2012-2013 Home Performance with ENERGY STAR® Process Evaluation/Market Characterization Assessment

Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, New York

Carley Murray
Project Manager

Prepared by:

Research Into Action, Inc.

Portland, Oregon

Jane S. Peters
President

Benjamin L. Messer
Senior Project Analyst

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Abstract

This report presents the findings from the combined process evaluation and market characterization and assessment (PE/MCA) of the 2012-2013 Home Performance with ENERGY STAR® program (HPwES). The research occurred between January 2014 and January 2015. The project aimed to assess the program's activities and progress during 2012-13, to determine potential strengths and weaknesses of the program's processes and explore the benefits and concerns of participating in HPwES, and to characterize current and emerging home improvement markets in New York State. First, the team used data from the program database to assess program activities completed during 2012-13. Second, the team identified strengths and weaknesses of the program's processes, as well as the benefits and concerns of participation, through surveys with 13 HPwES staff, 52 participating contractors, 570 participating households, and 312 households that had an HPwES home energy audit, but did not further participate in the program. Third, the team used data from these surveys, in addition to surveys with 129 nonparticipant residential contractors and 770 nonparticipant households, as well as secondary sources, to characterize current and emerging home improvement markets in New York State, including HPwES target markets and future market potential.

Key Words

Green Jobs –Green New York (GJGNY), Home Performance with ENERGY STAR® (HPwES), energy efficiency, existing single-family homes, market assessment, market characterization, process evaluation, Regional Greenhouse Gas Initiative (RGGI), whole-home energy upgrades.

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Summary

This report presents the findings from the process evaluation and market characterization and assessment (PE/MCA) of the 2012-2013 Home Performance with ENERGY STAR® (HPwES) program offered by the New York State Energy Research and Development Authority (NYSERDA). The research was conducted over 13 months from January 2014 through January 2015.

At the time this study took place, NYSERDA's HPwES program had been an integral part of NYSERDA's energy efficiency program portfolio since its launch in 2001. The HPwES program operated with the long-term objective of changing the market for residential energy efficiency by increasing the supply of highly qualified contractors trained in building science methods. It used building science and a whole-house approach to identify opportunities to increase the energy efficiency of existing, low-rise, one- to four-unit family housing stock through heating fuel and electricity-related savings. Energy efficiency improvements through this program included building shell measures, high-efficiency heating and cooling systems, domestic water heaters, ENERGY STAR appliances, and energy-efficient lighting. In addition to the cost-effective energy savings offered, HPwES addressed residential health and safety issues to increase the long-term durability of New York's housing stock.

Key Findings

Program Success

This PE/MCA of the HPwES program covered the period from January 1, 2012 to December 31, 2013 and was conducted between January 2014 and January 2015. By the end of 2013, the program database had recorded nearly 55,000 projects with about 34 GWhs of gross electric savings and 1.8 million MMBtus in gross gas savings since it began in 2001. In 2010, HPwES began providing free or reduced cost comprehensive home energy assessments (home energy audits, or audits). Between 2010 and the end of 2013, the program delivered more than 48,000 home energy audits, with nearly 35,000 audits completed during the evaluated program period (2012-13). About 25% of households (11,626) that had an HPwES energy audit in 2012-13 participated in the program.[1] About 716 projects (6%) came to the HPwES program through the constituency-based organization (CBO) outreach program during the evaluated program period, and were not included in this evaluation study. The 2012-13 HPwES participants represent about 0.3% of the New York State single-family, owner-occupied households, and their HPwES projects

[1] Conversion rates by contractors varied widely, from a minimum of 4% to a maximum of 90%. The median was 23%.

accounted for more than five GWhs of program-reported gross electric savings and more than 400,000 MMBtus of program-reported gross gas and delivered fuel savings.

The program encouraged, but did not require whole-house treatment. During the 2012-13 program period, HPwES supported upgrades in three types of home energy system: 1) heating, ventilation, and air-conditioning (HVAC) system; 2) shell system; and 3) plumbing system.[2] Upgrades that included two or more of these systems ("multiple-system upgrades") constituted a whole-house treatment, while upgrades to one system ("single-system upgrades") did not. Using this definition, nearly 75% of HPwES projects involved single-system upgrades (51% shell-only and 22% HVAC-only) and 27% involved multiple system upgrades. Of the 231 participating contractors in the 2012-13 program period, HVAC and multi-system contractors performed the majority of HPwES projects and did more multiple-system projects compared with general and insulation contractors.

Participating HPwES households during 2012-13 were surveyed for this evaluation in November and December 2014 and reported protecting their home's value, improving comfort, making their home more sustainable, and reducing energy use as the most important reasons for participating in HPwES. Participating households also reported being mostly satisfied with their HPwES experience. High percentages reported satisfaction with their overall experience (89%), their contractor's work (85%), and the information and incentives they received (83%). Moderately high percentages reported satisfaction with resolution of any issues (77%) and the energy savings obtained (74%).

The PE/MCA team surveyed participating 2012-13 HPwES contractors in September and October 2014 and most reported benefiting from participating in the program, particularly in regard to increasing their staff's expertise, variety of services provided, expected annual number of completed projects, investment in new equipment, revenue per project, and number of employees. Participating contractors, however, had mixed satisfaction with their program experience. Moderately high percentages reported satisfaction with their interactions with program staff (62%), eligible measures (58%), and incentives for participants (50%), while lower percentages reported satisfaction with the length of time to approve customer financing (35%) and projects (29%), receive payments (31%), and the amount of the contractor incentive (31%).[3]

Participating contractors in 2012-13 saw value in the cooperative marketing funds, BPI-certification, and the free or reduced-cost home energy audit for selling HPwES projects. These program features also appeared to have some impact on participating households in 2012-13; the most frequently reported source

[2] A home energy system is a group of technologies and equipment that, working together, perform an energy-related function in the home (for example, attic, floor, and wall insulation comprise the shell system, heating and cooling units, ducts, and fans comprise the HVAC system, water heaters and pipe insulation comprise the plumbing system, etc.).

[3] In 2014, the program implemented redesign efforts to address many of the sources of contractors' low satisfaction.

for learning about HPwES was through a contractor. Many participants reported always considering contractor certification, and participants ranked the energy audit as more influential in their decision to participate than the incentives or the financing options.

Market Characteristics for Households and Contractors

The PE/MCA team identified the following characteristics regarding the home improvement market New York State in 2012-2013:

- Both the 2013 American Housing Survey (AHS) and a nonparticipant survey from a web panel representative of New York State homeowners conducted in January 2015 estimated that 60% to 67% of homeowners, respectively, completed a home improvement project in the last two years.[4]
- Nearly half (44%) of respondents from a web-panel representative of nonparticipant New York State homeowners in one- to four-unit dwellings reported completing an energy-specific home improvement project of $2,000 or more in the past two years ("home energy upgraders").[5]
- Sixty percent of these nonparticipant home energy upgraders reported installing at least one of the HPwES core measures (HVAC, air sealing, and insulation), and 9% reported installing all three core-measures.
- Some nonparticipant home energy upgraders appeared to take a whole-house approach in their project; 18% reported installing four to seven of the energy-related upgrades.
- The most common reasons nonparticipant home energy upgraders reported for doing their projects were to upgrade or resolve problems with their home; very few reported doing their project to save energy or improve comfort.
- Very few nonparticipant home energy upgraders (8%) reported having a home energy audit before their project, but those who did found it effective and helpful overall.

[4] The 2013 AHS defined a home improvement project as making changes to, replacing, or adding one of 74 different components of the home, including home's rooms and layout, shell or envelope, flooring, electrical and plumbing, HVAC, outdoor spaces, and additional buildings on the property, like a garage. The PE/MCA team's nonrespondent web panel survey defined a home improvement as making one of the following changes to the home: breaking through outside wall to add rooms, extend a room or raise part of the roof, adding insulation, air sealing, replacing windows, adding or replacing water heating equipment, installing a new heating system, adding a new central air conditioner, new appliances, remodeling or upgrading the kitchen or bathroom(s), or finishing a basement.

[5] Energy-related upgrades included heating system, cooling system, air sealing, insulation, water heating system, appliances, and windows.

- Of the 44% of single-family home energy upgrades in New York State in 2012-13, HPwES participating households comprised about 1%.

Nonparticipant home energy upgraders surveyed in January 2015 were slightly more likely to be white and older, and to live in single-family detached (versus attached) homes. They were also much more likely to have higher levels of education and income compared to participating households. Likely due to the AHPwES component of the program, participating households were more demographically similar to the New York State owner-occupied household population compared to nonparticipant home energy upgraders, particularly in terms of household income. The AHPwES component and provision of incentives appeared to enable a broader range of households to make home energy upgrades than could do so without the program.

Using an InfoUSA list from April 2014, the PE/MCA team identified approximately 9,300 general, HVAC, insulation, and other specialty contractors who provided the measures supported by HPwES.[6,7] These 9,300 contractors reported completing about $18.2 billion in residential (new and existing buildings) sales with about 73,000 employees in 2013. The 231 HPwES program contractors comprised about 2% of this population and about 5% of the $18.2 billion in residential sales. The majority of the 9,300 contractors were general contractors, while most participating contractors were specialty contractors, of which HVAC contractors were the most common.

Participant contractors surveyed in September and October 2014 reported doing more energy efficiency work and having more professional training, compared to nonparticipating contractors surveyed in December 2014. For example, 20% of the surveyed nonparticipant contractors reported providing home energy audits, while 62% of participating contractors reported performing audits outside the program. Nonparticipant contractors reported doing diagnostic audits less frequently and less comprehensively compared to participating contractors. Nonparticipants reported installing energy-efficient measures in 57% of all of their jobs, on average, while participants reported doing this in 79% of their jobs. All participating contractor firms and just 2% of nonparticipating contractor firms (4% of all market contractor firms) have at least one Building Performance Institute (BPI) trained employee. In addition, 94% of surveyed

[6] In April 2014, the team purchased the list of contractors with SIC codes in the 152 (General Building Contractors – Residential) and 17 (Construction Special Trade Contractors) categories from InfoUSA. The team matched and removed any participating contractors from the list and added former participating contractors from CRIS and non-participant BPI-certified contractors from BPI to the list. The team also included screening questions in the nonparticipant contractor survey to determine how many provided HPwES-like services to single-family households in NYS.

[7] In contrast, the NYSERDA Residential Statewide Baseline Study (RSBS 2015) found approximately 18,000 HVAC and plumbing contractors from an uncleaned and unverified list (see Appendix D for more details).

participating contractors, compared to 39% of surveyed nonparticipant contractors, reported at least one employee with training experience from a non-BPI professional organization.[8]

Preliminary Evidence of Additional Measure Adoption and Market Effects

The PE/MCA team was tasked with finding any evidence of potential additional measure adoption and market effects that the Impact Evaluation team would investigate further. The team found some preliminary evidence of potential additional measure adoption among households and contractors. Households could receive a free or reduced-cost diagnostic audit through HPwES and then decide to participate or not participate in the program to make energy-efficient upgrades. Of the households who had a HPwES audit in 2012-13 and did not participate further in the program (audit-only households, surveyed between September and December 2014), 44% reported installing at least one of the energy-efficient upgrades recommended in their HPwES audit outside the program. These type of upgrades were further investigated by Impact Evaluation team to assess program influence.

In addition, 12% of 2012-13 participating households surveyed in November and December 2014 reported making an upgrade from their audit that was not installed through HPwES, and 12% of nonparticipant home energy upgraders surveyed in January 2015 reported considering HPwES participation when doing their project. Most of these nonparticipant home energy upgraders reported not participating in HPwES because they thought they were ineligible or that participation would be too costly or burdensome. The PE/MCA team could not determine whether the audit, HPwES participation, or HPwES awareness had any effect on these households' decision to make upgrades.

The PE/MCA team also found some preliminary evidence of the HPwES program's influence on contractors' market behavior. As the program theory predicted, 2012-13 participating contractors surveyed in September and October 2014 reported installing some energy-efficient measures in most of their projects (an average of 79%), and a majority (62%) reported performing diagnostic energy audits for their customers outside the program. Many participating contractors also reported an increase in staff expertise (83%), services offered (71%), projects completed (69%), investment in new equipment (65%), revenue per project (62%), number of employees (60%), and profitability (40%) due to their participation in HPwES. In addition, a majority of participating contractors (65%) mentioned that their program-required affiliation with BPI helped differentiate their firm from their competitors, and that they preferred to hire BPI-certified employees (62%). One-third of these contractors also reported paying their BPI-certified employees a higher wage than non-certified employees.

[8] Extrapolating the nonparticipant contractor survey responses to the state suggested about 2,400 contracting firms with a BPI-certified employee. However, the BPI website listed 412 contracting firms with a BPI-certified employee in New York State. Only three of these 412 firms matched the responding firms in the nonparticipant contractor survey.

Market Opportunities for HPwES Upgrades

The PE/MCA team found that great potential remained for HPwES upgrades in the New York State home improvement market. While trends in many home improvement activities had been flat since 2007, energy upgrade improvements showed a slight upward trend. Opportunities existed because most existing HVAC and water heater systems were not energy efficient; the majority of households lacked programmable thermostats or higher-efficiency insulation, and some households reported comfort issues related to their HVAC system, drafty building shell, or high energy costs. Further attesting to the opportunity, half of nonparticipant home energy upgraders surveyed in January 2015 reported planning to make an energy-efficient upgrade in the next two years, and more than two-thirds expressed interest in having an energy audit before their next project. Many also reported, however, that they needed information to increase their confidence in energy savings in addition to equipment rebates, access to low-interest financing, and assistance finding a contractor to help them make energy-efficient upgrades in the future.

Conclusions and Recommendations

- **Conclusion 1:** HPwES theory assumed **BPI training was sufficient to enable contractors to sell comprehensive upgrades, yet most upgrades were not comprehensive**. Slightly more than one quarter of HPwES projects included upgrades to multiple home systems, while most of the projects (73%) were to single systems. The program theory suggested that BPI training would be sufficient to enable contractors to sell comprehensive upgrades. Contractors did find value in their training on comprehensiveness from BPI and found it helped them explain the recommendations of the audit, yet most made upgrades primarily within their specialty. The program theory, therefore, appeared to be missing a step for contractors to fully transition to selling whole-house upgrades. Findings from the recently completed Better Buildings Neighborhood Program evaluation (Research Into Action, et al 2015) demonstrated that supporting contractors who target whole-house, especially through sales training and ongoing engagement, was a primary driver of successful whole-house upgrade programs.
    - **Recommendation 1:** Train contractors in more than building science; train them how to ***sell*** and install home energy upgrades outside of their specialty, and support them with ongoing engagement.
- **Conclusion 2:** **Home energy audits helped generate projects.** Participant homeowners indicated that the comprehensive home energy audits were influential in their decision to do a home energy upgrade. Participant and nonparticipant contractors said the home energy audits helped sell the home energy upgrades. When asked, the home energy upgraders who did not participate in the program, expressed interest in obtaining a home energy audit before their next project. Though contractors noted that a home energy audit was expensive and that the GJGNY incentives did not

fully cover the cost, they, along with the other market actors, had a positive assessment of the benefits in terms of stimulating home energy upgrades.

  - **Recommendation 2:** Continue providing free or reduced-cost home energy audits to facilitate market engagement with the whole-house approach and support market transformation.

- **Conclusion 3: The limited consistency of previous HPwES PE/MCA evaluations made it difficult to measure market changes over time.** There was one process evaluation in 2005 and two MCA studies, one in 2004 and another in 2009. Only the 2004 MCA study included groups and questions comparable to the current PE/MCA. In addition, each study (including this one) sought to accomplish many and varied objectives, focused on different indicators, made long-term tracking of market indicators difficult for measuring market transformation or market effects.

  - **Recommendation 3:** Support market transformation and the ability to pivot and modify programs early with focused tracking studies that track market indicators at regular intervals.

  - **Recommendation 4:** Use the core set of research objectives and indicators in the program theory and logic model to track market progress. When updating, ensure that measurement is often enough to track both old and new indicators to permit comparisons before the old indicator is dropped.

1 Introduction

This report provides the findings of a PE/MCA of the HPwES program, conducted for NYSERDA between January 2014 and January 2015.

1.1 Evaluation Context

This PE/MCA covered the 2012 and 2013 program years. The HPwES program was constantly evolving, however, and two key initiatives had changed or would change the HPwES program in the near future. First, a mid-2014 internal HPwES process review resulted in substantial changes to the HPwES program, with the goal of clarifying, simplifying, and speeding up the program process for participants. These program changes are noted throughout the report. Second, the final approval of the NYSERDA Clean Energy Fund proposal to the Department of Public Services, expected in 2015 or 2016, would likely result in a shift in the primary focus of NYSERDA's program administration away from incentive-based resource acquisition programs to market transformation programs and market-based initiatives to support energy efficiency and renewable energy in the state.[9] These proposed changes were still in development, and began subsequent to the design of data collection activities supporting this evaluation. The conclusion of this report attempts to draw connections from this evaluation to inform NYSERDA's evolving role in the State's new energy efficiency landscape.

1.2 Program Description

This section presents a brief summary of NYSERDA's HPwES program. Appendix A includes a more detailed description of the program and an analysis of program and implementation staff perspectives.

At the time this study was conducted, NYSERDA's HPwES program had been an integral part of NYSERDA's energy efficiency program portfolio since its launch in 2001. The HPwES program operated with the long-term objective of changing the market for residential energy efficiency by increasing the supply of highly qualified contractors trained in building science methods that maximize energy savings potential from qualified projects. The HPwES program used building science and a whole-house approach to identify opportunities to increase the energy efficiency of existing low-rise residential buildings. The program reduced energy use in New York State's existing one- to four-unit family housing stock through heating fuel and electricity-related savings. Energy efficiency improvements through this program in 2012-13 included building shell measures, high-efficiency heating and cooling systems, hot water heaters, ENERGY STAR appliances, and energy-efficient lighting. In addition to the cost-effective energy savings

[9] See "Proceeding on a Motion of the Commission to Consider a Clean Energy Fund" (CASE 14-M-0094) 5/8/2014. Also of significance is the overall effort to improve the energy industry in New York "Reforming the Energy Vision" (CASE 14-M-0094) 4/24/2014, State of New York Public Service Commission.

offered, HPwES addressed residential health and safety issues to increase the long-term durability of New York's housing stock.

In 2012-13, the HPwES program included three types of financial subsidies to encourage energy efficiency upgrades: subsidized energy audits, measure incentives, and low-interest financing. Energy Efficiency Portfolio Standards (EEPS) funds provided financial incentives to help offset the cost of qualifying, cost-effective installed natural gas and electric measures. The Regional Greenhouse Gas Initiative (RGGI) supported HPwES through incentives for delivered fuels measures and funding for the GJGNY program, which provided free and reduced-cost comprehensive energy audits, low-interest loans for cost-effective scopes of work, and outreach to targeted homeowners by constituency-based organizations (CBOs) through the GJGNY Outreach program.[10] Energy audits were free for households with incomes less than 200% of Area Median Income (AMI), and partially subsidized for households with incomes between 200% and 400% of AMI. NYSERDA offered two loan products with below-market interest rates and alternative qualification criteria for applicants with lower credit scores: the On-Bill Recovery (OBR) Loan, which was paid off through the utility bill, and the Smart Energy Loan, a separate loan product.

There were two HPwES program paths in 2012-13, a market rate HPwES path and an Assisted path (AHPwES) for households with incomes between 60% and 80% of State or Area Median Income, whichever was higher. Incentive levels varied by path; market rate participants were eligible for a High Efficiency Measure Incentive (HEMI) of 10% of eligible measure costs, and assisted participants were eligible for an incentive of 50% of eligible measure costs.

1.2.1 Contractor Participation and the Building Performance Institute

HPwES relied on BPI-accredited contracting firms (GoldStar™ Firms as of 2014) to assess and install energy efficiency improvements. Building Performance Institute (BPI) was closely involved in the HPwES program as the organization that develops and maintains best practice standards for the whole-house building science approach. NYSERDA and BPI had worked together to develop contractor certification guidelines and manage contractor accreditations for more than a decade.[11] BPI-accredited firms had specialized training in energy audits and efficiency retrofits based on this whole-house building science approach. Becoming a participating HPwES contractor required contracting firms to ensure sufficient staff

[10] Funded through the Green Jobs - Green New York Act of 2009 (A.8901/S.5888 and chapter amendment A.9031/S.6032) Laws of New York, 2009.

A more complete discussion of the role of Constituency-Based Organizations can be found in Phase I and Phase II of the Process Evaluation and Market Characterization Assessment of the GJGNY Outreach Program, prepared by Research Into Action and published in March 2014 and Summer 2015; a summary is included in the Appendix J. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-EMEP-GJGNY-Outreach.PDF

For a complete review of the GJGNY programs and the other GJGNY evaluations completed or underway see http://www.nyserda.ny.gov/About/Green-Jobs-Green-New-York.

[11] See the forthcoming BPI evaluations.

certification to meet BPI accreditation requirements, apply to NYSERDA for approval, and sign a program agreement. HPwES was complemented by a workforce development initiative that strengthened the program delivery infrastructure through the training and certification of technicians.

The HPwES program expected participating contractors to address how the whole house functions, and it provided incentives and financing to support installation of a wide array of eligible measures that achieve extensive and long-lasting fuel and electric savings. As of 2012-13, contractors completed home energy audits for all enrolled homeowners by taking an inventory of the current home conditions (including diagnostic testing of combustion appliances, and blower-door testing for air-infiltration rates) and developing a work scope for proposed improvements, including a cost and energy savings estimate. The energy assessment allowed the contractor to recommend improvements that were holistic and maximize the energy savings achieved in every home.

In 2012-13, NYSERDA provided technical, financial, and marketing support to participating contractors, and specific incentives and reimbursements for contractors encouraging a variety of activities desired by the program, such as an incentive that is 5% of eligible measure costs to help offset the costs of completing advanced modeling, and a 2% referral incentive for working with BPI-certified contractors with other specialties.

1.2.2 Program Promotion and Marketing

In 2012-13, HPwES program promotion occurred through a mixture of NYSERDA-sponsored activities, the efforts of program-affiliated contractors, and outreach conducted by CBOs. NYSERDA supported contractor-initiated marketing through its cooperative marketing program. Contractors who completed at least one HPwES project were eligible for between $5,000 and $200,000 in cooperative marketing funds on a sliding scale, based on the number of projects completed in the previous year and the marketing channel. All materials had to follow consistent content guidelines.

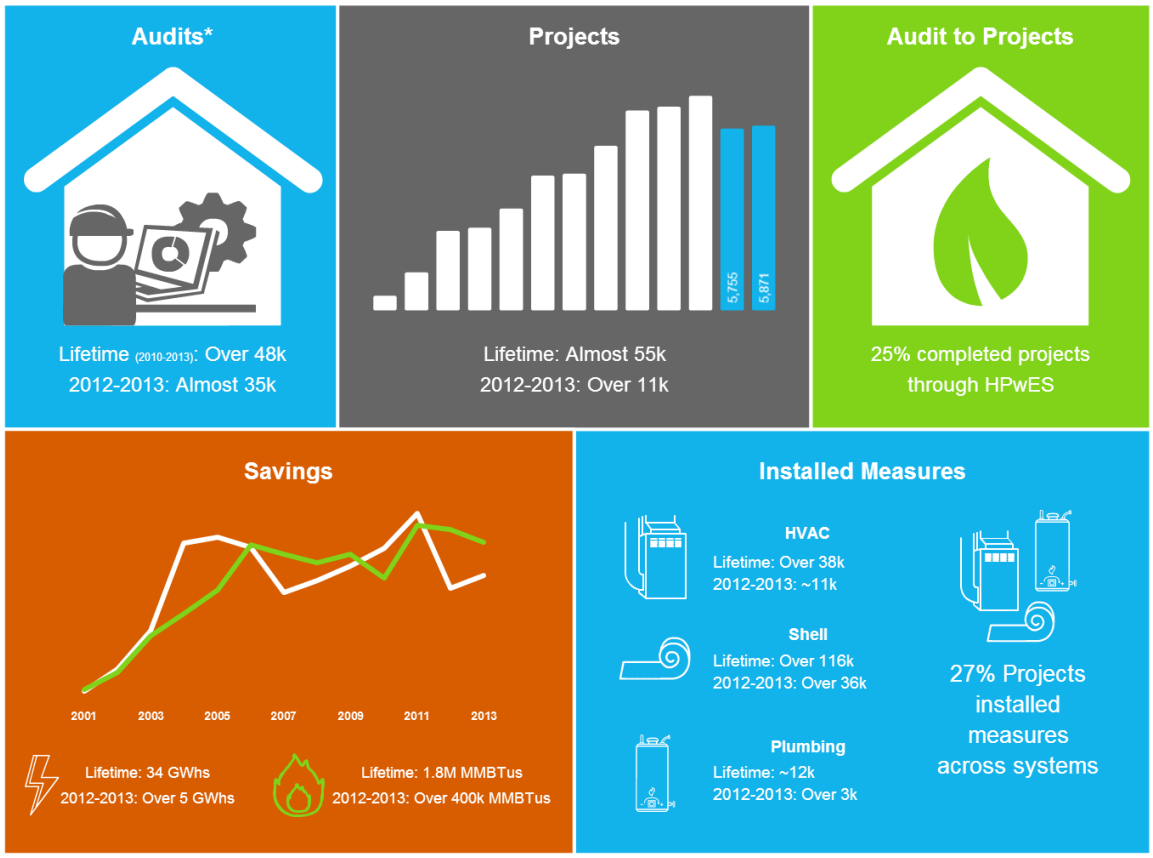
1.2.3 Program Delivery and Quality Assurance

NYSERDA managed the HPwES program and worked with its contractors, Conservation Services Group (CSG), Honeywell, Energy Finance Solutions (EFS), Energy Savvy, and Brand Cool, to deliver and implement all elements of the program. In 2012-13, program activities included managing the main program database, the Comprehensive Residential Information System (CRIS), and the New York Home Performance Portal, through which program staff, contractors, and consumers had access to project data. Consistent with the program goal to improve the quality of residential energy efficiency projects, the quality control and quality assurance (QA/QC) activities were an important program component. To ensure contractors' work met the high quality standards defined by NYSERDA and BPI, the program staff conducted ongoing field QA/QC processes of at least 10% of all completed projects.

1.2.4 Program Status

NYSERDA rolled out HPwES in 2001, adding assisted program opportunities in 2002, Energy $mart Residential Loan Fund financing options in 2006 to 2011, GJGNY financing options in 2010, and free or reduced-cost audits in late 2010. The annual number of projects completed steadily increased year over year to an all-time high of 6,842 projects in 2011. In total, NYSERDA's HPwES program had completed nearly 55,000 projects by December 31, 2013. The program-reported savings were more than 34 GWhs of electricity and 1.8 million MMBtus between 2001 and 2013 (Figure 1-1).

Figure 1-1. HPwES Program Reported Status



* HPwES began tracking all audits in 2010, prior to this time the program tracked audits for completed projects only. The total lifetime tally of 48,000 audits includes audits from 2010 to the end of 2013.

1.2.5 Logic Model

Understanding the program goals and the mechanism through which the program sought to affect the New York State retrofit market was critical to an effective PE/MCA of the HPwES program. The long-term goals for the HPwES Program were to:

1. Create a market-based system of supply and demand that supports the renovation of existing homes toward greater energy efficiency using a "house-as-a-system" approach.

2. Enhance the capacity of the market to supply "one-stop-shop" services for comprehensive energy efficiency for existing one- to four-unit family homes.

3. Improve the quality of residential energy efficiency installations through a whole-house approach emphasizing the "house-as-a-system" approach and high-quality installation techniques.

4. Develop a network of BPI-certified technicians (and accredited contracting firms) that market, sell, and provide comprehensive "house-as-a-system" energy assessments and services that focus on increasing the health, safety, durability, comfort, and energy efficiency of existing one- to four-unit family homes.

5. Lessen the burden imposed by energy consumption and other utility-related costs with a significant emphasis on providing this benefit for low- to moderate-income residents.

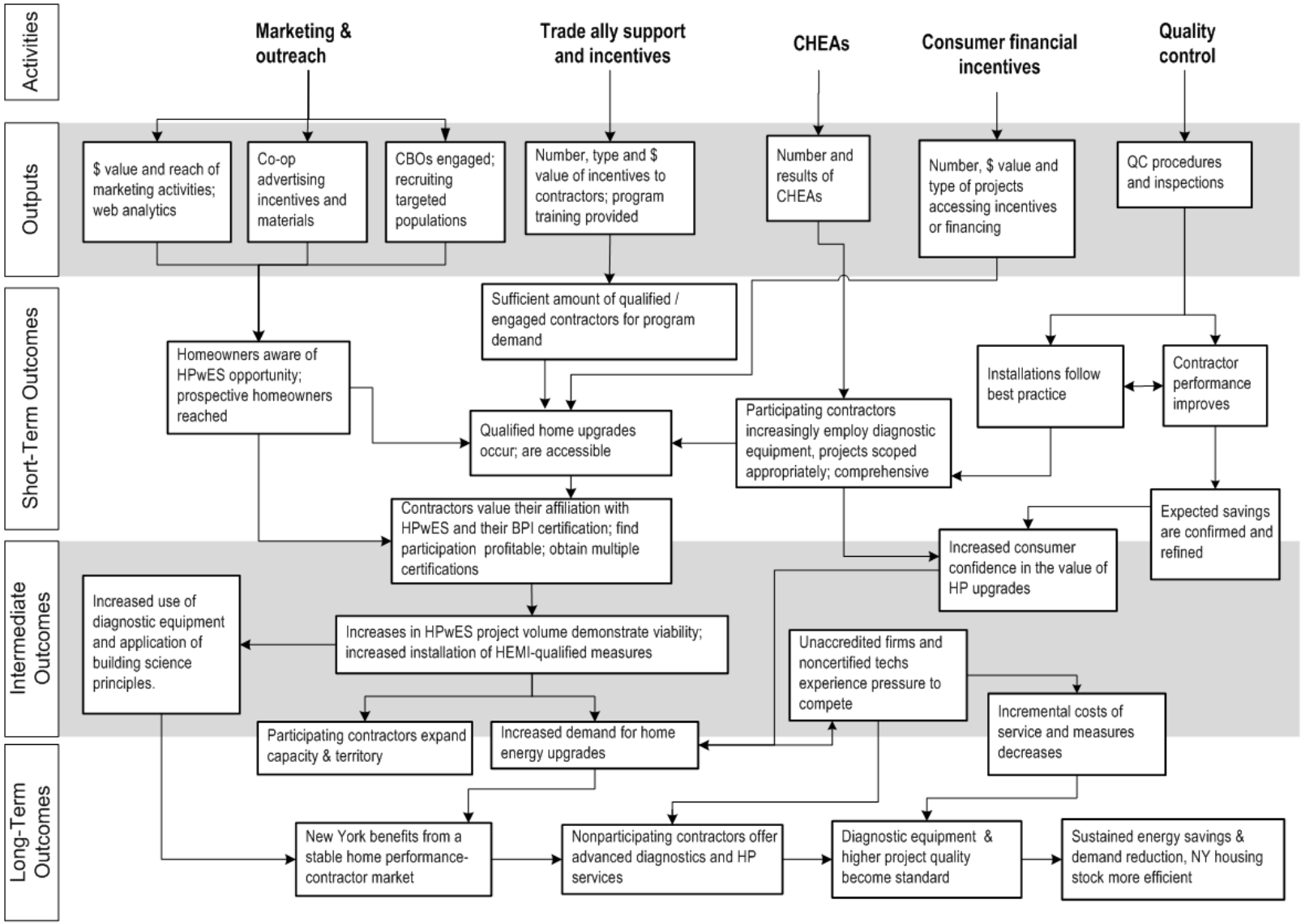
6. Create sustainable energy savings and environmental benefits.

From January 2014 to January 2015, the evaluation team worked with HPwES staff to update the program logic model (see Appendix B). The logic diagram provided an overview of the program activities and the key outputs, and short-, intermediate-, and long-term outcomes these activities were designed to produce (Figure 1-2). Underlying this program logic were testable assumptions about the program and market, including:

- Supply: The HPwES program built an industry of professionals who can diagnose and treat homes with high energy bills, shell or comfort problems, or health and safety problems, and developing this industry would lead to market pressure on nonparticipating contractors to provide similar services.

- Demand: Informing homeowners about the benefits and opportunities of home upgrades supported by building science principles through home energy audits would lead to increased demand for comprehensive projects and increased completion of comprehensive projects.

Figure 1-2. Initiative Logic Diagram



1.3 Evaluation Methodology

Between January 2014 and January 2015, the evaluation team conducted a document review, a database analysis, and collected data from six groups (Table 1-1). In September and October 2014, the team conducted interview surveys with HPwES contractors active in 2012 or 2013. Between September and December 2014, the team worked with NYSERDA's survey contractor Abt SRBI to survey HPwES participants completing projects in 2012 and 2013, as well as 2012-13 GJGNY audit recipients who had not completed HPwES projects (audit-only households). The audit-only sample included both natural gas-heated homes and delivered fuels-heated homes. The natural gas sample was conducted through the GJGNY Impact Evaluation team's larger survey, and included only those who had not installed any major measures since their audit. Participant and audit-only CBO-affiliated contacts also were sampled; CBO-affiliated results were excluded from this report and separately reported in the CBO Phase II PE/MCA (Appendix J).

For the nonparticipant home energy upgrader survey conducted in January 2015, the team surveyed New York State homeowners who had completed at least $2,000 in home improvement projects in the past two years. Each of the nonparticipating consumers had included some energy-related upgrades, such as windows, appliances ("other upgrades" group), HVAC insulation, or air sealing upgrades in those projects ("core upgrades" group"). The team screened this group for those in either the "other" or the "core upgrades" group who would likely qualify for AHPwES based on their incomes. The team used an incidence test to develop quotas.

For the nonparticipant contractor survey conducted in December 2014, the team used company information and Standard Industrial Classification (SIC) codes from InfoUSA to identify and classify New York State residential contractors into four categories: general contractors and one of three types of specialty contractors (HVAC, insulation, or "other" residential specialty). These lists were matched with NYSERDA and BPI contractor lists.

Table 1-1. Summary of Data Collection Activities and Sampling

Group		Population	Completes	Method	Dates
Program and implementation staff		13	13	In-depth phone interview	
2012-13 Participating contractors		231	52	Phone interview	September to October, 2014
2012-13 Participant households	Market rate	7,116	400	Phone survey	November to December, 2014
	Assisted	3,805	170		
2012-13 Audit-only households	Natural gas	17,422	202	Web or phone survey w/ Impact Evaluation team	September to December, 2014
	Delivered fuels	680	110	Web survey	
Nonparticipant home energy upgraders	Other upgrades	NYS nonparticipant homeowners in 1-4 unit buildings	208	Web panel survey	January, 2015
	Core upgrades		323		
	Assisted		239		
Nonparticipant contractors	General contractor	8,406	65	Phone survey	December, 2014
	HVAC specialty	2,488	41		
	Insulation specialty	226	11		
	Other specialty	1,810	12		

1.4 This Evaluation

The PE/MCA of the 2012-13 HPwES program addressed the following six research objectives:

1. Assess program operations, identify potential issues, and develop recommendations to improve program operation and performance

2. Document program progress and explore the value, benefits and concerns associated with completing HPwES-qualified projects and living in upgraded homes

3. Develop a comprehensive understanding of current and emerging markets

4. Provide baseline and background information required by NYSERDA to define and deliver programs to target markets

5. Track changes in markets over time with a specific focus on market indicators that are likely to be affected by program offerings

6. Develop preliminary estimates of market effects

This report draws on seven activity-specific memos (see Appendices) that presented detailed findings from each data collection activity. To address the evaluation research objectives, this report is organized into six chapters. Chapter one provides an overview of the program and the scope of the evaluation. The next three chapters provide information about the residential energy efficiency upgrade market in New York State: chapter two characterizes the residential single-family household efficiency upgrade market; chapter three characterizes the residential contractor efficiency market; and chapter four provides a market model of HPwES and a preliminary assessment of market effects. Chapter five summarizes program process evaluation findings, and chapter six summarizes the PE/MCA team's findings by research issue, along with conclusions and recommendations.

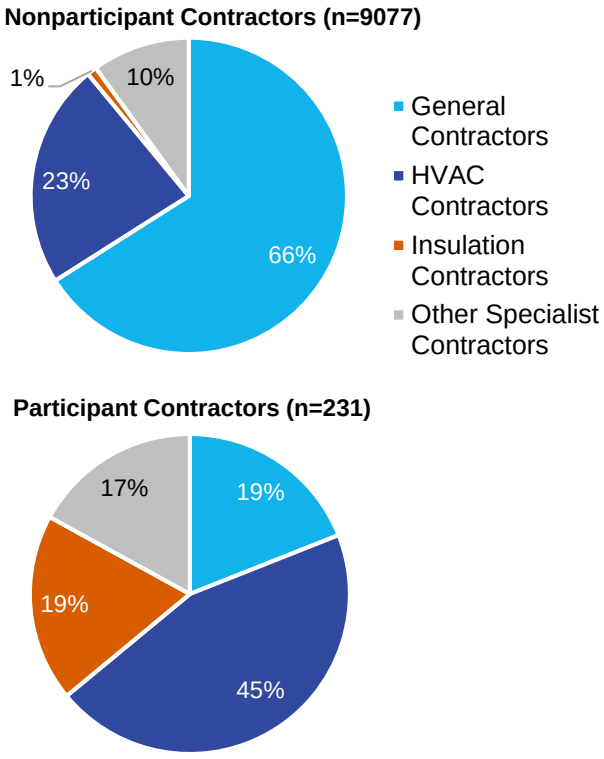
2 Residential Contractor Market Characterization and Assessment

The PE/MCA team characterized and assessed the New York State residential contractor market using data collected from NYSERDA's CRIS database for 2012 (Appendix C), an April 2014 InfoUSA, a survey of residential market contractors conducted in December 2014 (Appendix D), and a survey of participating HPwES contractors conducted in September and October 2014 (Appendix G). The team limited the market analysis to general, heating, ventilation, and air conditioning (HVAC), insulation, and "other" specialty contractors who serviced and/or installed home upgrades supported by HPwES in existing single-family households in New York State. Appendix D presents more detailed information on the methods used in this research and the results from the analysis.

2.1 Residential Contractor Estimates and Characteristics

The PE/MCA team identified an estimated 9,300 active residential general, HVAC, insulation, and other specialty contractors in New York State who install or serviced at least one of the types of upgrades supported by HPwES in existing single-family households (BPI 2014; InfoUSA 2014; Appendix C; Appendix D).[12] About two-thirds of these nonparticipant contractors were general contractors and one-third were specialty contractors (i.e., HVAC, insulation, and other specialty trades) (Figure 2-1; Appendix D). At the end of 2013, HPwES participating contractors comprised about 2% of all residential contractors, and a much higher percentage were specialty contractors (81%) compared to nonparticipant contractors (34%) (Figure 2-1; Appendix D).

Figure 2-1. Nonparticipant and HPwES Participant by Contractor Trades



[12] Contractor estimate was from a survey of 129 nonparticipant respondents applied to the cleaned and verified sample frame of 13,300 contractors (see Section Appendix D). In contrast, the NYSERDA Residential Statewide Baseline Study (RSBS 2015) found approximately 18,000 HVAC and plumbing contractors from an uncleaned and unverified list (see Appendix D for more details).

Residential contractors had an estimated $18.2 billion in residential sales and employed about 73,000 employees in New York State in 2013 (Appendix D). Participating contractors and nonparticipant contractors with a BPI-certified employee(s) reported higher residential sales and more employees per firm compared to market contractors (Appendix D).

Nearly three-fourths of market contractors surveyed in December 2014 reported a favorable outlook for their business over the next two years, and more than one-third reported being interested in expanding their residential services in the next two years (Appendix D). The most common types of services nonparticipant contractors reported interest in adding to their business included installing energy-efficient measures, conducting energy audits, and installing building automation systems.

2.2 Contractor Training

Training was much more common for participating contractors compared to nonparticipant contractors (Appendix D; Appendix G). Nearly all (94%) of surveyed participating contractors reported having at least one employee with non-BPI training experience in 2014 (Table 2-1) compared to 39% of surveyed nonparticipant contractors.[13] Using the BPI list of 412 BPI-certified contractor firms in New York State and comparing that to the list of participating contractor firms in the HPwES program, as of December 2014, 87% of participating contractors were included on BPIs listing as having at least one BPI-certified employee compared to 2% of nonparticipating contractors (Table 2-1).[14] Including both participating and nonparticipating contractors, 4% of the 9,308 market contracting firms had a BPI-certified employee. Most surveyed participating contractors (79%) placed a high value on BPI certification for differentiation among competitors, the hiring of employees, and marketing to customers.

Table 2-1. Number of Firms in New York State Matched to BPI's List of Firms with a BPI-Certified Employee, by HPwES Participation Status

Contractor Type	Number of contractors	Matched to BPI list of certified contractors	
		Number	Percentage
Participant contractors	231	200	87%
Nonparticipant contractors	9,077	212	2%
Total	9,308	412	4%

[13] Non-BPI training organizations for which employees had certification include North American Technician Excellence (NATE), American Society of Heating, Refrigeration, and Air-conditioning Engineers (AHSRAE), Air Conditioning Contractors of American (ACCA), National Oil-heat Research Alliance (NORA), and Residential Energy Services Networks (RESNET).

[14] All participating contractors were required to have a BPI certified employee. The team matched 87% of participating contractor firms to the BPI list posted at the time of the matching (December 2014). This was likely due to the list not being up-to-date and/or some participating contractors currently pursuing BPI certification.

Nonparticipant contractors surveyed in December 2014 over-reported the number of staff with BPI certification. Twenty percent reported having at least one BPI certified employee, whereas just 2% of responding firms matched to the BPI list of certified contractors in New York State. Extrapolating the reported 20% of firms to the population resulted in about 2,400 firms with a BPI-certified employee, whereas the BPI website listed 412 firms as of December 2014, a 582% overestimate. This was likely due to several factors:

- Respondents could have considered a BPI-certified subcontractor as part of the firm for their response.
- Respondents could have had an employee with an expired certification or an employee currently pursuing certification.
- Respondents could have hired a BPI-certified employee or have an employee who earned certification before the BPI list was updated.
- Respondents could have been confused about which certifications employees have and mistakenly affirmed "BPI" when asked (Appendix D).

Nonparticipant contractors who reported not having an employee with BPI or non-BPI certification mentioned several reasons for why this was the case. These included not having time to deal with certification tests or paperwork (41%), an inability to afford fees to get or maintain certification (41%), customers who do not care about certifications like BPI (33%), a lack of relevancy for BPI-certification for most of their jobs (32%), and no need for additional training (28%).

2.3 Financing

Overall, about half of participating and nonparticipant contractors surveyed in September and October 2014 reported advising their customers on different project payment options (in addition to standard cash, check, or credit), and one-fourth of all contractors reported offering customers financing options (Appendix D). Surveyed contractors who offered financing options reported offering, from the most to least common, the following options: manufacturer financing, in-house financing, distributor financing, bank financing, other third-party financing, NYSERDA financing, utility financing, and GE Capital financing. Among participating contractors, however, NYSERDA financing was the most common type financing option reported (65%).

2.4 Energy Audits

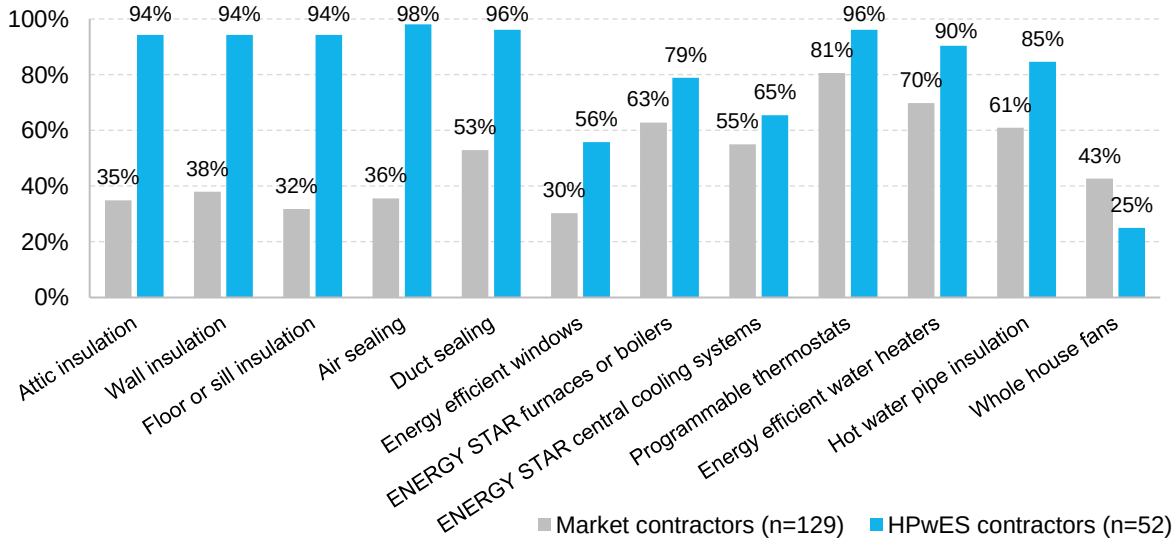
Nearly two-thirds of participating contractors surveyed in September and October 2014 reported providing diagnostic energy audits outside the program, and 20% of nonparticipant contractors surveyed in December

2014 reported performing a home energy audit in the past two years (Appendix D; Appendix G). Based on these findings, the PE/MCA team estimated about 2,000 contractor firms in New York State provided home energy audits as of December 2014. Surveyed participating contractors reported always recommending a diagnostic audit to their customers. Almost all nonparticipant contractors who reported performing home energy audits in the past two years reported performing walk-through audits (96%), and about three-fourths reported performing diagnostic audits; however, diagnostic energy audits provided by nonparticipant contractors appeared to be less comprehensive than those provided by participating contractors. Nonparticipant contractors reported having fewer types of diagnostic audit equipment and less frequent use of their diagnostic equipment compared to participating contractors (Appendix D).

2.5 Installation Practices

Nonparticipant contractors surveyed in December 2014 reported promoting energy-efficient products over standard products in 71% of their residential projects and installing energy-efficient products, rather than standard products, in 57% of their residential projects (Appendix D). Promotion and installation of energy-efficient products was more common among specialty contractors compared to general contractors. In addition, a few surveyed nonparticipant specialty contractors reported installing products from other specialty trades. As shown in Figure 2-2, however, a much higher percentage of surveyed participating contractors reported installing a variety of energy-efficient products and performing more energy-efficient HVAC practices compared to the number reported by surveyed nonparticipant contractors (Appendix D).

Figure 2-2. Percentage of Participating and Nonparticipant Contractors Who Install Different Types of Residential Energy Efficient Measures



A majority of surveyed nonparticipant contractors (61%) reported rarely hiring subcontractors, which suggested that most contractors did projects with a scope of work that fit their firm's skillset (Appendix D).

Nonparticipant contractors that reported hiring subcontractors mentioned electrical, HVAC, plumbing, insulation and air sealing, duct and sheet metal, and carpentry as the trades they hired.

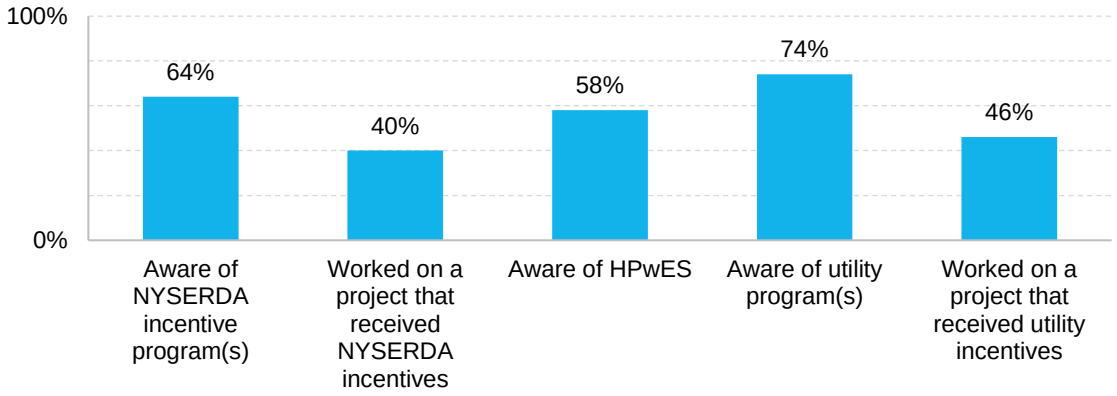
Callbacks were uncommon for surveyed participating contractors, as well as nonparticipant contractors. More than three-fourths of participating and nonparticipating contractors reported that they typically had to return to 10% or fewer of their projects to address a customer complaint. Most of the specific types of problems reported by participating contractors involved issues with attics, crawlspaces, or Cape Cod-style homes, while the most common issues reported by nonparticipant contractors concerned the HVAC system not working correctly or the customer needing more information on using or maintaining equipment (Appendix D; Appendix G).

2.6 Energy Efficiency Program Awareness and Participation

Most nonparticipant contractors in New York State surveyed in December 2014 reported awareness of NYSERDA incentive programs (64%), and HPwES specifically (58%), and 40% reported working on a NYSERDA-incented project (Figure 2-3; Appendix D). In addition, more than half reported some interest in participating in NYSERDA's programs in the future (54%). The most common sources of program awareness included trade allies, word of mouth, and advertisements.

Surveyed nonparticipant contractors reported somewhat higher awareness of and experience with utility incentive programs in New York State (Appendix D). Nearly three quarters of nonparticipant contractors reported awareness of a utility incentive program (74%) and 46% reported working on a residential project that received utility incentives (Figure 2-3; Appendix D). The most common utility incentives were from National Grid, Con Edison, NYS Electric & Gas, and Rochester Gas & Electric. Higher percentages of nonparticipant specialty contractors reported awareness of and experience with both NYSERDA and utility incentive programs compared to general contractors.

Figure 2-3. Percentage of Nonparticipant Contractors with Awareness of and Experience with NYSERDA and Utility Incentive Programs (n=129)



2.7 Summary

In New York State in late-2013, there were at least 9,300 active general, HVAC, insulation, and other specialty contractors in the single-family market who installed at least one of the types of energy upgrades supported by HPwES. These contractors reported about $18.2 billion in residential sales in 2013. About 2% of these contractors were actively participating contractors in 2012-13. Participating contractors were much more likely to be specialty contractors (versus general contractors) and reported more in annual sales and employees per firm compared to nonparticipant contractors.

Nonparticipant contractors surveyed in December 2014 reported doing or having interest in doing various energy efficiency activities, such as getting training and certifications related to energy efficiency, providing diagnostic home energy audits, and promoting and installing energy-efficient measures in their residential projects. Most nonparticipant contractors also reported awareness of utility (74%) and NYSERDA (64%) incentive programs, including HPwES (58%), and more than half expressed interest in participating in these programs in the future.

The research indicated, however, that nonparticipant contractors were not the same as participating contractors in regards to their work in energy efficiency. Participating contractors surveyed in September and October 2014 reported having more training experience and certifications, performing audits more frequently and comprehensively, installing more types of energy-efficient equipment, and using more energy efficiency practices compared to nonparticipant contractors.

3 Single-Family Households Market Characterization and Assessment

The PE/MCA team characterized and assessed the home improvement market for existing single-family households in New York State using multiple secondary and primary data sources. To identify nonparticipant homeowners, the team surveyed members of a web panel of all homeowners in New York State in January 2015.[15] Detailed information on the methods used to collect and analyze the data, as well as the results from analyses, is in Appendix E, Appendix F and Appendix H.

3.1 Household Estimates and Characteristics

In New York State in 2013, there were approximately 5.3 million single-family one- to four-unit households, of which about 4.7 million were occupied households and 3.4 million were owner-occupied households (American Community Survey [ACS] 2013). During 2012-13, 0.2% of New York State single-family one- to four-unit household population – about 11,300 households – participated in HPwES (participant households) and 44% of the nonparticipant owner-occupied households reported a home improvement project of at least $2,000 that included an energy-related upgrade (nonparticipant home energy upgraders)[16] (Appendix C; Appendix F). These upgrades included heating equipment, cooling equipment, air sealing, insulation, windows, water heating equipment, and appliances.

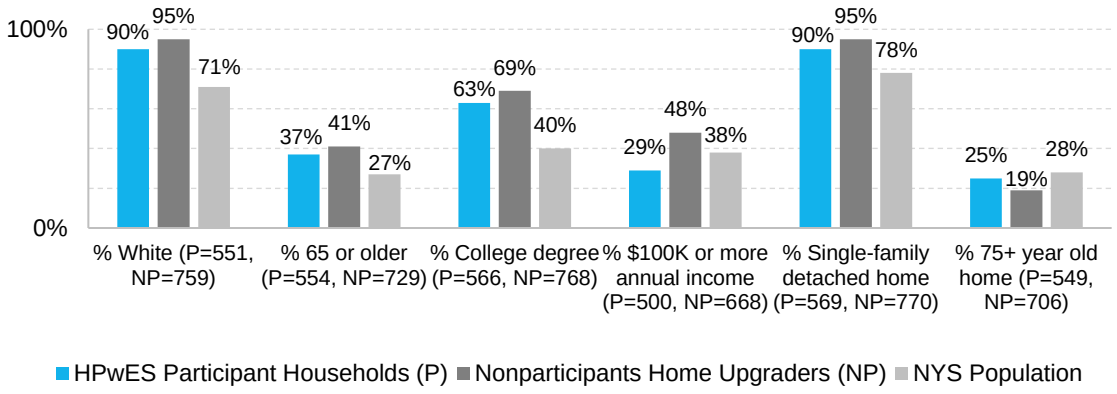
2012-13 participant households surveyed in November and December 2014, compared to nonparticipant home energy upgraders surveyed in January 2015, were more demographically similar on some variables to the New York State population (Figure 3-1; ACS 2013; Appendix F; Appendix H). Surveyed participant households were more likely to be non-white and slightly younger, have lower levels of education and income, and live in older, single-family homes than surveyed nonparticipant home energy upgraders. These demographic differences were at least partially due to the AHPwES component of the program, which targets lower-income households in New York State that would have more difficulty affording $2,000 or more in upgrades. Surveyed market-rate participants also reported lower incomes than surveyed nonparticipant home energy upgraders, with about one-third of participant households and nonparticipant

[15] Abt SRBI contracted with a web panel provider to use a web panel representative of all homeowners in New York state for the HPwES nonparticipant survey. The panel provider assured Abt SRBI that the web panel met the demographic criteria of all New York homeowners across multiple housing types. Homeowners in the web panel accessed the HPwES nonparticipant survey as part of their agreement with the web panel provider.

[16] The team identified nonparticipant home energy upgraders by surveying a web panel representative of all New York State homeowners. The survey began with screening questions to determine whether respondents met the criteria for being a home energy upgrader in a 1-4 unit dwelling who had included an energy related upgrade in their project. One thousand seven hundred and thirty-three members of the web panel started the survey (RR: Table F-3 indicates that 1,859 started the survey.) and 41% met the home energy upgrader criteria and reported they had not participated in HPwES.

home energy upgraders reporting they receive some public assistance, including Social Security (Appendix F; Appendix H). This was likely due to the impact of incentives for upgrades, which could attract different types of households than those making home energy upgrades outside the program.

Figure 3-1. 2013 Demographic Characteristics of Surveyed HPwES Participant Households and Nonparticipant Home Energy Upgraders, and the New York State Population



3.2 Household Energy Characteristics

As of 2013, 100% of owner-occupied households in the Northeast U.S. had electricity; more than half had natural gas, and more than one-third had fuel oil for some type of end-use (American Household Survey [AHS] 2013). All New York State single-family, one- to four-unit households also had some type of heating equipment, most commonly central forced air furnaces (46%), steam/hot water systems (28%), and baseboard heating (18%), and most used natural gas (55%) or a delivered fuel (33%; includes oil, propane, or kerosene) as the heating fuel (NYSERDA Residential Statewide Baseline Study [RSBS] 2015). In addition, most New York State single-family households (85%) had central air-conditioning (CAC) equipment or a room AC unit, all households had water heating equipment, most of which were storage tanks, and a majority of households had foundation, wall, and floor insulation (RSBS 2015; Appendix E).

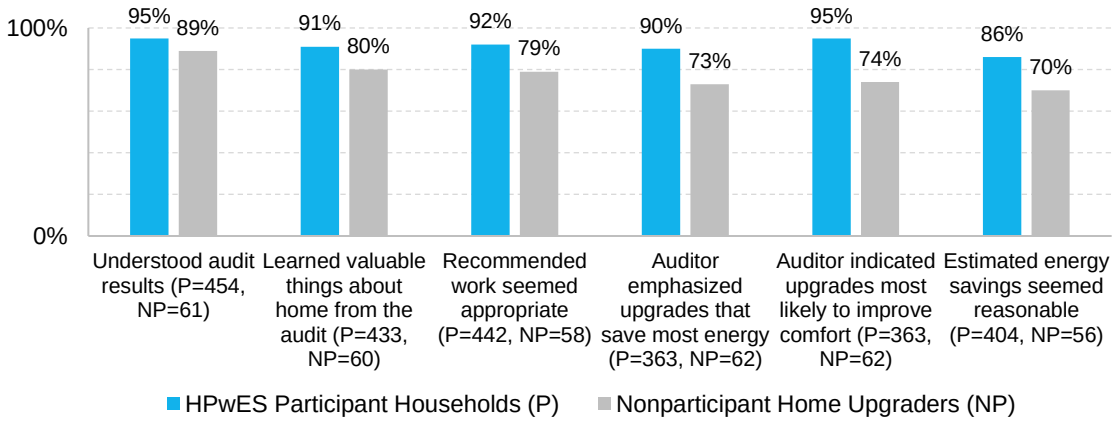
3.3 Home Energy Audits

All participant households received a home energy audit as part of their participation in the program. In contrast, very few nonparticipant home energy upgraders surveyed in January 2015 who spent at least $2,000 on a home improvement in the past two years that included an energy upgrade (8%) reported having a home energy audit, but a majority (66%) who did not have an audit indicated high interest in having one before their next project (Appendix F).

Most surveyed nonparticipant home energy upgraders who had had an energy audit indicated that the audit and auditor were effective, and many learned about home upgrades that they had not previously considered (Appendix F). More surveyed participant households than surveyed nonparticipant home energy upgraders,

however, rated their audit and auditor as effective (Figure 3-2; Appendix F; Appendix H). In addition, most 2012-13 participant households (98%) had the contractor who performed the home energy audit do their HPwES project, while most surveyed nonparticipant home energy upgraders (65%) who had an energy audit hired a contractor other than their energy auditor to perform their home improvement project (Appendix F; Appendix H).

Figure 3-2. Percentage of HPwES Participant Households and Nonparticipant Home Energy Upgraders Who 'Agreed' or 'Strongly Agreed' with Statements about their Home Energy Audit



3.4 Home Energy Upgrade Activities

Among the home energy upgrades listed in Figure 3-3, surveyed participant households and nonparticipant home energy upgraders reported making an average of two upgrades in 2012-13; however, there were substantial differences in the types of upgrades each group made (Appendix C; Appendix F). There was some evidence that a few surveyed nonparticipant home energy upgraders took a multi-system approach to making energy-related upgrades: 20% installed all three of the "core" energy upgrades (i.e., insulation, air sealing, and HVAC), 60% installed at least one, and 18% installed four or more of the energy-related upgrades in Figure 3-3 (Figure 3-4; Appendix F). In addition, a majority of nonparticipant home energy upgraders who included these upgrades reported hiring a contractor, particularly for projects that included HVAC, window, or water-heating upgrades. All participant households had a contractor install their upgrades through the program (Appendix F).

Figure 3-3. Percentage of HPwES Participant and Nonparticipant Projects That Included Energy-Related Upgrades

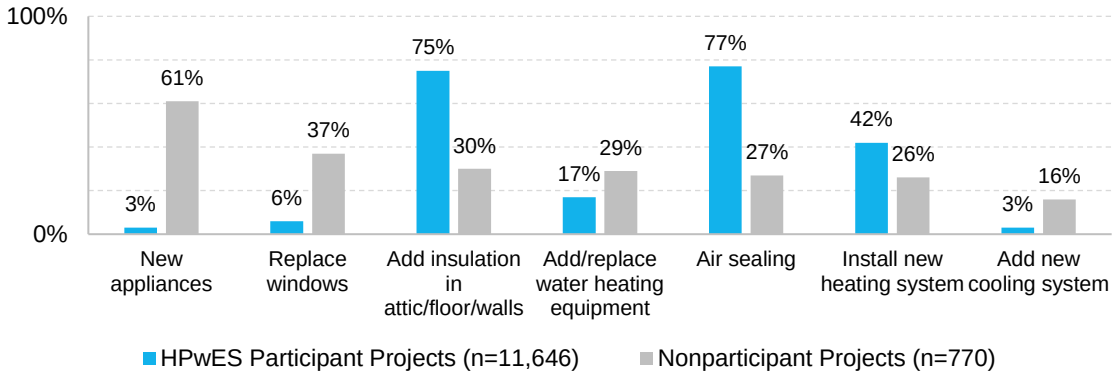
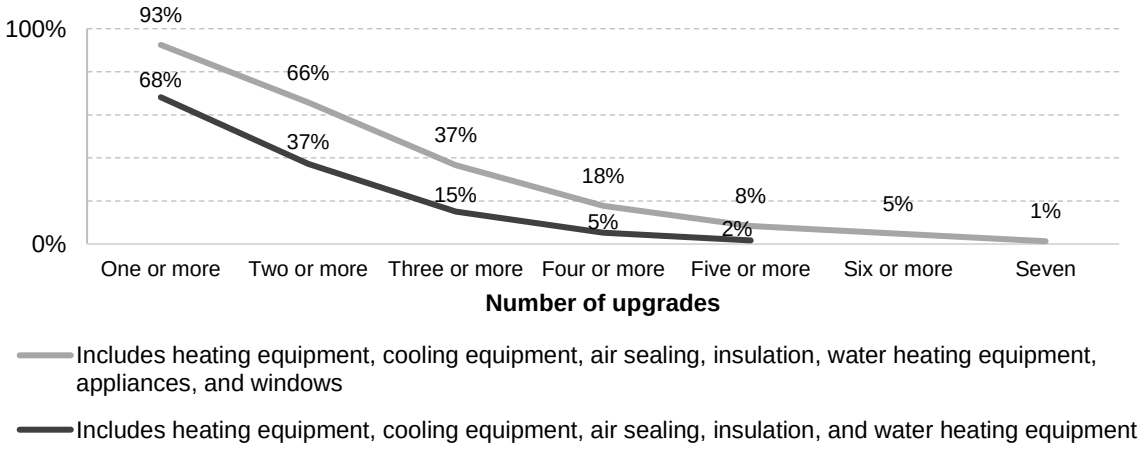


Figure 3-4. Percentage of Nonparticipant Home Energy Upgraders that Made One or More Energy-related Upgrades as Part of their Home Improvement Project in the Past Two Years

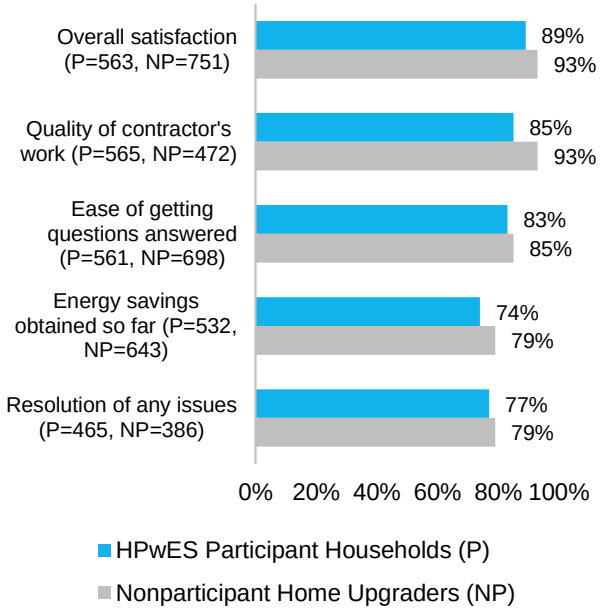


The 2013 American Housing Survey estimated that 60% of Northeast owner-occupied households completed a home improvement project of any kind in 2012-13, which was about $13.5 billion spent annually in home improvement activities (AHS 2013).[17] The PE/MCA survey of nonparticipant homeowners resulted in a similar proportion (67%) who completed a home improvement project in the last two years, 44% of whom completed an energy-specific home upgrade. In the previous two years, 37% of nonparticipating home energy upgraders had made window upgrades, 32% had made a heating and/or cooling upgrade, 30% had made an insulation upgrade, 29% had made a water heating equipment upgrade, and 27% had made an air sealing upgrade.

[17] The $13.5 billion in estimated annual home improvement expenditures is less than the $18 billion reported in annual contractor residential sales since the latter includes sales from new construction and multifamily projects.

Only a few of the nonparticipant home energy upgraders surveyed in January 2015 reported that saving energy or energy costs was their primary reason (6%) and motivation (11%) for making their energy-related improvements upgrades in 2012-13 (Appendix F). Instead, most surveyed nonparticipant home energy upgraders reported making their energy improvements as a part of a larger remodeling project, and most home energy upgraders reported being motivated to do their energy project primarily to improve comfort or aesthetics, update features or equipment in their home, or to protect or increase their home's value (Appendix F). In addition, most surveyed participant households and nonparticipant home energy upgraders reported satisfaction with their overall project and various aspects of their project, including energy savings obtained so far (Figure 3-5; Appendix F; Appendix H).

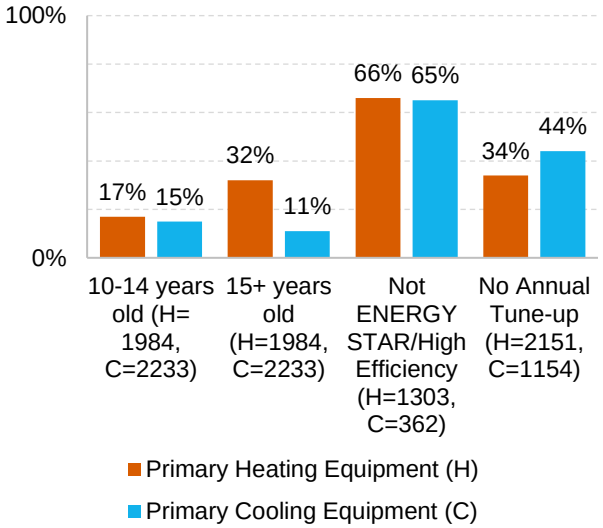
Figure 3-5. Percentage of HPwES Participant Households and Nonparticipant Home Energy Upgraders Satisfied with their Project



3.5 Home Upgrade Market Potential

There was potential in the New York State household population for making energy-related upgrades in the future (Appendix E). For example, according to the RSBS (2015), many primary heating and cooling systems in single-family homes were near the age of replacement, were not high efficiency, and/or were not serviced regularly (Figure 3-6).

Figure 3-6. Percentage of Primary Heating and Cooling Systems in New York State Households with Potential for Upgrade

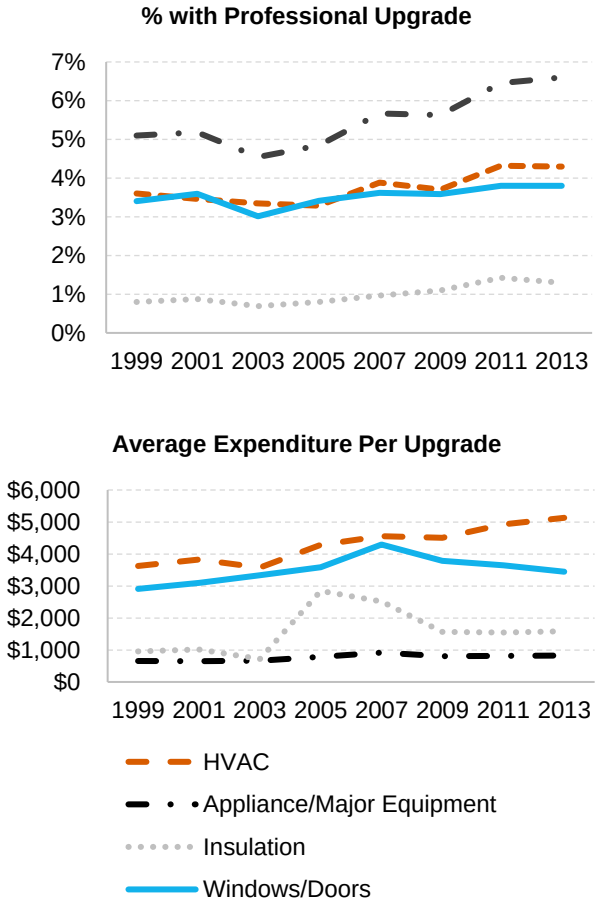


Similarly, according to the 2009 Residential Energy Consumption Survey (RECS), about one-third of owner-occupied households had a programmable thermostat, and some households set their winter indoor

temperature to 71 degrees or higher (12%) and summer indoor temperature to 70 degrees or lower (38%) throughout the day. The 2013 AHS found few owner-occupied households in the Northeast (5%) also reported being uncomfortably cold due to heating system inadequacies or high heating costs. In addition, 40% of storage water heaters in the single-family homes in New York State were 10 years or older, and about 75% did not have high-efficiency insulation; 20% of owner-occupied households in New York State had no or poor quality insulation and door weather-stripping (RECS 2009; RSBS 2015).

Overall trends in the home improvement market showed a gradual increase in the percentage of homes making energy-related upgrades between 1999 and 2013, but trends in expenditures on these upgrades were mixed (Figure 3-7; Appendix E). The annual percentage of Northeast U.S. owner-occupied households that had had professional HVAC, insulation, window/door, and appliance/water heater projects had been gradually increasing between 1999 and 2013 (Joint Center for Housing Studies [JCHS] 2015). Professional project expenditures also had been increasing for HVAC projects since 1999, but had leveled off for insulation and appliance/water heater projects and gradually decreased for window/door projects since 2007 (JCHS 2015). A substantial percentage of Northeast households did home improvement projects that had potential for HPwES upgrades. Many surveyed nonparticipant home energy upgraders reported the following reasons for making their energy-related improvements: remodeling a kitchen or bath (3.1%); adding a room (1.4%); replacing roofing or siding (6%); or adding, removing, or upgrading a ceiling, wall, or floor (5.7%) (JCHS 2015). Trends in the percentage of households doing these general types of projects (except roofing), however, had been flat or declining since 2007 (JCHS 2015).

Figure 3-7. Percentage of Northeast Owner-Occupied Households Reporting Professionally-installed Upgrades and Average Expenditure Per Upgrade, 1999-2013



About half of nonparticipant home energy upgraders surveyed in January 2014 reported planning to make upgrades in the next two years to reduce their home's energy use (Appendix F). The most common upgrades nonparticipant home upgraders planned to make were energy-efficient windows or doors, energy-efficient lighting, energy-efficient appliances, wall insulation, attic insulation, and/or weatherization. Many nonparticipant home energy upgraders, however, reported they needed to have confidence in the potential energy savings, and would need rebates to offset the costs of equipment, access to low-interest financing, and, potentially, assistance finding a contractor to help them make energy-efficient upgrades in the future (Appendix F).

3.6 Contractor Selection

Of the nearly two-thirds of surveyed nonparticipant home energy upgraders who hired a contractor to do their home improvement project in 2012 or 2013, about half got multiple contractor bids, compared to about one-fourth of participant households (Appendix F; Appendix H). Most surveyed nonparticipant home energy upgraders reported finding their contractor through their personal networks, but a few mentioned advertisements, the Internet, a community or nonprofit organization, or an event (Appendix F). Many surveyed nonparticipant home energy upgraders also reported considering whether a contractor was certified, but very few reported awareness or consideration of organizations with which contractors may have been affiliated or from which they may have received certification, such as NYSERDA or BPI (Appendix F). In contrast, surveyed participant households reported substantially higher awareness of these types of organizations (Appendix H).

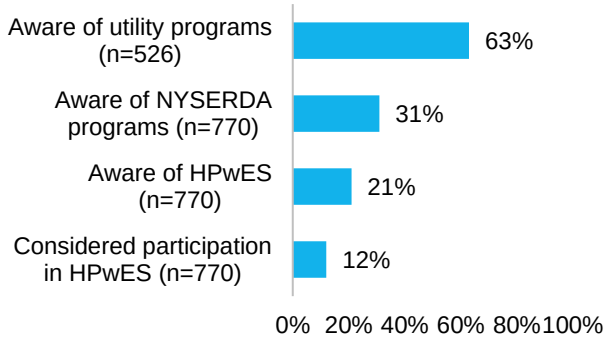
A majority of participant households surveyed in November and December 2014 and nonparticipant home energy upgraders surveyed in January 2015 reported that a contractor's ability to assess different parts of the home and make energy savings recommendations, as well as to use diagnostic equipment and software to estimate energy savings potential were important (Appendix F; Appendix H). Notably, a substantially higher percentage of surveyed participant households, compared to surveyed nonparticipant energy home upgraders, ranked these contractor qualities as important.

3.7 Project Funding and Awareness of Incentive Programs

More than half of surveyed participant households reported paying for their 2012 or 2013 project with a program-sponsored (30%) loan and/or other type of loan or financing (23%), while most surveyed nonparticipant home energy upgraders reported paying for their project with cash/check (65%) and/or a credit card (42%) (Appendix F; Appendix H). In addition, a few surveyed nonparticipant home energy upgraders, particularly households receiving public assistance, also reported receiving financial assistance for their project in the form of utility incentives (14%), or other type of grant, incentive, or tax credit (12%) to pay for their project (Appendix F).

Nearly two-thirds of nonparticipant home energy upgraders surveyed in January 2015 reported awareness of utility incentives or rebates for energy efficiency upgrades, and awareness was higher among home upgraders receiving some form of public assistance (Figure 3-7; Appendix F). Reported awareness of NYSERDA programs that provide incentives or rebates was much lower among surveyed nonparticipant home energy upgraders (31%), particularly awareness of HPwES (21%) (Figure 3-8). In 2004, 20% of nonparticipants reported awareness of HPwES. According to the RSBS (2015), New York State single-family households most often reported not participating in energy efficiency programs due to lack of awareness.

Figure 3-8. Percentage of Nonparticipant Home Energy Upgraders Aware of Utility and NYSERDA Incentive Programs



About one in ten surveyed nonparticipant home energy upgraders reported they had considered participating in NYSERDA's HPwES program when planning their home improvement project in 2012 or 2013 (Figure 3-8; Appendix F). The most frequently mentioned reason consumers aware of HPwES reported for not participating, particularly for assisted home energy upgraders, was that they thought they were ineligible for participation (33%). The second most commonly reported reason for not participating was that home energy upgraders thought participating would be too expensive or that incentives were not high enough (14%). Other reasons home energy upgraders reported for not participating in HPwES included that they thought participation would be too burdensome or require too much time (9%), that the incentives for the upgrade(s) they planned to make had expired (6%), and/or that they did not want to use a NYSERDA contractor (3%).

3.8 Summary

During 2012-13, participant households comprised 0.2% of the New York State target population of one- to four-unit single-family households. During the same time, 68% of surveyed nonparticipant respondents completed some kind of home improvement project. The proportion of households that reported completing home improvement projects in the nonparticipant survey was very similar to the AHS's (2013) estimate of 60% of Northeast owner-occupied households. Forty-four percent of surveyed nonparticipant, owner-occupied one- to four-unit households in New York State included an energy-specific upgrade in a home improvement project of $2,000 or more in 2012-13, representing an important segment for this study.

Participant households surveyed in November and December 2014 were more demographically similar to all New York State households compared to nonparticipant home energy upgraders surveyed in January 2015, and were more likely to be lower-income and eligible for public assistance benefits. This was likely

due to the AHPwES component of the program that targeted lower-income households, and to the incentives provided through HPwES that attracted different types of households than those making home energy upgrades outside the program.

Very few surveyed nonparticipant home energy upgraders reported having an energy audit (8%) in 2012 or 2013; however, many expressed high interest in having an audit before their next project (69%). Surveyed participant households and nonparticipant home energy upgraders reported making an average of two energy-related upgrades in the past two years. A majority of nonparticipant home energy upgraders (62%) reported hiring a contractor to do their project, and a few reported taking a multi-system approach (8%) by installing five or more upgrades. Both participant households (89%) and nonparticipant home energy upgraders (93%) reported overall high satisfaction with their project. In contrast to participant households, however, more surveyed nonparticipant home energy upgraders reported making their energy-related upgrades as part of a larger home upgrade project, or to resolve problems, not to save energy or improve comfort.

Substantial potential existed for upgrades in the New York State target population. About half of nonparticipant home energy upgraders surveyed in January 2015 reported plans to make energy-efficient upgrades in the next two years. In addition, many heating, cooling, and water heating systems were nearing the age of replacement and/or were not high efficiency. As of 2013, about half of single-family households in New York State also did not have a programmable thermostat or high-efficiency insulation; some owner-occupied households had no or poor quality insulation (19%) and door weather-stripping (21%); and a few reported being uncomfortably cold due to heating system inadequacies or high heating costs (5%).

Nearly one-third of surveyed participant households reported using a program-sponsored loan to pay for their project (30%) in 2012-13, while most nonparticipant home energy upgraders reported paying for their 2012-13 project with cash (65%) and/or credit card (42%). A few nonparticipant home energy upgraders reported receiving a utility incentive (14%) and 12% reported receiving another type of financial assistance, such as a non-utility incentive, tax credit, or grant to pay for their project.

About one-third of nonparticipant home energy upgraders surveyed in January reported awareness of a NYSERDA program, and about two-thirds reported awareness of a utility program. About 20% reported awareness of HPwES, unchanged from 2004, and 12% reported considering participating in HPwES when planning their project. The most common reasons nonparticipant home energy upgraders reported for not participating were that they thought they were ineligible or that participating would be too costly.

4 Market Model and Preliminary Evidence of Potential Additional Measure Adoption and Market Effects

4.1 Market Model and Market Energy-Related Upgrade Activities in 2013

The PE/MCA team constructed a market model of the whole-house home improvement market in New York State in 2013 based on the research in this report conducted during January 2014 to January 2015. This market involved multiple interconnected actors, many of whom were influenced by the HPwES program (Figure 4-1).

In the upstream market, two forces influenced the manufacture and distribution of energy-efficient products within the marketplace: codes and standards and market demand. Codes and standards for energy-efficient products evolve continually, and for many energy efficiency products, this process involves accounting for ENERGY STAR specifications or creating new specifications for these products. Manufacturers then build products to these specifications and sell them wholesale to distributers or retailers. NYSERDA's HPwES program influenced this process by offering incentives for specific products or product brands, and by providing information to ENERGY STAR and product manufacturers regarding products' performance and issues.

The second force influencing the upstream market was demand for energy-efficient products among contractors, distributors, and retailers, as well as their customers. HPwES had taken a lead in stimulating this demand by recruiting contractors and households to participate in the program and providing financial incentives to offset the costs of participation.

Residential contractors, training organizations, CBOs, and financial lenders comprised the midstream market for home improvements. A small minority of contractors in the market, many of whom were participating HPwES contractors, reported providing whole-house energy efficiency services in the market in 2013. The majority reported promoting and installing energy efficiency upgrades for their customers, but did not report taking a whole-house approach (Appendix D). There also were contractors in the market who provide diagnostic home energy audits and/or market their services to customers through various marketing activities to generate projects.

Training organizations such as the BPI, which receives some support from NYSERDA, and others such as the North American Technician Excellence (NATE) and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) provided energy efficiency training and certification for contractors. Participating contractors and some nonparticipant contractors had employees with certifications and experience from these organizations, and these contractors were more likely to provide more comprehensive services.

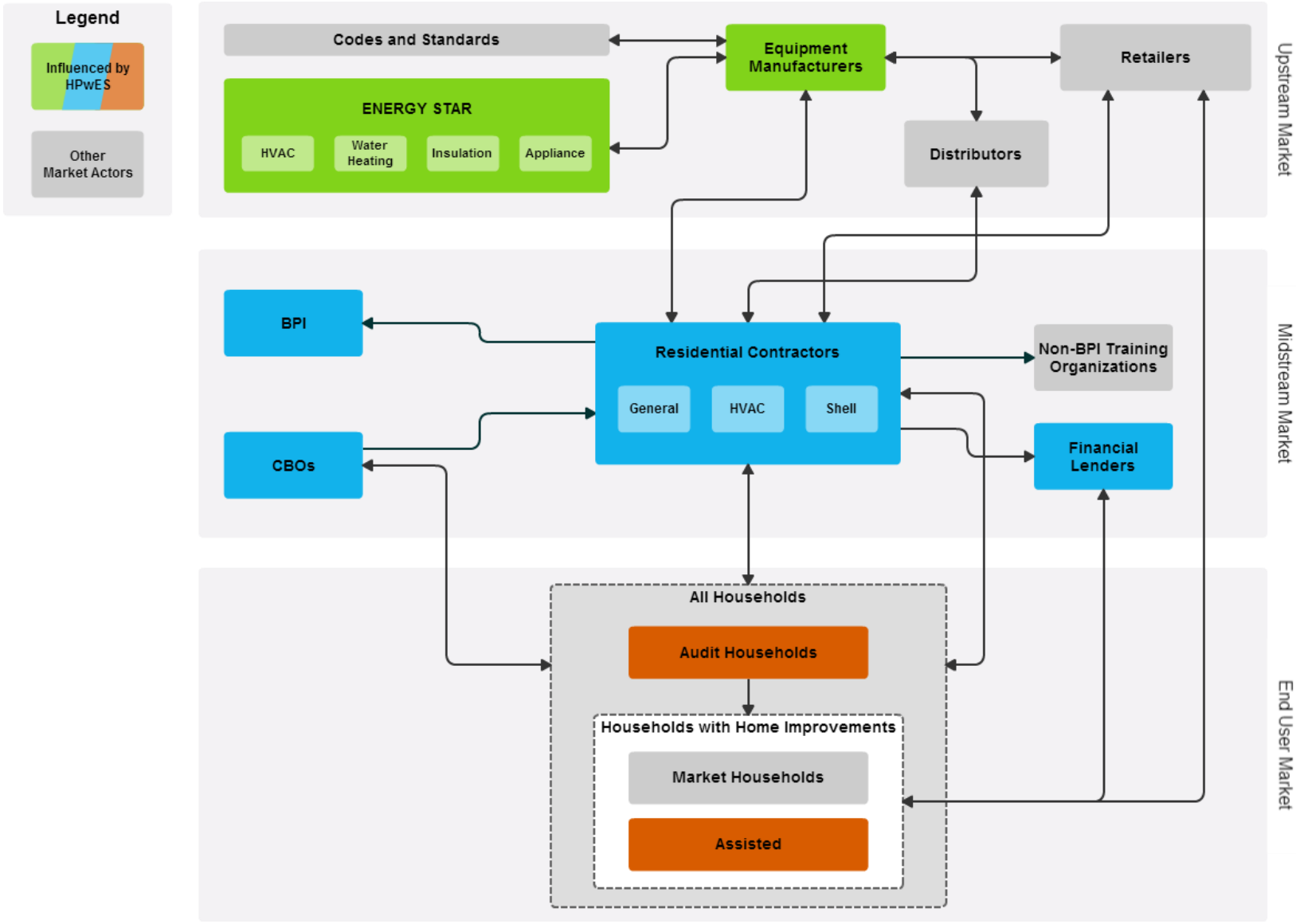
Some CBOs in New York State worked to connect contractors with households that wanted or needed energy efficiency upgrades, particularly low-income households. CBOs conducted marketing and outreach services to households in their local communities and directed them to local contractors who could perform the upgrades. HPwES provided some support to fourteen CBOs throughout New York State that were active in the home improvement market.

Financial lenders provided loan products to households to help pay for their home improvement project(s). Some of these lenders provided specialized products with low interest rates to households for making energy efficiency upgrades and a few employed alternative underwriting criteria in order to provide loan products to households with poor credit rating scores. Participant contractors worked with these lenders to offer loan products directly to their customers as a means to sell their services.

In 2013, single-family, one- to four-unit market and assisted households (Appendix E; Appendix F) represented the end-user market for home improvements in New York State:

- Nearly half (44%) of owner-occupied one- to four-unit single-family households reported making home improvements of $2,000 or more in 2012-13 that involved upgrades to energy-related equipment.
- About 8% of households, particularly those motivated to save energy and/or improve comfort in their home, reported making comprehensive upgrades in 2012-13, 0.2% of whom participated in HPwES; other households reported making upgrades outside of HPwES as part of a larger home renovation or repair project.
- About 8% of owner-occupied, single-family households also reported having a home energy audit before their project in 2012-13 to identify potential upgrades to make in the future.
- More than one-third of households (39%) reported making energy efficiency upgrades without a contractor, but most (61%) reported hiring a contractor to do their project in 2012-13, and households reported finding contractors through referrals, advertising, and CBOs.
- A few households (12%) also reported using loans to help pay for their project in 2012-13, particularly those that participated in HPwES, but most (88%) reported paying for their project with cash or credit cards.

Figure 4-1. Market Model for Energy-Related Upgrades in Existing NYS Single-Family 1-4 Unit Households



4.2 Contractor Market for Residential Energy-Related Upgrades

The evaluation team identified an estimated 9,300 active contractor firms in New York State as of late-2013 that provided energy efficiency services supported by HPwES.[18] These firms reported about $18.2 billion in residential sales and about 73,000 employees in 2013 (Table 4-1).

Using lists of participant and nonparticipant contractors from InfoUSA, CRIS, and BPI, the PE/MCA team concluded that HPwES contractors, former HPwES contractors, and nonparticipants contractor firms with a BPI-certified employee (BPI-certified nonparticipant contractors) each comprised a small percentage of all contractor firms in 2013. The PE/MCA team estimated these as 2.5% for HPwES contractors, 2.1% for former-HPwES contractors, and 1.9% for BPI-certified nonparticipant contractors (Table 4-1). Based on InfoUSA and survey data for confirmed participant and BPI-certified nonparticipant contractor firms, however, these firms had a much higher percentage of market share (residential sales) and employees per firm compared to other contractor firms in 2013 (Table 4-1).

HPwES contractors' primary trade differed substantially from nonparticipant market contractors in 2013 (Table 4-1). Most HPwES contractors were specialty contractors, such as HVAC or insulation, while most nonparticipant market contractors were general contractors. These trends occurred among former-HPwES and BPI-certified nonparticipant contractors relative to nonparticipant market contractors.

Table 4-1. 2013 Counts and Percentages of NYS Residential Contractor Firms, Annual Residential Sales, and Employees, by Contractor Type*

	Total	Total Annual Residential Sales (in billions)**	Total Employees	% of Total Firms	% of Total Annual Residential Sales	% of Total Employees
All Contractors	9,308	$17.9	72,844	100%	100%	100.0%
General Contractors	5,911	$12.8	42,700	63.5%	70.7%	58.6%
HVAC Contractors	2,208	$3.5	17,923	23.7%	19.2%	24.6%
Insulation Contractors	212	$0.2	2,208	2.3%	1.3%	3.0%
Other Specialty Contractors	977	$1.3	10,013	10.5%	7.4%	13.7%

Continued…

[18] Contractor estimate is from survey of 129 nonparticipant respondents applied to the cleaned and verified sample frame of 13,300 contractors (see Appendix D). In contrast, the RSBS (2015) found approximately 18,000 HVAC and plumbing contractors from an uncleaned and unverified list (see Appendix D for more details).

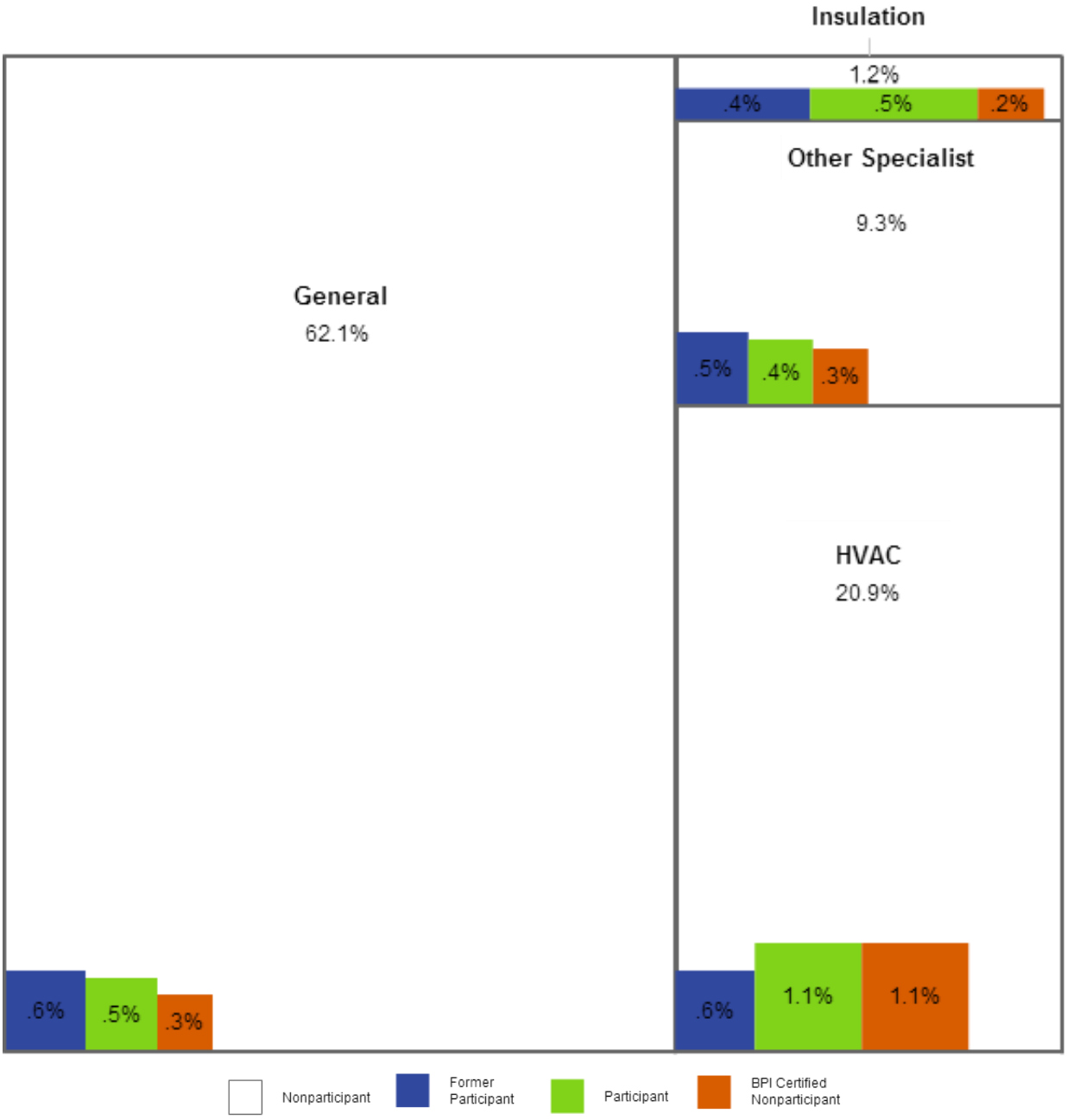
	Total	Total Annual Residential Sales (in billions)**	Total Employees	% of Total Firms	% of Total Annual Residential Sales	% of Total Employees
Nonparticipant Market Contractors	8,704	$16.2	64,199	93.5%	90.7%	88.1%
General Contractors	5,778	$12.3	41,689	62.1%	67.7%	57.2%
HVAC Contractors	1,950	$2.7	13,876	20.9%	15.0%	19.0%
Insulation Contractors	112	$0.07	888	1.2%	0.4%	1.2%
Other Specialty Contractors	864	$1.1	7,746	9.3%	6.1%	10.6%
HPwES Contractors	231	$0.9	4,158	2.5%	5.2%	5.7%
General Contractors	44	$0.3	514	0.5%	1.6%	0.7%
HVAC Contractors	105	$0.4	2,284	1.1%	2.3%	3.1%
Insulation Contractors	43	$0.1	727	0.5%	0.5%	1.0%
Other Specialty Contractors	39	$0.1	633	0.4%	0.7%	0.9%
BPI-certified Nonparticipant Contractors	174	$0.5	2,561	1.9%	2.6%	3.5%
General Contractors	31	$0.1	157	0.3%	0.7%	0.2%
HVAC Contractors	100	$0.3	1,258	1.1%	1.4%	1.7%
Insulation Contractors	16	$0.02	314	0.2%	0.1%	0.4%
Other Specialty Contractors	27	$0.06	832	0.3%	0.3%	1.1%
Former-HPwES Contractors	199	$0.3	1,926	2.1%	1.5%	2.6%
General Contractors	58	$0.1	340	0.6%	0.7%	0.5%
HVAC Contractors	54	$0.07	505	0.6%	0.4%	0.7%
Insulation Contractors	41	$0.03	279	0.4%	0.2%	0.4%
Other Specialty Contractors	47	$0.05	802	0.5%	0.3%	1.1%

* Estimated counts of nonparticipant market contractor firms were calculated by applying results from a survey of 129 nonparticipant contractors to the sample frame of 13,300 contractors from InfoUSA; counts of HPwES and former HPwES contractors were obtained from NYSERDA's CRIS database; counts BPI-certified nonparticipant contractors were obtained from the BPI website. All Contractors' annual revenues and employees included in the InfoUSA sample frame are self-reported (see Appendix D for more details).

** Numbers may not sum to totals due to rounding.

Figure 4-2 is a graphical representation of the data displayed in Table 4-1 to illustrate the relative size of contractors in the market making energy-related upgrades in 2013.

Figure 4-2. Contractors in Market for Energy-related Upgrades in NYS Single-Family One- to Four-Unit Households in 2013



4.3 Household Market for Residential Energy-Related Upgrades

In 2013, HPwES participant households comprised a small percentage of the NYS single-family, one- to four-unit household population. About 0.3% of the population had an HPwES home energy audit in 2013 and about 0.2% made upgrades through HPwES. Using data developed for this study, Table 4-2 displays the estimated number and percent of New York State one- to four-unit households that made energy related home improvements and hired a contractor in 2013. Isolating projects with HPwES supported measures dropped this estimate to about 22% of single-family owner-occupied, one- to four-unit households.[19] These upgrades included, from most to least common: appliances, windows, HVAC, insulation, water heater replacement, and air sealing. Participant households represented 0.8% of the total market of New York State home energy upgraders with a home improvement project of $2,000 or more that included an energy-related upgrade.

In 2013, 1.7% of households that reported an HVAC and/or insulation upgrade in the previous two years participated in HPwES. This was in comparison to the 2004 results that found 1.2% of HVAC and/or insulation upgrade households participated in HPwES. While all HPwES participants had a home energy audit and had a contractor complete their project, 8% of nonparticipant home energy upgraders had an audit, and 65% hired a contractor for their project.

[19] Data from the PE/MCA team's survey of nonparticipant households identified energy-related upgrades for projects over $2,000, the AHS survey did not. Since the AHS and nonparticipant survey estimates for all home upgrade projects closely aligned, the market share estimates for energy-specific upgrades relied on data from the nonparticipant survey of New York State single-family 1-4 unit homeowners conducted for this study.

Table 4-2. Estimated NYS Single-Family One to Four-Unit Households that Made Energy-related Home Improvements and Hired a Contractor in 2013*

	Estimated Households	% of Total Households	% Hired a Contractor to do Home Improvement Project
Single-Family 1-4 Unit Occupied Households	4,700,600	-	
HPwES Home Energy Audit	13,635	0.29%	
HPwES Participant	5,712	0.18%	100%
Single-Family 1-4 Unit Owner-Occupied Households	3,406,619	72.5%	
Performed project of $2,000 or more that included HPwES-supported measure(s)**	693,247	22%	65%
Performed home energy audit before project*	59,956	1.8%	76%
Project included: **, ***			
HVAC	254,815	7.5%	75%
Insulation	224,837	6.6%	61%
Air Sealing	202,353	5.9%	57%
Water Heater	217,342	6.4%	67%
Appliance	457,168	13.4%	56%
Window	277,299	8.1%	70%

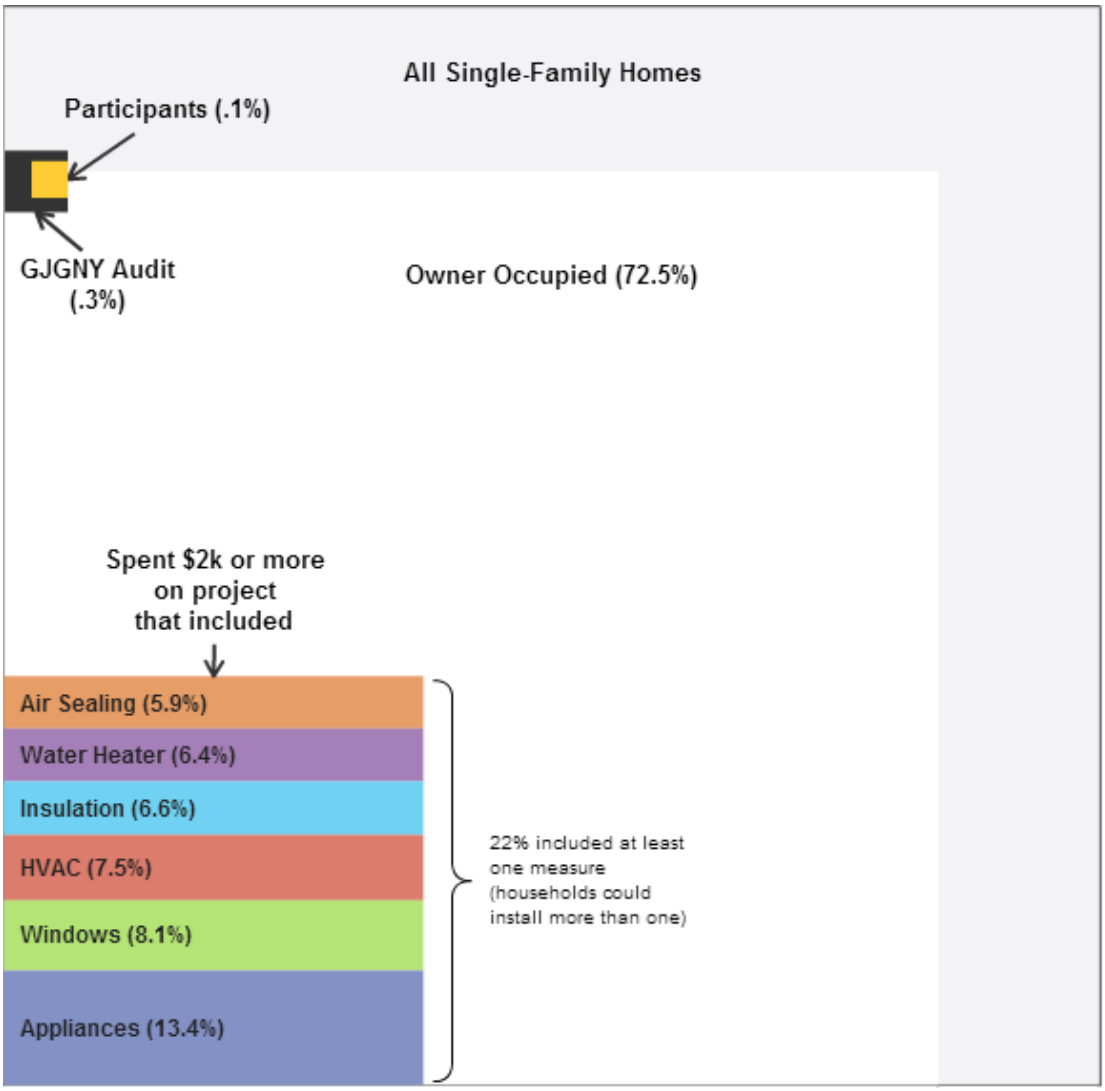
* Homeowner estimates are derived from results of a survey of 770 nonparticipant homeowners and from the NYSERDA CRIS database. The 770 nonparticipant survey respondents were obtained from a web panel representative of the 3.4 million homeowners in New York State (see Appendix F for more details).

** Percent of total out of total single-family 1-4 unit owner-occupied household population.

***Households could include more than one measure in their home improvement project.

Figure 4-3 is a graphical representation of the estimates displayed in Table 4-2 to illustrate the relative size homeowners in the market making home energy-related upgrades in 2013.

Figure 4-3. Residential Actors in Market for Energy-related Upgrades in NYS Single-Family One- to Four-Unit Households in 2013



4.4 Preliminary Evidence of Potential Additional Measure Adoption and Market Effects

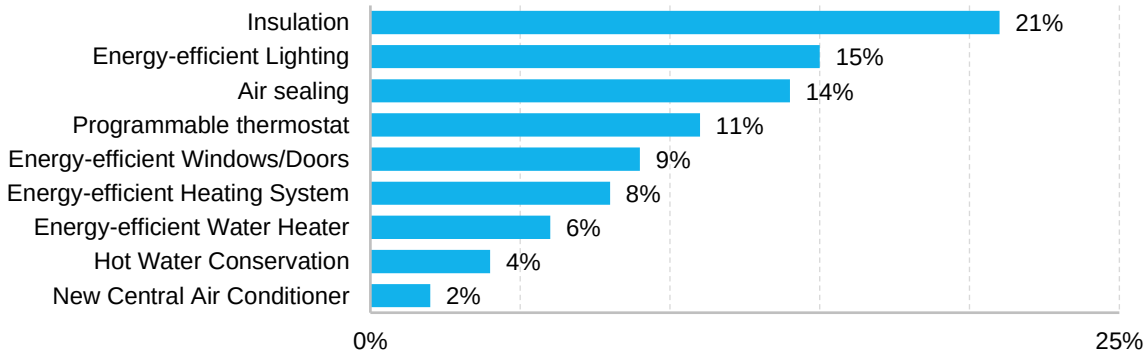
The PE/MCA team sought to identify any evidence of potential additional measure adoption and market effects that NYSERDA's Impact Evaluation team would investigate further. The team found preliminary evidence of additional measure adoption among households that had an HPwES audit but did not participate, as well as among HPwES participant households.

To estimate evidence of additional measure adoption from 2012-13 audit-only households, the PE/MCA team used data from the PE/MCA team's survey of 69 HPwES audit-only delivered fuels households (see Appendix I) and from the Impact Evaluation team's survey of 5,332 HPwES audit-only natural gas

households conducted during September to December 2014. The PE/MCA team combined the datasets and applied weights to account for the higher proportion of natural gas households in the survey data compared to the NYS single-family household population (RSBS, 2015). In the population as of 2014, 55% used natural gas for heating and 32% used delivered fuels (fuel oil and propane) for heating (13% use a heating fuel other than natural gas or delivered fuels) (RSBS, 2015). The team used these self-reports to estimate the percentage of these households that installed an upgrade after having the HPwES home energy audit. These were not verified installations, and therefore only preliminary indicators of potential additional measure adoption.

Overall, 44% of HPwES audit-only natural gas and delivered fuels households reported installing an upgrade after their HPwES energy audit, which results in about 12,500 households in NYS (Figure 4).[20] Nearly one-quarter of these households (21%) indicated that they had installed an insulation upgrade, and less than one-fifth of respondents indicated that they had installed energy-efficient lighting and air sealing upgrades (15% and 14%, respectively). About one in ten audit-only households reported that they had installed a programmable thermostat and/or energy efficient windows/doors, and less than 10% reported installing a high-efficiency heating system or water heater, hot water conservation measures, and/or a new central air system (Figure 4-4). The mean number of the upgrades per audit-only respondent who installed an upgrade after their HPwES energy audit was one, with a range of one to seven; however, the team was unable to determine whether the home energy audit caused households to install upgrades. This would be further investigated by the Impact Evaluation team.

Figure 4-4. Percentage of HPwES Audit-only Households with Natural Gas or Delivered Fuels that Installed At least One Upgrade Recommended in the HPwES Audit (n=5,401)*



* Respondents could select more than one upgrade.

[20] 30,257 households had an HPwES home energy audit in 2012-13 but did not participate in HPwES, and of these, 94% reported having natural gas or delivered fuels as their primary heating fuel.

After participating in HPwES in 2012-13, some participants (12%, or 1,360 households) reported installing at least one of the upgrades recommended in the HPwES audit that were not installed as a part of their HPwES project.[21] Of these households, one-fourth (25%) installed shell measures such as insulation, windows, or doors, and a small number of households installed other measures, such as appliances, lighting, duct sealing, air sealing, water heater, or HVAC (8% for each). The team, however, was unable to determine whether participation in HPwES caused households to install additional measures outside the program.

The team also found preliminary evidence that the program influenced contractors' market behaviors. Participating contractors in 2012-13 reported providing HPwES-like services to their residential customers outside of NYSERDA's HPwES program. Nearly two-thirds of participating contractors (62%) reported performing full diagnostic audits in the market outside of the program in 2012-13. Participating contractors also reported installing energy-efficient upgrades in 79% of their 2012-13 projects, on average, which the program theory predicted.

In addition, participating contractors mentioned valuable impacts on their business due to their participation in HPwES and/or their having a BPI-certified employee on staff. Many contractors reported that HPwES participation increased the level of staff's expertise (83%), the variety of services offered (71%), expected annual completed projects (69%), investment in new equipment (65%), revenue per project (62%), number of employees (60%), and profitability (40%). About two thirds (65%) of participating contractors reported that their BPI affiliation required by NYSERDA was valuable for differentiating their firm from competitors, nearly two-thirds (62%) reported that they preferred to hire BPI-certified staff, and one-third reported paying their BPI-certified employee(s) a higher wage than non-certified employees.

[21] There were 11,330 HPwES participants in 2012-13.

5 Program Process Assessment

During January 2014 to January 2015 the evaluation team assessed the HPwES program processes by analyzing the program database, and interviewing program staff, participating homeowners, audit-only participants, and participating contractors. The evaluation team investigated participants' experiences with program outreach, audits, upgrades, financing, and drivers and barriers to participation.

5.1 Program Marketing and Outreach

Program staff confirmed in 2014 that NYSERDA conducted marketing and outreach activities to promote energy efficiency services through the HPwES program. Staff reported the program design relied heavily on contractor-based marketing. Specifically, participating contractors received financial incentives to invest in program-branded marketing collateral, which they could present to potential customers. In return, NYSERDA referred customers to participating contractors. Staff also noted they actively recruited CBOs to increase participation among hard-to-reach populations, such as low-income homeowners. These results were reported in the CBO Phase II PE/MCA (Appendix J).[22]

Half (52%) of HPwES contractors surveyed in September and October 2014 reported that they took advantage of NYSERDA's co-op marketing funds in 2013-14 to help pay for print and media advertising. Contractors also reported other promotional methods such as developing a company website, attending home shows, and working with CBOs. They stated that their firm's own marketing activities through these promotional methods yielded the highest number of HPwES audit jobs. Consistent with this finding, a large portion of homeowners (43%) reported learning about HPwES from their contractor.

Contractors also acknowledged that NYSERDA's mass marketing contributed to increasing customer general awareness of the program, with 44% of audit-only participants reporting they learned of the program through mass media advertisements, NYSERDA, or utility marketing efforts. Two-thirds of the contractors (65%) reported working with CBOs to cultivate audit leads, and more than half of the interviewed contractors (55%) mentioned generating audit leads through CBOs.

5.2 Customer Experience

During the interviews in 2014, the evaluation team asked program staff, participating contractors, and participants (full and audit-only) about the audit and measure installation experience, quality assurance, and project completion time. The evaluation team's database analysis contributed to these insights.

[22] Research Into Action. GJGNY CBO Outreach Program Process Evaluation and Market Characterization Assessment: Phase II. Final Report. NYSERDA Contract 26276. April 2015.

5.2.1 Audit

The comprehensive energy audit was the first step in program participation. The program theory assumed that a free or reduced-cost energy audit educated and engaged customers, and allowed contractors to market the program and sell the recommended upgrades. According to the program database, about 25% of households that received an energy audit during 2012-13 went on to participate in the program within the same timeframe.[23] Program staff provided a slightly higher conversion rate estimate of 30% to 33%. Program staff noted that their estimate excluded recent audits that had not had time to mature. According to implementation staff, nationally, a good audit-to-retrofit conversion rate was between 33-35%. Program staff reported that they suspected that contractors with low conversion rates were completing the GJGNY audit, and then completing the upgrades outside of the program.

In September and October 2014 participating contractors reported strong support for the program-required comprehensive diagnostic audits used to sell HPwES jobs. Many (81%) confirmed that they always recommended a diagnostic audit rather than a walk-through audit to all customers. In addition, all participating contractors confirmed using program-required modeling software to estimate energy savings for customers, and indicated modeling gave them confidence in demonstrating financial savings and payback to customers. Most (90%) also noted that providing customers with this information gave them an advantage over firms that do not use modeling software. While HPwES influenced contractors to use a comprehensive diagnostic audit approach for program projects, surveyed contractors reported they employ this comprehensive approach less frequently for non-HPwES jobs (on average 49% of all residential jobs).

Most (88%) contractors reported they consistently faced difficulties when acquiring the consumption data needed to calibrate the model, particularly delivered fuel consumption data (42%). Many (60%) contractors also reported encountering challenges when modeling complex homes, particularly those with additions. These contractors estimated it took an average of five hours to complete a comprehensive diagnostic audit (2.6 hours to complete the in-home assessment, 2.4 hours to complete the modeling); however, more experienced contractors appeared to deliver their results faster than did less experienced contractors. Auditors with a minimum of fifty HPwES projects reported taking an average of 4.4 hours per audit, whereas less experience auditors reported taking an average of 5.5 hours per audit.

As of December 2013, the program's average incentive for an audit was $250, and if it resulted in a project, the contractor received up to $500 for completing the advanced modeling. Most (90%) contractors noted they took a loss when conducting audits, and were largely dissatisfied with the program reimbursement rate for the audit.

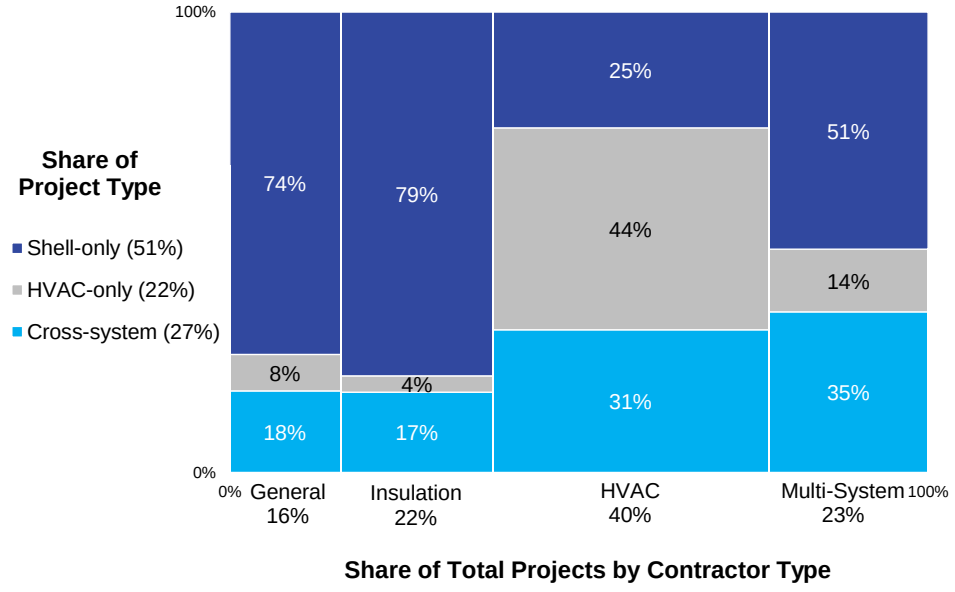
[23] The 25% conversion rate includes all audits completed within the evaluation period divided by the resulting number of audits that completed a project through HPwES.

5.2.2 Measure Installation

Full participants, and many audit-only participants, went on to complete recommended measures after receiving an audit through the HPwES program in 2012-13. Participants (full and audit-only) reported air leakage, aging heating systems, and ice dams as the most common problems identified in their audit. Full participants noted the audit results providing recommended upgrades paired with estimated savings from these recommendations positively influenced their decision to participate. In addition, most full participants acknowledged that the availability of incentives and financing was an important factor to completing upgrades. Furthermore, almost all (98%) full participants used their audit contractor to install the recommended measures.

About a quarter (27%) of full participants had not considered making upgrades before reviewing audit results in 2012-13. Similarly, about two-thirds of participants (63%) reported that prior to the audit they had not planned to upgrade as many measures as they did. These findings provided evidence of audit results successfully convincing customers to move forward with upgrades. Consistent with these findings, a majority of contractors (77%) reported successfully upselling customers to move from small-scale home improvement projects to more comprehensive HPwES projects; however, a statistical analysis of project data indicates most projects tend to include measures within a measure category rather than including measures across categories. For example, most projects that installed building shell insulation, tended to also include air sealing, but not furnaces or other non-shell measures. In total, about a quarter of projects (27%) included installation of measures across systems, and HVAC and multi-system contractors were most likely to install these cross-system projects (31% and 35% of total projects installed respectively, Figure 5-1).

Figure 5-1. Proportion of Projects by Contractor-Type and Project-Type



Many audit-only participants (61%) reported making audit-recommended upgrades outside of the program in 2012-13. Moreover, some full participants (12%) reported making additional upgrades outside of the program in 2012-13. More than half (59%) of audit-only participants completed the upgrades in a Do-It-Yourself (DIY) fashion, without a contractor, and 20% hired a participating HPwES contractor to complete upgrades outside of the program.

About a third (30%) of audit-only participants reported in September to December 2014 that the primary barrier to recommended upgrades was cost. Audit-only participants also cited several other reasons for not moving forward:

- Audit recommendations were minimal or no specific recommendations were made (16%)
- Difficulty securing financing (8%)
- Problems with the audit process or auditor (8%)
- They did not qualify for program incentives (6%)

5.2.3 Quality Assurance

Participant survey data collected in November and December 2014 indicated a perception of high post-installation inspection rates across the years. Program data indicated that, between 2007 and 2013, NYSERDA conducted inspections on 11% of projects on average each year[24]; however, almost two-thirds of surveyed participants (66%) reported receiving a post-installation inspection, indicating participants' potential confusion between NYSERDA's QA inspection and contractors' standard test-out inspections.

About a quarter (22%) of participants who reported receiving an inspection after their 2012-13 project noted that at least one issue emerged during the inspection. NYSERDA quality assurance (QA) staff inspected 905 jobs for projects completed between 2012 and 2013, almost two-thirds (64%) of these inspected projects passed inspection. Of the remaining 36% that failed their inspection, most failed due to minor health and safety infractions, including small gas leaks.[25] These minor problems were consistent with homeowners reporting that the inspections findings were readily resolved.

[24] Program staff noted they attempt to inspect at least 10% of projects per year. Analysis of CRIS data indicate the program met or exceeded this goal in every year from 2007 to 2012. In 2013, the program conducted fewer inspections (5%) which meets the minimum inspection rate allowed by HPwES branded programs.

[25] Failed inspections are rated in severity – with F1 rated projects deemed failures due to minor infractions, while F3 rated projects fail due to larger infractions requiring urgent response by the contractor.

5.2.4 Project Time

The evaluation team's analysis of the CRIS database revealed a wide range of 2012-13 project completion times, from 35 to 284 days (medians for 10th and 90th percentiles of total project time respectively), and the overall median time was 112 days. The largest lag time (about 65% of the project cycle time) fell between audit completion and measure installation. Specific project characteristics appreciably increased project timing:

- Projects with on-bill repayment (OBR) financing took on average 61 days longer to complete than projects without OBR.
- Delivered fuel projects took longer than natural gas projects, adding approximately a three-month delay for kerosene fuel projects and a month delay for oil or propane projects; this was true irrespective of whether the project involved fuel conversions.
- EEPS 2-funded projects took about a month longer than EEPS 1-funded projects, and assisted projects took about 17 days longer than market-rate projects. The lag time between project approval and work completion contributed most to these delays.

Program staff noted in 2014 that the improved oversight of contractors' audit submissions has increased the paperwork and data collection burden on contractors. One staff member noted that about half of contractors' paperwork submissions contain errors, requiring contractors to resubmit their work, and, consequently, increase delays to obtain project approval. These findings from the database and staff are consistent with the large percentage (71%) of contractors reporting dissatisfaction with the length of time for project approval.

5.3 Role of BPI Accreditation Requirement

Both program staff and contractors confirmed that NYSERDA's HPwES program required all participating contractor firms to have BPI accreditation. The HPwES program theory assumed BPI accreditation would help ensure contractor quality. To this end, staff members mentioned encouraging participating contractors to obtain specialized BPI certifications (for example, Building Analyst or Building Envelope certification). Aligning with program staff, most (79%) participating contractors mentioned in September and October 2014 that BPI certification enhanced their ability to identify energy savings opportunities and deliver high-quality work. Also, contractors used skills garnered from BPI training to sell projects. For example, contractors commonly reported that explaining the concept of the "home as an integrated system" to potential customers when discussing the benefits of HPwES provided potential customers with a foundation to understand the program and its benefits. The interview data, however, suggested there was a large discrepancy in BPI certification status among staff performing audits and staff performing installations. While nearly all participating contractors who performed audits in 2012-14 were BPI certified, a much

smaller proportion of the contracting firm crew supervisors and installers were certified. Specifically, as of October 2014:

- Forty percent of 2012-13 participating contractors indicated less than half of their supervisors hold a BPI certificate.
- Eighty-one percent of 2012-13 participating contractors reported less than half of their installers hold a BPI certification.

5.4 Financing

As of December 2014, NYSERDA offered the following two tiers of loans through the HPwES program:

- Tier 1, reflecting historical Fannie Mae underwriting standards, and
- Tier 2, allowing other ways of identifying credit worthiness beyond typical limits on debt-to-income ratios.

Most (78%) contractors reported that being able to offer financing was particularly helpful in convincing homeowners to complete a project in 2012-13 that otherwise might have stalled. Similarly, most (67%) full participants – especially assisted project participants – mentioned that the availability of financing influenced their decision to complete upgrades through the program in 2012-13. While two-thirds (65%) of contractors indicated that program financing was the only financing option they offered, a minority of contractors also mentioned the possibility of combining program financing with manufacturers or distributors' financing options. Though contractors found financing a useful tool, a notably high proportion of contractors expressed frustrations with the financing process, particularly the complexity of the paperwork (79%) and the time required for loan approval (67%). Program staff also mentioned in 2014 the finance approval process as one of the most complex elements of the program.

While contractors used financing options to increase participation in 2012-13, less than half of full participants applied for it, and less than one-third received a loan from NYSERDA. In addition, program staff reported about 30% of loan applicants were denied between 2012 and 2013.

5.5 Program Satisfaction

A majority (89%) of the participating homeowners were satisfied with their overall program experience in 2012-13. Specifically, participants noted they were satisfied with the quality of work performed, the program information and incentive amount received, and the increased comfort in their home after participation. Though most participants (81%) reported their home's energy use decreased, one-quarter (26%) noted the savings they obtained were less than what their auditors estimated.

Participating contractors surveyed in September and October 2014 reported mixed satisfaction with HPwES program elements. While more than half (62%) of surveyed contractors indicated satisfaction with program staff's communication and support, and the diversity of the eligible measures (58%), most contractors reported dissatisfaction with the time it took to obtain approval of financing (65%), measures (71%), and payments (79%). Nevertheless, many contractors found their association with HPwES to be beneficial to their business, especially for improvement (83%) and diversification (71%) of their expertise in home improvement services. Interview and database analyses suggested that the program provided less experienced contractors access to a new customer base and helped boost revenues. Finally, many participating contractors' business models relied on the program, with two-thirds of participating contractors (67%) estimating that more than half of their work received incentives or financing through HPwES.

5.6 Summary

NYSERDA's multi-pronged marketing and outreach approach successfully cultivated audit leads in 2012-13, and contractors recognized the value of these audits, while noting that they required additional outlays not covered by the program. Despite these additional expenses, contractors valued audits since they successfully encouraged homeowners to participate in HPwES. While program-sponsored audits assessed homes comprehensively, most upgrades funded through the program focused on one measure category, shell, or HVAC, with a minority of projects installing measures across multiple measure categories. Program-funded audits spurred both full and audit-only participants to make energy saving upgrades outside of the program.

Program features such as contractor BPI-certification and options to finance upgrades helped induce homeowners to participate in 2012-13. Participating contactors perceived the value and benefits of BPI-certification – and noted that BPI training helped them deliver higher quality work. Yet, while all participating contractor staff performing audits were BPI-certified, many contractors executing jobs were not. Program-provided financing options played an important role in convincing homeowners to make upgrades through the program, and contractors used these options as a sales tool.

Participating homeowners were satisfied with HPwES, yet contractor satisfaction was mixed largely due to the time it took contractors to receive approval and payments. Project completion time varied from 35 to 284 days (on average 112 days), and specific project characteristics (OBR financing and delivered fuel projects) appreciably increased the time it took to complete projects in 2012-13. Participants reported a higher-than-possible rate of post-project inspection, indicating possible confusion between BPI test-out procedures and the program's QA inspection procedures.

6 Conclusions and Recommendations

The PE/MCA team focused on six research objectives in conducting this project. The following presents the evaluation findings by research objective.

6.1 Assess program operations, identify potential issues, and develop recommendations to improve program operation and performance

Homeowner participants were satisfied with the program.

- HPwES participants and audit only recipients reported high levels of satisfaction with nearly all aspects of the process.

The cooperative marketing program mobilized contractors to recruit homeowners.

- Half of participating contractors received cooperative marketing funds, and homeowner participants most commonly heard of the program through their contractor: 43% of homeowner participants reported hearing of the program through their contractor. More than three-fourths of participating contractors also reported positive impacts of NYSERDA marketing.

Contractor responses suggested that they perceived program processes as somewhat burdensome, but program staff have demonstrated responsiveness in implementing changes to streamline program processes since this evaluation.

- Although the program staff provided extensive support, the HPwES program, by design, was largely delivered to participants through contractors. Contractor responses suggested they viewed some program processes as burdensome. Contractors reported that procuring energy usage data for modeling was difficult and that audit reimbursements did not cover their costs. Contractors also reported low levels of satisfaction with program processes, including the time to gain approvals for financing (35%), project approval (29%), and time and amount of contractor reimbursement (31%).

- Recognizing that program paperwork processes required valuable contractor and staff time, as a result of the 2014 internal process improvement effort, program staff implemented changes to streamline the audit, contract, financing paperwork, and review process in order to increase the proportion of correctly modeled contractor submissions and reduce overall program timeline for participants. These changes occurred after the program evaluation period.

Contractors reported that they value comprehensive audits and that the audit was helpful when explaining recommendations, yet a small proportion of HPwES projects (27%) included upgrades to multiple home systems.

- Program contractors were specialty contractors. Despite a 2% additional program incentive for working with other HPwES-approved contractors, many of the projects were single-system oriented.

Inspection procedures may be confusing to some participants

- Program staff reported that, of the 10% of projects that receive formal onsite QA inspections, roughly half of all projects had at least one finding. Since the majority of contractors were present at inspection, the contractors could immediately address many findings, and many required no project changes. A majority of contractors (58%) reported that they were satisfied with the level of program support to help ensure projects pass inspection. Homeowner participants reported some lack of clarity about the inspections; 60% reported receiving inspections although 10% of projects, on average, received them. Of those, one-fifth reported problems with installation, many more than occurred in the QA/QC process. This suggested that homeowners may have confused the test in/test out procedures with the QA/QC program inspections.

- Program staff members reported that they had begun to revise inspection procedures to make the experience a learning process for contractors. These changes occurred after the program evaluation period.

6.2 Document program progress and explore the value, benefits and concerns associated with completing HPwES-qualified projects and living in upgraded homes

The program continued to grow in participation by homeowners and increased contractor involvement, and has resulted in the acquisition of energy and demand savings.

- In 2012 and 2013, 231 participating contractors delivered 30,257 comprehensive energy audits and 11,626 HPwES upgrades to 11,330 participants, including 4,108 AHPwES projects and 3,720 GJGNY-financed projects, totaling 410 kMMBtu first year ex-ante energy savings.

Homeowners valued the information about their home that the comprehensive audit provided, but contractor training and certifications in and of themselves were not a key selling point.

- A majority of homeowner participants (88%) rated accessing information about their home's energy performance as influential in their decision to participate in HPwES, nearly three-fourths

(72%) of respondents reported that they completed more upgrades than they had been considering prior to the audit.

- Contractors also reported the audit process was an effective marketing, educational, and sales tool.
- Fewer participants rated contractor training or certifications as characteristics they considered in contractor selection compared to other contractor characteristics, such as service quality or cost of bid (41%, 86%, and 77%, respectively). Less than half of participants (43%) reported awareness that participating contractors received special accreditation, although most contractors (90%) reported they use BPI as a sales point, and most (79%) find BPI valuable to their firms.

Participant households reported participating in the program to reduce energy use and improve comfort.

- Participants reported reducing their home's energy use (47%) and improving their home's comfort (29%) were the most important reasons for participating. A large majority of homeowners (82%) reported drafty homes prior to participating.
- Seventy-four percent of participant homeowners reported they were satisfied with the energy savings obtained, 18% were neutral, and 8% were dissatisfied with the savings obtained.
- Cost remained the largest barrier to completing HPwES projects, although nonparticipant home energy upgraders reported somewhat different motivations for completing upgrades, with a primary focus on home comfort, protecting home value, and modernizing the home and a secondary focus on saving energy, improving health, and helping the environment.
- A majority of contractors (78%) reported that GJGNY financing was important in motivating projects, and 67% of HPwES participants reported that the availability of financing influenced their decision to complete an upgrade.
- Program staff reported that they had recently transitioned to marketing the comfort improvements and specific home solutions the program provides, over contractor qualifications and energy savings. This new emphasis was more consistent with homeowner values.

Contractors report benefits of HPwES participation. Contractors report that HPwES increases staff technical expertise, variety of services provided, and number of projects; more than half have increased revenue and employees. At the same time, more than two-thirds reported that profitability stayed the same or decreased in past two years.

6.3 Develop a comprehensive understanding of current and emerging markets

The HPwES program sought to transform the whole-house residential retrofit market by creating a market-based system of supply and demand that supports the renovation of existing homes toward greater energy efficiency using a 'house-as-a-system' approach.

Many homeowners were completing energy-related upgrades, but energy audit prevalence was low.

- Outside of the HPwES program, over the past two years 44% of New York state nonparticipating homeowners had spent $2,000 or more on an energy-specific home upgrade. Sixty percent of these nonparticipant home energy upgraders included core energy efficiency measures (HVAC, insulation, or air sealing). Unlike HPwES participants who were most frequently motivated by reducing home energy use, nonparticipant home energy upgraders were most frequently motivated by a desire to upgrade their home or solve a specific problem with their home.

- Eight percent of nonparticipant home energy upgraders reported receiving an energy audit prior to their upgrade, the majority of whom received their audit free or at a discounted price.

HPwES was recruiting somewhat lower-income homeowners than those completing upgrades outside the program.

- Nonparticipant home energy upgraders who completed upgrades outside the HPwES program were more likely to be older, Caucasian, have a higher level of education and income, and live in a newer detached home than HPwES participants. They also reported higher incomes than market-rate participants and fewer (31%) reported receiving some form of public assistance compared to HPwES participants (35%).

Nonparticipating contractors frequently promoted efficient products and sought efficiency training, but demonstrated less comprehensive efficiency knowledge, performed fewer energy audits, and had less training than HPwES participating contractors.

- Sixty-two percent of participating HPwES contractors reported providing comprehensive audits outside of the program, while 20% of nonparticipating contractors reported providing energy audits, which were also generally less comprehensive.

- Seventy-one percent of nonparticipant contractors reported promoting energy efficiency, and 57% reported installing efficient products. Forty-eight percent of nonparticipant contractors reported providing integrated efficiency services. Nonparticipant contractor responses suggest that their energy efficiency knowledge was less comprehensive than HPwES participant contractors;

nonparticipant contractors reported installing fewer types of efficient products and providing fewer efficient HVAC service practices.

- Using the BPI list of BPI-certified contractors in New York State, as of December 2014, 2% of nonparticipant contractor firms had at least one employee with BPI-certification, compared to all participating contractor firms. Eleven percent of surveyed nonparticipant contractors reported a high likelihood of pursuing BPI-certification in the future. Thirty-nine percent of surveyed nonparticipant contractors and 94% of surveyed participating contractors reported that at least one employee had attended a non-BPI efficiency training program.

6.4 Provide baseline and background information required by NYSERDA to define and deliver the program to target markets

- 2012-13 participating HPwES contractors comprised about 2% of residential contractor market; however, they represented 5.2% of annual residential sales and 5.7% of contractor firms' employees.

- 2012-13 participating HPwES households comprised about 0.3% of owner-occupied households, but 1% of households with a home improvement project that included an energy-related upgrade.

- Between 2006 and 2013, NYSERDA served 1% of owner-occupied New York State households through HPwES.

Between 1999 and 2013, there was a slight increase in the annual percentage of households in the Northeast U.S. that installed HPwES measures and a slight decrease in the percentage of households that performed other home improvement activities. The HPwES measures included HVAC, insulation, energy-efficient appliances and major equipment (including water heaters), and windows and doors. Since 1999, trends in home improvement expenditures on HPwES measures had increased for HVAC, insulation, and appliances and major equipment, but had declined for windows and doors since 2007.

There remained potential for HPwES upgrades in the single-family residential market. Many primary heating and cooling systems were near the age of replacement, were not high efficiency, and/or were not serviced annually. About one-third of households had a programmable thermostat, and a few households reported being uncomfortably cold due to heating system inadequacies or high heating costs. In addition, many water heaters were near the age of replacement, most households did not have high-efficiency insulation, and 20% had poor quality insulation and/or door weather-stripping.

Interest in HPwES-like services was high in the market but many households needed more confidence that energy savings would be realized and/or needed assistance with making these upgrades. A majority of nonparticipant home energy upgraders (69%) was interested in having a home energy audit before their next project. About half also reported having plans to make energy-efficient

upgrades in the next two years. Most nonparticipant home energy upgraders also thought it was important to hire a contractor who could assess the whole house to make energy savings recommendations and who could use diagnostic equipment to estimate savings potential. However, many of them needed information to increase their confidence that energy savings from energy-efficient upgrades would be realized and/or needed incentives to offset upgrade costs, low-interest financing to avoid high upfront costs, and/or assistance finding a contractor to install the upgrades.

Levels of HPwES awareness were consistent with the program's supply-driven program theory. Twenty-one percent of nonparticipant home energy upgraders and 58% of nonparticipant contractors reported awareness of HPwES. In contrast, 31% of home energy upgraders and 64% of contractors reported awareness of any NYSERDA program, and 63% of home energy upgraders and 74% of contractors reported awareness of a utility program. More than half of contractors expressed interest in participating in a NYSERDA program.

A majority of market contractors were general contractors, while most HPwES contractors were specialty contractors. About 65% of market contractors who provided HPwES-like services were general contractors, about 25% specialized in HVAC, 10% specialized in another trade, and 1% specialized in insulation. In contrast, among HPwES contractors active in 2012-13, 19% were general contractors, 45% were HVAC contractors, 19% were insulation contractors, and 17% were other specialty contractors. Less than half of the HPwES contractors (39%) reported hiring subcontractors.

A few nonparticipant home energy upgraders considered HPwES participation:

- Of the nonparticipant home energy upgraders who made an energy-related upgrade, 21% were aware of HPwES, and 12% considered participating (more than half of those aware). The most common reasons why nonparticipant home energy upgraders did not participate in HPwES were that they thought they were ineligible or that incentives were not high enough. A few also mentioned that participation would be too burdensome or require too much time, that incentives expired or were no longer offered for their planned upgrades, or that they did not want to use a NYSERDA contractor. In addition, only a few nonparticipant home energy upgraders (7%) had heard of BPI, but most had heard of ENERGY STAR (80%).

6.5 Track changes in markets over time with a specific focus on market indicators that are likely to be affected by program offerings

This evaluation did not assess changes in the New York State residential efficiency retrofit market over time because the different sampling strategies, small sample sizes, populations, and survey questions used in past HPwES MCAs preclude comparison with results of this study. For example, the two previous evaluations of HPwES did not include surveys of nonparticipant households, and the topics and questions

asked to participant contractors and households, and nonparticipant contractors, were substantially different across all three HPwES evaluations due to competing objectives and performance indicators.

6.5.1 Develop preliminary estimates of market effects

The HPwES logic model included market indicators to assess a wide variety of potential market transformation and market effects from HPwES activities. This evaluation assessed supply of and demand for energy efficiency services in the nonparticipant market.

There was some preliminary evidence in support of potential market effects in the contractor market:

- Participating contractors were doing comprehensive audits outside of program and, even though most contractors always recommended a diagnostic audit to their customers, a low proportion of their work outside the program included these audits. Participating contractors were also installing energy-efficient upgrades in the majority of all their jobs on average (79%).
- Most participating contractors reported that their participation in HPwES led to increases in staff expertise (83%), services offered (71%), projects completed (69%), investment in new equipment (65%), revenue per project (62%), and number of employees (60%). Forty percent also reported an increase in profitability. A majority of participating contractors (65%) mentioned that their affiliation with BPI was valuable for differentiating their firm from their competitors, and that they preferred to hire BPI-certified employees (62%). One-third also reported paying their BPI-certified employees a higher wage than their non-certified employees.

There was some preliminary evidence in support of potential additional measure adoption in the residential consumer market among participants and partial participants:

- A few program participants (12%) reported doing additional efficiency upgrades outside of the program based on recommendations from their home energy audit, the most common of which were shell measures. Nearly half of partial participants (i.e., those that received an audit, but did not participate in the program) that used natural gas or delivered fuels as their primary heating fuel (44%) reported installing at least one upgrade recommended in their home energy audit, the most common of which were insulation, energy-efficient lighting, and air sealing. The Impact Evaluation team investigated this further.

6.6 Conclusions and Recommendations

- **Conclusion 1: HPwES theory assumed BPI training was sufficient to enable contractors to sell comprehensive upgrades, yet most upgrades were not comprehensive**. Slightly more than one quarter of HPwES projects included upgrades to multiple home systems, while most of the projects (73%) were to single systems. The program theory suggested that BPI training would be sufficient to enable contractors to sell comprehensive upgrades. Contractors did find value in their training on comprehensiveness from BPI and found it helped them explain the recommendations of the audit, yet most made upgrades primarily within their specialty. The program theory, therefore, appeared to be missing a step for contractors. Findings from the recently completed Better Buildings Neighborhood Program evaluation (Research Into Action, et al 2015) demonstrated that supporting contractors, especially through sales training and ongoing engagement, was a primary driver of successful whole-house upgrade programs.
    - **Recommendation 1:** Train contractors in more than building science; train them how to ***sell*** and install home energy upgrades outside of their specialty, and support them with ongoing engagement.
- **Conclusion 2: Home energy audits helped generate projects.** Participant homeowners indicated that the comprehensive home energy audits were influential in their decision to do a home energy upgrade. Participant and nonparticipant contractors said the home energy audits helped sell the home energy upgrades. When asked, the home energy upgraders who did not participate in the program expressed interest in obtaining a home energy audit before their next project. Though contractors noted that a home energy audit was expensive and that the GJGNY incentives did not fully cover the cost, they, along with the other market actors, had a positive assessment of the benefits in stimulating home energy upgrades.
    - **Recommendation 2:** Continue providing free or reduced-cost home energy audits to facilitate market engagement with the whole-house approach and support market transformation.
- **Conclusion 3: The limited frequency of previous HPwES evaluations made it difficult to measure market changes over time.** Previous process and market evaluations were limited in frequency (one process evaluation in 2005 and two MCA studies, one in 2004 and another in 2009). This lack of frequency prevented extensive insights as to program performance and market reception. Further, the length of time between studies and the fact that each study (including this

one) had to accomplish many and varied objectives, focused on different indicators, made long-term tracking of market indicators difficult for measuring market transformation or market effects.

- **Recommendation 3:** Support market transformation and the ability to pivot and modify programs early with real-time evaluations that can track market indicators at regular intervals.
- **Recommendation 4:** Use the core set of research objectives and indicators in the program theory and logic model to track market progress. When updating, ensure that measurement is often enough to track both old and new indicators to permit comparisons before the old indicator is dropped.

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