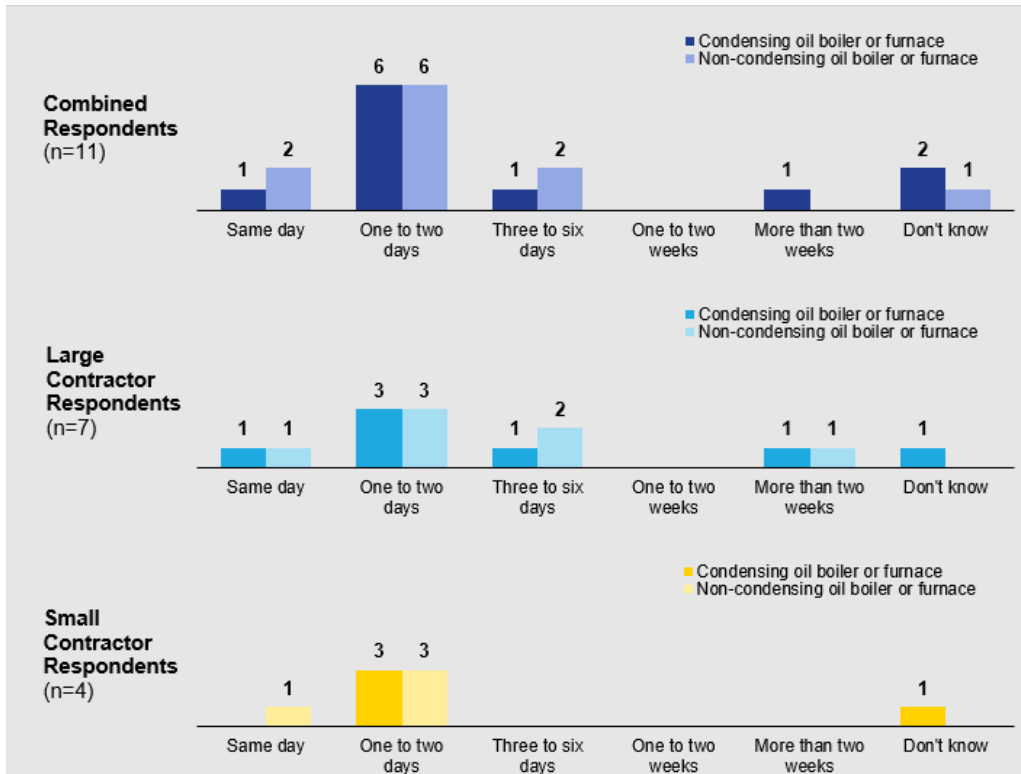
**Note:** Counts shown are not weighted.

**Source:** HVAC contractor survey. Question, "How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning oil boiler or furnace replace their existing system prior to failure?"

### Delivery Time of Technology

As shown in Figure 17, delivery times between a condensing and noncondensing oil boiler and furnace did not differ. Six of 11 contractor respondents reported that it typically takes one to two days to deliver the equipment to customers. Large and small contractors reported similar delivery timeframes for condensing and noncondensing units, although the survey sample sizes were very small.

FIGURE 17. TIME IT TAKES TO DELIVER OIL BOILERS AND FURNACES TO CUSTOMERS



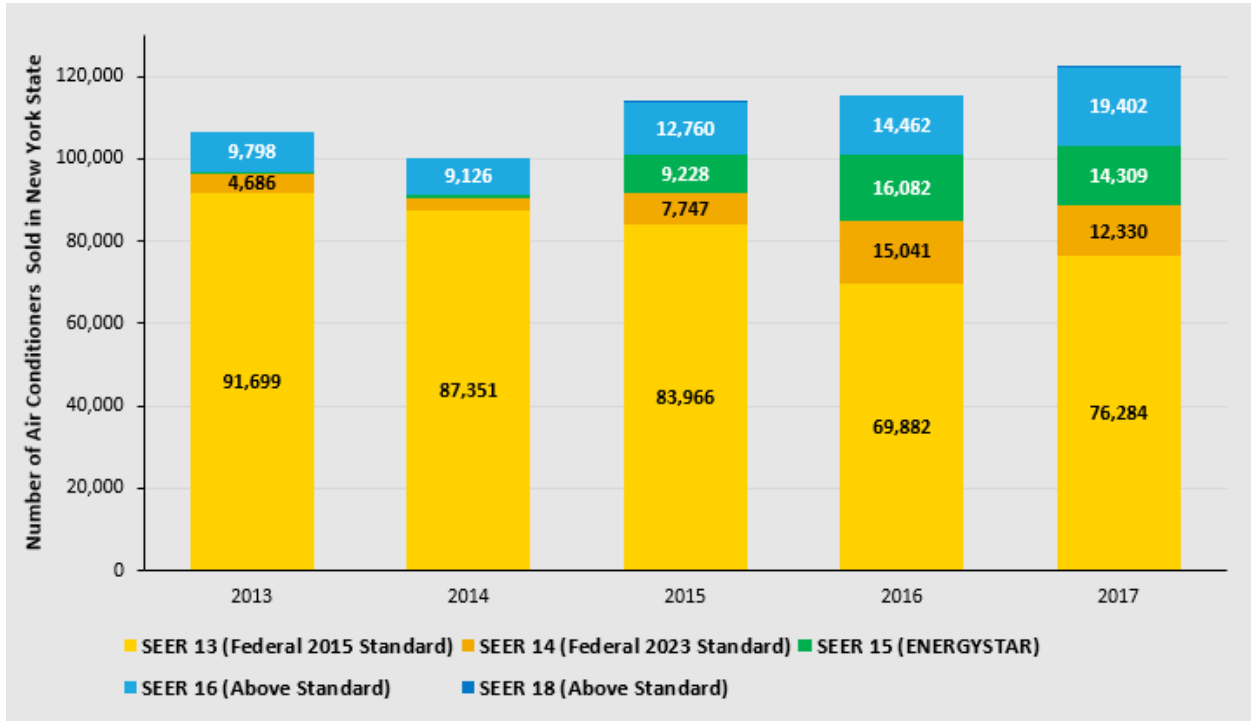
Note: Counts shown are not weighted.

Source: HVAC contractor survey. Question, "How long would you say it typically takes to have a condensing/noncondensing oil boiler or furnace delivered to the customer?"

## CENTRAL AIR CONDITIONERS

Sales of central air conditioners increased between 2014 and 2017 in the state (Figure 18). Between 2013 and 2017, a total of 558,585 central air conditioners were sold, the highest sales volume occurring in 2017.

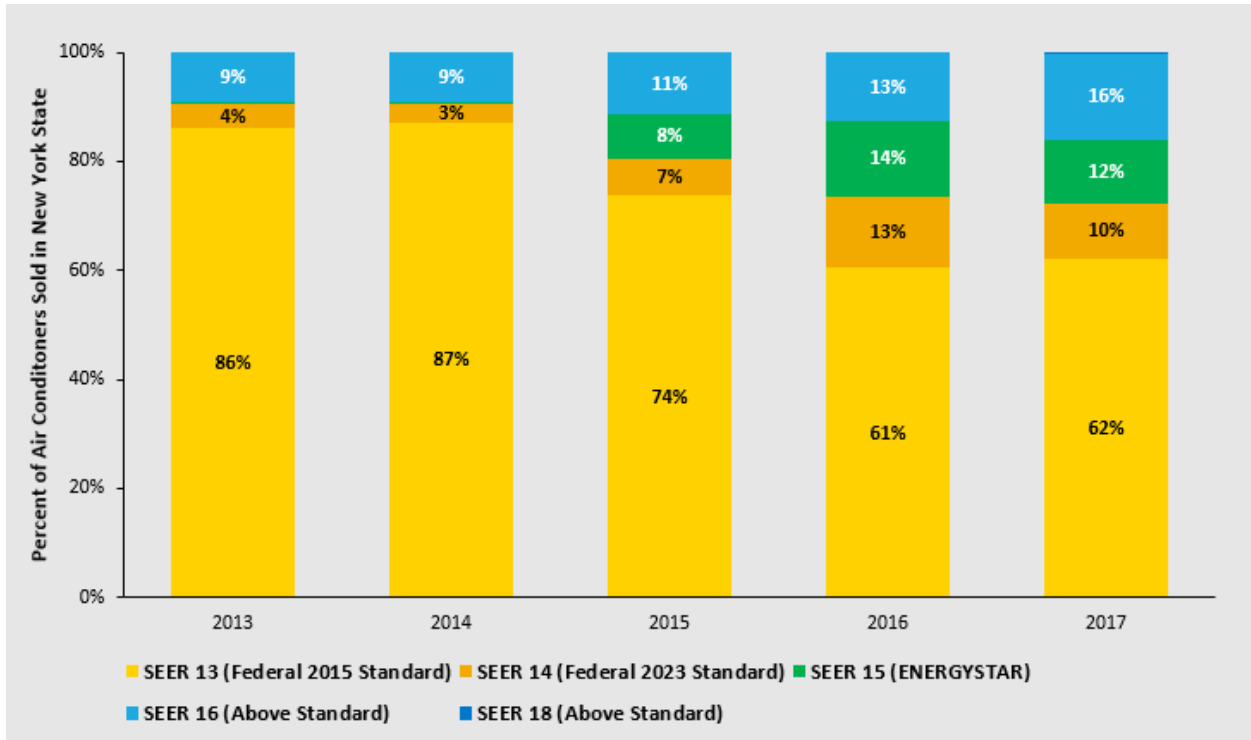
FIGURE 18. NUMBER OF CENTRAL AIR CONDITIONERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



Source: D+R HARDI Data

Statewide sales of high-efficiency central air conditioners—those with efficiency greater than the 2015 federal standard of the seasonal energy efficiency ratio/energy efficiency ratio (SEER/EER) of 13/11.2—increased each year between 2013 and 2016 and dipped only slightly in 2017. In 2013, high-efficiency central air conditioners made up 14% of total sales and, in 2017, accounted for 38% of sales (Figure 19). Of the 558,585 central air conditioners sold over the five-year period, 65% met the 2015 federal standard. The remaining 35% met either the 2023 federal standard or ENERGY STAR® specifications or were at or above a SEER/EER 16/13 level of efficiency.

FIGURE 19. PERCENTAGE OF CENTRAL AIR CONDITIONERS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



Source: D+R HARDI Data

It is important to note that these results are relevant for about half of the residential cooling equipment types. Table 7 compares cooling equipment found in existing and new homes, based on the 2019 RBSA. In summary, the 2019 RBSA found that 45% of existing homes have central air conditioning systems. A much higher percentage (77%) of new homes have central air conditioning. A significant portion of existing homes (40%) have room air conditioners, while fewer new homes (11%) cool with room air conditioners. More than 90% of homes use some type of cooling system.

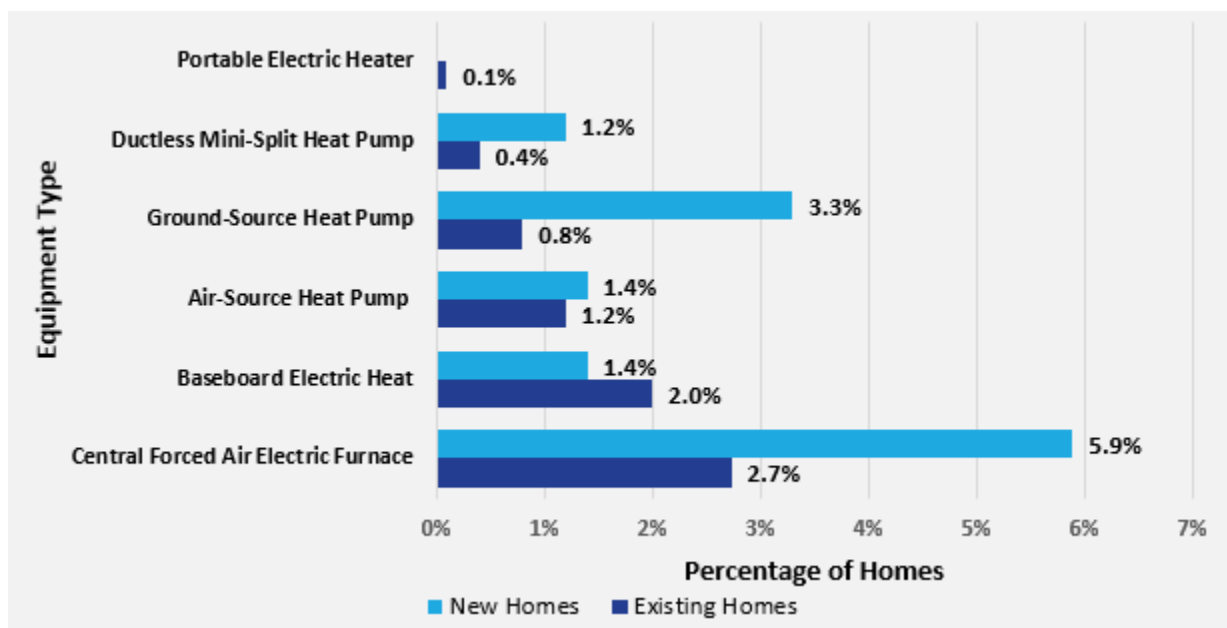
TABLE 7. COMPARING THE PRESENCE OF COOLING EQUIPMENT AND TYPE IN NEW AND EXISTING HOMES

Type	Existing Homes	New Homes
Central Air Conditioning System	44.9%	76.9%
Room or Window Air Conditioner	40.4%	11.0%
No Air Conditioning	9.7%	7.1%
Heat Pump	4.7%	4.9%
Other	0.3%	0.0%

## AIR-SOURCE HEAT PUMPS

The D+R HARDI data includes statistically valid annual sales summaries of ductless mini-split and air-source heat pumps. The summary does not include ground-source heat pumps or other electric heating systems like electric resistance baseboard heat and electric forced air furnaces. Figure 20 expands on the details presented in Figure 2, using RBSA data to compare inefficient (i.e., electric resistance) heating systems and heat pump systems in new and existing homes. Approximately 7% of existing homes and 12% of new homes are heated with electric heat. Although heat pumps are installed in more new homes (6%) than existing homes (2%), a greater percentage of new homes (7%) have systems with inefficient electric resistance heat.

FIGURE 20. COMPARISON OF SYSTEM TYPES BETWEEN ELECTRICALLY HEATED NEW AND EXISTING HOMES



Source: 2019 RBSA

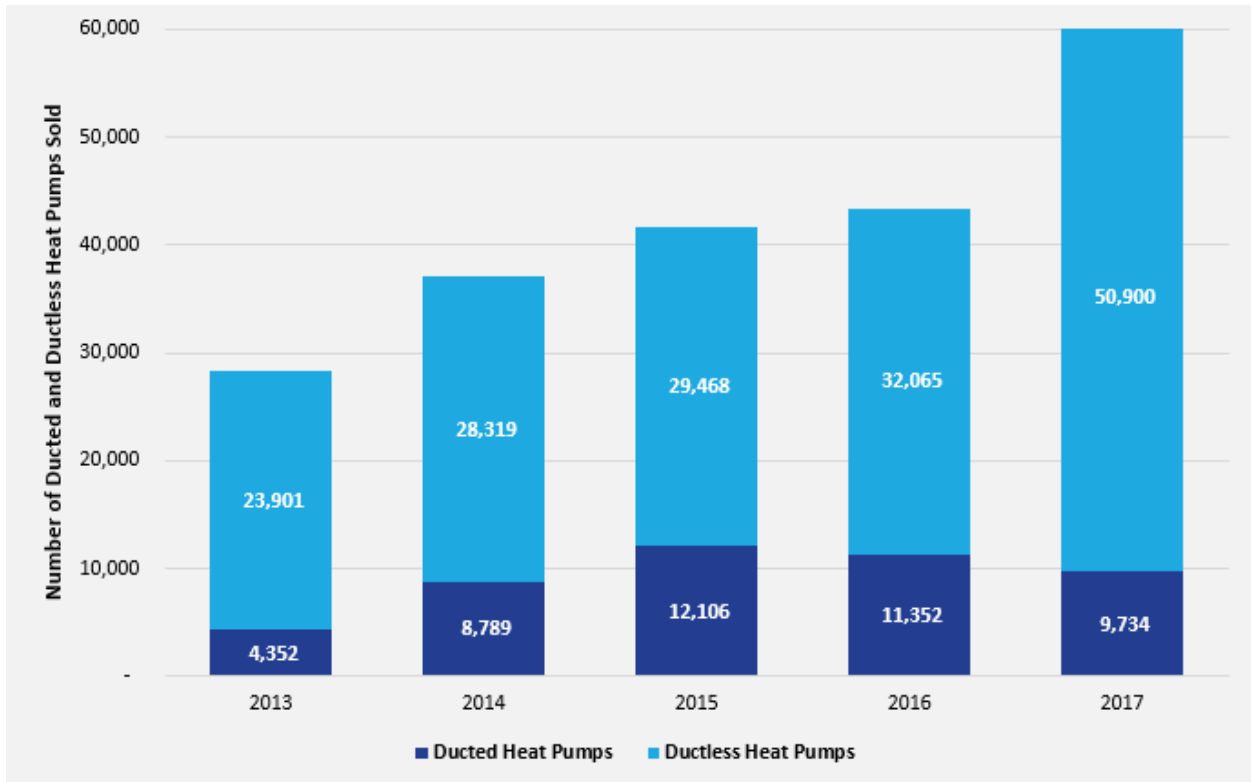
This section presents market size estimates and market penetration from D+R HARDI data of air-source heat pumps by efficiency tier, followed by the contractor survey findings on air-source heat pumps. Relevant findings from the market actor interviews are also included.

### Air-Source Heat Pump Sales and Efficiency Data

The sales volume of ducted and ductless air-source heat pumps is increasing (Figure 21). In 2017, twice as many ducted and ductless heat pumps were sold compared to 2013 for each technology. Four times as many ductless heat pumps than ducted heat pumps were sold between 2013 and 2017: 164,630 ductless heat pumps compared to 46,333 ducted heat pumps.

In line with these findings, most of the market actors Cadmus interviewed (two manufacturers and two distributors) also said that air-source heat pumps—in particular, ductless heat pumps—are one of the fastest growing markets in the state.

FIGURE 21. NUMBER OF DUCTED AND DUCTLESS HEAT PUMPS SOLD BETWEEN 2013 AND 2017

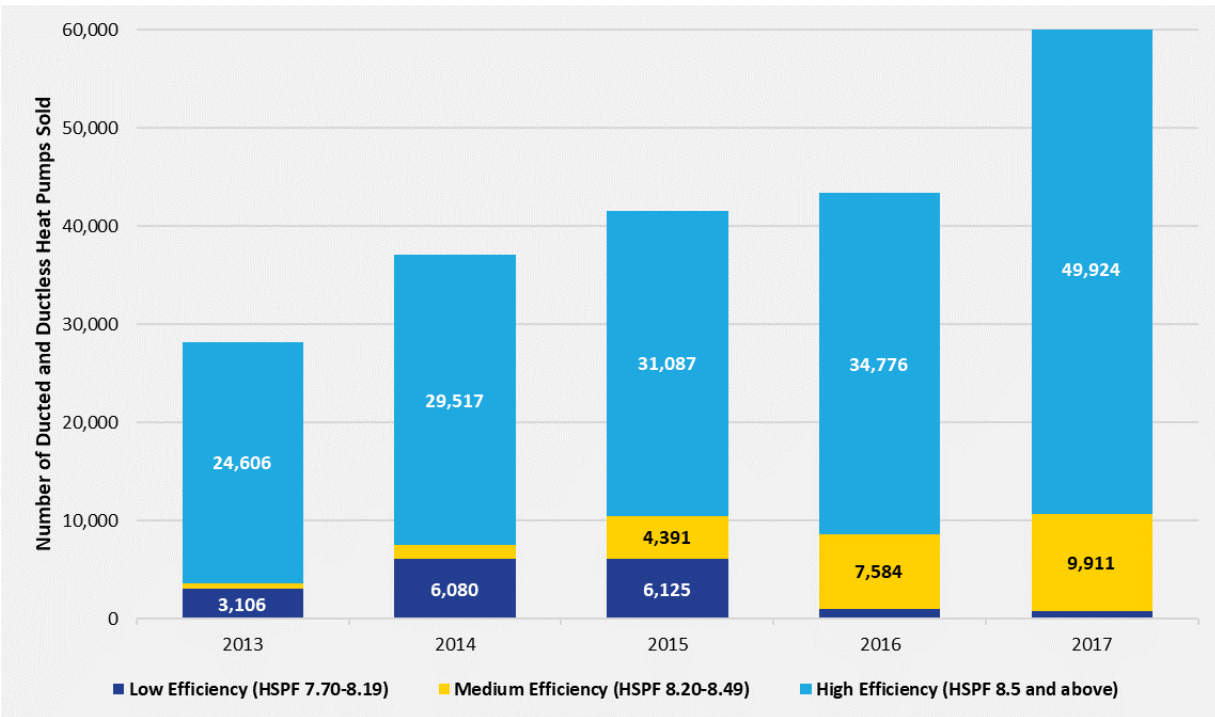


Source: D+R HARDI Data

As shown in Figure 22, the proportion of medium-efficiency heat pumps—ducted and ductless heat pumps with HSPF 8.20-8.49—sold in the state increased each year between 2013 and 2017. Sales of low-efficiency heat pumps—ducted and ductless heat pumps with HSPF 7.70-8.19—decreased sharply between 2015 (15% of total sales, n=41,603) and 2016 (2% of total sales, n=43,417).



FIGURE 22. NUMBER OF HEAT PUMPS (DUCTED AND DUCTLESS) SOLD BY EFFICIENCY TIER 2013 TO 2017



Source: D+R HARDI Data

### Ducted Heat Pumps

Twice as many ducted heat pumps were sold in 2017 than in 2013 (Table 8 and Figure 23). Between 2013 and 2017, a total of 46,333 ducted heat pumps were sold, with the highest sales volume in 2015.

Between 2013 and 2017, sales of low-efficiency (HSPF 7.70-8.19) ducted heat pumps decreased. In 2015, the federal standard for ducted air-source heat pumps changed to 8.2 HSPF. Accordingly, Table 8 and Figure 23 show a sharp decrease in sales of ducted heat pumps that did not meet the new standard in 2016. Six times as many heat pumps in the efficiency tier of 7.70-8.19 HSPF were sold in 2015 compared to 2016. There was also a corresponding uptick in sales of compliant units, especially in the next efficiency tier of 8.20-8.49 HSPF.

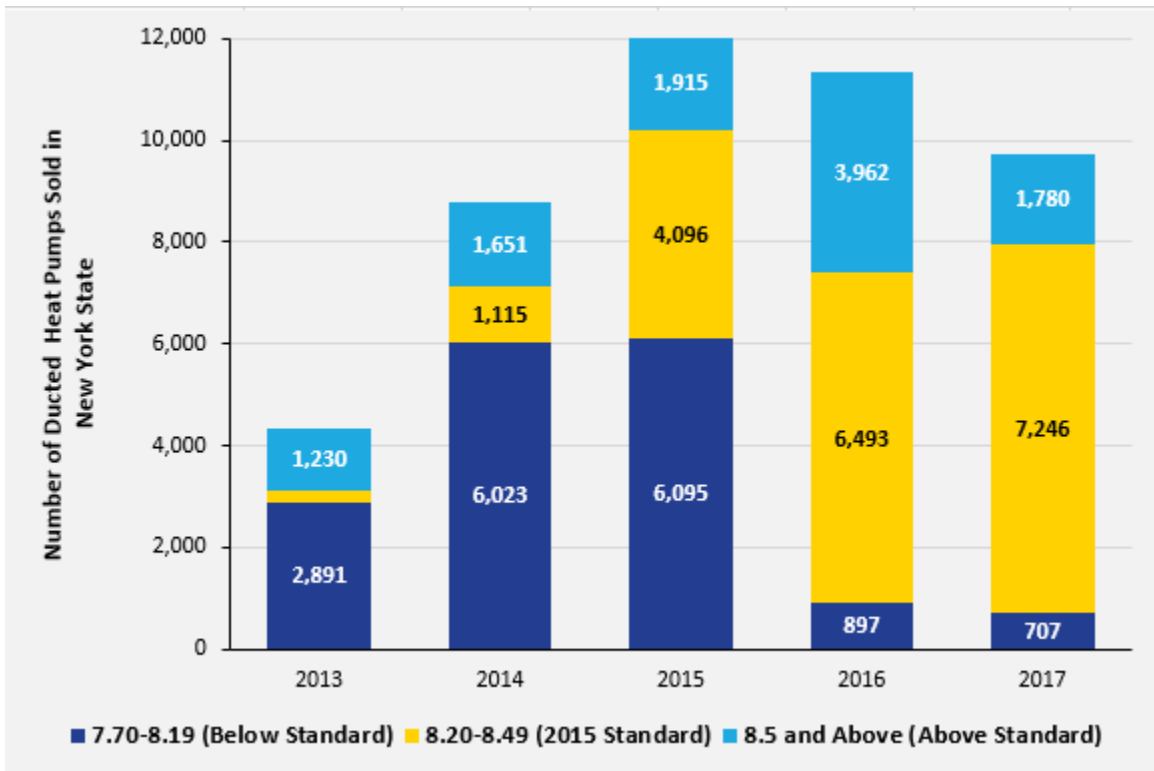
Sales of high-efficiency ducted heat pumps also increased in 2016: twice as many above-standard ducted heat pumps were sold in 2016 compared to 2015. This growth was driven largely by an increase in sales of heat pumps that were 11.00 HSPF or higher, the most efficient tier of ducted heat pumps. In 2017, the volume of above-standard heat pumps sold returned to the pre-2016 trend.

TABLE 8. NUMBER OF DUCTED HEAT PUMPS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017

Efficiency Tier	HSPF	2013	2014	2015	2016	2017
Below Standard as of 2015	7.70-8.19	2,891	6,023	6,095	897	707
Meets 2015 Federal Standard	8.20-8.49	230	1,115	4,096	6,493	7,246
	8.50-8.99	104	176	473	772	804
Above Standard	9.00-9.49	613	878	933	920	559
	9.50-9.99	52	202	97	216	80
	10.00-10.49	26	18	0	284	80
	10.50-10.99	0	0	0	91	0
	11.00+	435	378	412	1,680	257
<b>Total</b>		<b>4,352</b>	<b>8,789</b>	<b>12,106</b>	<b>11,352</b>	<b>9,734</b>

Source: D+R HARDI Data

FIGURE 23. NUMBER OF DUCTED HEAT PUMPS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



**Note:** Federal standards prohibit manufacturers from selling equipment below standard efficiency. Distributors may sell existing inventory. The D+R HARDI Data represents equipment sold by distributors.

**Source:** D+R HARDI Data

### Ductless Heat Pumps

Twice as many ductless heat pumps were sold in 2017 compared to 2013 (Table 9 and Figure 24). Over the five-year period, the number of ductless heat pumps sold increased each year, with the largest increase between 2016 and 2017. In 2017, NYSERDA began offering contractors incentives for installing air-source heat pumps. Between August 2017 and June 2019, more than 11,000 rebated air-source heat pump units were installed through the program, which may account for some of the increase in heat pump sales between 2016 and 2017.

Between 2013 and 2017, sales of low-efficiency (HSPF 7.70-8.19) ductless heat pumps decreased. Table 9 and Figure 24 show that most low-efficiency units were sold in 2013, and then sales dropped off between 2015 and 2016. Similar to ducted heat pumps, there was a corresponding uptick in sales of ductless heat pumps in most other efficiency tiers, especially in the highest efficiency tier of 11.00 HSPF and higher.

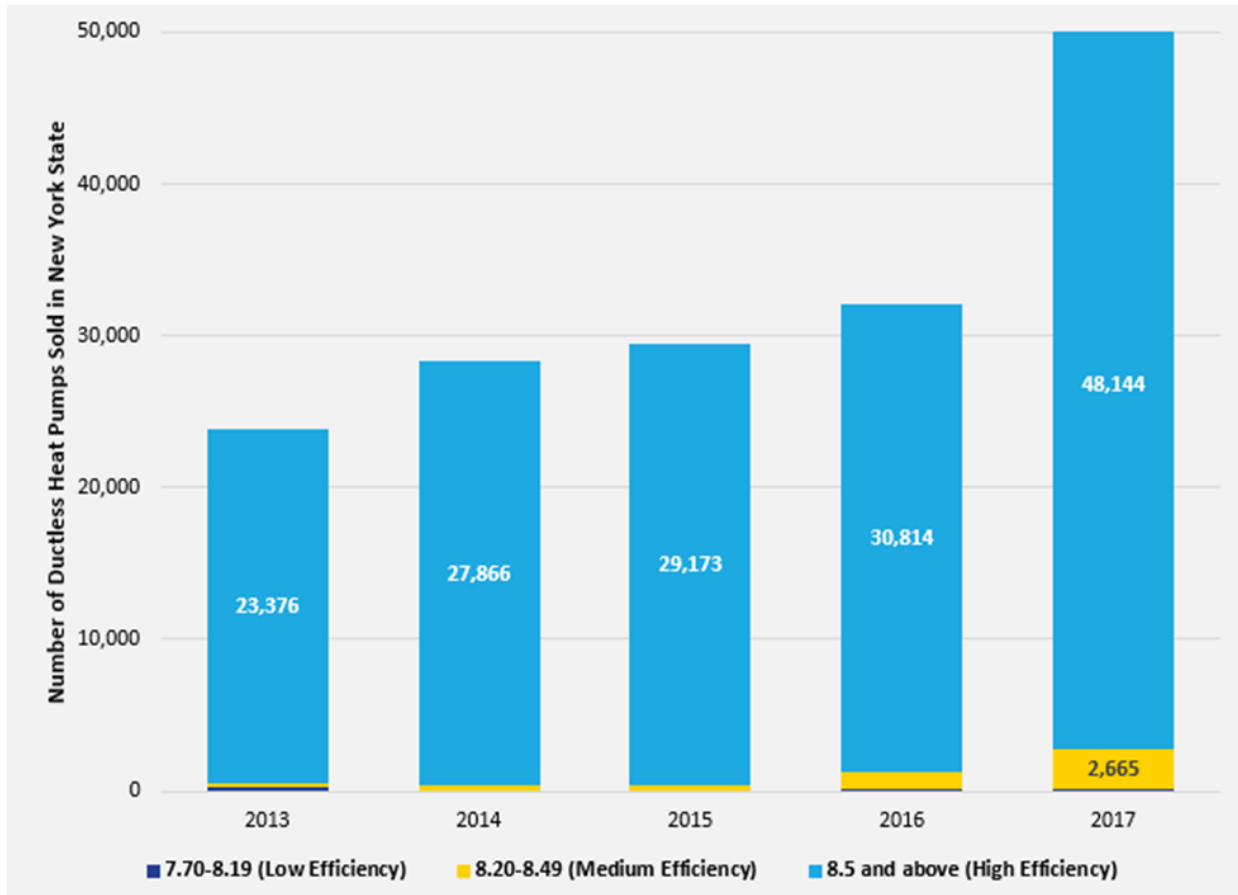
Sales of high-efficiency ductless heat pumps increased each year between 2013 and 2017 and increased dramatically in 2017. All high-efficiency tiers showed growth in 2017, but ductless heat pumps rated 11.00 HSPF or higher showed the largest gains, accounting for nearly 40% of the unit sales increase.

**TABLE 9. NUMBER OF DUCTLESS HEAT PUMPS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017**

Efficiency	HSPF	2013	2014	2015	2016	2017
Low Efficiency	7.70-8.19	215	57	29	160	91
Medium Efficiency	8.20-8.49	287	368	295	1,090	2,665
	8.50-8.99	1,934	1,586	1,386	1,699	3,041
High Efficiency	9.00-9.49	7,044	8,326	7,050	6,541	8,570
	9.50-9.99	4,274	5,211	5,103	4,649	6,841
	10.00-10.49	5,587	6,032	4,867	4,265	6,978
	10.50-10.99	1,767	1,586	1,504	3,303	5,894
	11.00+	2,770	5,126	9,262	10,357	16,820
<b>Total</b>		<b>23,877</b>	<b>28,291</b>	<b>29,497</b>	<b>32,065</b>	<b>50,900</b>

Source: D+R HARDI data

FIGURE 24. NUMBER OF DUCTLESS HEAT PUMPS SOLD BY EFFICIENCY TIER BETWEEN 2013 AND 2017



Source: D+R HARDI Data

## Contractor Survey Findings on Air-source Heat Pumps

### *Sales and Installations of Technology*

The surveyed contractors who sold or installed air-source heat pumps (n=50) reported selling or installing a combined total of 3,027 units in the past year, ranging from one to 1,000 units, with an average of 60.5 units and a median of 20 units.<sup>7</sup> Large contractors reported selling or installing a combined total of 2,526 units, ranging from two to 1,000 units, with an average of 81.5 units and a median of 20 units. Small contractors reported selling or installing a combined total of 501 units, ranging from one to 100 units, with an average of 26.4 units and a median of 15 units.

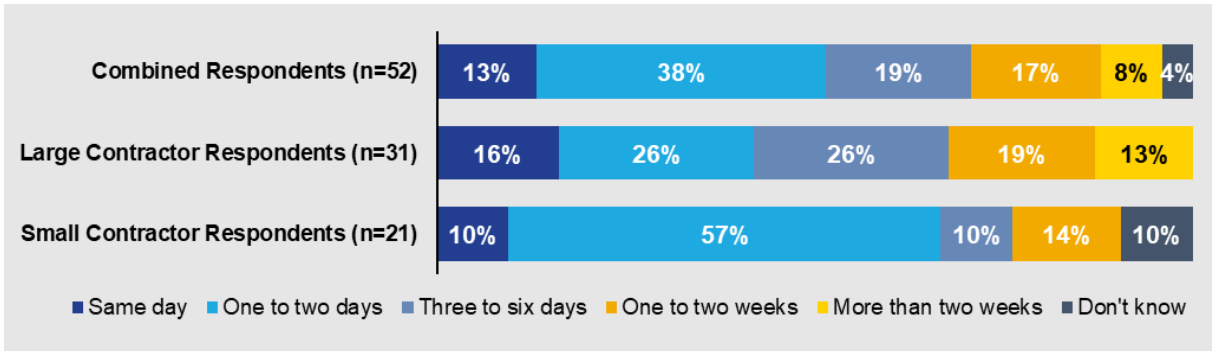
Of the 3,027 air-source heat pump units sold or installed in the past year by the surveyed contractors, approximately 1,619 units (56%) were cold climate air-source heat pumps. These made up a greater proportion of the units for large contractors (60%) than for small contractors (33%).

<sup>7</sup> The values reported are not weighted by contractor company size.

### Delivery Time of Technology

As shown in Figure 25, 51% of the respondents reported that delivery of air-source heat pumps to customers typically takes within two days, with 13% indicating same day and 38% one to two days. Large and small contractors reported different delivery timeframes, although sample sizes were too small to confirm the difference through statistical significance testing. Small contractors reported faster delivery times (67% within two days) than large contractors (42% within two days).

FIGURE 25. TIME IT TAKES TO DELIVER AIR-SOURCE HEAT PUMPS TO CUSTOMERS



**Note:** percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "How long would you say it typically takes to have an air-source heat pump delivered to the customer?"

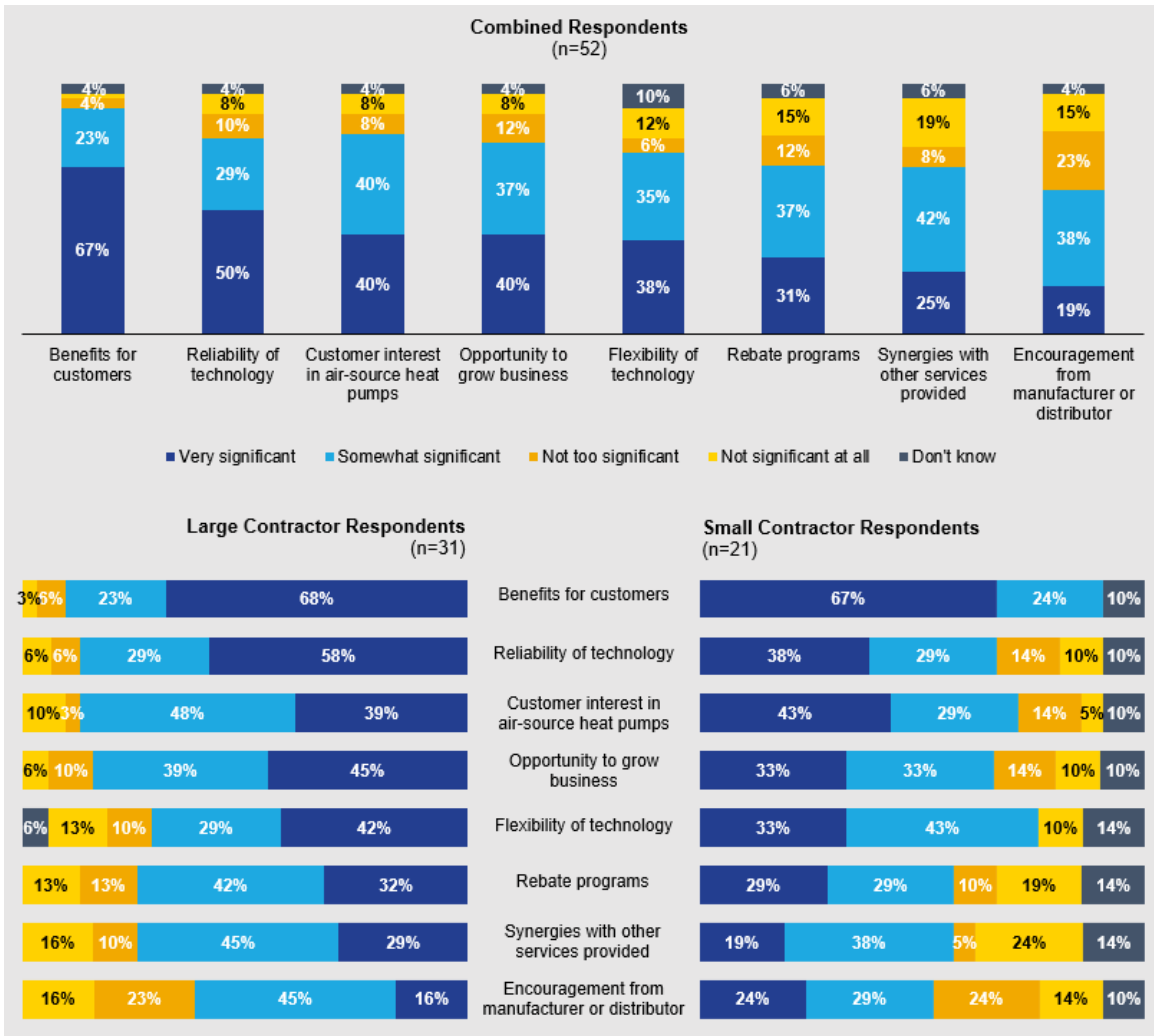
### Motivations to Install Technology

When asked to rate the significance of particular motivators for respondents to install air-source heat pumps, the top three were benefits for customers, customer interest in the technology, and the reliability of the technology. Note that two of these place emphasis on the customer (benefits for customers and customer interest).

Figure 26 shows that 90% of respondents rated benefits for customers as *significant*, with 67% specifically rating it as *very significant*. Eighty percent rated customer interest in air-source heat pumps as *significant*, with 40% specifically rating it as *very significant*. Seventy-nine percent of respondents rated reliability of technology as *significant*, with 50% specifically rating it as *very significant*.

Large and small contractors differed somewhat on their top three significant motivators. Benefits for customers emerged as the top motivator for both types of contractors. However, large contractors rated reliability of technology and opportunity to grow business as their other top motivators. Small contractors rated customer interest and reliability of technology as their other top motivators.

FIGURE 26. SIGNIFICANCE OF MOTIVATORS FOR CONTRACTORS TO INSTALL AIR-SOURCE HEAT PUMPS

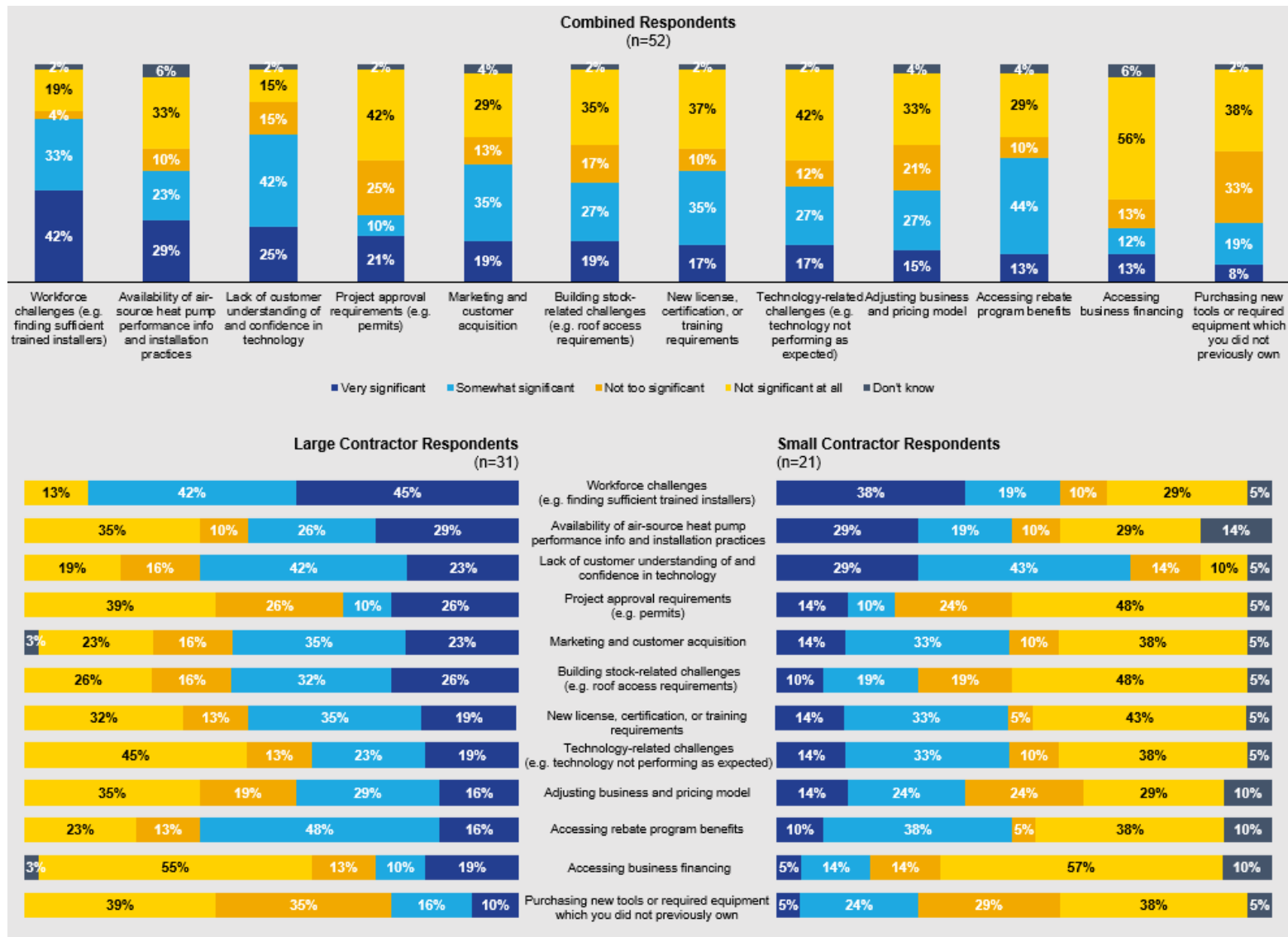


### Challenges to Implement Technology Among Contractors Who Install It

Workforce challenges, lack of customer understanding of and/or confidence in air-source heat pumps, and accessing rebate program benefits emerged as the top three significant challenges for contractors to implement air-source heat pumps. Figure 27 shows that 75% of respondents rated workforce challenges as *significant*, with 42% specifically rating it as *very significant*. Sixty-seven percent of respondents rated lack of customer understanding/confidence as *significant*, with 42% specifically rating it as *somewhat significant*. Fifty-seven percent of respondents rated accessing rebate program benefits as *significant*, with 44% specifically rating it as *somewhat significant*. Only workforce challenges received *very significant* ratings, whereas the other two challenges mostly received *somewhat significant* or *not significant at all* ratings.

Large and small contractors reported the same top three significant challenges—workforce challenges, lack of customer understanding/confidence, and accessing rebate program benefits. Notably, a greater proportion of large contractors tended to rate workforce challenges as significant (87%) than small contractors (57%), though sample sizes were too small to confirm the difference through statistical significance testing.

FIGURE 27. SIGNIFICANCE OF CHALLENGES FOR CONTRACTORS TO IMPLEMENT AIR-SOURCE HEAT PUMPS



Note: percentages shown are not weighted.

Source: HVAC contractor survey. Question, "Please rate how significant of a challenge each has posed to the successful operation of your air-source heat pump business. Tell me if it has been very significant, somewhat significant, not too significant, or not significant at all as a challenge for your business."



*Challenges to Implement Technology Among Contractors Who Do Not Install It*

Of the 72 surveyed contractors, 20 said their companies currently do not sell or install air-source heat pumps in single-family residential homes. Of these 20 respondents, six (30%) said they have considered offering air-source heat pumps to their residential customers but reported several significant challenges in their companies’ decision not to install air-source heat pumps. These challenges related to the workforce, lack of customer understanding of/confidence in air-source heat pumps, technology, purchasing new tools or required equipment, new license/certification/training, and project approval requirements.

Of the 20 respondents whose companies currently do not sell or install air-source heat pumps, 70% gave a variety of reasons for not offering it to their customers. Respondents mentioned startup costs involved with implementing a new technology, not having familiarity working with the new technology, customers lacking awareness/understanding of the technology, lack of confidence in the technology’s performance, and suitability for the customer (Table 10).

**TABLE 10. WHY SOME CONTRACTORS HAVE NOT CONSIDERED OFFERING AIR-SOURCE HEAT PUMPS**

Reason	Combined Respondents (n=14)	Large Contractor Respondents (n=2)	Small Contractor Respondents (n=12)
Cost to business of training, tools, and other startup costs to begin installing technology	6	1	5
Not our area of work or not equipped to do that kind of work	5	1	4
Lack of customer awareness and understanding	5	0	5
Lack of confidence in technology’s performance or suitability for my customers	4	0	4
Was not aware of the technology	2	0	2
Cost of technology for customers	2	0	2

**Note:** Multiple answers were allowed. Counts shown are not weighted.  
**Source:** HVAC contractor survey. Question, "Which of the following reasons reflect why your business has not considered offering air-source heat pumps?"

**WATER HEATERS**

Cadmus conducted surveys and interviews with HVAC market actors (contractors, distributors, manufacturers, and trade associations) to explore common practices in the residential water heater market. HARDI data were not available for water heaters, so Cadmus estimated the market penetration of water heater equipment and fuel types using the 2019 RBSA results. This section summarizes the RBSA findings and contractor survey findings pertaining to water heaters.

**RBSA Findings on Water Heaters**

2019 RBSA site visit data show that water heater fuel type differs between new homes and the existing residential building stock (Table 11). Although nearly the same percentage of new and existing homes have access to natural gas, approximately 67% of existing single-family homes throughout the state have natural gas water heaters compared to 56% of new homes. Electric water heaters are far more common

in new homes (26%) than in existing homes (14%). This is also true of propane water heaters—15% of new homes use propane compared to 5% of existing homes. Only 1.2% of the new construction homes have fuel oil water heaters, whereas 14% of existing homes have fuel oil water heaters.<sup>8</sup>

**TABLE 11. COMPARISON OF WATER HEATER FUEL TYPE IN NEW AND EXISTING HOMES**

Fuel Type	Existing Homes	New Homes
Natural Gas	66.6%	56.4%
Fuel Oil	13.6%	1.2%
Electricity	13.9%	26.0%
Propane	4.7%	15.3%
Kerosene	0.2%	0.0%

The RBSA survey showed another significant difference in water heater types installed in new homes. On-demand (tankless) water heaters are much more common in new homes, with 25.5% in new homes compared to 6.5% in existing homes. Heat pump water heaters are also more common in new homes (7.5%) than in existing homes (less than 1%).

Statewide, 74.6% of homes have a storage tank water heater. The second most common type (14%) is a water heater integrated with the home’s heating system (e.g., boiler with indirect hot water heating). The new efficiency standard for electric storage water heaters requires that units with a rated storage volume greater than 55 gallons must have a uniform energy factor (UEF) of approximately twice that of units less than 55 gallons. Consequently, larger electric units require a different type of technology—a heat pump water heater. Natural gas water heaters greater than 55 gallons also require significantly higher efficiency than smaller-capacity units, meaning larger systems must also use different technology (incorporating a condensing heat exchanger).<sup>9</sup>

The new standard, implemented in 2015, has had a modest impact on the efficiency requirement of water heaters less than 55 gallons. The 2019 RBSA found that relatively few storage water heaters throughout the state are large enough to be subject to the most stringent federal standards. RBSA site-visit data indicate that only 7% of all storage water heaters have a capacity of greater than 55 gallons, leaving most households unaffected by the new higher efficiency standards. For each natural gas storage water heater reported through the RBSA site visits, Cadmus calculated the unique federal minimum efficiency value according to the algorithms provided in the Code of Federal Regulations (Table 12).

<sup>8</sup> Based on RBSA survey data.

<sup>9</sup> This is a general statement about the differences in efficiency of water heaters. The Code of Federal Regulations (CFR) 430.32 includes additional details for sizes above and below 55 gallons. There are four draw patterns with varying efficiency requirements, and the natural gas water heaters with capacity less than 55 gallons do not definitively require standard combustion whereas water heaters above 55 gallons do not definitively require condensing technology.

TABLE 12. FEDERAL MINIMUM EFFICIENCY ALGORITHMS FOR GAS-FIRED STORAGE WATER HEATERS

Product Class	Rated Storage Volume and Input Rating (if Applicable)	Draw Pattern	UEF
Gas-fired Storage Water Heater	≥20 gal and ≤55 gal	Very Small	$0.3456 - (0.0020 \times V_r)$
		Low	$0.5982 - (0.0019 \times V_r)$
		Medium	$0.6483 - (0.0017 \times V_r)$
		High	$0.6920 - (0.0013 \times V_r)$
	>55 gal and ≤100 gal	Very Small	$0.6470 - (0.0006 \times V_r)$
		Low	$0.7689 - (0.0005 \times V_r)$
		Medium	$0.7897 - (0.0004 \times V_r)$
		High	$0.8072 - (0.0003 \times V_r)$

Table 13 lists the average efficiency of the natural gas storage water heaters more or less than 55 gallons from the 2019 RBSA. The table also includes the average UEF values based on the reported storage capacity for each draw pattern.<sup>10</sup> Because the most common water heater draw patterns are medium and high, they offer the best comparison to the average of the UEF recorded in the RBSA.

TABLE 13. COMPARISON OF STATEWIDE NATURAL GAS STORAGE WATER HEATER EFFICIENCY TO CURRENT FEDERAL STANDARD

Water Heater Capacity	RBSA Site Visit		RBSA Raw Data		Minimum UEF by Draw Pattern			
	Capacity	Manufactured Before 2015	Average EF	Average UEF	Very Small	Low	Medium	High
More than 55 gallons	7%	59%	0.60	0.62	0.26	0.52	0.57	0.64
Less than 55 gallons	93%	58%	0.65	0.69	0.60	0.73	0.76	0.78

These data show that the most predominant water heaters (less than 55 gallons) have an average UEF (0.69) within the range of the federal minimum efficiency criteria for units with medium- and high-draw patterns. In summary, most natural gas water heaters do not exceed the federal minimum efficiency criteria.

## Contractor Survey Findings on Water Heaters

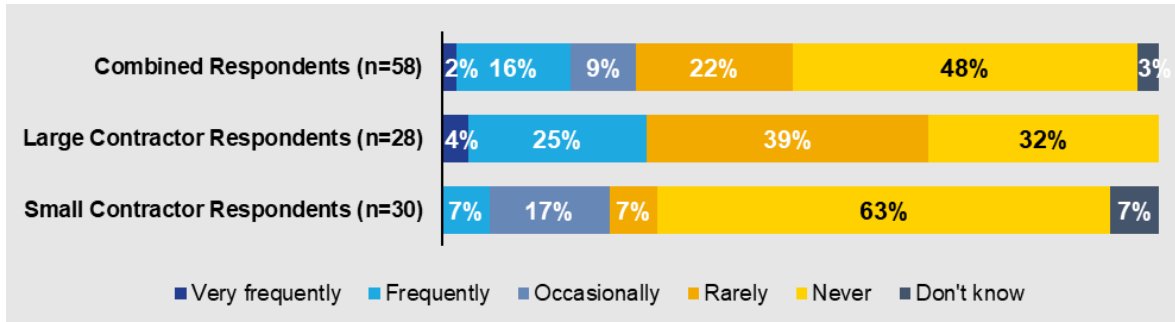
### Technology Recommendations

Of the surveyed contractors who installed water heaters often, most do not recommend a heat pump water heater to customers needing a new water heater. Figure 28 shows that 18% of respondents said they *very frequently* or *frequently* recommended a heat pump water heater, with 16% reporting that they *very frequently* recommend it. Large contractors tended to recommend a heat pump water heater

<sup>10</sup> U.S. Department of Energy test protocol established in 2017 replaces energy factor (EF) with UEF. EF and UEF are not directly comparable.

more often (29%) than small contractors (7%), although sample sizes were too small to confirm the difference through statistical significance testing.

**FIGURE 28. HOW OFTEN CONTRACTORS RECOMMEND A HEAT PUMP WATER HEATER TO CUSTOMERS**



**Note:** percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "For your customers in need of a new water heater, how often do you recommend a heat pump water heater?"

The 41 respondents who said they *rarely* or *never* recommend a heat pump water heater gave the following as their primary reasons: higher consumer cost than a conventional water heater, lack of familiarity with the technology, and poorer performance in cold climates compared to a conventional water heater. Table 14 lists all of the reasons given by the respondents. Large contractors most frequently cited higher consumer cost and lack of familiarity with the technology. Small contractors most frequently cited the lack of familiarity with the technology and cold climate performance.

**TABLE 14. WHY CONTRACTORS DO NOT RECOMMEND A HEAT PUMP WATER HEATER**

Reason	Combined Respondents (n=41)	Large Contractor Respondents (n=20)	Small Contractor Respondents (n=21)
More expensive to the consumer than conventional water heaters	32%	35%	29%
Not familiar with the technology	27%	20%	33%
Does not perform as well in cold climates than conventional water heaters	22%	10%	33%
More complex to install than conventional water heaters	12%	5%	19%
Customer tends to stick with existing equipment	10%	10%	10%
Not as energy efficient as natural gas	7%	10%	5%
Takes longer to install than conventional water heaters	7%	5%	10%
Not as readily available as conventional water heaters	7%	5%	10%
Does not work well in small, confined spaces	7%	5%	10%

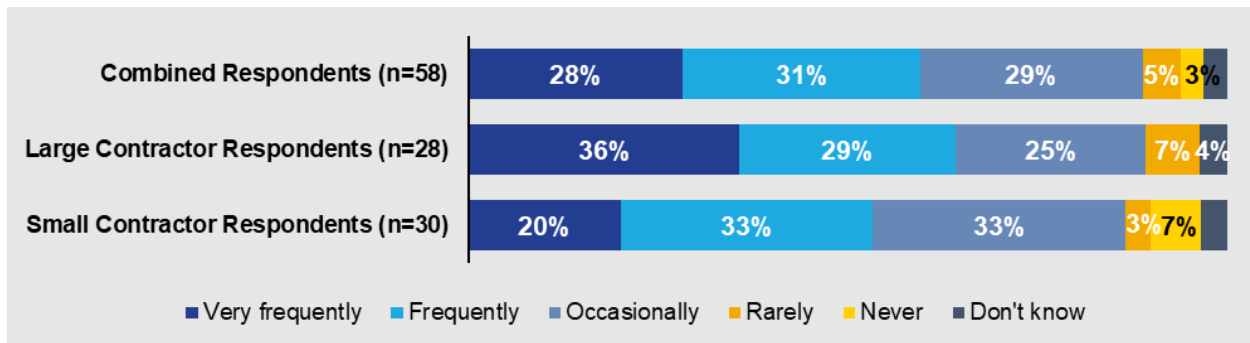
**Note:** Multiple answers were allowed. Percentages may add up to more than 100%. Percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "What are the main reasons you rarely or never recommend heat pump water heaters?"

### Early Replacement

The majority of the surveyed contractors who installed water heaters said they often recommend that customers with an old but still functioning unit replace their existing system prior to failure. As shown in Figure 29, 59% of respondents said they *very frequently* or *frequently* recommended an early replacement, with 31% reporting that they *frequently* recommended it. Large contractors tended to recommend an early replacement more often (65%) than small contractors (53%), although sample sizes were too small to confirm the difference through statistical significance testing.

FIGURE 29. HOW OFTEN CONTRACTORS RECOMMEND WATER HEATER REPLACEMENT PRIOR TO FAILURE TO CUSTOMERS



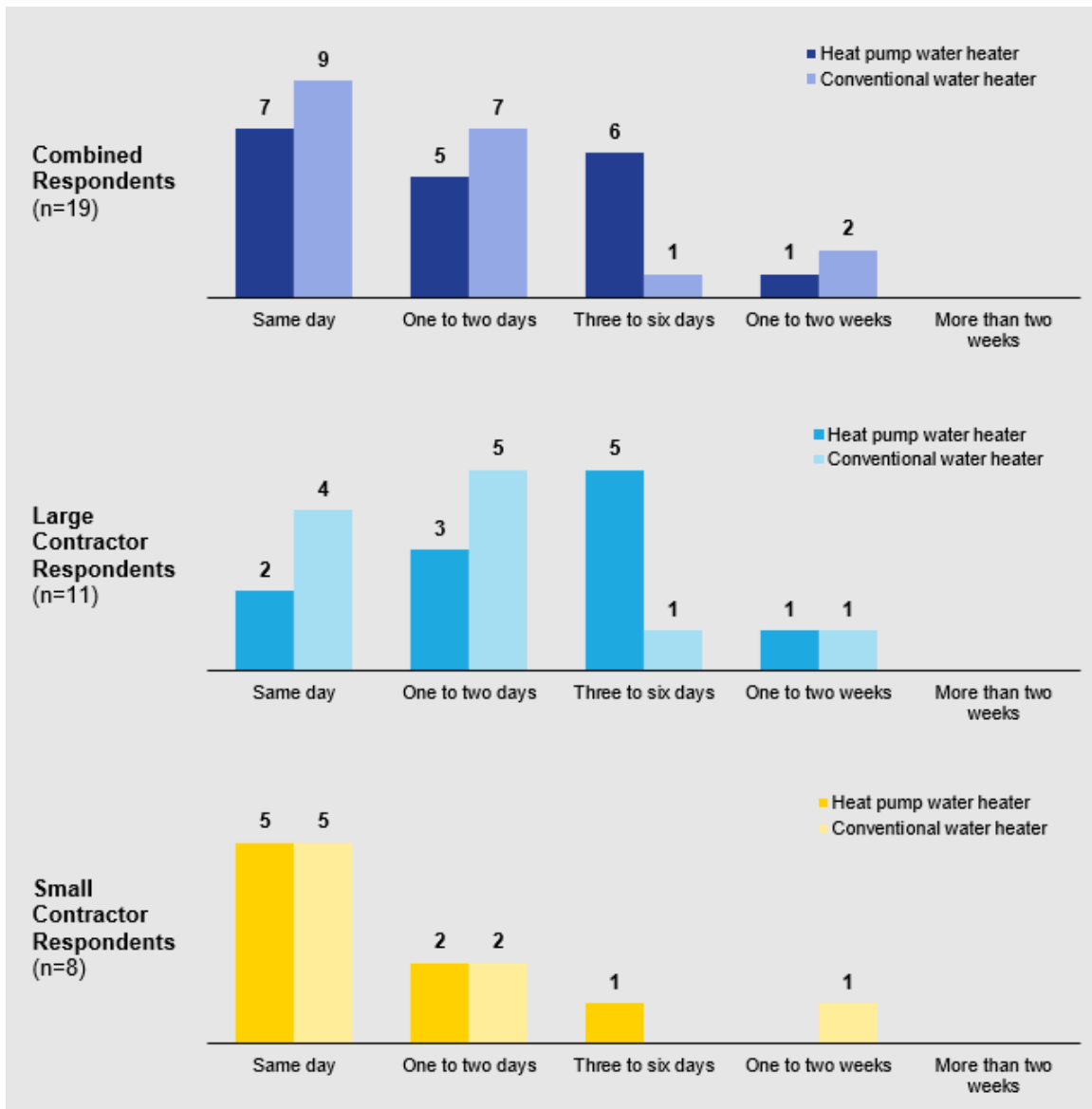
Note: Percentages shown are not weighted.

Source: HVAC contractor survey. Question, "How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning water heater replace their existing system prior to failure?"

### Delivery Time of Technology

Figure 30 shows that respondents reported slightly different delivery times between a heat pump water heater and a conventional water heater, although the sample size of respondents was very small and therefore responses cannot be generalized to the population. Twelve respondents reported that heat pump water heaters are typically delivered to customers within two days, and 16 respondents reported that conventional water heaters are typically delivered within two days. Small contractors reported faster delivery times than large contractors for both types of water heaters. Furthermore, small contractors reported more uniform delivery times between the two types of water heater.

FIGURE 30. TIME IT TAKES TO DELIVER WATER HEATERS TO CUSTOMERS



**Note:** Percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "How long would you say it typically takes to have a heat pump water heater/conventional water heater delivered to the customer?"

## RENEWABLE HEATING AND COOLING

This section includes market penetration of renewable heating and cooling technologies, based on RBSA data. The technologies are ground-source heat pumps, biomass boilers, solar space and domestic hot water heating, and wood pellet stoves. This section also summarizes the contractor survey findings pertaining to renewable heating and cooling. Relevant findings from market actor interviews are also included.

## RBSA Findings on Renewable Heating and Cooling

The 2019 RBSA found low penetration of renewable heating and cooling technologies. Approximately 1% of existing homes and 3% of new construction homes have a ground-source heat pump, 0.4% of existing homes and 0.6% of new construction homes use a wood pellet stove as the primary source of heat, and 0.2% of homes statewide have a solar water heater (used for heating domestic hot water). None of the homes sampled in the RBSA had a biomass boiler or a solar water heater for space heating.

## Contractor Survey Findings on Renewable Heating and Cooling

### *Technology Considerations*

Of the 72 surveyed contractors, 33% reported installing or selling renewable heating and cooling technologies.<sup>11</sup> Of the contractors who did not install or sell any of these technologies (n=44), 23% have considered offering renewable heating and cooling technologies to their customers. Large and small contractors appeared to differ: 28% of large contractors (n=18) and 19% of small contractors (n=26) have considered renewable technologies. However, the sample size was too small to confirm the difference through statistical significance testing.

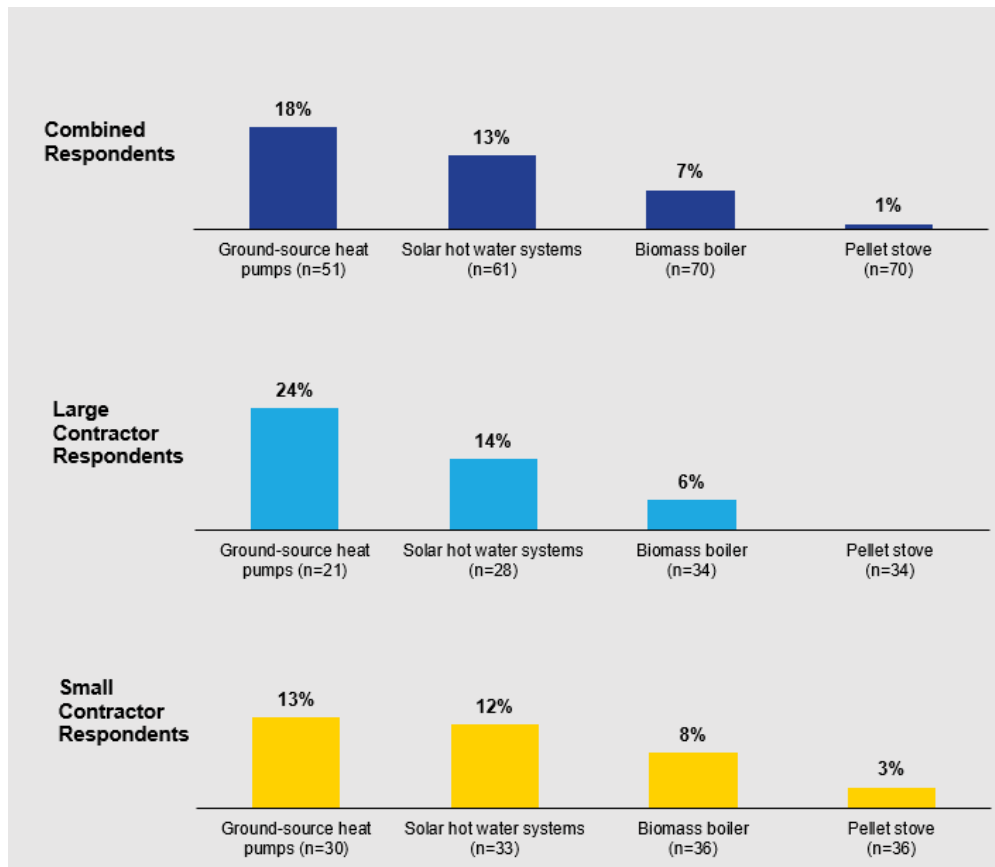
Of the four renewable technologies shown in Figure 31, ground-source heat pumps received the highest proportion of consideration from contractors (18%) and pellet stoves the least (1%). Large contractors tended to show more consideration for ground-source heat pumps than for the other three technologies. Small contractors tended to show similar proportions of consideration across the four technologies.

The two distributors Cadmus interviewed said that they do not commonly sell biomass systems. They noted that this equipment is more likely to be sold through hearth/fireplace businesses or hardware stores that likely source the equipment outside of the typical distribution models rather than through traditional HVAC contractors.

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<sup>11</sup> This percentage is weighted by contractor company size.

FIGURE 31. PROPORTION OF CONTRACTORS CONSIDERING OFFERING RENEWABLE TECHNOLOGIES



**Note:** Percentages may add up to more than 100% because respondents gave answers on each applicable technology. Percentages shown are not weighted except for the category none of technologies considered for combined respondents.

**Source:** HVAC contractor survey. Question, "Of the following technologies, which, if any, have you considered offering to your customers?"

### *Contractor Challenges to Implementing Technology*

Table 15 shows the various challenges for the eight contractors who have considered renewable technology. Although there were very few respondents, challenges tended to differ by technology. Contractors who have considered offering ground-source heat pumps frequently mentioned challenges with purchasing new tools, the workforce, and new administrative requirements. Contractors who have considered offering solar hot water systems frequently mentioned challenges with the workforce and acquiring new licenses. Contractors who have considered offering biomass boilers frequently mentioned challenges with adjusting the business and pricing model, marketing, and customer acquisition.



TABLE 15. CHALLENGES TO CONTRACTORS CONSIDERING TO OFFER RENEWABLE TECHNOLOGIES

Challenge	Respondents Considering Ground-Source Heat Pumps (n=8)	Respondents Considering Solar Hot Water System (n=6)	Respondents Considering Biomass Boiler (n=3)
Purchasing new tools or required equipment which you did not previously own	7	0	1
Workforce challenges (e.g., finding sufficient trained installers)	6	3	1
New project-related administrative requirements (i.e., project permits and/or rebates)	5	1	1
Acquiring new licensing specific to ground-source heat pump installation	4	3	0
Completing new trainings or certifications specifically for ground-source heat pump installation	4	2	1
Adjusting business and pricing model	4	1	3
Marketing and customer acquisition	4	1	3
Accessing business financing	4	0	0
Other	1	2	0

**Note:** Multiple answers were allowed. Counts shown are not weighted. None of the respondents who answered this question were considering pellet stoves.

**Source:** HVAC contractor survey. Question, "Which of the following posed a challenge to your business or otherwise prevented you from deciding to install ground-source heat pumps?"

# Additional Supply Chain Insights

The following section summarizes HVAC contractor survey findings about energy efficiency program awareness, perceived value of energy efficiency, quality installation and maintenance practices, and training and certification trends. When applicable, Cadmus compared these survey findings to those from the 2015 RSBS.

## ENERGY EFFICIENCY AWARENESS AND VALUE

More contractors were familiar with the energy efficiency programs offered by electric and natural gas utilities in New York State than by NYSERDA. A significantly higher proportion of respondents said they were *very familiar* or *somewhat familiar* with utility programs (80%) than with NYSERDA programs (53%).<sup>12</sup>

Familiarity with programs differed by large and small contractors. In particular, a significantly higher proportion of large contractors (74%) than small contractors (49%) were familiar with NYSERDA programs.<sup>13</sup> A significantly higher proportion of small contractors were familiar with utility programs (79%) compared to NYSERDA programs (49%).<sup>14</sup>

Due to differences in the survey question design, comparisons in energy efficiency program awareness cannot be made between the current study and the previous study. In the 2015 RSBS, 93% of large contractors and 63% of small contractors were familiar with energy efficiency programs in New York State. The 2015 RSBS survey did not distinguish between utility programs and NYSERDA programs. Figure 32 shows the full breakdown of contractor responses in the 2019 RBSA.

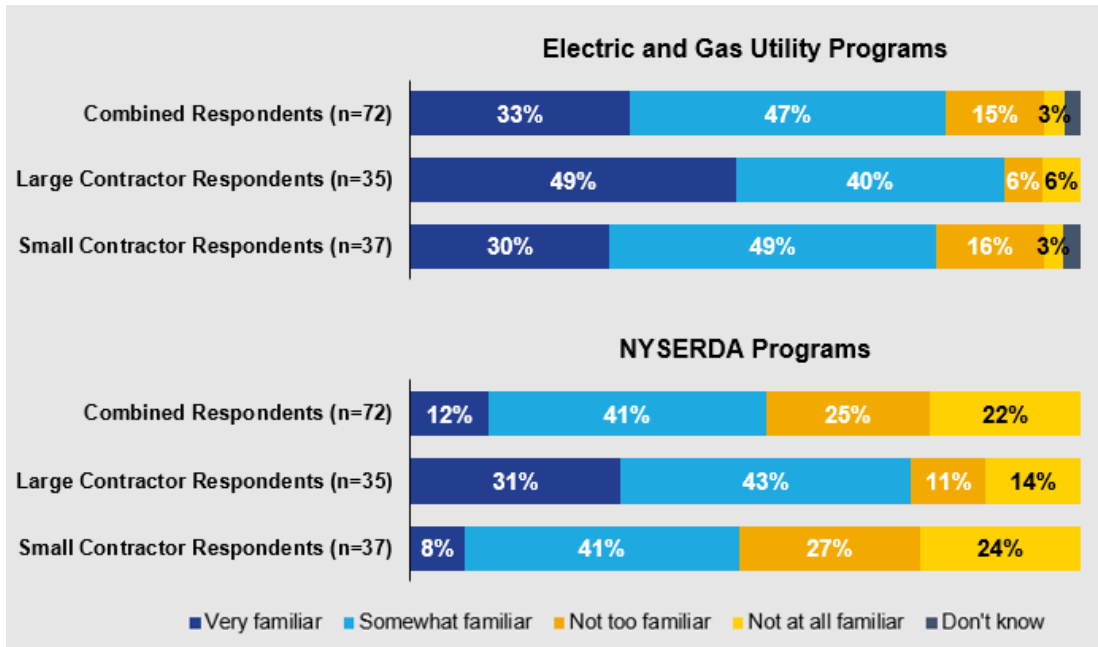
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<sup>12</sup> The difference is significant at the 95% level ( $p \leq 0.05$ ).

<sup>13</sup> The difference is significant at the 90% level ( $p \leq 0.10$ ).

<sup>14</sup> The difference is significant at the 95% level ( $p \leq 0.05$ ).

FIGURE 32. CONTRACTOR FAMILIARITY WITH ENERGY EFFICIENCY PROGRAMS



**Note:** Percentages for combined respondents are weighted by contractor company size.  
Percentages for large and small contractor respondents are not weighted.

**Source:** HVAC contractor survey. Question, "How familiar are you with programs offered by electric and gas utilities in New York State/NYSERDA to promote energy efficient HVAC and water heating equipment?"

For most contractors, less than half of their HVAC and water heating installations in the past year received a rebate. Respondents reported, on average, that 28% of their installations received a rebate from NYSERDA or a utility program, and 15% of their installations received a rebate from manufacturers (Table 16). Although large contractors tended to show a higher proportion of rebated installations than small contractors, the differences were not statistically significant. On average, large contractors reported 39% of rebated installations and small contractors reported 25.5% of rebated from NYSERDA or a utility program.

TABLE 16. PROPORTION OF CONTRACTOR'S HVAC AND WATER HEATING INSTALLATIONS THAT RECEIVED A REBATE

Statistic		Combined Respondents	Large Contractor Respondents	Small Contractor Respondents
Proportion of installations that received a rebate from NYSERDA or utility program	Mean	28%	39%	25.5%
	Median	13%	30%	10%
	Range	0% - 100%	0% - 100%	0% - 100%
	Count (n)	71	35	36
Proportion of installations that received a rebate from manufacturer	Mean	15%	23.5%	13.5%
	Median	2%	10%	0%
	Range	0% - 100%	0% - 100%	0% - 100%
	Count (n)	71	34	37

**Note:** Percentages for combined respondents are weighted by contractor company size. Percentages for large and small contractor respondents are not weighted.

**Source:** HVAC contractor survey. Question, "In the past year, approximately what percent of the HVAC and water heating equipment you sold and installed in New York State received a rebate through a NYSERDA or utility incentive program?" "in the past year, approximately what percent of the HVAC and water heating equipment you sold and installed in New York state received a manufacturer rebate?"

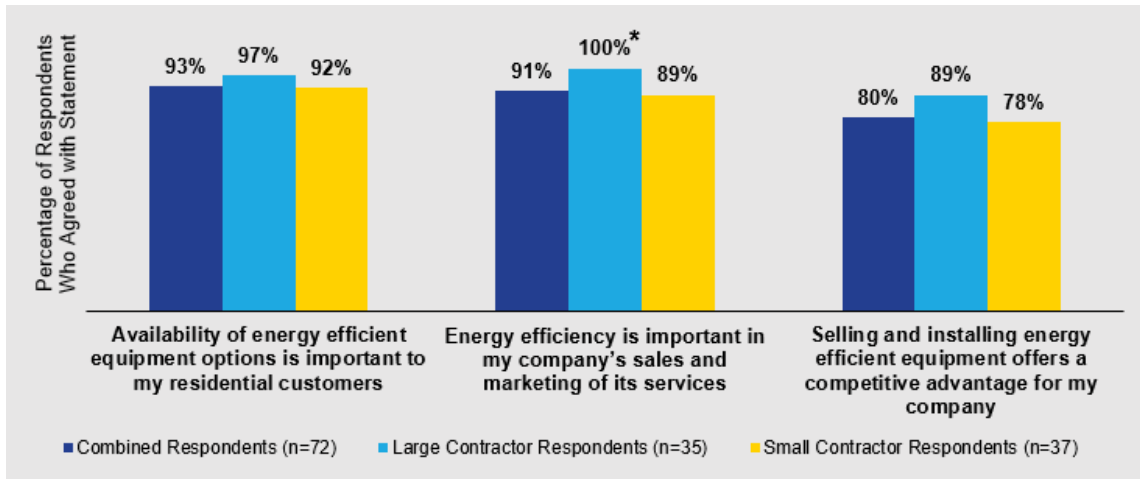
The vast majority of contractors perceive energy efficiency as valuable for their customers and business. As shown in Figure 33, most contractors agreed with the following statements about energy efficiency:

- Availability of energy-efficient equipment options is important to my residential customers (93% agreed)
- Energy efficiency is important in my company's sales and marketing of its services (91% agreed)
- Selling and installing energy-efficient equipment offers a competitive advantage for my company (80% agreed)

A large majority of large and small contractors agreed with all three statements. A significantly higher proportion of large contractors (100%) than small contractors (89%) agreed with the second statement that energy efficiency is important to the company's sales and marketing.<sup>15</sup>

<sup>15</sup> The difference is significant at the 90% level ( $p \leq 0.10$ ).

FIGURE 33. CONTRACTOR AGREEMENT WITH STATEMENTS ABOUT ENERGY EFFICIENCY



**Note:** Percentages for combined respondents are weighted by contractor company size. Percentages for large and small contractor respondents are not weighted. An asterisk (\*) denotes that the difference between large and small contractors is significant at the 90% level ( $p \leq 0.10$ ).

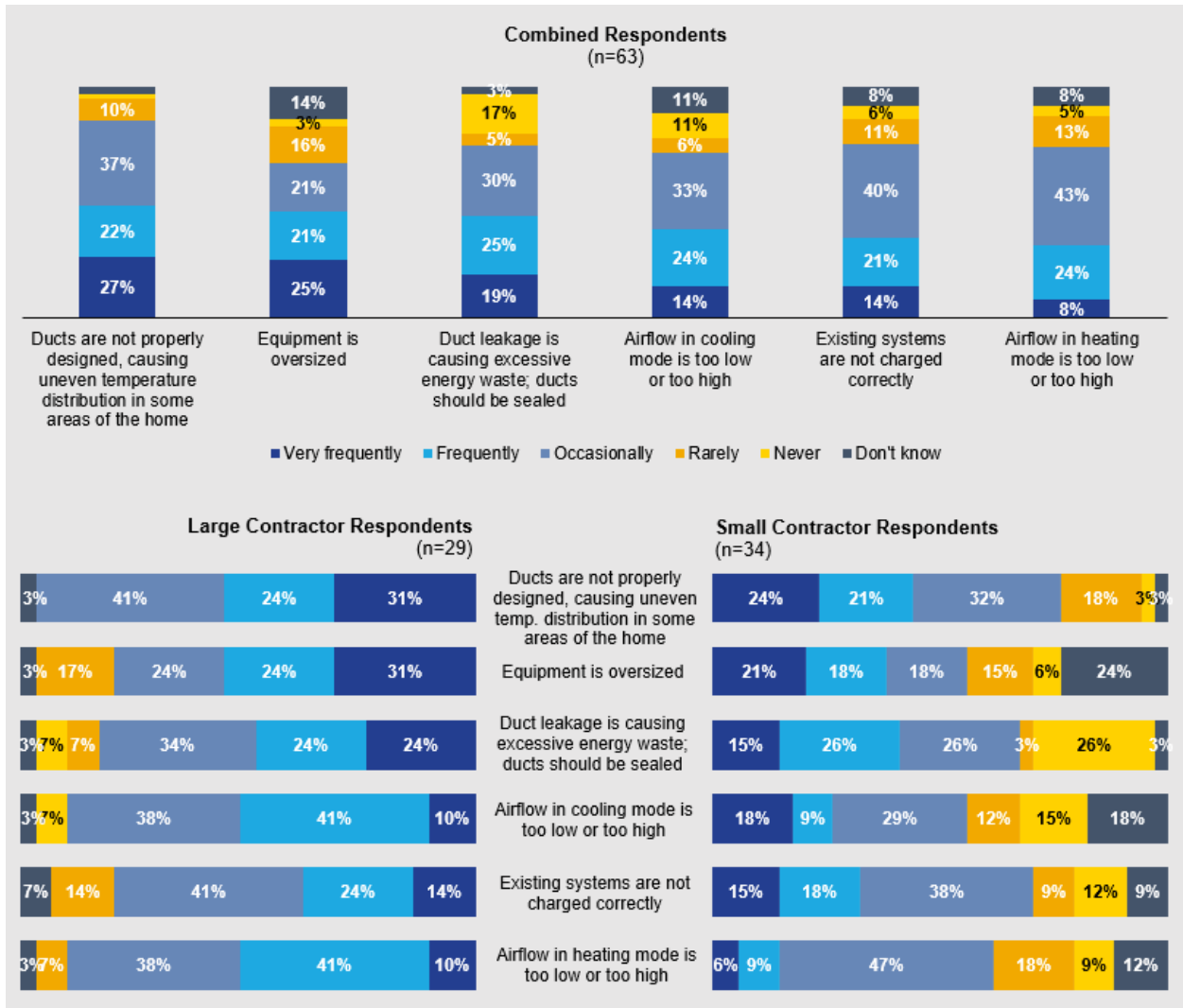
**Source:** HVAC contractor survey. Question, "For each of the following statements, please tell me if you strongly agree, somewhat agree, somewhat disagree, or strongly agree."

## QUALITY INSTALLATION AND MAINTENANCE

Of the 70 surveyed contractors who installed HVAC systems, 84% reported that they perform maintenance on existing systems installed by other HVAC companies. These respondents often found issues with improperly designed ducts, oversized equipment, and duct leakage. As shown in Figure 34, 49% of contractors said they *very frequently* or *frequently* encountered ducts that were not properly designed, with 27% indicating this happens *very frequently*. Forty-six percent said they *very frequently* or *frequently* encountered equipment that was oversized, with 25% indicating this happens *very frequently*. Forty-four percent said they *very frequently* or *frequently* encountered duct leakage, with 19% indicating this happens *very frequently*.

Large and small contractors appeared to encounter issues with installations completed by other HVAC companies at different frequencies. Large contractors tended to encounter issues more often than did small contractors across all categories, although sample sizes were too small to confirm the difference through statistical significance testing. As shown in Figure 34, the occurrence of encountering an issue *very frequently* or *frequently* tended to be even across categories for large contractors; this was less even for small contractors.

FIGURE 34. OCCURRENCE OF ISSUES WHEN CONTRACTORS PERFORM MAINTENANCE ON INSTALLATIONS COMPLETED BY ANOTHER HVAC COMPANY



**Note:** Percentages shown are not weighted.

**Source:** HVAC contractor survey. Question, "When you go into a home to perform maintenance of an existing system installed by another HVAC company, how often do you encounter the following maintenance or installation issues?"

Besides the issues listed in Figure 34, contractors also reported encountering issues with poor- or low-quality installation practices (49%), general equipment sizing (17%), and dirty parts (15%), as shown in Table 17. In particular, a greater proportion of small contractors reported that they encountered poor- or low-quality installation practices (60%) compared to large contractors (38%). On the other hand, a greater proportion of large contractors reported that they encountered dirty parts (24%) compared to small contractors (5%). The differing frequencies of issues observed between large and small contractors in Figure 34 and Table 17 suggest that contractors may not have similar views about quality installation and maintenance.

TABLE 17. OTHER COMMON ISSUES OBSERVED WHEN CONTRACTORS PERFORM MAINTENANCE ON INSTALLATIONS COMPLETED BY ANOTHER HVAC COMPANY

Common Issue	Combined Respondents (n=41)	Large Contractor Respondents (n=21)	Small Contractor Respondents (n=20)
Poor installation practices/low quality of work	49%	38%	60%
Equipment sizing issue (undersized or oversized)	17%	10%	25%
Failure to clean (dirty filters and coils)	15%	24%	5%
Inconvenient location or not enough service area access	10%	14%	5%
Poor quality of materials used	5%	10%	0%
Other unique responses	5%	5%	5%

**Note:** Multiple mentions were allowed. Percentages may add up to more than 100%. Percentages shown are not weighted.  
**Source:** HVAC contractor survey. Question, "Are there any other common maintenance or installation issues you see when performing maintenance of an existing system installed by another company?"

## TRAINING AND CERTIFICATION

The majority of HVAC companies require their technicians to attend training on energy efficiency, quality maintenance, or quality installation. Of the 70 surveyed contractors, 60% reported that their companies require their technicians to attend training.<sup>16</sup> Notably, a significantly higher proportion of large contractors (82%) said their companies require training compared to small contractors (56%).<sup>17</sup>

Respondents frequently specified that their technicians attended training from manufacturers (79%) and utilities (25%). Specifically, respondents who indicated manufacturers most frequently mentioned receiving installation and servicing training from Mitsubishi, Carrier, Daikin, Fujitsu, and Trane. Large contractors more frequently specified training from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and the Air Conditioning Contractors of America (ACCA), while small contractors more frequently specified training from supply houses (Table 18).

Less than half of HVAC companies require their technicians to obtain industry certification. Of the 70 surveyed contractors, 42% reported that their company require that their technicians obtain industry certification.<sup>18</sup> Notably, a significantly higher proportion of large contractors (76%) than small contractors (36%) require certification.

<sup>16</sup> This percentage is weighted by contractor company size.

<sup>17</sup> The difference is significant at the 95% level ( $p \leq 0.05$ ).

<sup>18</sup> This percentage is weighted by contractor company size.

Respondents frequently specified that their technicians obtained certification from the U.S. Environmental Protection Agency (67%), North American Technician Excellence (44%), and manufacturers (36%).

TABLE 18. HVAC CONTRACTOR TRAINING, CERTIFICATION, AND MARKETING TRENDS

Survey Question	2015 Survey			2019 Survey		
	Combined Contractors	Large Contractors	Small Contractors	Combined Contractors	Large Contractors	Small Contractors
Firm requires HVAC technicians attend trainings on energy efficiency, quality maintenance, or installation?	82.5% said yes (n=40)	87% said yes (n=15)	80% said yes (n=25)	60%* said yes (n=70) ▼	82% said yes (n=34) ▼	56% said yes (n=36) ▼
From what organizations?	67.5% mfrs. 5% ACCA 5% utilities 2.5% AHRI (n=40)	60% mfrs. 13% ACCA 13% utilities 7% AHRI (n=15)	72% mfrs. 0% ACCA 0% AHRI 0% utilities (n=25)	79% mfrs. 25% utilities 17% AHRI 12% ACCA 10% supply houses (n=48)	86% mfrs. 36% utilities 21% AHRI 21% ACCA 18% supply houses (n=28)	70% mfrs. 25% supply houses 10% utilities 10% AHRI 0% ACCA (n=20)
Firm requires HVAC technicians obtain industry certification?	67.5% said yes (n=40)	93% said yes (n=15)	52% said yes (n=25)	42%* said yes (n=70) ▼	76% said yes (n=34) ▼	36% said yes (n=36) ▼
What types of certifications?	12.5% EPA HVAC 7.5% NATE 2.5% BPI 40% other (n=40)	27% EPA HVAC 7% NATE 7% BPI 47% other (n=15)	4% EPA HVAC 8% NATE 0% BPI 36% other (n=25)	67% EPA HVAC 44% NATE 36% mfrs. 15% BPI 13% refrig (n=39)	73% EPA HVAC 50% NATE 35% mfrs. 19% BPI 15% refrig (n=26)	54% EPA HVAC 31% NATE 38% mfrs. 8% BPI 8% refrig (n=13)
Have mfrs. provided marketing or other support to help you promote high-efficiency equipment?	N/A	N/A	N/A	66%* said yes (n=70)	74% said yes (n=34)	64% said yes (n=36)
Which mfrs. and what support have they provided to help you promote high-efficiency equipment?	N/A	N/A	N/A	Mitsubishi, Carrier, Daikin, Trane, Navien, American Standard, York, Amana, Bosch, Goodman, and Heil and marketing/advertising co-ops		

**Note:** All percentages shown are not weighted except for the item denoted with an asterisk (\*). ▼ indicates a decrease from 2015 to 2019. The 2015 study had far fewer respondents than the 2019 study; therefore, any differences observed should not be treated as conclusive.

**Source:** NYSERDA residential statewide baseline study, volume 3: HVAC market assessment (July 2015). 2019 HVAC contractor survey.

ACCA = Air Conditioning Contractors of America, AHRI = Air-Conditioning, Heating, and Refrigeration Institute, BPI = Building Performance Institute, EPA = Environmental Protection Agency, NATE = North American Technician Excellence



As shown in Table 18, the proportion of HVAC companies requiring their technicians to attend training and obtain industry certification appears to have decreased since the previous baseline study. However, the 2015 RSBS sample size was smaller than the current 2019 RBSA sample, and the two studies used different survey methodologies. Therefore, this observed decrease in training and certification is not conclusive.

New to the current 2019 RBSA, contractors answered questions about whether they received any marketing support from manufacturers to help them promote high-efficiency equipment. The majority of contractors (66%) said they received marketing support.<sup>19</sup> Contractors identified dozens of manufacturers offering marketing support including Mitsubishi, Carrier, Daikin, Trane, and marketing/advertising co-ops. Notably, the four manufacturers that respondents indicated as receiving marketing support from (Mitsubishi, Carrier, Daikin, and Trane) were also the same manufacturers from which respondents indicated receiving installation and servicing training.

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<sup>19</sup> This percentage is weighted by contractor company size.

# Appendix A. NYSERDA RBSA HVAC Assessment Contractor Survey

Research Objectives	Corresponding Question Numbers
Understand HVAC contractor recommendations and sales practices regarding high-efficiency and renewable heating & cooling (RH&C) equipment	0-0; 0-0; 0; A3-0; 0
Explore HVAC contractor barriers & opportunities to installing high-efficiency and RH&C equipment	0;0;0;A2 -0;B1-B3
Understand HVAC early replacement/early equipment retirement decision-making	0-0; 0-0; 0
Gauge HVAC contractor familiarity with and use of HVAC and RH&C incentive programs in New York state	C1-C3
Assess HVAC contractor experience and proficiency with quality design aspects	D1
Gauge HVAC contractor and manufacturer training and certification practices	E1-0

**Target Audience:** HVAC and water heating contractors in New York State

**Expected Number of Completions:** n=70

Contractor Size	Target Sample Size
Small (<10 employees)	40
Large (≥10 employees)	30
<b>Total</b>	<b>70</b>

**Estimated Duration of Survey:** 15 minutes

### Variables to be Pulled into Survey

- **CASEID:** Unique case identifier
- **CITY:** Contractor location – city (in the State of New York)
- **COUNTY:** County where the HVAC contractor is located
- **ZONE:** Climate zone where the HVAC contractor is located

**CONTRACTOR:** Company Name

**FULLNAME:** Contact first name and last name

**SIZE:** Small (≤10 employees) or large (>10 employees)

**EMAIL:** Contact email address

\* Denotes questions from the 2015 NYSERDA Residential Statewide Baseline Study HVAC Assessment Contractor Survey

~ Denotes questions from the 2018 NYC ASHP Contractor Survey

## Survey Introduction

Hello, I'm **[INTERVIEWER NAME]** from APPRISE and I'm calling on behalf of the New York State Energy Research and Development Authority, or NYSERDA.

A1. May I speak with **[FULLNAME]**? OR **[IF NO NAME]** May I speak with the person who handles sales, installation, and/or servicing of heating, cooling, and/or water heating equipment at your company? **[IF THAT PERSON IS NOT AT THIS PHONE NUMBER, ASK FOR THEIR NAME AND PHONE NUMBER AND START AGAIN]**

1. Yes
2. No or not a convenient time **[ASK IF RESPONDENT WOULD LIKE TO ARRANGE A MORE CONVENIENT TIME OR IF YOU CAN LEAVE A MESSAGE FOR A MORE APPROPRIATE PERSON]**

(Don't know) **[ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]**

(Refused) **[THANK AND TERMINATE]**

We are conducting a study about the residential HVAC market in New York, and are interested in hearing contractors' perspectives. You may have recently received a letter in the mail from NYSERDA about this important study. This is not a sales call; the research we're doing will inform programs offered by NYSERDA to promote adoption of HVAC equipment in New York.

We are offering a \$25 incentive, via an Amazon gift card, to a limited number of qualifying contractors who complete a survey. Your responses will be kept confidential and used for research purposes only. Would you be willing to participate and answer a few questions for me today?

**[IF NEEDED]** This survey should take approximately 15 minutes

**[IF NEEDED]** NYSERDA offers objective information and analysis, innovative programs, technical expertise, and funding to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels.

**[IF RESPONDENT AGREES TO PARTICIPATE]** Thank you! First, I need to ask you a few questions to ensure you qualify for the study.

## Screeners/Contractor Company Information

Does your company sell or install heating, cooling, or water heating equipment for single-family residential customers in the state of New York? By single-family residential, I mean residential dwellings that include 1 to 4 living units in the building.

1. Yes
2. No **[THANK AND TERMINATE]**

Including yourself, approximately how many employees work for your company in New York state?

1. [RECORD NUMBER]
  - a. [IF <10 EMPLOYEES ASSIGN TO SMALL CONTRACTOR QUOTA]
  - b. [IF >=10 EMPLOYEES ASSIGN TO LARGE CONTRACTOR QUOTA]

What is your role within your company?

1. Owner/President/CEO
2. Installer
3. HVAC Technician
4. Sales Staff
5. Office/Administrative
6. Other [SPECIFY]

Which of the following are you involved with at your company? [READ LIST, SELECT ALL]

1. HVAC Equipment Sales
2. HVAC Equipment Installation
3. HVAC Equipment Servicing
4. None of the above [THANK AND TERMINATE]

Are you the person or one of the people most familiar with your company's heating and cooling equipment sales, installation, servicing, and maintenance practices in the state of New York?

1. Yes
2. No [ONLINE SURVEY: THANK AND TERMINATE] [TELEPHONE SURVEY: ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]

For the rest of the questions, please think about your company's work in New York State only.

I'd like you to tell me which of the following types of HVAC and water heating equipment your company sells or installs in single-family (1 to 4 unit) homes in New York state ? [READ LIST; SELECT ALL THAT APPLY]

- (a) What HVAC or water heating equipment type or types would you say make up the majority of your sales? [DO NOT READ LIST; PROBE ON SPECIFIC TECHNOLOGIES AS NEEDED; SELECT ALL THAT APPLY]

Equipment Category	Technology	0. Equipment sold/installed	0(a). Majority of equipment sales
<b>Boilers</b>	a. Natural Gas Boilers		
	b. Oil Boilers		
<b>Furnaces</b>	c. Natural Gas Furnaces		
	d. Oil-Fired Furnaces		
	e. Electric Furnaces		
<b>Central Air Conditioners</b>	f. Central Air Conditioners		
<b>Air-Source Heat Pumps</b>	g. Central Ducted Air-Source Heat Pumps		
<b>Ductless Heat Pumps</b>	h. Ductless Mini-Split Heat Pumps		
<b>Water Heaters</b>	i. Natural Gas Water Heater		
	j. Oil Water Heater		

Equipment Category	Technology	0. Equipment sold/installed	0(a). Majority of equipment sales
	k. Electric Resistance Water Heater		
	l. Heat Pump Water Heater		
<b>Ground-Source Heat Pumps</b>	m. Ground-Source Heat Pumps		
<b>Pellet Stoves</b>	n. Pellet Stoves		
<b>Biomass Boilers</b>	o. Biomass Boilers		
<b>Solar Hot Water Systems</b>	p. Solar Thermal Hot Water Systems		

Does your company install wi-fi enabled thermostats (such as Nest or ecobee)?

1. Yes
2. No
98. (Don't know)
99. (Refused)

Thinking about all of your company's residential HVAC and water heating equipment sales and installations in New York State, what proportion would you say are sold or installed for new construction homes (versus existing homes)?

1. [RECORD PERCENTAGE]

## Overview of Equipment Sales and Installations

Next, I'd like to ask you some more detailed questions about a few of the HVAC equipment types you said you sell and install.

[ASK IF 0a or 0b=1] What proportion of the boilers you sold and installed included indirect hot water heating?

1. [RECORD PERCENTAGE]

In the last year, about what percent of your customers who had oil heat switched to a different heat source?

1. [RECORD PERCENTAGE]
2. None of my customers have oil heat [SKIP TO 0]

For a customer who wants to stop using oil heat, which of the following equipment types do you most commonly recommend? [READ LIST; SELECT MULTIPLE RESPONSE]

1. Electric furnace
2. Electric baseboard
3. Central air-source heat pump
4. Ductless heat pump
5. Geothermal heat pump
6. Propane system
7. Pellet stove
8. Pellet boiler
9. Another equipment type? [SPECIFY; PROBE FOR SPECIFIC EQUIPMENT TYPE AND FUEL TYPE]

(Don't know)

(Refused)

In the past year, please tell me if you have installed more than five of each of the following equipment types: [READ EACH EQUIPMENT TYPE] [1=YES/2=NO/98=DON'T KNOW/99=REFUSED]

1. [ASK IFB6 - a or B6 - c =1] Natural gas boilers and furnaces [1=YES/2=NO/98=DON'T KNOW/99=REFUSED]
2. [ASK IFB6 - b or B6 - d =1] Oil boilers and furnaces: [1=YES/2=NO/98=DON'T KNOW/99=REFUSED]
3. [ASK IFB6 - l, j, k, or l =1] Water heaters [1=YES/2=NO/98=DON'T KNOW/99=REFUSED]

## Boilers and Furnaces

[NOTE TO REVIEWER: Respondent will be screened for and randomly assigned to one of the fuel-specific modules (i.e. natural gas boilers and furnaces or oil boilers and furnaces)]

[IF 0.1=1 ELIGIBLE FOR MODULE A] [Note to reviewer: Screens for respondents that sold at least 5 natural gas boilers and furnaces]

[IF 0.2 =1, ELIGIBLE FOR MODULE B] [Note to reviewer: Screens for respondents that sold at least 5 oil boilers and furnaces]

[IF RESPONDENTS ELIGIBLE FOR BOTH, RANDOMLY ASSIGN RESPONDENT TO MODULE A OR MODULE B]

## Module A. Natural Gas Boilers and Furnaces

The next questions are about natural gas boilers and furnaces.

When recommending **natural gas boilers and furnaces** to your customers in need of a new heating system, how often do you recommend a **condensing** model? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
2. Frequently
3. Occasionally
4. Rarely
5. Never

(Don't know)

(Refused)

[ASK IF 0=4 OR 5] What are the main reasons you [0 RESPONSE] recommend condensing natural gas boilers and furnaces? [DO NOT READ LIST; SELECT ALL THAT APPLY]

1. High upfront cost
2. Long payback period
3. Installation requires more work for a condensing unit than a non-condensing unit
4. Non-condensing systems outlast condensing systems
5. Condensing systems are not as readily available as non-condensing systems

6. Other [SPECIFY]

How long would you say it typically takes to have a **condensing natural gas boiler or furnace** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How long would you say it typically takes to have a **non-condensing natural gas boiler or furnace** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning natural gas boiler or furnace replace their existing system prior to failure? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
  2. Frequently
  3. Occasionally
  4. Rarely
  5. Never
- (Don't know)  
(Refused)

[ASK IF 0=1, 2, or 3] When you recommend that your customers replace their older, but still functioning, natural gas boiler or furnace, what do you most commonly recommend they replace it with? [READ LIST; SELECT ONE RESPONSE]

1. Another natural gas boiler or furnace
2. Central air-source heat pump
3. Ductless heat pump
4. Something else [SPECIFY]

## Module B. Oil Boilers and Furnaces

The next questions are about oil boilers and furnaces.

When recommending **oil boilers and furnaces** to your customers in need of a new heating system, how often do you recommend a **condensing** model? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
  2. Frequently
  3. Occasionally
  4. Rarely
  5. Never
- (Don't know)  
(Refused)

[ASK IF 0=4 OR 5] What are the main reasons you [0 RESPONSE] recommend condensing oil boilers and furnaces? [DO NOT READ LIST; SELECT ALL THAT APPLY]

1. High upfront cost
2. Long payback period
3. Installation requires more work for a condensing unit than a non-condensing unit
4. Non-condensing systems outlast condensing systems
5. Condensing systems are not as readily available as non-condensing systems
6. Other [SPECIFY]

How long would you say it typically takes to have a **condensing oil boiler or furnace** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How long would you say it typically takes to have a **non-condensing oil boiler or furnace** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning oil boiler or furnace replace their existing system prior to failure? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
2. Frequently
3. Occasionally



4. Rarely
  5. Never
- (Don't know)  
(Refused)

[ASK IF D11=1, 2, or 3] When you recommend that your customers replace their older, but still functioning, oil boiler or furnace, what do you most commonly recommend they replace it with? [READ LIST; SELECT ONE RESPONSE]

1. Another oil boiler or furnace
2. Natural gas boiler or furnace
3. Central air-source heat pump
4. Ductless heat pump
5. Something else [SPECIFY]

## Water Heaters

[ASK 0-0 IF 0.3=1]

The next questions are about water heaters.

For your customers in need of a new water heater, how often do you recommend a **heat pump water heater**? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
  2. Frequently
  3. Occasionally
  4. Rarely
  5. Never
- (Don't know)  
(Refused)

[ASK IF 0 =4, OR 5] What are the main reasons you [0 RESPONSE] recommend heat pump water heaters? [DO NOT READ LIST; SELECT ALL THAT APPLY]

1. Not familiar with the technology
  2. More expensive to the consumer than conventional water heaters
  3. Take longer to install than conventional water heaters
  4. More complex to install than conventional water heaters
  5. Don't perform as well in cold climates as conventional water heaters
  6. Not as readily available as conventional water heaters
  7. Other [SPECIFY]
- (Don't know)  
(Refused)

[ASK IF C1.I >0 & E1 is not 5, 98, 99] How long would you say it typically takes to have a **heat pump water heater** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
2. One to two days

3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How long would you say it typically takes to have a **conventional water heater** delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)  
(Refused)

How often do you recommend that your customers with an older (i.e., nearing the end of its lifespan) but still functioning water heater replace their existing system prior to failure? [READ LIST; SELECT ONE RESPONSE]

1. Very frequently
  2. Frequently
  3. Occasionally
  4. Rarely
  5. Never
- (Don't know)  
(Refused)

## *Air-Source Heat Pumps*

The next questions are about air-source heat pumps. **For the purpose of these questions, air source heat pumps (ASHPs) refer to both ductless mini-splits, as well as central, ducted air-source heat pump systems.**

### ASHP Installers

[ASK 0-A3 IF 0.g=1 or 0.h =1 ]

Approximately how many air-source heat pumps did you sell and install in the past year? (Your best estimate is fine)

[RECORD NUMBER]

[IF F1>0]

I want to ask you next about cold climate air-source heat pumps. Cold climate air-source heat pumps are designed to operate efficiently at colder temperatures. To meet the cold climate specification, the air-source heat pump must include a variable capacity compressor and meet the performance requirements of having a coefficient of performance greater than or equal to 1.75 at 5 degrees Fahrenheit at maximum capacity, as well as a Heating Season Performance Factor of 10 or more.

1. Of all the air-source heat pumps you sold and installed in the past year, approximately what percent were cold climate air-source heat pumps? **[RECORD PERCENTAGE]**

~Next, I'll read to you a list of potential reasons why a business may have started selling or installing air-source heat pumps. Please rate how significant of a **motivator** each was for your business. Tell me if it was very significant, somewhat significant, not too significant, or not significant at all as a motivator for your business when you began installing air-source heat pumps. **[READ LIST; REPEAT RATING SCALE IF NEEDED]**

Rating			
Very significant	Somewhat significant	Not too significant	Not significant at all

1. Customer interest in air-source heat pumps
2. Reliability of technology
3. Flexibility of technology
4. Opportunity to grow business
5. Rebate programs
6. Benefits for customers
7. Synergies with other services provided
8. Encouragement from manufacturer or distributor
9. Other **[SPECIFY]**  
(Don't know)  
(Refused)

A2. ~Next I'll read to you a list of potential challenges to operating a successful business selling or installing air-source heat pumps. Please rate how significant of a **challenge** each has posed to the successful operation of your air-source heat pump business. Tell me if it has been very significant, somewhat significant, not too significant, or not significant at all as a challenge for your business. **[READ LIST; REPEAT RATING SCALE IF NEEDED]**

Rating			
Very significant	Somewhat significant	Not too significant	Not significant at all

1. Purchasing new tools or required equipment which you did not previously own
2. Adjusting business and pricing model
3. Availability of information about air source heat pump performance and installation practices
4. Accessing business financing
5. New license, certification, or training requirements

6. Lack of customer understanding of and confidence in technology
7. Project approval requirements (e.g. permits)
8. Building stock-related challenges (e.g. roof access requirements)
9. Technology-related challenges (e.g. technology not performing as expected)
10. Workforce challenges (e.g. finding sufficient trained installers)
11. Accessing rebate program benefits
12. Marketing and customer acquisition
13. Other [SPECIFY]

A3. How long would you say it typically takes to have an air-source heat pump delivered to the customer? [READ LIST IF NEEDED; SELECT ONE RESPONSE]

1. The same day
  2. One to two days
  3. Three to six days
  4. One to two weeks
  5. More than two weeks
- (Don't know)
- (Refused)

### Non-ASHP Installers

[ASK 0-0 IF 0.g=0 & B6.h=0]

~ You indicated that your company does not sell or install air source heat pumps in single-family residential homes. Has your company ever considered offering air-source heat pump products or services to your residential customers?

1. Yes
  2. No [SKIP TO 0]
- (Don't know) [SKIP TO 0]
- (Refused) [SKIP TO 0]

A4. ~ Next I'll read to you a list of potential challenges that may or may not have prevented you from deciding to install air-source heat pumps. Please rate how significant of a **challenge** each was in your business' decision not to install air-source heat pumps. Tell me if it was very significant, somewhat significant, not too significant, or not significant. [READ LIST; REPEATRATING SCALE IF NEEDED]

Rating			
Very significant	Somewhat significant	Not too significant	Not significant at all

1. Purchasing new tools or required equipment which you did not previously own
2. Adjusting business and pricing model
3. Availability of information about air source heat pump performance and installation practices
4. Accessing business financing
5. New license, certification, or training requirements
6. Lack of customer understanding of and confidence in technology

7. Project approval requirements (e.g. permits)
8. Building stock-related challenges (e.g. roof access requirements)
9. Technology-related challenges (e.g. technology not performing as expected)
10. Workforce challenges (e.g. finding sufficient trained installers)
11. Accessing rebate program benefits
12. Marketing and customer acquisition
13. Other [SPECIFY]

~[ASK IF 0=2] ~Which of the following reasons reflect why your business has not considered offering air-source heat pumps? [READ LIST; SELECT ALL THAT APPLY]

1. Wasn't aware of the technology
2. Cost of technology for customers
3. Cost to business of training, tools, and other startup costs to begin installing technology
4. Lack of confidence in technology's performance or suitability for my customers
5. Lack of customer awareness and understanding
6. Other [SPECIFY]

## B. Renewable Heating and Cooling

B1. Of the following technologies, which, if any, have you considered offering to your customers?

[READ LIST; SELECT ALL THAT APPLY] [IF MULTIPLE RESPONSE SELECTED, ASK 0]

1. [ASK IF 0.m=0] Ground-source heat pumps [IF ONLY RESPONSE SELECTED SKIP TO 0]
2. [ASK IF 0.n=0] Pellet stove [IF ONLY RESPONSE SELECTED, SKIP TO B2]
3. [ASK IF 0.o=0] Biomass boiler [IF ONLY RESPONSE SELECTED SKIP TO 0]
4. [ASK IF 0.p=0] Solar hot water systems [IF ONLY RESPONSE SELECTED SKIP TO B3]
5. None of these technologies [SKIP TO H1]

[ASK IF MULTIPLE RESPONSE SELECTED FOR B1] Of these technologies, which one have you most seriously considered offering to your customers? [READ LIST; SELECT ONE RESPONSE]

1. [ASK IF B1.1=1] Ground-source heat pumps [SKIP TO 0]
2. [ASK IF B1.2=1] Pellet stove [SKIP TO B2]
3. [ASK IF B1.3=1] Biomass boiler [SKIP TO 0]
4. [ASK IF B1.4=1] Solar hot water systems [SKIP TO B3]

## GSHP

Which of the following posed a challenge to your business or otherwise prevented you from deciding to install ground-source heat pumps? [READ LIST, SELECT ALL THAT APPLY]

1. Purchasing new tools or required equipment which you did not previously own
2. Acquiring new licensing specific to ground-source heat pump installation
3. Completing new trainings or certifications specifically for ground-source heat pump installation
4. Workforce challenges (e.g. finding sufficient trained installers)

5. Adjusting business and pricing model
6. Accessing business financing
7. Marketing and customer acquisition
8. New project-related administrative requirements (i.e. project permits and/or rebates)
9. What other challenges did you encounter? **[SPECIFY]**

**[SKIP TO 0]**

## Biomass

B2. Which of the following posed a challenge to your business or otherwise prevented you from deciding to install pellet stoves?

1. Purchasing new tools or required equipment which you did not previously own
2. Acquiring new licensing specific to pellet stove installation
3. Completing new trainings or certifications specifically for pellet stove installation
4. Workforce challenges (e.g. finding sufficient trained installers)
5. Adjusting business and pricing model
6. Accessing business financing
7. Marketing and customer acquisition
8. New project-related administrative requirements (i.e. project permits and/or rebates)
9. What other challenges did you encounter? **[SPECIFY]**

**[SKIP TO 0]**

Which of the following posed a challenge to your business or otherwise prevented you from deciding to install biomass boilers?

1. Purchasing new tools or required equipment which you did not previously own
2. Acquiring new licensing specific to biomass boiler installation
3. Completing new trainings or certifications specifically for biomass boiler installation
4. Workforce challenges (e.g. finding sufficient trained installers)
5. Adjusting business and pricing model
6. Accessing business financing
7. Marketing and customer acquisition
8. New project-related administrative requirements (i.e. project permits and/or rebates)
9. What other challenges did you encounter? **[SPECIFY]**

**[SKIP TO 0]**

## Solar Hot Water

B3. Which of the following posed a challenge to your business or otherwise prevented you from deciding to install solar hot water systems?

1. Purchasing new tools or required equipment which you did not previously own

2. Acquiring new licensing specific to solar hot water system installation
3. Completing new trainings or certifications specifically for solar hot water installation
4. Workforce challenges (e.g. finding sufficient trained installers)
5. Adjusting business and pricing model
6. Accessing business financing
7. Marketing and customer acquisition
8. New project-related administrative requirements (i.e. project permits and/or rebates)
9. What other challenges did you encounter? **[SPECIFY]**

**[SKIP TO 0]**

### *C. High-Efficiency Equipment Perceptions and Program Awareness*

I'd like to ask you a few questions about your thoughts on the role of energy-efficient equipment in your business. In this context, "high-efficiency" equipment refers to equipment including condensing boilers, furnaces, and water heaters; multi-speed or variable-speed central air conditioners; ductless heat pumps; air-source heat pumps; and heat pump water heaters.

For each of the following statements, please tell me if you...**[READ RATING SCALE]** **[RANDOMIZE ORDER]**

Rating			
<b>Strongly Agree</b>	Somewhat Agree	Somewhat Disagree	Strongly Disagree

1. Selling and installing energy efficient equipment offers a competitive advantage for my company
2. Energy efficiency is important in my company's sales and marketing of its services
3. Availability of energy efficient equipment options is important to my residential customers

C1. How familiar are you with programs offered by **electric and gas utilities** in New York State to promote energy efficient HVAC and water heating equipment? **[READ LIST; SELECT ONE RESPONSE]**

1. Very familiar
  2. Somewhat familiar
  3. Not too familiar
  4. Not at all familiar
- (Don't know)  
(Refused)

C2. How familiar are you with programs offered by **NYSERDA** to promote energy efficient HVAC and water heating equipment? **[READ LIST; SELECT ONE RESPONSE]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar

- 4. Not at all familiar  
(Don't know)  
(Refused)

C3. In the past year, approximately what percent of the HVAC and water heating equipment you sold and installed in New York state received a rebate **through a NYSERDA or utility incentive program?**

- 1. [RECORD PERCENTAGE]

C4. In the past year, approximately what percent of the HVAC and water heating equipment you sold and installed in New York state received a **manufacturer rebate?**

- 2. [RECORD PERCENTAGE]

### D. Quality Design and Installation

[ASK IO-I2 IF 0.a,b,c,d,e,f,g,or h=1]

I0. Does your company perform maintenance on existing systems installed in homes by other HVAC companies?

- 1. Yes
- 2. No
- 98. Don't Know
- 99. Refused

D1. [IF I0 = Yes] When you go into a home to perform maintenance of an existing system installed by another HVAC company, how often do you encounter the following maintenance or installation issues? [READ EACH ONE; RECORD RATING]

Rating				
Very Frequently	Frequently	Occasionally	Rarely	Never

- 1. Existing systems are not charged correctly
- 2. Ducts are not properly designed, causing uneven temperature distribution in some areas of the home
- 3. Duct leakage is causing excessive energy waste; ducts should be sealed
- 4. Airflow in cooling mode is too low or too high
- 5. Airflow in heating mode is too low or too high
- 6. Equipment is oversized

I2. [IF I0 = Yes] Are there any other common maintenance or installation issues you see when performing maintenance of an existing system installed by another company?

- 1. Yes [RECORD RESPONSE]
- 2. No
- 98. Don't Know
- 99. Refused



## E. HVAC Training and Certification

[ASK E1-E4 IF 0.a,b,c,d,e,f,g,or h=1]

E1. \*Does your firm require HVAC technicians attend training courses on energy efficiency, quality maintenance, or quality installation?

1. Yes
2. No
- Don't know
- Refused

E2. \*[ASK IF E1 =1] From what organizations? [SELECT ALL THAT APPLY]

1. Air Conditioning Contractors of America (ACCA)
2. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
3. Utility-sponsored Training
4. Manufacturer-provided training [SPECIFY: Which manufacturer(s) and what topics?]
5. Other [SPECIFY]

E3. \* Does your firm require HVAC technicians obtain industry certification?

1. Yes
2. No
- Don't know
- Refused

E4. \*[ASK IF E3 =1] What type(s) of certification(s)? [SELECT ALL THAT APPLY]

1. North American Technician Excellence (NATE)
2. Building Performance Institute (BPI)
3. EPA HVAC Certification
4. Manufacturer Certification [SPECIFY]
5. Other [SPECIFY]

[ASK E5 AND 0 OF ALL RESPONDENTS]

E5. Have the manufacturers of the equipment you sell provided marketing or other kinds of support to help you promote high efficiency equipment?

1. Yes
2. No
- Don't know
- Refused

[ASK IF 0=1] Which manufacturers and what support have they provided to help you promote high efficiency equipment?

1. [RECORD RESPONSE]

## Closing

E6. [TELEPHONE SURVEY] Thank you for answering our questions! Before you go, can I get your name and email or mailing address to send you the \$25 Amazon gift card? Your information will only be used to mail you the gift card. We will not use your information for marketing. [FILL IN FORM IF YES TO THE GIFT CARD]

First and Last Name:

Email (If EMAIL preferred method)

Street Address (If MAIL preferred method)

City: (If MAIL preferred method)

State: (If MAIL preferred method)

Zip code: (If MAIL preferred method)

[SCREENER TERMINATION MESSAGE] Those are the questions we have for you today. This survey is seeking information on residential HVAC and water heating sales and installation practices in New York state. Thank you for your interest in helping us out.

[IF RESPONDENT EXPRESSES INTEREST OR HAS QUESTIONS ABOUT NYSERDA ENERGY EFFICIENCY PROGRAMS: For more information about NYSERDA's energy efficiency programs to help homeowners more efficiency heat and cool their homes, or to be become a NYSERDA-qualified contractor, you can visit NYSERDA's website at <https://www.nyserda.ny.gov/>]

# Appendix B. Codes and Standards

The efficiency of equipment is dictated by codes and federal standards, and changes to these affect customers' energy-consumption patterns and behaviors. Table 19 lists the current standard for single-family residential equipment and any pending equipment standard change. The new standard is noted for measures for which a future standard would have a higher efficiency than a current market practice baseline.

TABLE 19. CURRENT AND PENDING STANDARDS BY EQUIPMENT TYPE

Category	End-Use Equipment Type	Current Standard (Year Effective)	Efficiency	New Standard (Year Effective)	New Efficiency
Residential Air Conditioners and Air-source Heat Pumps	Central Air Conditioners	2015	SEER 13	2023	SEER 14
	Heat Pumps (Split Systems)	2015	SEER 14/8.2 HSPF	Expected 2023	SEER 14/8.8 HSPF
	Heat Pumps (Packaged Systems)	2015	SEER 14/8 HSPF	Expected 2023	N/A
	Ductless Mini-Split Heat Pumps	N/A	N/A	N/A	N/A
Residential Natural Gas Furnaces	Non-weatherized Gas Furnaces	2015	80% AFUE	No new standard pending	N/A
	Mobile Home Gas Furnaces	2015	80% AFUE	No new standard pending	N/A
	Weatherized Gas Furnaces	2015	81% AFUE	No new standard pending	N/A
Residential Oil-Fired Furnaces	Non-weatherized Oil-Fired Furnaces	2013	83% AFUE	No new standard pending	N/A
	Mobile Home Oil-Fired Furnaces	1990	75% AFUE	No new standard pending	N/A
	Weatherized Oil-Fired Furnaces	1992	78% AFUE	No new standard pending	N/A
Residential Natural Gas and Oil-Fired Boilers	Gas-Fired Hot Water Boilers	2012	82% AFUE	2021	84% AFUE
	Gas-Fired Steam Boilers	2012	80% AFUE	2021	82% AFUE
	Oil-Fired Hot Water Boilers	2012	84% AFUE	2021	86% AFUE
	Oil-Fired Steam Boilers	2012	82% AFUE	2021	85% AFUE
Renewable Heating and Cooling	Ground Source Heat Pumps		16 EER/3.1 COP		
	Biomass Systems				
	Solar Space and Water Heating				

Source: Electronic code of federal regulations

In addition to the standards listed in the table above, in 2015 the National Appliance Energy Conservation Act raised the federal minimum efficiency for the most common types of storage water heaters. The new efficiency standard requires a UEF requirement of approximately 2.0 for electric residential water heaters with a storage volume more than 55 gallons.

This effectively prohibits the sale of residential electric resistance water heaters of that size, because the UEF of 2.0 can be achieved only by a heat pump water heater. For electric water heaters with storage volume less than 55 gallons, the minimum UEF increased modestly to approximately 0.95. Similarly, the act requires a higher minimum UEF for gas storage water heaters above 55 gallons. For example, the minimum UEF for a 60-gallon gas-fired water heater increased from 0.56 to 0.75, which effectively requires a condensing design-heat exchanger.

- **Water Heaters:** In 2015, the National Appliance Energy Conservation Act raised the federal minimum efficiency for the most common types of storage water heaters. The new efficiency standard requires a UEF requirement of approximately 2.0 for electric residential water heaters with a storage volume more than 55 gallons. This effectively prohibits the sale of residential electric resistance water heaters of that size, because the UEF of 2.0 can only be achieved by a heat pump water heater. For electric water heaters with storage volume less than 55 gallons, the minimum UEF increased modestly to approximately 0.95. Similarly, the act requires a higher minimum UEF for gas storage water heaters above 55 gallons. For example, the minimum UEF for a 60-gallon gas-fired water heater increased from 0.56 to 0.75, which effectively requires a condensing design-heat exchanger.